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ARC, A MULTIPLE PEST-RESISTANT ALFALEA

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ARC, A MULTIPLE PEST-RESISTANT ALFALFA

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SUMMARY

Arc is a vigorous growing alfalfa cultivar (*Medicago sativa* L.) with high resistance to anthracnose (*Colletotrichum trifolii* Bain) and the pea aphid (*Acyrtosiphon pisum* (Harris)) and moderate resistance to the alfalfa weevil (*Hypera postica* (Gyllenhal)) and bacterial wilt (*Corynebacterium insidiosum* (McCull.) H. L. Jens.).

Arc is a product of more than 40 years of breeding and research. It was developed for the Middle Atlantic, Southern Appalachian, and Southern Corn Belt States through the cooperative efforts of alfalfa researchers in the Agricultural Research Service and the agricultural experiment stations of Maryland, North Carolina, Pennsylvania, and Virginia. It was released in May 1974 by the U.S. Department of Agriculture and these four experiment stations.

This is the first alfalfa cultivar bred for high resistance to anthracnose, one of the most damaging diseases of alfalfa in the warm humid areas of the United States. Approximately 80 percent of the Arc plants are highly resistant to this disease. This high resistance has been shown in field tests under naturally occurring anthracnose epiphytotics from Maryland to Kansas and Pennsylvania to North Carolina.

Arc's multiple pest resistance and vigorous growth characteristics will provide growers with increased yields, reduced weed competition, longer lived stands, and lower disease and insect losses than presently are obtained with other cultivars. In broadcast plots at Beltsville, Md., Arc has provided an additional 3 years of production after a bacterial wilt epiphytotic rendered plots of wilt-susceptible cultivars unproductive.

Growers should expect some weevil feeding on Arc; however, damage will be less than on other cultivars. Under light-to-moderate infestations, Arc will produce a satisfactory first cut of forage without insecticide control. In areas of higher weevil damage, the need for insecticides will be reduced, and better timing of applications may be possible as a result of delayed development of weevil damage on Arc. Greater control over the timing of insecticide applications may also enhance the success of biological control agents in pest management programs where both chemical and nonchemical controls are used.

INTRODUCTION

The value of host plant resistance in reducing losses to alfalfa pests has been amply demonstrated in the development and use of cultivars with multiple pest resistance.

Arc was the first alfalfa cultivar (*Medicago sativa* L.) bred for resistance to anthracnose. It was developed to provide growers with an alfalfa that combined high resistance to anthracnose (*Colletotrichum trifolii* Bain) and the pea aphid (*Acyrtosiphon pisum* (Harris)) and moderate resistance to the alfalfa weevil (*Hypera postica* (Gyllenhal)) and bacterial wilt (*Coryne-*

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bacterium insidiosum (McCull.) H. L. Jens.). The breeding procedures were previously described by Devine et al. (1975).¹¹ Arc was released in May 1974 by the U.S. Department of Agriculture and the agricultural experiment stations of Maryland, North Carolina, Pennsylvania, and Virginia.

Anthracnose disease was described by Bain and Essary (1906). During warm moist periods in the summer and fall, anthracnose spores germinate and penetrate the growing stems of susceptible alfalfa plants, forming oval-shaped lesions (fig. 1). The fungus grows through the stem into the crown of the plant, severely weakening or killing it (Graham et al. 1972). If susceptible plants survive, their vigor is drastically reduced and their competitive ability so weakened that the stand may be taken over by weeds (Devine and McMurtrey 1975). Anthracnose epiphytotics occur annually over large areas of the Middle Atlantic and Southeastern States. The extent of anthracnose damage in the southern Corn Belt is now being assessed.

Among the complex of insects attacking alfalfa, the alfalfa weevil continues to be one of the most important economically. Although weevil populations have declined in the Middle Atlantic and Northeastern States since 1967, the infestation level and severity of weevil damage have increased sharply in much of the Midwest and Southeast. The distribution of the alfalfa weevil in 1976 is shown in figure 2. This insect causes severe losses in alfalfa production in much of the eastern half of the United States south of 40° latitude and in scattered areas of the North Central and Western States. The invaded areas of Missouri, Kansas, Oklahoma, and eastern Texas have sustained increasingly severe damage by the alfalfa weevil since the early 1970's. In addition, the weevil remains a serious threat to alfalfa production in all the Southeastern and Southern States. Weevil populations are presently low in much of this region because the alfalfa acreage has been severely reduced from previous weevil attacks. However, populations would be expected to increase rapidly and cause serious damage with an increase in alfalfa production.

DISEASE RESISTANCE

Arc is highly resistant to anthracnose (Devine et al. 1971 and 1974). In laboratory tests, approximately 80 percent of the plants had a highly resistant reaction (fig. 3, table 1). The contribution of anthracnose resistance to performance has been outstanding. In naturally occurring anthracnose epiphytotics in broadcast field plots, Arc and its preceding cycles, MSHp6F-An3W3 and MSHp6F-An2W2, were highly resistant to anthracnose at Beltsville, Clarksville, Hagerstown, and Wye Mills, Md., Salisbury, N.C., Blacksburg, Va., Landisville and Hanoverville, Pa., Manhattan, Kans., Wooster, Ohio, and Chickasha, Okla., during 1970-74 (tables 2-4). Under conditions of severe anthracnose stress in Maryland, yields of Arc are as much as double those of susceptible cultivars at the third and fourth harvests of the season (Devine and McMurtrey 1975). High anthracnose resistance markedly increased forage yield, resistance to weed encroachment, and stand longevity.

Arc is moderately resistant to bacterial wilt. Results of the Minnesota test for bacterial wilt resistance are given in table 5. In broadcast test plots at Beltsville, Arc provided an additional 3 years of production after a bacterial wilt epiphytotic rendered plots of wilt-susceptible cultivars economically unproductive.

The high level of anthracnose and moderate level of bacterial wilt resistance in Arc were developed by three cycles of selection for resistance in the laboratory and greenhouse at Beltsville (Devine et al. 1971). Seeds were planted in flats of steamed soil and covered with sand. Two weeks after seeding, the seedlings were inoculated with the fungus causing anthracnose and held 3 days in a moisture chamber for incubation of the disease. Approximately 1 month after inoculation the seedlings were examined for anthracnose symptoms, and the highly resistant plants were selected for screening for bacterial wilt resistance. The selected plants were dug from the flats; their roots were clipped and immediately soaked in a suspension containing the bacterial wilt organism. After soaking, the seedlings were planted in peat pots and grown in the greenhouse. Six to eight weeks later the top growth of these plants was cut and

¹¹The year in italic after authors' names refers to Literature Cited, p. 9.



FIGURE 1.—Anthracnose disease symptoms on alfalfa stems, showing straw-colored oval-shaped lesions with dark margins and many minute black bristles or setae in the center. “Shepherd’s crook” (right) is often observed on dead stems. (Courtesy F. I. Frosheiser.)

Distribution of Alfalfa Weevil

Hypera postica

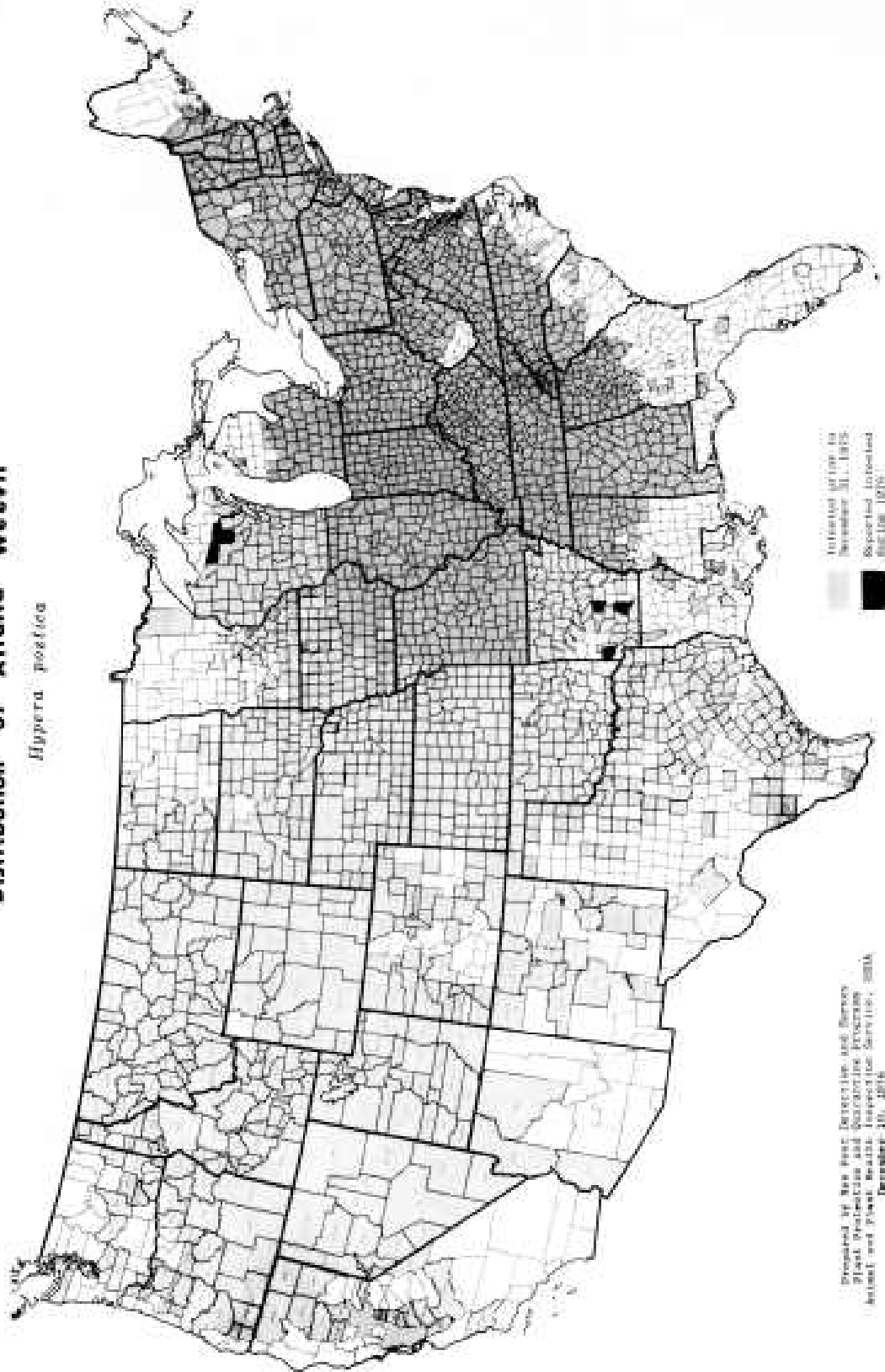


FIGURE 2.—Distribution of the alfalfa weevil. All shaded areas were infested prior to December 31, 1975.



FIGURE 3.—Reaction of Arc and other alfalfa cultivars, in laboratory tests for resistance to anthracnose disease, 3 weeks after inoculation with *Colletotrichum trifolii* Bain. Note vigorous green growth of anthracnose-resistant Arc.

the regrowth examined for symptoms of bacterial wilt. Plants free of symptoms were selected for intercrossing to produce the next cycle.

INSECT RESISTANCE

Alfalfa Weevil

Arc has a moderate level of tolerance to the alfalfa weevil. Its resistance to this insect was developed by five cycles of phenotypic recurrent selection for vigor and weevil resistance in field tests. Two of these cycles were in North Carolina and three were in Maryland (Devine et al. 1975).

In Maryland, North Carolina, and Virginia field tests, Arc or its preceding cycles, MSHp6F-An3W3 and MSHp6F-An2W2, were equal in tolerance or significantly more tolerant than Team to larval feeding damage (table 6). The value of weevil tolerance in Arc was particularly apparent when larval feeding damage was assessed during the entire first harvest growth. In North Carolina under severe alfalfa weevil infestation, Arc retained a satisfactory level of tolerance throughout this period, whereas other vigorous but less tolerant cultivars, such as Apalachee and Saranac, received considerably more defoliation as the season progressed (table 7). Vigorous spring growth, as demonstrated by Apalachee and Saranac, seems to depress weevil damage but does not provide a sufficient level of tolerance to be relied on as a means of control.

Growers can expect to find feeding damage on Arc, as evidenced by the data in tables 6 and 7. However, under light-to-moderate larval feeding damage, Arc will produce a good first cutting of forage without insecticide control. In areas of higher weevil damage, the need for insecticides will be reduced, and better timing of applications may be possible as a result of delayed development of weevil damage on Arc. Greater control over the timing of insecticide applications may also enhance the success of biological control agents in pest management programs where both chemical and nonchemical controls are used.

The weevil resistance of Arc is attributed primarily to tolerance, which is the ability of the plant to withstand and recover from insect

damage. Arc produces vigorous spring growth and heavy stem terminals. It has well-developed axillary buds, which can continue growth after the terminal stem bud is destroyed by larval feeding. In addition, the improved vigor and stand persistence of Arc resulting from disease resistance contribute indirectly to the cultivar's tolerance to weevil larval feeding (fig. 4).

Pea Aphid

Arc and its preceding cycles of selection have high resistance to the pea aphid. In laboratory tests, Arc's resistance significantly reduced the survival and fecundity of aphids or increased the survival of alfalfa seedlings when grown under heavy aphid infestation (table 8). In field tests, significantly fewer aphids were collected from Arc and its preceding cycles than from susceptible cultivars (table 9). High pea aphid resistance is an obvious asset in cultivars grown where this insect is a serious pest.

To assess the contribution of this type of resistance to forage production is more difficult in areas where the pea aphid is generally at subeconomic levels. Under these conditions, however, the reduction in aphid populations, such as occurs on Arc particularly in the fall, may contribute to improved vigor and persistence of the cultivar by enhancing late-season growth and related development of root reserves prior to dormancy.

Other Insect Pests

Arc shows moderate susceptibility to yellowing caused by feeding of the potato leafhopper (*Empoasca fabae* (Harris)), with generally more tolerance than Saranac and Williamsburg but less than Cherokee and Weevilchek (table 10). Precautions should be taken to protect Arc, as well as all alfalfa cultivars, from leafhopper feeding damage, since no cultivars are resistant enough for adequate protection under heavy infestation. The full benefit of Arc's anthracnose resistance will not be realized unless leafhoppers are controlled. Growers should examine their fields regularly during the period of major leafhopper activity from June through September to determine the need for insecticide control. Information on insecticide recommendations and timing of applications can be obtained from State agricultural experiment stations.



FIGURE 4.—Vigorous spring growth of Arc's preceding cycle, MSHp6F-An3W3, in contrast to adjacent plots of anthracnose-susceptible cultivars. Arc's vigorous growth reduces alfalfa weevil damage and suppresses weed competition and encroachment.

Arc is also susceptible to the spotted alfalfa aphid (*Therioaphis maculata* (Buckton)).

AGRONOMIC CHARACTERISTICS

Forage Yields

Forage yields of Arc and its preceding cycles were generally superior to those of other cultivars in Maryland, North Carolina, southeastern Pennsylvania, and Virginia, as shown in tables 11-24. Arc yields well on the first harvest because of its vigorous spring growth. In later harvests, subject to anthracnose epiphytotics, Arc produces high yields of forage with excellent color (Devine 1976). Its yield advantage tends to increase with age of the stand. This is attributed to increased persistence resulting from anthracnose and bacterial wilt resistance. In Kansas, Nebraska, New York, Ohio, Oklahoma, and central Pennsylvania, preliminary data indicate that Arc produces satisfactory yields.

Resistance to Weed Encroachment

The anthracnose resistance of Arc permits the expression of vigorous growth during the warm months from midsummer to early fall. This strong competitive growth suppresses the development of weed species. Other cultivars lacking high anthracnose resistance are debilitated and may suffer severe weed encroachment (tables 12-14).

Growth Characteristics

Arc makes exceptionally vigorous spring growth in comparison with most of the other cultivars adapted to the mid-Atlantic region. It starts growth early and grows vigorously until harvest (table 25). Data on recovery after cutting and maturity, based on plant height and bloom, respectively, are given in tables 26 and 27. The data on its preceding cycle, MSHp6F-An2W2, are indicative of Arc's growth response after cutting. Although regrowth is slow during the first week after cutting, there-

after it is vigorous, equaling or surpassing that of most check cultivars. After anthracnose epiphytotics, the vigorous fall growth of Arc is particularly striking in contrast to that of susceptible cultivars (table 28).

Winter Hardiness

The principal alfalfa sources from which Arc was developed were derived from breeding programs initiated before 1935 in Kansas and Nebraska. Apparently the winter hardiness of these stocks was not lost in later selection in North Carolina and Maryland. After exposure to winter conditions over four seasons, Arc and its earlier cycles have produced good forage yields at several locations in the Middle Atlantic States. Good yields have also been obtained after two winters at Manhattan, Kans., Lincoln, Nebr., and Ithaca, N. Y.

Persistence

Under the severe anthracnose epiphytotics common in the States of the mid-Atlantic region and the Southeastern United States, Arc has proved more persistent than susceptible cultivars in which stands may be thinned as early as the first or second season of growth. In tests at Beltsville, broadcast plots of Cherokee, DuPuits, Glacier, Saranac, Team, and Williamsburg showed severe stand depletion after anthracnose and bacterial wilt epiphytotics. The plots of Arc's preceding cycle, MSHp6F-An3W3, maintained adequate stands and yielded 6 tons per acre of alfalfa hay in the fifth growing season. Arc's superiority in persistence is evident in the stand counts reported in table 29. The estimates of percent cover by alfalfa at 10 locations in tables 30 and 31 indicate Arc is superior to check cultivars in stand longevity at most locations.

Seed Yields

As shown in table 32, Arc produced satisfactory seed yields in the seed growing area of Washington State (Rincker 1976).

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TABLE 1.—*Anthracnose resistance of Arc alfalfa, its preceding cycles, and check cultivars in laboratory tests, Beltsville, Md.*

Entry	Plants in disease class ¹					Plants tested	Average severity index ²
	1	2	3	4	5		
	Percent	Percent	Percent	Percent	Percent	Number	
<i>Test 1</i>							
Arc, MSHp6F-An4W4 -----	88	1	0	6	5	189	1.38
MSHp6F-An3W3 -----	89	1	1	4	5	212	1.36
MSHp6F-An2W2 -----	78	1	1	11	9	209	1.74
MSHp6F -----	20	1	1	52	26	169	3.64
Glacier -----	5	1	2	59	33	197	4.15
Saranac -----	5	1	1	66	27	149	4.13
Vernal -----	1	0	3	52	44	160	4.42
LSD (0.05) -----						---	0.34
<i>Test 2</i>							
MSHp6F-An3W3 -----	79	4	1	5	11	96	1.67
MSHp6F-An2W2 -----	74	1	1	8	16	104	1.91
Bonanza -----	6	1	3	56	34	103	4.10
Cherokee -----	2	1	3	61	33	98	4.19
DuPuits -----	1	3	1	33	62	88	4.49
Glacier -----	1	1	1	33	64	118	4.60
Moapa -----	10	1	6	41	42	102	4.02
Saranac -----	4	0	0	41	55	97	4.37
Team -----	17	1	2	44	36	54	3.79
Weevlchek -----	2	2	6	51	39	105	4.22
Williamsburg -----	4	0	2	56	38	102	4.22
LSD (0.05) -----						---	0.43

¹ 1 = highly resistant, 5 = dead plant.

² Calculated by averaging disease class of each plant per replication.

TABLE 2.—Anthracnose resistance of *Arc alfalfa*, its preceding cycles, and check cultivars in field tests in Kansas, Maryland, North Carolina, Pennsylvania, and Virginia, 1970-72

Entry	Anthracnose damage				Diseased plants per plot				
	Manhattan, Kans., 9-14-72 ¹	Beltsville, Md. Non- irrigated, 9-10-71 ²	Irrigated, 9-10-71 ²	Clarksville, Md., 8-14-70 ³	Wye Mills, Md. 9-29-71 ⁴	10-24-72 ⁵	Salisbury, Blacksburg, N.C., Va., 7-17-72 ⁶ 10-7-71 ⁷	Landisville, Pa., 10-10-72 ⁸	Blacksburg, Va., 9-23-72 ⁹
	Score	Score	Score	Score	Score	Score	Score	Number	Number
Arc, MSHp6F-An4W4 ----	3.5	...	...	...	...	1.4	...	1	...
MSHp6F-An3W3 ----	...	0	...	...	...	...	...	...	...
MSHp6F-An2W2 ----	...	.3	.8	1.0	1.4	...	1.2	...	0.8
Apalachee-----	...	...	...	...	...	2.6	...	...	...
Cherokee-----	...	3.7	2.7	2.0	2.6	1.8	2.5	...	3.5
DuPuits-----	...	7.7	6.0	4.0	4.5	...	4.0	...	8.5
Glacier-----	6.2	7.3	5.7	...	...	5.5	...	31	...
Iroquois-----	...	...	...	...	...	6.5	...	20	...
Saranac-----	...	8.0	4.7	4.0	3.9	5.0	4.8	27	10.5
Team-----	5.5	2.3	4.0	2.8	2.3	2.2	3.6	7	3.0
Tempo-----	...	...	...	...	...	...	4.2	...	...
Vernal-----	5.5	...	...	...	...	2.5	...	7	...
Weevichek-----	...	...	...	...	...	...	2.6	...	...
Williamsburg-----	...	4.3	3.3	2.8	2.9	2.0	3.8	...	5.8
LSD (0.05)-----	0.3	2.9	2.5	1.2	0.8	2.2	0.7	8	2.8

¹ Seeded 4-24-72; 1 = least and 9 = most damage.

² Seeded 5-8-70; 0 = least and 9 = most damage.

³ Seeded 5-2-70; 1 = least and 4 = most damage.

⁴ Seeded 3-70; 1 = least and 5 = most damage.

⁵ Seeded 4-5-72; 1 = least and 9 = most damage.

⁶ Seeded 9-71; 1 = least and 5 = most damage.

⁷ Seeded 4-9-70; 1 = least and 5 = most damage.

⁸ Seeded 1972.

⁹ Seeded 4-9-70.

TABLE 3.—*Anthracnose resistance of Arc alfalfa, its preceding cycles, and check cultivars in field tests in Maryland, Pennsylvania, and Virginia, 1973*

Entry	Anthracnose damage ¹				Diseased plants per plot ²	
	Beltsville, Md., 8-1	Hagerstown, Md., 8-17	Wye Mills, Md., 5-22	Blacksburg, Va., 10-5	Landisville, Pa., 8-22	Hanoverville, Pa., 10-5
	Score ³	Score ⁴	Score ⁵	Score ⁵	Number	Number
Arc, MSHp6F-An4W4 -----	1.0	0.8	1.2	1.8	1.2	1.3
MSHp6F-An3W3 -----	1.0	---	---	---	---	---
MSHp6F-An2W2 -----	1.0	---	---	---	---	---
MSHp6F -----	1.8	---	---	---	---	---
Agate -----	---	---	---	---	2.6	---
Buffalo -----	---	---	---	---	---	41.0
Cherokee -----	1.2	---	2.5	---	---	---
DuPuits -----	---	---	---	4.2	---	---
Glacier -----	5.8	---	4.0	4.8	---	---
Iroquois -----	---	4.0	4.0	---	14.4	64.3
Saranac -----	4.8	4.0	3.8	3.8	6.6	83.5
Team -----	1.8	.8	2.5	2.2	---	12.0
Vernal -----	3.2	2.8	3.5	2.0	6.4	---
Williamsburg -----	2.8	3.5	2.5	2.5	---	---
LSD (0.05) -----	1.5	1.6	1.2	1.2	13.4	---

¹ Seeded spring 1972.

² Seeded spring 1973.

³ 1 = least and 9 = most damage.

⁴ 0 = least and 5 = most damage.

⁵ 1 = least and 5 = most damage.

TABLE 4.—*Anthracnose resistance of Arc alfalfa and check cultivars in field tests in Kansas, Ohio, and Oklahoma*

Entry	Anthracnose damage			Wooster, Ohio, 9-5-74 ²	Diseased stems, Chickasha, Okla., 10-3-74 ³
	Manhattan, Kans.				
	7-31-73 ¹	9-10-73 ¹	8-1-73 ²	Score	Number
Arc -----	2.2	2.0	2.8	1.0	1
Agate -----	---	---	4.2	---	---
Buffalo -----	---	---	3.8	---	---
Cherokee -----	---	---	3.8	---	---
Cody -----	---	---	4.5	---	---
Dawson -----	---	---	4.2	---	---
DuPuits -----	---	---	6.2	---	---
Glacier -----	6.2	5.5	---	4.0	8
Kanza -----	---	---	4.0	---	---
Lahontan -----	---	---	5.8	---	---
Ramsey -----	---	---	4.2	---	---
Saranac -----	---	---	---	3.5	16
Team -----	4.5	4.2	4.5	3.0	4
Vernal -----	4.8	4.5	4.5	2.2	16
LSD (0.05) -----	1.1	0.6	0.8	0.6	8

¹ Seeded spring 1972; 1 = least and 9 = most damage.

² Seeded spring 1973; 1 = least and 9 = most damage.

³ Seeded spring 1974; diseased stems per 0.5 m quadrant per plot.

TABLE 5.—*Bacterial wilt resistance of Arc alfalfa, its preceding cycles, and check cultivars in Minnesota field tests*

Entry	Plants in disease class ¹						Plants tested	Average severity index ²
	0	1	2	3	4	5		
	Percent	Percent	Percent	Percent	Percent	Percent	Number	
<i>1970 test</i>								
MSHp6F-An2W2 -----	2.4	3.0	6.6	26.9	58.7	2.4	167	3.42
Narragansett -----	.6	.6	1.6	8.9	71.8	16.1	124	3.95
Ranger -----	8.6	10.7	12.3	24.1	42.8	1.6	187	2.78
Vernal -----	32.7	19.0	14.8	20.2	13.1	.6	168	1.64
LSD (0.05) -----								0.78
<i>1971 test</i>								
Arc, MSHp6F-An4W4 -----	0	2.9	13.9	33.2	44.7	5.3	208	3.33
MSHp6F-An3W3 -----	.4	.9	3.9	24.2	59.7	10.8	231	3.75
MSHp6F-An2W2 -----	.5	0	3.1	15.8	52.0	28.6	196	4.06
MSHp6F -----	.6	.6	3.3	16.0	48.6	30.9	181	4.05
Glacier -----	0	0	0	.7	49.2	50.0	134	4.50
Narragansett -----	0	.7	0	1.4	27.9	70.0	147	4.66
Ranger -----	3.8	4.9	7.1	20.9	53.8	9.3	182	3.46
Saranac -----	21.7	26.3	13.1	19.4	13.7	5.7	175	1.99
Vernal -----	19.4	14.8	10.6	20.7	24.1	10.3	377	2.54
LSD (0.05) -----								0.49

¹ 0 = no symptoms, 5 = dead plant.

² Calculated by averaging disease class of each plant per replication.

TABLE 6.—Foliage feeding by alfalfa weevil larvae on Arc alfalfa, its preceding cycles, and check cultivars in field tests in Maryland, North Carolina, and Virginia

Entry	Average larval feeding				Foliage consumed by larvae												
	Clarksville, Blacksburg, Md.,		Warsaw, Va.		Raleigh, N.C.			Salisbury, N.C.									
	5-11-72	5-26-72	4-30-73	4-30-74	5-11-70	4-17-71	5-1-72	4-24-74	5-2-72	4-30-73	4-30-73	4-30-73	4-30-73	4-30-73	4-30-73	4-30-73	4-30-73
Score ¹	Score ²	Score ²	Score ²	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent
Arc, MSHp6F-An4W4	3.8	1.8	1.5	---	---	---	---	20	30	32	---	---	---	---	---	---	57
MSHp6F-An3W3	4.2	---	---	---	---	---	---	---	23	32	---	---	---	---	---	---	---
MSHp6F-An2W2	5.2	1.6	---	---	34	51	16	---	---	---	---	---	---	---	---	---	---
Apalachee	---	---	4.2	3.5	73	82	43	52	65	78	---	---	---	---	---	---	76
Atlantic	---	---	---	---	78	84	39	---	---	---	---	---	---	---	---	---	---
Buffalo	6.8	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Cherokee	6.6	3.5	3.5	3.0	79	88	38	46	80	71	---	---	---	---	---	---	80
DuPuits	---	1.7	3.5	3.0	---	---	---	---	---	---	---	---	---	---	---	---	---
Kanza	8.2	---	---	---	---	---	---	80	---	---	---	---	---	---	---	---	---
Saranac	5.6	2.2	3.0	3.0	68	80	33	38	52	63	---	---	---	---	---	---	69
Team	6.0	1.9	1.8	2.2	40	64	22	20	45	56	---	---	---	---	---	---	56
Vernal	6.8	---	3.5	3.2	---	---	---	---	---	---	---	---	---	---	---	---	71
Weevlchek	5.2	4.3	3.8	2.8	74	82	37	42	---	---	---	---	---	---	---	---	78
Williamsburg	7.2	3.0	4.2	2.8	---	---	---	62	---	---	---	---	---	---	---	---	---
LSD (0.05)	1.2	1.0	0.7	0.7	11	7	7	10	10	12	---	---	---	---	---	---	5

¹ 1 = least and 9 = most feeding.

² 1 = least and 5 = most feeding.

TABLE 7.—Foliage feeding by alfalfa weevil larvae on a preceding cycle of Arc alfalfa, MSHp6F-An2W2, and check cultivars in field test A-188, Raleigh, N.C., 1970

Entry	Defoliation			
	4-22	5-6	5-11	
	Percent	Percent	Percent	Percent
MSHp6F-An2W2	38	43	34	
Apalachee	59	67	73	
Atlantic	63	78	78	
Cherokee	67	78	79	
Saranac	53	76	68	
Team	28	52	40	
Weevlchek	54	73	74	
LSD (0.05)	11	16	11	

TABLE 8.—*Pea aphid resistance of Arc alfalfa, its preceding cycles, and check cultivars in laboratory tests, Beltsville, Md.*

Entry	Living nymphs ¹		Seedling survival at ² —	
	Test 1, 4-7-72	Test 2, 4-25-72	24°C, 1-23-71	16°C, 4-15-71
	Number	Number	Percent	Percent
Arc, MSHp6F-An4W4 -----	40.5	32.2	71	42
MSHp6F-An3W3 -----	---	---	66	---
MSHp6F-An2W2 -----	---	---	75	---
MSHp6F -----	31.6	27.6	77	48
Kanza -----	25.7	19.5	77	58
Ranger ³ -----	94.9	65.0	---	11
Team -----	27.3	18.4	76	47
Williamsburg ³ -----	---	---	17	---
LSD (0.05) -----	18.2	13.3	14	15

¹ Caged plant infested with 4 mature females — living young counted 7 days later; 8 replications.

² Seeded in flats 12 by 24 inches, 1 row of 75 seeds per entry per flat; 6 replications.

³ Susceptible.

TABLE 9.—*Pea aphids, per 10 sweeps, feeding on Arc alfalfa, its preceding cycles, and check cultivars in Maryland field tests¹*

Entry	Beltsville		Wye Mills	
	1970 sward test, 8-7-73 ²	1972 sward test, 9-13-73 ³	10-4-72 ⁴	8-8-73 ⁵
	Number	Number	Number	Number
Arc, MSHp6F-An4W4 -----	---	110	35	---
MSHp6F-An3W3 -----	331	98	---	---
MSHp6F-An2W2 -----	269	108	---	49
MSHp6F -----	---	97	---	---
Cherokee -----	447	174	188	---
Glacier -----	---	---	161	---
Saranac -----	---	---	147	---
Team -----	189	77	62	17
Vernal -----	---	---	325	---
Weevlchek -----	---	---	231	---
Williamsburg -----	764	216	271	176
LSD (0.05) -----	293	67	96	85

¹ Broadcast plots 5 by 16 ft.

² Seeded 5-8-70.

³ Seeded 5-13-72.

⁴ Seeded 4-4-72.

⁵ Seeded 3-70.

TABLE 10.—*Leafhopper yellowing of Arc alfalfa, its preceding cycles, and check cultivars in Maryland and Virginia field tests*

Entry	Clarksville, Md.			Blacksburg, Va., 7-21-72 ³	Orange, Va., 6-28-73 ⁴
	Test 1, 7-24-72 ¹	Test 2			
		7-1-70 ²	7-6-71 ²		
	Score	Score	Score	Score	Score
Arc, MSHp6F-An4W4 -----	6.8	---	---	2.6	4.0
MSHp6F-An3W3 -----	5.4	---	---	---	---
MSHp6F-An2W2 -----	6.0	4.8	4.5	---	---
Buffalo -----	5.6	---	---	---	---
Cherokee -----	6.0	3.3	3.8	---	---
DuPuits -----	---	5.3	7.3	3.2	---
Florida 66 -----	---	5.5	5.5	---	---
Kanza -----	6.2	---	---	---	---
Saranac -----	7.4	5.0	5.3	4.0	2.2
Team -----	6.0	3.5	4.8	2.6	3.2
Vernal -----	5.8	---	---	3.1	1.5
Weevlchek -----	4.8	4.3	3.3	---	1.0
Williamsburg -----	6.6	5.8	6.0	3.7	3.5
LSD (0.05) -----	1.4	1.5	1.4	0.9	0.9

¹ Seeded 4-15-71; broadcast plots 5 by 16 ft; 1 = least and 9 = most yellowing.

² Seeded 5-2-70; broadcast plots 5 by 16 ft; 1 = least and 9 = most yellowing.

³ Seeded 4-20-72; 15-ft rows, 3 ft apart; 1 = least and 5 = most yellowing.

⁴ Seeded spring 1973; 15-ft rows, 3 ft apart; 1 = least and 5 = most yellowing.

TABLE 11.—*Hay yield in nonirrigated and irrigated plots of preceding cycles of Arc alfalfa, MSHp6F-An3W3 and MSHp6F-An2W2, and check cultivars, Beltsville, Md.*¹

Entry	Yield per acre including weeds at 12-percent moisture			
	1971	1972	1973	1974
	<i>Tons</i>	<i>Tons</i>	<i>Tons</i>	<i>Tons</i>
<i>Nonirrigated plots</i>				
MSHp6F-An3W3 -----	7.28	7.48	6.46	6.85
MSHp6F-An2W2 -----	7.12	7.06	6.29	5.98
Cherokee -----	6.73	5.67	4.55	5.27
DuPuits -----	6.54	5.47	3.57	3.69
Glacier -----	6.38	5.47	3.57	3.92
Saranac -----	6.66	6.10	5.09	5.38
Team -----	6.93	6.29	4.64	5.20
Weevlchek -----	6.49	6.45	5.57	5.74
Williamsburg -----	6.51	5.97	4.46	4.94
LSD (0.05) -----	0.53	0.66	0.96	0.17
<i>Irrigated plots</i> ²				
MSHp6F-An3W3 -----	7.88	7.25	6.07	6.36
MSHp6F-An2W2 -----	7.70	7.23	6.13	6.06
Cherokee -----	7.17	6.04	4.25	5.27
DuPuits -----	6.90	5.55	3.60	3.67
Glacier -----	6.48	5.62	3.91	3.83
Saranac -----	7.40	6.59	5.36	5.85
Team -----	7.26	6.65	5.01	4.79
Weevlchek -----	7.11	6.62	5.55	6.32
Williamsburg -----	7.42	6.35	4.27	4.69
LSD (0.05) -----	0.47	0.81	0.98	0.17

¹ Seeded 5-8-70; broadcast plots 5 by 16 ft; 4 harvests per year.

² 1970-73 seasons; no irrigation in 1974.

TABLE 12.—Estimated weeds in nonirrigated and irrigated plots of preceding cycles of Arc alfalfa, MSHp6F-An3W3 and MSHp6F-An2W2, and check cultivars, Beltsville, Md.¹

Entry	1971			1972			1973			1974				
	8-5	9-10	6-12	7-10	8-10	10-20	5-29	6-28	8-8	9-1	6-5	7-8	8-13	9-16
	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent
<i>Nonirrigated plots</i>														
MSHp6F-An3W3 ²	4	3	2	0	12	21	3	6	27	5	8	6	4	2
MSHp6F-An2W2	8	7	2	0	27	21	7	8	30	7	8	22	5	10
Cherokee	10	15	10	14	55	53	38	47	87	30	40	77	27	43
DuPuits	17	55	8	40	83	82	80	67	94	57	87	99	84	96
Glacier	13	50	15	32	73	77	65	68	96	58	98	97	90	94
Saranac	15	47	11	10	67	63	23	35	70	22	35	50	12	25
Team	10	12	5	8	58	56	36	48	83	33	53	82	45	62
Weevlchek	10	20	11	4	47	42	13	14	42	10	7	18	8	13
Williamsburg	10	13	7	24	63	57	53	60	85	38	73	88	48	82
LSD (0.05)	8	14	12	21	15	25	27	24	18	25	19	16	18	18
<i>Irrigated plots³</i>														
MSHp6F-An3W3 ²	3	5	4	0	22	13	8	6	22	11	8	10	5	6
MSHp6F-An2W2	4	10	6	0	32	15	7	6	23	10	10	22	15	15
Cherokee	9	20	13	17	60	50	55	52	82	35	47	73	40	47
DuPuits	17	50	10	33	77	73	68	62	92	40	89	97	60	89
Glacier	25	63	22	48	72	63	72	67	93	38	94	98	62	94
Saranac	13	42	6	12	60	42	16	17	52	9	18	30	6	13
Team	10	35	8	18	58	45	27	32	68	14	26	52	13	28
Weevlchek	7	17	6	4	52	47	23	20	33	20	11	22	5	6
Williamsburg	8	18	7	14	58	60	65	53	78	25	70	77	45	52
LSD (0.05)	NS	24	12	21	14	19	27	25	18	23	22	23	19	20

¹ Seeded 5-8-70; broadcast plots 5 by 16 ft.

² Less weed encroachment attributed to anthracnose and bacterial wilt resistance.

³ 1970-73 seasons; no irrigation in 1974.

TABLE 13.—*Alfalfa cover, weeds, and hay yield of Arc alfalfa, its preceding cycles, and check cultivars, Clarksville, Md.*¹

Entry	Estimated alfalfa cover			Estimated weeds		Hay yield per acre including weeds at 12-percent moisture ²	
	11-3-71	5-6-72	9-30-72	7-24-72	10-4-72	1973	1974
	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Tons</i>	<i>Tons</i>
Arc, MSHp6F-An4W4 ³ -----	80	50	83	39	12	6.99	7.66
MSHp6F-An3W3 -----	85	62	91	36	6	7.56	7.70
MSHp6F-An2W2 -----	79	50	84	38	13	7.16	6.99
Buffalo -----	53	21	62	63	26	6.22	6.28
Cherokee -----	66	32	70	50	19	6.42	6.45
Kanza -----	36	15	39	68	39	5.82	6.38
Saranac -----	43	28	63	45	27	6.70	6.51
Team -----	52	27	67	39	24	6.53	6.81
Vernal -----	32	20	55	50	32	6.24	5.92
Williamsburg -----	43	16	61	55	26	6.48	6.09
LSD (0.05) -----	14	13	19	14	15	0.64	---

¹ Seeded 1971.² 4 harvests per year.³ This seed lot had severe chalcid damage and was of low quality.TABLE 14.—*Hay yield of a preceding cycle of Arc alfalfa, MSHp6F-An2W2, and check cultivars, Wye Mills, Md.*¹

Entry	Yield per acre including weeds at 12-percent moisture				Estimated weeds, 9-14-73
	1971 ²	1972 ³	1973 ³	Average	
	<i>Tons</i>	<i>Tons</i>	<i>Tons</i>	<i>Tons</i>	<i>Percent</i>
MSHp6F-An2W2 -----	7.16	7.36	6.60	7.04	21
Cherokee -----	7.10	6.72	5.72	6.51	42
DuPuits -----	6.93	6.45	5.37	6.25	57
Florida 66 -----	6.16	5.52	5.34	5.67	54
Moapa -----	5.25	5.12	4.16	4.84	71
Saranac -----	6.41	6.36	5.76	6.18	57
Team -----	6.74	6.30	5.72	6.25	43
Williamsburg -----	6.54	6.24	5.91	6.20	39
LSD (0.05) -----	NS	0.48	0.47	---	19

¹ Seeded March 1970; severe anthracnose damage occurred during late summer 1971.² 5 harvests.³ 4 harvests.

TABLE 15.—*Hay yield of Arc alfalfa and check cultivars in Maryland, North Carolina, and Virginia*¹

Entry	Yield per acre including weeds at 12-percent moisture						
	Wye Mills, Md.			Salisbury, N.C.		Warsaw, Va.	
	1972 ²	1973 ³	1974 ³	1973 ⁴	1974 ³	1973 ³	1974 ³
	<i>Tons</i>	<i>Tons</i>	<i>Tons</i>	<i>Tons</i>	<i>Tons</i>	<i>Tons</i>	<i>Tons</i>
Arc -----	1.83	7.54	6.72	5.19	5.38	5.80	7.04
Cherokee -----	1.68	7.49	6.36	4.26	4.05	5.45	6.72
Glacier -----	1.67	6.71	5.86	4.22	4.32	5.41	6.64
Iroquois -----	1.90	6.74	5.02	---	---	---	---
Saranac -----	1.72	7.09	6.05	4.42	5.08	5.89	7.26
Team -----	1.57	7.06	6.49	4.08	4.13	5.81	7.13
Vernal -----	1.49	6.74	6.03	4.37	4.69	5.60	6.64
Williamsburg -----	1.35	6.19	5.64	---	---	5.78	6.92
LSD (0.05) -----	NS	0.58	---	0.60	0.80	0.48	0.45

¹ Seeded spring 1972.² 1 harvest.³ 4 harvests.⁴ 5 harvests.TABLE 16.—*Hay yield of Arc alfalfa, a preceding cycle, MSHp6F-An3W3, and check cultivars in North Carolina*

Entry	Yield per acre at 12-percent moisture						
	Clayton, test FVT 85 ¹				Salisbury, test A-200 ⁴		
	1971 ²	1972 ³	1973 ²	Average	1972 ²	1973 ³	Average
	<i>Tons</i>	<i>Tons</i>	<i>Tons</i>	<i>Tons</i>	<i>Tons</i>	<i>Tons</i>	<i>Tons</i>
Arc, MSHp6F-An4W4 ⁵ -----	3.47	5.61	4.16	4.41	4.71	5.82	5.26
MSHp6F-An3W3 -----	3.85	6.02	4.53	4.80	4.32	5.71	5.02
Apalachee -----	3.75	5.49	3.98	4.41	4.00	5.48	4.74
Atlantic -----	3.45	5.15	3.64	4.08	---	---	---
Cherokee -----	3.90	5.53	3.67	4.37	3.25	4.40	3.82
Cody -----	3.09	4.64	2.85	3.53	---	---	---
Florida 66 -----	2.97	5.32	4.04	4.11	---	---	---
Saranac -----	---	---	---	---	4.00	4.50	4.25
Team -----	3.46	4.99	3.63	4.03	4.04	4.25	4.14
Tempo -----	3.35	4.99	3.52	3.95	---	---	---
Weevlchek -----	3.48	5.12	3.72	4.11	---	---	---
Williamsburg -----	3.43	5.28	3.58	4.10	---	---	---
LSD (0.05) -----	0.25	0.40	0.34	---	0.30	0.83	---

¹ Seeded 9-16-70; planted in 3 drilled-row plots 2.5 by 15 ft.² 4 harvests.³ 5 harvests.⁴ Seeded 3-18-71; planted in 3 drilled-row plots 2.5 by 15 ft.⁵ This seed lot had severe chalcid damage and was of low quality.

TABLE 17.—*Hay yield of a preceding cycle of Arc alfalfa, MSHp6F-An2W2, and check cultivars, Raleigh, N.C.*

Entry	Yield per acre at 12-percent moisture								
	Test A-192 ¹					Test A-188 ⁵			
	1970 ²	1971 ³	1972 ³	1973 ⁴	Average	1970 ⁴	1971 ⁴	1972 ⁴	Average
	<i>Tons</i>	<i>Tons</i>	<i>Tons</i>	<i>Tons</i>	<i>Tons</i>	<i>Tons</i>	<i>Tons</i>	<i>Tons</i>	<i>Tons</i>
MSHp6F-An2W2 -----	2.91	6.09	5.88	5.32	5.05	7.19	7.31	8.62	7.71
Apalachee -----	2.61	5.88	6.18	5.35	5.00	6.45	5.53	6.44	6.14
Atlantic -----	---	---	---	---	---	6.25	6.03	7.19	6.49
Bonanza -----	2.59	5.23	4.86	4.24	4.23	---	---	---	---
Cherokee -----	2.71	6.08	5.84	5.00	4.91	5.45	4.93	6.53	5.64
DuPuits -----	2.36	5.54	5.78	5.22	4.72	---	---	---	---
Florida 66 -----	2.65	5.55	5.61	5.13	4.74	---	---	---	---
Moapa -----	2.18	4.94	4.88	4.60	4.15	---	---	---	---
Saranac -----	2.35	5.32	5.28	4.85	4.45	5.96	5.48	6.77	6.07
Team -----	2.68	5.98	5.50	5.15	4.83	7.08	6.97	8.33	7.46
Weevlchek -----	2.30	5.47	5.68	4.93	4.60	5.84	5.56	6.94	6.11
Williamsburg -----	2.49	5.45	5.34	4.77	4.51	---	---	---	---
LSD (0.05) -----	0.40	0.57	0.73	0.65	---	1.00	0.80	1.04	---

¹ Seeded 4-9-70; broadcast plots.² 3 harvests.³ 5 harvests.⁴ 4 harvests.⁵ Seeded 9-17-69; planted in 3 drilled-row plots 2.5 by 10 ft.TABLE 18.—*Hay yield of a preceding cycle of Arc alfalfa, MSHp6F-An2W2, and check cultivars, Blacksburg, Va.¹*

Entry	Yield per acre at 12-percent moisture			
	1971	1972	1973	Average
	<i>Tons</i>	<i>Tons</i>	<i>Tons</i>	<i>Tons</i>
MSHp6F-An2W2 -----	5.82	6.22	5.05	5.70
Cherokee -----	5.86	5.88	4.32	5.35
DuPuits -----	5.50	5.93	3.82	5.08
Florida 66 -----	4.97	5.06	3.72	4.58
Saranac -----	5.44	5.82	4.35	5.20
Team -----	5.58	6.37	4.76	5.57
Weevlchek -----	5.60	5.73	4.94	5.42
Williamsburg -----	5.93	6.10	4.74	5.59
LSD (0.05) -----	0.40	0.58	0.58	---

¹ Seeded 4-9-70; 3 harvests per year.

TABLE 19.—*Hay yield of Arc alfalfa and check cultivars in Virginia*

Entry	Yield at 12-percent moisture		
	Blacksburg ¹		Orange, ²
	1973	1974	1974
	<i>Lb per plot</i>	<i>Lb per plot</i>	<i>Tons per acre</i>
Arc -----	3.94	5.44	5.91
DuPuits -----	2.61	3.00	---
Glacier -----	3.25	3.74	---
Saranac -----	3.91	4.70	5.41
Team -----	3.65	5.39	5.64
Vernal -----	4.22	5.16	5.58
Weevlchek -----	---	---	5.66
Williamsburg -----	3.89	4.57	5.03
LSD (0.05) -----	0.55	0.95	NS

¹ Seeded 4-20-72; plots, single 15-ft rows spaced 3 ft apart; 3 harvests per year.

² Seeded 4-16-73; plots 5 by 15 ft; 4 harvests.

TABLE 20.—*Hay yield of Arc alfalfa and check cultivars, Hanoverville, Pa.¹*

Entry	Yield per acre at 12-percent moisture	
	1973 ²	1974 ³
	<i>Tons</i>	<i>Tons</i>
Arc -----	2.79	7.25
Buffalo -----	2.34	6.06
Iroquois -----	2.60	6.56
Saranac -----	3.10	6.57
Team -----	2.49	7.19
Weevlchek -----	2.74	7.00
LSD (0.05) -----	0.40	0.75

¹ Seeded spring 1973.

² 2 harvests.

³ 4 harvests.

TABLE 21.—*Hay yield of Arc alfalfa and check cultivars in New York and Pennsylvania¹*

Entry	Yield per acre at 12-percent moisture							
	Ithaca, N. Y.				Pennsylvania			
	Helfer field		Snyder field		Landisville		Rock Springs	
	1973	1974	1973	1974	1973	1974	1973	1974
	<i>Tons</i>	<i>Tons</i>	<i>Tons</i>	<i>Tons</i>	<i>Tons</i>	<i>Tons</i>	<i>Tons</i>	<i>Tons</i>
Arc -----	4.50	5.17	5.14	4.80	4.28	3.86	4.21	4.35
Glacier -----	4.68	5.58	5.60	4.93	3.58	3.44	4.05	3.99
Iroquois -----	4.66	5.50	5.48	4.65	3.62	3.32	4.62	4.27
Saranac -----	4.71	5.62	5.50	4.81	3.47	3.25	4.68	4.22
Team -----	4.40	4.82	4.92	4.66	3.99	3.46	4.58	4.52
Vernal -----	4.60	5.16	4.90	4.44	4.03	3.21	4.59	4.66
LSD (0.05) -----	0.34	0.48	0.40	0.28	0.58	0.24	0.42	0.33

¹ Seeded spring 1972; 3 harvests per year.

TABLE 22.—Hay yield of *Arc alfalfa* and check cultivars in Kansas and Ohio

Entry	Yield per acre at 12-percent moisture					
	Manhattan, Kans.				Wooster, Ohio,	
	Seeded 4-24-72		Seeded 4-17-73		seeded 4-20-73	
	1972 ¹	1973 ²	1973 ¹	1974 ²	1973 ¹	1974 ²
	Tons	Tons	Tons	Tons	Tons	Tons
Arc -----	7.17	11.17	7.55	9.74	2.98	5.24
Agate-----	---	---	6.92	8.26	---	---
Buffalo -----	---	---	7.19	9.60	---	---
Cherokee -----	---	---	7.74	9.88	---	---
Cody -----	---	---	7.15	9.26	---	---
Dawson DCC 72 -----	---	---	7.26	8.01	---	---
Glacier -----	6.48	9.97	---	---	2.98	5.17
Kanza KCC 72 -----	---	---	7.42	9.74	---	---
Lahontan -----	---	---	6.64	9.39	---	---
Ramsey -----	---	---	6.68	9.40	---	---
Saranac -----	---	---	7.20	8.90	2.73	4.90
Team -----	6.73	10.34	7.78	9.68	2.70	5.38
Vernal -----	6.58	10.08	7.14	9.25	2.50	4.57
LSD (0.05) -----	0.43	0.64	0.50	0.59	NS	NS

¹ 3 harvests.² 4 harvests.TABLE 23.—Hay yield of *Arc alfalfa* and check cultivars in Oklahoma

Entry	Yield per acre at 12-percent moisture							
	Chickasha		Mangum,	Muskogee,	Stillwater		Tipton	
	1974 ¹	1974 ²	1974 ³	1974 ⁴	1974 ⁵	1974 ⁶	1973 ⁷	1974 ⁸
	Tons	Tons	Tons	Tons	Tons	Tons	Tons	Tons
Arc -----	4.51	0.94	4.88	3.02	2.18	2.48	3.85	3.84
Agate -----	---	---	---	---	---	2.18	---	---
Cody -----	4.70	---	4.49	2.64	---	---	3.39	3.53
Dawson -----	4.25	---	4.48	2.57	1.99	2.49	---	---
Glacier -----	---	.84	---	---	---	---	---	---
Kanza -----	4.52	---	4.42	1.94	---	2.49	3.36	3.64
Lahontan -----	4.78	---	5.35	---	---	---	---	---
Ramsey -----	---	---	---	---	---	2.02	---	---
Saranac -----	---	.93	---	2.73	1.93	2.31	---	---
Team -----	3.91	.86	4.34	2.53	2.13	---	3.31	3.74
Vernal -----	---	.93	---	2.85	2.11	2.12	---	---
Victoria -----	4.08	---	4.35	2.34	---	---	---	---
Washoe -----	3.93	---	5.36	2.33	---	---	---	---
LSD (0.05) -----	NS	NS	NS	0.45	NS	0.30	NS	NS

¹ Seeded 9-12-73; 4 harvests.² Seeded 4-16-74; 2 harvests.³ Seeded 9-20-73; 5 harvests.⁴ Seeded 10-5-73; 2 harvests.⁵ Seeded 5-9-73; 2 harvests.⁶ Seeded 5-10-73; 2 harvests.⁷ Seeded 3-27-73; 3 harvests.⁸ Seeded 3-27-73; 4 harvests.

TABLE 24.—Hay yield of *Arc alfalfa* and check cultivars in Nebraska

Entry	Yield per acre at 12-percent moisture				Scotts Bluff, 1974 ⁴
	Concord, 1974 ¹	Mead		1974 ³	
		1973 ²	1974 ²		
	Tons	Tons	Tons	Tons	Tons
Arc -----	6.16	7.70	7.77	8.81	6.70
Agate -----	---	---	---	8.42	---
Dawson DCC 72 -----	5.66	7.48	7.49	8.00	7.23
Glacier -----	---	7.19	7.26	---	---
Kanza KCC 72 -----	---	7.19	7.76	---	---
Ramsey -----	---	---	---	7.89	---
Saranac -----	5.61	7.37	7.99	7.90	7.81
Team -----	---	7.45	7.38	---	---
Vernal -----	5.79	7.65	7.64	7.98	---
LSD (0.05) -----	NS	0.44	0.53	0.77	1.00

¹ Seeded 4-17-73; 3 harvests.² Seeded 4-17-72; 4 harvests.³ Seeded 4-27-73; 4 harvests.⁴ Seeded 7-16-73; 3 harvests.TABLE 25.—Spring vigor based on plant height of *Arc alfalfa*, its preceding cycles, and check cultivars in broadcast tests in Maryland and North Carolina

Entry	Plant height							
	Beltsville, Md.				Clarksville, Md., 5-11-72	Raleigh, N.C., test A-188		
	Nonirrigated		Irrigated			4-9-70	4-20-70	5-4-72
	4-30-71	5-4-72	4-30-71	5-4-72				
	Cm	Cm	Cm	Cm	Cm	Cm	Cm	Cm
Arc, MSHp6F-An4W4 ¹ -----	---	---	---	---	35	---	---	---
MSHp6F-An3W3 -----	36	44	37	38	38	---	---	---
MSHp6F-An2W2 -----	32	41	36	39	37	24	33	48
Apalachee -----	---	---	---	---	---	24	31	39
Atlantic -----	---	---	---	---	---	20	29	38
Cherokee -----	31	34	32	33	31	20	29	39
DuPuits -----	30	34	34	33	---	---	---	---
Glacier -----	25	29	33	33	---	---	---	---
Saranac -----	30	37	33	35	35	23	33	40
Team -----	33	37	37	36	33	25	36	45
Weevlchek -----	26	32	29	34	35	22	33	40
Williamsburg -----	32	36	31	33	32	---	---	---
LSD (0.05) -----	4	4	4	4	3	2	4	4

¹ This seed lot had severe chalcid damage and was of low quality.

TABLE 26.—*Recovery based on plant height, approximately 18 days after cutting, of a preceding cycle of Arc alfalfa, MSHp6F-An2W2, and check cultivars in field test A-188, Raleigh, N.C.*¹

Entry	Plant height										
	1970			1971			1972				
	5-27	7-7	9-2	6-21	7-19	8-25	6-6	7-13	8-8	9-22	
	<i>Cm</i>	<i>Cm</i>	<i>Cm</i>	<i>Cm</i>	<i>Cm</i>	<i>Cm</i>	<i>Cm</i>	<i>Cm</i>	<i>Cm</i>	<i>Cm</i>	<i>Cm</i>
MSHp6F-An2W2 -----	29.0	28.3	55.3	47.0	24.3	44.8	53.5	60.8	39.7	37.5	
Apalachee -----	30.8	29.5	59.2	45.2	24.7	42.5	52.2	62.2	43.7	39.7	
Atlantic -----	26.0	26.5	54.7	48.2	24.2	43.8	51.0	58.0	41.2	36.3	
Cherokee -----	28.3	26.0	53.8	41.3	21.3	43.2	51.7	58.8	42.7	38.3	
Saranac -----	31.0	28.3	50.5	43.8	22.7	42.7	49.3	55.5	43.0	39.0	
Team -----	29.3	27.2	58.3	47.2	22.2	43.2	50.0	54.2	40.0	35.7	
Weevlchek -----	28.5	24.8	53.7	42.3	22.7	43.8	47.8	57.5	40.3	39.0	
LSD (0.05) -----	3.4	4.0	5.6	4.3	3.0	4.3	5.2	5.8	3.2	4.2	

¹ Seeded 9-17-69; planted in 3 drilled-row plots 2.5 by 10 ft.

TABLE 27.—*Comparative maturity of preceding cycles of Arc alfalfa, MSHp6F-An3W3 and MSHp6F-An2W2, and check cultivars as determined by bloom, Beltsville, Md.*

Entry	Estimated bloom		
	6-28-71	6-2-72	7-10-72
	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>
MSHp6F-An3W3 -----	5	4	25
MSHp6F-An2W2 -----	2	2	25
Cherokee -----	5	2	30
DuPuits -----	13	6	63
Glacier -----	10	5	67
Saranac -----	7	3	40
Team -----	5	7	53
Weevlchek -----	5	1	53
Williamsburg -----	5	2	43
LSD (0.05) -----	5	2	15

TABLE 28.—Fall growth based on vigor and height of *Arc alfaifa*, its preceding cycles, and check cultivars in Maryland, North Carolina, and Virginia

Entry	Clarksville, Md., vigor, 11-3-71		Wye Mills, Md., height, 10-27-72		Vigor, 12-6-69		Raleigh, N.C. Height		Salisbury, N.C., height, 10-13-71		Blacksburg, Va., vigor, 9-15-72		Orange, Va., vigor, 9-27-74		Warsaw, Va., height, 10-31-72	
	Score ¹	Cm	Cm	Cm	Score ¹	Height		Cm	Cm	Cm	Score ²	Score ¹	Cm	Cm		
						11-4-70	10-19-71									
Arc, MSHp6F-An4W4	2.0	---	27	---	---	---	---	---	42	---	---	1.0	---	---	38	
MSHp6F-An3W3	1.4	---	---	---	---	---	---	---	43	---	---	---	---	---	---	
MSHp6F-An2W2	2.8	47	---	---	5.9	30	45	---	---	---	2.9	---	---	---	---	
Apalachee	---	---	---	---	4.0	35	45	---	43	---	---	---	---	---	---	
Atlantic	---	---	---	---	5.0	28	41	---	---	---	---	---	---	---	---	
Buffalo	4.0	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
Cherokee	3.4	47	31	30	4.7	30	44	---	38	---	3.2	---	---	---	38	
DuPuits	---	57	---	---	---	---	---	---	---	---	2.0	---	---	---	41	
Glacier	---	---	33	---	---	---	---	---	---	---	---	---	---	---	35	
Kanza	5.8	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
Saranac	4.6	44	34	30	5.0	30	42	---	40	---	2.4	2.8	---	---	34	
Team 4	4.8	38	26	30	5.1	30	43	---	42	---	3.2	3.0	---	---	33	
Vernal	8.0	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
Weeichek	6.0	39	29	32	5.3	32	42	---	---	---	---	---	---	---	35	
Williamsburg	4.8	50	34	---	---	---	---	---	---	---	1.8	1.8	---	---	38	
LSD (0.05)	1.6	12	NS	---	1.2	---	4	---	8	---	0.7	1.5	---	---	6	

¹ 1 = most and 9 = least vigor.
² 1 = most and 4 = least vigor.

TABLE 29.—Persistence based on stand of *Arc alfalfa*, its preceding cycles, and check cultivars after anthracnose and bacterial wilt epiphytotics in Maryland, Pennsylvania, and Virginia

Entry	Plants per 0.1 m ²						Plants per ft. ²			
	Beltsville, Md.		Clarksville, Md.		Wye Mills, Md.		Landisville, Pa.		Blacksburg, Va.	
	Nonirrigated, 8-24-73 ¹	Irrigated, 8-24-73 ¹	8-16-72 ²	8-16-72 ²	8-3-73 ³	8-3-73 ³	10-74 ⁴	10-74 ⁴	10-5-73 ⁵	10-5-73 ⁵
	Number	Number	Number	Number	Number	Number	Number	Number	Number	Number
Arc, MSHp6F-An4W4 -----	---	---	6.5	6.5	6.9	6.9	4.4	---	---	---
MSHp6F-An3W3 -----	4.7	4.3	---	---	---	---	---	---	---	---
MSHp6F-An2W2 -----	3.7	4.4	---	---	---	---	---	---	4.3	---
Cherokee -----	2.7	2.2	5.8	5.8	---	---	---	---	3.3	---
DuPuits -----	.9	1.3	---	---	---	---	---	---	2.4	---
Glacier -----	.9	1.2	---	---	5.1	5.1	3.0	---	---	---
Saranac -----	2.1	2.5	4.9	4.9	4.6	4.6	3.0	---	3.5	---
Team -----	2.7	3.3	5.0	5.0	6.7	6.7	3.5	---	2.5	---
Vernal -----	---	---	---	---	5.9	5.9	3.3	---	---	---
Williamsburg -----	1.9	2.0	4.3	4.3	---	---	---	---	4.2	---
LSD (0.05) -----	1.6	1.4	1.4	1.4	1.6	1.6	0.9	---	---	1.2

¹ Seeded 5-8-70.

² Seeded 4-15-71.

³ Seeded 4-5-72.

⁴ Seeded spring 1972.

⁵ Seeded 4-9-70.

TABLE 30.—Persistence based on stand of *Arc alfalfa*, its preceding cycles, and check cultivars in Maryland and Pennsylvania

Entry	Visual estimates of stand									
	Beltsville, Md.		Clarksville, Md.,		Wye Mills, Md.		Landisville, Pa.			
	Nonirrigated, 6-3-74 ¹	Irrigated, 6-3-74 ¹	11-1-73 ²	5-17-74 ³	11-4-73 ¹	11-2-73 ²	10-9-72 ¹	8-22-73 ²	Percent	Percent
Arc, MSHp6F-An4W4	---	---	86	96	---	99	---	---	---	72
MSHp6F-An3W3	82	83	76	---	---	---	---	---	---	---
MSHp6F-An2W2	87	78	72	---	66	---	---	73	---	---
MSHp6F	---	---	68	---	---	---	---	---	---	---
Buffalo	---	---	---	46	---	---	---	---	---	---
Cherokee	50	40	34	55	46	71	63	---	---	---
DuPuits	13	19	---	---	29	---	21	---	---	---
Glacier	3	8	22	---	---	54	---	---	---	33
Iroquois	---	---	---	---	---	66	---	---	---	34
Kanza	---	---	---	54	---	---	---	---	---	---
Saranac	56	67	26	41	26	59	65	33	---	---
Team	38	57	51	73	20	74	63	45	---	---
Vernal	---	---	26	51	---	66	---	28	---	---
Williamsburg	25	30	51	52	45	66	63	---	---	---
LSD (0.05)	16	18	19	13	19	14	20	20	---	20

¹ Seeded 1970.

² Seeded 1972.

³ Seeded 1971.

TABLE 31.—Persistence based on stand of Arc alfalfa, a preceding cycle, MSHp6F-An2W2, and check cultivars in North Carolina and Virginia

Entry	Visual estimates of stand												Score ⁶			
	Clayton, N.C., 10-3-73 ¹		Raleigh, N.C., 4-2-73 ²		Salisbury, N.C., 9-6-73 ³		Blacksburg, Va., 8-12-74 ¹		Blacksburg, Va., 9-5-73 ⁴		Warsaw, Va., 8-29-73 ⁴			Orange, Va., 9-27-74 ⁵		
	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent		Percent	Percent	
Arc, MSHp6F-An4W4	82	---	73	89	---	---	---	---	---	---	---	---	---	---	---	1.0
MSHp6F-An2W2	---	66	---	---	---	---	68	---	---	---	---	---	---	---	---	---
Apalachee	49	37	74	77	---	---	---	---	---	---	---	---	---	---	---	---
Atlantic	63	39	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Cherokee	62	37	52	55	24	---	---	---	---	---	---	---	---	---	---	---
Cody	54	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
DuPuits	---	---	---	---	---	---	10	24	47	---	---	---	---	---	---	---
Glacier	---	---	---	33	---	---	---	---	67	45	---	---	---	---	---	---
Saranac	---	32	41	55	51	62	67	67	62	67	4.8	---	---	---	---	---
Team	58	50	32	57	25	82	48	82	82	48	3.5	---	---	---	---	---
Vernal	---	---	---	73	---	---	---	---	91	50	2.5	---	---	---	---	---
Williamsburg	63	---	---	---	44	82	70	82	70	70	2.2	---	---	---	---	---
LSD (0.05)	18	22	17	17	22	11	16	16	16	16	1.2	---	---	---	---	---

¹ Seeded 1970.

² Seeded 1969.

³ Seeded 1971.

⁴ Seeded 1972.

⁵ Seeded 1973.

⁶ 1 = greatest and 9 = least stand.

TABLE 32.—Arc alfalfa seed yield per acre with several cultural practices at Agriculture Research and Extension Center, Prosser, Wash.¹

Planting method	Well irrigated				Sparingly irrigated ³			
	1971 ²		1973		1971 ²		1973	
	Lb	Lb	Lb	Lb	Lb	Lb	Lb	Lb
Rows seeded at 1 lb per acre	180	1,015	1,033	202	1,127	1,020	---	---
Plants spaced —	---	---	---	---	---	---	---	---
1 ft	448	988	1,106	452	1,053	901	---	---
2 ft	431	1,034	1,026	446	1,186	1,023	---	---
4 ft	356	1,021	928	412	1,130	939	---	---
Average	354	1,014	1,023	378	1,124	971	---	---

¹ Seeded 5-13-71 in 36-in rows.

² Seeding year production.

³ Irrigated half as many times as well-irrigated plots (about every 4 weeks in the growing season).