A Simple Method of Converting Rangeland Drills to Experimental Plot Seeders

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Highlight: Rangeland drills can be converted to experimental plot drills by mounting a cone seeder and a spinner divider over the seed box. The cone seeder feeds a uniform amount of seed over the length of a plot and the spinner divider splits the seed into fractions with each fraction going to a separate planting unit, i.e., disk openers, hoes, or shoes. This greatly reduces the labor involved in seed packaging and cleaning. Numerous forage species can be seeded in contiguous plots without modifying or recalibrating the planter.

Seeding rangelands and other sites to improved grasses and legumes often requires drills designed specifically for that purpose. Rangeland drills have been developed that are capable of seeding light, chaffy seeds into poorly prepared seedbeds on rugged terrain. New power tillage drills are capable of seeding directly into dry weather and poor planting. Therefore, it cannot be predicted as well as damage. Survival was significantly reduced with increased forage use ($r = .392$, $n = 22$) but the regression, $Y = 3.8430 + .5083 X$, accounts for only 35% of the variation. On the other hand, change in the number of undamaged trees (increase in damage associated with grazing) correlated closely with percent forage use ($r = .771$, $n = 22$). The regression, $Y = 1.7397 + .7715 X$, explains 59% of the variation. Thus, forage use is a good predictor of the increase in the percent of trees damaged as a result of grazing (Fig. 1).

The regression of damage on forage use (Fig. 1) indicates that even light grazing on first-year plantations will result in some damage. Thirty percent forage use will result in about 20% of the trees being damaged. Whether or not this damage is ultimately translated into growth reduction must await further study. Hughes (1976) found that it took combinations of different types of damage to reduce growth of slash pine. The major source of damage in our study was trampling.

These results are applicable only to plantations where site preparation was extensive and where plant succession is in the annual weed stage. The predominant forage plants on our study areas were horseweed (Erigeron canadensis) and other unpalatable annuals. Thirty percent total forage use might be quite high in this plant community and in order to achieve it cattle may have to travel extensively in search of palatable plants. Pearson et al. (1971) found that only heavy grazing (57% forage use) reduced first-year survival in slash pine, but the seedlings were planted on a climax bluestem grass community. The amount of damage one might expect in first-year plantations is not only related to the number of cattle and percent forage use but also the stage of plant succession and the amount of good forage available. An increase in the amount of palatable forage might be expected to reduce cattle damage to pine plantations and lower the slope of the regression presented.

Literature Cited


Numerous plot drills have been developed for seeding agronomic trials. Most are unsuitable for use in rangeland trials because they cannot seed chaffy grass seed or they cannot be used in rangeland seedbeds. Many agronomic plot drills have desirable features that can be used on rangeland drills.

The three main components of a plot drill are the seed feeding mechanism, seed dividing mechanism, and the seeding mechanism. Most rangeland drills have suitable seeding mechanisms. Only the seed feeding and seed dividing mechanisms need to be changed to convert them into plot seeders.

Feeding mechanisms are used to feed a uniform amount of seed over the entire length of a plot. Feeding mechanisms most commonly used on plot drills are slotted, revolving belts (Frey and Downs 1950; Patterson, et al. 1957) and rotating cones (Barker, et al. 1976; Beard and Freeman 1960; Berg 1958; Marshall 1972; Ojyjord 1963; and Schmidt 1971). Belts or cones are gear driven by planter or packer wheels and are geared so that one complete revolution of a cone or one-half revolution of a belt occurs when the planter moves the length of a plot. As the belt moves forward and the cone rotates, seed is dumped into a seed divider or directly into seed tubes. At the end of a plot, the self-cleaning belts or cones are empty and can be filled with seed for planting the next plot. Only the amount of pure live seed necessary to seed a plot is placed on a belt or in a cone, which simplifies calibration and keeps to a minimum the amount of seed needed. Cones are more compact and easier to feed than belts and it is easier to shield them from wind.

Seed dividers are used to split the seed into fractions with each fraction going to a separate planting unit, i.e., disk openers, hoes, or shoes. They make it possible to seed one plot with one packet of seed. This greatly reduces the labor involved in seed packaging in comparison to drills (Beard and Freeman 1960; and Berg 1958) that have no dividers but use a separate cone for each planting unit. Agronomic plot drills use various methods of dividing seed...
lots including baffle sets (Frey and Downs 1950; and Patterson et al. 1957), Boerner dividers (Clark and Fehr 1973), multiple outlet cones (Marshall 1972; and Schmidt 1971) and spinner dividers (Barker et al. 1976; and Øyjord 1963). Baffles and Boerner dividers are easily plugged and hence are not usable with chaffy grass seed. Spinner dividers can be used with all types of seed including chaffy grass seed. Chaffy grasses can be seeded with some multiple outlet cones (Schmidt 1971) but more than one cone is needed.

Øyjord (1963) developed and described the spinner divider, which he called a distributor. The operating principle of Øyjord's seed divider is simple. A tightly fitting spinning device is located inside a housing that is vented only with seed outlet tubes. The spinner can be a finned dome or a partially finned dome. As seed is dumped on top of the spinner, its rapid rotation throws the seed into the seed tube outlets. The rotation of the spinner effectively divides the seed sample. Spinners may be mechanically or electrically powered. Interchangeable distributors with two to ten seed tube outlets can be used for different numbers of seeding units.

A K. E. M. Corp.1 plot grain drill was modified into a cone seeder with a spinner divider by K. E. M. Corp. according to my specifications. The same procedure could be used to convert range-land drills to plot seeders using commercially available cones and distributors. A K. E. M. cone seeder and spinner divider unit was mounted over the seed box of the planter (Figs. 1 and 2). The cone is driven by one of the planter wheels using a gear drive assembly. The gear drive is directed through a Zero-Max1 unit, which makes it possible to vary plot length from 1.2 to 15.2 m by cranking new settings into the unit, which has a digital display. The drill has seven disk openers spaced 18 cm apart. Planting depth is regulated by adjusting the position of the planter wheels using a hand crank.

The cone is 20.3 cm in diameter and has 20 cells. The cone rotates on a plate that has an opening equal in size to a cone cell. As the cone rotates, seed drops through the cone plate and into the seed divider via a connecting tube. A seed cup is centered over the cone apex and fits into a sleeve in which it can slide up or down. Seed is poured into the cup and leveled. Seed is then dumped into the cone by raising the cup. The seed cup can be raised manually or by using an electromagnetic lifting device. A plexiglass box was built around the cone for protection from the wind. The bottom half of the side facing the operator was left open.

A small electric motor (Fig. 2) is used for rotating the spinner in the divider. The electric motor is powered by the tractor's battery. The operator can turn the motor off using a toggle switch mounted on the cone. Clear plastic seed tubes lead from the distributor outlets to the planting units. Distributors with four and seven outlets are shown in Figures 1 and 2, respectively.

Figure 2 shows the plot drills in use. Normal plot size is 4.5 m long x 1.25 m wide. Contiguous plots are separated by a 1.5-m alley. The cone is set to make one revolution when the drill moves 6 m. Seeding begins in the middle of an alley. The drill is empty and clean in the middle of the next alley and the cone is filled with seed and the process is repeated. The tractor wheels are used to mark the alley.

I have seeded 14 species of grass with this drill including smooth bromegrass, *Bromus inermis* Leyss.; four species of wheatgrass, *Agropyron*; creeping Foxtail, *Alopecurus arundinaceus* Poir.; switchgrass, *Panicum virgatum* L.; and sand lovegrass, *Eragrostis trichodes* (Nutt.) Wood. Extremely small seeds such as sand lovegrass can slip under the edges of the cone partitions as the cone rotates. This results in erratic feeding of seed into the seed divider and incomplete cleaning of the cone. Flat seeds such as smooth bromegrass sometimes slip under the edges of the cone partitions, causing the cone to jam. Both problems are solved by dumping approximately 20 ml of fine vermiculite into the cone before the seed is added. The vermiculite prevents seed from slipping under the cone partitions and gently sweeps the seed along. Vermiculite works so well that it is now used routinely with seed of all grass species.

Barker et al. (1976) has seeded 44 forage species with a cone seeder and a spinner divider, including little bluestem, *Andropogon scoparius* Michx. They were able to plant this extremely

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1 Mention of a trademark, proprietary product or vendor, does not constitute a guarantee or warranty of the product by the U.S. Department of Agriculture and does not imply its approval to the exclusion of other products or vendors that may also be suitable.
An Information Storage-Retrieval System for Resource Managers

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Highlight: An effective information storage and retrieval system is described. The system is inexpensive, and allows convenient cross referencing. It is especially useful for filing reprints and articles, but can also be used for photographs, microfiche, research data, and various other items.

One of the most troubling problems facing resource managers and researchers alike is storage and retrieval of information. Most of us easily accumulate large numbers of reprints, publications, and assorted reports during a career. Finding a report or searching for information on a specific topic, however, is often difficult and time consuming.

Various systems have been developed to facilitate filing and retrieval of reprints or reports. Perhaps the most common method is to file individual documents in file drawers or boxes under a subject heading. Unfortunately, this system does not easily permit cross referencing. Often a report contains information on more than one topic, and it is difficult to determine the appropriate subject heading. Retrieval of such information, therefore, requires searching through many reports filed under different headings, a process that is often frustrating.

This difficulty can be mitigated partially by using a complementary card-filing system. Subject headings are established, and author-title cards are filed under each relevant heading. Thus, cross referencing is done by searching several different headings. This method requires the preparation of several cards for each report, one for each keyword, which makes cross referencing inconvenient.

Another technique utilizes edge-punched cards (Adams 1955; Bryan 1966). This system allows cross referencing, but requires a considerable amount of planning in the development of a filing code. In addition, edge-punched cards are expensive.

Of course, the ultimate system for storage and retrieval of information is a properly programmed computer. Many programs exist for such applications, but we found FAMULUS, developed by the Pacific Southwest Forest and Range Experiment Station in the U.S. Forest Service, to be highly satisfactory (Burton et al. 1969; Scharpf et al. 1976). We have complete bibliographic files for Crater Lake National Park and John Day National Monument stored on tape, and we use the CYBER 73 computer at Oregon State University for search and retrieval. Unfortunately, many resource managers and field researchers do not have ready access to a computer.

For the last 2 years we have been using a manual system that allows efficient storage and retrieval of information and convenient cross referencing of several keywords. The system was originally developed for engineering applications and described by Conner and Nieves (1969). We have found this filing system to be very flexible and have adapted it for our own use in the areas of resource management and land-use planning. The system may be used for slides, photographs, or microfiche, as well as laboratory data, on-hand publications and reports, and material located in other areas, such as libraries.

How to File an Article

One need not purchase expensive punch cards or machinery. The cards used are 3-inches by 5-inches (or whatever size is desired).

When a publication is received that you wish to keep, it receives an accession number. The number is placed in either the upper left- or right-hand corner of the publication. The numbering of each successive article is continuous, regardless of topic or author. An accession card (3-inches by 5-inches) then is assigned to the article. On this card is listed accession number of article, author, title, and other bibliographic information, including an abstract if you wish. A completed accession card for an article by Wright (1972) is shown in Figure 1. If the article is not located in your files, but you still value a reference to it, its location may be listed below the other data.

Keywords then are assigned to the article. These are words that accurately describe important topics discussed or otherwise allow ready retrieval of the article. The specificity and number of keywords are at the discretion of the individual who will be using the files. If you wish, you may list the keywords on the accession card (Fig. 1). Many technical journals now supply preprinted accession cards to which you may only affix an accession number.

The next step in filing this article can readily be done by a secretary or assistant. For each new keyword, a keyword card is prepared. We use 3- by 5-inch cards that have been preprinted, with no keywords or accession numbers. The accession number of this particular article is placed in a column corresponding to its last digit (Fig. 2). That is, if an article was No. 235, this accession number is listed under column 5 on the appropriate keyword cards. Listing by the last digit allows ready expansion of the system and provides an orderly column of numbers for easy viewing. Try to keep the digits directly below each other in the

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References


Schwendiman, L. O., and Roland F. Sackman. 1960. The K.E.M. 20-cm cone does not have the capacity to handle enough seed of unprocessed little bluestem and big bluestem, Andropogon gerardii Vitman, to plant a 4.5-m plot. Excessive amount of seed in the cone causes plugging of the seed tubes. The granite grit used by Schmidt (1971) and Barker et al. (1976) is very abrasive and damages the brass plate of the cone.

Chaff and seed appendages of little and big bluestem and other chaffy grasses can be removed by using seed processing methods described by Harland and Ahring (1960); Schwendiman et al. (1940); and Weber (1939). Processed seed can be easily used in the cone seeder. However, all orifices in the planting system should be at least 2.5 cm in diameter.

A cone and spinner divider could be mounted on any rangeland drill to be converted into a plot seeder. The drill described in this paper differs from the one described by Barker et al. (1976) in that a much simpler method of converting the drill and shielding the cone was used. Cones and spinner dividers are available from several firms.

Literature Cited


