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HARVESTING and CLEANING GRASS and LEGUME SEED in the Western Gulf Region

SOIL CONSERVATION SERVICE

Western Gulf Region

Regional Headquarters, Forth Worth, Texas

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PREFACE

This handbook is an enlargement of Agronomy Memorandum No. 56, Western Gulf Region, Soil Conservation Service, which was issued September 14, 1943. It was issued originally as Section VI of the Western Gulf Region's Agronomy Handbook. Some of the introduced legumes and grasses included are relatively new in use.

All plants under Discussion of Species are arranged in alphabetical order according to scientific names. An alphabetical list of common names, on the page following the table of contents, is given to aid the reader in locating the desired plant in the text and on the plates. Plates are arranged in numerical order; plants are arranged on the plates in alphabetical order according to their scientific names.

The contributions to this handbook were numerous. Thanks are due many technicians of the Soil Conservation Service and others who are working with soil conservation districts. Members of the Cartographic Division, Western Gulf Region, Soil Conservation Service, deserve thanks for their excellent drawings. The University of Wisconsin Press kindly gave permission to use certain figures from The Leguminous Plants of Wisconsin by Norman C. Fassett, with drawings by Richard I. Evans. Use of the following illustrations from that publication is greatly appreciated: Figures 18 a, b, c; 19 a, b; 22 a, c; 26 a; and 78; and plates VI and XVI.

Many of the illustrations were made from fresh or pressed material. Others were taken from published material. Several species have never been illustrated before, so far as I know.

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HARVESTING AND CLEANING GRASS AND LEGUME SEEDS IN THE WESTERN GULF REGION

Prepared by Simon E. Wolff, Agronomist, Regional Nursery Division, Western Gulf Region
Soil Conservation Service

CONTENTS

List of grasses and legumes follows.

LIST OF COMMON NAMES

HARVESTING AND CLEANING GRASS AND LEGUME SEEDS

DETERMINING WHERE AND WHEN TO HARVEST

In learning whether the seeds of any field of grass are worth harvesting, a seed collector must consider several things. These include the size, location and condition of the field, the kind, size and capacity of the harvesting equipment, the number of inflorescences and their grain content or fill, the need and demand for seed. Collectors must recognize the proper stage of development to begin the harvest. They should be prepared to complete field operations as quickly as possible, so as to escape adverse weather conditions and loss of seed through shattering.

A farmer who harvests only a few acres for increase plantings usually does not need large equipment. He seldom needs to clean the seeds to meet commercial standards. He may want to cut low-fill material. Often he can meet his increased seeding needs by cutting or stripping the mature grass and scattering the uncured seedhay over the field to be seeded.

The commercial collector or soil conservation district that collects seeds for sale at a profit generally has equipment needed to harvest large acreages quickly. For wide distribution and for sale, the seeds should be cleaned to meet market or planting standards. Such collectors are most interested in high yields.

Actual experience with forage grass seeds is necessary for profitable harvests. Whether a stand of grass should be harvested depends primarily on two things: The average number of stems and how well the seedunits are filled with grain. The stand must be examined thoroughly. Abundance of stems and inflorescences is a good sign, but a careful examination must be made to determine the quantity and quality of the seeds. Typical seedunits should be examined from representative sites in the field to be sure the seeds are developing uniformly.

For most grasses, two field examinations of seed development are necessary. The early one is made approximately one week after flowering is well along. The second is made approximately five days before the harvest begins.

In making the early examination, consider the moisture content of the soil and seeds and general appearance of the flowering plants. When soil moisture is low, the plants lack turgidity, have a light green color and usually lack the vigor to exsert the styles and stamens. These organs then dry up within the flower, and no seeds are produced. If penetrating rains do not fall during the period of flowering and soil moisture is low, a second examination ordinarily will not be necessary, as the crop will be a failure.

The early examination is made by walking through the grass and sampling the stems enroute. Sample the poor sites with the good ones. About every 10 steps, break off the upper part of one stem bearing the inflorescence (often called seed head). Vary the selection by taking a stem from the center of one plant and from the edge of the next plant. Sample as many as 50 plants. Roll the samples in a newspaper and take inside for further examination.

Checking seed material one week after flowering is well advanced ordinarily does not require much skill. Most grains are easy to recognize in the formative stages. In many grasses, as the gramas, the soft grains have or may have a green color. In

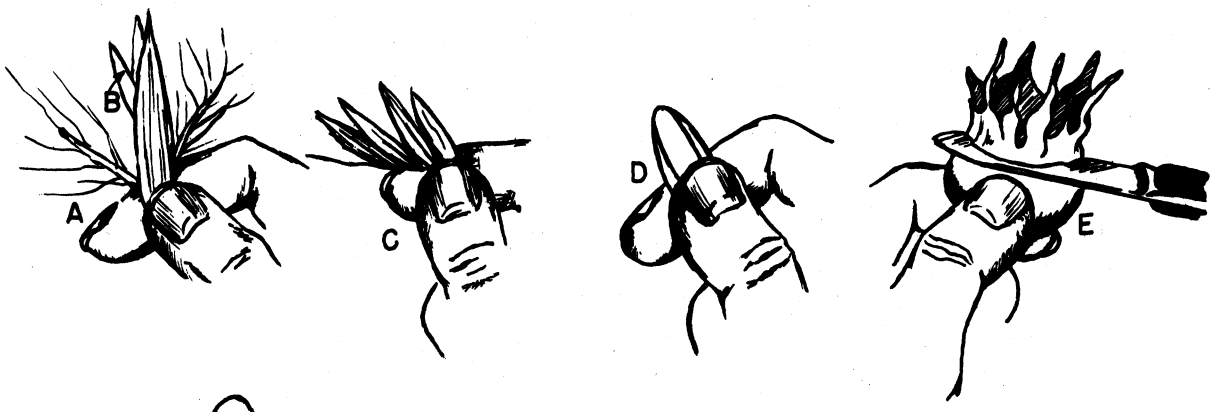
other grasses, they have a purple color. One week after flowering is well along, most of the grasses are in the soft-dough stage, some in the milk-dough stage and a few in the hard-dough stage. For fill and stage-of-ripening counts, take two seedunits each from near the top, middle and base of each inflorescence and pinch the base of each fertile floret. Record the empty (including those to bloom) and the filled florets and figure the percentage of those filled. Also count the number of grains that are in the various stages of maturity and the units that are still to open. This is necessary with grasses that have a long blossoming period in order to approximately set a date of harvest.

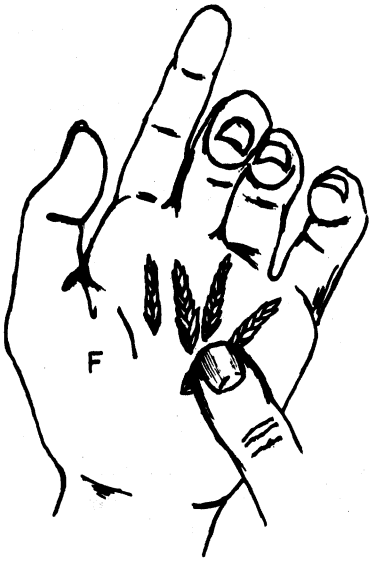
Make a second field examination about 5 or 6 days before the harvest begins. This is to be certain there are enough good seeds to justify collection. It also gives the exact condition of seed development. Use the same method as in the early examination, but sample as many as 100 plants. Place the material in a tight sack, carry it to a table and thoroughly mix, making certain that the green seedunits are fully represented with the easily shattered, near-ripe ones. Count out 100 units in groups of 10. Cut through each unit with a knife (fig. 1), or pinch the base between the thumbnail and forefinger, so as to squeeze out the grain if present. Record the filled and empty units. If the totals for each group of 10 follow a regular pattern, for example, 6 filled and 4 empty, stop after examining 100 units. If the totals for some of the groups vary widely, for example, 3 filled and 7 empty, continue examining until satisfied with the average of all the groups. An irregular number pattern usually indicates an uneven mix of the whole sample.

Potential seed production, based on a field examination and pre-harvest count, is an approximination. The actual fill may be high. But if stem production is meager, the crop may not be worth harvesting. The collector estimates production by (1) counting the seedstems in several unit areas, using a square foot or square yard, (2) averaging the number of seedunits per stem, (3) using the record of seed fill previously obtained or to be obtained, (4) using the number of square feet in an acre, and (5) knowing and using the number of seedunits in a pound of pure seed. Take a good stand of little bluestem as an example. The stems per square foot are 10. There are 200 units per stem and 60 percent contain grains. Multiply 10 by 200 by .60 by 43,560 and divide by 269,000. The result is 194 pounds of pure seedunits per acre. This is a high-producing field if all the seeds can be collected. Take a poor stand of little bluestem with 5 stems per square foot, 150 units per stem and a fill of 10 percent. Multiply 5 by 150 by .10 by 43,560, divide by 269,000 and the result is 12 pounds of pure seed per acre. Obviously this field of bluestem is not worth harvesting.

At all times during a seed-harvesting operation the collector checks carefully on the amount and quality of seeds he is getting. Borderline yields often become almost worthless yields overnight, if a wind or storm beats out some of the units. Checking the amount and quality is particularly important near the close of the harvest season, when loss through gradual shattering is likely to make operations unprofitable.

At what stage should grass and legume seeds be harvested to be of the highest quality? It is now recognized that grain, such as wheat, harvested when fully ripe is the best for feed, flour, and for planting. It also is known that legume seeds taken when hard and plump keep their viability longest. The grains of most grasses harvested in the hard-dough or vitreous stages are bright in color, plump, have a low moisture content, are usually high in germination and maintain viability better and longer in storage. Grass seeds harvested in the milk or the soft-dough stage are improperly developed, often shriveled, poor in color, and low in germination. Where possible, therefore, collect grass seeds in the hard-dough and vitreous stages and legume seeds when the coats are hard enough to withstand considerable pressure.

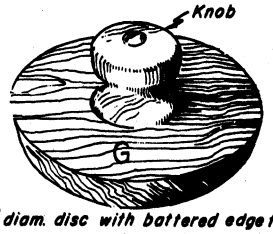




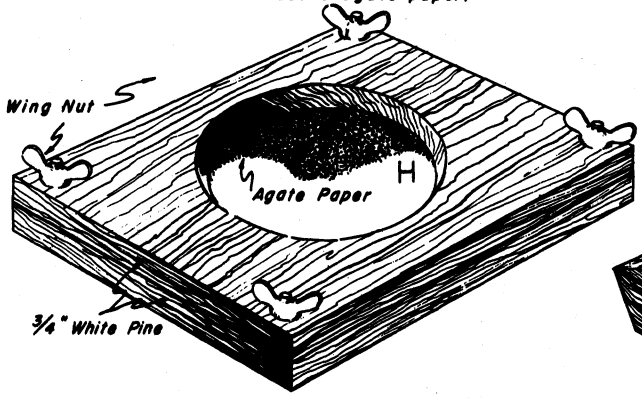
SOME FIELD METHODS OF DETERMINING "FILL" OF GRASS SEEDUNITS. (A) Pinching the base of a fertile, sessile spikelet of little bluestem, the grain (B) protruding; (C) pinching the base of several spikelets in a single spike of sideoats grama; (D) pressing across the center of a fertile floret of switchgrass; (E) cutting across the center of a buffalograss bur with a knife, and (F) rubbing out spikelets of weeping lovegrass in the palm of the hand. All seedunits and spikelets are enlarged.

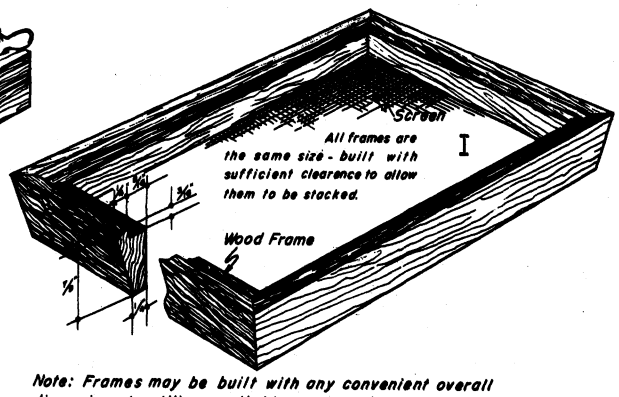
Shown below is a hand scarifier and screen used in Oklahoma for separating grains and legume seeds from chaffy coverings: Scarifier disc (G) and pan of scarifier board (H) covered with agate paper, and cutaway view of sifting screen (I).

Screens available from commercial sources.



Cut 6" diam. disc with battered edge from the top board - Cover bottom of disc and top surface of lower board with medium coarse agate paper.





Note: Frames may be built with any convenient overall dimensions to utilize available screens. Approximately 64 square inches should be adequate.

Figure 1.

HARVESTING METHODS

Equipment locally or generally available in this Region for harvesting grass and legume seeds may be the following: Grain binders, combines, mowers, strippers, windrowers, swathers, sweep rakes or bull rakes, bunchers, dump and side-delivery rakes, scythes and sickles.

COMBINE

The combine is the most popular machine for harvesting most grass and legume seeds. The smaller machines can be used on small acreages. Combines work most effectively when the seeds are mature or have passed into the hard-dough stage. But the risk of seed loss from shattering is important with some grasses and many legumes and may offset the usually lower costs of combining.

Threshing combines (fig. 2) are often classified as to whether they have spike-tooth, rasp-bar or angle-bar cylinders. The rasp-bar and angle-bar types are usually considered more satisfactory than the spike-tooth type, although varying the number of teeth in the last often effectively reduces the chopping of the straw. Some machines differ in types of screens. Several makes use two vane-adjusted screens in the cleaning shoe, while others have only one, the chaffer.

With many grasses (fig. 3), as some of the bluestems, panicums and lovegrasses, and a few legumes, high cylinder speed and vigorous action of other threshing parts are required to free the seeds or seedunits from the straw and envelopes. This nearly always results in trashy seeds unless clean screening is possible. With other grasses, as ryegrasses, bromes, gramas and wheatgrasses, and some legumes, as peas, the cylinder and cleaning parts are run slower resulting in less breakage of the straw and seeds. The clearance between the cylinder and concaves should always be as wide as possible and cylinder speed slowest that will result in complete threshing without undue breakage of the straw or cracking of the grains or seeds. With most grasses and a few legumes, the adjustment of the air and tailboard must receive careful attention. No air can be used to thresh fluffy-seeded grasses and only moderate amounts with the small, smooth-seeded ones.

The ordinary combine (fig. 4) or thresher has not always proved satisfactory for threshing many small-seeded grasses. In recent trials with sand lovegrass, a combine operator suggested that by using the straw rack as a sieve more chaff could be kept out of the cleaning shoe. On the machine used, the straw walkers were removed and a fine-mesh (22 x 22) wire screen was stretched across the straw rack. The chaffer was opened and the shoe sieve removed. By tilting the air upward all the chaff was kept above the screen. The grain, free of chaff, dropped directly to the grain auger. The seed did not need further cleaning. By using straw-rack screens with openings to suit the kind of grass or seed being threshed, it may be possible to do a nearly complete job of separating in the upper part of the machine. Such screens serve as vibrating or shaking scalpers.

The following points are listed as a guide to the inexperienced operator of combines:

1. Learn whether the crop is in a threshable condition.
2. Adjust the linear speed of the machine and the width of swath so as to keep the machine evenly loaded for clean threshing.
3. Adjust cylinder speed and cylinder-concave spacing to suit the condition of the seed material, i.e., to obtain clean separation, low straw breakage and uncracked grain.
4. With most grasses and a few legumes, reduce or cut off all air from

the cleaning fan to allow seeds to drop through the screens and to carry chaff out of the hood or into the tailings.

5. Adjust opening of chaffer, shoe sieve and special sieve, if one is used, to allow seeds or seedunits to fall through and keep all or most of the small pieces of straw and chaff from falling through. The right combination of air and opening will usually accomplish this. With a few fluffy-unit grasses, it is impossible to separate seeds from chaff on the chaffer and shoe sieve, when all air is cut off. The shoe sieve is then removed. The chaff and the seeds are dropped to the grain auger and augered to the seedbin.

STRIPPERS

Strippers for harvesting grass seeds combine several principles. The revolving drum type such as is used to harvest Kentucky bluegrass, is now commonly seen in the western states and is being used in the Region. The rotating drum bears staggered rows of spikes that catch the inflorescences and seedunits against the edge of the hopper, strip them from the stems and deposit them in the hopper back of the drum. For the most economical harvesting, the standing material should be dry enough to break easily, or else whole stems are pulled into the hopper. The bluegrass stripper, or similar machine, works well with the gramas, several bluestems, rescuegrass, and sweetclovers. A medium-sized tractor will pull three machines.

A self-propelled stripper (fig. 5) now in use in central Texas, consists of two revolving reels having bats faced with casings of automobile tires. The machine is built in one unit. The large front reel turns counter-clockwise and presses the seed-stems against the smaller stripper reel which turns clockwise and also is rubber-faced. The ripe seedunits are rubbed off and thrown into the hopper. The tough unripe units are left on the stems for further ripening. The tension between the reels and the speeds can be adjusted for the different grasses and the condition each one is in. The seed material taken is remarkably free of trash and rather uniform in quality. The average quality and purity is much higher than from any other stripper known. The machine works very well with little bluestem, sideoats grama and weeping lovegrass and is superior in comparative trials with the combine on King Ranch bluestem.

A light topping machine (fig. 6) is being used in central Texas to harvest native grass seeds. It was constructed from old binder parts. The bull wheel is geared to drive a medium-sized reel at high speed. The upper parts of the seedstems are slapped against the sharp metal edge of the hopper and broken off. Two and sometimes three reel bats strike a single bunch of grass before the machine passes over it. The seed material obtained is a good grade of seedhay. This harvester is useful on farms, highways and railway right-of-ways for topping small, irregular and rough blocks of grass.

BINDER

Grain binders are useful for harvesting seeds of most grasses and legumes. The advantage of the binder is that cutting can begin several days earlier than direct combining. In every case the sickle should be sharp, the bundles kept small and the shocks open. For the species that shatter easily, shallow pans should be fashioned and attached to the machine at points where seed loss is to be expected. With some species, the binder is used as a header and swather (fig. 7, A) by removing the bunching and tying mechanism.

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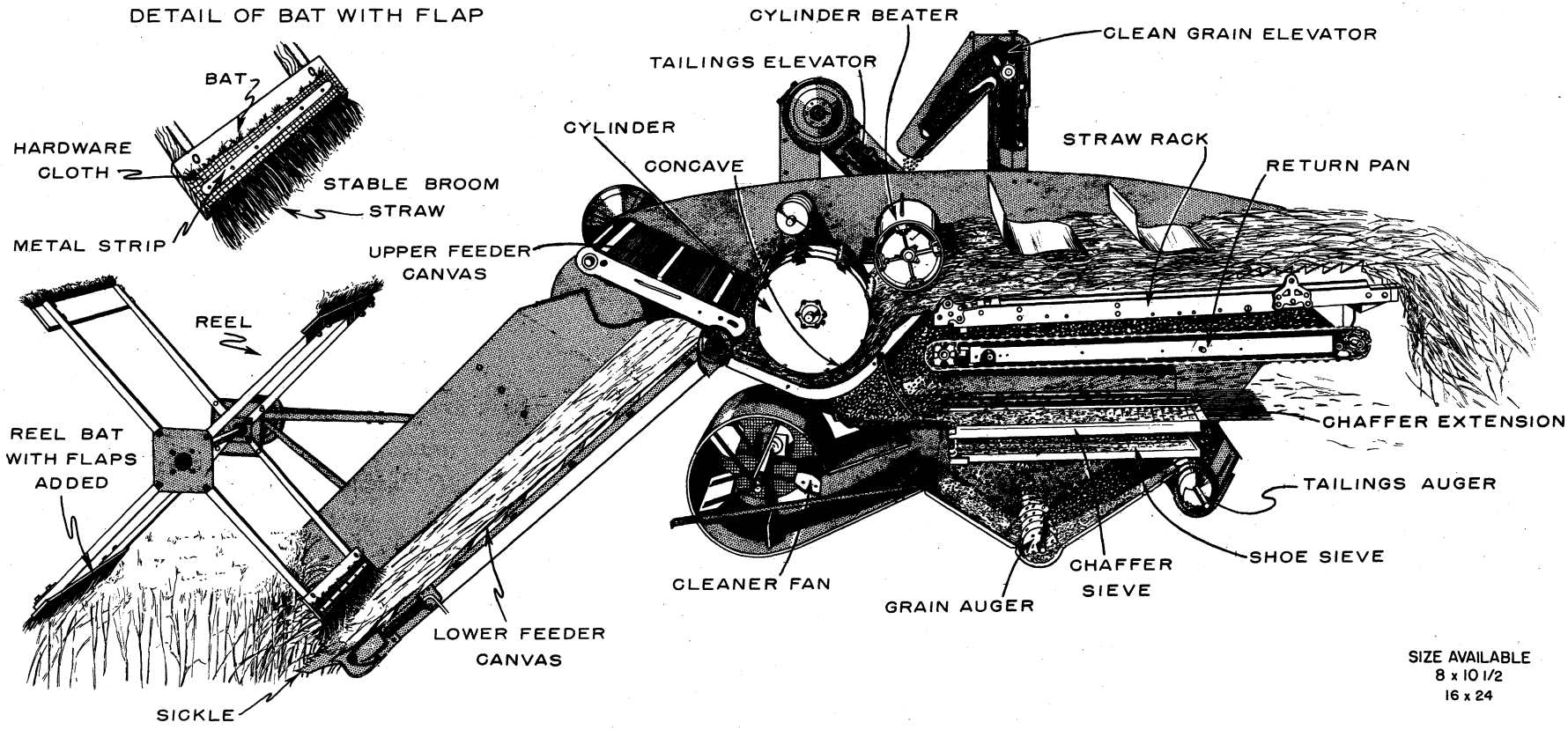

SIZE AVAILABLE
8 x 10 1/2
16 x 24

Figure 2

CUTAWAY VIEW SHOWING GENERAL ARRANGEMENT OF VARIOUS UNITS OF A COMBINE

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Figure 3. A, Combining King Ranch bluestem near Corsicana, Texas. B, Combining little bluestem from a native meadow in Oklahoma. C, Combining sericea lespedeza in eastern Oklahoma.

Figure 4. A, One way of collecting tailings of King Ranch bluestem that contain good seeds; the canvas is hung from the hood. B, Combining Dallisgrass from windrows in Louisiana.

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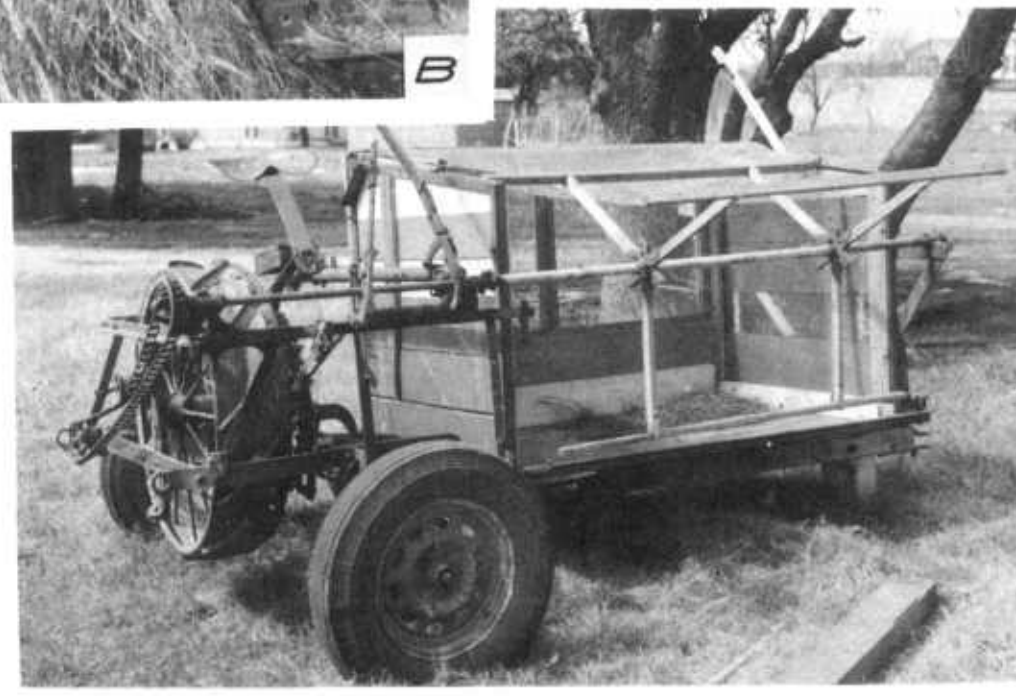
Figure 5. A, Two-reel stripper used in central Texas to harvest seeds of some native and introduced grasses; most often used on little bluestem. B, Another view showing belted slat of larger reel approaching and pushing seedstems against the smaller reel.

* * *

Figure 6. Dublin topper for harvesting seedhay of native grasses; the machine shown is mounted on a road truck.



MOWER AND WINDROWERS

Standard windrowers (fig. 7,C) attached to mowers move the fresh-cut material and deposit it on top of the stubble. The mowing and windrowing may be made a separate operation where wilting and some curing is desired in the swath. Easy-shattering legumes are seldom cured in the swath because of loss of seeds when the pods rupture. The side-delivery and dump rake are also used for windrowing.

SWATHER

Mechanical swathers are used with some legumes, as sweetclovers, that may be combined from the swath. The width of the swath must be adjusted to the width of the combine and the total amount of material the moving combine can handle.

BUNCHERS

For quick-shattering legumes, the bull rake or sweep rake (fig. 8) is a labor-saving tool. It can be used to make large cocks for a period of curing or bring material to the combine or thresher for stationary threshing. The dump rake can be used for bunching, or windrowing for the moving combine if the individual dumps are uniform in size.

LESPEDEZA HARVESTERS

The short-straw lespedezas are most often harvested with machines (fig. 9) that involve the use of a seed pan attached to the mower bar, and a shattering mechanism. The simplest unit consists of a wood or metal pan covered with a perforated screen (fig. 9,A). The seedhay falls on the screen and then it is raked and dragged across the screen by one man with a fork. The ripe pods and some trash shatter off and fall through the holes. The seed pan is popular with small farmers who harvest small lots of seed for their own use.

One machine (fig. 9,B) uses an endless slatted conveyor containing nails for shattering the pods. The slats drag the seedhay down and across the screen.

Other machines (fig. 9,C) use spiked slats that move eccentrically to push the seedhay down and across the screen. Still others use one or two reels to push the seedhay across the screen.

The last three types are driven by wheels that help to support the units. They are used by larger growers. Some are community owned.

SCYTHES AND SICKLES

Such hand tools, although not labor-saving, become useful where local areas, as waste corners, small meadows, or meadow strips, are to be seeded and not much seed material is needed. Harvesting seedhay from railroads and rough or brushy land is often cheaply done with the sickle or scythe.

SEED CLEANING AND PROCESSING

Most grass and legume seeds require some cleaning for uniform planting. The costs of cleaning vary with the kind of seed material, the abundance or absence of noxious and other weed seeds and the purity. Where harmful seeds, as dodder, are present the cleaning should be carefully done. Soil conservation districts and individuals harvesting, cleaning and marketing seeds for in-state and interstate shipment should see that the information on seed tags is in line with the requirements of the state into which the seed is transported.

The first step in cleaning or putting seed in a plantable condition is to remove excess straw and trash. Another step may be the removal of extra appendages and coats that, if not removed, make cleaning and planting difficult or impossible. It may be possible to combine in one operation the removal of excess trash and reduction in size of the items mentioned above where the whole can be used in planting equipment. Seed scarifiers are sometimes used on the legumes to remove appendages and coats. But for most grasses the hammer mill is one of the best machines for this job.

SEED SCALPERS

A home-made, vibrating scalper (fig. 10) is a useful tool for rough-cleaning trashy seeds. This cleaner prepares seeds for planting in drills equipped to handle trashy seeds, and in many instances, prepares them for sale without further cleaning. It can be made in part from scrap materials. The wooden frame supports an inclined screen of usually quarter-inch hardware cloth. The incline is adjustable to slopes 6 to 12 inches. The eccentric drive connected to a small motor, vibrates the screen and causes the seeds to fall through, while the coarse trash rides over the screen. With fluffy seeds the capacity of the cleaner is increased by rubbing the material back and forth and spreading it out in a thin layer on the screen.

The barrel scalper was constructed for a soil conservation district in western Oklahoma. It cleans the seeds of little bluestem, Indiangrass and sideoats grama where they can be handled in trashy seed planter boxes. The capacity is 1500 or 2000 pounds of clean seed a day when turned by hand and greater when turned by a motor. A hinged panel opens to load the machine and empty the trash. It also can be made in a farm shop from scrap metal.

CLEANERS

The two-screen, farm fanning mill (fig. 11) is used for cleaning many kinds of seeds. Screens with different-sized openings are used to sort the seeds, and the air blast separates the trash from the seeds. By adjusting the feeding slot, the pitch of the screens, and repeating the process, usually any desired purity can be obtained. With a few fluffy-seeded grasses, however, the cleaning process should be reversed. This is accomplished by adjusting the screens so as to allow the trash to drop through and be carried out the seed trough, while the fluffy seeds, instead of the trash, are blown off the screens.

The following chart lists sieve sizes (openings) to use in a 2-screen cleaner for many of the species described in this publication. The accompanying illustration gives the types of openings. The round-hole and oblong openings are made in perforated metal; the slotted and square mesh openings are made of wire cloth. The sizes suggested in the chart may not always be suitable for cleaning the seeds at hand. Other screens should be tried. Only the seeds that screen readily are listed.

Larger cleaners equipped with three or more variable-pitch screens generally do a faster, more thorough job. They also are equipped with traveling screen brushes and air adjustments.

The gravity cleaners are useful in sorting mixtures of seeds, or in size- and weight-grading seeds within a species. Unfilled units usually can be separated from the filled ones. The seeds are fed onto a vibrating, adjustable pitch canvas. The differences in weight, shape and size of seeds and roughness of coats cause the different seeds to travel at variable speeds in a diagonal direction and fall into different slots and containers at the bottom.

Figure 7. A, Swathing Hubam sweetclover seedhay on a high-cut stubble with a binder. B, Combining Hubam sweetclover from the swath. C, Windrowing ryegrass and hop clover seedhay in Arkansas.

Figure 8. Using a buncher or sweep rake to carry hay to the machine.

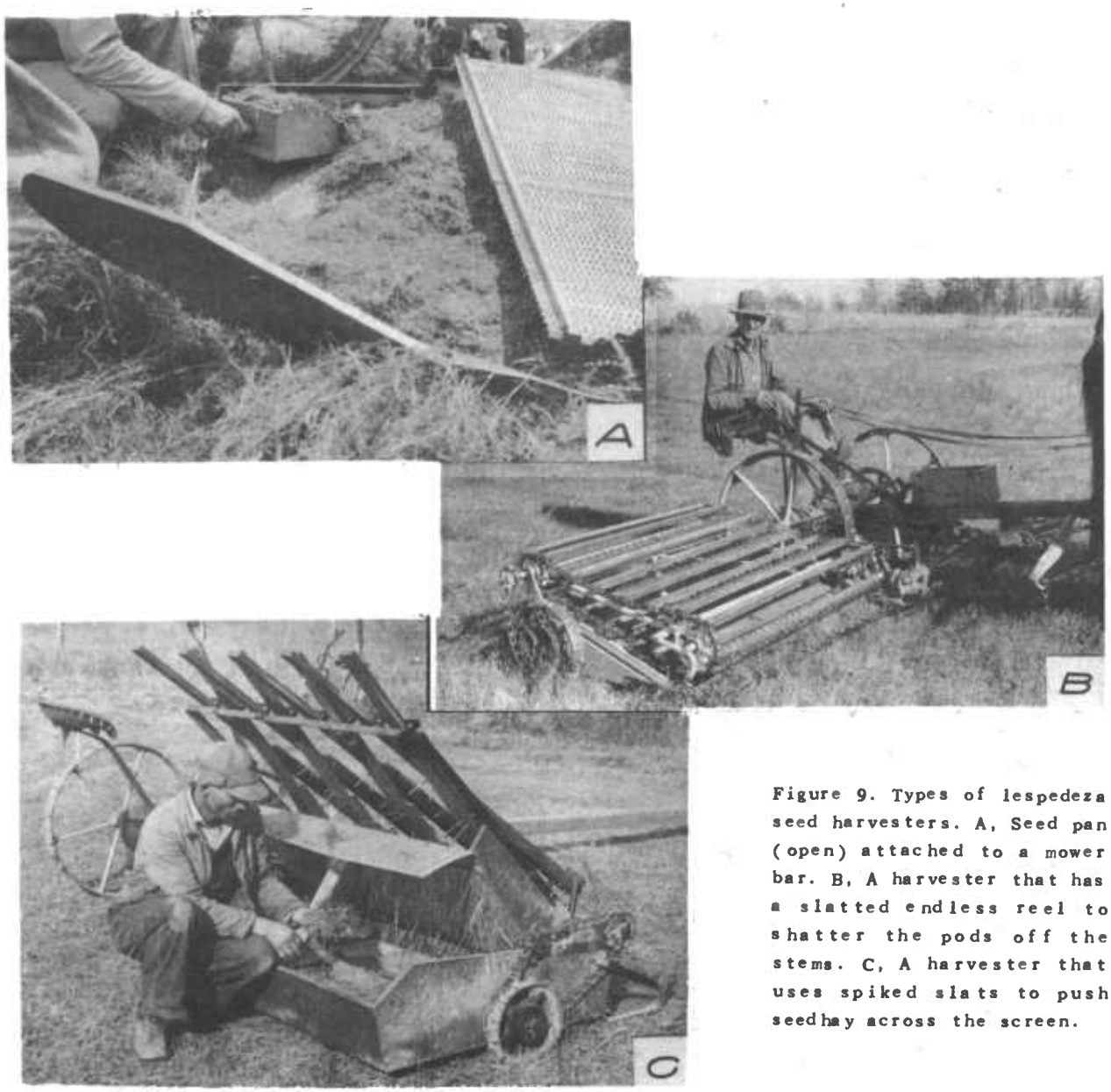


Figure 9. Types of lespedeza seed harvesters. A, Seed pan (open) attached to a mower bar. B, A harvester that has a slatted endless reel to shatter the pods off the stems. C, A harvester that uses spiked slats to push seedhay across the screen.

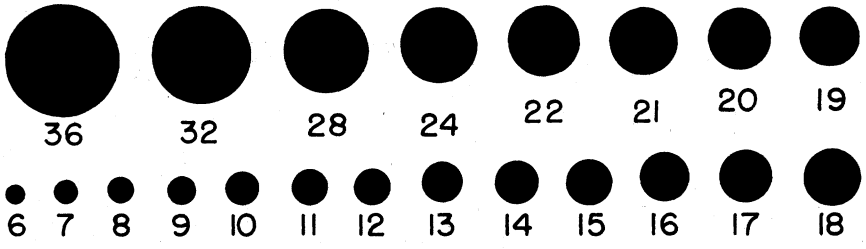
Figure 10. The vibrating seed scalper is useful to separate coarse material from trashy seeds.

Figure 11. Cleaning hairy vetch and rye seeds with a fanning mill. The spiral separator (right) separates the vetch and rye seeds.

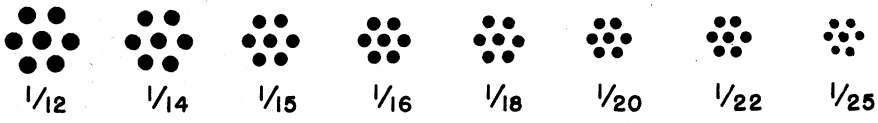
SUGGESTED SCREENS FOR TWO-SCREEN CLEANERS

Species	Top screen	Bottom screen
GRASSES		
Agropyron cristatum	3x16 or 1/18x1/4	4x22 or 6x28
" intermedium	1/14 x 1/2	4 x 22
" smithi	1/14 x 1/2	4 x 22
Agrostis alba	28x28 or 30x30	50x50 or 60x60
Bouteloua curtipendula	1/12 x 1/2	6 x 22
Bromus catharticus	1/13 x 1/2	6 x 24
" inermis	1/13 x 1/2	6 x 24
Buchloe dactyloides (burs)	16	6
" " (hulled grain)	1/15	1/20
Cynodon dactylon	6 x 30	6 x 40
Dactylis glomerata	3 x 16	6 x 24
Eragrostis chloromelas	1/25	50 x 50
" curvula	1/24	36 x 36
" intermedia	1/25	50 x 50
" lehmanniana	40 x 40	60 x 60
" superba	1/22	32 x 32
" trichodes	1/24	36 x 36
Festuca elatior arundinacea	1/14 x 1/4	4 x 20
Lolium multiflorum	1/14 x 1/4	4 x 20
" perenne	1/14 x 1/2	4 x 20
Panicum antidotale	1/12	1/25
" obtusum	9	1/18
" virgatum	8	1/20
Paspalum dilatatum	3 x 14	1/14
" malacophyllum	1/15	30 x 30
" notatum	9	1/16
Phalaris tuberosa stenoptera	3 x 16	6 x 24
Secale cereale (vetch from)	7/64 x 3/4	9
LEGUMES		
Alysicarpus vaginalis	1/13	1/22 or 6x22
Coronilla cretica	1/13 x 1/2	6 x 24
Crotalaria intermedia	7	1/15
" spectabilis	12	8
Lathyrus hirsutus	12	6/64 x 3/4
Lespedeza bicolor	1/12	6 x 20
" cuneata	1/14 x 1/4	6 x 22
" stipulacea	6x15 or 1/18x1/4	1/16
" striata	6x14 or 1/16x1/4	1/14
Lotus americanus	1/13	6 x 22
" corniculatus	1/18	1/22 or 6x30
" uliginosus	1/22	6 x 38
Medicago arabica	1/13	6 x 22
" hispida	1/13	6 x 22
" lupulina	1/15	6 x 22
" orbicularis	1/12	6 x 20
" sativa	1/15	6 x 24
Melilotus alba annua	1/14	6 x 24
" indica	1/16	2 x 28
" officinalis	1/14	6 x 22
Pisum sativum arvense	17	5/32 x 3/4
Trifolium dubium	1/20	6 x 34
" hybridum	1/19	6 x 32
" incarnatum	1/13	6 x 22
" lappaceum	1/18	6 x 30
" pratense	1/15	6 x 22
" procumbens	1/22	6 x 36
" repens	1/19	6 x 32
" resupinatum	1/18	6 x 30
Vicia villosa	14	7/64 x 3/4

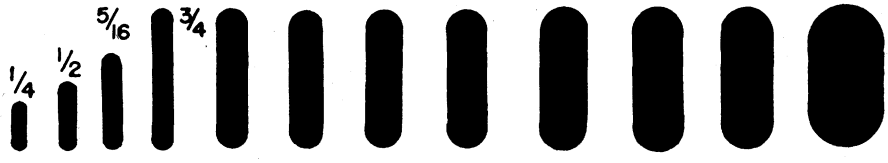
CLEANER SCREEN PERFORATIONS USUALLY AVAILABLE



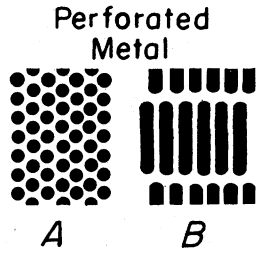
24 Ga. steel screens with round holes in 64ths from 6/64" to 36/64" as in A. Also available to 80/64".

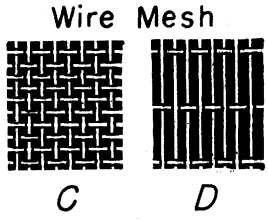


11 Ga. zinc screens with round holes from 1/25" to 1/12" as in A.



Oblong holes in both steel and zinc shown in pattern B, varying in widths from 1/22" to 24/64" and in lengths as shown.





Wire mesh as in C and D available in a wide range of opening sizes.

HAMMER MILL

There is no known choice of hammer mill for processing grass seeds. The mills with swinging hammers (fig. 12) and those with non-swinging hammers have been used successfully. The results depend on speed of the cylinder, size of screen openings, and rate of feed. Each of these things must be determined early in the milling operation of each grass or mixture.

Most farm hammer mills are designed for grinding feed. The usual cylinder speeds must be greatly reduced when processing grass seeds, in order to prevent breakage. In general, the longer the seeds are in proportion to their thickness, the slower the cylinder speed must be to avoid or reduce loss through breakage.

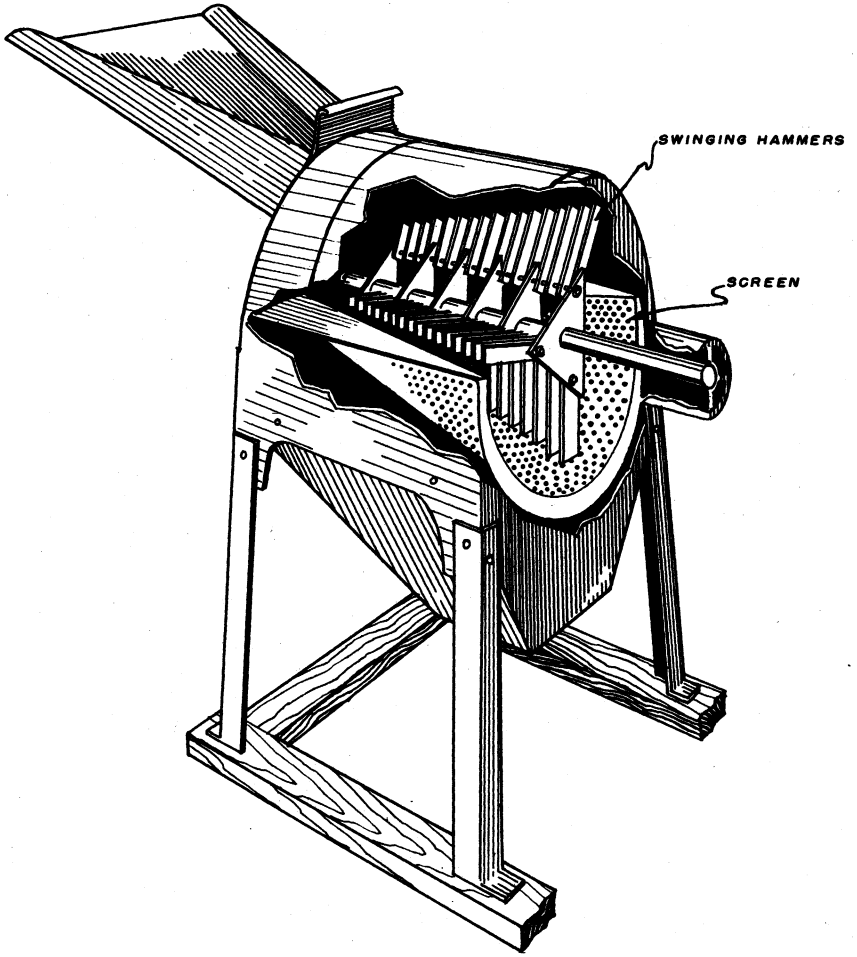
Screen openings of hammer mills vary in size and shape. Those with slot openings instead of round ones handle slender seeds with less breakage. When a screen of the correct size of opening is not at hand, use a coarser screen and increase the cylinder speed to obtain about the same result.

With most seeds the mill should be fed to its full capacity. The mass of seeds cushions the blow of the hammers, and the material rolls around until it is trimmed enough to pass through the openings. As soon as the material in the mill is reduced below capacity without any change in cylinder speed, the cushioning effect on the hammers is reduced and grinding and breakage is increased.

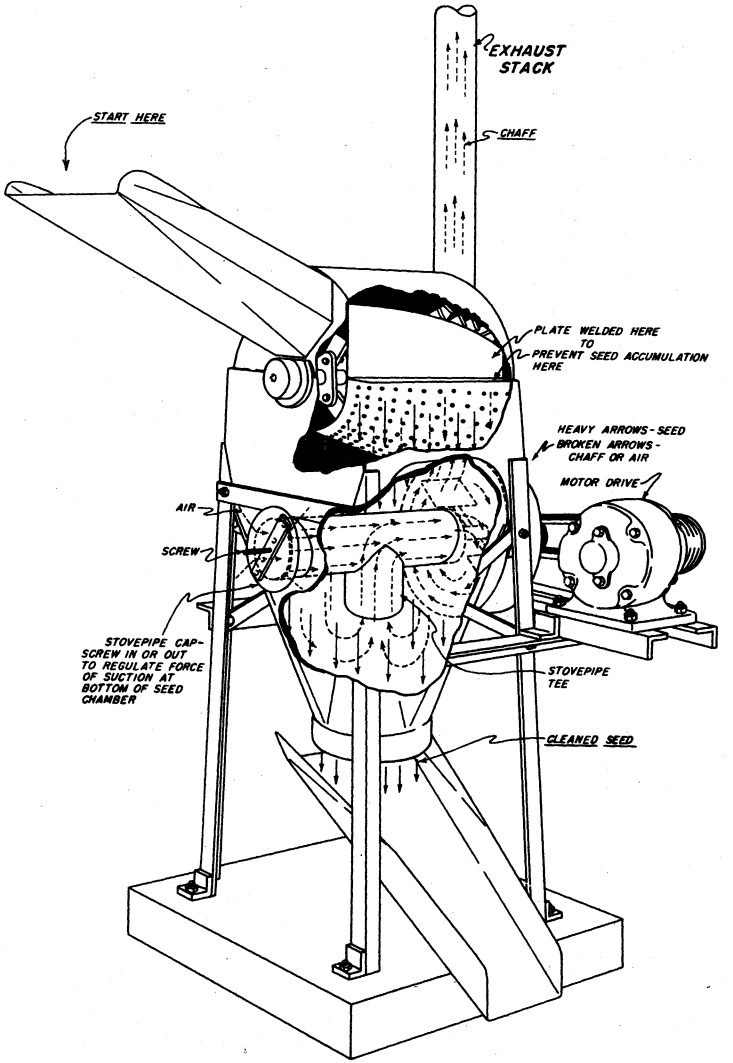
The procedure for adjusting the hammer mill is quoted below from U.S.D.A. Farmers' Bulletin No. 1985, Seed for Regrassing Great Plains Areas:

"1. Place in the mill a screen having openings slightly larger than seed to be processed.

2. Start the mill at slow speed. Fill the cylinder with seed material and keep it full.



Cut away view of hammer mill showing hammers and screen.



Hammer mill showing air exhaust system for removal of dust and chaff.

Figure 12

FARM TYPE HAMMER MILL

3. After a short trial run, carefully examine the seed that has passed through the mill. If few or no cracked or hulled seeds are found but many of the seeds retain the appendages you wished to remove, advance the cylinder speed by about one hundred revolutions per minute. Be careful to prevent cracking or damaging of seed. Overprocessing may greatly reduce germination.

4. Repeat step 3 until the greatest amount of trimmed material is being obtained with least breakage of seed. Differences in seed size within a given lot often make it necessary, after running the lot through the hammer mill and cleaning it in the fanning mill, to rerun the portion still untrimmed through a finer hammer mill screen."

STORING AND TESTING SEEDS

When seeds are properly cured before cleaning, they usually have the correct moisture content for storage. In humid areas, it has been difficult at times to obtain a good cure under natural conditions. Artificial drying then becomes necessary to reduce the moisture content and prevent deterioration in storage. In all climates, the storeroom should be well ventilated and insulated against extreme heat. For protection against mice and rats, the storage should be in tight steel bins or the structure lined with heavy metal screens. For temporary storage, the sacks should be stacked in such a manner that open space is left between each sack. Where seed insects are a problem, as they are with most legumes, the sacked seeds should be thoroughly fumigated before placement in the storeroom and the storeroom made tight enough to permit periodic fumigation or tight enough to keep fumigant present at all times.

Freshly harvested seeds of many legumes and grasses exhibit a profound dormancy. Even when they are bright and plump and have every mark of good quality, they may not germinate. Very often such seeds are sent to the laboratory shortly after harvest. There they are given the test for normal seeds but with poor results. A good rule is not to submit samples for germination tests until three months after harvest, and never without giving the date of harvest.

Sampling seeds for laboratory tests is seldom done during the cleaning period, unless the sample is stored with the lot. When cleaning is delayed for two or three months after harvest, a handful from each bag is kept back in a separate bag, the contents of this bag thoroughly mixed, and a proper-sized amount of the mixture sent to the laboratory. When the seeds are stored longer than six months, another sample should be collected and sent to the laboratory. To be of most value, samples should be taken and tests made shortly before the seeds are planted or sold. Proper sampling of bagged seeds follows: Five bags or less, sample each bag; more than five bags, sample every fifth bag, but not less than five.

Seed testing is an important thing to consider in any collecting and planting program and where seeds are held in storage until planted. Within the Region there are four state seed-testing laboratories which will test farmer-harvested seeds for nothing or at a very low cost. In Texas, at least, there is a laboratory for testing vetch seeds. The Soil Conservation Service laboratory at San Antonio tests seeds for soil conservation districts of all the states. For every lot of seed, the collector or owner should know the purity, germination and content of weed seeds and other agricultural seeds.

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DISCUSSION OF GRASSES

CRESTED WHEATGRASS *(Agropyron cristatum)*

Adaptation and Use. Crested wheatgrass is a hardy, drought-resistant, perennial bunchgrass, introduced from Russia. It is adapted to the High Plains of Texas and Oklahoma. It is being used successfully in irrigated pastures of the Oklahoma and Texas panhandles. In the same areas, it has done well on the heavier soils under dry-land conditions. Pure dry-land stands on the Amarillo Conservation Experiment Station have produced good gains on cattle. It requires heavy soil and good winter and spring rainfall for best growth. Under these conditions, it furnishes high-protein grazing from late fall until the following June. It is palatable to most livestock, as the leaves are less harsh than those of the native western wheatgrass.

Seed Areas. Seed can be obtained only from artificial stands.

Determining Potential Yield and Quality of Seed. Same as for western wheatgrass.

Harvesting. The season for harvesting corresponds to that of wheat or shortly after wheat ripens. It can be harvested with either binder or combine. Since the seeds ripen while the plants are still green, the straw has considerable feeding value. The seeds shatter readily. The harvest should begin as the grains reach the stiff-dough stage.

The crop may be combined or headed or cut with a grain binder and shocked and threshed after curing, or cut and windrowed and threshed using a pickup attachment on the combine. In threshing the cured bundles or seedhay, all or most of the concaves should be removed and all air cut off.

Care of Green Seed. Same as for western wheatgrass.

Cleaning. Same as for western wheatgrass.

Processing. Except for the awned types, the seed can be planted with ordinary grain drills without processing.

Quality. Good quality recleaned seeds have an approximate bushel weight of 22 pounds, a purity of 88 percent, a 7-day germination of 69 percent, a total germination of 86 percent, a longevity of 2 years or more, 200,000 per pound of pure seed, consist principally of florets, and have a short dormant period seldom exceeding a month.

INTERMEDIATE WHEATGRASS *(Agropyron intermedium)*

Adaptation and Use. Intermediate wheatgrass is a perennial, sod-forming grass with heavy rootstocks. It is not as aggressive as western wheatgrass. Introduced from the Soviet Union and extensively tried in the northern and central parts of the Great Plains and Pacific Northwest. It appears to be adapted to a variety of soils and climatic conditions, both for pasture and forage. It is more drought-resistant than smooth brome and, in some cases, less hardy and less drought-resistant than crested wheatgrass. Seeding failures are rare. It is one of the easiest grasses to establish with good records from southern and southwestern Kansas, Panhandle of Texas and western Oklahoma. Further trials in parts of western and northern Oklahoma and western Texas should yield information on climatic and soil adaptation.

Likely Seed Areas. Commercial seed is available for limited plantings. Some seed is being grown in southwestern Kansas.

Harvesting. Same as for western wheatgrass.

Cleaning and Processing. Same as for western wheatgrass.

Quality. The seedunit is the smooth filled floret. Good seeds are somewhat larger and heavier than those of western wheatgrass. Such seeds have a purity of 89 percent, a 7-day germination of 80 percent, a final germination of 91 percent, and a longevity of over 2 years. There are 88,000 seedunits in a pound of pure seed.

WESTERN WHEATGRASS (*Agropyron smithi*)

Adaptation and Use. Western wheatgrass occurs naturally and has its most important use in Oklahoma and Texas north of latitude 33° and west of longitude 97°. It is also native to northwest Arkansas. It is usually found growing in heavy soil subject to occasional flooding or accumulation of run-off water, though it is by no means confined to such sites. It is a valuable grass for winter and spring grazing and for use in vegetating terrace outlet waterways. Near Woodward, Oklahoma, it is furnishing abundant, high-protein pasturage from a planting made in 1943 on upland sandy soil typical of that along the North Canadian River. An excellent stand was obtained in this field at the outset, and summer annual weeds had not made any appreciable invasion by 1949.

Likely Seed Areas. Best seed areas in the Region are the several large playa lakes in the vicinity of Perryton, Pampa and Dalhart, Texas, and the railroad right of way between Hooker, Oklahoma and Spearman, Texas. Important collections of seed have been made here in the past, and seed from these areas is better adapted to the balance of the Region than is seed from more northerly points.

Determining Potential Yield and Quality of Seed. Since the plants develop from underground stems, the number of seedstems will depend on the kind of soil, the fertility and moisture. Lack of uniformity in spike (head) development may be an indicator of poor fill. The seeds mature about 2 to 3 weeks after wheat ripens. Shattering is slow, so that harvesting can be delayed or scheduled with convenience. For reasonable yields, at least 50 percent of the florets should contain grains. The percentage should be checked closely. This is done by separating and pinching the middle of each floret with the fingernail. A filled floret can be dented only; an unfilled one can be flattened. Sampling the stand by gathering florets from at least 10 plants and cutting across each one with a knife is a quick way to determine fill. Use care that ergot-filled florets are not mistaken for grain-filled florets.

Harvesting. The season for harvesting is generally about 3 to 4 weeks after wheat harvest. Allow about 3 weeks after blooming for the grain to reach hard dough. Cutting should start as soon as most of the seeds shatter readily when the heads are pinched or whipped sharply against the palm of the hand. An ordinary combine is the best machine for the job. Use cylinder-concave spacing of 3/8 to 1/2 inch and cylinder speed of 1200 to 1400 RPM. The air-blast should be greatly reduced, but some air is helpful in removing light trash and empty florets from the seed. Both upper and lower adjustable sieves may be used, with the vanes set to just allow the flow of seed to fall through. Windrowing, followed by pickup threshing after the seeds have cured, is also an excellent method of harvesting. Heading, followed by stacking and later threshing, can be done. Binders are not ordinarily satisfactory. Small areas can be mowed and the seedhay scattered direct on the field to be seeded. The stripper will do a good job of harvesting.

Care of Green Seed. Combined and stripped seeds should be allowed to cure before sacking. Seeds from the other methods of harvesting mentioned can be sacked as soon as threshed.

Cleaning. Careful combining or threshing will yield seeds of a plantable quality without recleaning. If an excessive amount of stemmy material is present in the seeds, it can be quickly and easily removed by running the seeds over a scalper.

Processing. Processing is not necessary to prepare western wheatgrass for planting with a grass drill. When the seeds are to be planted with a regular grain drill, they should be processed lightly in a hammer mill to remove the awns.

Quality. Combined or thresher-run seeds should have a purity of 70 to 80 percent. Recleaning in a fanning mill will raise this to 90 percent or better. Germination is usually low for several months after harvest, but should reach 80 percent by the following year. There are about 110,000 smooth, filled florets (seedunits) in a pound of pure seed.

REDTOP (*Agrostis alba*)

Description, Adaptation and Use. A tufted perennial, with rhizomes and moderately coarse decumbent or erect stems. It forms an open turf. Panicle open, pyramidal-oblong, reddish, the branches many, spreading and in distinct whorls; spikelets small, one-flowered, the lemma rarely with a short awn. This is the common redtop cultivated for meadows, pastures and lawns in most of the northern and northeastern states; occasionally found as an escape in the cooler part of this Region and northward. Adapted to northern Arkansas and northeastern Oklahoma. Best suited to heavy and wet soils low in lime. Sometimes planted with timothy and red clover and will usually outlive both. It is a favorite grass for legume-grass mixtures in most states of the humid regions. The fine-stemmed forms are used as golf-green grasses in the Southeast and occasionally in this Region.

Likely Seed Areas. None in the Region. Nearly all commercial seed comes from Illinois and Missouri.

Managing for Seed. Growth begins in early spring. Flowering and fruiting occurs in June and July. As with many other grasses, the flowering in a single panicle is not uniform and covers a period of 7 to 10 days. When planning to harvest seeds, the first blooms should be noted and an examination made about 7 days later to determine development. There is a very short period in which to cut the crop for seed before it shatters. Fill can be determined by pinching the developing spikelets or cutting across each on a board.

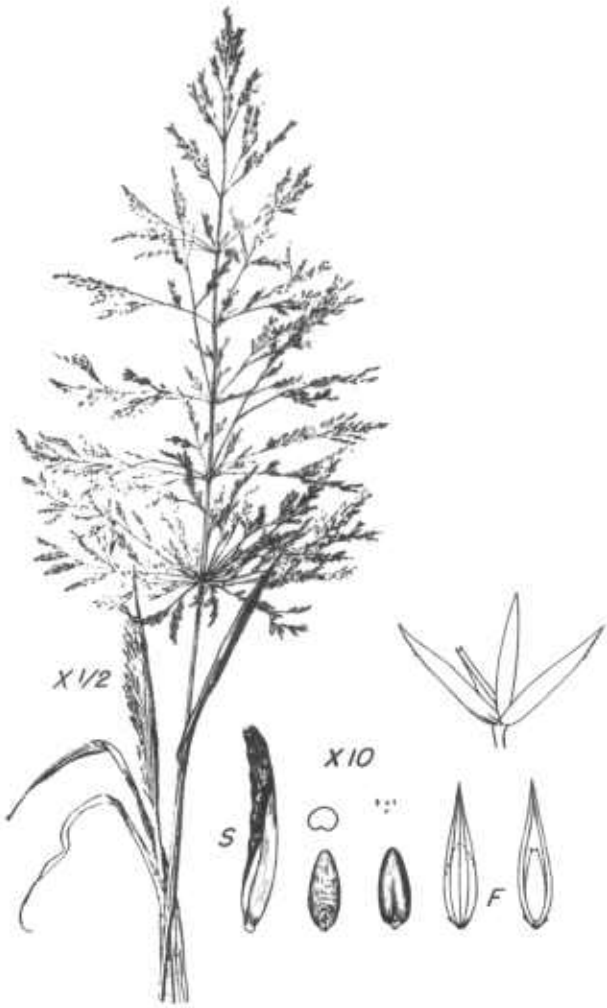
Production Under Cultivation. In pure broadcast stands the average yields are about 55 pounds per acre. Exceptional yields are considerably higher.

Harvesting. Most machinery companies suggest combining the standing grass and they give careful directions. Some of these are: (1) Use extra concaves and close the openings in the concaves, (2) use cylinder speed from 1300 to 1600 RPM and spacing of 1/16 to 3/8 inch, (3) keep chaffer and adjustable sieve three-fourths closed to nearly closed, (4) use special 24 x 24 screen in lower part of cleaning shoe, and (5) close off all air from fan and if necessary hang a curtain across the straw rack back of cylinder to cut down air from cylinder.

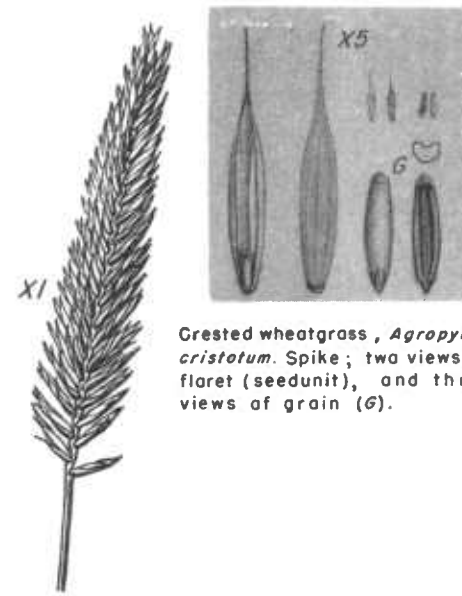
Considerable seed is taken with the bluegrass strippers. Some seedhay is bound, shocked and threshed from the shock or stacked and threshed. A greater percentage of grains will thresh from cured seedhay than from standing seedstems.

Care of Green Seeds. Combined and stripped seed material will need curing before sacking.

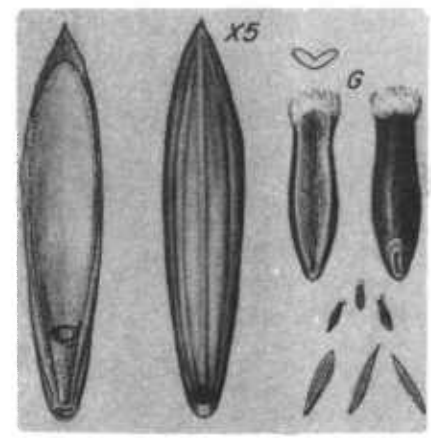
Cleaning. Cleaning requires careful screening and wind adjustment. Openings of triangular perforated screens range from 1/8 to 10/64 inch and slotted screens from 9/64 x 3/4 inch to 11/64 x 3/4 inch. Stripped material can be run over vibrating scalper to remove coarse trash before final cleaning in the fanning or several-screen mill.



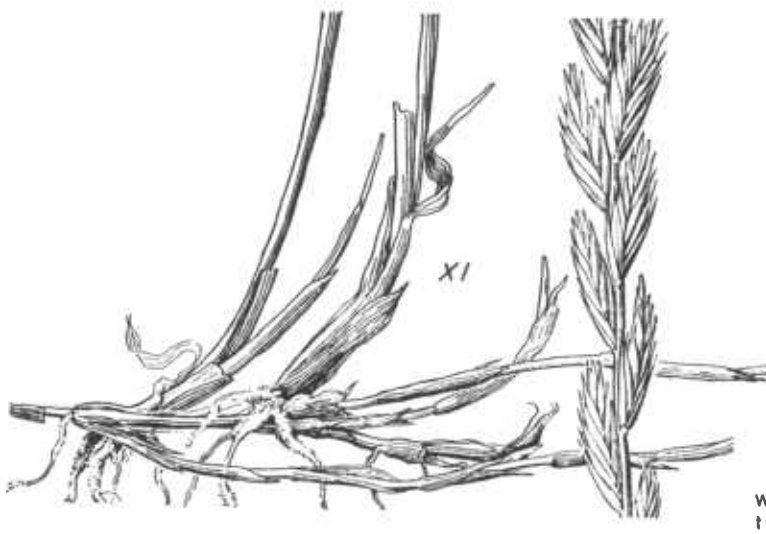
Redtop, *Agrostis olbo*. Panicle; apen spikelet; twa views af flaret (*F*); three views af grain; sclerotium (*S*) af ergat retained in the flaret.

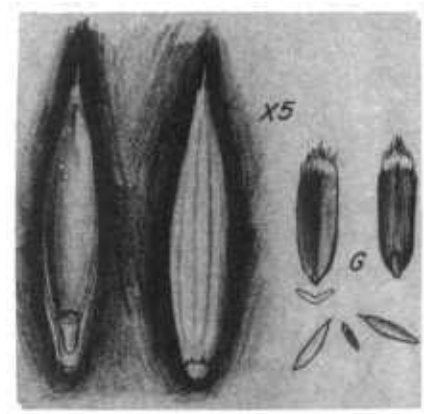


Crested wheatgrass, *Agropyron cristotum*. Spike; twa views af flaret (seedunit), and three views af grain (*G*).



Intermediate wheatgrass, *Agropyron intermedium*. Twa views af flaret (seedunit), and three views of grain (*G*).





Western wheatgrass, *Agropyron smithi*. Plant; twa views af flaret (seedunit), and three views af grain (*G*).

PLATE I

Quality. Most lots of redtop seed contain mixed units of florets, grains and spikelets and in the order listed. Fancy recleaned seed, containing a high percentage of grains, weighs 30 to 38 pounds or more per bushel. The average commercial seed weighs 14 pounds per bushel. Some records indicate a wide range of viability in stored seed. The Danish seed-testing station stored various seeds at usual room temperature and tested them over a period of many years and the germination of redtop did not drop below 91 percent for the first 6 years. In this country the seeds usually are held in storage not more than 2 years. The average purities range from 92 to 97 percent. The grain is small and there are about 5,500,000 of them and approximately 5,000,000 florets in a pound.

BIG BLUESTEM (*Andropogon furcatus*)

Adaptation and Use. Big bluestem is adapted to the eastern half of Oklahoma and Texas, to a small area in northwestern Arkansas in what is known as the Tall Grass Prairie, and in a greater part of the prairies east of the 30-inch rainfall belt. It may occur on lowlands and areas of rapid infiltration west of this belt. Except in the strictly tall grass sites, it occupies the lower slopes because it needs more moisture than does the little bluestem. It is usually found mixed with little bluestem and Indiangrass. It is used for hay and grazing.

Likely Seed Areas. The most likely seed areas of big bluestem are in northern Oklahoma extending eastward from the vicinity of Enid to the state line. Seed formation becomes more erratic farther south due to the generally earlier appearance of the blooms and higher temperatures which affect pollination and fertilization. In 15 years of observation by the writer, the fill in the southern parts of the Region has never been found to exceed 20 percent, except once in one local area in Kenedy County, Texas. Local areas (colonies) should be examined throughout this 4-state Region during the production season in order to discover seed-producing strains. Nature somewhere has produced such strains if man could find and propagate them. Well preserved native meadows either on bottoms or adapted heavy soil uplands furnish the most satisfactory stands for harvest.

Determining Potential Yield and Quality. For a pure stand to be worth harvesting, the seedstems should show a good density, with 20 percent of the fertile spikelets filled. Where the stand is mixed with little bluestem and Indiangrass, or if the stand is to be harvested as seedhay and used locally, the fill may be less than 20 percent. To determine fill, select at random not fewer than 50 fertile spikelets and pinch each one near the base with the thumbnail and forefinger. Also be sure to test the stalked spikelet, as it often contains a well-developed grain.

Production Under Cultivation. In exceptional years the seed yields under dry-land conditions on the nursery at San Antonio were as high as 150 pounds per acre. Yields from natural stands will be less.

Harvesting. The harvest season is from September 20 to periods of heavy frost. Small combines can be used successfully to harvest after the grain has passed the hard-dough stage. At this stage the joints of the raceme break apart easily and separate from the straw without close adjustment of cylinder and concave and without breaking the straw. Any overload on the straw rack will prevent good separation of spikelets from the straw. Underloading can be accomplished by heading high, reducing the speed of the tractor and cutting only a part of the swath. Slow threshing with air reduced will always give best results. The stand can be cut with a grain binder, shocked, cured and threshed with stationary combine or threshing unit. If no combine or thresher is available, and only a short haul is involved, the seedhay can be mowed, raked and hauled to the field to be vegetated.

Care of Green Seed. Fresh seeds from the combine need curing for several days before being sacked. They can be kept in an open shed where air can circulate and stirred about twice each day.

Cleaning and Processing. Since only local areas will be harvested and since this grass occurs generally as a mixture, special cleaning is not usually necessary. The seeds can be processed with a hammer mill and recleaned in a fanning mill to permit drilling with grass drills, or processed to the point where the grain is the unit.

Quality. The purity of the seed material from the combine varies from 15 to 40 percent. The seedunit is the fertile spikelet, the joint of the raceme and the stalk of the sterile spikelet. Frequently the sterile spikelet produces a well-developed grain. The trashy units have a 7-day germination of 31 percent and a final germination of 52 percent. The grain has a 7-day germination of 82 percent. The seeds may remain dormant 6 months or longer after harvest, but sometimes germinate well a month after harvest. Known longevity is 3 years. There are, on the average, 165,000 trashy seedunits in a pound and 191,000 grains in a pound.

SAND BLUESTEM (*Andropogon halli*)

Adaptation and Use. This grass occurs in Texas and Oklahoma on sandy land west of longitude 99° and north of latitude 32°. In places it intergrades with big bluestem. Intermediate forms of both species occur frequently. Its use is largely confined to erosion control of sandy lands and grazing.

Likely Seed Areas. Few seed areas large enough for machine collection are available, because the grass is usually heavily grazed. Small areas are found on dunes, in sandy bottoms, abandoned fields and right-of-ways. Acreages have been established by the Woodward nursery on Cheyenne and Dalhart Land Utilization Projects for seed production.

Yields and Fill. Sand bluestem normally produces seed material having a low fill. Careful checks are always necessary before harvest. Some years ergot is common and replaces many of the normal grains of the fertile spikelets. The method of determining quality is the same as for big bluestem.

Production Under Cultivation. Sand bluestem is relatively easy to grow under cultivation. Yields of 80 to 150 pounds of seed per acre have been obtained under dry-land conditions at Woodward, Oklahoma. It responds well, in seed production, to applications of nitrogen. It is an excellent grass to grow under irrigation for seed, grazing and hay.

Harvesting. Usually the same as for big bluestem, from October 1 to frost. The air-blast on the combine should be completely cut off, and only the top adjustable sieve (chaffer) left in the cleaning shoe. Because the spikelets are very hairy, their separation from the trash is slow, and the seedhay must be fed through the separator at a slower rate than big bluestem.

Care of Fresh Seed. Same as for big bluestem.

Cleaning and Processing. Seed material of sand bluestem is normally trashy as it comes from the combine, and should always be recleaned before planting. The simplest method of cleaning is to run the material over a scalper to remove the stems and other large impurities. A fanning mill can be used, but the rate of cleaning is slower and, therefore, more expensive. The seed material from the combine can be processed in the hammer mill to remove the hairs and awns, without excessive damage to the grain. A grass drill equipped to handle trashy material is required to plant the recleaned seed.

Quality. In general the quality of the seed is similar to that of big bluestem. The purity averages 27 percent, the 7-day germination 48 percent, the final germination 59 percent, the longevity over 3 years. There are 113,000 seedunits in a pound of pure seed. The dormant period of new seed is 1 to 3 months, or sometimes longer.

CAUCASIAN BLUESTEM (*Andropogon intermedius caucasicus*)

Description, Adaptation and Use. An upright bunchgrass, 2 to 3 feet tall, leafy at and near the base, and with rather fine stems. The panicle with an axis more than 1½ inches long often moderately branched or bearing simple branches (racemes). It is distinguished from King Ranch bluestem by the upright, stiff stems which seldom dry a straw color, the normally shorter basal leaves containing some red pigment, and the branched, purple panicle having a longer axis. It was introduced from Asia and has been under trial for a number of years in the western half of the Region. It is a fair forage and seed producer, but lacks the seedling aggressiveness of King Ranch bluestem. Suitable for grazing in low rainfall areas and is reported more palatable than many native and introduced bluestems where grown under the same conditions.

Likely Seed Areas. None established.

Managing for Seed. Growth starts in early spring. Stems and seeds are produced through June to the frost period in the fall. Attention should be given to the period of highest yields, probably in late June and late September. When heavily grazed, the seedstems may never elongate. The upper racemes mature and often shatter before the lowest are developed. The seed harvest should start when the maximum number of filled spikelets are available.

Production Under Cultivation. No records available. Fifty pounds per acre is a good yield.

Harvesting. Caucasian bluestem can be harvested with the combine. The procedure will be about the same as for King Ranch bluestem. In the dry climate where it is now being grown, the bluegrass stripper should be suitable for taking the seeds.

Care of Green Seed. See little bluestem.

Cleaning. See little bluestem.

Quality. The seedunit of Caucasian bluestem resembles that of King Ranch bluestem. It is smaller and has fewer hairs on the stalks and joints of the racemes. The samples tested show there are about 1,000,000 units in a pound. Laboratory records give a 7-day germination of 24 percent and a rather low final germination of 39 percent. Occasional lots after four months' storage have a 7-day germination of 60 percent. Field germinations have been good.

KING RANCH BLUESTEM (*Andropogon ischaemum var.*) (T-3487)

Adaptation and Use. King Ranch bluestem is a deep-rooted, semiprostrate, tufted perennial. The growth is unusually vigorous after drought. It is well suited to a wide range of soils and conditions. Known to be salt tolerant on the Texas Gulf Coast. Strongly competitive with grasses of like or lower stature. Produces seeds from June until frost. Will invade short-grass and mid-grass pastures. Seedlings survive competition of annuals. Well suited for overseeding thin and eroded soils for erosion control and for use in conservation cropping systems on cropland. Livestock graze it readily. Useful for hay, pasture, spoil-bank and dam protection and vegetating waterways. It is a strong competitor for moisture, and, if kept vigorous, shows promise of competing with low brush in southern Texas. Productive under irrigation. It was introduced into Texas probably on the King Ranch about 1910. There it spread in competition with native grasses and Rhodesgrass.

Likely Seed Areas. It was first distributed by the Soil Conservation Service nurseries in trial plantings and to the soil conservation district cooperators. Several growers

at various places in Texas and Oklahoma now grow seeds for sale. There are no important wild stands.

Managing for Seed. Stems are produced throughout the growing period, from April to cold weather. The first crop is ready between May 15 and June 15, the second 30 to 45 days later, one in September and generally one in October or November. The number of harvests will always depend on distribution and amount of rainfall. The summer fill is usually lowest, the September fill the highest.

Potential yield is hard to estimate. Where there are 10 inflorescences per row-foot and the majority have some purple color in the branches, check closely for stage of flowering and condition of developing grains. When filled this many inflorescences per row-foot will produce from 18 to 25 pounds of seed per acre. If 40 percent of the units are filled, the yield of pure seed should be 8 to 10 pounds per acre. Stands of 5 stems per row-foot are probably not worth combining. Usually 3 to 5 days are needed for an inflorescence to complete its flowering. The lowermost spikelets of each raceme are always last to come into flower. Start the combine when a third to half the racemes show light-brown color and slight shattering at the tips. This period is also determined by pulling the more mature inflorescences lightly through the thumb and fingers. When about half the joints break off or pull apart, it is time to harvest.

Fill, during the development period, can be observed by pinching the small, fertile spikelets. When they contain a developing grain, there is some purple color when observed against the light. The grain is usually purple-coated when soft. Since only the brown spikelets contain amber or hard seeds, most of the material will be taken in the medium-dough stage. Empty spikelets often take on a straw or papery color.

Harvesting. King Ranch bluestem can be harvested with any combine, but with difficulty owing to the immaturity of many inflorescences. The canvas-type combine is considered best if a choice is possible. Flaps or brushes are added to the reel bats to push the material back onto the canvas. The cylinder speed is high, from 1500 to 1800 RPM; the spacing 1/4 to 1/8 inch or closer from the concaves. (One producer insists that toothed cylinder and concave does a better job of separating than the rub-bar or rasp-bar types. It is run at medium speeds and with ½-inch spacing between cylinder and concaves.) Where stem height varies, an extra man is often used to change height of sickle to keep an even lot of material on the canvas or in the auger. Start the machine as soon as morning dampness leaves the standing material. Take as few leaves and weeds as possible. Lowering the front end of the chaffer and raising the rear end increases the efficiency of cleaning. Open the chaffer. Remove the shoe sieve. Cover the chaffer extension with thin metal to block off tailing material from auger. Remove all air, preferably by removing fan blades. Keep clean-grain pan free of sticky material so as to allow chaffy seeds to slide to the clean grain auger. Use a box sled or canvas and catch all tailings. The conventional grain bin and auger are of no use to unload the chaffy seeds. They should be sacked as they drop from the grain spout. A plywood box, having a hinged door at the side and bottom, was recently built to replace the grain bin and auger. The trashy seeds are dropped into the bed of a pickup truck from the box.

A two-reel stripper, constructed at Goldthwaite, Texas was used for comparison with a standard combine to harvest seeds of King Ranch bluestem. The stripper obtained seeds suitable for planting without cleaning. It has several advantages over the combine for harvesting seeds of this grass.

Another method of harvesting is to mow and evenly windrow the seedhay, cure and combine from the windrow.

The seedhay of King Ranch bluestem is very valuable for mulching and seeding dams and fills. It can be mowed, windrowed and baled or baled directly from the swath. It can be moved as loose seedhay to the planting site, if distance is not great.

Care of Green Seed. Whether sacked at the combine or removed loose, the trashy material as it comes from the combine must be dried for at least 2 days. If piled over 4 inches thick, stir to keep from heating. Drying on porous canvas or wood floor is best. Concrete sweats.

Cleaning and Processing. The seed scalper can be used for the first cleaning. The seeds are usually plantable after one scalping. For better cleaning, the larger cleaners are used. In these the usual cleaning process is reversed; i.e., the seeds are blown out by the fan, and the trash, weed seeds and heavy material screened out through the clean seed spout. This method produces seeds of higher purity.

Combine tailings are not easy to clean on a vibrating scalper. They may be run through the hammer mill at 800 RPM using a 1/4-inch screen and sacked without further cleaning. Such seed material is fine enough to flow through a cotton box or a grass-seed drill. The commercial seedsmen can sell such material on a pure live seed basis. One operator runs his combine tailings over a scalper and then through a pecan sheller to reduce the hairs and appendages of the seedunit. This gives him higher purity and increased plantability of seeds.

Quality. New seeds of King Ranch bluestem are usually dormant for 1 to 4 months. For most accurate results, seed tests should be delayed for at least 60 days after harvest. The seedunit, as with other bluestems, is the joint of a raceme, the fertile spikelet, and the stalk of the neutral or male spikelet. For practical purposes, the seedunit is called a trashy spikelet. The average purity of trashy seed is 25 percent, the 7-day germination 29 percent, and final germination 57 percent. There are 777,000 filled seedunits in a pound of pure seed. The longevity is 4 years. The purity of hammer-milled tailings is about 1 percent, of seedhay 2.25 percent. As new methods of cleaning are found, the purity and plantability of King Ranch bluestem should improve.

SEACOAST BLUESTEM (*Andropogon littoralis*)

Description, Adaptation and Use. As now recognized, seacoast bluestem in a strongly rhizomatous, leafy perennial. Rhizomes normally thick and scaly; stems not crowded, medium in size, compressed, leafy throughout, the upper leaves grading into the leafy bracts of the flowering branches; leaves wider than those on the average little bluestem plant, flat throughout or somewhat folded at the base; seed branches short or long, bearing single hairy racemes which often do not protrude fully from the leafy bracts; spikelets hairy, not spreading. Differs from typical little bluestem in the prominent rhizomes, the leafy stems, and the conspicuously bracted, hairy inflorescence. The natural range is the dune and deep sands of the Gulf Coast, and the plants are most abundant in Kleberg, Kenedy, Brooks, Jim Wells, Duval and Jim Hogg counties. It is abundant and dominant where properly managed in these counties. Used for pasture, hay and dune revegetation. Has been tried as far north as Guthrie, Oklahoma, where it survived the cold but did not produce seed. Near Decatur, Texas and near Minden, Louisiana it produced good vegetative growth but failed to flower early enough to ripen viable seeds. Probably best adapted to the sandy soils of the 4 tiers of counties next to the Gulf Coast and all the Rio Grande Plain. May be useful in the dune sands farther west.

Likely Seed Areas. Pastures of Kenedy and other counties of the Rio Grande Plains where it has not been reduced or eliminated by prolonged yearlong grazing. Patches from a square rod to several acres in extent may be found in several counties. No increase blocks have been established.

Managing for Seed. This bluestem is a poor seed producer in most years. It has a long growing period and is inclined to develop flowers during the very short days of the

year before the temperatures prohibit further growth. The first racemes begin to appear about mid-October. Flowering is well under way but not completed by November 1. Seed is harvested from November 15 to December 15 depending on the moisture. During some years flowering is arrested by drought and never resumed. The seed-producing areas should be checked during the late flowering period and again before harvest to determine potential yield. Shriveled seed may be abundant in a dry fall.

Harvesting. Early harvests were made with a sickle. The seedhay was topped and placed in a sack, dried on a canvas and resacked. Binding and curing in the shock is probably the easiest way to harvest the seed. Selected areas in some of the counties will have native stands that can be handled with a binder.

Combining is possible with well ripened material. The resulting seeds will be very trashy.

For dune control this grass has been cut and spread on open dunes. If taken at the time seeds are ripe this is a practical way to control small blowouts or open dunes and reestablish a cover. The seedhay must be punched in the moving sand to hold the material in place.

Yields Under Cultivation. Not known. At the San Antonio nursery a block established in 1940 produced some seeds about 1 out of 3 years and then only in limited quantities.

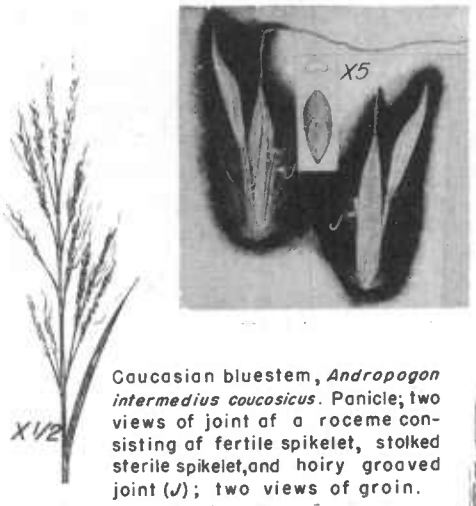
Cleaning. Topped seedhay is threshed in the combine and run over a scalper. For planting from a grass-seed drill the combined seed must be run through a hammer mill.

Quality. Seacoast bluestem seedunit has the same makeup as other bluestems. The purity of samples from native and nursery collections has been extremely low, averaging 12 percent, the 7-day germination 29 percent and the final germination 50 percent. Many shriveled seeds are usually found in the seed lots. A pound of pure seedunits contains 321,000 seeds. The units are about the size of those of little bluestem and are difficult to separate from hairy units of the latter.

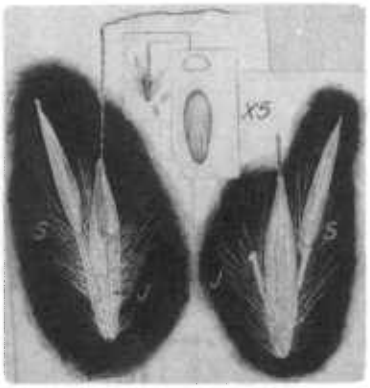
ANGLETON BLUESTEM (*Andropogon nodosus*)

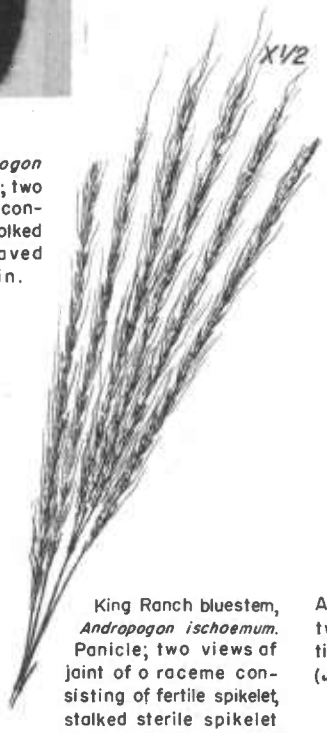
Description, Adaptation and Use. A fine-stemmed, branching, leafy perennial. Some of the stems lean in a close stand. When the plants are separated, part of the stems are prostrate and root at the nodes. Under grazing, the stems spread and rooting is increased. A deep-rooted grass with medium tufts and sparse fruiting stems; the purplish nodes marked with a hairy ring; leaves moderately long and smooth, reduced in size on the upper part of the stem; ligules short, firm, truncate or rounded with an irregular margin; the stems just below the racemes rather densely hairy; fertile and sterile spikelets crowded and overlapping, giving the appearance of a two-ranked scaly spike, similar in size and color (purplish), obovate, flattened 7- to 9-nerved, hairy on the lower half, and somewhat toothed at the tips; awn of fertile spikelet less than an inch long, closely twisted and bent. The stem hairy at and below the racemes and the broad overlapping spikelets distinguish this bluestem from any other now used in the Region. It is an introduced tropical bluestem, adapted to rich, moist soils and rather resistant to drought. Extensively tried on the Texas Experiment Station at Angleton, Texas under the name *Andropogon annulatus*. It also has been tested by the Texas Experiment Stations at Balmorhea, Lubbock and Chillicothe, Texas where it withstood the mild winter of 1925-26. At Temple, Texas the plants remained alive for several years. Its most extensive use probably will be in rainfall areas above 30 inches and lower rainfall areas under irrigation, all in the milder parts of the Region. An excellent grass for hay, pasture and waterways.

Likely Seed Areas. None. Scattered patches on the Gulf Coast Prairie are increasing in size. Where planted or transplanted it seems to spread slowly in the native vegetation. Low seed production will naturally keep it confined to local areas.

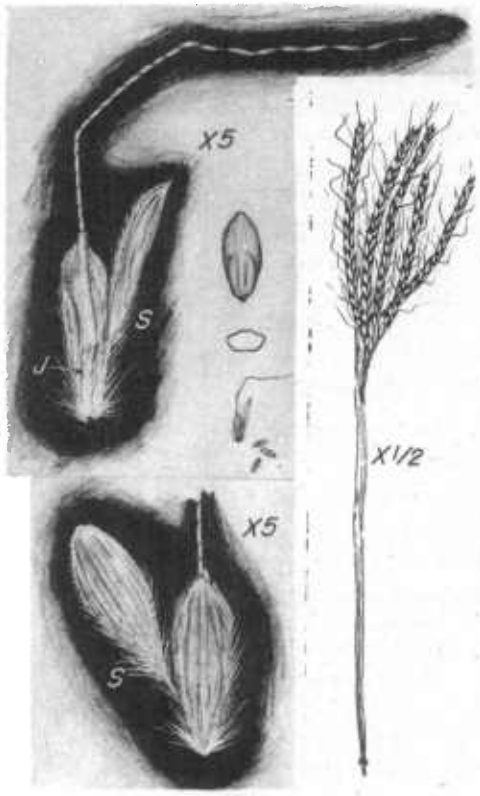


Caucasian bluestem, *Andropogon intermedius coucosicus*. Panicle; two views of joint of a roceme consisting of fertile spikelet, stolked sterile spikelet, and hoiry grooved joint (*J*); two views of grain.



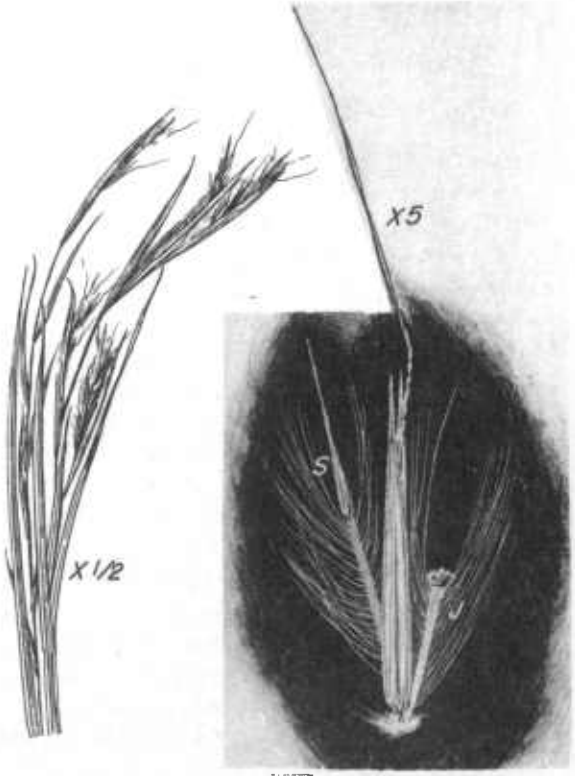


King Ranch bluestem, *Andropogon ischoemum*. Panicle; two views of joint of o raceme consisting of fertile spikelet, stalked sterile spikelet (*S*), and grooved hairy joint (*J*); two views of grain.



Angletan bluestem, *Andropogon nodosus*. Inflorescence; two views of joint of o roceme composed of fertile spikelet, stolked sterile spikelet (*S*), and hoiry joint (*J*); two views of grain.

Little bluestem, *Andropogon scoporius*. Ponicle; joint (*R*) of a raceme composed of fertile spikelet (*F*), stalked sterile spikelet, and hairy joint (*J*); same unit (R_1) after passing through a hammer mill; grain (*G*).



Seacoast bluestem, *Andropogon littorolis*. Ponicle; joint of raceme composed of fertile spikelet, stolked sterile spikelet (*S*), and hairy joint (*J*).

PLATE 2

Potential Yield and Quality. The chief objection to the continued use of this grass is its failure to produce enough seedstems and filled spikelets to warrant seed harvest. An average of 3 such stems per square foot is considered excellent. Usually the average is less than one. Production should be increased to 5 or more stems per square foot before yields are reasonable. Considerable trial work must be done on this grass before the seeds can be marketed commercially at a fair price.

The first seedstems appear in May and if moisture remains favorable others will continue to appear throughout the summer and fall. Mowing or uniform grazing may help to increase the number. The grazing animals should be removed several weeks (usually by May 1) before the maximum number of stems are expected. Fill is erratic. Seldom do half the fertile spikelets contain grains. Pinching the spikelets is an easy way to determine fill. But the examiner should be sure he is selecting the awned fertile spikelets to test. If the awns have fallen it is not easy to separate the two kinds. The seeds are harvested when the grains are in the hard-dough stage. Shattering is usually delayed until the seed material is dead ripe and dry.

Production Under Cultivation. Twenty pounds of seedunits with a 40 percent fill is a good acre yield. Ten or 15 pounds is probably nearer the average.

Harvesting. Most seeds from small blocks have been harvested by cutting the tops and sacking them. This is expensive where the stems are scattered.

The seeds combine about like King Ranch bluestem. Much of the seed material is carried out with the tailings which should be saved and hammermilled or spread out on other planting sites. Seeds of higher purity will be obtained if the material is mowed, cured and threshed slowly. Small acreages can be handled as seedhay by topping the stems and hauling them green or cured to the new planting site.

Care of Green Seed. Combined seeds must be dried before sacking.

Cleaning. Any cleaner with a good fan will clean the seed. The spikelets are removed from the heavy trash by blowing them out of the dust cone and trash exit with the fan. The heavy trash is then taken out through the grain spout.

Quality. The seedunit is made up of the fertile spikelet, the joint of the raceme and the stalk of the neutral spikelet. Cleaned seeds usually contain a mixture of seedunits and neutral spikelets and because of that and low fill, the average purity is only 43 percent. The 7-day germination is 45 percent and the final germination 79 percent. Both the 7-day and final germination are high for the bluestems. A pound of pure seed contains 234,000 seedunits. The seeds should not be held longer than 2 years before planting.

LITTLE BLUESTEM *(Andropogon scoparius)*

Adaptation and Use. Little bluestem occurs throughout much of the Region east of longitude 100° and west of that longitude in the sands. It is adapted to a wide range of soils in rainfall belts above 25 inches. In the Cross Timbers it increases rapidly under good grazing management following the removal of the oaks. In cut-over pine land, it helps to control erosion until crowded out by shade and litter from second-growth pine. It is equally important for hay and pasture west of the pine belts.

In many problem areas in soil conservation, particularly in the true and mixed prairies and eastern plains, stands have been greatly reduced by yearlong and close grazing, and the species replaced by inferior grasses.

Likely Seed Areas. Seed areas range from the Coastal Prairie northward throughout the prairies of Texas and Oklahoma and in sections of the West Cross Timbers and Rolling Plains. Large blocks may be found in the sand plains bordering many rivers. It occurs in pure, or nearly pure stands more often than big bluestem, particularly on well-managed pastures. Such pastures are now considered the most dependable of all sources of seed in quantity. By inspection of the pastures in the spring, arrangements can be made to defer grazing after June 15, or at a later date to permit proper stem development. Following the seed harvest, grazing can be resumed.

Experience shows that natural meadows are not a dependable source of seed. Usually the meadow is cut for hay after July 15 when seedstems have made considerable growth. This apparently precludes the possibility of a large number of stems developing after the summer cutting. Even when meadows are cut by July 1 before any elongation occurs, the stems that develop later in ordinary years are too few to justify holding for a cutting of seed in the fall.

Railroads of northwest Arkansas, Oklahoma and Texas have many miles of nearly pure little bluestem or mixed bluestems on the right-of-ways. In most places, this material can be cut with a mower or topped with a stripper and used as seedhay or threshed. Permission to harvest the seed has always been easy to obtain.

Potential Yields and Quality. As stated above, preliminary surveys of possible seed-producing areas should be made in the spring and summer. A brief outline for determining seed potential is as follows: (1) Locate and treat seed areas so that full culm production will occur if and when it rains, (2) in mid-August visit the areas and determine stem production (if rains come late, the stems may not push up until after mid-August). If only one or two stems per tuft are found, the area will be worthless for seed production, (3) if stem production is normal, i.e., 4 or more per tuft and the tufts closely spaced, revisit the area about September 25 to determine progress of blooming and stage of grain development, (4) on or after October 1, revisit area and sample the seed for fill and quality. At this time, potential yield and quality can be determined by pinching the base of sessile, fertile spikelet. If most of the purplish-colored grains are squeezed out intact, the crop is ready for harvest; if a third or more of the grains squeeze out as soft milky dough, the seeds will be ready in another week. If less than 5 out of 50 spikelets checked at random contain a developing grain, the fill is only 10 percent and is considered poor and not worth harvesting. If 15 out of 50 are filled, the material is fair or good. If 25 are filled, the material is excellent. Many such checks made in Oklahoma, Texas and Louisiana during October 1942 showed a fill of good or excellent. Seed yields of such material with heavy stem production may be as much as 600 pounds per acre. This fill is very definitely tied up with rainfall, soil moisture and air temperature. Good soil moisture in early July assures culm production. Good soil moisture in late August and most of September ordinarily assures seed production.

Production Under Cultivation. Under dry-land conditions at San Antonio, Texas, production in rows under cultivation varies greatly from 100 to 300 pounds of seed per acre. Yields from pastures will average less, 75 to 200 pounds per acre. Under irrigation, the yields could be 500 pounds per acre.

Harvesting. The harvest season generally is from October 1 to November 1. In exceptional years, it may be earlier or later. In 1942 the harvest period was after November 1. The optimum period is about October 10.

Direct combining is entirely satisfactory. The operator must be prepared to complete the job in the shortest possible period before wind, storms and frost cause a quick dispersal of the seedunits. The air-blast on the combine is cut off completely, only the top adjustable sieve (chaffer) used, and the space above the tailings auger covered so nothing returns to the cylinder for rethreshing. Cut long straws. Set the cylinder speed at about 1000 to 1200 RPM and the cylinder spacing at about 3/8 inch. Avoid overloading the separator by adjusting the forward speed of the combine to the stand of grass being cut.

Harvesting with a grain binder, stacking and threshing is a satisfactory method of obtaining seed. The same precautions as when combining should be used. A cloudy day with high humidity permits the most economical threshing.

Cutting the seedhay with a mower or binder, raking green or while damp and then hauling directly to the field to be planted is an economical way to harvest and plant little bluestem, particularly where small acreages are involved. This practice was used to some extent in the early days by foreign-born settlers. The home-made, topping-stripper constructed in central Texas works well on little bluestem.

Hand-cutting the tops of seedstems on areas where machines cannot be used is economical where labor is cheap. A good man with a half-sickle will cut 30 to 100 pounds per hour. The weight of the seed in the tops varies from 15 to 40 percent. One man, therefore, should be able to hand-cut about 100 pounds of seed per day, enough when cured to plant 5 acres. Topping is most economical where each bunch contains many stems.

Care of Fresh Seed. Seeds from the combine should be spread out and cured for at least a day in sun and air. When cured in a building the seeds should be piled not to exceed a foot in depth, stirred twice daily to prevent heating and the room ventilated to carry off the moist air.

Cleaning and Processing. Seed material from the combine and usually from the stripper is normally low in purity. It contains considerable straw and other coarse material. A cheap method of removing this trash is to run the material over or through a scalper. The fanning mill will accomplish the same thing.

The ordinary hammer mill serves better than any other machine for producing plantable seeds from trashy material:

1. It partially frees the material of awns, hairs and other appendages.
2. It reduces the coarse trash to a uniform size.
3. It makes the mass of seed easier to handle in drills and planters.

Quality. Seeds from a combine have a purity range of from 20 to 65 percent. In the upper range, some good seeds are lost in the chaff that passes over the covered chaffer extension. New seed is low in germination. Tests in Missouri indicate that maximum germination of stored little bluestem seed is at least a year from date of harvest. Seeds from the northern part of the Region have a lower initial germination than those from the southern part. Therefore seeds from northern Oklahoma should be planted in January and February in order to obtain the necessary alternate freezing and thawing (alternation of temperatures) to place the embryo in readiness to germinate. The average laboratory germinations of many samples is 31 percent in 7 days and 48 percent total. The average purity is 30 percent, the average number of seedunits per pound of pure seed 269,000, and the longevity 3 years. The seedunit is the fertile spikelet, the joint of the raceme, and the stalk of the sterile spikelet.

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SIDEOATS GRAMA *(Bouteloua curtipendula)*

Adaptation and Use. Sideoats grama is one of the most widely distributed grasses in the Region. It is adapted to a variety of soils and conditions. It is found on the slopes of mountains, is common in shallow eroded soils, and may be a minor grass in the tall grass prairies. It remains in soils of alkaline reaction in low rainfall and low altitude belts longer than in neutral or acid soils. It is rare in the sandy soils of the Forested Coastal Plain.

Its principal use is for grazing, although a small amount in good meadow land is not undesirable. It can be used in pasture mixtures in most of the Region west of the timber belt. Exceptions to this are the deep sands of the Rio Grande Plain and other parts of southern Texas and the rainfall belts below 14 inches at lower altitudes.

Likely Seed Areas. Pure stands of sideoats grama are not common. The most promising areas for the collection of seed with machines are in central, western and northern Oklahoma and Kansas and in the Panhandle of Texas. Frequently in the Texas Panhandle, the grass makes sufficient growth in the summer after good rains to produce a late seed crop. Under these conditions, large quantities of seed can be taken. A good way to handle collections of seed is to determine locally in the spring where the stands are of sufficient density to produce seed in quantities. In case rainfall and other weather conditions are favorable, watch such areas for stem production.

Seed increase plantings have been established by many soil conservation district cooperators in Oklahoma and Texas.

Determining Potential Yield and Quality. The seedunit of threshed or combined seed is usually the spike. Where the material is broken up in combining or processing, it may be a mixture of a variety of units, such as spikes, partial spikelets or naked grains. Sideoats first blooms in midsummer, at a time when humidity and temperature are unfavorable for pollination. Seed crops are rare at that time. Where good late summer rains occur, conditions are more favorable for pollination; and a second lot of seedstems may develop (this seldom takes place in an area where an early seed crop was produced). The seedset then is usually higher than in early or midsummer. A casual examination of a stand of sideoats grama can be very deceiving to the eye, as the sterile spikes have the same external appearance as fertile spikes. Seedset is usually low in sideoats grama. A good fill is one in which 75 percent of the spikes have one or more of the spikelets (fertile florets) filled. Any time the percentage of filled spikes gets as low as 10, the material is of doubtful quality, as this represents only 2½ percent of the fertile florets filled (assuming the average number of spikelets in a spike to be 4).

Determining quality and fill in the field resolves itself into determining what percentage of the spikes possess one or more grains. This can be done from the milk or early dough stage to after maturity of the grain, which represents a period of two to three weeks. Take the spike between the nail of the thumb and flesh of the forefinger and press along the rachis. Usually one pinch will force out the immature or mature grain. If a hundred spikes are pinched at random in a field and 10 or more contain grain, the material may be worth harvesting and the checker can be fairly certain he has sampled the area adequately.

In certain years sideoats grama is attacked by an insect, the larvae of which feed on the developing grains and possibly the stamens. In the soft-dough stage, these larvae are pink-skinned; and when pinched out, the pink contrasts with the usually green color of the immature ovary (developing grain) or the amber of the mature grain. If such insects are common, a thorough sampling should be made.

During the pollination period, moisture conditions may become reduced, and normal exsertion of the anthers and stigmas does not occur in many spikelets. In other words, there is not enough moisture in the plant to produce turgidity and ordinary exsertion

of the floral organs. This is common in drought-stricken stands. The anthers under most conditions are colored pink. Under droughty conditions, they remain inside the bracts. When an inspection for potential yields is made, the pink-colored anthers may be mistaken for a developing grain.

During 1949 a stem rust ruined the seed crop near Dalhart, Texas by stopping seed development. Too much moisture was the cause of increase of the rust.

Production Under Cultivation. Sideoats grama is one of the easiest grasses to grow under cultivation. It should be planted in rows and cultivated like any other row crop. Yields under dry-land cultivation range from 100 to 300 pounds, and under irrigation from 400 to 600 pounds or more per acre in two or more cuttings a year.

Harvesting. The harvest season varies from July 1 to October 1, depending of course on rainfall and soil moisture. Since the spike development is not uniform, the period for harvesting is often short, of 1 to 2 weeks duration.

The combine is commonly used to harvest the seeds. The sickle is set high so as to top the seedstems. The cylinder speed is reduced. The wind and sieves are adjusted to allow all the spikes to shake through the sieves without mixing in too much chaff, since the weight of the empty spikes will vary but little from the filled ones. Where speed is necessary to complete the harvest, the seed material coming from the combine will probably need recleaning, if clean seeds are wanted.

A field of sideoats grama can be bound with a binder and threshed. Where this operation is local and the seeds are to be used close by, the bundles can be spread on the field to be planted and scattered by hand. Mowed material can be used in the same way.

The bluegrass stripper does a good job of harvesting the tops of sideoats grama, but the material will need cleaning for planting from a cotton box hopper and drill.

Care of Green Seed. When seeds are combined at the optimum period, a large percentage of the grains may be soft and immature. Respiration is rapid in such seeds. Therefore treat the green seeds in a manner that will prevent heating and molding.

Cleaning and Processing. Combine-run seeds usually contain varying amounts of stems and leaves which should be removed before planting. Quality can be greatly improved by re-running the material through the combine with close chaffer setting and a light air blast; by running the material over a scalper; or by cleaning it in an ordinary fanning mill. Regardless of the cleaning method used, special drills are required to plant the seeds.

It is difficult to process sideoats grama uniformly using a hammer mill. Hammermilled material contains some free grains in the mixture of trashy florets and spikes. These should be removed in a fanning mill to obtain a uniform planting material. It is not recommended that sideoats grama seed material be processed in a hammer mill unless the intent is to reduce the entire lot to clean grain.

Quality. The purity of the seeds from the combine or thresher is generally less than 30 percent. It varies from almost 0 to 90 percent. Seeds (based on the spike as the seedunit) having a purity below 15 to 20 percent are of doubtful value for marketing, and below 8 percent of questionable value for even local use. The average purity of many samples of spikes in the laboratory was 21 percent, the 7-day germination 51 percent, and the final germination 58 percent. The units are fairly readily germinable. The dormant period is short. Where the seed material was broken down by hammermilling to florets and grains, the 7-day germination was increased to 65 percent and the final germination to 85 percent. There are 143,000 seedunits (spikes) in a pound of pure spikes, 250,000 in a pound when the units are mixture of spikes, florets and grains, 680,000 in a pound when the units are florets and grains, and 719,000 in a pound of pure grain.

BLACK GRAMA *(Bouteloua eriopoda)*

Description, Adaptation and Use. A perennial bunchgrass with slender, wiry, arched stolons that root to form an open turf. Most stems partially or wholly covered with close woolly hairs; leaves short; spikes 3 to 8, usually 4 or 5; spikelets prominently awned, not crowded; fertile floret and grain slender; rudiment (undeveloped floret) slender, the stalk bearing a tuft of hairs, the awns long. A grama of the dry hills of southwest and far west Texas and the Black Mesa of the Oklahoma Panhandle. Grows on limestone and granitic, usually shallow soils, although not entirely limited to such conditions. Has probably increased in most areas, as less drought-resistant grasses, like the andropogons and blue grama, are crowded back through overuse and erosion. Used for grazing.

Likely Seed Areas. Slopes west and north of Van Horn, Texas mostly in Hudspeth County, and in Loving, Ward and Winkler counties.

Potential Yield and Quality. Black grama growth follows the summer rains. Should the rains fall in August, stem and seed maturity may be delayed until near frost. Stems normally elongate in September, flowering occurs in early October and seeds are mature by or during the last 2 weeks of October. This date will vary with changes in soil moisture and rainfall. Fill will depend on conditions during the bloom period. Extremely hot and dry weather will usually result in poor fill. Under exceptionally good conditions, stem production may equal 5 stems per square foot. Usually it is less.

Production Under Cultivation. Seed yields are low under cultivation and will not exceed 100 pounds per acre under dry-land conditions. Seed yields from pastures seldom exceed 50 pounds per acre.

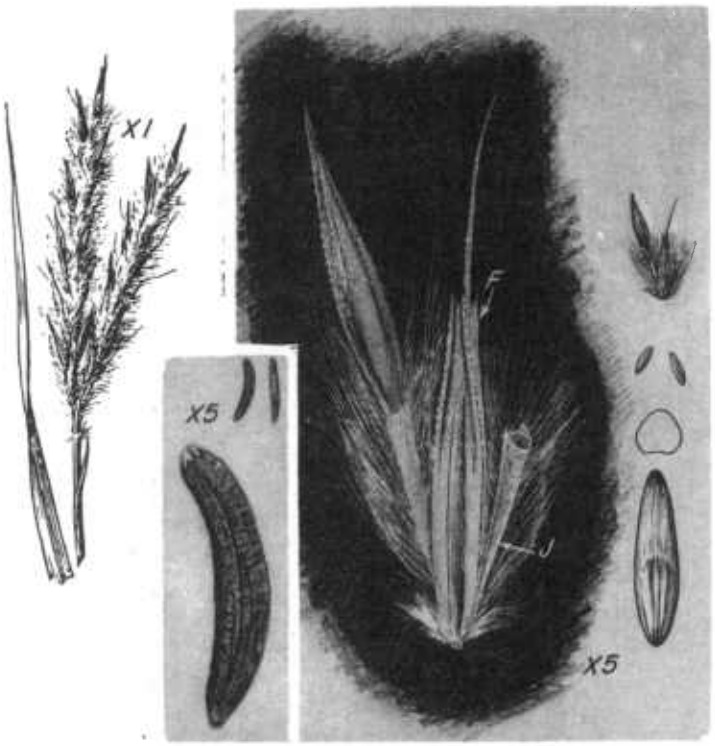
Harvesting. The most economical machine to use is the seed stripper. Start the machine as soon as the spikelets are near the shattering point. If plants and tops remain tough the machine will pull more of the plant into the machine and increase the trash content. Regulate height adjustment so that only the spikes are stripped. The linear speed of the machine should be adjusted to take in only the tops and to keep out other parts of the plant.

Consider well the area to be harvested according to the machinery available so that the main harvest does not cover more than one week. High, dry winds will soon blow out fully ripe spikelets. The seeds can be harvested with a combine but the practice is not economical when the low yield is considered.

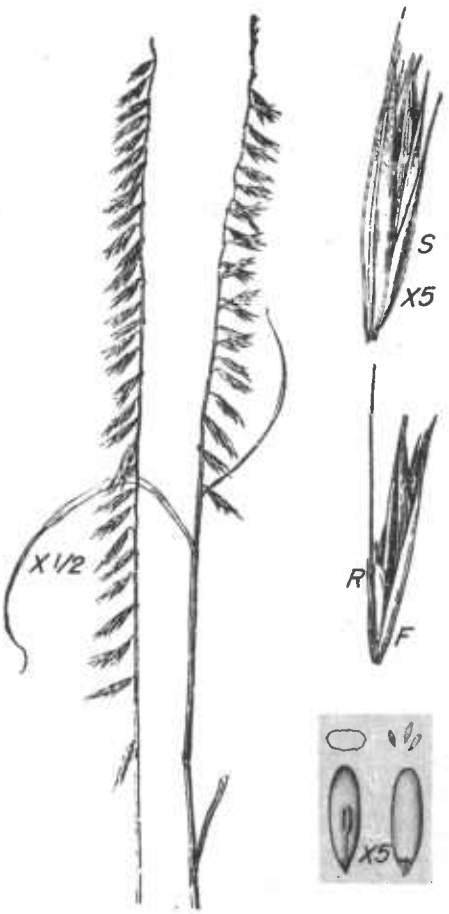
Care of Green Seed. The seed material can ordinarily be cured outdoors if loosely sacked and exposed to the wind and sun.

Cleaning. Properly stripped seed contains some trash some of which can be removed by a vibrating scalper or fanning mill. This process is more efficient in damp weather because then the rudiment awns tend to hug the floret. Hammermilling stripped seed material will produce plantable seed.

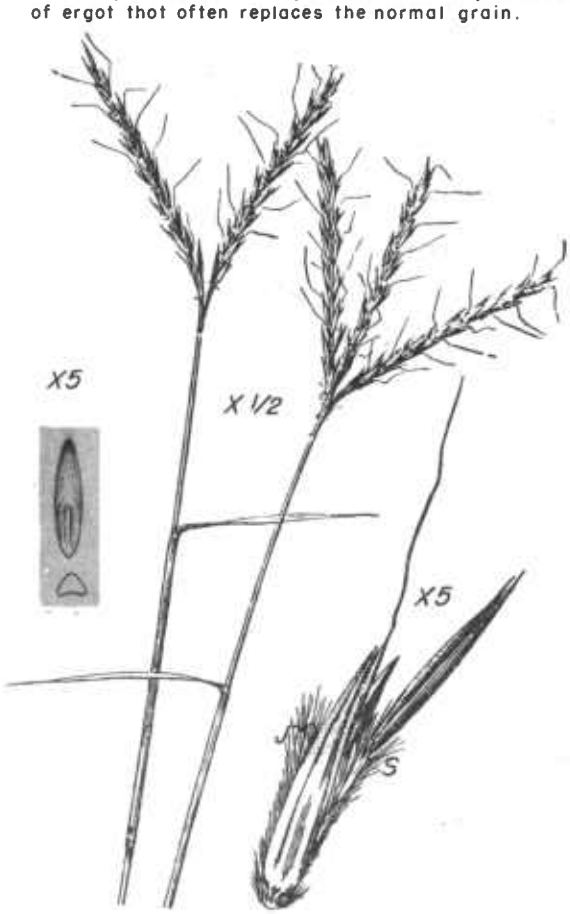
Quality. The seedunit consists of the filled fertile floret and awned rudiment which does not separate from the floret. There are 1,300,000 in a pound of pure seed. Most material received at the laboratory is rather low in purity (37 percent), the 7-day germination is 11 percent and the final germination 22 percent. This is a low average 7-day and final germination. The known longevity is 4 years, but generally the seeds should not be held longer than 3 years before planting.



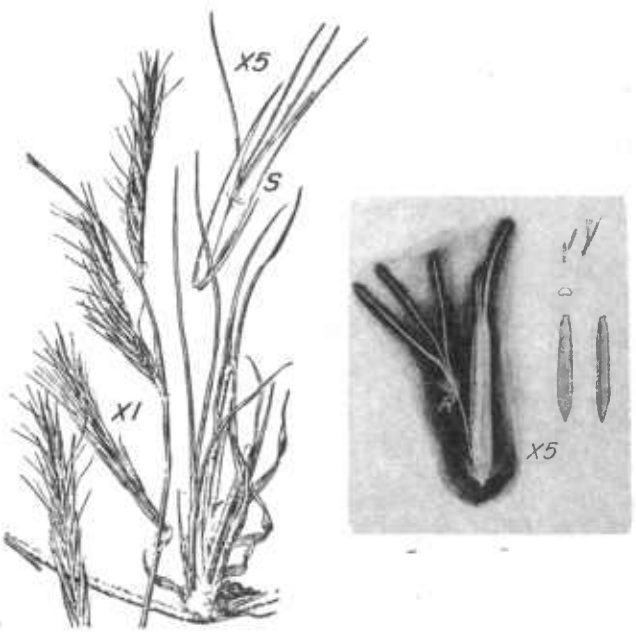
Sand bluestem, *Andropogon hollii*. Inflorescence; joint of raceme composed of sessile fertile spikelet (*F*), stalked sterile spikelet and hairy joint (*J*); two views of grain; a banana-shaped, horny mass or sclerotium of ergot that often replaces the normal grain.



Sideoats grama, *Bouteloua curtipendula*. Two panicles; seedunit or spikelet (*S*), floret (*F*) with rudiment (*R*), and three views of grain.



Big bluestem, *Andropogon furcatus*. Inflorescences and joint of raceme composed of sessile fertile spikelet, stalked sterile spikelet (*S*), and hairy joint (*J*); two views of grain.



Black grama, *Bouteloua eriopoda*. Part of plant and spikelet (*S*); fertile floret and slender awned rudiment (*R*) exposed; three views of grain.

PLATE 3

SLENDER GRAMA (*Bouteloua filiformis*)

Adaptation and Use. Slender grama is a tufted, fine-stemmed perennial, native to the Rio Grande Plain of Texas, south of the Nueces River, and westward to Arizona. It thrives best in the medium and fine-textured soils that are freely to slowly permeable and alkaline in reaction. The vigor of the seedlings is remarkable on the Edwards Plateau where it has been tried extensively. This may be due to the increase in rainfall, in altitude and to the fewer long, hot, dry periods. Seedlings will survive on the Plateau on rock ledges as long as any of the grasses. Under Arizona conditions, it is rated as an inefficient plant during hot, dry periods. For efficiency of reproduction, it is exceeded only by species of threeawn and red grama. In Val Verde County, Texas, on exposed rocky slopes, seedlings have always replaced old plants following years of extreme drought. In such locations, at least three flowering periods occur annually.

Trials indicate it can be planted and stands obtained in northern Texas, but natural increase is doubtful. The plant loses its competitiveness when planted that far out of its range, because it lacks cold resistance. It has more value than hairy grama in mixtures of sideoats grama, little bluestem and Texas wintergrass in the adapted medium-rainfall areas. Not recommended north of latitude 31°.

Likely Seed Areas. Small areas may be found along railroads in the Rio Grande Plain. In addition to the seed supplied to soil conservation districts by the San Antonio nursery, one commercial seed grower (near Uvalde) is known to be growing seeds as a regular crop. Seed multiplication blocks are increasing in the Dos Rios District and other places. There is a need for more seed production, to supply the needs in southwestern Texas.

Determining Potential Yield and Quality. Slender grama produces bristly spikes which are the normal seedunits unless broken up by processing. The units are bulky, awny and difficult to sack and handle. The 2- to 5-flowered spikes are pale-green when developing and straw-white when mature. When white, they shed easily. When green, the grains are in the soft-dough or medium-dough. The fill is easiest to determine at this stage. The mature spikes can be pinched to force the grains out. A high percent of the spikes may be empty if conditions during the flowering period do not permit proper pollination and fertilization.

Production Under Cultivation. Under nursery dry-land conditions, production has been erratic. The first crop planted was the most successful, yielding 100 pounds of seed after 90 days of growth. Three crops a year can be taken if the fertility is renewed. The average annual yield per acre will not exceed 100 pounds.

Harvesting. Seeds mature from late June to frost, depending on moisture. The plants never stop flowering if moisture is available. Stripping the spikes is now considered the most economical way to harvest, using the bluegrass type of seed stripper. Start the stripping shortly after the first spikes drop and when most of the remaining ones will complete their ripening.

The seeds can be combined. But because of the difficulty of picking up the semi-prostrate stems and because the cut material is hard to move through the augers and elevators, this method is not as practicable as stripping. In separating the spikes from the straw, close the chaffer to the point where it will allow the spikes to pass through and let the straw ride over. Cut off all air. Combined seeds are always trashy.

In several soil conservation districts excellent stands have been obtained by mowing the stems while a little damp, raking and spreading the seedhay on the field or pasture to be planted. Immature spikes will often develop more viable grains under these conditions.

Care of Green Seed. Trashy strippings and combine material contain considerable moisture. Spread such material on drying canvases or platforms and thoroughly dry if further cleaning and sacking are intended.

Cleaning and Processing. In order to plant slender grama spikes from a cotton box planter, the trash must be removed. This can be done by running through a hammer mill and then through a fanning mill. Material from the hammer mill can be planted from a 2-wheel, No. 4 lime and fertilizer distributor. Hammermilled material produces a mixture of spikes, spikelets and free grain. When large lots of material are treated, it may be advisable to separate the very small grains from the trashy units and plant separately in adapted grass seed drills.

Quality. The ordinary seedunit is the spike. It may be a mixture of spikes, partial spikes and florets if hammermilled. A pound of pure filled spikes contains 206,000 seedunits; a pound of pure mixed spikes and spikelets 365,000 seedunits; and a pound of grain contains 1,428,000 units. The average purity of spikes is 23 percent, of mixed spikes and spikelets 31 percent and samples of grain 55 percent. The 7-day germinations of these three kinds of units average 28 percent, 20 percent and 55 percent, respectively; the final germinations 45, 39 and 55 percent.

From these tests, it is evident that the grains germinate in a 7-day period. Fluffiness of the other units which prevents moisture from reaching the grain would be the main reason for delayed germination.

Seeds of slender grama have retained good viability at the San Antonio nursery after 5 years of storage.

BLUE GRAMA *(Bouteloua gracilis)*

Adaptation and Use. Blue grama occurs throughout the drier parts of the plains from Canada to Mexico. Although frequently associated with buffalograss, it does not have the range or importance of buffalograss in Texas and Oklahoma, except in some parts of the High Plains and in the Desert Grasslands, the latter, west of longitude 103°. Its extension eastward has been limited, whereas buffalograss has invaded the wetter prairies. Its present eastern limit begins on a line west of Del Rio, Texas that passes northward through the western counties of the Rolling Plains, then eastward to Sherman, Texas, then north through Oklahoma. Southward in Texas, it appears to be limited in its spread eastward by low altitudes, higher rainfall and taller grass competition. Trials now indicate blue grama can be used somewhat east of its natural range.

Its use is for grazing and erosion control; occasionally it is cut for hay. In recent years, several commercial seed firms have been harvesting and buying seeds which now are handled by many dealers throughout the Region.

Likely Seed Areas. The High Plains of western Kansas, Oklahoma, Texas and eastern New Mexico and Colorado have been sources of seed in the past. The Marfa Highlands of southwestern Texas is another likely source. Good yields are associated with heavy rainfall at least a month prior to the harvest season. Pastures that produce heavy yields of seed one year rarely produce profitable yields the next year. Two crops may be obtained in some areas in the same year.

Determining Potential Yield and Managing for Yields. Predicting yields in advance of the harvest is difficult, because the plants often bloom profusely, then the soil moisture becomes exhausted and the grains fail to mature. If soil moisture is determined to be sufficient to mature the seed, early diagnosis of production is fairly certain. Uniformly thick stands of seedstems possessing 6 grains per spike should be profitable to harvest. Six grains per spike is equivalent to a 15 percent fill. Material of lower quality may be harvested for local use where cost is not the prime factor. As the grass approaches

maturity, a pre-harvest test can be made by pinching the fertile floret of each spikelet. Oftentimes the immature grain will ooze out as a green-covered milky substance. If mature, it will be amber-colored. If 2 out of 4 florets are filled, the material is excellent. Yields from good pasture areas may produce 300 pounds of seed per acre. The average more nearly approaches 100 pounds. The method of harvesting influences the yield greatly.

If a seed crop matures in late July or early August, it often is of low quality, as high temperatures prevent proper pollination. Should the period of pollination be accompanied by moist cloudy weather, the chances are better for a crop. Seeds produced in September and October, ordinarily before the first frost, are usually the best. A slight frost does not affect ripening. The florets shatter quickly when high winds follow a sharp freeze. They then may be lost in a period of a few days. Under conditions of drought, frost and high winds, the harvest season seldom lasts more than 7 days. Under reversed conditions, the florets may remain on the spike for weeks.

Production Under Cultivation. There has been no demand to place the grass under cultivation for seed production because somewhere in the region native stands have produced seed at an economical price. Farm seed plots outside the general range of the species should be encouraged.

Harvesting. Direct combining is a satisfactory method of harvesting. Begin when the seeds are in the hard-dough stage. The air is cut off, and only the chaffer is needed in the cleaning shoe. The cylinder-concave spacing is 1/4 to 3/8 inch, and the cylinder speed near 1200 RPM. Cover the opening above the tailings return auger so that material coming off of the chaffer rides out of the combine instead of being returned to the cylinder.

Windrowers can be used if the cutting is started before the spikelets have reached full maturity. This allows the material to cure out in the swaths or bunches. It can then be threshed with a combine or stacked and threshed after the heating period is over. Higher seed yields are often obtained with these methods.

Bluegrass strippers work efficiently, when the upper part of the plants have lost their toughness to allow stripping. Strippers can be operated at a lower cost than combines.

Where hay is desired as seeding material, the crop can be mowed and moved while damp and spread on the field to be sodded.

Care of Green Seed. Combined seed material must be cured before sacking. It can be hauled to an open shed and turned daily for several days to prevent heating. Placing the combined seeds on a rack where the air can circulate beneath it will cut the cost of curing. Any method of forcing air through the seed will reduce the cost of curing.

Cleaning and Processing. Blue grama seed material from the combine usually requires some cleaning prior to planting. This can be done with a scalper, or by running the trashy seed back through the combine in the presence of a gentle air blast. During the 1949 harvest near Marfa, Texas, seed from the stripper was aired, hammermilled and sacked ready to plant. No scalping needed. Special grass drills are required to plant either floret material or clean grain. The latter can be obtained by processing carefully and thoroughly with a hammer mill, but is not a common practice.

Quality. The purity of blue grama depends primarily on the original fill and care in harvesting. A large number of laboratory samples consisting of florets and spikelets had an average purity of 39 percent, a 7-day germination of 60 percent and a total germination of 65 percent. The dormant period is short, and the longevity about 4 years. There are 795,000 trashy filled florets in a pound.

HAIRY GRAMA *(Bouteloua hirsuta)*

Description, Adaptation and Use. A small-tufted perennial bunchgrass; stems slender and spreading, averaging 12 inches in height; basal leaves 3 to 5 inches long, hairy; inflorescence of 1 or 2, seldom 3, spreading spikes, the midrib of which is naked above the middle and ending in a prominent sharp point; spikelets hairy, the glumes with long, black-based hairs and the rudiment without hairs. This small bunchgrass is distributed throughout most of the grasslands of the Region and has increased in the tall and mid grass areas. It is adapted to most soils regardless of alkalinity and acidity. Its use is for grazing and then in mixtures of better grasses.

Likely Seed Areas. Never found in pure stands of any size. Local areas of less than an acre occur in the West Cross Timbers and Grand, Reddish and Coast prairies.

Potential Yield and Quality. Hairy grama is a warm season grass. Stems are produced in July and August; flowering occurs from late August to late September. The average ripening period of the spikelets is the last two weeks in September, although this depends on soil moisture. Each plant normally bears from 5 to 15 stems and each spike contains from 25 to 35 spikelets. Seed yield depends on the number of filled florets which seldom is half the total number. When the average number of stems per square foot is 10 and the fill is 50 percent the yield is 25 pounds of pure seed per acre. This represents a near maximum yield. Normally 40 pounds per acre of trashy seed of 25 percent purity is considered a good yield.

When still in the soft-dough condition 7 days after flowering, the fill can be determined by pinching along the midrib of the spike and counting the number of soft green grains that ooze out. This is the best period to check fill. After the seeds are ripe, fill is best determined by counting a given number of florets and shelling them out in the hand, or cutting across each one with a knife. Shattering begins soon after maturity. Some years the spikes retain all or most of the florets until after frost. This is a good indication of no fill or low fill.

Production Under Cultivation. Has never been placed under cultivation.

Harvesting. Hairy grama can be combined after the florets begin to shatter, as at this stage they are easily separated from the stalk. By using medium speed and spacing of the cylinder, closing the chaffer one-half, keeping the shoe sieve three-fourths open and increasing the shaking, most of the seeds can be carried to the seed bin without choking the return auger. When mixed with green stems of other plants the cylinder and shaking speed must be increased to sift the light florets through the sieves.

Where hairy grama is mixed with weeds and other green plants, as little bluestem, mowing while the dew is on, raking and bunching while the plants are tough is a good way to cure the seed material. Only the best spots should be cut. The bunches can be threshed with less difficulty than the standing plants.

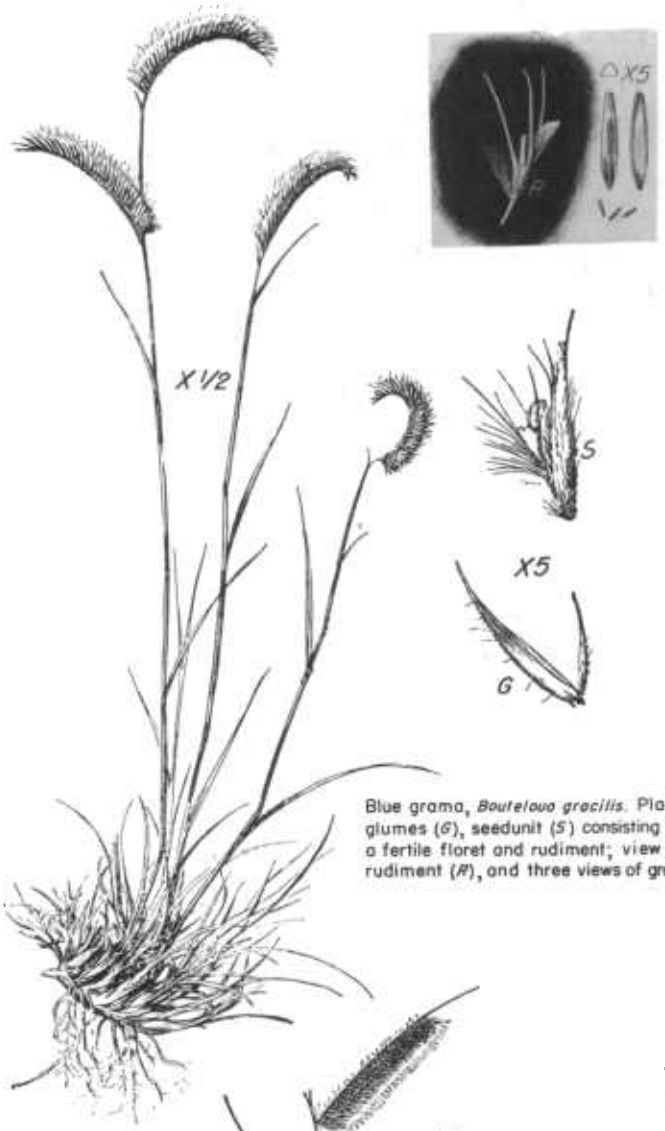
As with most gramas, the stripper is a useful tool to harvest the seed cheaply.

The seedhay also can be mowed and scattered immediately on the area to be seeded.

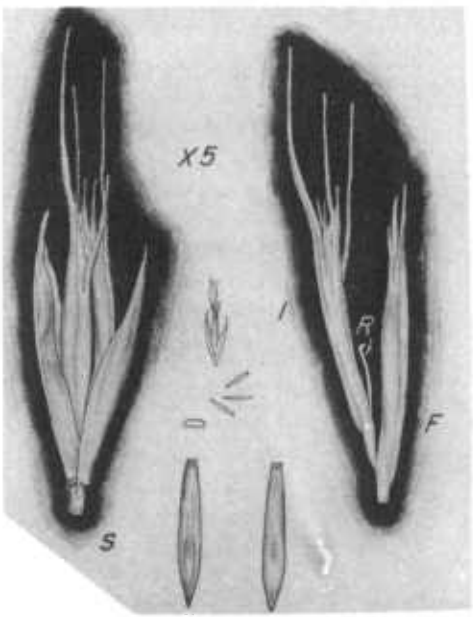
Curing Green Seed. Trashy seeds from the combine should be dried before sacking.

Cleaning. Trashy seeds can be run over the scalper to remove the bulk of the trash. It may be necessary to rub the screen to get the fluffy florets through. If the scalped seeds remain trashy they can be hammermilled and planted without further cleaning. The trashy seeds from the combine or stripper also can be put in a plantable condition with a hammer mill.

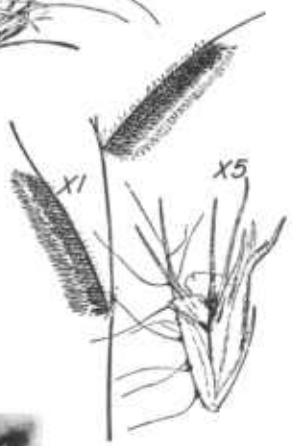
Quality. Most samples of hairy grama received at the laboratory are of low quality, because cleaning to pure seed is difficult in any cleaner. The seedunit is the fertile

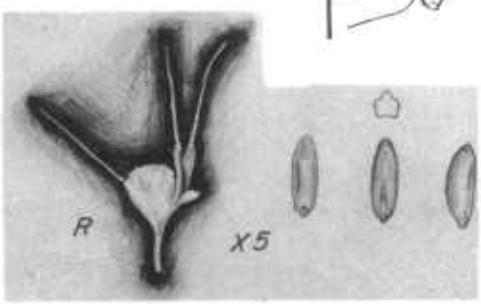


Blue grama, *Bouteloua gracilis*. Plant; glumes (*G*), seedunit (*S*) consisting of a fertile floret and rudiment; view of rudiment (*R*), and three views of grain.

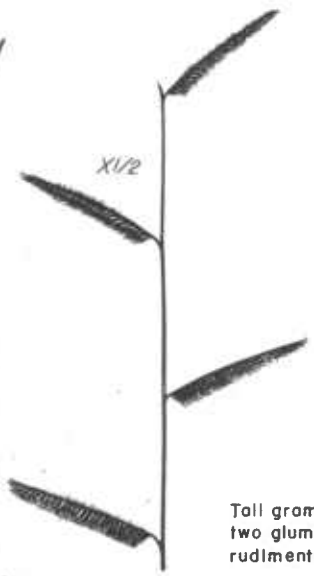


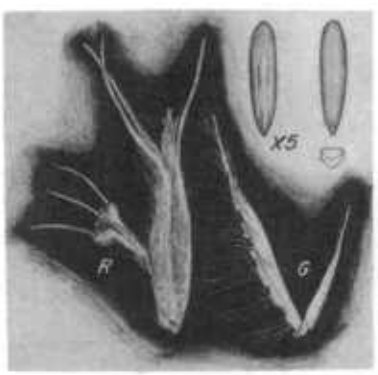
Slender grama, *Bouteloua filiformis*. Two growing plants; spikelet (*S*); fertile floret (*F*), infertile floret (*I*), and bare rudiment of third floret (*R*); three views of grain.





Hairy grama, *Bouteloua hirsuta*. Inflorescence and spikelet; rudiment (*R*), and four views of grain.





Tall grama, *Bouteloua hirsuta pectinata*. Inflorescence; two glumes (*G*), and fertile floret with part of awned rudiment (*R*) exposed; three views of grain.

PLATE 4

floret and the prominently awned rudiment and is called a trashy floret. The seeds in a mass are light and fluffy. The average purity of all samples is 26 percent, the 7-day germination 13 percent and the final germination 39 percent. There is a normal dormant period of 1 to 3 months or longer after harvest, as in nature the seeds do not germinate until early spring. The low total germination is probably due to the many shriveled or poorly developed grains. A pound of pure seed contains 685,000 units (trashy florets).

TALL GRAMA *(Bouteloua hirsuta pectinata)*

Description, Adaptation and Use. This variety is considered only a form of the species by some Agrostologists and a distinct species by others. It has enough characters to distinguish it as a species. A tufted grass, which stools to form crowns as much as 10 inches in diameter; stems stiff, often 3 feet in height turning straw color in the fall and bearing 3 to 6 spikes; leaves medium long; spikes straight an inch or more long bearing 40 or more spikelets and usually ending in an undeveloped spikelet; florets 40 or more per spike, larger than in the species, the rudiment with 2 tufts of short hairs. Tall grama ranges through the shallow limestone prairies and Edwards Plateau of Texas to the limestone hills of southern Oklahoma. It is limited to shallow or rocky limestone hills or caps where the grass cover is naturally thin. It does not thrive in the deep soils in competition with taller grasses. Useful for erosion control and grazing when mixed with such grasses, as sideoats grama and little bluestem.

Likely Seed Areas. Limestone hills and slopes of the Grand Prairie that have lost most of the bluestem cover.

Potential Yield and Quality. Tall grama has about the same growing period as hairy grama, but the flowering and fruiting periods are normally later. If moisture is low in August and September flowering may be delayed until early October or as late as the last week in October. The number of stems per plant seldom exceeds 10. Five per square foot is an excellent stand. Seed yields are low.

With few stems per plant, an average of 3 spikes per stem and 40 spikelets per spike the total number of seedunits per acre is equal to or exceeds that of hairy grama. Twenty-five pounds of pure seed per acre is a high yield in fairly pure stands. Careful examination of the seed material before harvest is necessary to be certain of sufficient fill for harvest. Shattering begins soon after maturity and is accelerated by a heavy frost.

Production Under Cultivation. This grass is not cultivated for seed except in plots, but if planted in rows the yield should exceed that of native stands.

Harvesting. Tall grama can be stripped with a bluegrass stripper when the site is not too rocky. Most of the spikelets must be near the shattering point for best stripping. Smooth areas can be combined but usually the blocks are too small for economical operations. Mowing and scattering the seedhay is a good practice where the plantings are to be made locally. This provides needed mulch for the protection of the seeds and eliminates the cost of harvesting and cleaning.

Care of Green Seeds. Cure stripped or combined seed material on canvas before sacking or cleaning.

Cleaning. By running the stripped or combined material over a scalper most trash can be removed. For mixture plantings and where all the florets have not been separated from the spikes, it may be advisable to run the seeds from the scalper through the hammer mill. Hammermilling the stripped or combined material also produces plantable seeds.

Quality. The seedunit of tall grama is the trashy filled floret. It is considerably larger and heavier than the unit of hairy grama. There are about 500,000 in a pound of pure seed. Uneven ripening of small lots collected in past years has produced seeds of only fair quality and low purity.

RESCUEGRASS (*Bromus catharticus*)

Adaptation and Use. Rescuegrass is an annual (under certain conditions biennial) bunchgrass which germinates and grows during the cooler months of the year. It was introduced into the United States over a hundred years ago. It received its common name in 1853, and since that date the seeds have been in the trade. Rescuegrass is best adapted to humid regions with mild winters, beginning its growth in the fall, growing during the milder parts of the winter and cooler part of the spring, and maturing in May. It behaves as a winter and early spring annual. It is a rich-land grass. Its best growth-range is probably in the soils derived from limestone or those containing lime. In such areas, particularly in the humid sections, it is naturalized in parks, pastures, on roadsides, in waste places and yards. It is most used for grazing and is often overseeded on short grass pastures, although under favorable conditions (deep, well-watered alluvial flats) it is grown for hay. A very growthy form, Texas 46, has been developed, increased and certified by the Texas Agricultural Experiment Station.

Likely Seed Areas. City lots, parks and roadsides are the best seed areas. In such places, seeds mature and germinate each year undisturbed. Satisfactory stands may be found on many areas where the native grasses are kept short in the fall. Several growers supply seeds to local areas, but not in the amounts to meet the demand. A good deal of seed is imported from Australia.

Determining Potential Yield and Quality. Flowering begins as soon as the inflorescence unfolds. Generally it is not uniform within the inflorescence. The spikelets are large, often an inch in length, flattened and made up of 4 to 12 florets. The lowest florets bloom and ripen first. During the milk or early soft-dough stage, the florets are green. As they age, they turn pink and later light brown. During the pink-bronze stage, the grain is in the medium-dough stage or even harder. Seeds harvested during this stage will be viable. If a wait of one week occurs, the florets shatter. Fill and yield can be estimated by cutting across or pinching the individual florets.

The empty and poorly developed florets are most often found at the tip of the spikelets. If on sampling the stand, more than half the spikelets are empty, the yield will be low. It is a rare thing to find more than half the florets empty in a year when moisture is adequate. A light seed crop may be expected when the rainfall is light during March and April. The total yield of seed depends on the density and development of the stems and inflorescences. When the inflorescence droops at midstage of development, one can be almost certain the spikelets are well filled. If they point straight up, it will pay to examine them closely. If the number of seedstems is 10 per square foot and the development otherwise is normal, a good yield may be expected. With only 2 or 3 seedstems per square foot, the yield is questionable.

Production Under Cultivation. A broadcast stand on fertile land that has been rogued of weeds may yield 600 to 800 pounds of clean seeds per acre. Under irrigation, the average yield is considerably higher. Cases are on record of a crop of hay and a fairly good crop of seeds having been taken from a field in one year.

Harvesting. The seed harvest begins about April 1 in south Texas and is 5 weeks later in northern Oklahoma. The maturity of the seeds varies with moisture and the general temperatures (a cold spring will delay the harvest). The period of harvest seldom lasts more than 10 days in any one locality due to the easy shattering of the spikelets.

The bluegrass and two-reel strippers are good machines to harvest rescuegrass seed. The combine also is a good implement to harvest rescuegrass. Start the machine in the early stages of shattering; cut close enough to reel the seedstems onto the canvas; keep the reel speed down to prevent scattering of the shattered spikelets; run the cylinder just fast enough to complete the shattering; use some air and open the chaffers part way. A few growers cut and windrow the seedhay as shattering starts. Curing is completed in the swath. Heavy storms will beat some of the florets off the stems. The combining should start as soon as the material in the windrow is cured.

A lawnmower, rigged to strip the stems and shielded to catch shattered florets, works successfully in short-stemmed plants.

Care of Green Seed. A shock is due anyone who harvests and threshes semigreen rescuegrass seed and puts it in a sack. In 12 hours the material will be so hot that only constant stirring in moving air can prevent loss in viability. It is difficult to properly cure the seeds on a concrete floor unless the room is force-ventilated. The best curing is when the seeds are placed on a rack or canvas in the open where air can get to them from all sides.

Cleaning. The floret bracts cling to the grain and cannot be removed by processing. A well-developed floret is about two-thirds the size of an oat seed. Since the grain makes up more than one-third of the weight of a filled unit, the empty florets can easily be separated from the filled florets with any cleaning mill, and high purities can be obtained without any processing.

Quality. The seed of rescuegrass is the smooth filled floret. Lots properly harvested and carefully cured and cleaned should have a purity and germination of 90 percent. Laboratory analyses show an average purity of 94 percent, a 7-day germination of 38 percent and a final germination of 85 percent. Fresh seeds remain dormant for several months, as the 7-day germination figures point out. Seeds of low quality usually lose their viability by the end of the second year after harvest. Some samples of high quality seed have remained viable for 5 years. In purchasing rescuegrass seeds, be sure of the source, the age and the date of the last germination test.

SMOOTH BROME (*Bromus inermis*)

Description, Adaptation and Use. A long-lived, leafy perennial, spreading from strong underground stems, and forming a dense even sod; stems 2 to 3 feet tall, smooth; leaves broad, smooth and with closed sheaths; panicle erect, the branches in whorls; spikelets usually smooth, somewhat compressed, the florets usually bearing a short awn. Naturalized in the northern and central states; cultivated for hay and pasture, and suitable for waterways. Usually grown with alfalfa for permanent pasture and mixed hay. Adapted to regions of moderate rainfall and low to moderate summer temperatures. Under dry-land trials it shows promise in the northern part of the Region. Considered suitable under irrigation through northern and western Oklahoma and the High Plains of Texas. Prefers rich loams and clay loams. Southern strains from Kansas and those recommended by the Oklahoma Station should be used. Among those are Achenbach, Lincoln and Fisher. Established blocks should be watched for adaptation characteristics suitable for southern growth conditions.

Likely Seed Areas. None established in the Region.

Potential Yield and Quality. Growth in this Region will be best in cool weather and least in winter and in summer, except at higher altitudes. The stems elongate at the beginning of hot weather; flowering occurs in June, and fruiting during July. Under dry-land conditions seed formation may be erratic. North of our Region 75 percent of

the florets usually are well filled. That percentage will be lower here. A fill of 40 percent will be suitable for seed harvest. Poorly developed florets will be common in thick stands.

An examination of the field should be made during the period when the spikelets are turning brown. The average fill is easily determined by pulling near-ripe florets from about 50 plants and cutting across 100 with a knife. The thin grain is easy to see in cross-section. The mature florets do not shatter as readily as do those of some bromes. Yields depend on stem production and on good moisture relations during the flowering and fruiting period.

Production Under Cultivation. Yields as high as 700 pounds per acre have been reported. The average is from 200 to 500 pounds. When cultivated in rows on fertile soils, yields should be 500 pounds an acre.

Harvesting. Two methods of harvest are used. (1) Bind the seedstems when most of the florets are ripe, cure in open shocks and thresh with a combine or thresher; (2) combine when most of the florets are dead ripe.

Use the cylinder speed (1000 to 1200 RPM) necessary to separate the florets without breaking the straw; set cylinder clearance at 3/8 and 1/2 inch; carry the chaffer three-fourths open, the shoe sieve one-third open, and cut off all or most of the air. For clean threshing use a special 5/32 x 3/4 screen below shoe sieve.

Care of Green Seed. Combined seed should be dried before full sacking.

Cleaning. Final cleaning of seeds can be done in a fanning mill or 3-screen mill. Fair quality material requires careful adjustment of sieves, feed and wind to clean to 85 percent purity once through the mill.

Quality. The seedunit is the smooth filled floret. Well-cleaned, plump seed lots should have a purity of 90 percent. This allows some percentage for partially developed grains. Most seed lots have a purity around 85 percent, a 7-day germination of 65 percent and a final germination of 85 percent. The number of filled florets varies from 136,000 to 150,000 to a pound, although one author says there are as many as 200,000. Known viability in storage is 4 years. Seeds normally should not be held longer than 3 years before planting.

BUFFALOGRASS *(Buchloe dactyloides)*

Adaptation and Use. Buffalograss occurs naturally in the Western Gulf Region from the Coastal Prairie near Houston to Brownsville, Texas northward west of the eastern timber belt. It is usually absent from or rare in the wetter prairies adjoining the timber belt and in the area west of longitude 104°. Most of the mixed prairies originally contained scattered plants. Under grazing, or after the taller grasses were reduced in stature and numbers, the buffalograss spread. This increase extended into the drier sections of the tall grass prairies. Buffalograss is of great importance in the heavy and loamy soils and absent or of no importance in the sands.

Buffalograss is used largely for grazing. It and blue grama are the most important pasture plants of the High Plains. In sections of the Rolling Red Plains and Grand Prairie where sheep have grazed the pastures yearlong over a period of years, the buffalograss turf prevails over all other grasses. In much of the Edwards Plateau of Texas it remains in and along the draws and flats, while curlymesquite *(Hilaria belangeri)* stays or has replaced it on the uplands.

Buffalograss, because of its desirable turf qualities, is in demand for revegetation purposes. Sod in the immediate vicinity of land to be regrassed has been used. Since

seeds have been on the market, the increase has been mostly from plantings. The seeds can be used to revegetate golf courses, lawns, athletic fields, air fields, pastures, borrow ditches and banks along highways and pasture waterways. The supply is now nearly in balance with demand.

Likely Seed Areas. In this Region the most likely seed areas are around the playa lakes of the High Plains and Edwards Plateau, and the closely grazed pastures of the Grand Prairie, Edwards Plateau and intermountain flats just west of the Edwards Plateau. Other areas may be found in the Blackland and Central prairies of Texas and Oklahoma. It does not take a large block of pure buffalograss to produce considerable seed. Areas most likely to produce are those that have been managed so other grasses have been eliminated or reduced. Sheep pastures such as are found in the Grand Prairie of Texas are good seed blocks. There is no rule that will serve as a guide to seed production. The seed areas must be visited and investigated to determine that.

Determining Potential Yield and Quality. Assuming that we have possible sites in mind for obtaining buffalograss seeds, the best plan is, (1) visit the area in April and May and note the number of pistillate (female) and staminate (male) spikes produced and the distribution of the two sexes. Also note the stage of flowering. (2) About 12 days after the full bloom period, make another visit to determine potential quality and yield of the immature spikes (burs). Examine 50 burs at random throughout the field, or fewer if the seed block is small, by cutting across each one and noting the number that have grains. If harvesting is to be made from the ground, examine some of the burs lying on the ground that were produced in previous years. The mature grains are usually a little pinker than hard wheat and less than 1/16 inch in length and width. There are 1 to 4 grains per bur. The average is approximately 1.6. (3) Estimate the number of filled burs per square foot by using the rule that 1 plus per square foot equals about a pound per acre. A hundred per square foot equals 100 pounds and more per acre. If the number of filled burs is fewer than 25 per square foot the material is doubtful for harvesting, assuming that only two-thirds of all the burs will be taken. Of course, this is a matter of availability of labor, total relative costs and urgency of need. Certainly material of the low yield of 16 pounds per acre can not be harvested economically with machinery.

Production Under Cultivation. Cultivating for seed production has not been tried on any scale in the Region. It was successfully tried at the Fort Hays Experiment Station by L. E. Wenger who states: "Establishing seed fields of unproved types of buffalograss on which irrigation can be practiced is one method of assuring a successful harvest of seed every year. Yields of some of the selected strains of buffalograss at the Fort Hays Experiment Station have equaled 1000 pounds of seed per acre during the year the stand was in its prime. Under cultivation a field planted for seed is the most productive about the third year. During its entire productive life, which usually is from 5 to 6 years, an acre of buffalograss under irrigation will produce about three times as much as it will during its most productive season. In the case of the 1000-pound strain, 3000 pounds would approximate the entire production from an acre of land. At the end of the fifth or sixth year renovation or replanting is necessary as weeds begin to come in. Growing improved strains under cultivation, but without irrigation is not as dependable as where artificial water can be supplied. However, the yields for the first few years usually exceed what can be expected from native pastures."

Harvesting. There can be no definite period designated for harvesting seeds of buffalograss. Usually the first spring crop is mature around June 20. Some years the crop may mature earlier or later. Very often burs accumulate on a pasture from two or more crops in one year. If of enough importance, these can be harvested any time that weather and other conditions permit. The current crop on standing grass should be harvested before shattering is very evident and while many of the burs are still green.

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Various methods and kinds of machines involving several principles have been constructed and used to secure the burs.

1. Combines. Grain combines equipped with auxiliary motor and lespedeza guards have been used successfully. To handle the short stems horizontal extensions of the cutting bar have been adapted. This allows the bar to ride just above the surface of the ground. Flailing bats or brooms must be attached to the reel bats to push the material back onto the canvas. Where the seedstems are tough and green, fast cylinder speed is necessary. This requires removal of the concaves in order to prevent breakage when stones get into the cylinder. There is no special advantage in any one type of cylinder. It is important to remember the combining must be done before many of the burs have fallen but not before the majority are nearly ripe.

   The seedhay can be combined from the windrow or cock. The material should be loosely windrowed if later threshed by the moving combine.

   The seedhay can be cut, raked damp and cured in the cock. Later the cock is stacked and threshed until the machinery is available. The seedhay also can be mowed damp, raked and spread directly on the planting area.

2. Flailing machines. One type involves the principle of pieces of chain attached to a revolving reel. The burs and some trash are caught in a pan. Another type is the lawnmower. At the Blackland Experiment Station at Temple, Texas a lawnmower was altered by removing the cutter blade, cutter bar and roller, and fastening a shield above the reel to deflect the shattered burs into the grass catcher. To be successful the foliage had to be of a height that the mower-reel could handle. As no actual cutting occurred most of the foliage passed beneath the mower. The power lawnmower is a handy machine for harvesting the burs from small or large grazed areas that are fairly free of stones and debris. It works well in close-cropped pastures where the burs are produced within an inch of the ground. The machine should be equipped with height swivels, grass catcher and a shield that starts at the back edge of the cutting bar and extends far enough over the reel to permit all cut material to flow into the grass catcher. Such a machine is easily adjusted for cutting from 1/2 inch to 3 inches above ground.

3. Suction machines. The suction principle for picking up light burs was one of the first to be tried. The first machine used a small gasoline motor to run a suction fan to which was attached a heavy hose and suction nozzle. A nozzle guard reduced the size of the nozzle opening and kept out stones and sticks. The machine worked well in small blocks relatively free of debris. It would not take seed from the ground when much foliage screened the nozzle. On closely grazed areas relatively free of top growth one man could collect a good amount of seed in a day.

   Another machine was constructed using revolving agitators in the nozzle, similar to the revolving brush in some vacuum cleaners, to loosen the material on the soil.

   One of the latest suction machines, powered by a V-8 motor, has a 25-inch suction fan that pulls the material through a vacuum box. This allows the burs and heavier material to drop into a cylinder cleaner that removes the burs from the smaller material and results in seeds of relatively high purity (50 percent). The pickup attachments consist of 3, 12-inch metal shoes attached to flexible hose connections. This arrangement permits a movement to conform to the uneven surfaces of the turf. A wire brush is attached in front of each shoe to loosen any seed that may be in drifts. The machine is usable only on grass that is grazed fairly close. Yields of 250 pounds per acre of 80 percent purity are on record for this machine.

4. One machine embodies the principle of the whirlwind lawnmower. The revolving cutting blade operates near the ground and lifts and blows the cut material into the cleaner.

5. The wind-blast machine reverses the principle of the vacuum cleaner. The high speed fan forces air through the foliage and litter on the ground, after an agitator stirs the material, in such a manner as to lift the burs and trash into the catching mechanism.

   Burs collected by some vacuum and wind-blast machines generally contain a high percentage of trash or foreign matter of about the same weight as the burs, which makes cleaning difficult and expensive.

6. Hand-harvesting burs with stable brooms is economical. One method is to loosen and sweep the burs into small piles and then into dust pans. Usually one man operates the broom and another the pan. This method is recommended for farmers who are going to plant the trashy material without further cleaning. Sweeping is easier when the seed-producing area is located on gentle slopes where the burs with other trash collect in small drifts. The drifts should be swept up before the growth of the grasses interferes with the sweeping.

   Another source of seed to be taken with brooms and shovels may be found in woven wire fences at the foot of slopes in buffalograss pastures. After intensive rains seed-bearing litter from the pasture collects on these fences. The mixed trash and seed should be collected before it disintegrates. Sometimes high-water drifts of almost pure burs are left along intermittent streams in flash-flood areas.

   In buffalograss pastures where the large red ants are common, several pounds of clean seed may be found around a single ant mound. Some farmers have found it economical to sweep up these seeds.

Care of Green Seed. Burs harvested during the summer from standing foliage contain enough moisture to heat and mold if sacked at the machine. Cure this on a canvas in the open. Dry burs from the ground do not need further curing. Wet burs from the ground should not be sacked until dry.

Cleaning and Processing. Seeds harvested with a combine or other machines, and containing mainly top-growth material from the grass plants usually can be satisfactorily cleaned with a fanning mill. Use round-hole screens at the top of the mill to permit the burs to pass through, and slotted screens at the bottom to remove pieces of stems and other material similar in shape and size to the stems. The trash may need a second cleaning.

Seeds harvested with suction machines and brooms and containing a preponderance of trash do not clean to a high purity with an ordinary fanning mill. On the first run through the mill the coarse and very fine material separates out. A second run through the mill still leaves a high percentage of trash. Two runs through the mill nearly always clean the seed where it can be planted with a cotton planter. Much of the seed distributed from the San Antonio nursery in the past 6 years has been of less than 35 percent purity.

Processing buffalograss seed material involves the use of considerable machinery. Running the material through a hammer mill at low speeds removes the manure and most of the pieces of wood, but often breaks up some of the burs and frees the grains which mix with the fine material to make two classes of seed.

Clean processed burs do not germinate any better than unprocessed burs. They do handle better and cost less to ship. They contain less trash and bulk and handle easily in the germinater. But for ordinary field planting, either in a drill or cotton planter, they are not better, for the drill or planter can be regulated to accommodate the mixture as well as the pure seed. The cost of processing small lots will always be a factor in determining the desirability of processing.

Quality. A bushel of clean filled burs weighs about 15 pounds. Old weathered burs that have lost the points from the bracts may weigh less. The number per pound varies from 30,000 to 65,000. The average is 48,000. Of a large number of samples analyzed, the average purity is 65 percent, 7-day germination 16 percent and total germination 67 percent. Most commercial seed now has a purity of 90 percent or higher. For general planting, the quality of the seeds depends first on purity and second on germination. At the Fort Hays, Kansas Experiment Station, Wenger found: "Germination of buffalograss normally is very low usually running less than 10% in untreated seed. Seed that has been allowed to weather on the ground for a considerable period sometimes may exhibit slightly higher germination. This type of seed is usually obtained by the vacuum or wind-blast machines where the seed has been allowed to lay on the ground during one or more winters. Usually the germination of the best of this seed does not reach 40%, the figure that should be considered a minimum for germination of seed that is to be planted without treatment. If the seed does not germinate as much as 40%, special treatment should be employed to overcome the natural dormancy.

"Good germination of samples indicating low germination can be obtained by treating the seed in the following manner: Soak the seed for 24 hours in a 0.5% solution of salt peter (potassium nitrate). Then chill at 41° F for six weeks. The seed should be maintained thoroughly wet during the chilling period even if it means resoaking for short periods at intervals during the chilling. Immediately following the removal of seed from chilling, thorough drying, employing temperatures below 110° Fahrenheit should be accomplished. At temperatures higher than 50° F, the drying process should be completed within a 24-hour period to eliminate the danger of having the seed sprout. Once treated in this manner the seed can be handled in the usual manner or stored for at least two years without any lowering of germination.

"Use of the above treatment on any lot of low germinating seed, in which the viability has not been injured, will raise the germination to 75% of the potential germinating strength of that lot of seed. A 0.5% solution is prepared by mixing one-half pound of salt peter with 100 pounds of water. For the sake of convenience the seed is usually handled in bags during the soaking and chilling phases of the treatment."

At the Soil Conservation Service Laboratory at San Antonio, Texas, the following method has obtained the highest germination (to within 10 percent of the count of filled burs) for the past 5 years: Prechilling or stratification of burs for 4 weeks at 5° C (41° F) in moist soil consisting of equal parts of sand, local black clay soil and screened acid peat. After 4 weeks (cold) stratification in petri dishes, tests are moved to room temperature where most of the burs germinate within 7 days. The laboratory was unable to obtain increased germination by presoaking the seed. Miscellaneous tests of burs 2 or more years old indicate no pretreatment (chilling, soaking or alternation of temperatures) is necessary for germination.

Wenger's method is more practicable for small seed producers.

RHODESGRASS (*Chloris gayana*)

Description, Adaptation and Use. Rhodesgrass is a perennial bunchgrass producing runners that root at the joints. The stems are leafy and end in a cluster of spikes, 2 to 4 inches long. Introduced into this country in 1902. Some of the early seed was distributed along the Gulf Coast in 1904. Although placed under trial at the experiment stations, the results of the early experiments did not indicate its true value, since stock would not eat it readily if other more palatable plants were present. Its vigor of growth, long growing period and heavy seed production indicate it to be well adapted to heavy soils near the Gulf Coast, particularly on the west side bordering the Rio Grande Plain. It thrives best on the deep rich loams and sandy-clay soils. It will

not persist on shallow hardpans. It makes excellent growth on poor, deep sandy soils if properly fertilized with nitrogen.

Tests in different latitudes plainly point out its limitations to cold. It should not be planted as a perennial north of a line running east and west through Austin, Texas. It can be used as an annual in cultivated land as far north as Oklahoma but is not recommended for that climate. It has no place in range revegetation or rainfall areas below 25 inches, where it must compete directly with native plants. It is excellent, where adapted, for reseeding abandoned land and for irrigated valleys, where it may become a stray along irrigation ditches. It is of equal value for hay and for pasture. On rich soils, it is used as a combination hay and pasture crop. It fits well into the conservation cropping system in South Texas, e.g., Rhodesgrass or Rhodesgrass and sweetclover 3 years - row crops 2 years.

In recent years, this grass has become a major host for a scale insect, *Antonina graminis*. This insect is common in the vicinity of Kingsville, Texas. It fastens itself to the formative tissue just above the nodes, from below the well-aerated groundline to several inches up the stem, in positions where it is protected by the leaf sheaths. It reduces the vitality of the plant, and when droughts occur the plant may die. The King Ranch, the first prominent user of Rhodesgrass, has now substituted other grasses in its pasture and hay program, partly because of the attacks of this insect. Winter-hardy and insect-resistant strains are needed to increase the use-area of this grass. Cold-resistant strains are being developed.

Likely Seed Areas. During its 45 years of trial and spread, Rhodesgrass has not become naturalized in the Western Gulf Region. Occasional colonies may be seen along highways, irrigation ditches and other points where there are excellent temporary growing conditions. All seeds are harvested from improved pasture or cropland, or imported from Australia.

Determining Potential Yield and Quality. In the vicinity of San Antonio, Texas the first crop of seeds matures from June 10 to July 5. Flowering begins in late May and more or less continues as the stems develop. In a single field, therefore, the flowering periods may be of several weeks duration. Seed development, under these conditions, is not uniform, and examinations must be made in order to start the harvest at the right time. The early or first crop is the most productive one. Inspection of seed development should be a week or 10 days after flowering begins and be repeated each week. Seed formation is determined by separating the lowest or fertile floret from the upper empty ones and pinching it. Select only the florets that are beginning to lose their color. Potential yield can only be estimated. If one-half of the fertile florets are filled, the crop may be considered excellent. Fill as low as 10 percent may be harvested for local planting.

Production Under Cultivation. All production of seed and hay is from cultivated stands. For seed, plant in rows to permit one or two cultivations to control weeds and increase the vigor of the plants before the "middles" fill in. If moisture is not too limited, the growth will completely cover the ground by the end of the first year. Where the crop is grown primarily for grazing, the seeds may be drilled or broadcast. For increased stem production, side-dress the rows in early spring of the second year with 30 pounds of nitrogen per acre.

July seed yields from February seedings in rows, under excellent dry-land conditions, have been as high as 350 pounds per acre with a purity of 40 percent. If the plants are kept vigorous, old stands will produce as much. The average annual yield at San Antonio from 3 or 4 harvests is about 400 pounds. Most of the lots are not cleaned to a high purity. Under irrigation 4 harvests should yield 600 pounds of good quality seed per acre. The cost of harvesting, cleaning and sacking seldom exceeds 12 cents a pound.

Harvesting. Seeds from Rhodesgrass in South Texas can be harvested about 3 times each year, if the grass is used only for seed during the growing season. The harvests are spaced approximately as follows, using the information obtained under dry-land conditions on the San Antonio nursery: June 22, August 10 and September 25.

Binding is one economical way to harvest because the slow curing of the stalk and stem permits the threshing of a higher quality and quantity of seed. The binding should begin after some dispersal of the early maturing florets and while the late flowering ones are still in the dough stage, or during the midstage of grain development. After thorough curing for about 2 weeks in the shock, the bundles may be threshed with a combine or thresher.

Most operators prefer to combine the seeds directly from the standing stems. Start the combine several days later than binding should begin, and after 5 to 10 percent of the spikelets have shattered. Usually only the upper third of the stems are taken into the machine. Since the stems and leaves are still green, taking more than this will cause trouble in the cylinder. Cylinder speed should be 1400 to 1600 RPM and clearance about 1/4 inch to handle the green straw and break up the partly green spikes. This should not break up the stems and leaves to the point where they will later clog the sieves.

A modification of this method of combining has been tried. The sickle is set lower so as to take about half the straw. The combine is set to thresh only the riper material. The tailings and straw are raked into windrows while still damp, allowed to cure thoroughly, and again combined. The second lot of seed, from the straw, usually contains a high percentage of shrunken grains and is of lower quality.

Where seeds of high purity are obtained directly from the combine, experience in adjusting the combine is important. Only by trial and error can one combine high quality seeds that do not need further cleaning in a fanning mill. Even then, some good seeds pass out with the tailings.

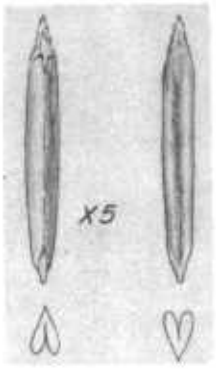
Rhodesgrass can be topped with a bluegrass stripper and the resulting mixture run through a thresher or combine to obtain clean seed. The 2-reel stripper also should be economical to use.

For local plantings where mulch is needed to control wind and water erosion, the seed-stems can be cut low with a mower and the damp seedhay hauled to the field and spread out or lightly disked to keep it in place.

Care of Green Seed. Seeds from the combine are too wet to sack and must be cured and dried several days.

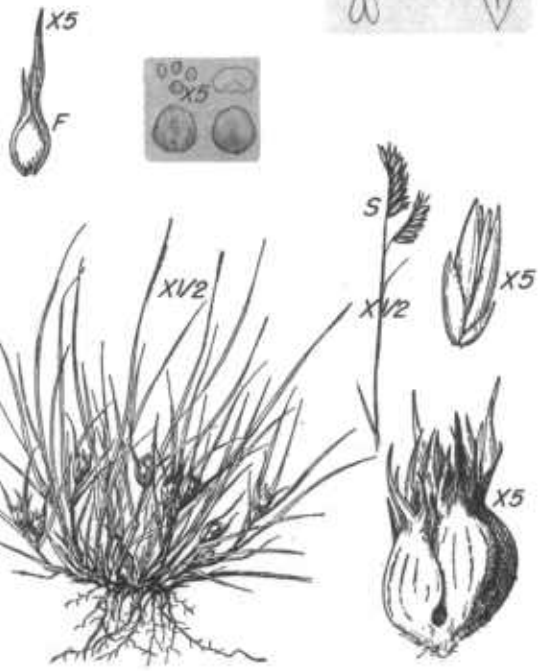
Cleaning and Processing. At the San Antonio nursery, most combined seeds are recleaned in the fanning mill to reduce the amount of light trash present. Some empty florets can be removed, but very high purities are hard to obtain. One run through the fanning mill will clean a rather trashy lot enough to readily pass through the hopper of a cotton planter or grass drill. Processing is not necessary to obtain plantable seed.

Quality. The seedunit (trashy floret) is composed of the fertile floret, the second empty floret, and one or two rudimentary florets. This group has been called a spikelet. Laboratory analyses of many seed lots give an average purity of 33 percent, a 7-day germination of 60 percent, and final germination of 93 percent. The 7-day germination of pure grain is 70 percent. There are 1,700,000 seedunits in a pound of pure seed and 2,970,000 grains in a pound. The dormant period of trashy units is short; the longevity in storage is 5 years.

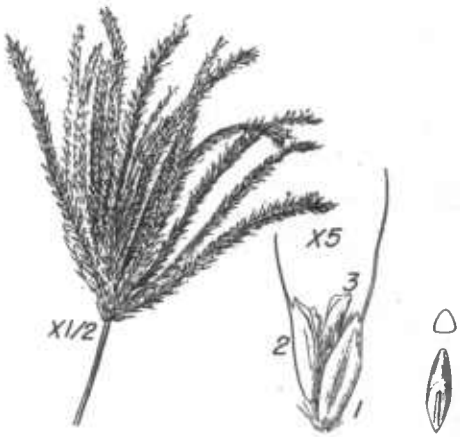


Rescuegross, *Bromus catharticus*. Panicle; two views of floret (seed-unit), and four views of grain.

Smooth brome, *Bromus inermis*. Plant and spikelet (*S*); two views (*F*) of floret (seedunit), and three views of grain.



Buffalograss, *Buchlae dactyloides*. A pistillate plant and spike or bur (seedunit); staminate inflorescence (*S*) and spikelet; a grain-bearing floret (*F*) from the bur, and three views of grain.



Rhodesgross, *Chloris gayana*. Inflorescence of many spikes; normal floret arrangement in spikelet: (*1*) fertile (seed-bearing), (*2*) empty and (*3*) a rudiment; two views of grain.

PLATE 5

BERMUDAGRASS *(Cynodon dactylon)*

Description, Adaptation and Use. Bermudagrass is a vigorous turf-forming perennial forming underground stems and runners above ground. Extreme variation in size and types of plants occur. Short-leaved and short-stemmed plants have been segregated. Several high-yielding forage strains have been selected.

Bermudagrass is native to India and perhaps other parts of the old world. It is completely naturalized in the southern states and is now recommended for pastures on the better soils throughout all the first and most of the second tier of states north of the Gulf of Mexico. It makes its best growth on rich, moist bottoms and in rich uplands that retain their original fertility. It is best adapted to well-drained soils. It will tolerate some salinity.

Its greatest use is for pasture, filling the same position in the southern states as does Kentucky bluegrass in the northern states. In northern Arkansas the two grasses overlap, the bluegrass making good growth on the northern exposures, the Bermudagrass on the southern exposures. In parts of the Gulf Coast states the grass is commonly mowed for hay. It withstands close grazing, but like any grass it should be allowed periods of rest to hold its vigor and keep out poor-quality competitive vegetation. A third most important use is for vegetating pasture and meadow waterways and small drainage areas.

Likely Seed Areas. Most of the seeds planted in the Region come from the irrigated valleys of Arizona and southern California. It has been generally assumed that native strains do not pollinate and produce viable seed, but check samples sent to the laboratory over a period of years show definitely that in certain years seed production and fill are high in parts of Louisiana and Texas. That fact was very noticeable during May 1943 all through southern Texas. Seven samples taken from Riviera to Corpus Christi and San Antonio had an average fill of 67.7 percent. Other areas in south Texas have been checked since 1943. It is found that hardly a year passes that this grass does not produce some seeds. During the past few years, at least 2 growers have harvested several thousand pounds on the Gulf Coast Prairie of Texas.

Seeds are found where the grass is managed for the greatest stem production. Roadsides mowed at intervals on many of the state highways have large areas of pure stands of Bermudagrass. Wherever seedstems are dense and areas large enough, a likely seed area may be present. Yet because of the erratic way the seeds develop in the humid belts there is no way to predict yields.

Determining Potential Yield and Quality. The small, one-flowered spikelets of Bermudagrass are borne in 2 rows along a slender axis. Pick a single spike of the several at the end of a seedstem, count the number of spikelets, rub all in the palm of the hand until the florets are rubbed out, blow the chaff away, then press each floret with the thumb nail. If filled with a grain it will not dent easily. Several spikes examined at random will soon show whether there are many grains present. To more accurately determine the quality of the material, sample the area by clipping one or more stems from each of 100 scattered plants; place them in a sack or take them inside out of the wind; thresh on a blotter or board, and cut across a fair sample of the florets with a sharp knife. A hundred florets from the well-mixed sample will give a fairly accurate record of fill and quality. By counting the seedstems on a given area, the yield can be estimated.

Harvesting. The seedstems of Bermudagrass seldom exceed 8 inches in length. Combining is easy if the sickle can be lowered to within 3 or 4 inches of the ground. There is not much danger of shattering unless the seeds are very ripe. By using heavy canvas belt or broomstraw flaps on the reel bats most of the stalks will be cut and pushed back on the moving canvas. Reel speed should be stepped up; cylinder speed and spacing should be sufficient to separate the florets from the straw. A few ranchers in the Gulf

Coast Prairie are harvesting seed very efficiently by mowing, windrowing and combining with pickup attachments. The cylinder is run at high speed, the chaffers kept nearly closed and all air cut off.

Short-stemmed Bermudagrass can be cut with a power lawnmower equipped with a pan to catch the seedhay. This type of machine seems excellent for collecting seedhay along highways that are mowed several times a year. Such material could be collected locally by farmers and carried directly to the field to be planted. It may be more practicable to cure the seedhay thoroughly, put it up in small stacks and use it as seed material when the time for planting is appropriate.

Care of Green Seed. Seeds taken with a combine must be carefully dried before sacking or placing in a bin.

Cleaning and Processing. Unhulled Bermudagrass seed coming from the combine needs only to be cleaned with a fanning mill. To obtain hulled seed, process with a hammer mill. Use a 1/8-inch hole screen and RPM of about 1000.

Quality. Both hulled and unhulled seeds are on the market. The hulled seeds consist mainly of pure grains, the unhulled of florets and some grains. Laboratory analyses show the average purity of the unhulled seeds 98 percent, the 7-day germination 28 percent, the final germination 77 percent, and 1,580,000 in a pound of pure seed. The hulled seeds (grain) are 98 percent pure, have a 7-day germination of 56 percent, a final germination of 87 percent, and 2,051,000 per pound. Based on these figures, and disregarding the importance of the high percentage of readily germinable hulled seed, the price of unhulled seed on the market should be about 68 percent of that of the hulled. Unhulled seeds are probably worth about half that of the hulled, when proper evaluation of the readily germinable hulled seeds is made in terms of a 7-day stand. The cost of hulling should not exceed 5 cents a pound.

ORCHARDGRASS *(Dactylis glomerata)*

Adaptation and Use. Orchardgrass, called cocksfoot in England, is a native of Europe. It was first cultivated in Virginia in 1760 and is now naturalized in this Region as far south as central Arkansas. It is a long-lived bunchgrass with somewhat flattened stems and long, folded or flattened bright green leaves. The flowers are clustered on the upper sides of stiff branches.

Orchardgrass starts growth early in the spring, flourishes on rich soils, and grows well on poor soils and in moderate shade. It is especially useful for late winter and spring grazing in the Ozark Plateau soils and in northwestern Arkansas and northeastern Oklahoma. It is used in irrigated mixtures in western Oklahoma and western Texas and is showing promise under trial in the Blackland of North Texas. It is also being tried in irrigated pastures in southwest Texas. It is grown in mixtures of red, alsike and Ladino clovers and alfalfa. In some northeastern states it is proving valuable in pastures with Ladino clover. In the southern and southwestern parts of this Region the hot midsummer temperatures and reduced soil moisture will prevent its use under dry-land conditions.

Likely Seed Areas. Pastures and fields of northern Arkansas.

Determining Fill and Managing for Seed. The fill of orchardgrass is fairly uniform and seldom fails. Just before time to harvest, check the fill by squeezing the florets between the thumb and forefinger. The soft slender grain in the medium- and hard-dough stages breaks easily. Well-spaced bunches produce more stems and seeds. Stem and seed production increase on run-down stands after applying 100 pounds of nitrate of soda per acre in early spring. For maximum seed yields do not graze until after the seeds are harvested.

Production Under Cultivation. Dry-land yields of seed range from 8 to 25 bushels and average 12 bushels per acre. This is equivalent to 160 to 175 pounds.

Harvesting. Orchardgrass seeds mature in late May or before middle June. Two methods of harvesting are used: (1) Binding, shocking and threshing, and (2) combining. Start binding when the dry clusters (florets) break apart if struck by the hand or shatter easily when rubbed in the palm of the hand. The stems are still green. The grain is in the medium- or hard-dough stage. If cut earlier there is some shriveling, if later too much shattering. Cut while damp, taking just enough of the stems to make bundles and leave most of the leaves. If shattering is advanced, cover the bundle carrier, pick the bundles off the carrier and save the shattered seed. Shock loosely with butts apart to give good circulation of air, and without handling the tops. Cure for one week and then stack, or cure 2 to 3 weeks and thresh from the shocks. Use a canvas on the wagon when threshing from the field. If the field is to be cut for hay, the bundles when dumped can be hauled to the threshing site and shocked in windrows.

Combining direct is a common method of harvesting. Begin when the florets break apart rather easily but before shattering is advanced. The sickle is set as high as possible, the cylinder is run at moderate speed and with good clearance; the shaker is speeded up; the chaffer and shoe sieve left one-half open, and only enough air used to allow the hairy florets to drop through the sieves. When bound, cured well in the shock and threshed, the grain will be of a higher quality than when combined direct.

Small acreages of orchardgrass can be harvested with bluegrass strippers that are adjusted high enough to take only the upper half of the stems. Start the stripper when the florets break apart easily.

Care of Green Seed. Material from the combine should be carried to the drying canvases or drying rooms, spread out and stirred frequently to prevent heating and molding.

Cleaning. Threshed seed is normally clean enough for the market. Combined seed should be run through the fanning mill to remove chaff and straw.

Quality. The seedunit is the filled floret. The purity averages 86 percent, the 7-day germination 30 percent, the final germination 82 percent. There are 532,000 filled florets in a pound. Fresh or even month-old seeds do not germinate readily, as the 7-day germinations show. The junction between the lemma and palea is at first impermeable to water. The dormant period usually exceeds 1 month. At the U. S. Regional Pasture Research Laboratory, State College, Pennsylvania the germination of seeds 2 weeks old at 22° to 28° C. (recommended temperature) was 23 percent, 4 weeks old 26 percent. By subjecting the moistened, freshly harvested and dormant seed to temperatures between 5° and 15° C for a period of 10 to 14 days and then to 22° to 28° C, 90 percent germination was obtained. Daily alternation for 2 weeks of the low temperatures and 28° C resulted in germinations of 95 to 96 percent. This suggests fall or very early spring seedings to encounter the alternation of temperatures necessary for maximum germination. Threshed seeds nearly always germinate better than combined seeds.

CANADA WILDRYE (*Elymus canadensis*)

Adaptation and Use. Canada wildrye is a winter-growing, perennial bunchgrass native to most sections of the Western Gulf Region, but at present limited largely to protected or semiprotected areas along roadsides, streams and bottoms. It has a relatively high water requirement. The old plants begin growing in the fall after the weather becomes cooler and may make considerable forage before winter if the moisture is sufficient. Seedstems form in early June. The seeds mature from late June to mid-July and remain on the stems until the stalk breaks or until the spike is shattered.

This grass probably was of considerable importance in the original vegetation of part of the High and Rolling plains eastward through some of the prairies. It has not withstood heavy yearlong grazing. Its present use is for winter and spring grazing. It should be planted in pure stands or in pastures where rotation grazing is practiced.

Likely Seed Areas. One may find this grass in patches or scattered stands along ditches, streams, railroads, roadsides and in bottoms. It is seldom found in areas large enough to take with machinery.

Determining Fill and Quality. Seeds of this wildrye are usually high in quality; the fertile floret is nearly always filled and plump. Estimated yields from the large-spiked varieties collected in central Texas range up to 400 pounds per acre.

It is not an easy matter to determine fill in this wildrye, as the spikelets are arranged in pairs at each node, and each spikelet usually consists of 1 fertile floret and 2 to 5 empty ones. The fertile one, however, is larger and its fill can be determined by pressure of the thumb nail and first finger. A fairly good appraisal can be made of local material by examining 2 to 4 spikelets from 20 spikes taken from different plants. It should be noted that the lemma and palea adhere closely to the slender grain and remain a part of the seedunit. Canada wildrye is ordinarily ready for harvest late in July or early in August in the northern part of the Region. In south-central Texas, the spikes are ready by July 10. The seeds do not shatter easily. The harvest period may be extended over a period of several weeks. When harvest is withheld until a month or more after ripening, there is a tendency for the culms to break under the weight of the spikes.

Production Under Cultivation. Under row irrigation, seed yields are as high as 900 pounds per acre, while dry-land yields are seldom over 300 pounds per acre. The largest block in the Region is on the Dalhart Land Utilization Project.

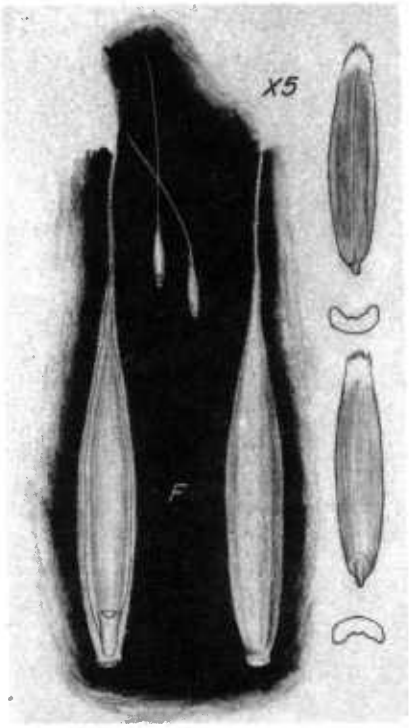
Harvesting. Any grain combine adapted to the terrain will harvest Canada wildrye. The ripe clusters of spikelets break off easily. Cylinder speeds, therefore, need not be any greater than for wheat. The space between the cylinder and concaves are so adjusted as to thoroughly break up the spikelets and remove as many of the long awns as possible without breaking the filled floret. Since the spikes are borne on a long nearly naked stem, the total amount of straw will not affect the separation of grain and straw. The chaffer and shoe sieve are kept nearly open and the wind reduced to a low volume. An additional screen is not necessary.

Hand harvesting patches of wildrye is best accomplished with a half-sickle. The material is headed and sacked as it is cut.

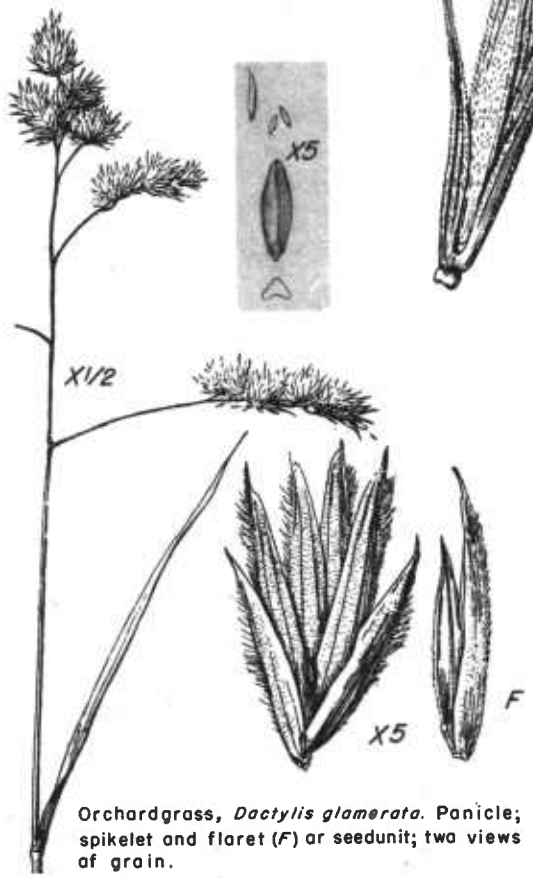
Care of Green Seed. If the seeds are taken when thoroughly ripe and do not contain green trash, drying in sacks is practicable.

Cleaning and Processing. Clean combine-run seeds can be planted with considerable difficulty, using a grass drill, and are not plantable with an ordinary grain drill. Processing in a hammer mill removes the long awns and generally should be done before planting is attempted. After the processed seeds have been recleaned, they can be planted with an ordinary grain drill, as well as with a grass drill.

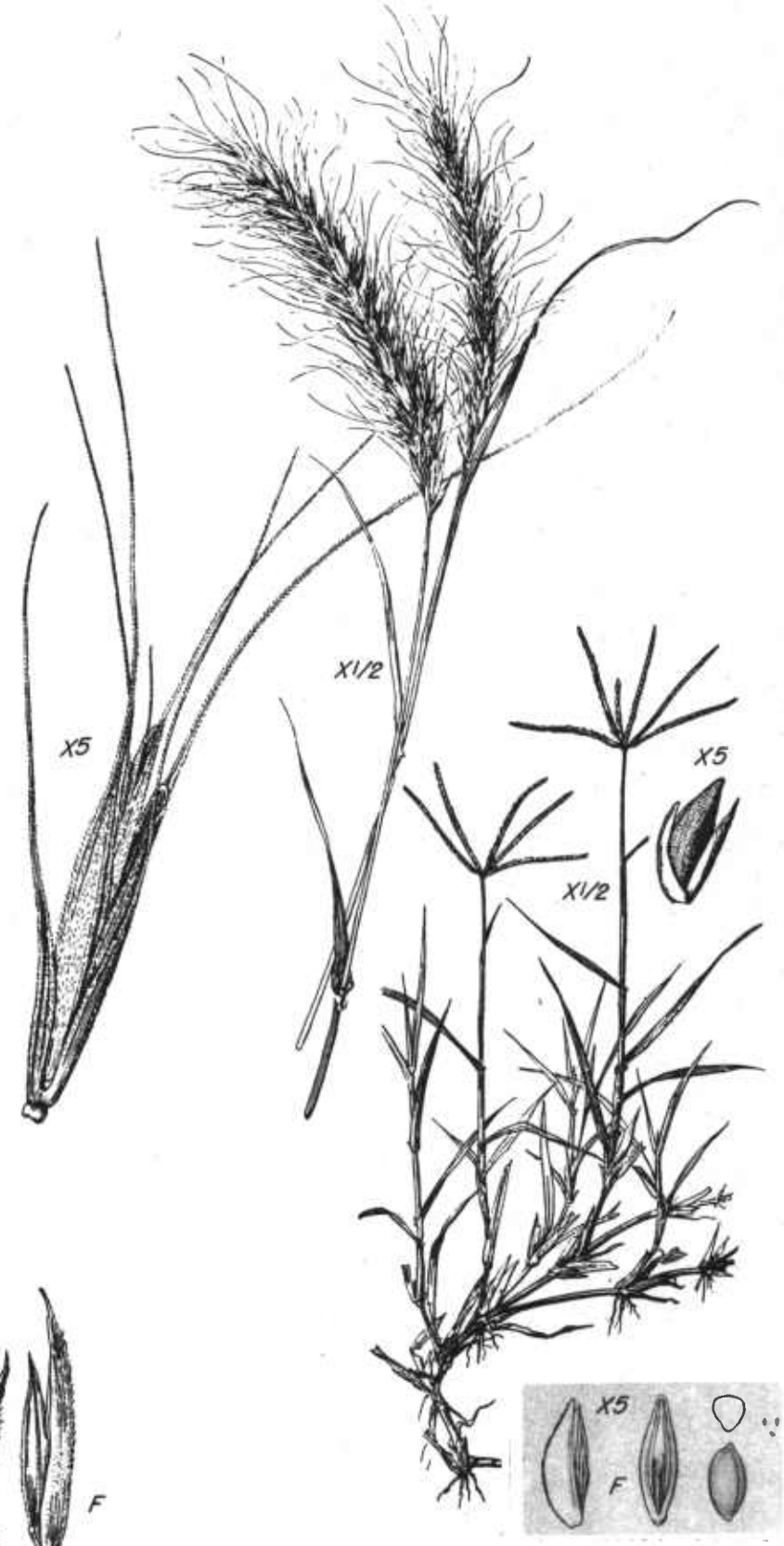
Quality. The average purity of laboratory samples consisting of florets is 78 percent, the 7-day germination 42 percent and total germination 79 percent. Canada wildrye in most cases requires more than 7 days to reach a good germination. One pound of pure seed contains 121,000 filled florets. The longevity seldom exceeds 2 years.



Canada wildrye, *Elymus canadensis*. Two spikes and spikelet; two views (*F*) of floret (seedunit), and four views of grain.



Orchardgrass, *Dactylis glomerata*. Panicle; spikelet and floret (*F*) or seedunit; two views of grain.



Bermudagrass, *Cynodon dactylon*. Plant and spikelet; two views (*F*) of floret (unhulled seed), and two views of grain (hulled seed).

PLATE 6

VIRGINIA WILDRYE *(Elymus virginicus)*

Adaptation and Use. A cool-season perennial bunchgrass of low moist woods and along streams. It is rare west of central Oklahoma and central Texas. The plants differ from those of Canada wildrye in the stiff upright stems and spikes, the stiff-awned spikelets, and the bowed glumes. Several varieties have been described, ranging from short-awned and smooth-spiked to the bristly-hairy and long-awned forms. Adapted to bottomland pastures and seasonal use.

Likely Seed Areas. Stream terraces and bottoms from northeast Oklahoma to east-central Texas. Usually the brush should be cleared before acreages of any size can be harvested.

Potential Yield and Quality. About the same as Canada wildrye. The ripening periods of the 2 species are substantially identical when found in the same locality.

Production Under Cultivation. No figures available.

Harvesting. Same as Canada wildrye.

Cleaning. Same as Canada wildrye.

Quality. The seedunit is the filled fertile floret. San Antonio laboratory samples have a 70 percent purity, a 7-day germination of 66 percent and a final germination of 84 percent. There are 73,000 units in a pound. The known longevity without much loss of viability is 3 years. In most cases storage probably should not exceed 2 years before planting.

BOER LOVEGRASS *(Eragrostis chloromelas)*

Description, Adaptation and Use. Boer lovegrass is a long-lived, perennial bunchgrass, native of South Africa. From seed it makes rapid growth, and in 3 years forms dense clumps. The basal leaves, which make up the bulk of the foliage, are rather long (24 to 36 inches), narrow, flexible, curving outward and characteristically bluish-green in color. The seedstems are erect and rather stiff. The panicle is usually 8 to 10 inches long, open and erect, the branches stiffly spreading. Differs from weeping lovegrass in having wider, bluish-green leaves, in the fewer, stiffer stems, the shorter, upright, stiff-branched panicles and smaller seeds. The seeds were introduced from South Africa in 1932 by Dr. J. F. Crider and planted at the Boyce Thompson Southwestern Arboretum. In Africa, the grass grows in a climate "predominantly dry, with hot summers, frosty winters, and an erratic rainfall of 12 to 20 inches falling mostly in summer".

Adapted to a variety of soils in the southwestern one-fourth of the Region. Trials indicate it may be important in dune control on the West Gulf Coast and in sandy and heavy soil plantings elsewhere. It lacks cold resistance and should be planted south of the Red River. In critical rainfall areas prolonged cold will kill out established stands. Useful for pasture and hay when properly managed to conserve vigor.

Likely Seed Areas. None

Potential Yield and Quality. Planted in early spring in rows, Boer lovegrass often matures some stems and a light seed crop by early fall. Full development of the clump seldom occurs before the third year. The plants should enter the fall period with good leaf growth to build food reserves for the spring seed crop. Removal of the old aftermath, about the time spring growth starts, by mowing or grazing followed by an application of a nitrogenous fertilizer increases seed production. The flowering stems develop early and mature seeds by early June. Seeds can be taken throughout the summer and fall if moisture remains good. The spring crop is the largest. Like weeping lovegrass, the seeds mature unevenly in a single inflorescence. Careful examination of

representative material is essential to learn the correct period when the most seed will be available. This period is sometimes after the terminal spikelets of the branches show signs of shattering. When about 25 percent of the grains indicate advanced stage of ripening or when most of the seeds in the lowest whorl of the panicle have become light brown in color the material is ready. Ordinarily there is a period of about one week when the crop can be harvested without much loss.

Yield Under Cultivation. Seed yields are less than half the yields obtained from weeping lovegrass.. Under average dry-land conditions, annual yields of 100 to 150 pounds per acre may be expected. Fifty pounds per acre is a good yield at any one cutting. Under irrigation, the yield should be from 100 to 300 pounds per acre. At the Tucson, Arizona Soil Conservation Service nursery over a 4-year period, the acre yields were as follows: 1936, 80 pounds; 1937, 239 pounds; 1938, 85 pounds; 1939, 313.5 pounds.

Harvesting. Same as for weeping lovegrass.

Care of Green Seed. Same as for weeping lovegrass.

Cleaning. A several-screen fanning mill will clean Boer lovegrass. Use a round-hole (1/20-inch) screen at the top to let the seeds through and a blank at the bottom, when only small amounts of inert and chaffy material are present in the lot. When weed seeds are present use a 1/25-inch round-hole screen at the top and a 40 x 50 mesh screen at the bottom. Screens with larger openings can be used to remove the excess chaff, or the seed material can be run over a scalper.

Quality. The seeds (grain) are seldom uniform in size. On the average they are a little more than half the size and the same shape and color as those of weeping lovegrass. Any lot will contain a small percentage of light-colored shriveled grains. In a pound of pure seed there are 2,900,000 grains. Fresh seeds are nearly always dormant for several months. The average 7-day germination is 48 percent, the final 71 percent. Purities are high and average 96 percent. The seeds have been kept in storage 4 years and found to be quite viable. Under most conditions they should not be held longer than 3 years before planting.

WEEPING LOVEGRASS *(Eragrostis curvula)*

Description, Adaptation and Use. Weeping lovegrass is an introduced, perennial, bunchgrass with a deep, fibrous root system. The long slender leaves develop rapidly in the young plants, and at maturity and in the large tufts they droop to the ground. The seedstems often reach more than a yard in height and bear large, somewhat drooping panicles. The spikelets are olive-green in color.

Introduced into Arizona several years ago from South Africa, it was soon placed on trial in other states. It is apparently adapted to a great variety of soils and conditions, except extremely alkaline soils. It grows on poor sandy acid soils too low in nutrients for field crops without heavy fertilization, but responds to fertilization and soils of higher fertility levels. Its reaction to winter temperatures has been contradictory. It appears capable of withstanding rather low winter temperatures in the presence of adequate soil moisture. It makes good growth in areas of high soil temperatures. Its range is limited to about 15 inches of rainfall and where not less than 8 inches fall during the warm months. In comparison with native species, the seedlings have a high mortality rate in heavy litter of the cedar brakes of central Texas, but make excellent growth after complete establishment. The species has been satisfactory for: (1) Controlling wind and water erosion, (2) a cover on land too poor to grow field crops, (3) broad, shallow waterways of low velocity, and (4) hay, pasture and soil improvement. It is good for regrassing abandoned land and should be used for supplemental grazing.

Likely Seed Areas. No seed areas to be found except as a result of artificial seeding.

Determining Yield and Managing for Seed. Seeds of weeping lovegrass do not mature evenly in the panicle, nor do the panicles blossom at the same period. Usually the spikelets at the tips of the branches mature first and those at the base of the branches and base of the panicle last.

Careful examination at frequent intervals is necessary to learn the progress of seed development. The average age of the grains can be determined by gathering spikelets from the top, middle and base of the panicle and rubbing them out in the palm of the hand. The young grains are whitish in color; the mature ones are amber and have a dark scar opposite the embryo. When about 25 percent of the grains are amber, the material is ready to harvest. Should the harvest be delayed, the ripe grains shatter out. Time of harvest and approximate yields can be determined by counting the number of spikelets to be hand-tested, taking the average number of florets in a spikelet, and noting the relative number of ripe and immature grains.

The flowering stems of weeping lovegrass are few under some dry-land conditions. The plant seems to need a shock to induce stem production. This has been accomplished by fertilizing, close cutting, and in some nursery trials, by controlled burning at the right time. Where the plants are widely spaced the seedstems are plentifully produced, but when crowded, they are fewer. Irrigating sometimes will bring out the stems. A side-dressing of 30 to 40 pounds of nitrogen per acre in the spring after growth starts will greatly increase the seed yield.

Production Under Cultivation. Seed yields under dry-land conditions range from 25 to 150 pounds per acre; under irrigation, 600 pounds. A yield of 1100 pounds has been recorded.

Harvesting. The first crop of seed ripens from the last two weeks in June to the first week in July, according to latitude. Succeeding harvest periods will depend on fertilization, rainfall or irrigation and the way in which the plants are handled.

A double-reel stripper is a good machine to harvest the ripe seeds and leave the developing panicles for a second run. The two runs are spaced about 10 days apart. The seed material obtained consists of ripe grains and chaff.

The grain binder can be used satisfactorily when the seedhay is cured before threshing. The stems should be cut fairly high and the bundles carefully shocked so that little of the grain is lost. By doing this, the relatively green, soft grains will mature through the normal process of curing. In hauling the cured bundles or loose material, be sure to use a canvas to catch shattered grain.

The combine is used to harvest weeping lovegrass seeds, but sometime during the operation some of the crop will be lost. If the grain is allowed to mature on the stalk before starting operations, some of the early maturing spikelets will have shattered. If combined too green, the very immature spikelets will not thresh out or break up.

On individual farms where the size of the seed block is small, perhaps less than half acre, the farmer can easily cut and thresh the seeds by hand. The seedstems may be cut with a mower or scythe, cured some and placed in small cocks while still damp to keep shattering at a minimum. After curing for two weeks, the whole cock can be dumped onto a canvas and flailed out by hand.

As with most grasses, a practicable method of increasing the acreage of this grass is to cut the seedhay and move it while green to the new planting area where it can be spread on the ground and lightly disked in.

Care of Green Seed. Seeds properly cured in the shock can be sacked when threshed. Freshly combined seeds should be dried for several days to prevent heating.

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Cleaning and Processing. Weeping lovegrass seeds are easily cleaned in fanning mills. The trash will be carried off the upper screen which should have holes of a size to permit all the seeds to fall through. Many of the shriveled seeds can be removed with a lower screen having holes too small for the well-developed grains to fall through.

Quality. Many samples of seed received at the laboratory have an average purity of 95 percent, a 7-day germination of 84 percent, final germination of 87 percent, and about 1,500, 000 grains per pound of pure seed. After 5 or 6 months of dormancy most of the seeds germinate in 7 days. This is true under field conditions. Known longevity is 5 years.

PLAINS LOVEGRASS *(Eragrostis intermedia)*

Description, Adaptation and Use. An erect perennial bunchgrass with a large much-branched open panicle of lead- colored or bronze- tipped spikelets. The tall form resembles sand lovegrass, the shorter form, mourning lovegrass. Distribution is region-wide but most important on the plateaus and plains of the western half. In limestone soils the leaves often show considerable brown or red, whereas in the acid sandy soils they are green. Useful for grazing in mixtures of native grasses.

Likely Seed Areas. Southern section and breaks and divides of Edwards Plateau in Texas and northern part of Rio Grande Plain.

Potential Yield and Quality. Growth starts early in the spring. Flowers may be produced from May until fall. The main seed crop is in May and June following spring rains. Field examinations show that many of the florets fail to mature plump seed. Fill and maturity are determined by averaging the number of florets (6) in the spikelet, picking several at random, and shelling them out in the palm of the hand. The seeds are very small. Harvesting starts when shattering has begun at the tips of the branches but before much loss.

Production Under Cultivation. Unknown, but probably will not exceed 25 pounds per acre.

Harvesting. No areas large enough to combine are known. Bluegrass and other strippers are suitable machines to collect the seed and can be used where the sites are not too rocky. Until now, all seed has been handstripped or cut with sickles.

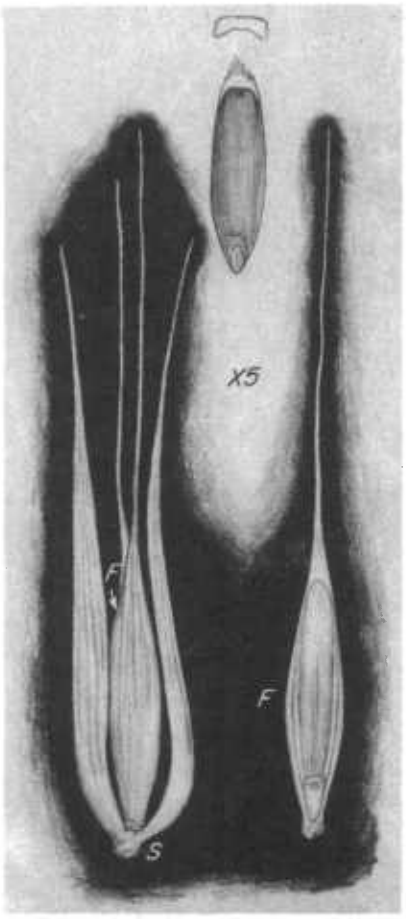
Quality. The few small lots of seed gathered have threshed out to uneven lots, many containing a large percentage of shriveled grains. The typical grain is reddish-brown, ovate or oblong and without a prominent sunken area on one side. They are very small with about 3,500, 000 in a pound. There is a dormant period of 6 months or more after harvest as the 7 - day germination is only 23 percent. The final germination is 39 percent plus 31 percent hard or dormant seed. The longevity is probably 2 years under cool storage.

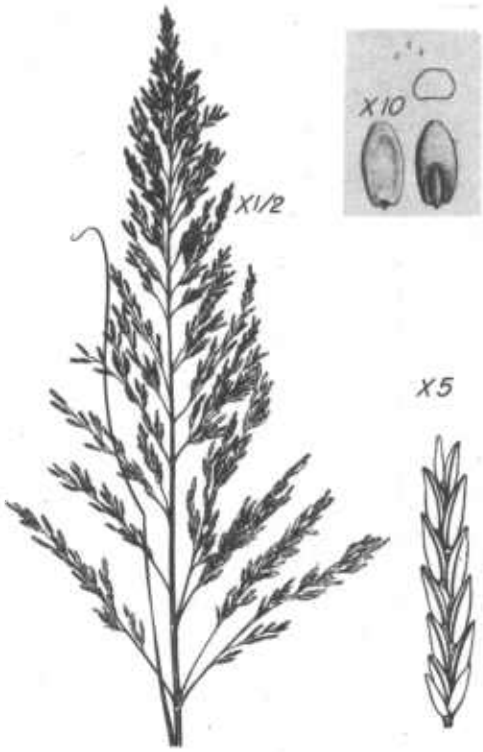
LEHMANN LOVEGRASS *(Eragrostis lehmanniana)*

Description, Adaptation and Use. Lehmann lovegrass is a perennial bunchgrass producing runner-like stems that root at the nodes to form an open turf. The number of stolons produced will depend to a large degree on how the grass is treated. If, in a dense stand, the plants are allowed to mature full top growth, the stolons will be few; if grazed and trampled, more of the stems become stolons. The stems are slender and seldom reach 2 feet in height. The panicle is open and upright.

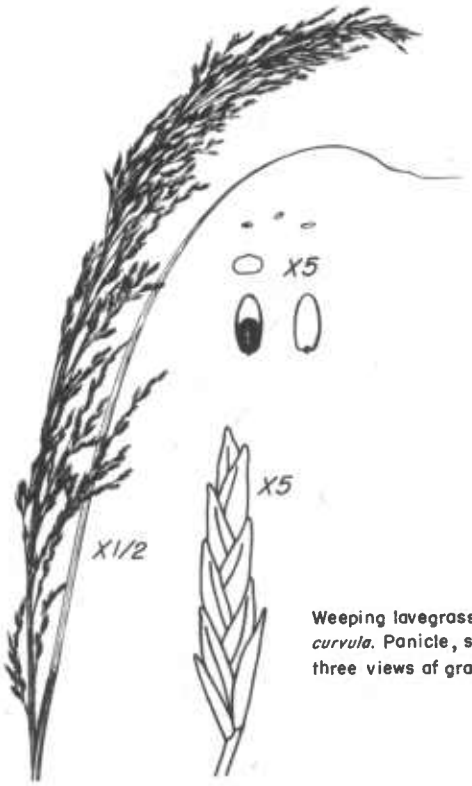
This lovegrass was introduced into the United States from Africa a number of years ago. Numerous trials have been made in several of the southwestern states under irrigated and dry-range conditions. It seems to be well adapted for pasture in low rainfall areas, in either sandy or heavy soils. It possesses considerable drought resistance

Virginia wildrye, *Elymus virginicus*. Upper part of stem and spike; spikelet (*S*), floret (*F*) or seedunit, and two views of grain.

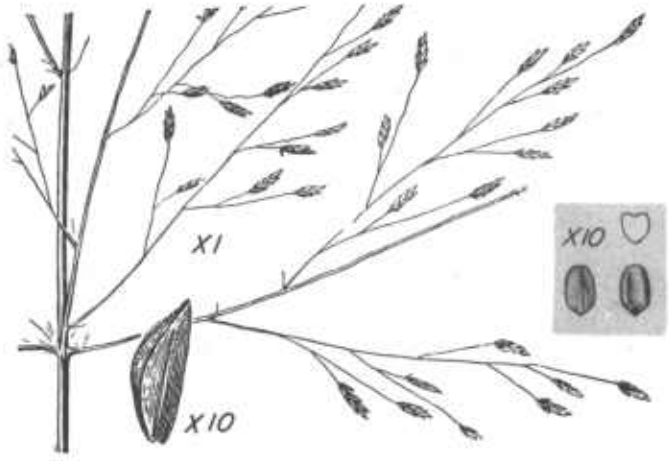




Boer lovegrass, *Eragrostis chloromelas*. A large panicle, spikelet, and three views of grain (seed).



Weeping lovegrass, *Eragrostis curvula*. Panicle, spikelet, and three views of grain (seed).



Plains lovegrass, *Eragrostis intermedia*. Part of panicle, floret, and three views of grain (seed).

PLATE 7

and withstands trampling and rather close grazing. It is recommended for planting only in southwestern Texas south of latitude 32° (Midland). North of this line it usually winterkills.

Likely Seed Areas. No seed sources of any size have been established. However, several soil conservation district cooperators in the Rio Grande Plain and El Paso County have acreages which are being used for seed increase.

Determining Potential Yield and Quality. Potential yield is difficult to determine with this grass because of its manner of growth. Anyone having experience in checking quality as indicated by the fill of the spikelets and keeping in mind the extremely small size of the seed (grain) can broadly estimate yield. The mature seeds of Lehmann lovegrass are hardly 1/32 inch in length, while those of weeping lovegrass are nearly twice as long. Both have about the same general characteristics of shape and color, the same time of flowering and maturity of the plants. Since the species is grown in low rainfall areas, seed maturity is often hastened by drought. Careful examination of the spikelets should be made to make certain there are not an excessive number of shriveled and immature grains present. This can be done by shelling out the tiny grains in the palm of the hand. Undeveloped grains are whitish or light tan in color; the mature grains are amber with a dark scar opposite the embryo.

Production Under Cultivation. An acre of Lehmann lovegrass was broadcast on the San Antonio nursery in the spring of 1937. Sixty pounds of clean seed of rather low quality were obtained in 1937. The average for 3 years was about 25 pounds.

Under irrigation, yields of seed have been reported as high as 500 pounds per acre. Monthly clippings of forage from row plantings under irrigation yielded as high as 4 tons per acre. The plants maintained good vigor after these clippings.

Harvesting. The first seed crop matures in late June or early July. The maturity dates of succeeding crops depend upon the fertilization, rainfall and irrigation.

Cutting, binding, shocking, and curing the seedhay in the field and later hauling the seed to the combine has proved a satisfactory method of harvesting. In case the stems are short, the crop can be combined without much loss. Near Fabens, Texas the seedhay is mowed, dried in piles, stacked, and threshed with a combine. The combine adjustments are: (1) Set cylinder close to concaves and run at high speed, (2) close vanes to chaffer, (3) use a one-notch setting of air to slightly lift stems from chaffer, and (4) use a 7/64-inch shoe screen to allow only fine trash to filter through with the grain. Be certain all doors and fittings are tight to prevent loss of fine seeds. The seeds are easily harvested with strippers. The two-reel, rubber-faced stripper works well on weeping lovegrass and should give equally good results with Lehmann lovegrass.

Small blocks can be hand harvested, flailed and recleaned with a fanning mill.

Care of Green Seeds. Seeds harvested fresh should be dried before sacking. Seeds well cured in the shock can be sacked at the thresher.

Cleaning. By using a fine-hole upper screen in the fanning mill to allow the naked and partly naked grains to fall through and at the same time to permit the trash to slide over, reasonably clean seed can be obtained. A similar screen below will further assist in removing light trash. Some rubbing of the screen with rubber-faced blocks may be helpful and necessary if the traveling brush does not keep the upper screen open. It is most difficult to separate immature or shriveled grains from the whole grains with a fanning mill. No processing is necessary.

Quality. The average purity of laboratory samples is 84, the 7-day germination 12 percent and the final germination 52 ± percent. The number of grains in a pound of

pure seed varies from 4,200,000 to 5,500,000. Most lots of new seed are almost completely dormant. Occasional lots of year-old seeds are still dormant. So far no method has been found that will break this dormancy. The known longevity is 4 years. The seeds are the smallest of all the grasses cultivated in the Region.

WILMAN LOVEGRASS (*Eragrostis superba*)

Description, Adaptation and Use. A leafy, tufted perennial introduced recently from South Africa; stems upright, smooth round, moderately fine, few to many from a tuft; basal and stem leaves rather long, the latter not reduced above; sheaths somewhat compressed with a dense tuft of hair near the collar; blades flat or slightly folded near base, gradually tapering to a slender point; inflorescence terminal occupying a third to half the total height of the plant, the lower branches spreading to upright 2 to 3 inches long, the upper ones reduced, all forming a fairly dense sometimes spike-like panicle; spikelets showy, heart shaped, very flat, as much as a centimeter broad and long; florets 12 to 15, spreading in the mature spikelets, acute, the palea with a distinct basal bow that projects out beyond the base of the lemma; seeds oblong-elliptical or ovate-oblong rounded at the top, the ovary wall thin and cellular and easily broken, rupturing when the spikelets are run through a hammer mill. The growing period at San Antonio extends throughout the year except for a short period in the winter. Field trials have been started only recently, so adaptations have not been worked out. Probably adapted to a range of soils from the sands to the clays. Doubtfully hardy north of the southern third of the Region. It has the appearance of a good hay grass.

Potential Yields and Quality. The individual plants grow off fast after seedlings are established, but not as rapidly as weeping lovegrass. Flowering stems often form the first year and flowering seems to be continuous from early spring to freezing weather. Ripe spikelets and flowering spikelets may be found in the same panicle most any time. Dead ripe spikelets do not break up easily; the seeds remain in the spikelets after the latter drop to the ground. Increased yields of both forage and seeds can be obtained with irrigation.

Likely Seed Areas. None. Still under trial.

Harvesting. Small lots can be stripped by hand. The bluegrass or two-reel stripper will work well in large stands, and the spikelets can be combined. Partially developed and immature spikelets will make up a fair percentage of the total number harvested with machinery. It may be possible to shell the grains from the bracts in the combine when the spikelets are dry.

Care of Green Seed. Seed harvested from standing material with a stripper or combine will always contain green, undeveloped spikelets. Such seed should be dried before sacking is attempted.

Cleaning. The spikelet, containing perhaps as many as 10 ripe grains, should be broken up for economical planting. The palea and lemma must be torn apart to release the grain. This is accomplished by hammermilling. Some grains will be broken in the process. Reclean in a fanning mill. Hammermilled seed is plantable from grass drills without further cleaning, but the smooth grains may sift to the bottom of the hopper and set up an uneven rate of planting.

Quality. Wilman lovegrass seeds (grains) are usually brown or dark brown in color and less than twice the size of grains of weeping lovegrass. Figures are not available, but it is estimated that a pound of pure grain contains about 1,000,000 seeds.

SAND LOVEGRASS *(Eragrostis trichodes)*

Adaptation and Use. Sand lovegrass is a perennial bunchgrass, native to the plains and open woods of central United States as far south as south-central Texas. It grows in sandy soils and is most common in the savannah type of vegetation, that is, where grasses and shrubs (sand sagebrush or shinnery oak) or grasses and trees (post oak and blackjack oak) compete in what is normally a prairie climate. It seldom grows in pure stands. When mixed with the woody vegetation and over extensive areas, it has been reduced or even eradicated by continuous grazing.

It is considered one of the most palatable of native grasses in sandy soils, and valuable because of its early spring growth. Where allowed to form seed, it is a good volunteer and has a place in regrassing sandy or loamy soils of the Cross Timbers, sand sagebrush and shinnery areas and some of the loamy soils of the plains. Its use may extend to the Rio Grande Plain but not into southwestern Texas.

Likely Seed Areas. Extensive seed collections of sand lovegrass are not possible from native stands with machinery unless the areas are cleared of stumps and brush. Such areas are found in recent clearings of oak timber where brush has been removed. Pastures cleared of stumps and brush and held for winter grazing are likely seed areas. All seeds now available are obtained from planted stands.

Determining Potential Yield and Quality. Yields from native stands are difficult to determine. Usually the tufts of grass occur scattered in ungrazed open places, but seldom more than one or two to a 100 square feet. Well developed individual plants under such conditions may possess many seedstems. Poundage of seed from these local areas can be estimated only by sampling a number of scattered plants, threshing out a given number of spikelets from each plant in the palm of the hand and then counting the grains. When 40 well-developed grains are rubbed out of 10 spikelets, the fill is excellent. It is not unusual to find most of the florets filled, but with some of the grains poorly developed. If only one-fourth of the florets produce sound grains, the material may be considered too poor for extensive harvesting but good enough for a small local cutting. When mature, the grains are usually dark purple in color.

Production Under Cultivation. Sand lovegrass can be expected to produce good seed yields nearly every year when planted in 36-to 42-inch rows and cultivated. Under dry-land conditions, the yield is 60 to 200 pounds per acre. Under irrigation, it may reach 600 pounds per acre, although 400 to 500 pounds might be more nearly the average. Only one crop is produced in September or early October. Total production is nearly equal to the demand.

Harvesting. The shattering of ripe seeds at maturity limits the harvest period to about 10 days after the first grains turn purple. The seeds may be harvested with the combine, stripper, binder, or by hand. Combining when most of the grain is in the hard-dough stage is a satisfactory method of harvesting. Necessary adjustments of the combine are: (1) Remove fan blades or disconnect fan drive, (2) remove perforated sieve in cleaning shoe, (3) set cylinder as close as possible to concaves, (4) run cylinder at highest speed, (5) set vanes of chaffers so as to allow all possible trash to ride out of machine without losing seed, and (6) be certain all doors and fittings are tight to prevent loss of the fine seeds.

As with other lovegrasses, the double-reel stripper will do a good job of harvesting the seeds. Binding, curing and threshing is also a satisfactory method of harvesting.

Care of Green Seed. Freshly harvested seeds contain a good deal of moisture and must be spread out and dried before bagging in order to prevent heating.

Cleaning and Processing. Seeds from the combine or thresher are readily cleaned with a fanning mill. The upper screen should have openings large enough (1/22) to allow

the grains to fall through quickly, while the bottom screen should have openings of such size (36 x 36) as to allow only the small, shriveled or undeveloped grains to fall through. The florets and spikelets that are mixed with the uncleaned seed from the combine will, under such screening, move out in the trash. Small lots of seed can be flailed out by hand on a canvas and the spikelets and florets rubbed through a screen with small openings to obtain pure seed. Seeds threshed with a combine and recleaned in a fanning mill do not need any processing to improve the handling qualities.

Quality. First quality seeds have a purity of 92 to 95 percent. Samples received at the laboratory averaged 92 percent. They had a 7-day germination of 76 percent, a final germination of 80 percent and 1,800,000 grains in a pound. The grains vary considerably in size. Dormancy is erratic. A laboratory test should be obtained before time to plant. Some lots remain in the soil a year before germination occurs. In storage the seed retain good viability for 3 years.

SUITER FESCUE (*Festuca elatior arundinacea*)

Adaptation and Use. A strain of tall fescue that has been growing on the Suiter farm in Menifee County, Kentucky for over 50 years. The Kentucky Experiment Station began testing it at Lexington in 1932. Since then demonstration plantings have been made in many states. A cool-season bunchgrass, with stiff stems, long and rough-margined leaves and a usually open panicle of several-floret spikelets. Regional trials indicate the grass is adapted as far west as central Oklahoma and central Texas under dry-land conditions on fairly fertile and fertile, water-holding soils and throughout the western parts under irrigation. It may be grown alone for supplemental pasture and in mixtures with adapted legumes for grazing and soil improvement. Has proved useful when planted thick on fairways of golf courses. Known as Ky-31 fescue in the trade and cannot be distinguished botanically from alta fescue.

Likely Seed Areas. None.

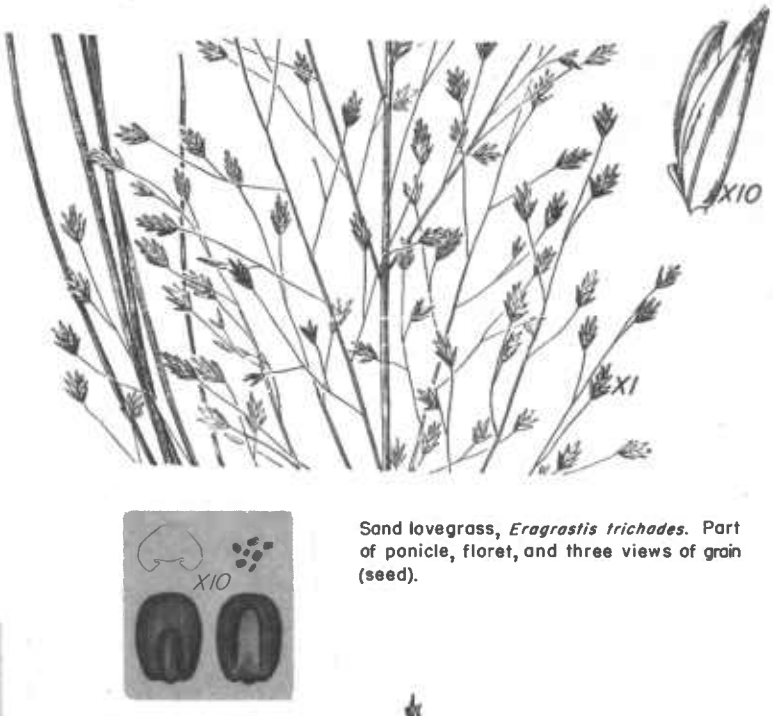
Potential Yield and Managing for Seed. For seed production, plant in the fall in 3-foot rows and cultivate. Apply a complete fertilizer at seeding time. Add lime to acid soils. Apply about 30 pounds of nitrogen in early spring. Annual applications of nitrogen and less frequent additions of phosphorus are required in all soils, also some potash where there is a deficiency. Do not graze the grass the first year and only moderately until about March 1 of the second year. A high mowing to cut back weeds and level the growth is a good practice after grazing. After seed is harvested, mow to obtain an even growth for the fall and winter grazing period.

Seedstems begin to appear the second week in April in the southern part of the Region, somewhat later farther north. The plants are in full bloom about May 10 to 20 and mature in June. Shattering may begin from early spikelets while many others are still green and tough. The seeds are ready to harvest if some florets drop into the hand when the spikelets are pulled through the thumb and fingers. At this stage most of the seeds will be in the hard-dough stage and the grains will be dark or purplish in color.

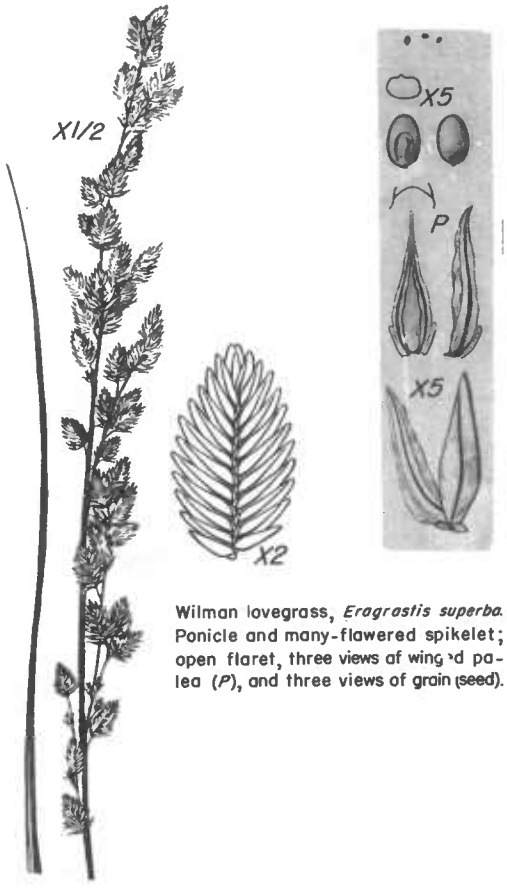
Yields Under Cultivation. For seed production row plantings have certain advantages over broadcast stands. The yields are usually higher, cleaner seed is produced, the stand is easier to maintain and fertilize, and crops can be produced under less favorable conditions. The yields vary from 50 to 1200 pounds per acre. The average is around 250 to 300 pounds. Experimental yields of alta fescue seed at the Oregon Experiment Station, Corvallis over a 5-year period averaged 376 from 2-foot rows, 452 pounds from 3-foot rows, 476 pounds from 4-foot rows, and 374 pounds from broadcast stands. First year yields seldom equal those of succeeding years.

Harvesting. Cutting and binding seems to give the highest yields, as it permits cutting before shattering is under way and allows ripening and curing in the bundle. Binding begins when the seeds are beginning to turn dark or are still somewhat yellow. Shock

Lehmann lovegross, *Eragrostis lehmanniana*. Panicle, spikelet, and three views af groin (seed).



Sand lovegrass, *Eragrostis trichodes*. Part of ponicle, floret, and three views of grain (seed).



Wilman lovegrass, *Eragrostis superba*. Ponicle and many-flawered spikelet; open flaret, three views af wing›d palea (*P*), and three views of grain (seed).

Suiter fescue, *Festuca elatior arundinacea*. Panicle and spikelet; twa views of floret (seedunit) ond enlarged base (*F*) af floret; three views of grain.

PLATE 8

the bundles while damp, in long shocks without caps to permit aeration. The cured bundles will lose seeds when handled. Take precautions and use tight beds or canvas covers to save the shattered florets. If binding continues during the period of rapid shattering the following alterations can be made on the binder to catch shattered seed: Fashion a metal pan below space between lower canvas and upper canvas so that seed will run into a box sled attached to rear of binder. Use a cover of sheet metal to catch seed sliding off the tying and packing platform. The bundles are set off the carrier which is covered with a metal pan and the shattered seed swept out of the pan. Such alterations will not be necessary on small acreages.

Suiter fescue combines well. A slight loss of seed is to be expected because the start is usually delayed several days over binding. Due allowance must be made for quick combining, if dry weather prevails and the crop becomes increasingly dry. The adjustments to the combine are: Set sickle high, set reel to bend the tops over the draper before the sickle hits the stems, run cylinder at medium speed, set cylinder spacing at 1/4 to 3/8 inch, leave chaffer and shoe sieve two-thirds closed, set both these sieves to slope gently to rear of machine, and open air vents slightly. When conditions are dry and ripening advanced, cylinder speed should be reduced to suit the easy separation of the florets.

The crop can be cut and windrowed and combined from windrow. Any extra turning in wet weather will entail loss from shattering. Pickup tines should be used on the combine.

Care of Green Seed. Seeds from the combine are naturally moist and should not be sacked. If artificial driers are not available, spread the seeds in an artifically or well-ventilated room on a tight wooden floor and stir to prevent heating or sweating. Filling porous sacks a third full, placing them on ventilated screens and turning occasionally is an easy way to dry and cure where there is forced ventilation.

Cleaning. Seeds harvested from weed-free stands need little cleaning other than to remove trash. When mixed with weed seeds, the 3-screen cleaner is a good machine to use for proper separation. Seeds of Italian and perennial ryegrass are so similar in shape and weight to alta and Suiter fescue that it is impossible to clean them out of the fescue seed.

Quality. To maintain absolute purity of Suiter fescue seed, foundation and increase blocks must be strictly supervised and widely separated from plantings of alta and meadow fescue. Large lots of seed being brought into the Region are mixed with the ryegrasses. Growers desiring pure seed should buy only fully certified seed having the backing of an organization committed to the placement of high-quality pure seed. Local growers planting on weedy ground are learning that the weedy bromes, like chess brome (cheat) thrive in Suiter fescue; and since the fruiting periods are similar, the seeds cannot be separated in threshing or cleaning. When such conditions prevail, and the grower wishes to produce seed for sale, it would be best for everybody concerned to dispose of the old block, clean up a new seed block, plant pure seed and rogue the undesirable grasses that cannot be separated in threshing or cleaning. Keeping Suiter fescue seed reasonably pure is going to be a hard task because of the number of grasses that have seed of about the same size, shape and weight.

Purity and germination data are slowly accumulating for Suiter fescue seed. The averages do not vary a great deal from those of alta fescue. The standards for the latter are: Purity 97 percent, germination 90 percent, longevity 2 years and number of seeds per pound 277,000. The purities of Suiter fescue received in the Region have varied from 81 to 99 percent. The low purity samples nearly always contain some undesirable, even though not noxious weeds, as mayweed camomile and japanese brome. The germinations are seldom below 85 percent or more. The 7-day germinations are usually 80 percent or higher. The number of seeds in a pound of pure seed varies from 217,000 to 342,000 a pound. Well-cured seeds usually can be stored for 2 years without much loss in viability.

THATCHGRASS *(Hyparrhenia hirta)*

Description, Adaptation and Use. A tall, smooth, leafy bunchgrass, our strain introduced from South Africa; tufts leafy, becoming large in age; stems upright with bluish cast, rather slender and leafy; leaves with bluish cast, narrow and drooping; inflorescence a much-branched panicle, usually occupying the upper third of the plant; spikelets small, hairy and borne through late spring, summer and fall in paired racemes (these on slender stalks) that usually diverge from each other at maturity; grains small. Established plants have a deep root system. Since the plants bloom more or less continuously during the hot weather it has been difficult to obtain seeds in quantity. Trials indicate that thatchgrass is well adapted to a variety of soils in the southern third of the Region in the medium-low rainfall belt. It is one of 3 grasses that made excellent growth from seeds on the dry sand dunes of Kenedy County, Texas. The growth is quick and production high under irrigation. It is most useful for hay, but suitable for grazing. The few trials on record indicate that it is palatable to livestock when grazed reasonably close.

Likely Seed Areas. None. Seed blocks are being established under cultivation and from sod and seeds.

Determining Fill and Managing for Seed. Seeded in the spring the plants often make enough growth by June to produce several seedstems. Second-year growth may have as many as 15 stems per tuft; 5-year-old plants as many as 50 to 75 per tuft. Flowering begins in May and continues until late fall. Seedfill is erratic.

Generally, the June crop is best and the late September crop next best. Hardly any filled spikelets are found during the summer months. Mowing has aided seedfill; fertilization only slightly. It has been considered likely that a fertilization and an irrigation applied as the stems develop in May and again in early September may assist pollination and fertilization and increase fill, because moisture will be readily available during the flowering period. The potential seed yield is high because of the large number of spikelets produced, but the actual is insignificant. When a method of producing seeds in quantity is found, this grass may find a wider use in the southwestern part of the Region.

Determining fill is a difficult task. The individual spikelets are very small and fuzzy. Pinching each spikelet with the thumb and forefinger is probably the easiest way to find the grains. Placing the spikelets on a board and cutting across each one with a sharp knife is another way to learn fill. Each grain will give a "click" sound as the blade passes through it.

Harvesting. The stems have been topped with a combine, but the seed material obtained is trashy due to the difficulty of separating the light hairy spikelets from pieces of leaves and stem. No air can be used and because of that the separation on the sieves is difficult.

The cylinder is run at medium speed to separate the joints of the racemes. Since the tops contain many bracteal leaves these are broken up and mixed with the hairy spikelets. A method of handling this trashy material in the combine is described under King Ranch bluestem.

The stems can be cut and bound, cured and threshed in a separator. The threshing should be done during a damp period so as to keep down the fluffiness of the spikelets and improve the separation. The material is fed rather slowly through the machine.

The seedstems can be mowed and scattered on the planting areas. When the operator is doubtful whether the spikelets contain grains this method will use any seed that may be present in the material.

Production Under Cultivation. Nursery yields have never exceeded 100 pounds an acre. The yields from full grown plants with well-developed inflorescences could yield more than 300 pounds an acre.

Care of Green Seed. Combined seed should be dried 24 hours before sacking. The material will cure if placed loosely in sacks and set out in the wind.

Cleaning and Processing. Scalping the seeds on a single-screen shaker and rubbing the spikelets through the screen will remove much of the trash. Further cleaning is a doubtful practice unless the seed material is hammermilled first. Hammermilling will produce a uniform planting material, and remove many of the awns and soft hairs. Such material can be planted with grass-seed planters.

Quality. The seedunit of thatchgrass consists of a joint of the raceme, the filled fertile spikelet and stalk of the sterile spikelet, all firmly united. The purity obtained for the past 10 years on the San Antonio nursery has varied considerably. The average is 23 percent. The 7-day germination is 43 percent, and the final germination 47 percent. The dormant period is short as shown by the 7-day germination. A pound of pure seed contains 614,000 units.

ITALIAN RYEGRASS *(Lolium multiflorum)*

Description, Adaptation and Use. Italian ryegrass is a short-lived, perennial bunchgrass widely cultivated and handled as a winter annual in the South. It can be distinguished in fruit from perennial ryegrass by the awned lemmas and greater number of florets in a spikelet. It differs from the wheatgrasses in the arrangement of the spikelets which are placed edgewise to the rachis. The leaves of ryegrass are smooth-margined. A large number of cultural varieties have been described. The trade name for Italian ryegrass is domestic ryegrass or common ryegrass. It usually contains a mixture of about 90 percent Italian and 10 percent perennial ryegrass. Italian ryegrass is an important hay plant in Europe, where under heavy fertilization it produces enormous tonnages. Considerable seed is grown in the Pacific coast states. In the southern states it is used as a winter lawn grass, winter cover crop, or more often for winter forage. It will withstand lower temperatures than rescuegrass. It prefers the rich loams but will grow well in the sands if properly manured and fertilized. It does not survive standing water, and on well drained land responds to irrigation. It is used to overseed permanent pastures in the more humid sections, but must be capably managed to reseed, as rescuegrass does, under close grazing. Heavy rains in April, May and June will keep the plants green, delay maturity and definitely retard the growth of the permanent or base grasses. On rich soils, it is very aggressive and is apt to crowd out winter clovers unless grazed heavily or mowed.

Likely Seed Areas. None. The grass has never become naturalized. Seeds are produced only under cultivation. Most of the seeds used in this Region are grown in Oregon and Washington.

Production Under Cultivation. Italian ryegrass is a high-yielding hay grass where it is well adapted. Seed yields are reported to reach 800 pounds per acre. Some seeds are produced locally in Arkansas and other states.

Determining Potential Yield and Quality. Potential yield depends upon the stand and number of seedstems produced as well as the fill. Flowering begins near the end of the spring in late April or early May. Inspection of the florets by pinching or cutting about 10 days after flowering is well along will furnish evidence of development. Like rescuegrass, the bracts of the floret adhere closely to the grain at maturity and remain as part of the seedunit.

Harvesting. Two methods are recommended for harvesting ryegrass seed: (1) Bind and thresh the bundles, and (2) combine from the windrow. Direct combining of stemmy material is not satisfactory because of shattering. It can be used on short straw, but some seed will be lost.

Binding should start shortly after some of the florets take on a reddish brown color and when a few shatter while the heads are being pulled through the hand. Shock the bundles while damp and use a canvas on the wagon when moving the bundles to the machine. Protection on the binder to save shattered seed is advisable where acreages warrant the cost. The bundle carrier should be replaced or covered by a metal pan.

Windrowing should start at the time binding begins, the crop lifted from the windrow with pickup tines as soon as it is dry enough.

While threshing the cylinder speed is kept fairly low, the cylinder-concave spacing wide and enough air directed the full length of the chaffers to keep the straw and chaff floating.

Care of Green Seed. The freshly harvested seed should be well cured before sacking.

Cleaning and Processing. If the awns are not removed from the florets in threshing, they can be removed with a hammer mill without much damage to the grain. For ordinary plantings in a grain drill, grass seed drill, cotton planter, or whirlwind seeder the awns will not interfere too much. For local planting, then, it is not considered necessary to process the seed.

Quality. Commercial seed of Italian ryegrass is fairly free of awns. The seedunit is the smooth floret. The purity is high. Laboratory samples average 94 percent purity, have a 7-day germination of 87 percent and a final germination of 92 percent. The average pound of pure seed contains 223,000 filled florets. Like rescuegrass seeds, the viability is reduced by the end of the second year, although a longevity of 4 years is recorded.

General. Perennial ryegrass seeds are very similar to deawned seeds of Italian ryegrass. Fresh seeds of each can be identified by the presence or absence of the awns. A mixture of the two species is unavoidable but all right for use in the Region.

PERENNIAL RYEGRASS (*Lolium perenne*)

Adaptation and Use. A weak perennial similar to Italian ryegrass. The slightly flattened stems are reddish at the base, the leaves folded in the bud; and the florets are awnless. Italian ryegrass has round stems that are yellowish-green at the base, leaves rolled in the bud and awned florets. Perennial ryegrass succeeds best in a cool moist climate having mild winters. It has been successfully grown in Arkansas and Louisiana, in the higher rainfall parts of Oklahoma and Texas and in irrigated pasture mixtures in the western part of the Region, but has never supplanted Italian ryegrass for lawns or winter pasture overseeding. It is mixed with most Italian ryegrass.

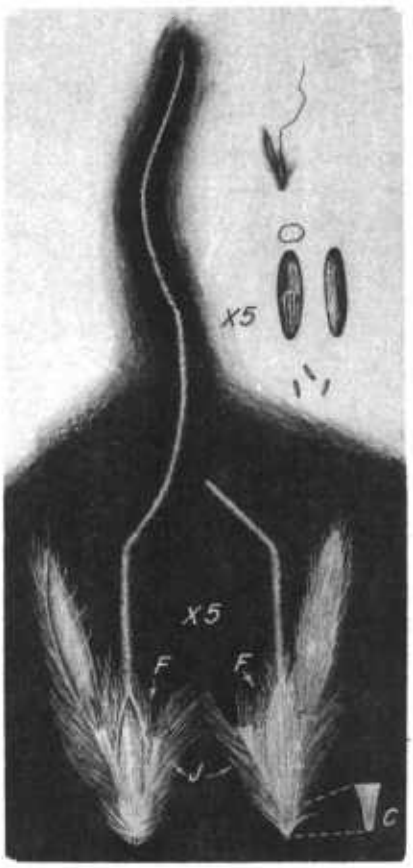
Likely Seed Areas. None.

Potential Yield and Quality. Same as Italian ryegrass.

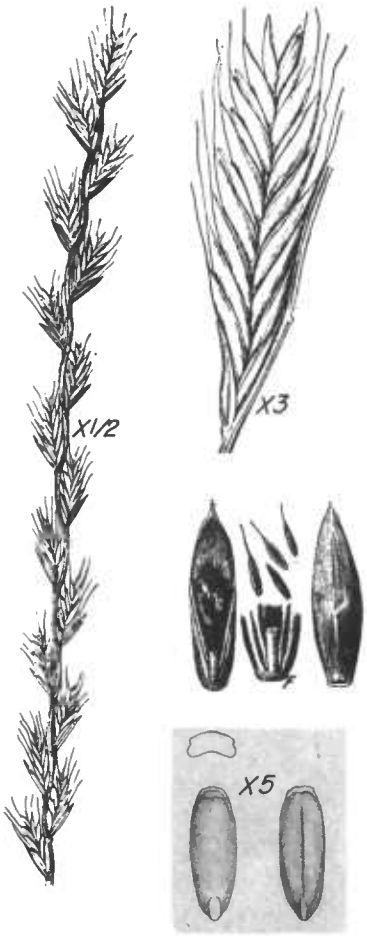
Production Under Cultivation. Same as Italian ryegrass.

Harvesting. Same as Italian ryegrass.

Cleaning. Same as Italian ryegrass.

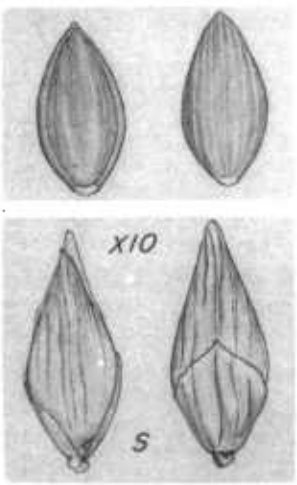


Thatchgross, *Hyparrhenia hirta*. Panicle; two views of joint of a raceme consisting of a hairy joint (*J*), a fertile sessile spikelet (*F*) and a stalked sterile spikelet; enlarged callus (*C*); three views of grain.



Italian ryegross, *Lalium multiflarum*. A spike and spikelet; two views of floret (seedunit), and enlarged base (*F*) of floret; three views of grain.

Perennial ryegross, *Lalium perenne*. A single spike; two views of floret (seedunit), and enlarged base (*F*) of floret.



Blue panicum, *Panicum antidotale*. Panicle; two views of spikelet (*S*), and two views of floret (seedunit).

PLATE 9

Quality. The seedunit is the smooth filled floret. There are 227,000 in a pound of pure seed. Laboratory purities and germinations approximate those of Italian ryegrass.

BLUE PANICUM (*Panicum antidotale*)

Description, Adaptation and Use. Blue panicum, sometimes called giant panic, is a deep-rooted perennial grass. The tough crowns are composed of short, thick rhizomes that often end in a bulbous swelling. The plant may reach a height of 8 feet under the best growing conditions. The lower half of the stems have large nodes and bony internodes, giving a bamboo-like appearance. Branching from the lower nodes is common if the main stem is cut off. In the mild climate of southern Texas, the stems do not always die back to the crown each year. The panicles (inflorescences) are terminal on the stems and branches.

The grass has been under trial and cultivation, as an introduced plant from Australia, for many years. Bridges, from trials in New Mexico, published in Experiment Station Bulletin 278, suggested the grass may have a place "along arroyos, in contoured areas, and in other places which receive runoff water". It has been recommended in an irrigated grass-legume mixture for Las Cruces and localities exhibiting similar climatic and soil conditions. In Texas it has done well in the lower Rio Grande Valley under irrigation, in other parts of the Rio Grande Plain and in the Rolling Red Plains.

The early vigor of blue panicum makes it an excellent winter grass in the Lower Rio Grande Valley, where it has become a factor in the winter-grazing of cattle. It soon loses its vigor in soils where soil nitrogen is used up rapidly by the plants. Plantings in heavy soil on the San Antonio nursery irrigated with sewage water produced remarkable yields of forage and seed. There was no deterioration in color and growth under such conditions. On similar soils without irrigation or fertilization, the stems lost their vigor and the leaves gradually became yellowish-green, indicating an unbalanced nutrition. The leaves and stems are very high in nitrogen during periods of rapid growth. Proper feeding with nitrogenous fertilizers seems essential to keep the grass vigorous.

In Hall County, Upper Pease and Salt Fork Soil Conservation Districts of the Rolling Red Plains, blue panicum has been tried under different conditions. According to District Conservationist George W. Taylor: (1) It apparently does best on a soil high in lime, (2) does well on gypsum and caliche where sorghums "gyp out", (3) is adapted to sands, but the volume of growth is greatest on the fertile types, (4) is easy to establish and maintain on gravelly slopes, (5) yields most on the medium- and coarse-textured permeable soils, (6) is very susceptible to damage by weeds and grasshoppers in the seedling stage, (7) spraying with 2, 4-D during the late seedling stage of the grass is fairly effective in controlling weeds, and (8) broadcast seedings get weedy and lose vigor.

Plants of this grass have withstood temperature of -18° F. at Woodward, Oklahoma.

Likely Seed Areas. From seed distributed to soil conservation districts by the Soil Conservation Service, several growers are now supplying seed to district cooperators and commercial markets. All seed is produced under cultivation.

Determining Potential Yield and Quality. Blue panicum is much like switchgrass in appearance and growth habits, but starts earlier in the spring. The first seed crop matures before hot weather arrives, usually about June 20. In the Hall County, Upper Pease and Salt Fork Soil Conservation Districts, the grass is often grazed in the spring of the second year up to 10 days before seed harvest which tends to lower the yield of seed. By examining the panicles 10 days after flowering is well advanced and following the procedure as outlined under switchgrass, the yield and stages of maturity can be determined. Under good-growth conditions, new panicles are produced through

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the summer and fall. These should be disregarded and attention centered on the production from the larger primary panicles. Under grazing where an unusual number of secondary panicles are produced, it may be profitable to wait for these to mature and disregard the primary panicles. Whatever type of panicle is harvested, examinations should be made often enough to determine the period of greatest production. Harvesting during this period always means some early shattering and some immature seeds.

Production Under Cultivation. Seed yields were as high as 600 pounds per acre from 2 and 3 combinings with sewage irrigation at the San Antonio nursery. Under dry-land conditions, 150 to 250 pounds per acre is a good yield. When the grass is grazed under dry-land conditions, the seed yields from one cutting in early summer are seldom 50 pounds per acre.

Harvesting. The combine can be used to harvest the seeds in all but very tall plants. A header would be better with growthy plants. The seeds separate readily from the straw either as florets or spikelets. The chaffer is kept nearly closed. A slight amount of air from the fan can be used. High quality seeds can be obtained by cutting and binding. There is always some loss of good seeds while handling the bundles. The platform canvas can be removed from the binder, the stems cut high, and when the platform is full, the cut material hauled to a drying shed or cured in loose bunches in the open. The best seeds usually shatter out on the binder platform.

Grass strippers work well with blue panicum. The mutilated stems should be cut after any stripping to keep the growth even for the next harvest.

Care of Green Seed. Thoroughly dry the fresh seeds by spreading thinly on drying sheets or platforms.

Cleaning. Seed material from a combine or stripper contains some straw and trash. It can be cleaned enough to plant by running it over a scalper, through a fanning mill, or back through the combine. The resulting mixture will be mainly florets with a small percentage of spikelets. The ratios of these two units will depend on the number of green spikelets obtained in the harvest. Processing the seeds is not necessary for ordinary planting.

Quality. The seedunit of blue panicum is the fertile floret. This is usually a mottled gray or dark gray. Straw-colored florets are either empty or immature. Many samples received at the seed laboratory had an average purity of 79 percent, a 7-day germination of 41 percent and a final germination of 55 percent. There are 679,000 filled florets in a pound. The purity of one lot obtained with a combine and fanning mill was 94 percent. This lot had a normal planting rate of about one pound per acre in 3-foot rows. Dormancy should be considered when figuring the planting rate of fresh seeds. The known longevity of seeds stored in southern Texas is 3 years.

VINE-MESQUITE *(Panicum obtusum)*

Adaptation and Use. Vine-mesquite is a leafy perennial grass that forms a small crown of knotty, hairy rootstocks. The stolons with swollen or knotty nodes often grow to 8 to 10 feet in length. If enough stolons form, a fairly dense turf may develop. This grass occurs through Oklahoma and Texas west of the eastern timber belt, westward to Arizona and northward to southern Kansas and southern Colorado. It is best adapted to heavy soils of flats (particularly overflow areas), outlets and inlets to dirt tanks, ponds, lakes and streams. It is very often found in and along highway and railway ditches and seems to become established early and spread fast when such places are disturbed. It usually is found in small patches of not more than 3 or 4 square rods in size. It does not survive where water stands for long periods, but will remain

alive under water and mud for short periods. It grows in sandy soils. In the spring the plants furnish considerable grazing. As they mature the stems become rather woody and the leaves harsh. The grass is most useful for erosion control and pasture, but in some sections is cut for hay. For Oklahoma and Texas west of longitude 98° it is valuable for vegetating terrace waterways and dirt spillways, and can be used to revegetate disturbed flats where extra water collects.

Likely Seed Areas. Seeds can be obtained from the patches of grass scattered throughout the western half of Texas, including the northern part of the Rio Grande Plain, and in western Oklahoma.

Determining Yield and Managing for Seed. The first crop of seeds ripen from June 20 to July 30, depending on latitude. A second crop may be produced in the same stand where good moisture prevails. Under close grazing seedstems are not produced. The good spikelets often fall off the plant before the filled florets shatter out; the empty spikelets may cling to the stems for many months giving the appearance of a good seed crop. Like many panicums, the fertile floret is hard and bony. When filled it most often has a dark-gray, streaked appearance; when empty the color is a pale gray or tan. Pinching the hard lemma and palea of 100 spikelets is an easy way to determine fill in the field. Usually a fill of 40 percent represents a good crop. If there are 20 good spikelets on each seedstem and 5 stems per square foot, the yield of pure seeds per acre is about 30 pounds. This is considered a good crop. Material of less than 5 percent fill is worthless for any kind of harvest. The harvesting period should be within 3 weeks after full maturity of the spikelets to insure getting the best material.

Harvesting. Several methods of harvesting are practicable. Any machine that will top the stems can be used. The stems can be handcut with a sickle. Power or horse-drawn mowers can be used to cut the seedhay and the material raked and cured in the cock and threshed with a small combine, or the seedhay can be spread directly on the planting site if the planting is to be done locally. The spikelets are easily stripped from the stems by hand and with mechanical strippers.

Care of Green Seed. Fresh seeds must be well cured before they are sacked.

Cleaning and Processing. It is not difficult to obtain fairly clean spikelets with the combine. Further cleaning is not necessary for drill plantings. If pure florets are wanted, the spikelets are run through a hammer mill at slow speeds and the empty bracts separated from the smooth fertile florets with a fanning mill.

Quality. The quality of vine-mesquite seed is based principally on the purity. The spikelet is the seedunit. Since the unfilled spikelets do not separate easily from the filled or fertile ones in a combine or fanning mill, it is not easy to obtain seeds of high purity. The samples analyzed at the laboratory had a purity of nearly 39 percent, a 7-day germination of 15 percent and a final germination of 37 percent. In a pound of pure seed there are approximately 143,000 spikelets. New seeds do not germinate as well as seeds several months old. According to information from the seed laboratory, when the hard floret covering is separated from the grain, there is a definite increase in germination. The known longevity in storage is 5 years.

SWITCHGRASS (*Panicum virgatum*)

Adaptation and Use. Switchgrass, a perennial, deep-rooted, semibunchgrass, occurs in much of the prairie region and makes up a small part of the total cover. In the wetter parts of some prairies, it may be found in nearly pure stands. It occurs in sandy soils throughout the Plains. Since it is ordinarily considered a tall grass, it is best suited for hay either on alluvial soils or uplands, and for pasture mixtures

in semihumid sections. It has been used with partial success in meadow waterways. Where properly grazed to maintain vigor, it remains in pastures. It is now conceded that the upland form of medium height growing in western Oklahoma is the more desirable one for pasture and meadow mixtures. The tall form is well adapted to the alluvial soils. Strains of upland switchgrass, as Blackwell and Oklahoma No. 1, are more productive and disease-resistant than the wild forms. They are available as certified seed.

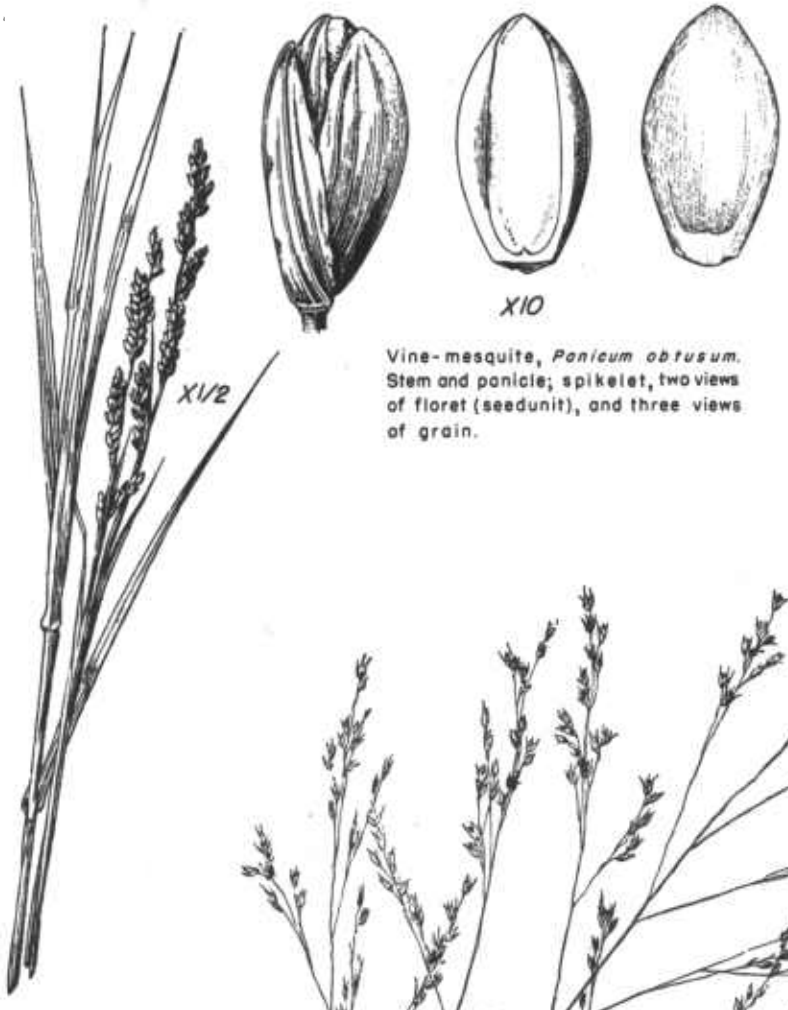
Likely Seed Areas. There are no large tracts of pure switchgrass where seeds may be collected. In many bottoms, several acres in extent may be found mixed with other grasses. On the sandy uplands of Oklahoma, small patches are found in areas protected from grazing.

Determining Potential Yield and Quality. Switchgrass has a rather definite ripening period that begins about August 25 and ends by September 20. Flowering is irregular in the same panicle. About 7 days after flowering has begun, an inspection of the area to be harvested should be made, to note progress of seed development. Test 25 to 50 florets to find out how the seeds are maturing. At this stage, most of the grains will be in the milk or soft-dough stage. A week later, make a careful examination. Take several lots of 10 spikelets in the palm of the hand and rub to remove the fertile floret, then squeeze each floret and count the number filled. Take samples from widely scattered plants, as often one plant growing among several others may be sterile or nearly so. If the collector is not sure of the fill after squeezing the florets, place the lots on a sheet of black paper or blotter and cut across with a knife. Where the plants are closely spaced and bear many stems and panicles and half the florets are filled, the yield may reach 350 pounds per acre. Shattering is an element to consider in switchgrass. Most collectors wait too long after flowering to examine for yield. Well-developed florets will shatter 10 days after maturity and sooner if the weather is windy. Look for this shattered condition. The filled florets shell out easily in the hand if ripe or nearly ripe. They are gray or streaked with purple, shiny and smooth. The unfilled florets seldom shatter easily and are dull gray or dull white in color.

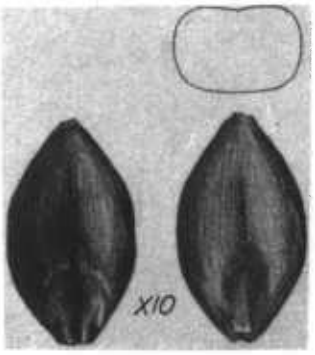
Production Under Cultivation. One objection to placing switchgrass under cultivation is that it is a one-crop-a-year grass. Yields, however, under optimum nursery conditions are excellent, justifying the cultivation and irrigation. Cornelius, writing from Kansas, states that stands are easily obtained, much higher seed yields secured, and usually higher purity is assured, where the crop is grown under cultivation. Cultivation also allows the growing and distribution of pure strains or varieties, in contrast with the many growth forms that appear under natural conditions. Yields under cultivation have reached 500 pounds per acre.

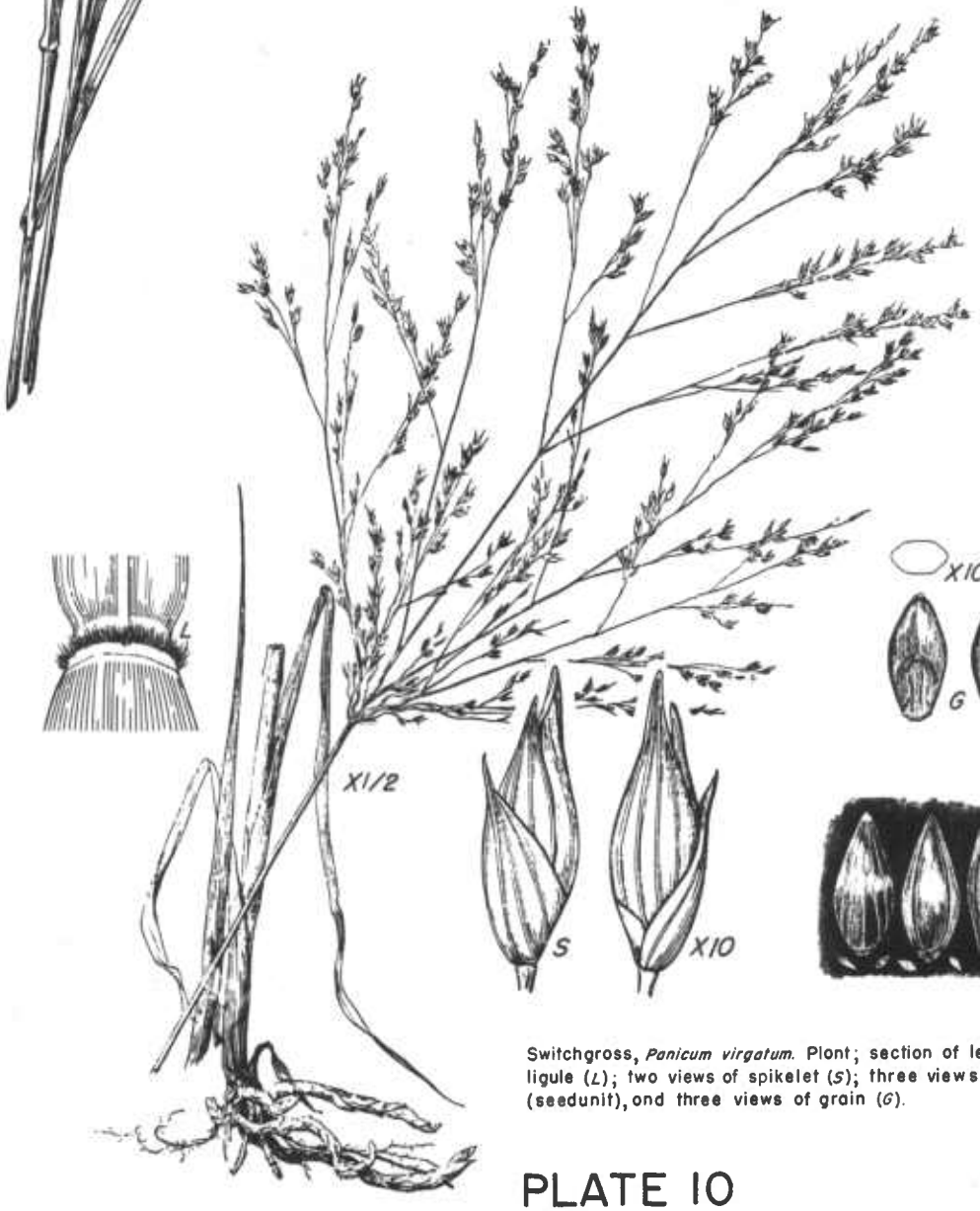
Harvesting. The harvest season is from August 25 to September 25. The usual period is around September 10. In exceptional years, seeds may ripen after September 25. The crop combines easily. Start the combine as shattering begins. Cut the straw high and thresh to remove only the ripe florets and near-ripe spikelets. Close the chaffer and use a screen with small openings. The crop can be cut with a grain binder, cured in the shock, and threshed. Handle the bundles carefully and while they are damp. Use a canvas to catch shattered seeds while hauling the bundles to the thresher. Small lots of seed can be obtained by topping the plants with a sickle, sacking loosely, and curing in the sacks. The seed can be flailed out of the straw.

Care of Green Seed. Combined seed should not be sacked immediately, but dried in the open or under air until sufficient moisture is lost to prevent heating.



Vine-mesquite, *Panicum obtusum*. Stem and panicle; spikelet, two views of floret (seedunit), and three views of grain.





Switchgross, *Panicum virgatum*. Plant; section of leaf showing ligule (*L*); two views of spikelet (*S*); three views of floret (seedunit), and three views of grain (*G*).

PLATE 10

Cleaning and Processing. Switchgrass seedunits (florets) are smooth and rather easy to separate from the trash in a fanning mill. Sometimes in improperly developed material the florets do not shatter and the seed lot remains a mixture of florets and spikelets. This does not interfere with planting, as both units pass through a drill. If only smooth florets are desired, the material is run through a hammer mill at slow speed (800 RPM) and the loose bracts removed with a fanning mill.

Quality. The seedunit is the filled smooth floret. The average purity of many samples is 76 percent, the 7-day germination 48 percent and the final germination 60 percent. The dormant period is variable. Some workers report marked dormancy in which maximum germination cannot be obtained until 18 months after harvest without special seed treatment. The longevity is 3 years. There are 389,000 filled florets in a pound of pure seed.

DALLISGRASS *(Paspalum dilatatum)*

Description, Adaptation and Use. Dallisgrass is a dark-green, broadleaf, tufted perennial bearing deep, strong roots. The leaves are mostly basal; the stems slender; the seed hairy and flattened.

It was introduced into the southern states about 1875, probably from South America, is naturalized and becoming common in the southern and southeastern coastal states. Its spread westward extends to near longitude 98°, or the 33-inch rainfall belt, and northward to east-central Oklahoma and central Arkansas. Farther west it is grown under irrigation.

It is adapted to a variety of soils but grows best in the fertile, moist alkaline clays and loams.

It provides excellent pasture in Louisiana, eastern and southeastern Texas, southern and eastern Arkansas, and southeastern Oklahoma. It mixes well with legumes and other grasses. Once established in lawns, it usually replaces Bermudagrass.

Determining Potential Yield and Quality. Preliminary checking of this grass for seed yields is not easy. Flowering in the racemes is not uniform. The flowering period may be affected by disease. About 12 days after flowering is advanced examine the field for disease and fill. If half the spikelets are diseased (bear a sticky substance), a profitable seed harvest is extremely doubtful. Field examination of healthy spikelets is tedious for pressure on the flat side is not an accurate measure of fill. Cutting across the spikelets with a knife is the best method. Only spikelets with a greenish-brown color should be checked. Where fewer than 10 percent show a developing grain the crop is in the doubtful class for harvest. Such material may be usable for seedhay, planting on areas close by. A fill of 30 percent is good if all the grains are healthy. A fill of 50 or 60 percent is excellent but not often found in this Region.

Production Under Cultivation. Yields of good seed under cultivation are rather uncommon, but are reported as high as 300 pounds per acre.

Harvesting. There are two methods of harvesting Dallisgrass seeds: (1) Direct combining, and (2) mowing, windrowing and combining from windrow. For easiest combining it is a good plan to graze the grass evenly but not too closely to about May 5. After that allow a period of 10 or 20 days' growth before the seedstems elongate. The stems then are uniform in height and have fewer leaves to interfere with combining.

In Louisiana where Dallisgrass is grown with a clover, such as Persian clover, the clover is combined in June and the Dallisgrass seeds harvested from second growth later in the summer.

Direct combining starts when some early-maturing spikelets have shattered and when most spikelets are brown in color. The sickle is set high, the cylinder run at 1300 to 1400 RPM and with a 1/4-inch clearance. The chaffer is set one-half to two-thirds open, the shoe sieve about half open, and the air is shut off. Combine only when the grass is dry.

Mowing and windrowing starts a few days ahead of the combine to prevent extra shattering. Threshing is done with a pick-up combine as soon as the seedhay is cured and dry.

For local plantings where mulch is needed, mow the grass, rake immediately, or while damp and spread the seedhay on the new planting area. This method has resulted in some excellent stands.

Care of Green Seed. Combined seed should be spread immediately on a drying canvas, rack or platform. The temperature of fresh seed in a mass rises very rapidly if it is not stirred.

Cleaning and Processing. Cleaning seeds of low purity is a problem where all good seeds are to be saved. Careful adjustment of the fanning mill is necessary to blow out some of the empty spikelets. Some operators say it is impossible to do a thorough job with a fanning mill. A gravity cleaner gives better results. The loose outer hairy bracts can be hulled from the floret with a hammer mill but the cost is not justified since no increased germination results.

Quality. Recleaned seeds of native Dallisgrass sold as spikelet material usually have a low purity, seldom above 40 percent. The average at the laboratory is 36 percent, the 7-day germination 28 percent, the final germination 53 percent. There are 288,000 filled spikelets in a pound of pure seed. Dormancy is the rule and shows up in the generally poor stands obtained under average field conditions. Treatment by chilling plus soaking in potassium nitrate has increased the germination in the laboratory. It is believed the delayed and erratic germinations in field plantings is the failure of moisture to penetrate between the lemma and palea. These two bracts closely clasp the grain and exclude moisture for indefinite periods.

New strains having higher purities, less disease and greater vegetative vigor are being developed at the Louisiana Experiment Station. Louisiana B230 and 430 are being planted in foundation seed blocks for possible release in 1950. These strains represent the best seeding material found in the first cycle of the Station breeding program. C. R. Owen of the Louisiana Station reports that up to now there is no definite criterion for selection for resistance to ergot disease in the field.

RIBBED PASPALUM (*Paspalum malacophyllum*)

Description, Adaptation and Use. A medium-large, olive-green or slightly purplish, leafy bunchgrass, in age forming large clumps from short, scaly rhizomes. Panicles with many racemes. The fertile lemma of the spikelet has 5 prominent ribs, whence the common name. Introduced from South America but not yet naturalized. Useful for hay and grazing. Adapted to well-drained neutral or acid, sandy loams but will grow in slowly permeable alkaline clays, on the southern side of Louisiana and Texas.

Likely Seed Areas. None.

Managing for Seed. First year stands seldom produce seedstems. When planted in rows and cultivated, second-year growth stools and matures stems and seeds. First flowers are produced in May and seeds are ripe by the middle of June at the San Antonio nursery. Additional harvests 6 to 8 weeks apart are possible under irrigation. Ripening is irregular and an examination should be made when many of the spikelets begin to lose the purple and turn brown. Pinching or cutting the florets will show the number filled. Although an apparently heavy seed producer, many of the spikelets do not fill.

Production Under Cultivation. Average yields on the San Antonio nursery have been low - approximately 50 pounds per acre.

Harvesting. Ribbed paspalum combines easily, as no shelling is required. The spikelets are merely separated or stripped from the stalks. Adjustments are: Moderate speed and 3/8-inch spacing of the cylinder, keep chaffer and shoe sieve three-fourths closed and use enough air to keep spikelets out of tailings.

The seed can be taken with bluegrass and two-reel strippers after ripening is advanced.

Care of Green Seed. Combined and stripped seed should be dried before sacking.

Cleaning. Most of the trash from stripped seed can be removed with the shaker scalper. Cleaning is completed with the fanning mill.

Quality. The seedunit of ribbed paspalum is the spikelet as it grows on the plant. Both glumes are absent in this species. The only extra scale that could be removed is the thin sterile lemma. The average purity of samples received at the laboratory is 50 percent, the 7-day germination 34 percent and the final germination 39 percent. These figures indicate a rather long dormant period for most of the seeds. There are approximately 1,000,000 seedunits in a pound of pure seed. The longevity is at least 2 years.

BAHIAGRASS (*Paspalum notatum*)

Description, Adaptation and Use. A perennial with short ascending stems and short, stout, horizontal rhizomes, forming a fairly close, tough turf. Leaves broad, crowded at the base; inflorescence a pair of racemes produced as a fork at the end of the stem; spikelets solitary, crowded, smooth and shining. A pasture grass introduced from the tropics; now naturalized along the Gulf Coast. Rare in Louisiana and scattered in Texas. The typical form is found in Bee, Refugio and Goliad counties and in a few spots west of these counties. A narrowleaf variety (Paraguay), less rhizomatous than the typical form, is fairly common in local areas from Bay City to Lufkin, Texas. It is winterhardy at Minden, Louisiana, while the typical form kills back from cold. Two other strains, Wilmington and Pensacola, are under trial in the Region. The latter is not cold-resistant. All forms adapted to both clayey and sandy soils. Moisture limits the use westward in the drier pastures. The Paraguay strain is proving suitable for airplane landing fields along part of the Gulf Coast.

Likely Seed Area. The Paraguay strain has been harvested by commercial collectors in the vicinity of El Campo, Texas. Local areas of the typical form are common around Blanconia, Texas.

Managing for Fill and Seed. Bahiagrass will make excellent growth on relatively poor soils when given plenty of nitrogen. The stems are produced in early May. Flowering and fruiting occurs in late May. Unless protected, the young stems will be eaten by livestock. In pastures the plants spread from seeds and vegetative offshoots. The ripe seeds are known to have been transferred by livestock. Fertilized row plantings produce as many as 15 stems per foot. Each stem may bear as many as 50 seeds. Fill is usually good and is determined by pinching the spikelets with the thumbnail or cutting across each with a knife. Harvesting begins when most of the spikelets are turning brown and before many shatter. A small percentage of the spikelets show ergot damage in most years.

Yield Under Cultivation. Maximum yields when planted in rows seldom exceed 100 pounds per acre. Broadcast stands probably yield 35 pounds an acre.

Harvesting. Bahiagrass is easily combined, as the inflorescence tops the leaves and can be cut without mixing in much trash. The cylinder speed is moderate and the spacing

close (1/4 inch or less) in order to strip the spikelets from the branches. The chaffer and adjustable shoe sieve are set three-fourths closed. Some air is used to float the pieces of stems off the sieve. A clean lot of seed is possible if the spikelets are uniformly ripe.

The spikelets can be taken with a power stripper probably more cheaply than with a combine. The material should be cured and threshed or cleaned when dry.

Care of Green Seed. Much of the combined seed is partly green and needs drying before sacking.

Cleaning. Normally most combined seed material is plantable without cleaning. Trashy material can be cleaned on a vibrating scalper or in a fanning mill.

Quality. The seedunit of Bahiagrass is the smooth, filled spikelet. The grain, besides being tightly enclosed within the fertile lemma and palea, is partially wrapped with the translucent outgrowth of the palea. The water seal is between the lemma and palea. If this can be broken either through scarification or soaking in sulphuric acid, germination is good. The purities range from 70 to 80 percent. This low purity is partly due to the difficulty of separating unfilled from filled spikelets. The 7-day germination is 54 percent and the final germination 60 to 70 percent. There are approximately 170,000 spikelets in a pound of pure seed. Stored seeds usually retain their viability for 3 years. In most instances, the storage should not be longer than 2 years.

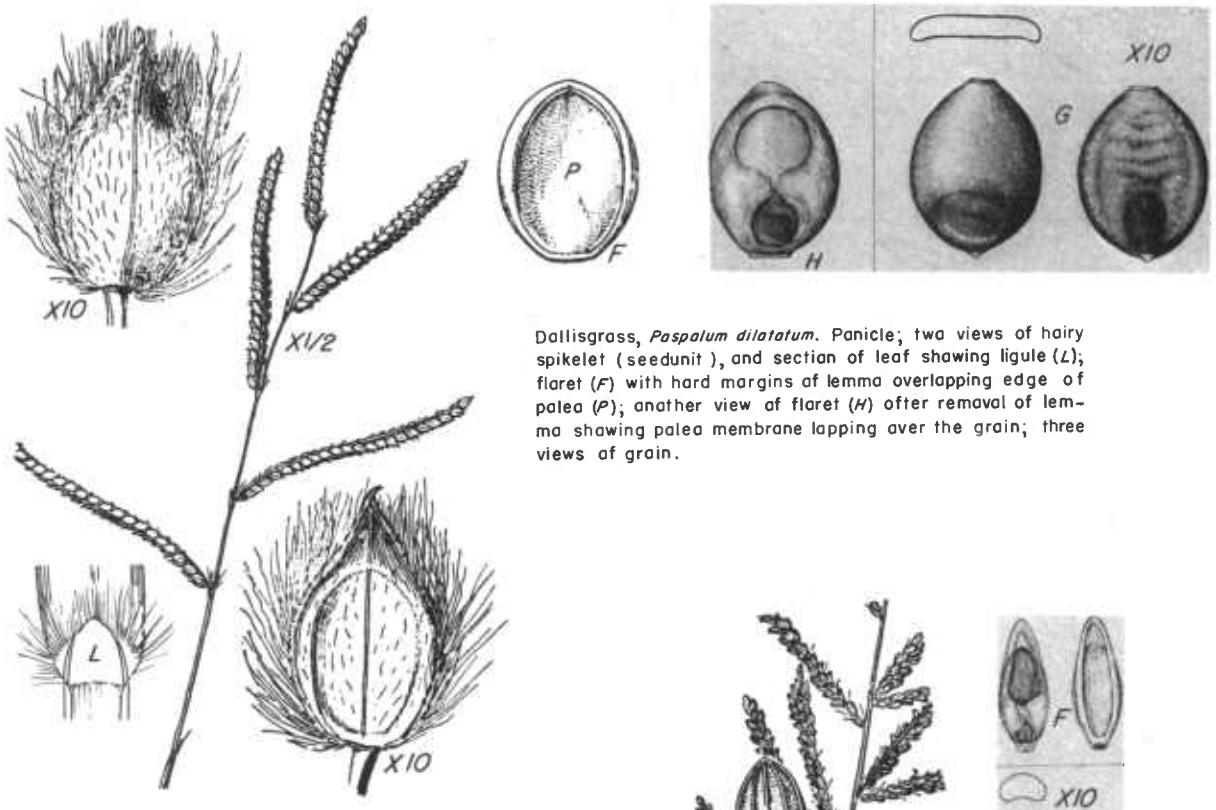
HARDINGGRASS (*Phalaris tuberosa stenoptera*)

Description, Adaptation and Use. A stout, upright, deep-green perennial with a rhizomatous, only slightly swollen base; stems stout, ending in a spikelike dense panicle; spikelets slightly winged, the fertile lemma hairy, and the single sterile lemma about one-third as long as the fertile one. A leafy, deep-rooted winter grass producing the most forage on fertile, well-watered soils of the southwestern part of the Region. Probably will not survive long under dry-land conditions in less than 30 inches of rainfall, or where the summer rainfall is not sufficient to maintain some soil moisture. Responds to nitrogen and phosphate fertilizers and is a high forage producer under irrigation on fertile land. At the San Antonio nursery seed production is extremely low without irrigation. Useful in irrigated pastures in mixtures or alone for supplemental grazing.

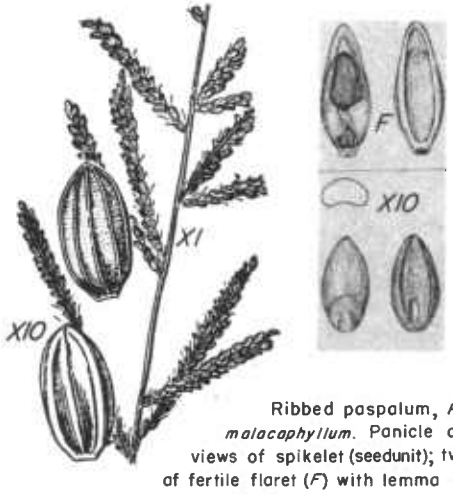
Likely Seed Areas. None in the Region.

Potential Yield and Quality. Growth begins in the fall under dry-land conditions, earlier when irrigated. Under irrigation for seed production it can be grazed during the winter and early spring. Stock should be removed by March 15 at San Antonio and before stems are ready to elongate. If the field is bunchy it should be mowed high. Stems are produced in April and flowers in late April and early May. The seeds generally are ready for harvest the last few days of May or the first week in June. The seeds ripen unevenly in the dense panicles and shattering is a problem. Harvesting should begin when the maximum number of spikelets show a well-developed fertile lemma and while some of the lower ones cannot easily be shelled from the glumes. This can be determined by picking a few short branches from the lower side of the panicle and shelling the fertile florets in the palm of the hand. The fertile florets must be pinched with the thumbnail to determine true fill which generally is good.

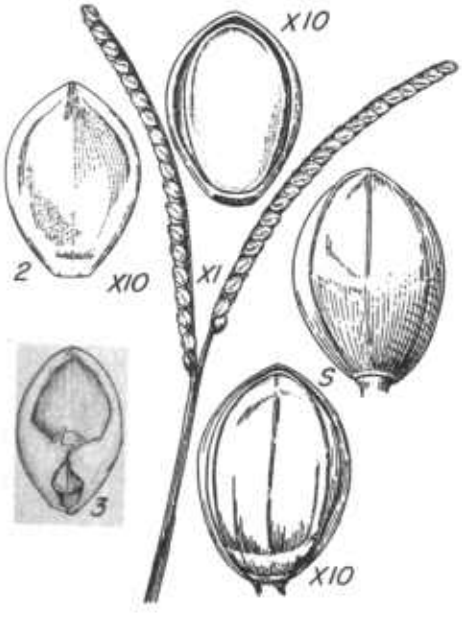
Production Under Irrigation. Under ideal conditions, seed production under irrigation should reach 200 pounds per acre. At the San Antonio nursery the highest yield has been 60 pounds per acre. It produces only one crop a year.



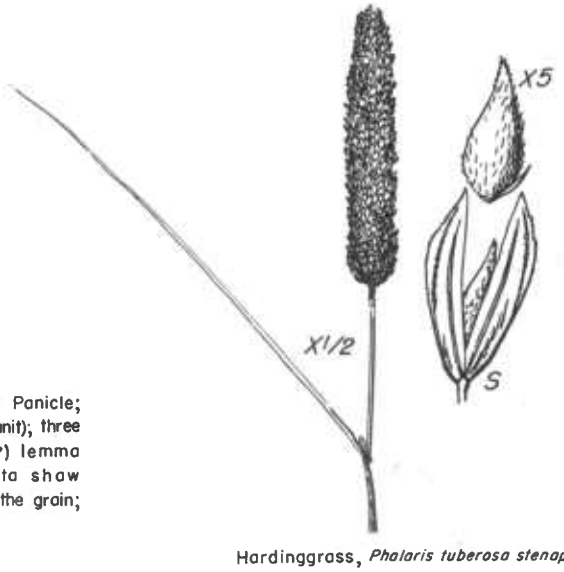
Dallisgrass, *Paspalum dilatatum*. Panicle; two views of hairy spikelet (seedunit), and section of leaf showing ligule (*L*); floret (*F*) with hard margins of lemma overlapping edge of palea (*P*); another view of floret (*H*) after removal of lemma showing palea membrane lapping over the grain; three views of grain.



Ribbed paspalum, *Paspalum malacophyllum*. Panicle and two views of spikelet (seedunit); two views of fertile floret (*F*) with lemma removed, and three views of grain.



Bahiagrass, *Paspalum notatum*. Panicle; two views (*S*) of spikelet (seedunit); three views of floret, (*1*) palea side, (*2*) lemma side and (*3*) lemma removed to show palea membrane lapping over the grain; three views of grain.



Hardinggrass, *Phalaris tuberosa stenoptera*. Panicle, spikelet (*S*), and floret (seedunit).

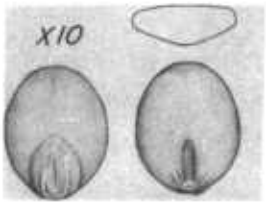


PLATE 11

Harvesting. Hardinggrass is easily combined, as the panicles stand above the leafy part of the stems. Cylinder spacing of 1/8 to 1/4 inch and speed of 1400 to 1600 RPM has been found most satisfactory. This removes the fertile florets from the glumes but leaves a trashy mixture on the shoe sieve. The chaff can be floated off by adjusting the shoe sieve close and using a small amount of air. Where good cleaning equipment is available the chaff need not be separated from the seeds in the combine. The seeds can be harvested with a bluegrass stripper and 2-reel stripper without mixing in much trash.

Care of Green Seed. Trashy seed material from the combine and stripper should be thoroughly dried before cleaning.

Cleaning. Trashy seed material can be run over the scalper to remove much of the coarse material. The fanning mill or 3 screen cleaner will separate the seeds from the small chaff.

Quality. The seedunit is the filled fertile floret with or without the short sterile floret (bract) attached at the base on one edge. It closely resembles the units of some species of native canarygrass. Quality depends on purity and whether the seeds have been carefully cured. The gravity cleaner is necessary to clean to high purity. The average purity at the laboratory is 90 percent, the 7-day germination 38 percent and the final germination 60 percent. Dormancy accounts for the low final germination. There are approximately 350,000 units in a pound of pure seed. Imported seeds often contain the seeds of other perennial and annual *Phalaris*.

TEXAS BLUEGRASS (*Poa arachnifera*)

Adaptation and Use. Texas bluegrass is a native perennial, sod-forming, cool-season grass with slender underground stems. It is found on the prairies and plains from southern Kansas to southern Texas and western Arkansas. It is widely but sparsely scattered in sandy upland pastures and not infrequently in small patches along stream bottoms and heavy upland soils. It is a major constituent of sand sagebrush range along the North and South Canadian rivers in Oklahoma, where it furnishes the bulk of green winter forage available in native pastures. It is well represented in many of the sand shinnery pastures. It seems best adapted to upland sandy or loam soils and to heavier soils in the presence of favorable moisture.

The protein content is very high during the period of fresh growth. Yearling steers fed 2 pounds of cottonseed cake per day on native range at the Southern Great Plains Unit near Woodward gained 27 pounds per head from mid-October 1948 to March 1, 1949. A similar lot of steers without any cake but grazing Texas bluegrass gained 67 pounds per head in the same period. Weather conditions during the period were extremely severe for cattle.

Seed supplies have not been adequate for extensive trials over the Region where the grass does not now occur. It has been successfully established from seeds in deep sand on the Range Unit of the Southern Great Plains Field Station, Woodward, Oklahoma. Fall seeding is probably preferable.

Likely Seed Areas. No extensive natural seed areas are known to exist. A few brush-free pastures between Pond Creek and Lamont, Oklahoma represent the best sources for bulk collections. Some seeds can be collected by hand along streams in northwest Oklahoma.

Potential Yield and Quality. The sexes of Texas bluegrass are found on separate plants and usually in separate colonies. The seed-bearing inflorescences are generally larger than those of the male plant and prominently "cob-webby". The fertile florets bear at the base several long webby hairs which are few or often absent from the male florets.

Fill is determined by squeezing the grains out of the fertile florets and counting to get the percentage. At Woodward, whenever a harvestable crop of seed heads are produced, the fill is apt to be high. A fill of 50 percent or more is good enough for harvest.

Production Under Cultivation. Production under irrigation and cultivation is entirely feasible and constitutes the only hope for market supplies. Increase blocks may be established from either seed or sod. Six-inch sods spaced 3 feet each way will spread and form a solid stand in 2 to 3 years. Plant the seed in 12- to 24-inch rows. A hand-sodded stand composed of 80 to 90 percent female plants and 10 to 20 percent male plants should return maximum yields, which might exceed 100 pounds per acre under irrigation.

Harvesting. In northern Oklahoma the seeds are ready to cut by early July. The kinky hairs on the fertile florets cling to everything they touch and are impossible to thresh in any known combine or thresher. The best method used to date is to remove all sieves from the cleaning shoe, remove the straw rack, disconnect all seed augers, and leave only the sickle, cylinder and grain drag to function normally. As the material is cut it goes intact through the cylinder and is carried by the grain drag to the empty cleaning shoe. When the shoe is full the material is removed by hand and tossed into a truck. This is called harvesting-by-hand-with-a-combine. A header would accomplish much the same result.

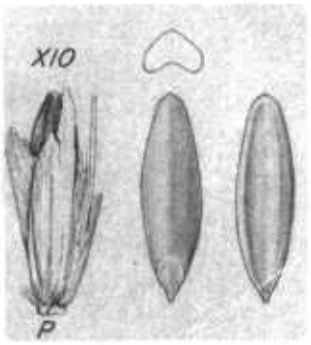
Care of Green Seed. Freshly cut seed material should be spread and dried before processing to avoid heating and molding.

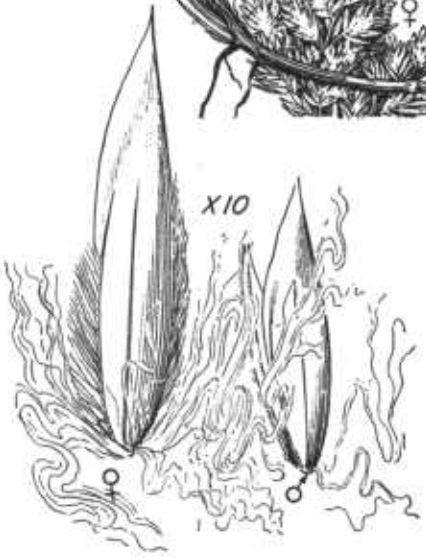
Cleaning and Processing. Texas bluegrass seed material must be processed to remove the webby hairs before it can be planted by any means. The combine-run material is fed direct into a hammer mill equipped with a screen having large (1/2-inch) openings to merely chop up the material. The chopped material is then rerun through the mill, equipped with a screen with much smaller openings and then through a fanning mill to remove free grain and clean florets. No fewer than 3 reruns, and sometimes as many as 7, are necessary to obtain clean plantable florets. The trash in the original combine-run material largely determines the time required in the processing and cleaning. The possibility exists that if the freshly cut seed material is run through a finely set ensilage cutter, the hammer mill time could be shortened.

Quality. Properly processed and recleaned seed is usually composed of 2 grades - clean grain and unhulled florets. The clean grain should have a purity of above 90 percent; unhulled florets a purity of 65 to 75 percent. Pure seed cannot be attained in either grade because of the normal presence of bits of stem the size and weight of the seed-units. A pound of pure clean grain contains about 2,500,000 seeds. A pound of pure processed but unhulled florets contains about 1,750,000 units. The known longevity is 5 years. Dormancy of 2 to 4 months is recorded.

INDIANGRASS (*Sorghastrum nutans*)

Adaptation and Use. Indiangrass is a deep-rooted, native perennial occurring throughout the tall grass and mixed grass prairies and in the tree-oak and shrub-oak savannahs. In the well protected savannahs it is an important part of the grassland vegetation. On sandy soils under such conditions it is more important than big bluestem. It is used in meadow mixtures in the Coastal, Grand, Blackland and eastern Oklahoma prairies. When planted in pure stands it will produce a ground cover sooner than either big or little bluestem. Where grazing is lighter than the commonly accepted standard in the Central Prairies, Indiangrass will increase, form a part of the forage with little bluestem and be an indicator of use. In the cutover West Cross Timbers where it is partially protected, good yields of hay are not uncommon.





Texas bluegrass, *Poa arachnifera* . Part of plant and pistillate (♀) and staminate (♂) panicles; pistillate (♀) and staminate (♂) florets; pistillate (*P*) floret (seedunit) from hammer mill, and three views of grain.

Indiangrass, *Sorghastrum nutans*. Panicle, leaf, and section of leaf showing ligule (*L*); seedunit or joint of a raceme composed of fertile spikelet, stalk (*S*) of sterile spikelet which never develops, and hairy joint (*J*); three views of grain.

PLATE 12

Likely Seed Areas. Mixed or pure stands in the protected West Cross Timbers furnish seeds for small harvests. Railroads in northern Arkansas, in parts of Texas and Oklahoma are sources of small lots of seed. Rarely anywhere are there blocks large enough to accommodate combines or binders. Growers have been slow to establish seed blocks to even start satisfying the demand for the seeds.

Determining Potential Yield and Quality. Indiangrass seeds mature from late September to frost or even later. The time depends on the August and September rainfall. The procedure for determining quality and yield is much like that for little bluestem. If late July and August moisture is enough to develop the stems then an examination of the stage of seed development should be made about 10 days after flowering starts (about September 10). If 20 percent of the grains are developing the seed is poor to fair, if 40 percent, the seed is good; if 60 percent or more, the prospects of a crop are excellent.

Indiangrass is one of the easiest grasses to check for fill. The fertile spikelet is large enough to handle easily and squeeze between the thumbnail and forefinger. A hundred spikelets can be examined in 10 minutes and if taken at random will supply all the information needed to set an approximate date for harvest. If, on September 20, 50 percent of the spikelets show evidence of maturing grain and the clumps are large, and average 1 per 9 square feet, the yield of seed should equal 125 pounds per acre.

Indiangrass ripens between September 25 and November 1. Seeds have been collected as late as November 15 in central Texas. The development of the large panicle is normally irregular, so harvesting should be planned at a time when some of the topmost spikelets have fallen and the middle ones are in the hard-dough stage. The spikelets fall in a week or 10 days after the grains have reached the vitreous-amber stage. A frost during this period followed by high winds hastens the shedding of the filled spikelets, but not the empty ones. The latter may hang on for several weeks and give the impression that good seeds are still available.

Production Under Cultivation. Small blocks on the nursery under dry-land conditions often yield 150 pounds per acre. Moisture is nearly always the limiting factor in stem production and seed yields. If planted in rows, under irrigation and fertilized with a high nitrogen fertilizer a good yield may be expected. In 1948 near Whitesboro, Texas fertilized non-irrigated row plantings had a 90 percent fill, while unfertilized native stands had less than 10 percent fill.

Harvesting. If the areas are large enough a combine or binder can be used to harvest Indiangrass. Both have worked satisfactorily on the nursery. Binding the straw when the uppermost spikelets are in the hard-dough stage permits more of the remaining grains to develop during the curing period in the shock. When combining the straw cut it high to reduce the amount taken through the cylinder and prevent overloading of the straw rack and chaffers. Keep cylinder speed fairly low (900 to 1100 RPM), the chaffer set half open and the wind cut down. Indiangrass may be cut and the seedhay spread on the planting areas. This method is recommended for badly eroded and gullied sites. Indiangrass can be topped economically with a sickle from wild stands. One man can cut 200 to 600 pounds of tops in a 10-hour day. The tops may be hauled to the planting area or cured on a canvas and stacked for threshing.

Care of Green Seed. Seedhay must be dried after topping; 24 to 48 hours of sunshine and air are needed before stacking starts. Fresh seeds from the combine should remain in the open and loose to cure well before sacking. Do not cure on concrete if other surfaces are at hand. Turn the seeds at least once a day while curing.

Cleaning and Processing. As combined, Indiangrass seeds contain considerable straw and chaff. The fanning mill will remove some of this trash. However, because the seed-unit is hairy and consists of 2 hairy stalks in addition to the long awn, processing

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with a hammer mill at rather slow speeds is almost necessary in order to trim the units where they will readily pass through a grass drill or cotton planter box with an agitator. Most processed material consists of deawned spikelets and naked grains. By adjusting the hammer mill carefully, the units can be processed completely and the chaff separated from the grain with a fanning mill. Clean seeds (grain) from the hammer mill contain a small percentage of chipped and broken grains. Deawning is quite necessary if the trashy seeds are to be mixed with other seeds and planted from a grass drill.

Quality. The average purity of Indiangrass seeds is 68 percent, the 7-day germination 35 percent, the final germination 62 percent. There are 175,000 filled trashy spikelets in a pound of pure seed. The viability period exceeds 2 years in storage. There is a period of dormancy of at least 3 months after harvest. Chilling increases the germination.

TEXAS WINTERGRASS *(Stipa leucotricha)*

Description, Adaptation and Use. A winter-growing, perennial bunchgrass. Stems slender, leafy only at the base; leaves narrow, evenly covered with short rough hairs; inflorescence a drooping panicle, expanding in April and May and consisting of numerous single-floret, awned spikelets; florets cigar-shaped, hard, one-seeded with a long, bent, twisted awn and a needle-like callus. Grows during the cool season from September until mid-spring. During the hot weather, the plants are semidormant, partly dry, harsh and unpalatable. Nearly awnless cleistogenes or fruits are abundantly produced in the lower sheaths near the ground-level. These germinate when fires burn off the tops and when the rain and animals tear the decaying sheaths apart. An increase in the number of plants usually follows a long drought. A native of the grasslands extending from the Gulf in southeast Texas to the Arbuckle Mountains in Oklahoma and west nearly to the High Plains. It has increased in many sites where the taller grasses have been reduced. A dependable grass in mixtures where moisture is available. Useful mainly for cool-season grazing. Prefers alkaline soils. Well adapted in the Grand Prairie, Edwards Plateau, Reddish Prairie, Coast Prairie, and sections of the Rolling Plains.

Likely Seed Areas. Rich divides of the southern Edwards Plateau and overgrazed brushy areas of southern and central Texas.

Determining Potential Yield and Quality. Along the Gulf Coast and inner prairies of the Gulf Coast, flowering begins in March and fruits mature in April depending on rainfall. Flowering is usually 3 weeks later in the northern part of the range. Only aerial seeds are harvested. Shattering takes place within a week after the florets are brown and mature. Usually some loss has occurred when the main crop is ready. Potential yield depends on the number of stems. A fair yield may be expected if the average number of stems is 5 per square foot and there are 24 seeds per stem. This is equal to an acre-yield of about 100 pounds of filled florets with the awns removed. One stem per square foot therefore will equal 20 pounds of pure seed per acre.

Production Under Cultivation. Texas wintergrass has never been cultivated for the seeds. Planted in rows and cultivated, the yields should be as large as from broadcast stands and a good deal cleaner.

Harvesting. Although there has been some demand for seeds, no one up to 1949 had found a successful method of harvesting. In 1949 several operators using bluegrass strippers were able to obtain fairly large quantities at reasonable costs. The stripped material is a mass of awns that can be handled best with a scoop shovel.

Trials in other years with combines were unsuccessful, as no combine will break or remove the awns. The ability of the florets to cling together and roll up caused trouble at several points in the combine.

Care of Green Seed. Stripped seeds can be piled to a depth of 2 feet without heating. The material should be cured for a day or two in the sun before it is piled.

Cleaning and Scarifying. The cured seed material cannot be cleaned in a combine. After extra drying in the sun, the following method of cleaning was worked out at the San Antonio nursery: Drive the hammer mill with tractor; keep speed of mill reduced to a minimum, i.e., just fast enough to hold the hammers out; use a 1/2 inch screen; feed the awned material slowly into the mill; pick up milled material with suction fan and carry it to cleaner, there using a blank sheet of metal instead of a screen and air to remove only the dust and small particles of trash. The seed material remaining consists of 50 percent of the florets free of awns, 35 percent with awns partly broken off, 15 percent with awns intact and attached, many pieces of callus, and all the broken awns detached by the hammer mill. Only a small percentage of the florets and grain was broken. With this experience, machinery can be constructed that will remove all awns and calluses and produce seeds high in purity and easy to plant. Those described above are plantable from grass drills.

Quality. Up to the time this is written, no method of obtaining readily plantable seeds has been found. Quality seeds should be the deawned florets with a fill not less than 75 percent. There are approximately 50,000 to 60,000 deawned filled florets in a pound. The germination of such seeds in the field should be high after the dormant summer period and not less than 50 percent in 7 days.

EASTERN GAMAGRASS (*Tripsacum dactyloides*)

Description, Adaptation and Use. A vigorous, smooth, leafy perennial spreading by thick, scaly rhizomes which radiate from center of clump and carry the thick bases of the leaves until disintegrated; stems and sheaths somewhat flattened; blades often 2 feet long and flat; inflorescence a simple spike or several branches, the male flowers (tassel) above and female (grain-bearing) below, the former drop off before the seeds are ripe, the latter break up at the one-seeded joints; fruit a single joint of the inflorescence, consisting of the thickened axis and the wholly or partially imbedded spikelet; grain 2 to 4 mm in diameter.

A tall grass of the eastern prairies, stream banks and stream bottoms. A narrowleaf form is known from the deep sands of East Texas. Isolated colonies are rarely seen along streams in West Texas. Used principally for hay but is a good grazing grass if managed to maintain vigor.

Likely Seed Areas. Stream bottoms in eastern and southeastern Texas and eastern Oklahoma. Also black or heavy soil prairies west of the timber belt of East Texas, where occasionally it makes up half the total grass cover.

Potential Yield and Quality. The leaf area of vigorous, closely spaced plants is equal to several tons of green fodder an acre. The plants should be cut in June for hay before the stems elongate and leaves become harsh. Flowers appear in late June. The fruit ripens in July and later, because of the uneven production of stems.

Several crops may be produced during the growing season when soil moisture brings out the stems. Uneven ripening and the normally few (1 to 2 per square foot) stems makes this grass a poor seed producer. With an average of 16 pistillate joints per stem and 1 stem per square foot the maximum seed production cannot exceed 100 pounds per acre. Half this amount is a high yield when the easy shattering of the ripe joints is considered. A yield of 10 pounds per acre is what may be expected. As the joints ripen, they lose their green color, become tan, and when mature, are shiny brown or shiny tan and bony. The grains will mature if picked just as the joints begin to change color.

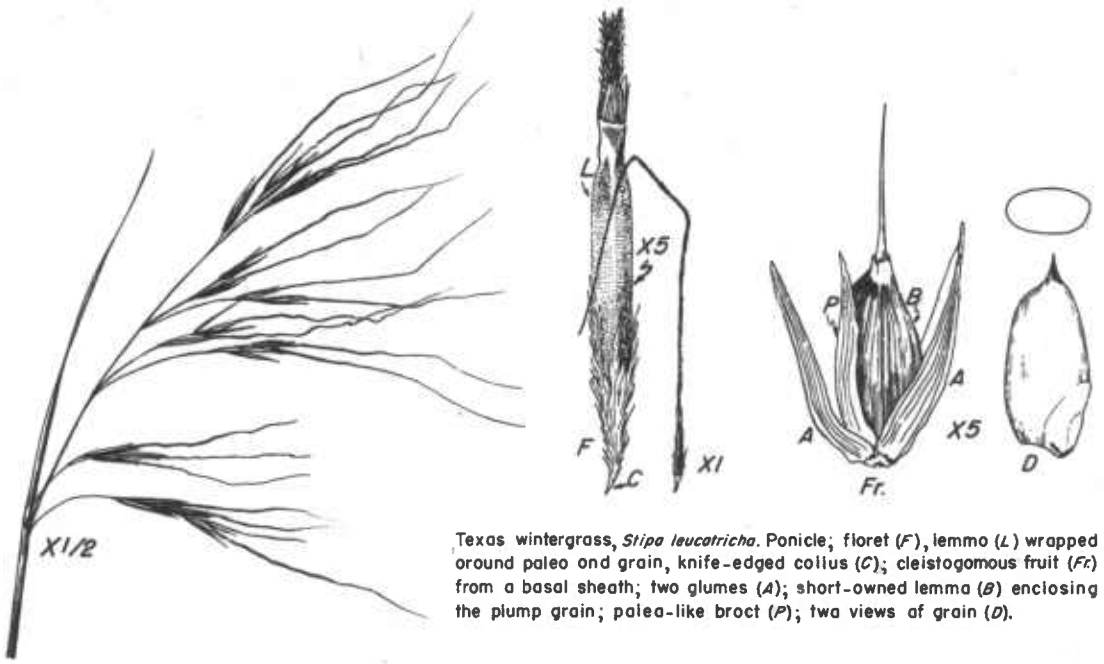
Fill is determined by cutting across the joint and the spikelet with a knife. Pressure of the thumb will not suffice. The material is of doubtful value if fewer than half the spikelets are filled.

Production Under Cultivation. Twenty pounds per acre is a good yield.

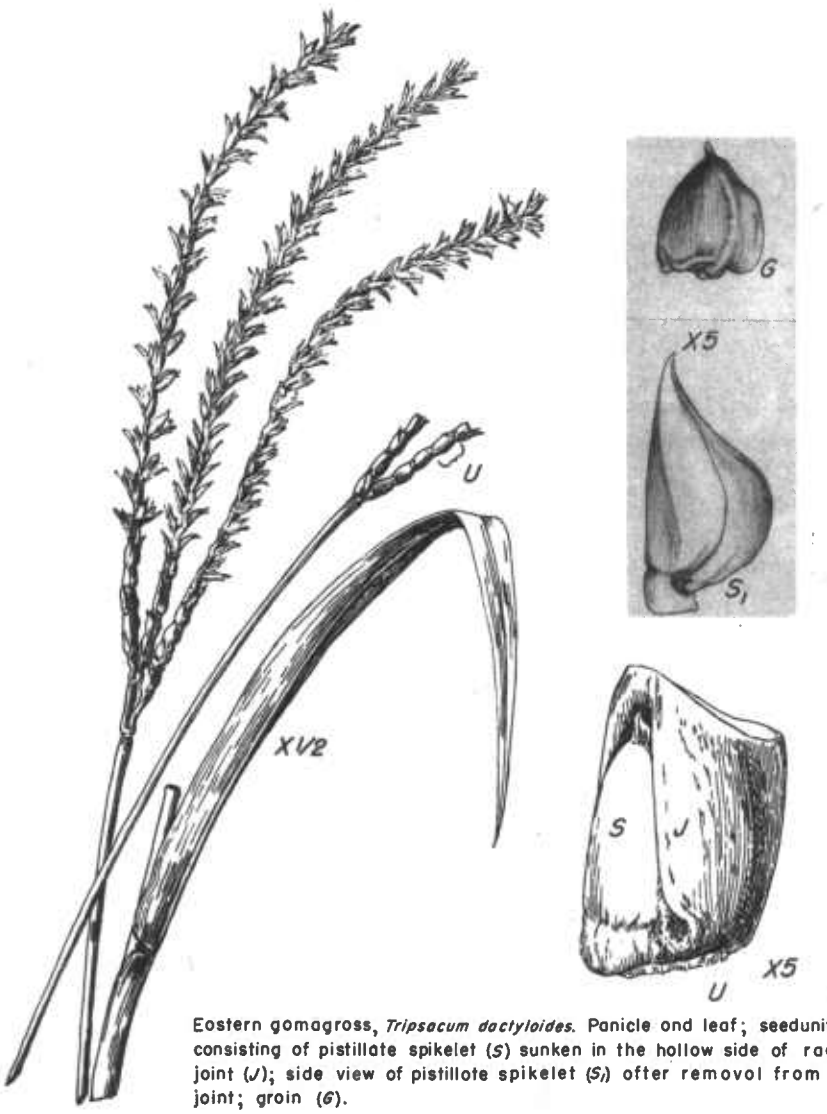
Harvesting. Eastern gamagrass can be stripped with a power grass stripper if the cylinder can be elevated above the leaves. It also can be combined. Handstripping is the usual method of harvest. Pure seed can be obtained with the latter method and with the combine. The low yield will not always justify the use of a combine.

Care of Green Seed. Seed hand-harvested or machine-stripped should be spread out and cured slowly.

Quality. The seedunit is a joint of the thick spike containing a deeply imbedded, filled spikelet. It is about the size of a kernel of corn. The fertile floret is completely enclosed within the bony glumes. The grain is 2 to 4 mm in diameter. There are about 7200 filled seedjoints in a pound of pure seed. The purities range from 95 to 99 percent, the 7-day germination, 60 percent. Field germination is slow unless some scarification is given the spikelets. The seeds maintain good viability in storage for 2 years.



Texas wintergrass, *Stipa leucotricha*. Ponicle; floret (*F*), lemmo (*L*) wrapped oround paleo ond grain, knife-edged collus (*C*); cleistogomous fruit (*Fr.*) from a basal sheath; two glumes (*A*); short-owned lemma (*B*) enclosing the plump grain; palea-like broct (*P*); twa views af grain (*D*).



Eostern gomagross, *Tripsacum dactyloides*. Panicle ond leaf; seedunit (*U*) consisting of pistillate spikelet (*S*) sunken in the hollow side of rachis joint (*J*); side view of pistillate spikelet (*S*,) ofter removol from the joint; groin (*G*).

PLATE 13

DISCUSSION OF LEGUMES

ALYCECLOVER *(Alysicarpus vaginalis)*

Adaptation and Use. Alyceclover is a summer annual, with unifoliate, nearly round leaves and slender jointed pods. It is a native of tropical Asia and was first introduced into the United States in 1910. It is not adapted to wet lands, makes poor growth in soils of low fertility, and is not planted outside the high rainfall belt of eastern Texas, southern Arkansas and Louisiana. Alyceclover is susceptible to rootknot or nematode. It is useful for hay, green manure and grazing. Late May seedings on clean seedbeds are recommended for seed production.

Seed Areas. Grown only under cultivation.

Managing for Seed. When seeds are wanted, the young crop should be mowed short about August 1, or when plants have reached a height of 8 inches. This induces branching, keeps growth shorter, reduces lodging and increases production. By waiting for more growth, a hay crop can be removed and the second growth allowed to develop seed. The harvest date is October 1 to 15. Harvesting begins when about one-half the pods are brown.

Harvesting. Two methods of harvesting are used. One, the clover is mowed while a little damp, cured in the swath about two days until the leaves and branches are dry, then picked up and threshed with a combine. The other, the standing plants, if upright, are combined direct. Lodged plants usually are tough and cannot be handled in direct combining. The seeds shatter easily. The combine need not be adjusted too close to obtain the seeds. Use enough air to keep the chaff off the lower sieve, and adjust this sieve to allow the smooth oblong seeds to drop through. The average run of combined seed is free of pods and contains only a small percentage of joints.

Production Under Cultivation. Yields up to 600 pounds per acre have been obtained. The average is hardly 300 pounds.

Care of Seed. Until thoroughly dry, the seeds should be placed in small sacks and set on racks where the air can freely circulate, or spread out and stirred occasionally.

Cleaning. The 3-screen mill is used to clean the seed. The upper screen is 1/13 inch, the second, 1/16 inch, and the third, 1/22 inch. In most cases, the results from one run through the mill are satisfactory. The gravity cleaner may be used to complete the cleaning.

Quality. The average purity of alyceclover is 98 percent, the 7-day germination only 12 percent, the final germination 60 percent with 23 percent hard seed. Most lots should be scarified before the planting to increase the germination. There are 308,000 seeds in a pound of pure seed. The known longevity is 4 years. Usually the seed should not be held more than 2 years before planting.

CRETE CROWNVETCH *(Coronilla cretica)*

Adaptation and Use. Much-branched, weak-stemmed, leafy, winter annual with small clusters of whitish flowers borne on stalks; pods very narrow, jointed, each joint containing a slender seed. Recently introduced from the Mediterranean Region. Makes excellent growth on fertile soil during the winter. The plant is covered with seed-pods in May. Has survived, reseeded and become naturally nodulated in 3 years in clay soil of the oak shinnery and grass pastures in Mills County, Texas. Probably not cold-hardy north of latitude 34°. Useful for cover and green manure. Suitable for temporary grazing with perennial grasses, but needs further trial.

Likely Seed Areas. None. Grown only in the Soil Conservation Service nursery so far as known.

Managing for Seed. No diseases or insects observed on the plants. When stem growth slows down, there usually are several clusters of flowers and pods produced. These become scattered when the stems elongate. Flowering is, therefore, quite indeterminate. Some joints will break apart before the usual May harvest. When the vines begin to dry up and most of the pods are brown, the crop is ready to harvest.

Production Under Cultivation. Without irrigation, the yields are between 150 and 300 pounds per acre. With irrigation and fertilization, the yields are as high as 750 pounds per acre.

Harvesting. This crownvetch can be harvested with a combine. Where the land is free of rocks and sticks, the sickle should be set within an inch of the groundlevel to pick up the semiprostrate stems; the cylinder set at 1/8 inch and with a speed of approximately 1500 RPM. The chaffer is set nearly closed and the wind cut off.

The stems can be cut with a mower while damp and windrowed before drying. Long pickup guards on the mower bar help to lift the nearly prostrate stems.

Care of Green Seed. Combined seed does not need much drying before it is sacked.

Cleaning and Processing. Seed material from the combine consists mostly of joints or pieces of pod, each covering a slender seed. Use the scarifier to break up the pieces, and reclean the material with a fanning mill. Trashy lots of combined seed have been run through the hammer mill without many seeds being broken. Use a 1/4-inch hole screen and a cylinder speed of 1000 RPM or less. Keep the mill full of material. Reduce the speed of the cylinder if too many seeds break during the milling.

Quality. Nursery-harvested seeds average 88 percent purity, have a 7-day germination of 57 percent and a final germination of 60 percent plus 31 percent hard seed. The seeds usually are readily germinable. There are 241,000 in a pound. The longevity is at least 2 years.

STRIPED CROTALARIA *(Crotalaria mucronata)*

Adaptation and Use. A tall, branched, leafy annual introduced from eastern Africa. Has smaller leaves (each with three leaflets), flowers, pods, and seeds than showy crotalaria. The flower is striped with narrow purple lines. The plants mature later and the stems are harder and do not break up as easily as showy crotalaria. The late maturity permits additional fall growth when soil moisture is sufficient. Striped crotalaria is adapted to the southern two-thirds of the Region in the moderate and high rainfall belts. In Florida it was selected as an important species from several tried for green manure and good seed habits.

Likely Seed Areas. No natural seed areas.

Managing for Seed. This plant will often make a late crop of seed. Shattering is light and the pods usually remain attached during part of the winter.

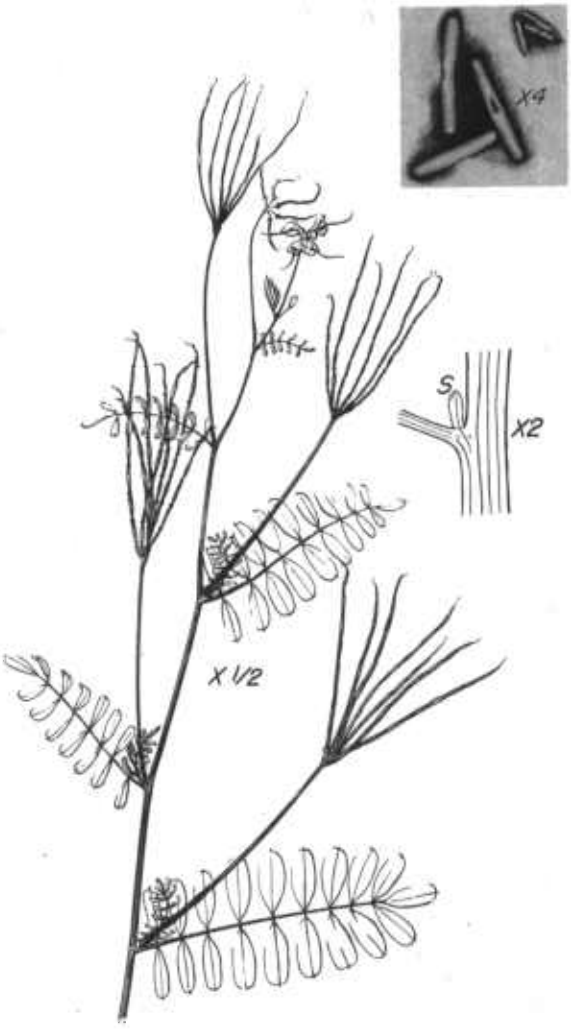
Production Under Cultivation. In rows 36 to 40 inches apart the seed yield is 300 to 500 pounds per acre.

Harvesting. Same as showy crotalaria.

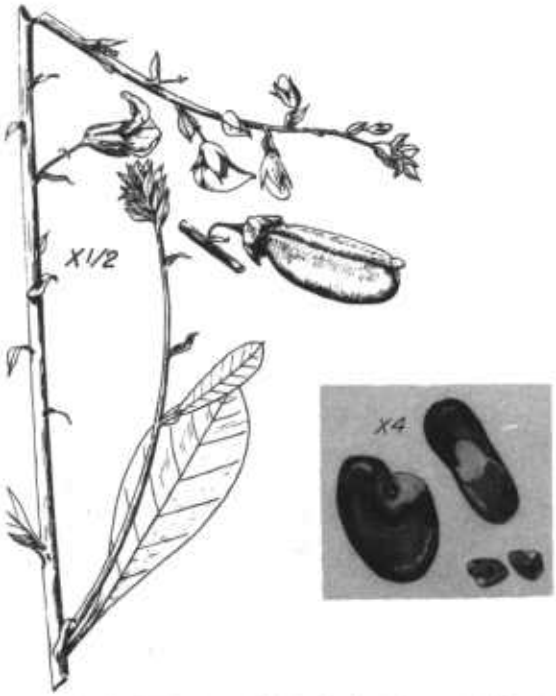
Care of Green Seed. Same as showy crotalaria.

Cleaning and Processing. Same as showy crotalaria.

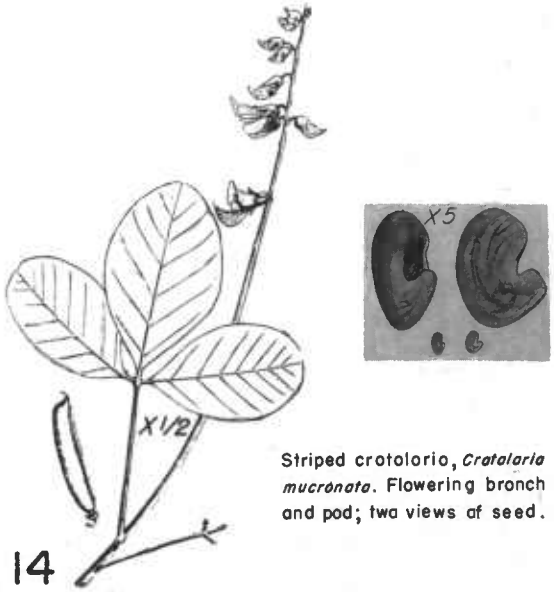
Alyceclover, *Alysicarpus vaginalis*. Flowering ond fruiting bronch; two views of seed.



Crete crownvetch, *Coronilla cretica*. Flowering and fruiting branch; section of branch and stipule (*S*); three views of seed.



Showy crotolorio, *Crotalaria spectabilis*. Flowering branch ond pod; two views of seed.



Striped crotolorio, *Crotalaria mucronata*. Flowering bronch and pod; twa views af seed.

PLATE 14

Quality. The laboratory tests of this species show a low average germination of 18 percent in 7 days, and only one percent additional in a 28-day period. More than 63 percent of the seeds are hard. Poor volunteer stands indicate that wintering on the soil does not give much increase in germination. Seed scarification, therefore, is necessary to obtain stands. There are 98,000 seeds in a pound of pure seed. They are about a third as large as those of showy crotalaria.

SHOWY CROTALARIA (*Crotalaria spectabilis*)

Adaptation and Use. A tall, branched annual with showy yellow flowers, large simple leaves and large inflated pods. Useful as a green manure and cover crop, in well-drained sandy soils of the southern two-thirds of the Region. When grown for more than one year in the same field it is known to have reduced rootknot or nematode. The seeds and forage are toxic to animals. Livestock usually will not eat the green forage unless extremely hungry. The stems are fibrous and disintegrate readily when dry to form an excellent mulch.

Likely Seed Areas. No natural seed areas.

Managing for Seed. For seed production, plant about May 15. The plants are indeterminate in flowering and pod development; mature pods, green pods and blossoms may be found on any plant. Under some conditions the pods pop and scatter the seeds shortly after maturity. Variations in soil fertility and moisture within a field increase variability of maturity. These factors make it extremely difficult to estimate yield and quality. Thick spacing causes the plants to mature more uniformly. Late planting in time for seeds to ripen will usually produce smaller plants. The smaller plants make harvesting easier. The harvest is usually in October after some or all the leaves have fallen. Shattering increases rapidly after a heavy frost.

Production Under Cultivation. Planted in rows 8 to 16 inches apart in fields of reasonably uniform soil and fertility and well cultivated prior to seeding to control weeds, the yields may reach 800 pounds per acre. The average is about half this amount. Yields from broadcast and volunteer stands are always lower.

Harvesting. Several methods have been tried Frequent hand picking of mature pods will insure maximum yield of top grade seed. But this method is only practicable on a small scale or where labor is cheap. A home supply of seed also is obtained by cutting the heads and threshing with a flail, or by striking the heads against a net wire stretched over a wagon bed or box.

For direct combining, frequent examinations must be made to determine the time the maximum number of seeds are available. The combine should be set to release the riper seeds but not more of the greener ones than necessary. A sticky material from the green seeds and pods tends to remain on the chaffer and lower screen preventing free movement of seeds. Also much green material, immature seeds, and pieces of stems cannot be screened or blown out because of this stickiness. The large seeds permit some air to be used. The combine must be cleaned daily to get all available seeds.

The crop can be cut with a binder, shocked under caps and threshed with a separator or combine. Some shattering will occur with this method.

Care of Green Seed. With much green material in combined seeds, heating occurs quickly. Spread thin and stir frequently until well dried. Allowing the seeds to heat reduces the viability.

Cleaning and Processing. Combined seeds are mixed with pieces of pods, stems and other material. When thoroughly dry they can be cleaned without difficulty in ordinary fanning mills using a No. 12 upper screen and No. 8 lower screen. Scarifying is necessary to obtain reasonably uniform germination. Use a scarifier that does not crack the thick seed coat.

Quality. Seeds grown in Alabama appear to be more uniform in color and size than those grown in Louisiana. Comparison of tests from the two states shows 83.46 percent and 65.17 percent pure live seed, respectively. There are 27,000 seeds in a pound of pure seed. The average purity is 99 percent, the 7-day germination 36 percent and final germination 38 percent plus an equal number of hard seed. The high percentage of hard seeds in any lot must be considered in any type of planting.

Diseases. No widespread epidemics of disease have been reported. Anthracnose, southern blight, stem canker and damping-off have caused some reduction in stands. Leaf spot is common and causes partial defoliation of some stands. The plants are resistant to nematode.

GUAR (*Cyamopsis tetragonoloba*)

Adaptation and Use. Guar is an upright, stiff-stemmed summer annual; the stems either with single leaders or much branched, 3 to 6 feet tall; leaflets three; flowers small, borne in axillary, clustered racemes along the stems and branches. Two varieties are grown in this Region--the compact or single-leader type with short branches and the open, branched type with more foliage.

In India, the young pods are used as human food and the whole plant as forage for cattle. In feeding trials, the seed residue, after the extraction of the gums, is palatable to livestock and has been used successfully in mixed feeds. In the late '20s, guar was tried under field conditions in the Blackland of Texas to see if it would evade root rot. Some plants were affected each year. It is now used as a soil-improving crop in rotation with flax in southern Texas, and has possibility for strip-cropping and improving peanut land in other parts of Texas and Oklahoma. The plants thrive in most soils, but grow best in the sandy loams.

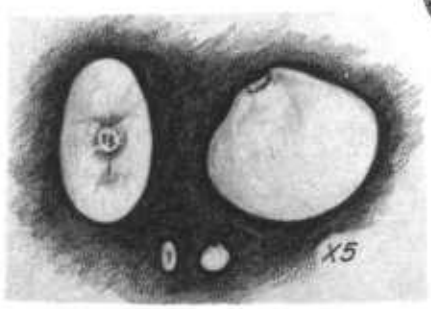
Likely Seed Areas. At present, only in the flax section around Kenedy, Texas.

Managing for Seed. When used in a rotation with flax, the seeds are planted in early June. They mature in October. Harvesting begins in late October or early November. Early April plantings will mature seeds in late July, and, if moisture is available, a volunteer crop will sprout when the seeds are disked under. The pods ripen even while the stems remain green and remain attached without shattering. If harvest is delayed, the seeds will turn dark, but discoloration of this sort does not affect germination. The pods are left until fully mature before harvesting.

Yields Under Cultivation. Usually 400 to 700 pounds per acre when planted in rows. Spring planted tests at the Wichita Valley Experiment Station, Texas during 1943, 1944, 1945, and 1946 produced an average yield of 724 pounds of seed per acre. In Arizona plots, yields have been as high as 2500 pounds per acre.

Harvesting. The season starts in late October and continues into November in the flax section; in August when the planting is in early April. The combine does a good job of harvesting. Adjust the reel to bend the stalks over the sickle before the sickle cuts them, as the jar from the sickle causes some pods to break away from the stem. Rubber belting or strips of stable broom attached to reel bats will help to prevent the scattering of pods. In Arizona, heavily lodged plants were harvested with a minimum loss with the combine reel removed. The apron or table-canvas machines seem to work better than the auger types. The cylinder-concave spacing should be wide to allow the stalks to pass through without shredding. Keep the cylinder speed low, as the pods break easily. Adjust the chaffer to carry out most of the short trash. Use as much air as is necessary. Proper adjustment of the machine results in a clean job of threshing.

Singletarypea, *Lothyrus hirsutus.* Fruiting branches; two views of seed.



Guar, *Cyomopsis tetrogonolobo.* Flowering and fruiting parts of stem of Texsel variety; enlorged views of bronched hoirs on upper (*U*) side of leaflet and on lower (*L*) side; two views of seed.

PLATE 15

Care of Green Seed. The seeds can be sacked at the combine, and stored without danger of heating. Rats will not eat the seeds of guar.

Cleaning and Processing. Normally, combined seeds do not need cleaning. Scarifying is recommended before planting, although satisfactory stands have been obtained from unscarified seed.

Quality. Laboratory samples to date have an average purity of 99 percent, a 7-day germination of 54 percent and a final germination of 65 percent plus 6 percent hard seed. There are 13,000 in a pound of pure seed. The longevity is 2 years. The dormant period is nearly zero for stalk-ripened seeds.

Diseases and Insects. In 1948 R. B. Streets, A. L. Matlock and D. C. Alpli reviewed the diseases and insects attacking guar in bulletin 216 of the Arizona Experiment Station. No serious plant losses from diseases or insects have been recorded. In Arizona where guar fields adjoined alfalfa fields, the three-cornered alfalfa hopper caused some damage to the leaves. Tree hoppers caused severe injury by girdling the young stems 2 to 4 inches above the soil line.

Guar is subject to such diseases as cotton root rot *(Phymatotrichum omnivorum)*, wilt *(Fusarium)*, Rhizoctonia root rot, and stem rot or southern blight *(Sclerotium rolfsi)*. The branched mesa variety is highly resistant to cotton root rot, while the unbranched, early maturing Texsel variety is fairly susceptible to this root rot but resistant to *S. rolfsi*. In 1943 *Mosaic* (virus) reduced seed yields in Arizona up to 50 percent, but did not reappear in 1948. In 1944 Chester reported that a lethal virus disease caused an estimated loss of 75 percent in a field of guar in Oklahoma. The disease became "masked in hot weather, but in the fall there was a spectacular return of symptoms". *Alternaria* leaf spot, the only common leaf disease, may cause extensive defoliation under abnormally humid conditions.

SINGLETARYPEA *(Lathyrus hirsutus var.)*

Adaptation and Use. Singletarypea, Caleypea, roughpea or wild winterpea, is a tendril-bearing, leafy, annual, winter legume. It is native to the Mediterranean region. The vines sometimes grow to 3 feet in length, become very rank and dense, and bear rough-hairy pods. Used as a cover and soil improving crop and for grazing. It is adapted to a variety of soils and conditions and thrives on the dark clays where other winter legumes fail because of poor drainage. It has been grown successfully as far west as the 35-inch rainfall line and has survived the cold as far north as Forrest City, Arkansas. Its range of use in our Region is not fully known.

Likely Seed Areas. None outside of cultivated areas.

Managing for Seed. The blossoms of this legume appear in late April and to the middle of May or later. Pods develop in late May and June. If there is moisture, flowering and fruiting continues and an abundance of pods form. Shattering begins after the pods turn brown and during the heat of the day. For the most seeds select the period when the vines show decline and the most pods are nearing maturity. Some growers plant oats with this "pea". The largest yields in southwestern Arkansas are obtained when planted with Abruzzi rye or in the stubble of combine sorghum to provide support for the vines. This prevents matting and excessive scalding and assures easier combining. In some cases after 2 successive years of growth in a field the vines become so rank they are difficult to combine. Third year stands from such fields are not always harvested for seed.

Production Under Cultivation. Seed yields are unbelievably high on well inoculated, fertile fields. Yields to 2000 pounds per acre are not unusual, the average is about 800 pounds.

Harvesting. The harvest period is from June 5 to July 1. Much shattering occurs when harvesting is delayed until all pods are brown. Start mowing and windrowing when one-half to three-fourths the pods are brown. Both operations should be completed while dew is on the vines. For best results in combining a standing crop, wait until about 90 percent of the pods are brown, set the sickle low, space the cylinder and concave wide and keep cylinder speed below 1000 RPM. Examine the seeds frequently, as it may be necessary to reduce cylinder speed two or three times a day to prevent cracking.

Care of Green Seed. The green "peas" from the combine will heat if stored in sacks or in a bin. They should be stirred and aerated until danger of heating is over. This takes about 10 days. Some growers clean the seeds before heating advances. The handling and aerating sometimes permit sacking from the cleaner.

Cleaning. Seeds from the combine vary from 50 to 90 percent pure. Cleaning is done with a 2-screen fanning mill or a 3-screen mill. Adjust the air in the fanning mill to blow out light seed and light trash. Use a No. 12 top screen, and a 6/64 x 3/4-inch bottom-screen. To obtain pure seeds free of oats, rye and pieces of crayfish mounds run the material through a spiral or cylinder separator. When the 3-screen mill is used the top screen has 3/8-inch perforations, the second the size to allow "peas" to fall through and the third with holes smaller than the "peas" to take out any small trash not blown out. Trials of different screen openings must be made each year to fit the size of seeds produced. Where a mixture of oats and rye and "peas" are wanted, cleaning with any fanning mill will produce plantable seeds.

Quality. Seeds tested at the laboratory have a 96 percent purity, a 7-day germination of 24 percent and a final germination of 40 percent plus 42 percent hard seed. There are 19,000 in a pound of pure seed. Normally they are not stored more than 2 years before planting. Scarified seed germinate readily and result in good first year stands.

SHRUB LESPEDEZA *(Lespedeza bicolor)*

Adaptation and Use. A shrub, 4 to 10 feet tall, slender and nearly glabrous; leaflets 3, oval; pods somewhat hairy, 1/4 inch long. Native to Japan. Introduced as an ornamental and hardy as far north as Boston, Massachusetts. Used in the southeastern and southern states for wildlife food (particularly quail), field borders and gully bank stabilization. It is a desirable honey plant in late summer. Use-area in the Region is west to eastern Oklahoma and eastern Texas and possibly the Cross Timbers. Grows best in well drained soils; not adapted to tight or wet soils.

Likely Seed Areas. Grown in nurseries and seed blocks.

Managing for Seed. Individual plants vary widely in number of seeds produced. With low fertility or competition many unfilled or poorly filled pods usually form. Under excellent growing conditions with a heavy set of pods, many will be empty or contain poorly developed seeds. The quality can be determined by feeling. A plump pod nearly always contains a hard, plump seed. Soft, flat, pale seeds are either dead or very weak.

Production Under Cultivation. For the most seeds, the plants are grown in rows, cultivated to control weeds and fertilized. June and summer flowering, resulting in a poor pod fill, decreases the ability of the plants to seed abundantly from normal fall flowers. Attempts to retard flowering and fruiting at the Minden Soil Conservation Service nursery by topping the plants in late May have not been successful, because each year summer drought seriously depressed summer and fall growth and prevented normal seed production. Production is more certain in the northern third of the Region.

Harvesting. Maturity of the pods is relatively uniform. Shattering (pod fall) results if the harvest is delayed after the pods ripen fully or become a deep brown. Combining

is a satisfactory method of obtaining the seeds except for wear and tear on equipment. The woody stems must be cut high to avoid running heavy stems through the machine. Some of the lower seed-bearing branches are then missed. If the same field is to be combined each year, the stubble from the previous year should be mowed short during the winter to reduce hazards of sharp, woody stems. Steel-tired equipment will prove more economical because of damage to rubber tires. Cutting the stems with a machete and piling before the seeds are dead ripe is a method of harvesting small acreages. After curing, the piles are placed on a canvas or tight floor and flailed for the pods. A third method of harvesting is to strip the ripe pods by hand after most of the leaves have fallen. The pods are placed in bags attached to the stripper's belt. Hand stripping is economical on small acreages.

Care of Green Seed. Pods combined and sacked ordinarily do not heat, but they should be stored so as to allow free movement of air around them. Mature, stripped pods can be sacked without further drying.

Cleaning and Processing. Whether combined or stripped, the seeds usually remain in the brown pods. Hammermilling is necessary to remove the hulls. The holes in the hammer mill screen should be large enough to accommodate the plumpest seeds but small enough to keep the unhulled ones from falling through. The optimum speed for most lots of seed will be near "grinding" speed, although trial runs should be made to determine this. The broken hulls are removed with the fanning mill.

Quality. The purity of shrub lespedeza seed lots averages 97 percent, 7-day germinations 57 percent, complete germinations 60 percent plus 26 percent hard seed. Most scarified seeds are readily germinable. There are 91,000 in a pound of pure seed. The longevity is 4 to 5 years but this period has not been fully substantiated.

SERICEA LESPEDEZA *(Lespedeza cuneata)*

Adaptation and Use. Sericea lespedeza is a vigorous, branching perennial producing buds on the stems above the crown and having a deep root system. Branches on well-developed older plants are numerous on the upper half of the main stems. The pods are borne in clusters of 2 to 4 in the leaf axils along the branches and part of the main stem. There are 2 kinds of flowers, some with and some without a corolla.

Used for soil conservation, soil improvement, hay, and grazing.

This introduced legume is adapted to a variety of neutral or acid soils. Good stands have been produced on soils of low fertility abandoned for cotton and other crops as well as on soils alkaline in reaction. Where the phosphorus level of the soil is low, flowering and seed development are retarded.

Climatically sericea will grow in any part of our Region in the higher rainfall areas.

Likely Seed Areas. None available except on farms. The plant has not spread to any extent beyond planted fields.

Managing for Seed. Several ways of handling sericea for seed have been tried. Most farmers prefer to take the first cutting for hay and the second for seed, even though less seed may be produced. The second cutting is more uniform in height, in branching and in seed maturity. This is an advantage in combining, windrowing and binding. Should 2 cuttings of hay be taken from high fertility soils, a light crop of seed is all that can be expected in normal years. To get the most seeds, it is advisable to cut the preceding hay crop by the middle of June or by July 1 and leave at least 4 inches of stubble to allow enough buds and stems to develop. Usually the earlier the hay is cut the larger the seed crop from the second growth. Spots infested with dodder should be cut, removed and burned before any dodder pods ripen.

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Production Under Cultivation. Sericea is a heavy seed producer. The yields in spaced rows reach 1000 pounds per acre; in broadcast stands they vary from 200 to 900 pounds; under irrigation, as high as 1200 pounds.

Harvesting. Harvest time varies with the location. October is the usual month. There are several methods, including cutting and binding, combining, mowing and windrowing, and mowing and combining from swath.

In binding, many farmers start when the pods turn brown one-third to one half way down the stems, shock without caps and thresh within 2 weeks. Any tool, like the sweep rake, that will carry the dry bundles to the thresher without extra handling saves seeds and labor.

Cutting and windrowing is completed in one operation. It should begin when the seeds near the tips of the branches are firm but not dead ripe. Start any time of the day when the stems are tough and before the pods are ready to fall from the stems. Windrowing works better on the smaller growth that is not over 36 inches high. After the stems are in the windrow, they will stand considerable rain and a lot of bad weather. In northeastern Oklahoma in 1948, stems windrowed the first week of November were satisfactorily combined the last week of December.

Coarse stemmy plants 5 to 8 feet tall are sometimes mowed, left in the swath and combined with a pickup attachment by picking up butt ends of stems first. The mower swath should be no wider than the combine. Such coarse material well cured need not be broken up too much while passing through the threshing unit to obtain all the seeds.

With large acreages, start mowing and windrowing before standing material is ready to combine direct, then go back to straight combining when the seeds are ready.

Combining starts when most of the seeds are firm, nearly hard and turning brown, and most of the pods are brown. A light frost puts such standing material in good shape to combine. A heavy frost induces shattering after one or two days. High wind after a heavy frost hastens the shattering to a point where the crop may be lost in 4 days. Most operators combine by separating the pods from the stems without hulling the seeds. Set the cylinder spacing at about 1/4 inch, the speed at 1100 RPM, the chaffer about half open, deliver the tailings back of the cylinder and use some air. With much green material, the cylinder speed is increased.

Care of Green Seed. Seeds cured in the shock and threshed or threshed from well-aired windrows can be sacked without danger of heating. Combined seeds will heat and should be spread out and dried before sacking.

Cleaning and Processing. Combined material consists mainly of unhulled seeds, some naked seeds and a small amount of trash. When trashy, the material can be scalped.

Hulling and scarifying can be done in one operation with a scarifier if the seeds are properly ripened. With many green seeds mixed in, it may be necessary to run the lot two or three times through the scarifier. For final cleaning, use the fanning mill or larger mill. Hulled seeds containing dodder can be recleaned in a velvet-roller dodder mill which usually reduces the dodder content to conform to most state laws.

Quality. Most sericea seeds are hulled before planting. The purity averages 98 percent, 7-day germination 37 percent and final germination 65 percent plus 20 percent hard seed. There are 364,000 in a pound of pure seed. Known longevity is 4 years. Unhulled seeds have a lower germination - 21 percent in 7-day and 30 percent in complete tests of 28 days. Hulling and scarifying well-ripened seeds are economical practices. When the lot at harvest time contains a high percentage of so-called soft seeds due to excessive moisture and a high percentage of green seeds, scarifying immediately after harvest is a questionable practice. Delay scarification of such seeds until near planting time.

KOREAN LESPEDEZA *(Lespedeza stipulacea)*

Adaptation and Use. A moderately growthy, drought-resistant, leafy, summer annual with broad leaflets and very prominent brown stipules. The fruiting branches bear close spaced leaves (bracteal leaves) and numerous pods which are usually hidden by the leaves.

Korean lespedeza is grown in the northern half of Arkansas and eastern Oklahoma. Used for soil improvement, in summer grazing mixtures and in conservation cropping systems. The strain "Climax" is being used in Oklahoma and elsewhere.

Likely Seed Areas. Cultivated for seed. No wild stands available. Commercial seed comes from North Carolina, Tennessee, Kentucky, and Missouri.

Managing for Seed. In dense stands, Korean branches abundantly on the upper half of the stems. Clipping and grazing induce branching. Growthy stands should be cut high for hay sometime between July 5 and July 20 and the second growth left for seed. Well developed plants produce hundreds of pods. These remain on the plant sometimes most of the winter. Disease has given some trouble in foliage development but little in seed formation. Severe attacks of disease are rare. Fields should be examined frequently during the summer for dodder. The spots of this parasite should be removed and burned before it develops pods.

Production Under Cultivation. Korean generally yields more seeds than other annual lespedezas. Over 1200 pounds of filled pods per acre are on record. The average yield is from 250 to 500 pounds per acre.

Harvesting. Korean is one of the easiest legumes to harvest. It holds the pods well into the fall and winter. The harvesting period, therefore, can be extended into late fall. The seeds usually are combined from standing stems. The same adjustments and screens as for Kobe and common are used, but the cylinder speed is increased to 1200 RPM. When weeds are mixed in, increase the cylinder speed. Lespedeza guards are used to pick up semiprostrate stems and provide closer sickle-guard spacing.

Since shattering is no problem, weedy Korean stands are mowed, windrowed, cured and threshed from the windrow, or carried to the machine by a sweep rake. The pan harvester is not suitable for harvesting because of the difficulty of separating the pods from the stems.

Care of Green Seeds. Where green weeds are mixed with Korean seeds in the combine, the seeds should be dried before sacking. Running freshly harvested seeds over the scalper will help dry them.

Cleaning. Cleaning Korean seeds which contain ragweed, dodder and other similar seeds, requires careful manipulations of screens. The gravity cleaner may be very desirable to separate such seeds. Hulled seeds sometimes contain the seeds of dodder. These can be reduced by running the lot through a velvet-roller dodder mill.

Quality. Korean filled pods or unhulled seed units, are blunt, veiny and subtended by a short-bracted involucre (calyx). The seeds are smooth, generally unspotted and somewhat larger than those of common lespedeza. There are 225,000 seeds in a pound of filled pods. The longevity is 2 to 3 years. After-harvest dormancy covers about a 3-month period.

COMMON AND KOBE LESPEDEZA *(Lespedeza striata)*

Adaptation and Use. Much branched leafy summer annuals; the flowers 1 to 3 together in the leaf axils; the one-seeded pods ripen in October and fall as a unit. Kobe is the higher-yielding variety with broad leaflets, maturing a little later than the

common. Common lespedeza has been in this country more than 100 years and is naturalized west to the 35-inch rainfall line in eastern Oklahoma and eastern Texas, mostly in soils of low fertility. Both kinds are used in conservation cropping systems and for grazing, strip-cropping and hay. Weeds are an important factor in total growth and seed production.

Likely Seed Areas. Idle mowed fields, mowed or grazed pastures and locally in waste places. Farmers often harvest their own seed. Arkansas and Louisiana produce considerable commercial seed.

Managing for Seed. For seed production, grow lespedeza on land free of such noxious weeds as dodder and Johnsongrass. A smooth seedbed is needed for efficient mowing and harvesting. Clip fields set aside for seed when weeds will interfere with harvesting machinery. Phosphate ordinarily increases growth at the expense of weeds. Managing the crop for seeds is largely a job of guessing the amount and time of rainfall. Rank growth in the summer will permit cutting one crop for hay and leaving the shorter aftermath for seed. The hay should be cut by July 15, but only if the growth is rank and live buds are found on the stems below the mowline, and when "firing" or dying of the lower leaves is absent or hardly noticed. When plants "fire up" for some distance on the stems, mowing in July will kill some of the plants. Two cuttings of hay will not prevent a volunteer stand the following spring but will reduce it. Some hard seeds always carry over to the second year. When two hay crops are cut and no seeds mature, volunteering is helped by leaving narrow uncut strips during the second mowing. Moderately good stands with many branches yield more seeds than dense stands with few branches. Branching is often increased by using the dense early growth for hay. Both varieties shatter so easily during harvesting operations that enough seeds are distributed to assure a volunteer stand the following year.

Production Under Cultivation. Seed yields are from 100 to 300 pounds per acre.

Harvesting. Common and Kobe mature seeds in October. Ordinarily the best harvesting is done after frost. Many small farmers use the metal seed pan that is bolted to the back of the cutter bar of the mower. The pan works best on short growth. It can be used on wetter land than heavy equipment can work on. The pans are covered with a perforated sieve and equipped with a shattering mechanism that drags the seedhay across the sieve. Without this mechanism one man must rake the stems by hand across the sieve. One large lespedeza harvester machine uses a continuous reel to drag the seedhay across the perforated sieve.

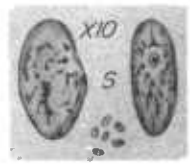
The grain combine is efficient in harvesting both lespedezas. The crop is windrowed before shattering begins, cured and combined, or carried to a stationary thresher or combine with a sweep rake. The seeds should be harvested rapidly after they are ready. When combining, set the cylinder spacing about 1/4 inch or less, use a cylinder speed of 1100 RPM, set the chaffer about half open, the shoe sieve a third open, and reduce the air. Some combines have a lespedeza attachment for use on the concaves to increase shelling. The auger-canvas conveyors give less trouble with dry material working under the canvas than do those with all-canvas conveyors.

Some farmers mow and stack the hay for threshing later. Excessive heating in the stack will reduce the vitality of the seeds.

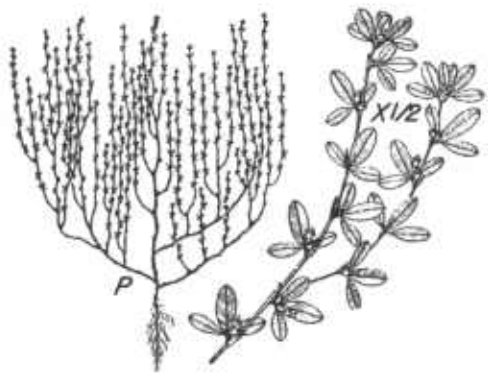
Care of Green Seed. Heating occurs when combined seeds contain green grass and weed seeds. Pan-threshed seeds should not be piled or sacked until cured.

Cleaning. Scalping Kobe and common seeds is an aid in the final cleaning. A several-screen cleaner is usually needed to remove most weed seeds. Dodder is about the same size and weight as the lespedeza seed and is difficult to screen out. A few commercial cleaners now use the velvet-roller dodder mill which will usually reduce the dodder content of hulled lots, but is ineffective with unhulled lots. Scarifying is not necessary for good germination.

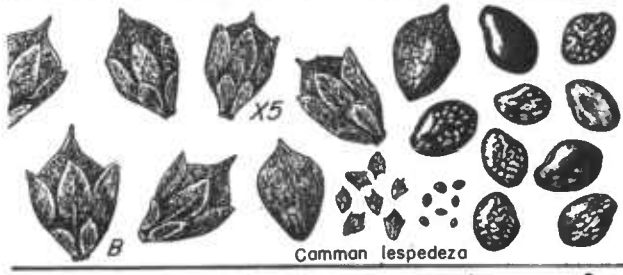
Shrub lespedeza, *Lespedeza bicolor*. Flowering and fruiting bronches; two views af seed, ond enlarged view af hilum (*H*).

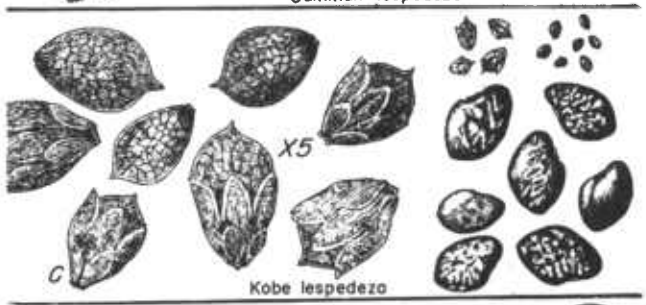


Sericea lespedeza, *Lespedeza cuneata*. Flowering and fruiting branches; two views of seed (*S*), and *A*, views of pads and seeds.



Common lespedeza, *Lespedeza striata*. Diagrammatic sketch of plant (*P*), and fruiting branches; *B*, views of pods ond seeds. *C*, Views af pads and seeds af Kabe lespedeza, *L. striata*.





Karean lespedeza, *Lespedeza stipulacea*. Part of stem in fruit; *D*, views af pods ond seeds.

PLATE 16

Quality. Most unhulled Kobe seed lots have a purity of 96 percent, a 7-day germination of 46 percent and a final germination of 65 percent plus 15 percent hard seed. There are about 200,000 seeds in a pound of filled pods. Common lespedeza has 310,000 seeds in a pound of filled pods. Kobe seeds are larger than those of common.

DEERVETCH (*Lotus americanus*)

Adaptation and Use. A slender-stemmed loosely branched annual 1 to 3 feet high, with 3-foliate leaves and pink flowers. It grows in sandy soils, frequently acid, and becomes prominent in overgrazed oak openings, and on abandoned cultivated land. It mixes well with short and mid grasses but is crowded out under the competition of tall grasses. It appears to have some value for soil improvements for the low quality soils of the Cross Timbers of Oklahoma and Texas. On such soils it responds well to phosphate fertilizers. It nodulates naturally when well established. "It has been used locally to control erosion in California gullies and abandoned land." It is a cool weather plant and is most important in the medium rainfall belts. It is rated well as a wildlife plant, and in California is considered important as browse for the mule deer.

Likely Seed Areas. Open spots, partial clearings in second-growth post oak and blackjack oak and on abandoned cultivated land that is on its way back to a permanent cover, and in the West Cross Timbers of Oklahoma and Texas. When abandoned cultivated land is protected from grazing this plant increases and produces fairly dense stands in spots.

Managing for Seed. The seeds germinate in the fall or in late winter and early spring during the warm periods. Flowering begins in April and continues into late May and early June. Ripe pods and flowers may be found on the same plant. The majority of the pods ripen the fore part of June and should be harvested then. The seeds are scattered by the twisting and rupturing of the pods lengthwise. Occasionally the slender pods are attacked by insects and the immature seeds eaten.

Production Under Cultivation. Not known.

Harvesting. The seeds should be collected in June. The time will depend on rainfall and soil moisture. Where the areas are large enough, the seeds can be taken with a small combine. Small areas can be mowed, raked and cocked and threshed from the cocks or hauled to the thresher. The seedhay may be cut, raked damp, hauled to and spread on the planting area.

Cleaning. Combined seed can be easily cleaned in a fanning mill.

Quality. The purity of samples received at the laboratory averaged 97 percent, the 7-day germination 23 percent and the 28-day germination 59 percent plus 35 percent hard seed. The fresh seeds are not readily germinable. In nature the alternate freezing and thawing during the winter conditions the seeds for early spring germination. A pound of pure seed contains 104,000 seeds.

BIRDSFOOT DEERVETCH (*Lotus corniculatus*)

Adaptation and Use. Known commercially as birdsfoot trefoil. A long-lived upright or spreading perennial legume with 5-foliate leaves, a deep spreading root system and in age possessing a large crown. Flowers yellow, tinged with red and borne in clusters at the ends of the branches; pods slender, about an inch long, several-seeded, splitting lengthwise, the halves twisting and throwing the nearly round seeds. In the midwestern climate it stays green during the summer. It will grow in poor soil, is drought resistant, high in protein, palatable, and salt tolerant. Recommended in the Northwest

and some sections of the Midwest as a valuable addition to hay and pasture lands not suitable for alfalfa. Its disadvantages are: (1) Difficult to obtain seeds from, (2) produces very little forage the first year, and (3) starts growth rather late in the spring. Its rainfall and irrigation area limits in the Western Gulf Region are not known. Field trials are now being made in all parts of the Region.

Variety *arvensis* is commonly used in the midwestern states. Variety *tenuifolius* is salt and heat tolerant.

Likely Seed Areas. None in our region. Commercial seed usually available. Much of it comes from New York, Oregon and Washington.

Managing for Seed. The pods of birdsfoot deervetch ripen unevenly during a long flowering period. First-year growth from seeds seldom produces flowers. When the pods reach the rich brown color, they are ripe and shattering is a matter of exposure to sunlight or heat. The shattered pods do not drop from the stems. To get maximum yields, it is necessary to watch the plant carefully and start the harvest when most of the pods are turning brown. The stems and leaves will still be green. In the western states and in Europe much of the harvesting is done at night or early in the morning while the dew is on and all parts of the plant are tough. Time of year to harvest varies somewhat with the climate and rainfall. The suggested method of managing the crop where rank growth is expected is to pasture or keep the plants clipped until late April and then leave the growth for seed. In this Region most flowers will develop before the hottest days of summer, by early July perhaps, and the fruiting period will be in July. In New York the best seed yields are from the first cutting. Yields depend almost entirely on care in handling to prevent shattering. Potential yields in New York from sample meadows, fertilized and poor, ranged from 673 to 112 pounds per acre. Lodged stems always produce less seed than upright stems.

Production Under Cultivation. Average yields in seed-producing areas of New York, Oregon and Washington are from 75 to 125 pounds per acre. Under favorable conditions 200 pounds may be harvested. "In seedings harvested since 1939 at the Mt. Pleasant Station (New York) yields ranging from 10 to 350 pounds per acre have been obtained."

Harvesting. Harvest time depends on the period when the most pods are turning brown. A good method is to mow and windrow when the dew is on. Wilting in the swath will induce some shattering. Raking with a side-delivery rake after wilting will assist shattering. The windrowed material can be bunched while tough. The buck or sweep rake is useful for this. The cocks can be cured in the field, or hauled to the thresher with the buck rake, or stacked. A minimum of handling and exposure to the sun will reduce shattering.

Combining from the windrow if the material can be cured sufficiently is the favorite threshing method. Separation is best when using a 1/15-inch round-hole screen and some wind. Broken stems and pieces of pods should be taken out by the straw carrier and chaffer. The cylinder should be run at medium speeds.

Care of Green Seed. Because of the possible short period curing in the windrow and the presence of many partially developed pods and green seeds in the mixture it is advisable to spread and dry the seeds coming from the combine to prevent heating and molding.

Cleaning. If the seeds are trashy, much inert material and light grass seeds may be removed by moderate wind in a fanning or several-screen mill. A sieve with 1/18-inch round perforations is satisfactory for removing larger weed and crop seeds. A 1/20-inch sieve is more satisfactory but removes some of the larger deervetch seeds. A bottom sieve with 1/22-inch round-hole perforations or a 6 x 30 wire screen is most useful. Screen brushes are helpful in keeping the screen openings free. Dodder is difficult to remove from deervetch seeds.

Quality. The average purity of samples received at the Regional laboratory is 96 percent, the 7-day germination 45 percent and the 28-day germination 53 percent plus 26

percent hard seed. It is believed the method of handling in the field affects germination. For example, in New York, a crop cut, wilted, cocked over night, stacked for 18 hours to sweat, and then dried gave an average germination of 81 percent. A similar crop cut and cured in the field for 10 days resulted in an average germination of 7 percent. "It is a common belief that combine harvesting results in a higher germination and less hard seed than other methods." The variety *arvensis* has 375,000 seeds in a pound, the variety *tenuifolius* has 400,000 in a pound. The known longevity is 6 years.

WETLAND DEERVETCH (*Lotus uliginosus*)

Adaptation and Use. Often called big trefoil. A long-lived spreading to upright yellow-flowered perennial, forming rhizomes. Short plants resemble alfalfa. Less winter-hardy than birdsfoot deervetch. Grown in western Oregon and northern California. Primarily used for pasture but is often cut for silage and hay. Grows well with tufted grasses. Adapted to wet, acid soils and will withstand long periods of surface flooding after the plants are well established. Limestone as fertilizer failed to give improvement in stands or in yields. Well adapted to sand dunes of Oregon. There are two varieties - smooth (*glabriusculus*) and hairy (*villosus*). Field trial plantings have been made in this Region.

Likely Seed Areas. Commercial seed available in limited quantities. Under trial only in this Region.

Managing for Seed. First year stands seldom flower. In Oregon the stands are managed for seed by keeping the growth short either through grazing or by clipping until May 15 or as late as June 1. In this Region grazing on excess growth probably should end by late April. Flowering should take place in May and June and the seed harvested in early July before the hottest weather of summer. Watch the plants closely to note when the most pods are available. Be careful not to confuse the twisted, shattered pods with the unshattered ones. As soon as the pods turn brown they are subject to shattering. In most places seed formation depends on insects, especially honeybees and bumblebees.

Yield Under Cultivation. On the John Jacob Astor Branch Experiment Station, Astoria, Oregon seed yields for many years varied from 75 to 225 pounds, with an average of 127 pounds. Under favorable conditions yields may exceed 225 pounds.

Harvesting. The same conditions and methods apply as with birdsfoot deervetch. On drier soils mow and windrow in one operation while the plants are tough. Thresh with a combine. On wet lands the windrow is turned to facilitate drying. Use small-sized windrow to obtain quick curing and allow for considerable green material to pass through combine. With weather normal, combining begins the second day after mowing. Sometimes the windrows are shocked as soon as material is wilted, and after curing carried to the thresher with a buck rake. Under certain conditions, i.e., in the absence of lodging, it may be profitable to combine the standing stems.

Care of Green Seed. Unless well cured when threshed the seeds should be spread and dried.

Cleaning. Ordinary cleaners are satisfactory.

Quality. The seeds are very small, almost round, olive-green, or some variation of green, but without speckling, some turning brown with age, especially around the hilum. There are 800,000 to 1,000,000 seeds in a pound of pure seed. European workers held seeds of this deervetch for more than a decade and germinated a lot each year. The

percentages were 71, 73, 53, 45, 58, 44, 39, 24, 31 and 25. Levy in New Zealand reports the average germination 71.7 percent plus 24 percent hard seed. Storage in this Region probably should be limited to 2 years.

WHITE LUPINE (*Lupinus albus*)

BLUE LUPINE (*Lupinus angustifolius*)

Adaptation and Use. White lupine is a silky-white, branched, upright plant with coarse stems; leaves digitate with 7 inversely lanceolate leaflets; flowers in rather dense racemes which terminate the main axis at one or more nodes, the flower stalks enlarging in fruit; pods 4 to 5 inches long, covered with silky hairs; seeds white, nearly round from the side view but decidedly flattened and with sides dented.

Blue lupine is more slender in every respect, leafier and with narrower leaflets; the pods are smaller; the seeds are smaller, plump and slightly longer than wide.

The principal uses for both lupines are cover crops and green manure. They are adapted to acid sandy soils but are doing well in nearly neutral sandy soils. When properly inoculated and fertilized they are suitable for light sandy soils. Not hardy in the northern two-thirds of the Region. Best adapted to the southern part of the Coastal Plain, Coastal Prairie and the eastern part of the Rio Grande Plain. At Minden, Louisiana both species have been too sensitive to cold to justify widespread planting. Efforts are being made to select cold-resistant strains.

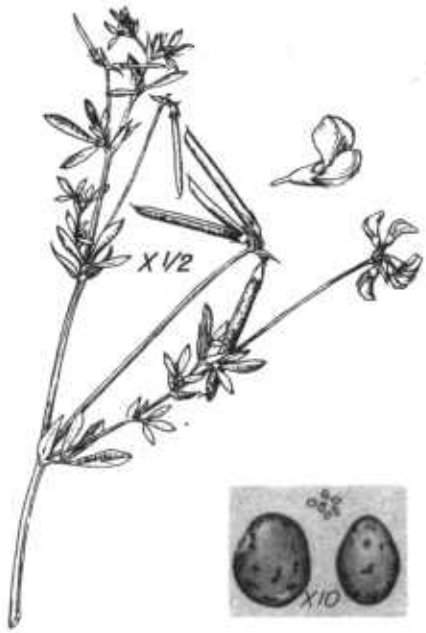
Likely Seed Areas. None established. Produced only under cultivation.

Managing for Seed. Larger yields of seed are made on early rather than late plantings; October seedings usually outyield December seedings. On the northern fringe of adoption the seedings should be in September and early October. Early spring seedings are possible if the moisture is adequate in late spring to keep the plants growing. Large acreages for seed production are planted on different dates to extend the harvest period and allow for continuous combining. Best yields are obtained from row plantings. In early stages the plants often suffer from damping-off diseases, but the records show such losses do not increase where plantings are repeated annually. Rabbits often cut the young plants off near the ground, eat the stems and leave the foliage. Flowering begins in early April and continues as new growth develops into early June. Early fall seedings mature by late May or early June. The lower leaves fall off as the pods mature. During some years rapid changes in atmospheric humidity induce early shattering. For proper combining most of the seeds are allowed to become fairly ripe. It is best to start the combine before shattering begins. When cut, cured and threshed the harvest begins several days earlier.

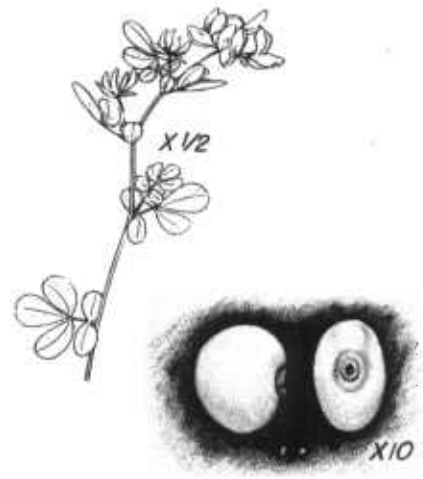
Harvesting. Most lupine seeds are harvested with combines. The fairly mature pods shell easily. The amount of material taken into the machine should be watched carefully. Cylinder speeds of 1100 to 1200 RPM on green material are probably right to start. When the pods are dry it may be necessary to reduce the cylinder speed to 850 RPM or less. The cylinder spacing of 3/8 to 1/2 inch is necessary for both lupines. Set the chaffer, shoe sieve two-thirds open and wind valves wide open or two-thirds open. For the blue lupine a lower sieve of about 3/8-inch opening may be used but is not necessary to obtain fairly clean seed.

The seed crop can be cut with a mower while the plants are damp and bunched almost immediately. Threshing is done with an ordinary thresher or combine. Farmers who grow small patches, pull the plants when the seeds are fully ripe and flail them over stretched woven wire or on hard ground.

Care of Green Seed. Immediately after harvest, lupine seeds contain a good deal of moisture which must be reduced as quickly as possible to insure good germination. If

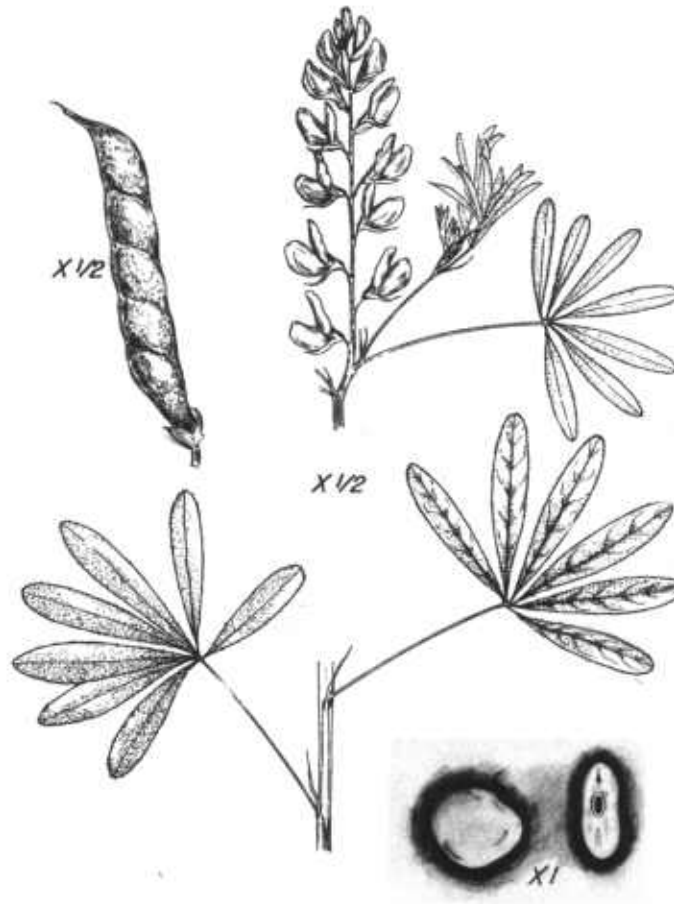


Birdsfoot deervetch (trefoil), *Lotus corniculatus*. Flowering and fruiting branches, and two views of seed.



Wetlond deervetch, *Lotus uliginosus*. Flowering bronch,and twa views of seed.

Deervetch, *Lotus americonus*. Flowering and fruiting branches; two views af seed.



White lupine, *Lupinus albus*. Flowering branch, moture pod,ond two views af seed.

PLATE 17

green seeds are present in the lot do not sack. Spread 2 to 3 inches deep on dry floors or on raised platforms where the air can be circulated and stir until all danger of heating is over. Through experience growers have learned that lupine seeds dried slowly in a mass have a low germination even though they did not heat appreciably or discolor. Rather rapid artificial drying with heat is a satisfactory method of curing. In trials at the Georgia Experiment Station lupine seeds were dried from 17.3 percent moisture to 13 percent, using 3 pounds of calcium chloride for 100 pounds of seed. The chloride cost approximately 3 cents a pound. The seeds were placed in a tight-walled bin with a screened bottom. The air was dried by drawing it over brine from the chloride then over the flakes of the chloride and from there it was forced through the seeds with a fan. This method of drying avoids risk from fire and the danger of injury to germination from overheating.

Cleaning. The fanning mill will easily remove all trash from lupine seeds.

Quality. Properly cured white lupine seeds are nearly white or have a creamy tinge, much flattened, 6/16 inch wide and 7/16 inch long. The purity is 99 percent, the 7-day germination 70 percent and the final germination 85 to 90 percent. The number per pound varies from 900 to 1500.

A very short dormant period is common in many lots. They should be planted by the second fall after harvest and not carried over another year. However, some lots have germinated 100 percent after 5 years storage and ordinarily do not contain any hard seeds. The maximum storage period has not been determined.

Blue lupine seeds are smaller, 4/16 inch wide and 5/16 inch long, roundish or slightly angled and with mottled gray-tan coat. In size and shape they resemble small navy beans. The purity is 97 to 99 percent, the 7-day germination at the laboratory 79 percent plus 1 percent hard seed, although the standard germination is listed at 90 percent. Usually some hard seeds are present in every lot. The number per pound varies from 2500 to 3000.

The seeds of both species contain a higher percentage of alkaloids than the other parts of the plant, and are poisonous to livestock. "Nonalkaloid strains have recently been developed in blue, white and yellow lupines, but in the blue lupine these strains have not been fully stabilized."

SPOTTED BURCLOVER *(Medicago arabica)*

Adaptation and Use. Smooth winter annual with spreading stems, heavily spotted leaflets, toothed, not cleft, stipules and spiny pods with 4 coils. Several named varieties are: Southern spotted, early giant and manganese. The early giant form is noted for rapid and early growth and earlier seed production. Manganese burclover is known for its cold resistance and recognized by the large maroon spots on the leaflets. The species and its varieties are well adapted to the higher rainfall and acid soils areas of the Region. They will grow on alkaline soils farther west. They are considered more resistant to cold than California burclover. Used principally for green manure and grazing.

Likely Seed Areas. Vacant lots, mowed or grazed waste areas, and grazed bottomlands, river terraces and upland pastures.

Managing for Seed. Same as California burclover.

Harvesting. Same as California burclover.

Care of Green Seed. Same as California burclover.

Cleaning and Processing. Same as California burclover.

Quality. Most spotted burclover is planted in the bur. The seeds are smaller than those of California burclover and generally there are more in a bur. As burs, the purity ranges from 63 to 80 percent, the 7-day germination is low - 13 percent plus 76 percent hard seed. The poor 7-day germination should always be considered when planting the burs for quick sprouting. The number per pound is 22,000. The known longevity is 3 years.

CALIFORNIA BURCLOVER (*Medicago hispida*)

Adaptation and Use. Nearly smooth winter annual legume with spreading stems. One form has a very small purple spot at the base of each leaflet; others are without spots on the leaflets. The stipules are deeply cleft. The pods, usually in clusters, have 3 distinct coils. Plants with spineless pods occur frequently and should be preferred in the sheep and goat sections. This burclover was long ago introduced into our Region. It has become naturalized in the southern half but is restricted to waste places, bottomlands and well watered pastures. It is adapted to soils alkaline in reaction and is not spreading to any extent to the acid soils of high rainfall areas.

Used for soil improvement and grazing.

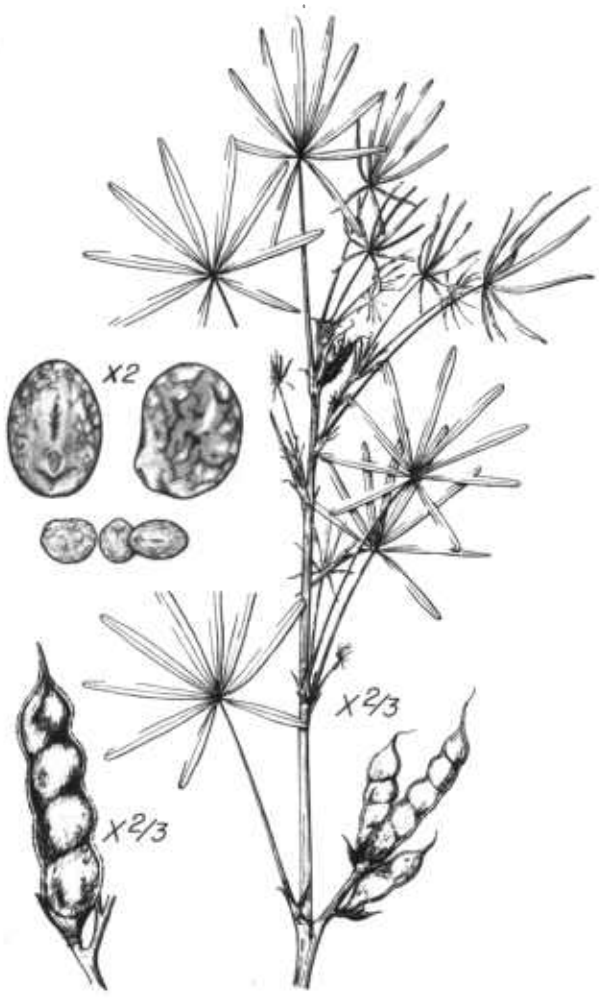
Likely Seed Areas. Vacant lots and roadsides where the tall grasses are kept short; also bottomland and river terrace pastures that are closely grazed during the winter, from southern Oklahoma through central to southern and western Texas.

Managing for Seed. A dry fall and dry early winter sometimes prevent germination of the hard seeds. Volunteering is, therefore, erratic. When the stand is fairly uniform by the first of April, one can obtain an idea of stem and flower production. By the middle or last of May, total production can be estimated. In most years, setting of seed in the pod is not a problem. The burs fall after they have matured and dried. In June and July when the stems are dry, they can be handled and easily detached from the roots for hand harvesting or raking. The burs usually contain 3 to 6 seeds.

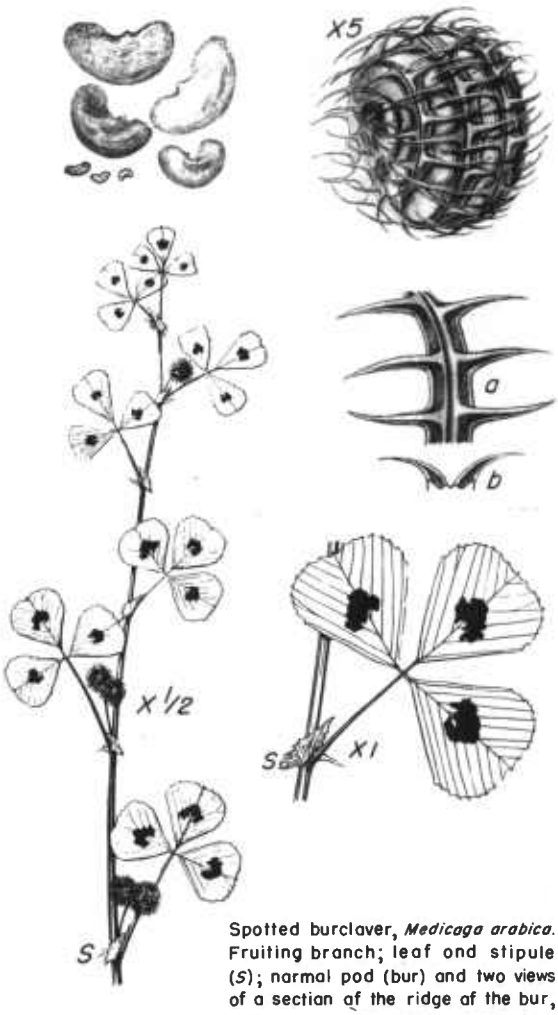
Production Under Cultivation. One hundred to 200 bushels of burs per acre, or 300 to 800 pounds of seed. Occasionally the total number of burs produced is so low as not to justify harvesting.

Harvesting. Most burclover seed is harvested and kept in the bur. There are several methods of obtaining the burs. (1) Raking the vines off with a horse rake or garden rake and then raking or sweeping the burs in piles. This works well where green weeds do not interfere with raking. (2) Mowing and raking off the vines, then using a suction machine to pick up the burs. One suction machine drawn by a medium-sized tractor consists of a spout 26 x 7 inches that runs on a wooden slide on the ground and a 52-inch gin fan that is run by the power take-off of the tractor. During the week of June 20, 1949, this machine sucked up enough material in 3 hours to clean out 741 pounds of clean seed (not burs). Various types of suction machines have been built. Such machines work best when the surface of the ground is uniform and free of trash, weeds, sticks, and rocks.

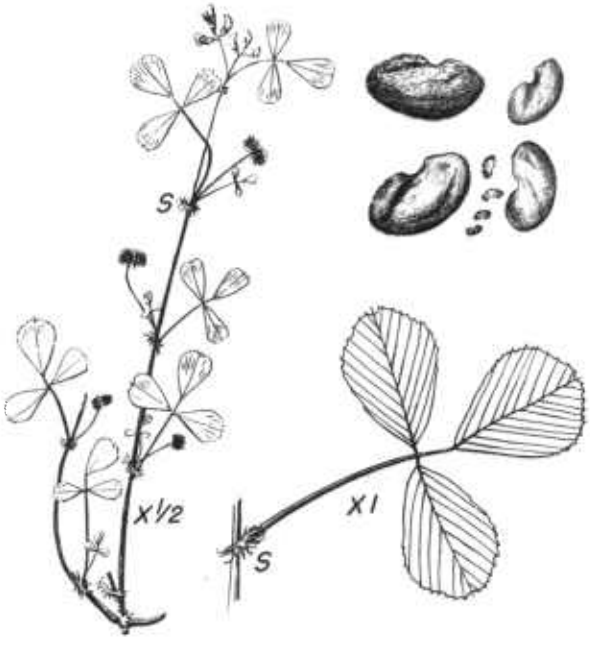
Burclover may be harvested by mowing the plants when about a fourth of the burs are fully ripe and beginning to drop, leaving the mowed material in the swath and threshing with a slow-moving combine equipped with pickup tines. By using a special screen beneath the shoe sieve, clean seeds can be obtained. The cylinder is run at top speed, around 1600 RPM, and the cylinder spacing set at 1/8 inch. Any burs not broken up are taken back through the tailing auger and elevator and again run through the cylinder. The most rapid method of harvesting is to allow the burs and hulled seeds to fall through the chaffer and shoe sieve and be taken directly to the grain bin. When this is done, the cylinder spacing is 3/8 inch and the cylinder speed reduced to merely knock the burs off the stems.

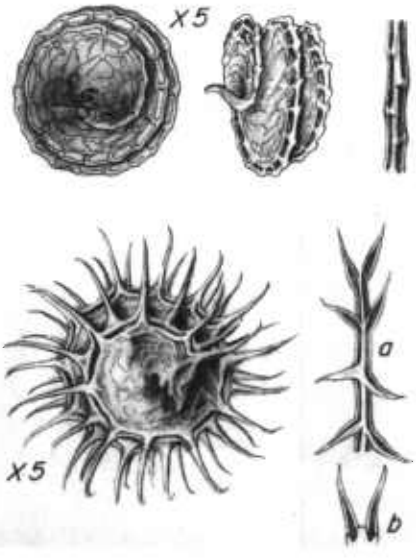


Blue lupine, *Lupinus angustifolius*. Flowering and fruiting branch, and mature pod; two views of seeds.



Spotted burclaver, *Medicago arabica*. Fruiting branch; leaf and stipule (*S*); normal pod (bur) and two views of a section of the ridge of the bur, back (*a*), and profile (*b*); view of four seeds.





California burclover, *Medicago hispida*. Fruiting branch; leaf and stipule (*S*); two views of spineless bur and section of the ridge of bur; side view of normal bur and views of a section of the ridge, back (*a*), and profile (*b*); view of four seeds.

PLATE 18

Care of Green Seed. Dry burs can be raked into piles without danger of heating. Seed combined from the swath or windrow will not need curing before final sacking.

Cleaning and Processing. Considerable burclover is sold in the burs. To obtain clean seeds, the burs are hammermilled using a 1/8-inch screen and a speed of approximately 2200 RPM, and then run through the cleaner to remove the pieces of burs.

Quality. Laboratory analyses show the average sample of burs to be 63 percent pure, and to have a 7-day germination of 20 percent plus 71 percent hard seed. There are 38,000 burs in a pound of pure burs. Seed samples have a purity average of 95 percent, a 7-day germination of 48 percent and a final germination of 80 percent plus 12 percent hard seed. Some of these samples probably consisted of scarified seeds. There are 139,000 seeds in a pound of pure seed. A bushel of burs contains from 2 to 4 pounds of seed. The longevity of the seeds is at least 3 years. For ready germination, the seeds should be scarified, where scarification by the hammer mill is not evident.

BLACK MEDIC *(Medicago lupulina)*

Adaptation and Use. Black medic, also called hop medic, blackseed hopclover, and black trefoil, is a spreading, hairy annual with 4-angled stems, mucronate leaflets, toothed stipules, rather dense clusters of small yellow flowers and dense or loose clusters of black, spiral pods. It is widely naturalized and in local areas is grown for pasture and seed. There appear to be annual and perennial forms. It is best adapted to blacklands and old terrace and bottomland soils and requires high lime and phosphate for maximum growth. Phosphate applications in southeastern Oklahoma have consistently increased seed yields. It is most suitable in legume-grass pastures, but probably not in areas where annual rainfall is below 32 inches.

Likely Seed Areas. Pastures on farms. Spread to waste places and roadsides is slow because of natural competition. In such sites, the plants are usually too scattered to harvest seeds.

Managing for Seed. Grazing improves the stem production of black medic on heavy soils by reducing the shade of associated grasses and opening up the turf. In southeastern Oklahoma, it is necessary to remove livestock by April 10 for highest seed yields. If weeds are competing, mowing is advisable after the stock are removed, to give uniform conditions for harvest. The flowers open early on the lower part of the plant and usually mature their pods before the main crop is ready. Leaf rust sometimes reduces growth and seed yields.

Production Under Cultivation. Yields vary widely from a few pounds to 300 pounds per acre.

Harvesting. The harvest season usually is short. The optimum time is from June 1 to 10. As worked out in southeastern Oklahoma, the best method of harvesting is to mow when the stems are damp, using a sickle bar no longer than the width of the pickup attachment on the combine. Combine from the swath after 24 to 48 hours drying. Any disturbance, such as raking or windrowing, will produce excessive shattering. The cylinder-concave spacing is close, approximately 1/8 inch; the cylinder speed high, 1500 to 1800 RPM. Use enough air to keep chaff slightly lifted from the lower screen and away from the seed (pods and seeds). It is not necessary to break the pods and release the seeds while combining, as this can be done in a scarifier or hammer mill.

Seedhay of black medic can be cut and windrowed in one operation and combined from the windrow. The windrowing should be done while the material is damp and tough to reduce the amount of shattering.

Care of Green Seeds. Seeds from the combine contain a good many green pods and soft seeds which cannot be left in sacks more than a few hours. Spread out and stir until thoroughly dry.

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Cleaning and Processing. To remove hulls from the seeds, scarify in a hammer mill, using cylinder speed of about 1500 RPM and a 1/8-inch round-hole screen. Keep enough pod material in the mill to prevent cracking of the seed coats. Usually the hammer mill gives enough scarification for good germination. Trial runs and examinations will determine this. One cleaning in a fanning mill or 3-screen mill will ordinarily produce a marketable lot of seed. Storage should be away from rats and mice.

Quality. The average purity of this small-seeded legume is 94 percent, the 7-day germination 56 percent, and the final germination 58 percent plus 11 percent hard seed. The seeds germinate readily. There are 302,000 in a pound of pure seed. The known longevity is 5 years, but seeds of this age should always be tested for vitality before planting. There is a market for good seeds in this Region.

BUTTON MEDIC (*Medicago orbicularis*)

Adaptation and Use. Often called button clover. It resembles snail medic (snail clover). An annual, moderately leafy legume with decumbent or trailing stems, when grown in open stands, that reach a length of 36 inches. The leaflets are serrate on the margin and in that and shape resemble those of several clovers. The stipules have the same shape as those of burclover, but are more deeply cleft. The flowers are in small clusters and yellow. The veiny, narrow-ridged pod consists of 3 or more much compressed coils.

Button medic was introduced into this country in 1899. It gained in favor in California, was tested throughout the southern states, but never came into good use, except in local areas in Texas and as a forage plant in Tennessee. It is well established in and around many towns in central Texas and a few in southern Oklahoma. It seems to be naturally adapting itself in the medium rainfall part of the Region and where the soils are alkaline. It prefers shallow limestone soils where the grasses seldom form a complete cover.

Properly managed it could become an important pasture plant. In the sheep and goat sections it should be increased in place of the spiny-podded burclovers, as the pods do not cling to the wool and mohair and cause dockage.

Likely Seed Areas. Along railroads, on vacant lots in towns of central Texas. It has not become acclimated to any extent in southern Oklahoma.

Managing for Seed. The pods of button medic ripen in June and drop from the green vines shortly after drying. The maturity is not uniform. The partially ripe pods are eaten by grazing animals. Production will depend upon proper deferment from grazing. Where grown alone or in a mixture the animals should be removed by the first of May or sooner to allow regrowth and plenty of flowers to develop.

Production Under Cultivation. Tests in California indicate that seed yields of button medic are twice those of California burclover. There the yields ranged from 790 to 1160 pounds per acre under partial irrigation. Seeds have been harvested in this Region but production figures are not available. Yields should be 300 pounds per acre on good soil.

Harvesting. One way to gather the seed is to rake away the vines and sweep the pods in piles. The pods can be collected with suction machines.

Care of Green Seed. Pods cured and dried on the ground can be sacked.

Cleaning. Seed material gathered with brooms or with suction machines is very trashy and contains a good deal of dirt, gravel and other foreign matter. The pods are light. When dumped in a tank or running water they can be skimmed off with a screen leaving

the bulk of the trash and all the gravel. The pods then can be hammermilled or threshed with a combine or clover huller. The smooth seeds are easily separated from the hammermilled material in a fanning mill.

Quality. Laboratory tests show the average purity of the seed lots to be 90 to 98 percent, the 7-day germination 47 percent and the final germination 50 percent plus 41 percent hard seed. The total number viable is 90 percent. There are from 120,000 to 150,000 in a pound of pure seed. The seeds are slightly smaller than seeds of crimson clover. The longevity period is listed at 3 years. Storage in the southern states should be limited to 3 years.

ALFALFA *(Medicago sativa)*

Adaptation and Use. A deep-rooted, leafy perennial, bearing violet-blue, or mixed yellow and violet-blue upright flowers in loose clusters at the ends of branches and coiled pods with 2 to 3 spirals. In Europe it generally is known as lucerne. One of the most important forage crops in the United States. Used for soil conservation and soil improvement. It is widely distributed, with new adaptations and varieties increasing in number. Southwest common and improved common, such as buffalo (a variety resistant to bacterial wilt) are widely adapted winter-hardy varieties, and like the Grimm variety, are suitable for the extreme northern portion of the Region. Hairy Peruvian, low in cold-resistance but very drought-resistant, is adapted to the southern part of the Region. Fertile bottom terrace and upland soils well drained, fine and medium in texture and with favorable moisture relationships are most suitable for alfalfa. It should not be planted in soils containing the cotton root-rot fungus. Suitable for all parts of the Region where moisture is sufficient for proper growth except the highly saline or alkali soils.

Likely Seed Areas. None outside of cultivated fields. Scattered plants may be found along highways.

Managing for Seed. The crop that develops during the hottest part of the summer generally matures the most seeds. In this Region it may be either the second or third cutting. In the seed-producing areas of Oklahoma and northwest quarter of Texas the second crop is cut for seed. But in some localities where the concern is not for a maximum seed yield, the third or fourth cutting is for seed. Over a wide range of conditions, slow uniform growth and reduced stem stands usually produce more seeds than rank growth and thick stands. Pasturing the stand until early summer, then clipping to even the growth, often produce more seeds than when the first crop is mowed for hay.

Moisture conditions determine which crop is best for seed. Ideal conditions prevail when there is good subsoil moisture and a rain at or near the time the alfalfa is cut for hay with no more moisture until after the seeds are harvested. Good rains during the period of rapid growth induces too dense a stand and fewer blooms. Be sure the hay cutting just ahead of the seed crop is taken before the shoots near and on the crown reach sickle height.

Apply irrigation water carefully. Too much water stimulates rank growth, disturbs the moisture balance on the stigma and in the atmosphere surrounding the stigma and prevents fertilization. This causes the flowers to drop. Too little water may induce browning of the blossoms. Height of water table, kind of soil and rate of evaporation are conditions that must be considered in the amount of water applied. Conditions that favor slow and continuous growth generally favor seed set.

Insects are a problem and an aid in seed production. Where sucking *Lygus* bugs are common in seed-producing communities, control is possible by thoroughly cleaning up alfalfa fields and weed hosts along the borders and waste places in the winter. The seed crop is started by cutting the first crop of alfalfa at the same time in all

fields. This prevents the bugs from moving back and forth to fields that are in different stages of growth and starves them out. A spring-tooth harrowing also is recommended late in the fall, early in spring and after each crop is harvested to help control these bugs.

Most alfalfa flowers require tripping by good-sized insects for a good seed set. Tripping forces the stigma and anthers against the standard, which ruptures the anthers and scatters the pollen. Honeybees after nectar do not trip many flowers. They do increase seed set through cross-pollination while gathering pollen.

Alfalfa responds to fertilizers. An application of 150 to 250 pounds of 0-20-0 from October to February has increased seed production in northwestern Texas.

One farmer in northwestern Texas has successfully produced seeds and controlled some insects by using a mulch of the first spring cutting. He combined the seeds in July and left the straw on the ground without further treatment in the fall. In early February he burned the field. The fire consumed only the tops of the standing plants and some of the loose straw. With this treatment the harvest period varies from July 15 to September 15.

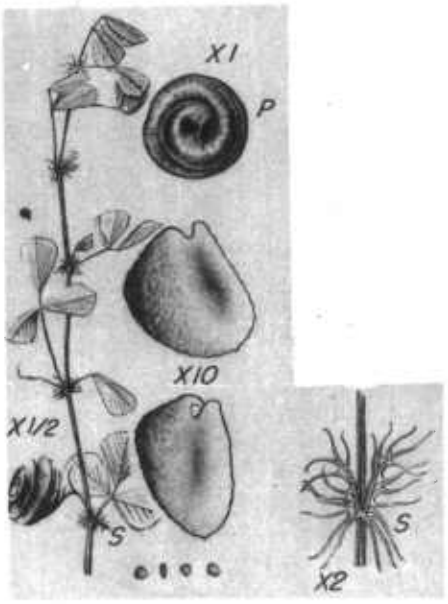
Production Under Cultivation. Seed yields average about 350 pounds per acre. The range is from 200 to 1000 pounds.

Harvesting. Several methods of harvesting are used. Mowing and windrowing usually begins when about three-fourths of the pods are brown. To avoid shattering mow while the dew is on and the pods damp. The windrower is generally attached to the mower. A side-delivery rake can be used immediately after mowing. Allow the plants to dry thoroughly. Combine from the windrow after dew is gone. Use the tine pickup attachment. Slow the cylinder speed to approximately 1000 RPM or slower if stems are brittle. Set cylinder close to concaves. Clover concaves are sometimes used. Use what air is necessary. The amount will depend on whether seeds are fully cleaned or rough-cleaned by removal of lower screen in the shoe. Some operators take out all bottom screens and reduce the wind to save all the seed and depend on recleaning to remove the trash. For advanced cleaning an alfalfa screen with 10 openings per inch is used below the adjustable shoe sieve in some machines, or is inserted in place of the removable shoe sieve in others.

When combining standing material, it may be necessary to set the fine-mesh screen sloping toward the back to prevent clogging. Windrow-combining should be completed before rain falls, as alternate wetting and drying causes some seeds to pop out of the pods. Direct combining is practicable. Allow most of the pods to ripen. Wait until dew is off the plants. Lower the sickle to obtain the seed-bearing parts of the plants. Keep cylinder speed low enough to knock out the seeds with fairly close cylinder spacing. Pull combine at a speed to keep a thin layer of straw on the racks. This also can be done by adjusting width of swath. The toughness of the stems and leaves often causes the seeds to stick to the straw when it lies thick on the racks. Use some air to keep green pieces of leaves moving off the chaffer and adjustable shoe sieve, to prevent clogging of the latter and the alfalfa sieve.

Occasionally the wilted windrowed material is piled in small cocks to cure. It is desirable to thresh as soon as possible. If threshing is delayed the cocks can be stacked.

Care of Green Seed. When cured in the windrow the seeds can be sacked at the machine. When combined direct, spread the seeds out under cover on a wooden floor or canvas to a depth not to exceed 2 inches and stir 5 or 6 times daily to keep them cool. Where curing space is not available for such curing, use the sack method. Fill porous sacks about one-third full, lay them flat and turn every 3 or 4 hours, shaking the sacks in turning. An air blast across the curing floor is always helpful in moving the moist air away from the seeds. All curing should be under cover, as direct sunlight will discolor the seeds.



Button medic, *Medicago orbiculoris*. Fruiting branch, side view of coiled pod (*P*), two views of seed, and pair of stipules (*S*).

Block medic, *Medicago lupulino*. Fruiting branch; leaf, stipules and section of the stem; pod and three views of seed.

Hubam sweetclover, *Melilotus alba annua*. Two views of seed.

Alfalfa, *Medicago sativa*. Flowering and fruiting branch and pod; view of five seeds.

White sweetclover, *Melilotus alba*. Flowering branch; mature pod in calyx, and two views of seed.

PLATE 19

Cleaning. Any fanning mill will clean alfalfa seeds, but usually two runs are necessary. A spiral-screen cleaner, or one used especially for alfalfa, is considered best for proper separation of shrunken seeds from plump seeds. Combined seeds properly cured can be cleaned in the stationary combine. The seeds are usually sacked without scarifying. Store in a dry, cool place free of rodents.

Quality. High quality alfalfa seeds should have a purity of 98 percent, a combined germination and hard seed percentage of 90 and weighs 60 pounds to the bushel. At the San Antonio Laboratory the average 7-day germination is 69 percent plus 14 percent hard seed. When properly stored the seeds retain their viability for a number of years. Stored at ordinary room temperature in Denmark, yearly germinations for 7 years were as follows: 91 + 8, 88 + 7, 93 + 3, 84 + 3, 79 + 3, 65 + 3, and 61 + 2. Grimm alfalfa seeds scarified by several methods and then stored 14 years in New Jersey gave the following germinations: Untreated, 23 percent plus 1 percent hard seeds; dry heat for two hours at 60° C., 17.2 percent; sandpaper, 0.8 percent, and sulfuric acid, 0.0 percent. In this Region, for best results the seeds probably should not be stored longer than 5 years. There are 200,000 to 225,000 seeds in a pound of pure seed.

HUBAM SWEETCLOVER (*Meliotus alba annua*)

Adaptation and Use. Hubam sweetclover, also called Hubam or Hubamclover, is a tall, widely branched, white blossom annual with well-developed tap roots and numerous lateral roots. Dormant stem buds seldom develop above the crown. The stems are coarse unless closely spaced. This crop is especially adapted to heavy, alkaline soils. In this Region, it is planted mostly in the Blackland, Coastal and Grand prairies and the Rolling Red Plains, in the rainfall belt between 25 to 38 inches. Its principal uses are for soil conservation, soil improvement, hay, pasture, and seed. Often seeded in Johnsongrass fields for mixed pasture, or used for hay and seed in a rotation. It becomes a volunteer crop in Johnsongrass.

Likely Seed Areas. Seeds are produced only on cultivated land. The plant has spread to disturbed places along roads but is of no importance there.

Managing for Seed. When moisture is adequate as it usually is during April, May and June, stem height reaches 6 or 7 feet. The average is 5 feet. Flowers appear in late May, and the fruits mature in July. Seed development is not uniform due to the long flowering period. Insects and diseases ordinarily do not interfere with proper seed development. Seed yields increase when honeybees are abundant in the crop during the flowering period.

Production Under Cultivation. Experimental trials at the Texas Research Foundation, Renner, Texas in 1947 showed that where all the seeds were harvested by hand the yield was as high as 874 pounds per acre; windrowed or placed in a swath with a binder and threshed, 690 pounds; and combined from mature standing plants, 635 pounds. When grown with Johnsongrass and grazed, with the harvest delayed until the plants are nearly dead, the shattering is heavy and the yield seldom exceeds 200 pounds per acre.

Harvesting. Hubam seeds are harvested in several ways. Swathing (often called windrowing), leaving a 12- to 18-inch stubble, is now considered most economical. The platform swather and the grain binder, minus the knotting attachments and bundle carrier, are used. The factory-made platform swather cuts the material 12 to 18 inches high, lays it on the platform, carries it to the end of the machine, and crops it in an even swath on the high stubble. Shattering is at a minimum. The binder does the same thing through two upper canvases, but shatters more seed.

Windrowing is completed in one operation with the mower and attached windrowing tines, or in two operations with a mower and side-delivery rake. It rolls the stems without

much shattering. But too many coarse and bare stems are left, which make combining difficult. The rows also are subject to compaction by rain and rolling by wind on the short stubble.

Where possible, swathing and windrowing should be done at night or when the stems are tough, and when about two-thirds of the seeds are hard and the pods brown. It must be done when moisture is present to prevent shattering. A simple method to determine starting time is by stripping the pods by hand. When they strip easily, moisture is insufficient; when they cling to the stem, moisture is sufficient to begin.

Cutting can be carried on immediately after light rains, as soon as the tractor can be operated on the ground. The size of the combine should be known before swathing starts. The width of swath should not exceed the width of the combine reel by more than 2 feet; for example, a 7-foot swath for a 5-foot combine. For the best combining, the cut material should remain in the swath or windrow not fewer than 4 sunny days. No pickup attachment is needed for swath-combining but is desirable for windrow-combining.

Many operators set the combine to turn out only clean or hulled seeds. This is not necessary and is apt to crack some seeds. Adjust cylinder speed to 1500 to 1600 RPM. Space cylinder and concave 1/4 to 1/3 inch. Set chaffer to take out the straw. Use enough wind to lift chaff off the lower sieve and keep the coarser chaff from dropping through the chaffer. This will produce a mixture of hulled and unhulled seeds.

Combining the standing plants is a method of harvesting frequently used. To eliminate as many green stems and green pods as possible start the machine when about 90 percent of the pods and seeds are dead ripe. This is nearly always preceded by some shattering of the pods.

Care of Green Seed. Seeds cured in and combined from the swath or windrow can be sacked to await cleaning and processing, but should not be piled. Seeds combined from standing plants contain a fair percent of green pods and moisture. Spread such material on a wooden floor to a depth not to exceed 6 inches and stir at 3-hour intervals for 2 to 3 days, or until no apparent moisture remains. Heating and molding invites discoloration and loss of viability.

Cleaning and Processing. Hubam seeds should be cleaned with a No. 14 screen. The use of a No. 15 screen results in a loss of some large plump seeds. Most cleaning plants handling Hubam are equipped with scarifiers. The seeds can be hulled and scarified in the same operation. Where they are to be planted locally without a germination test, the cleaning and scarifying can be put off until near planting time. Commercial and local seeds should be cleaned and scarified by 2 months after harvest to allow time to complete purity and germination tests prior to fall planting time.

Quality. The average purity of laboratory samples is 95 percent, the average germination less than 50 percent, with a high percent of hard seed. Scarifying increases the germination to 70 or 80 percent and decreases the percent of hard seed. Holding the seed in storage more than 3 years is not a good practice.

ANNUAL YELLOW SWEETCLOVER (*Melilotus indica*)

Adaptation and Use. A winter annual of the milder parts of the Region. Fine-stemmed to 3 feet tall; flowers yellow, 2 to 2.5 mm long, about half the size of the biennial sweetclovers; pods wrinkled, about 2 mm long and about two-thirds the size of the biennial yellow sweetclover. Long introduced and adapted to the southern half of the Region. The naturalized range is being gradually extended northward. Plants now may be found along railroads and highways north of Fort Worth and Dallas, Texas and in northern Louisiana. Adapted to a wide range of soils when properly inoculated, including those on the acid side. Used for soil improvement, cover crop in orchards and cotton fields, in conservation cropping systems with sugarcane, and winter grazing on grassland.

It has done well as a soil improving crop in the Red River Valley of Louisiana. It is the earliest of the sweetclovers, in South Texas often making 6 inches of growth by mid-winter when moisture is available. The plants are fairly resistant to disease.

Likely Seed Areas. Railroads and vacant lots often have extensive stands. Northern forms should be used and propagated to extend the range.

Managing for Seed. With enough moisture the germination occurs in late September and October in South Texas. Growth is uninterrupted by cold in that part of the state. Flowers begin to appear early in March and the pods mature by the middle or last of April in the vicinity of San Antonio. Harvest begins after some of the earliest pods fall and when the potential yield is greatest. Large yields and quality seed depend on moisture being available in April during the heavy blossoming and fruiting period.

Production Under Cultivation. Yields as large as 400 pounds per acre have been taken; the average is probably 175 pounds.

Harvesting. The crop can be handled with a combine when most pods are brown and before a great amount of shattering occurs. Usually most of the leaves have fallen at this period. No particular adjustments are necessary. The reel is set to bend the plants over the draper before the sickle hits the stems in order to catch shattered pods. Set speed of cylinder at 1100 to 1200 RPM and spacing at 1/4 inch, open chaffer and shoe sieve one-third, return tailings to cylinder, set air valves one-third open, use a 1/12-inch round-hole sieve below shoe sieve for final cleaning. In case a scarifier or hammer mill is to be used for final cleaning the crop need not be cleaned close in the combine.

The crop can be bound, shocked and threshed with a combine or thresher. The binding should be started a week ahead of the combine period, or when about 10 percent of the pods are ripe.

Dead ripe seed can be stripped with a bluegrass stripper and the resulting material run over a scalper and then through the hammer mill and finally the cleaner.

As with Hubam sweetclover the crop can be placed in a swath on the high-cut stubble and combined by running pickup guards under the swath.

Care of Green Seeds. Seed from the combine should be dried before sacking. Scalping will help dry the seed.

Cleaning. Rough-combined seeds can either be scarified and screened or hammermilled and screened. Seed uniformly threshed can be cleaned in the fanning mill.

Quality. Seeds of this species resemble those of several other sweetclovers but are smaller in size. Clean samples average 95 to 98 percent purity, have a 7-day germination of 48 plus 31 percent hard seed. The average pure, live seed reaches 90 percent. The average Texas samples (354,000 to a pound) have smaller seeds than samples from other Regions (275,000 to a pound). The known longevity is 9 years. As a rule the seeds should not be stored longer than 3 years before planting.

MADRID SWEETCLOVER (*Melilotus officinalis var.*)

Adaptation and Use. Madrid sweetclover, is a yellow blossom biennial with a vigorous root system. When planted in the spring the plants develop a strong, leafy crown the first year and many stems, leaves and flowers the second spring. It differs from ordinary yellow sweetclover in its leafiness and fine stems. Only in a dense stand are the differences discernible. It is becoming an important soil-conserving, soil-improving, hay, and pasture crop through the Grand Prairie, Rolling Red Plains and Reddish Prairies

of Oklahoma and Texas and the Blackland Prairie and Edwards Plateau of Texas. It produces unusually well both for pasture and hay when seeded with small grains and Johnsongrass.

Likely Seed Areas. At least two associations in the Region are selling pure seeds. Many farmers are growing seeds for local planting.

Managing for Seed. Spring planting develops flowers and fruit the second year about a month ahead of Hubam sweetclover. Except for some loss from cotton root rot, the crop produces plenty of seeds when the rainfall is sufficient to bring out stems and flowers. No grazing of second-year growth is advised if satisfactory seed yields and stem residue are desired. Care must be used to keep this crop a uniform strain. It should not be planted for seed near other strains of yellow sweetclover. It will not cross with white sweetclover or its strains.

Production Under Cultivation. Seedings in 3-foot and 40-inch rows at 3 pounds per acre have yielded over 400 pounds of clean seed per acre and provided considerable grazing.

Harvesting. About the same as for Hubam sweetclover. One community obtains higher seed yields by using the binder and curing the bundles where they fall instead of shocking. When threshing the bundles, be sure to use a truck or wagon that has a tight bottom or is canvas-covered, to save seeds that shatter while vehicle is in motion.

Care of Green Seed. Same as for Hubam sweetclover.

Cleaning and Processing. Same as for Hubam sweetclover.

Quality. Most seeds on the market are high in quality. Laboratory reports show the average sample to be 99 percent pure, to have an 86 percent germination in 7 days and 315,000 seeds in a pound. The seeds are on the average smaller than those of yellow sweetclover. The longevity is not known, but well-matured and properly cured seeds should keep their viability 3 years. The demand for high-quality seeds remains good.

AUSTRIAN PEA (*Pisum sativum arvense*)

Adaptation and Use. Annual, winter-hardy, tendril-bearing legume with thick paired leaflets, leaflike stipules as in *Lathyrus*, and large green pods. Dixie-wonder pea is a southern adapted strain. Austrian pea is adapted to all parts of the Region in the high rainfall belt and is now being planted in the Rolling and High Plains in the 20- to 25-inch rainfall belt. It grows well on all soils except the imperfectly and slowly drained types. It generally is used for green manure, winter cover and soil improvement.

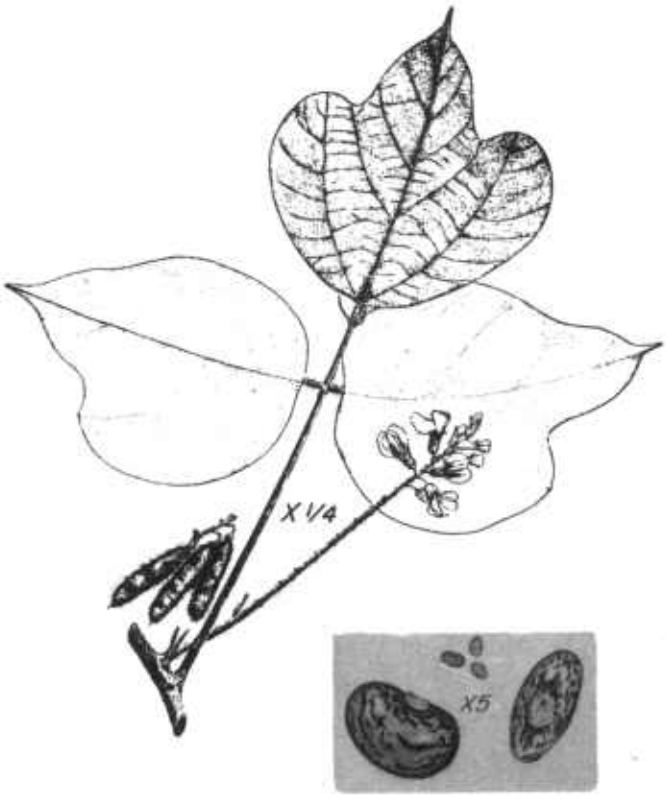
Likely Seed Areas. Most seeds are grown in the Pacific Northwest. Some seed produced in this Region and there is an opportunity for more to be harvested.

Managing for Seed. Insects and diseases are important factors in seed production in the South. Weevil damage may be serious. Dusting with DDT will control the insect. Mildew is a serious disease. It often attacks and destroys a field of peas in a week or 10 days, and is particularly destructive when the vines are heavy and matted. Seed growers overcome the seriousness of mildew to some extent by planting about half the number of seeds used for a cover crop, by planting the rows next to rows of old cotton stalks, and by seeding with a companion crop, as barley, rye, wheat, or oats. Barley, because of the way and time it matures, is the best companion crop for northeastern Arkansas.

Annual yellow sweetclover, *Melilotus indica*. Flowering and fruiting stem; portion of stem, and stipule (*S*); enlarged flower; pod with calyx attached, and two views of seed.

Yellow sweetclover, *Melilotus officinalis*. Leaf and stipules; enlarged flower; pod with calyx attached, and two views of seed. (See Madrid sweetclover.)

Austrian pea, *Pisum sativum arvense*. Flowering and fruiting stem, and pod; view of seed and hilum.



Kudzu, *Pueraria thunbergiana*. Piece of stem bearing leaf and flowers; three pods; two views of seed.

PLATE 20

Seed-shattering is light in the standing crop. The vines and pods can be left to mature well before combining starts.

Production Under Cultivation. Yields of seed in the Pacific Northwest are between 800 and 1000 pounds per acre. The yields in this Region are between 200 and 700 pounds.

Harvesting. Direct combining is satisfactory where the land is smooth and the vines are not matted to the ground and therefore difficult to pick up. Bedded land will interfere with the operation of the sickle, even if pickup guards are used. The cylinder and concave spacing must be very wide, the cylinder speed very slow, especially when the vines and pods are dry, to prevent cracking the seed. In northeastern Arkansas the same adjustments are used for peas as for soybeans.

Austrian pea plants can be cut and windrowed either with windrower or side-delivery rake. The crop is ready when 75 percent of the pods are mature. After a rain more shattering occurs in windrows than in standing vines.

The vines can be cut, bound and cured in the shock, and later threshed.

Care of Green Seed. Combined seeds contain too much moisture to leave in tight sacks; partially filled sacks can be set on racks and fanned, or left standing in the field where sun and wind will dry them. Seeds threshed from cured windrows can be safely sacked without heating.

Cleaning. Pure pea seeds can be cleaned easily with a fanning mill. Mixed with grain the seeds are separated in a spiral separator.

Quality. Most Austrian pea seeds are smooth, not wrinkled. There are about 2750 in a pound of pure seed. The 7-day germination tests average 89 percent, with few hard seeds. The longevity is about 3 years, but ordinarily the seeds should not be held in storage more than 2 years. Seeds in storage should be examined frequently for insect damage and fumigated.

KUDZU (*Pueraria thunbergiana*)

Adaptation and Use. A long-lived, vigorous vine having large leaves, each with 3 broad leaflets. The vines trail, twine and cling to form a dense mass of vegetation on open ground, trees, arbors and steep banks. It is used for erosion control, soil improvement, grazing, hay and ornamental cover. Because of its way of growing it is considered an unusual erosion control plant. It has been grown successfully on most soils, except those poorly drained or low in fertility. It is a high rainfall plant and should not be planted for field growth in areas where the rainfall averages less than 40 inches annually. The plant has little use where the vines are killed back to the crown by cold.

Likely Seed Areas. Most seeds are imported from Japan. No important seed production has been developed in this country. In this Region wherever the plants climb the number of flower clusters increase. The vines must be off the ground to produce flower clusters. Local areas where the plants set seed are not common. One area where seed production is consistent was located in southwest Arkansas on a backyard arbor. This arbor of approximately 1000 square feet annually produces 6 to 20 pounds of seed. Other arbors have been found producing seed in lesser quantities. Some seed-producing spots are found along the edges of protected woodlands. Reports indicate that seed production is more general east of the Mississippi River.

Managing for Seed. There is no way to know what the seed yield will be in any given location until the pods mature. Three to five seeds are borne in each pod. Insects sometimes attack the green pods and prevent seed development or the pods may half develop and remain empty. One should not be misled by prolific pod production; the

degree of fill needs to be determined in each planting. Eventually a way will be found to produce seeds economically. The demand will increase when it becomes more generally known that field plantings can be easily and cheaply established from seeds.

Production Under Cultivation. See Likely Seed Areas.

Harvesting. Maturity is in early fall. Handpick the pods when they are nearly dry and before they fall.

Cleaning. Dry pods can be shelled by hand or the seeds flailed out and the material run through the fanning mill.

Quality. The 7-day germination is low, only 24 percent. The 28-day germination is 32 percent plus 42 percent hard seed. There are 38,000 seeds in a pound of pure seed. The longevity is more than 2 years but this figure is not verified. All seeds should be scarified before planting.

HOP CLOVER (*Trifolium dubium*)
BIGHOP CLOVER (*T. procumbens*)

Adaptation and Use. These two winter clovers will be treated together because they usually grow in the same mixtures. Hop clover (called least hop and suckling clover) is a straggling, cool-weather annual with small loose heads of yellow flowers. Bighop clover (called large hop and low hop clover) is taller and has much larger flowers, larger heads, and the large petal of each flower is marked with prominent nerves. Both kinds grow on all types of acid and lime soils from the high rocky slopes to the wet overflow bottoms. Bighop is more important in grazing lands of the northern side of this Region than it is in the southern side. Both kinds are naturalized as far west as the 38-inch rainfall line. Generally used for pasture, occasionally cut for hay. Where bighop is in pure stands it is frequently cut for hay. When grown with ryegrass the mixture may be harvested for seeds or hay.

Likely Seed Areas. Pastures going into the winter closely grazed, vacant lots where the growth is kept short and abandoned fields that have been mowed and are too low in fertility for white clover, all in Louisiana, Arkansas, eastern Oklahoma, and eastern Texas.

Managing for Seed. Yields of these hop clovers vary with the fertility, other soil conditions and treatment of companion plants. Abandoned land in the adapted sections soon come back to hop, if grazed or clipped. By fertilizing the growth in the fall, the yield can be increased. Permanent pastures nearly always contain fairly uniform stands when the grass is grazed. The clover may be closely grazed until about 4 weeks before blossoming starts, then the livestock are removed. If there are weeds in the field at that time, the clover should be clipped to level the irregular growth and reduce the stature of the weeds and grasses. Grazing and clipping are conducive to uniform flowering. Blossoming begins in April and continues as long as moisture and cool weather prevail. The drying soil and long hot days of June soon stop growth and the plants die. Harvesting begins when about 75 percent of the flowers are brown and while the stems are still partly green, i.e., before shattering. The plants generally die in time for common lespedeza to serve as a summer legume on the same field.

Production Under Cultivation. The average yield from managed pastures is from 50 to 75 pounds per acre, below 50 pounds where little attention is given to deferred grazing and clipping.

Harvesting. Most harvesting is done with a mower and windrower in one operation when dew is on the plants. The windrows can be combined after complete drying, bunched

when partly cured, dried in the cock and the cocks carried to the stationary combine with a buck rake on a canvas-covered wagon, or stacked and threshed. The dry seedhay breaks easily and should not be handled more than necessary. Direct combining is possible when the crop is fairly free of other plants and matures uniformly.

The setting of the combine is similar to the setting for white clover. The adjustable sieve in the shoe is nearly closed and a fine-mesh screen (no larger than 1/14 inch) is inserted below the adjustable sieve. Some air can be used on the chaffer and adjustable sieve. The lespedeza seed pan is used by many farmers to harvest small lots of seed. The crop is left until fully ripe and ready to shatter.

Care of Green Seed. Seed-pan harvested seeds should be dried before sacking. Cleaning will help in the drying. Seeds combined from standing stems should be thoroughly dried before sacking.

Cleaning. The fanning mill will clean hop clover seed. A small-mesh top screen that will allow the clover seeds to sift through will remove most weed seeds.

Quality. The seeds of bighop clover are very small. There are approximately 2,000,000 in a pound; whereas there are 1,000,000 in a pound of hop clover. The seeds are not easily distinguishable from those of several other clovers. The purity of well cleaned seeds is high, the 7-day germination seldom exceeds 29 percent and the final germination averages about 50 percent with from 20 to 36 percent hard seed. The longevity is about three years but may be longer under proper storage.

ALSIKE CLOVER (*Trifolium hybridum*)

Adaptation and Use. A short-lived, hardy perennial, usually handled as a biennial; the nearly smooth stems 1 to 3 feet high bear pink flowers in round heads that are 3/4 inch in diameter and produced on long peduncles. Native of northern Europe. Naturalized in the northeastern states. Occurs often in this Region as a contaminant of red and white clovers; also planted in northern Arkansas and Louisiana. Adapted to a rainfall of more than 38 inches except in irrigated valleys of high elevations. Most often grown on and usually considered more suitable for bottomland, and wet, poorly drained overflow soils; a more certain crop there than red clover. Useful in high irrigated valleys. Planted for hay, seed and grazing. Seldom seeded alone for hay because of a tendency to lodge. Used with smooth brome, timothy, orchardgrass, redtop, tall fescues, red clover, and alfalfa.

Likely Seed Areas. Not much seed is produced in this Region. Most commercial seed is from the northern states, Canada or imported from Europe. A full explanation of yields and methods of harvesting are included here because of its potential use and value.

Managing for Seed. When seeded with winter grain or on the young grain in early spring, the growth is usually weak until the grain is removed, and may suffer severely if drought occurs in June. Early varieties of grain are recommended. When the growth promises to be rank in the absence of a companion crop, it is pastured until about May 15. This causes additional branching and produces more flower stalks. Irregular flowering and seed development results in a mixture of ripe and unripe heads. Harvesting starts when about three-fourths of the heads are brown and flowers reflexed. Shattering does not readily occur while the plant is green and tough, but in age some of the heads will be lost. An examination of a cross section of the ripe heads should be made by rubbing a given number of dry flowers in the palm of the hand. The pods enclosed within the calyx usually contain from 1 to 4 seeds. An average pod fill or seed set can be determined and the number of seeds ascertained by examining at least 10 heads from random plants. A hundred seeds per head is considered a good yield. The seeds are harvested in July and August and nearly always taken from the first crop because of poor second

growth. When the seed crop is taken early, the second growth often produces enough heads and seeds for good volunteer stands. Whether such stands will be used as a crop in succeeding years will depend on the weeds present in the young stand. Much seed is now grown under irrigation in high mountain valleys of Idaho. There the practice is to apply a heavy irrigation in the spring to produce maximum growth, and other waterings while the crop is blooming, until many of the heads mature. Better pollination through the use of bees usually increases the yield.

Production Under Cultivation. The average dry-land yields are 175 to 225 pounds per acre. Yields as high as 950 pounds are produced under irrigation.

Harvesting. Mowing and windrowing in one operation, curing well and combining with a pickup or guard attachment is the preferred method. If wilted in the swath, windrow when the dew is on. Direct combining is practiced if the crop has not lodged, matures properly and is reasonably free of weeds. Keep cylinder bars clean or vibration may build up from material in the green plants. General combine settings for threshing cured material are: Cylinder speed 1500 to 1600 RPM, cylinder spacing close, 1/8 to 3/16 inch; use 2 concaves, but usually not necessary to cover slots between concaves; leave adjustable chaffer a half to two-thirds open; use some air, a 1/12-inch round-hole special sieve, and do not overload the machine for best threshing.

Another method of preparing the seedhay for the combine or thresher is to bunch as soon as stems are wilted, and cure in the bunch. Thresh from the bunch or stack for later threshing, using a buck rake.

Care of Green Seed. Seeds directly combined need drying before sacking.

Cleaning. Seeds from the combine will, in most cases, need some recleaning; from stationary hullers, probably less cleaning. When weed seeds are present, careful screening is necessary.

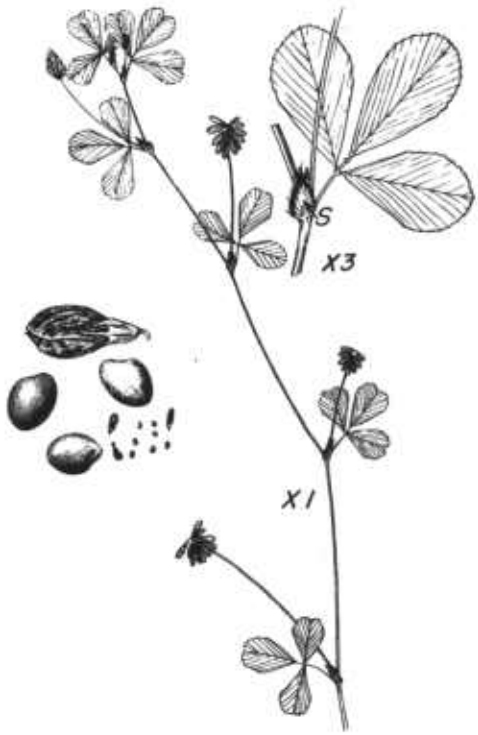
Quality. Alsike clover has a small seed. There are about 700,000 in a pound of pure seed. The purities are high. The average 7-day germination is about 80 percent with about 15 percent hard seed. The vitality in good storage holds up well for 4 years and then drops rapidly.

CRIMSON CLOVER (*Trifolium incarnatum*)

Adaptation and Use. A hairy winter annual 1 to 3 feet tall with cylindrical heads of pale crimson flowers. Ordinary strains are largely soft-seeded and do not maintain volunteer stands from year to year because most of the seeds are readily germinable in contact with moist soil. Dixie and Auburn are two superior varieties with hard seeds. Their seeds, however, cannot be separated from those of ordinary strains. Crimson clover is used for green manure, orchard cover, cool season grazing, hay, seed production, bee feeding and for a reseeding winter legume in permanent pastures. Adapted to various soils (except poorly drained muck and those of low fertility) ranging from the sands to the heavy clays and varying in acidity and alkalinity. Phosphate is necessary on all soils. Grown in the humid areas of the Region, in a rainfall of 35 inches or more and in irrigated valleys at higher elevations. Most seeds grown in the Region are of the hard-seeded strains.

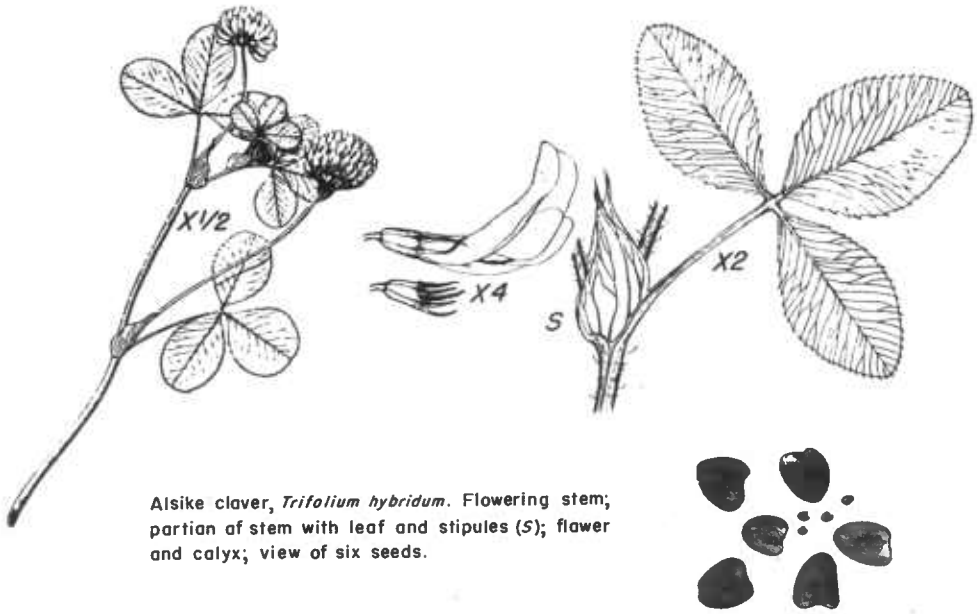
Likely Seed Areas. Under cultivation only. Seeds for local distribution are now being raised in this Region. Other southeastern states are supplying seed.

Managing for Seed. When seeded in September, growth is usually sufficient to survive winter-killing and heaving. When seeded in permanent grass or with a short-lived grass, there is less winter-killing. Seeded alone, the crop can be grazed in the southern part of our Region until March 1 to 10 and then allowed to flower and fruit. Seeded with



Hop clover, *Trifolium dubium*. Flowering branch, and section of stem with stipule (*S*) and leaf; flower, and three views of seed.

Crimson clover, *Trifolium incarnatum*. Flowering stems; three views of seed.



Alsike clover, *Trifolium hybridum*. Flowering stem; partian of stem with leaf and stipules (*S*); flower and calyx; view of six seeds.

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PLATE 21

oats or barley, the two crops usually mature about the same time and can be harvested together. Unfortunately the heads of crimson clover do not mature uniformly and the ripe pods, including the flowers, break off easily. Harvesting is a difficult problem, especially when the fertility is such as to cause lodging of the stems and rains interfere. The heads should be checked for fill and seed set. Counting and rubbing the brown flowers in the palms of the hand will give a good indication of fill and yield.

A good yield is one which has 75 to 80 seeds per head and an average of 12 heads per foot. Neither variety of the two hard-seeded strains named above is resistant to crown rot, a disease that at times reduces the stand but never exterminates it.

Production Under Cultivation. Usually 250 to 300 pounds of hulled seeds per acre under ordinary dry-land conditions and as high as 650 pounds under the best conditions.

Harvesting. Crimson clover is one of the most difficult crops to thresh. The seeds are produced in fragile pods which in turn are enclosed in a tough hull (calyx). The difficulty is in tearing the hull apart.

Direct combining is discouraged because of the green, often lodged stems, the mixture of ripe and green heads, and the presence of green weeds. This method will work where there is uniform ripening, an even stand of heads, and no green weeds. The two best harvesting methods are: (1) Cutting and windrowing on a high stubble when most of the seeds are in the hard-dough stage and combining with lift guards from the windrow, and (2) windrowing, followed by bunching, usually with a buck rake while material is damp, curing and threshing. Mowing and windrowing should be done at night or when material is damp. The windrows are left small (3 feet wide for a 5-foot combine) and uniform to give a slow, even feed into the combine. Experience indicates a larger yield can be obtained by threshing small windrows rather than large ones.

Be sure the material moves onto the draper without pulling or picking. Combine adjustments for dry, cured material include: (1) Cylinder speed of 1500 to 1600 RPM, (2) close spacing of cylinder and concaves, (3) full set of concaves, (4) closed slots between concaves, (5) chaffer, adjustable shoe sieve, special adjustable chaffer extension and tailboard adjusted so that all unhulled seeds drop to tailing auger and are carried back to cylinder (watch tailing elevator closely), (6) use what air is necessary to keep unhulled seeds from passing through shoe sieve, and (7) insert extra, round-hole 9/64-inch (1/10-inch) screen in lower part of shoe to sieve out the hulled seed. Adjustments for rough combining improperly cured material include: (1) Reduce forward speed of combine so as to keep a minimum amount of material on the chaffer and prevent clogging of elevator, (2) cylinder speed of 1000 to 1100 RPM, (3) cylinder clearance 1/8 to 3/16 inch, (4) normal number of concaves, and (5) enough air to blow chaff off chaffer. Threshed in this manner, one-third of the seeds are hulled and two-thirds unhulled. Since adjustments on the combine and thresher are numerous, hulling seeds of this clover becomes a special community job. Small lots of unhulled seed can be harvested with comb strippers or rotary brush strippers.

Care of Green Seed. Combined direct, the seeds must be spread, stirred and aired frequently to prevent heating. Immature seeds should not be stored until the moisture content is about 12 percent. Seeds cured in the windrow or stack can be sacked at the machine.

Cleaning. When threshers are adjusted to hull all the seeds, further cleaning may not be necessary. When hulled and unhulled seed are threshed, the hulled seeds are screened out in a mill and the unhulled seeds are run through a hammer mill and recleaned.

Quality. Crimson clover seeds are usually sold hulled. Some unhulled seeds, however, are marketed. Properly ripened seeds will retain their vitality for 3 years; after that, the vitality drops rapidly. Normally the seeds should not be held longer than 2 years before planting. The germination from all sources varies from 75 to 90 percent,

with an average of 85 percent. The 7-day germination average for the hard-seeded strains is 73 percent, the final germination 76 percent with some hard seeds. There are 140,000 seeds in a pound of pure seed.

LAPPA CLOVER *(Trifolium lappaceum)*

Adaptation and Use. Also called lap, lappacea, burdock and wild European clover. A hairy, leafy annual with slender, weak, often creeping stems 1 to 2 feet tall, roundish or obovate leaflets and small purplish-white flowers. The globe-shaped head with the long bristly calyx lobes looks like the fruit of burdock plants. The seeds are held tightly in the fuzzy calyx (hull).

Lappa clover was found growing wild near Snow Hill, Alabama in 1923. Since then it has been found at other points in Alabama and Mississippi especially in the Black Belt. It is best adapted to heavy more fertile soils that are not too acid, but has been grown successfully on soils coarser in texture. It is used for hay, pasture, cover crop and erosion control and fits in well with Johnsongrass and Dallisgrass, producing its maximum growth in spring before these grasses are important. Many stands in Alabama have volunteered for more than 10 years and are still good. "It has never been killed by cold in middle Alabama".

In this Region the probable range of adaptation is from North Texas and North Louisiana southward and as far west as the Blacklands of Texas (35 inches of rainfall).

Likely Seed Areas. Very little in this Region. Seeds are produced in Alabama and Mississippi.

Managing for Seed. Seedings are made in early fall with inoculated seeds and phosphate. Volunteering occurs when the moisture is available in the fall. Growth continues slowly during the winter. It reaches a height of 4 or 5 inches in February and makes rapid growth in March, April and May. Flowers appear in late April. The plants reach full maturity in early June and then die. When the soil is well inoculated the growth will smother out common lespedeza and white clover. The heads do not fall easily. There is almost no shattering of the flowers, or of the seeds from the closely invested hull. The seedhay can be handled without breaking and very much like white clover. If the plants are cut while still green, but with most of the heads brown the seedhay can be used for hay, threshed for seed, or scattered as seed mulch on new planting sites. The time of harvest is early or mid-June.

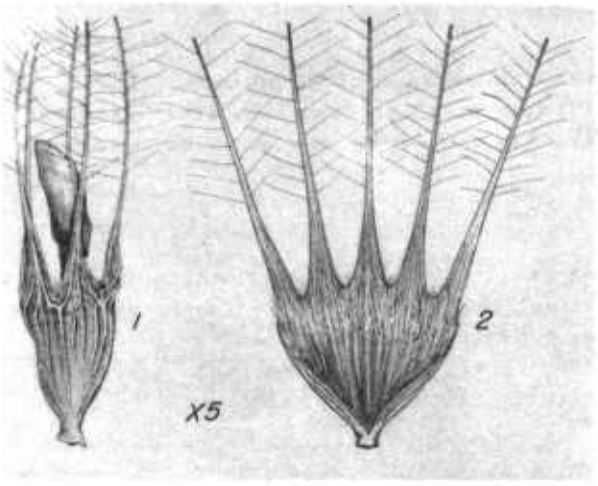
Yield Under Cultivation. Not too well known but believed to be 100 to 200 pounds per acre. Commercial seed is available.

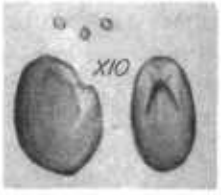
Harvesting. Lappa clover seeds are usually harvested by mowing and drying the seedhay in the swath, then windrowed, or bunched while the plants are tough. The somewhat wilted hay may be bunched and cured through a process of sweating which tends to reduce the toughness of the hull. The dry windrows can be combined, but separating the seeds from the hulls is difficult. The unhulled seeds from the combine or dry seedhay can be threshed with a clover huller. Also the unhulled seeds and seedhay can be run through a hammer mill and then through a fanning mill.

Care of Green Seed. Seeds cured and dried in the field can be sacked at the huller.

Cleaning and Processing. Unhulled seeds can be hammermilled at high speed, using a screen with approximately 3/16-inch round holes and cleaned with a fanning mill.

Quality. The seeds are somewhat larger than those of white clover, unspotted, usually yellowish to light purple in color. There are about 680,000 in a pound. The 7-day germination is slightly above 50 percent. The hard seed content is high. For best





Lappa claver, *Trifolium loppaceum*. Flowering bronch; enlarged stipule (*5*) ond leoflet; two views of colyx: (*1*) normol with corolla intact, and (*2*) split apen; twa views af seed.

Red clover, *Trifolium protense*. Plont and langitudinal view af inflarescence; view of three seeds.

PLATE 22

germination the seeds should be scarified. They are relatively long-lived and in most cases will retain good germinating qualities for 3 years in proper storage.

RED CLOVER (*Trifolium pratense*)

Adaptation and Use. An upright, leafy, and usually hairy perennial, most often grown as a biennial. The flowers are red, in a globe-shaped or egg-shaped head and not borne on stalks. This is the favorite legume of the northern states for hay and pasture. There are two forms--medium red and mammoth. Recent experiments have produced some promising selections for the Region. Kenland is one adapted to the southern conditions where anthracnose is normally prevalent and a serious disease. Kenland is long-lived and has maintained good stands into the third year. Other adapted varieties are: Louisiana Red, Cumberland, Kentucky 215, and Tennessee Anthracnose-resistant.

Red clover grows best on heavy, well-drained or moderately wet soils of good fertility. Acid soils must have lime, phosphate and potash. Climatically, red clover can be planted in the Region from eastern Oklahoma and eastern Texas eastward, and to some extent under irrigation on the High Plains.

Likely Seed Areas. Northern Arkansas has grown red clover for long periods and produces some seed. There is some commercial production of one or two promising varieties in Louisiana, the seeds of which are now becoming available.

Managing for Seed. Following the practice used in northern states, red clover is allowed to grow for one year, develop a good crown after the companion or nurse grain crop is cut and go through the first winter without much disturbance of top growth. The second year the first crop is cut for hay in early June and the regrowth, which produces more heads, is saved for seed. In this Region if it is seeded in the fall and makes sufficient growth to survive the winter, a seed crop can be taken the following summer or autumn. Set or fill depends on a number of factors, as (1) sufficient soil moisture to obtain and maintain full flowering, (2) an abundance of bumblebees and other pollinating insects, (3) the absence of injurious insects, as clover midge and chalcis fly, (4) competing weedy vegetation and (5) the time of the first cutting. The density of the second growth and the kinds and numbers of noxious or competing weeds will be factors in determining whether the crop should be harvested. Hot dry weather is not conducive to seed set. A dry period in the summer may suppress stem development. Early cutting, or proper pasturing and moisture relations following these practices will often determine the amount of second growth. In Idaho, under irrigation, the clover is usually pastured until about June 30. If the growth is uneven it is clipped at that time for subsequent even stem production.

A crop is reckoned on the basis of seed set and the number of heads per work area. An average of 10 heads per square foot and 60 seeds per head will produce about 100 pounds of seed per acre. This is a fair yield. With an average of only 30 seeds per head and 10 heads per square foot the yield is about 50 pounds per acre. This is doubtful seed to harvest for anything except home consumption unless the price is high and harvesting costs are reasonable. If there are fewer than 20 seeds to the head the crop probably should not be saved. The average number of seeds per head can be determined by clipping a given number of mature pods (dry flowers) from several heads, shelling them in the palm of the hand and counting the seeds. Then obtain by estimate or count the average number of flowers per head. The best time to cut red clover for seed is when the heads have turned brown and the seeds show a violet color. Sappy, growthy stems can be cut earlier than short, dry stems, as the seeds will mature on the sappy stem. Under irrigation where the crop can be matured uniformly and combined, the heads may be left until they are black or until the seeds have fully colored.

Production Under Cultivation. Two bushels (120 pounds) is a good yield under ordinary dry-land conditions. Under irrigation the yields are usually much greater.

Harvesting. Various machines have been used to cut the stems for seed but the most common are a mower with a windrowing attachment, and one with a bunching attachment. The windrower is preferred because it leaves the cut clover out of the path of the horses or tires. Some farmers mow the stems, windrow while damp with a dump rake and then when cured fork into small cocks. These should not be over 3 feet high and wide. One objection to straight mowing is that the horses or tractor wheels break off some of the heads. Hulling is sometimes done from cocks. More often the cocks are stacked and the stacks hulled after the sweating period is over. Hulling can be done with a moving combine from the windrow, but the material must be bone dry. The adjustments are about the same as for crimson clover and must be carefully made. Where the acreage is large enough in a community, a special clover huller is usually available. Such a machine consists of an ordinary threshing unit equipped with an auxiliary cylinder and concave with rasps for shelling the seeds from the hulls. The dry material is always fed evenly through a huller.

Care of Green Seed. Seeds combined direct must be carefully and thoroughly dried before sacking. When hulled from the cock or stack, they are sacked at the machine.

Cleaning. Most lots of seed from the huller have a high purity, provided they are free of noxious weed seeds. A cleaning by the fanning mill will usually remove the excess trash. Careful cleaning in the multiple-screen mill or gravity cleaner is necessary to remove noxious weed seeds.

Quality. Commercial seed standards for red clover are: Purity 98 percent; germination 85 to 90 percent; number of seeds per pound 275,000 to 313,000; longevity 4 to 6 years; weight per bushel 60 pounds. The Regional Laboratory shows a 7-day germination test of 76 and a final test of 77, plus 11 percent hard seed. Stored at the ordinary room temperature of 18° C. Danish seed tests show that from the fourth to the fifth year the germination dropped from 86 to 48 percent with almost no change in the hard seed percentage. In this Region, seeds probably should not be held longer than 3 years in storage.

WHITE CLOVER (*Trifolium repens*)

Adaptation and Use. A creeping perennial rooting at the nodes, forming small crowns, and without aerial stems. The white or pink heads of flowers and leaves are borne on long stalks from the creeping stems. Known in the South as "white Dutch clover." The southern type is more growthy than the northern and northeastern form. White clover is a valuable grazing crop and is widely adapted to the soils of this Region. It grows best in the humid sections on the well-watered first and second bottoms when well supplied with phosphorus and lime. Planting on poor hillsides is not recommended. Not grown where the rainfall is less than 36 inches except under irrigation.

Likely Seed Areas. These are found in southern Louisiana and in the delta lands of Arkansas and Louisiana. Grazed areas of good density also appear at many points in eastern Texas and eastern Oklahoma. Small plots can be harvested in some closely mowed city lots and parks throughout most of the high rainfall areas.

Managing for Seed. White clover is a low-growing plant that will not flourish in the shade. For dense even stands, all other plants competing for light must be kept short. Proper fertility will help to keep the plants vigorous and crowd out weeds. In the Western Gulf Region, do not grow white clover for seed alone; combine grazing with seed production for most profit. To maintain a stand of clover and keep carpetgrass reduced, the following practices are recommended: (1) Disk late in the fall, (2) disk in 200 pounds of 20 percent superphosphate on fine sandy loams and use 300 pounds of 0-12-12 or 0-14-7 on all other soils, (3) reseed all thin or bare spots, (4) graze the spring growth with cattle, removing the animals 6 weeks before maximum number of

flower heads are produced, (5) after removing the stock, clip all growth to a uniform level, (6) rogue such weeds as amaranth, charlock, catchfly, cinquefoil, canarygrass, mayweed camomile, plantain, sheepsorrel, and alsike clover, as their seeds are difficult to separate from white clover seed, and (7) keep growth clipped after seeds are harvested. Cross-pollination is needed for seedfill. Honeybees, the chief pollinating insect, can be used by placing hives in the vicinity of the clover during the blooming period. Fill can be determined by selecting a number of dry heads at random, obtaining an average of the number of flowers in each and then completely shelling out all seeds in the palm of the hand. An average of 70 seeds per head and 30 heads per square foot will produce an average yield. "Cut when two full sets of blooms have been made and when 75 percent of the seed in the second set of blooms are in the hard-dough stage." The first set of blooms yields the most seeds. Do not wait for all heads to mature, as many of the earliest will have lopped over to a point where the sickle bar will not touch them.

Production Under Cultivation. A hundred pounds of seed per acre is a normal yield from average stands. Under ideal conditions from a good stand 200 pounds per acre have been obtained.

Harvesting. The plants are cut close with a mowing machine in excellent condition and with enough power to prevent the sickle from pulling the plants. Mow when the plants are dry. If the growth is heavy, it can be left in the swath to cure completely; then combine. If the growth is thin or short, the cured hay must be raked into a windrow before combining. Windrowing is necessary if a heavy rain falls on the seedhay in the swath and cements it to the soil. Handle the seedhay as little as possible, but it must be turned when wet and be thoroughly dry when combined. To overcome adverse weather conditions and the costs involved in drying for combining from the field, the partially cured seedhay can be picked up from the windrow with a buck rake, or bull-rake stacker, stacked, and threshed after sweating is over.

Some growers use a mower with a buncher attachment. Others fasten a metal pan to the cutting bar and rake the heads into it. When the pan is full, the seedhay is placed in small bunches. Small compact bunches can easily be turned for drying. When thoroughly dry, such bunches can be forked into a canvas-covered truck or wagon and hauled to a stationary huller or combine.

Growers who have tried direct combining find it very difficult to get all the seeds, and some adjust their machines to obtain heads and segments of heads rather than clean seeds. Later, after thorough drying, they rethresh the heads.

Combining from the windrow requires skill, and adjustments must be made to suit conditions. Auxiliary-motor-equipped combines should be used, as it takes uniform cylinder speed to do a clean job. The cylinder speeds vary from 1100 to 1600 RPM. The cylinder spacing is close. Two concaves are used in some machines. The chaffer, shoe sieve, chaffer extension, and tailboard are set to return all unhulled seed to the tailings auger and cylinder. Use a special 1/14-inch screen below the shoe sieve to permit passage of clean seed only to grain auger.

Clean threshing is accomplished best with a clover huller equipped with a fine-mesh sieve.

Care of Green Seed. White clover seeds cured properly and thoroughly dried before hulling can be sacked at the machine. Cleaned seeds command a better price than combine-run seeds. Fanning mills carefully adjusted will generally clean such seeds if no noxious weeds are present. To remove most weed seeds, a several-screen cleaner or gravity cleaner is needed.

Quality. The seeds of white clover are very small. There are 800,000 to the pound. Danish investigations show that when the seeds were held at 18° C (room temperature),

the germination is not markedly lower, until the sixth year. The longevity standard is 2 to 3 years. The average purity is 95 percent, the average germination 75 to 80 percent. In some lots, the hard seed content is as much as 22 percent. Continuous wet weather at the time the crop is curing in the field is responsible for the browning of the seeds. This lowers the quality, even though the germination may not be materially reduced.

LADINO CLOVER (*Trifolium repens var.*)

Adaptation and Use. Ladino clover, a giant form of white clover, is showing much promise in grass-clover mixtures throughout much of the United States. Its height growth is about twice that of white clover. It is used in mixtures of permanent turf and bunchgrasses. It is extremely aggressive under favorable conditions and retards the encroachment of many weeds. For grazing it serves best where it is permitted to make good growth and is then grazed down to a height of about 4 inches. Livestock should then be removed until the plants have made good regrowth. It fits in well with rotational grazing and provides pasture for all classes of livestock and poultry. When grown with a grass it has proved valuable for hay and silage.

Likely Seed Areas. None outside of commercial production areas which are mostly in the irrigated sections of the western states.

Managing for Seed. This clover has been planted at many points in this Region. So far the reports are not promising for seed production, as it blooms sparingly. When it dies in the summer it does not reseed like the naturalized white clover strains do.

The seeds of this variety are like that of the other varieties and cannot be separated from them. For genetic purity it should not be sown in the vicinity of any other variety of white clover. In Oregon the crop is managed for seed production by grazing in the spring until about May 15. Two sets of blooms are allowed to develop and mature before harvesting begins. "Where irrigation water is properly and evenly distributed and the first set of mature blossoms is not destroyed or kept wet too long, this practice often results in increased seed yields." A long growing period is most desirable for this practice. Some growers cut the crop once for seed in the fall from a whole season's production of flowers. Under this treatment the crop is ready to harvest when 90 percent of the heads are brown and mature enough to thresh when dry. Irrigation water is usually kept off the field two weeks before harvest.

It is not practicable to combine the standing crop. In clover growing sections, clover hullers or combines with clover-hulling attachments are available. The crop is handled as described for white clover, that is by mowing and combining from the swath or windrow and by bunching and hulling.

Yield Under Cultivation. Yields vary from 100 to 400 pounds of seed per acre.

Cleaning. See white clover.

Quality. See white clover.

PERSIAN CLOVER (*Trifolium resupinatum*)

Description, Adaptation and Use. A true winter annual; the stems 10 to 24 inches tall, upright or weak and spreading; the leaves similar to those of white clover but more tapering at the base; the flowers pink, in small dense heads which are borne on the ends of slender stalks produced from the axils of the leaves. The most conspicuous feature of the plant is the inflated calyx. That part of the calyx tube bearing the two longer teeth enlarges into a small pear-shaped balloon and becomes veiny and papery-white. The

remainder of the calyx stays normal in size. The rather few-flowered heads in fruit are slightly more than a half inch in diameter.

Adapted to all of the Region in the rainfall area above 37 inches; not hardy in the North, but grown to some extent in the coastal region of the Pacific states. It is not recommended for upland sandy soils. Best adapted to low-lying, heavy, moist soils. On strongly acid soils finely ground limestone is recommended to reduce the acidity. All fertilizers should be applied in the fall before planting or before naturally sown seeds germinate.

Likely Seed Area. Local areas in Louisiana. There is a possibility, due to ready adaptation and the lightness of the pod and inflated calyx, that this clover will increase naturally and spread more rapidly than white clover. It is reported spreading to roadsides in eastern Texas.

Managing for Seed. Persian clover is seldom planted in pure stands. The best stands are obtained on Bermudagrass and Dallisgrass turfs, also on carpetgrass. Disking a turf on the last aids in establishment of a stand. Under ideal conditions Persian clover is a prolific seed producer. The flowers are self-pollinating, which favors seed-setting under unfavorable weather conditions. Honeybees undoubtedly help to increase seed production.

For maximum stem yields, grazing is recommended up to approximately four weeks before the flowers open, usually about April 1. The cattle are then removed and the field clipped to obtain an even growth and lower the stature of the weeds. This method favors uniform stem and bloom production and reduces the amount of straw to be handled when harvesting the seeds. Time of harvest is important. The inflated fruits break off the heads easily. Harvesting should start when most of the pods are light-brown in color and before the fruits are dry enough to break off even though many flowers are still open.

Harvesting. Persian clover does not combine well from standing stems. The method favored is mowing, but with the mower bar equipped with lifter guards. In thick or lodged stands a weed bar works better than the regular bar. The plants are wilted in the swath and windrowed while damp to roll the heads to the inside of the windrow as much as possible to reduce shattering. The windrows should be uniform for the best combining. Occasionally the wilted material is put in small cocks, cured and combined.

The recommended settings of the combines are: High cylinder speed (1600 RPM), use additional concaves, very narrow cylinder-concave spacing (1/16 and 1/4 inch), use 1/12-inch special screen below shoe sieve and a slight amount of air.

Threshing with clover huller is recommended when material is bone dry and hullers available. The easy shattering and inflated fruits suggest that the stems can be allowed to dry in the swath, then raked off with a dump rake and the fruits picked up with a suction machine with reduced fan speed.

Production Under Cultivation. Under ideal conditions seed yields are 600 pounds per acre. More often they range from 150 to 300 pounds per acre.

Cleaning. See white clover.

Quality. The seeds of Persian clover are olive-green to blackish-purple. Most lots contain some reddish-brown and yellow seeds. In size and color they are difficult to separate from those of white clover, being but slightly larger. There are 675,000 in a pound of pure seed. The purity is generally 95 percent or higher, the 7-day germination is low and the final germination plus hard seed seldom exceeds 85 percent. Very often there are some white clover seeds present in each sample when grown in Louisiana. The seeds should not be stored longer than 3 years.

HAIRY VETCH (*Vicia villosa*)

Adaptation and Use. A taprooted and fibrous-rooted winter legume with hairy or smooth, weak sprawling stems to 3 feet high; leaves compound and ending in a tendril; flowers hairy, purple and loosely clustered at the ends of the branches; pods 3- to 6-seeded. A smooth variety is about as common as the hairy form.

Adapted throughout the Region in sandy soils. Used for soil conservation, soil improvement, grazing, hay and seed production. Limited or summer rainfall restricts its use in the western part of the Region.

Likely Seed Areas. The West Cross Timbers seems to be a good production area. Considerable seed is now grown in eastern Texas. The Pacific Northwest still supplies a good deal of seed.

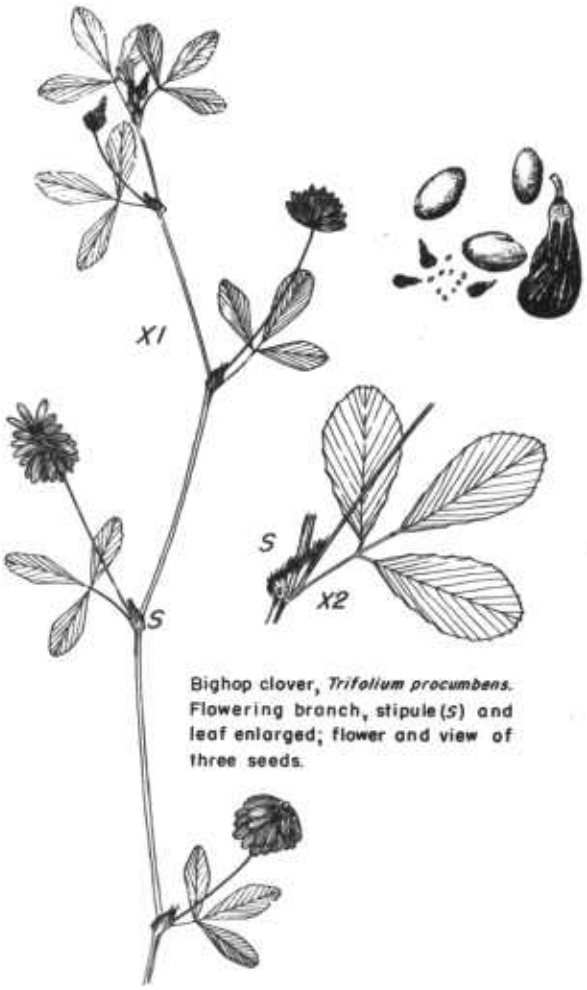
Managing for Seed. Vetch is grown alone and with a companion grain crop, such as Abruzzi rye, Balbo rye, oats, barley, or wheat. It is also overplanted on Bermudagrass. Moderate grazing in late winter and early spring reduces the shading effect of the grass and increases the branching of the vetch. For maximum seed production, livestock are removed about April 1 or 10. This allows 4 to 6 weeks of growth before flowering starts. Normal rainfall in late April and through May assures good growth. Seed yields depend on late April and May rainfall, proper fertilization in the fall, and on the absence of harmful insects and diseases. Successive crops of vetch encourage insects and diseases. Harvesting begins as soon as most of the pods are nearly mature, usually the second week in June, and before shattering advances.

Ten percent of the pods or more may be green when shattering starts. The crop must be examined to learn when the most and best pods are ready. A hot dry period or drought during part of the flowering period may cause flowers to drop. A late rain may increase flowering and result in a late crop.

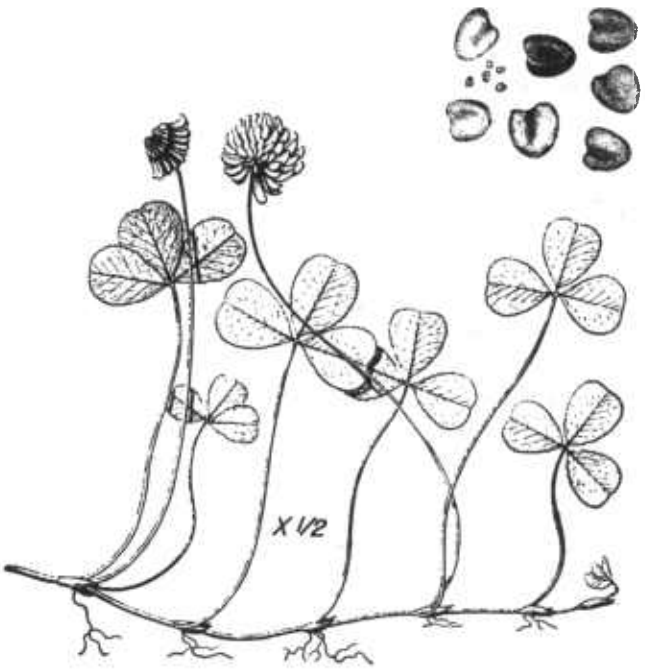
Harvesting. Several methods have been used. The combine is most popular in this Region. When the crop matures fairly evenly the combine should be used. Usually the combining starts while there are some green pods present. Some operators prefer to lose some seed and wait until the vines have dried and partially collapsed, and most of the pods are dead ripe. The vines handle better under such conditions. Adjustments of the auxiliary-motored combine for partly green vines are: (1) Use pickup reel to keep sickle clean; (2) use a divider-spreader bar to press the vetch away from the standing material; (3) use cylinder speed of 1200 to 1300 RPM, cylinder spacing of 1/4 to 1/2 inch; (4) open chaffer and shoe sieve enough to allow free passage of the seeds; (5) use a 5/32 x 3/4-inch or a 6/32 x 3/4-inch slotted screen beneath the shoe sieve when vetch is grown alone (widen the opening of all sieves and omit special screen if harvested with a grain crop); (6) use some air to keep chaff floating above shoe sieve, and (7) drop tailings back of cylinder. Because of rapid changes in moisture during a hot day, the cylinder speed will need to be reduced to suit dryness of seedhay. For dry stems the cylinder speed need not exceed 1000 to 1100 RPM.

Vetch has been successfully harvested with a mower and attached windrower. A gooseneck bar fastened to the mower shoe is helpful in separating the tangled plants. Start mowing when most of the seed is well formed and beginning to color and before the pods turn dark. The buck rake is used immediately to push the windrowed seedhay into large bunches where it is cured 3 to 5 days. The large bunches are carried to the combine or thresher with the buck rake and rolled onto a canvas. Sometimes the combine is pulled to the bunches. Since shattering is going on at the machine during threshing, a canvas should be spread out under the feeder to catch loose seed. Windrowed seedhay is picked up carefully with a tine attachment and combined.

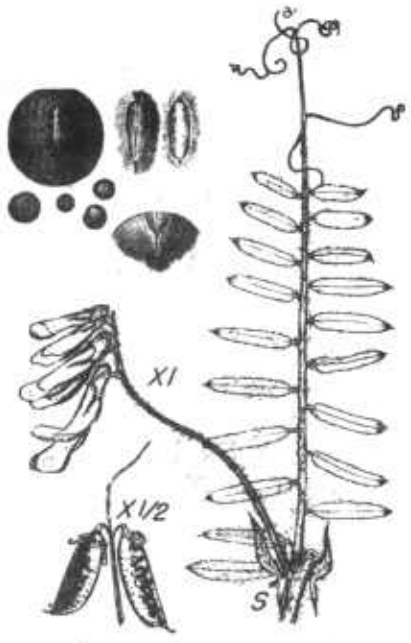
Vetch has been mowed and combined direct from the swath with a pickup attachment. Some seeds are lost during this operation. Where a part of the field ripens ahead of the remainder, or is weedy, it can be mowed and cured while the remainder of the field is being combined.



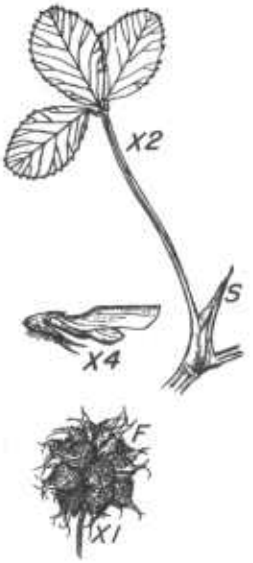
Bighop clover, *Trifolium procumbens*. Flowering branch, stipule (*S*) and leaf enlarged; flower and view of three seeds.



White clover, *Trifolium repens*. Rooted stolon; view of seven seeds.



Hairy vetch, *Vicia villosa*. Portion of stem showing leaf, stipule (*S*), and flowers; two pods; views of seed and hilum areas.



Persian clover, *Trifolium resupinatum*. Leaf, stipule (*S*) and flower; cluster (head) of fruits (*F*); two views of inflated calyx at the time seeds are mature, and two views of seed.

PLATE 23

Production Under Cultivation. Seed yields vary considerably. They are as low as 75 pounds per acre in dry years or when insects and diseases are bad. The range is 100 to 800 pounds per acre.

Care of Green Seed. Seeds combined with grain can be placed in porous sacks, set in the sun and air and turned until dry. Better to fill the sacks about one-third full.

Cleaning. When dry, the seeds are run through the fanning mill to remove trash and dirt and then through a spiral separator to separate the vetch from the small grain.

Quality. The seeds of hairy vetch are nearly round, and usually evenly colored dark-brown or blackish. They resemble the seeds of narrowleaf vetch. The laboratory records show an average purity of 96 percent, a 7-day germination of 58 percent and a final germination of 81 percent plus 8 percent hard seed. The number of seeds per pound varies from 16,000 to 20,000. Properly cured seeds remain viable for about 3 years. Most lots grown in the Region are planted in the fall or early winter following the harvest.

MEANING OF TERMS

Auricle - An ear. The earlike lobes found at the summit of the sheath in grasses.

Awn - A slender bristle at the end of an organ.

Callus - A downward extension of one of the following: (1) The rachilla, (2) mature lemma, (3) oblique section of the rachis.

Caryopsis - The grain or fruit of most grasses.

Fertile floret - The lemma and palea with an included pistillate or perfect flower.

Floret - The lemma and palea with or without an included flower. Florets may be perfect, staminate, pistillate, neuter, sterile, and rudimentary.

Fruit - The ripened ovary or this organ with the parts that may enclose it at maturity; the fruit of legumes is a one-to several-seeded pod.

Glumes - The pair of bracts at the base of a spikelet.

Grain - A caryopsis; a ripened ovule enclosed in and grown fast to the pericarp or ovary wall.

Inflorescence - The flowering part of a plant.

Lemma - The bract of the spikelet above the glumes; the outer bract of a floret.

Ligule - The appendage on the inside of a grass leaf at the junction of the sheath and blade.

Palea - The inner bract of a floret.

Panicle - An inflorescence with a main axis and subdivided branches.

Pedicel - The stalk of a spikelet; the stalk of a flower.

Raceme - An inflorescence in which the spikelets are pediceled on a rachis.

Rachis - The axis of a spike or raceme.

Rhizome - An underground stem; rootstock.

Seed - The fertilized ovule with an embryo formed within it; in grasses the grain with or without bracts or appendages.

Seedfill or fill - Applied to developing or developed ovules.

Seedhay - Cut stems of plants that bear ripe or ripening seeds; tailings from the combine may be seedhay.

Seed material - Usually applied to trashy seeds obtained by stripping, topping or rough combining; uncleaned seeds.

Seedunit - In grasses the grain alone or the grain with its attached or surrounding bracts or appendages.

Spike - An unbranched inflorescence in which the spikelets are without stalks.

Spikelet - The unit of the inflorescence in grasses, consisting usually of two glumes and one or more florets.

Sterile floret - One incapable of producing fruit; in grasses it may be staminate or without sexual organs.

Stolon - A stem above ground creeping and rooting at the nodes.

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