RB63-211 Performance of Alfalfas Under Five Management Systems

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SUMMARY

This bulletin reports stands, forage yields, and other agronomic data on alfalfas of diverse origin or type tested under five management systems at Lincoln, Nebraska.

Narrow-crowned and broad-crowned types were tested. The management systems involved non-irrigated alfalfa-bromegrass tests (a) continuously grazed with steers, (b) cut for hay, and (c) rotationally grazed with sheep; an irrigated alfalfa-bromegrass test rotationally grazed with dairy cattle; and irrigated tests of alfalfas in pure stands cut for hay.

Differential stand establishment of alfalfas was observed in alfalfa-bromegrass tests. In general, poorest initial stands were obtained with alfalfas having the associated characteristics of high degree of spring and fall vegetative dormancy, semi-prostrate to prostrate growth habit, and slow rate of recovery after cutting.

Rank of alfalfas for persistence varied with the management system. Persistence of narrow-crowned alfalfas such as Buffalo, Du Puits, and Grimm varied greatly with the management system. Polycross progeny of clone 2703, experimental synthetics A169 and A224, and the varieties Nomad, Rhizoma, and Vernal, all broad-crowned types, gave superior persistence under the wide range of management systems.

Rank of alfalfas for forage yield varied with the management system. Forage yields of A225, Du Puits, Grimm, Ladak, and Rhizoma varied greatly with the management system. A169, Buffalo, Ranger, and Vernal produced well under the wide range of management systems.

Plant characteristics which contributed to the rank of alfalfas for stand or yield, or both, appeared to be crown type in the non-irrigated test continuously grazed with steers, and bacterial wilt reaction in the irrigated test rotationally grazed with dairy cattle.

No differences in palatability of alfalfas were detected during two years of evaluation with dairy cows.

Performance of Alfalfas Under Five Management Systems[1]

W. R. Kehr, E. C. Conard, M. A. Alexander, and F. G. Owen[2]

INTRODUCTION

Alfalfa (Medicago sativa L.) is an important legume for hay and pasture. Alfalfa-grass mixtures also are used for hay and pasture. Mixtures usually produce higher forage yields than either component alone. Mixtures are more effective in preventing erosion, since ground cover is more complete with a mixture than with alfalfa alone. Mixtures also may be advantageous where winterkilling, heaving, or other legume stand losses occur, since grasses tend to fill-in where legumes die out. There seems to be less bloat danger from mixtures than from alfalfa alone, although much alfalfa is pastured without losses from bloat.

While much information is available on performance of alfalfas in pure stands clipped at various intervals, little information is available on performance of alfalfa-grass combinations in clipping trials. Even less information is available on performance of alfalfas in combination with grasses pastured in various ways.

Smooth bromegrass (*Bromus inermis* Leyss.) is commonly used in combination with alfalfa for pasture and hay in Nebraska. Information was needed on the performance of alfalfa-bromegrass combinations managed in different ways.

One objective of the alfalfa breeding program at the Nebraska station is to produce and test types of alfalfa which may be superior for various pastures. Some traits believed of possible value are: (a) wide and low set crown, (b) rhizomatous or creeping-rooted growth habit which would permit crowns to spread, (c) ability to go dormant under limited moisture conditions when companion grasses are low in production (to reduce the bloat hazard from pasturing alfalfa alone), (d) adequate wilt resistance (particularly important in the eastern one-third

[1]Cooperative research between the Crops Research Division, A. R. S., U.S.D.A., and the Nebraska Agr. Experiment Station.
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of Nebraska and under irrigated conditions), and (e) winter-hardiness. Rhizomatous and creeping-rooted plants are shown in Figures 1 to 3.

Experimental alfalfas were obtained. Tests were designed to obtain information on establishment, persistence, spread, and forage production of alfalfas under five management systems.

This bulletin reports stands, forage yields, and other agronomic data resulting from tests at Lincoln, Nebraska. Narrow-crowned and broad-crowned types were tested. The management systems involved non-irrigated alfalfa-bromegrass tests (a) continuously grazed with steers, (b) cut for hay, and (c) rotationally grazed with sheep; an irrigated alfalfa-bromegrass test rotationally grazed with dairy cattle; and irrigated tests of alfalfas in pure stands cut for hay.

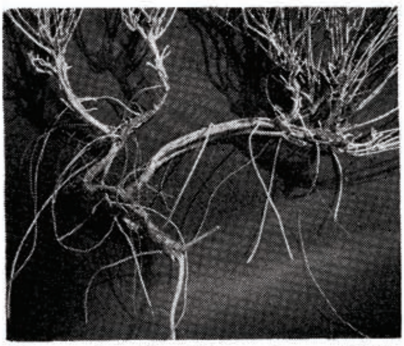

Figure 1.—A rhizomatous alfalfa clone showing crown-branching. Grown from a rooted vegetative cutting in a space-transplanted nursery.

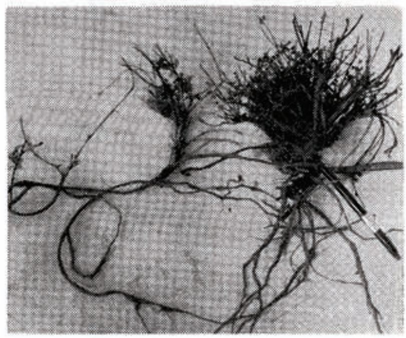

Figure 2.—A creeping - rooted alfalfa clone showing root connections between the original and new plants. Grown from a rooted vegetative cutting in a space-transplanted nursery.

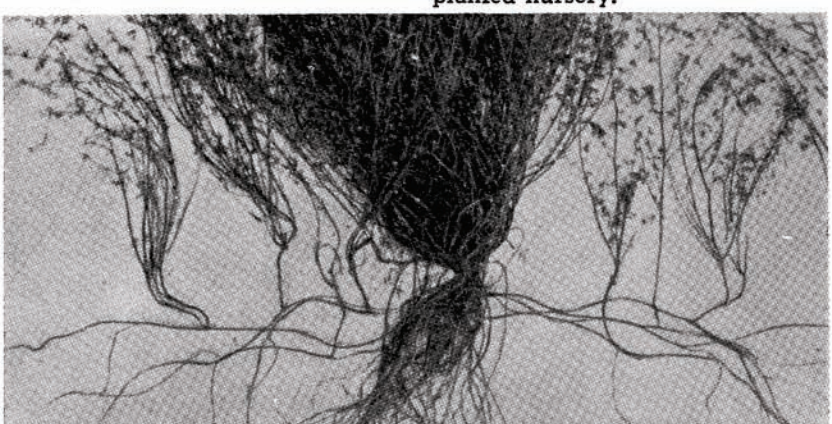

Figure 3.—Root-proliferating or creeping-rooted alfalfa showing new plants that developed from lateral roots (12).

LITERATURE REVIEW

Alfalfa-grass mixtures produced higher forage yields than alfalfa alone (9, 25) or grasses alone (4, 8, 15, 21) over a wide range of conditions.

Under non-irrigated conditions in Nebraska, continuous grazing of an alfalfa-bromegrass pasture with sheep caused a rapid decline in productivity and the pasture was discontinued after four years, whereas a rotationally grazed pasture was in good production 12 years after establishment (3). Decline of subsoil moisture rather than alfalfa stand depletion probably accounted for declining yields of alfalfa in the rotationally grazed pasture as years progressed.

Under non-irrigated conditions for a 3-year period in Nebraska, alfalfa-bromegrass pastured with steers produced more pounds of animal gain per acre than bromegrass fertilized with 60 lbs. of N per acre annually (10). The pastures were either continuously grazed or spring and summer grazing were followed by harvesting as hay or fall grazing of the aftermath. However, alfalfa-bromegrass produced less animal gain per acre than fertilized bromegrass when summer and fall grazing followed harvest of a bromegrass seed crop in the alfalfa-bromegrass mixture.

Alfalfa-bromegrass pastures produced more than twice as many pounds of animal gain per acre as non-fertilized bromegrass when the mixture was grazed continuously or spring and summer grazing was followed by harvesting as hay or a fall grazing of the aftermath. Under summer and fall grazing of the forage remaining after a bromegrass seed crop was harvested from an alfalfa-bromegrass pasture, the alfalfa-brome pasture and non-fertilized bromegrass produced about the same amount of animal gain per acre. Alfalfa stands were not appreciably reduced. It appeared that decline of subsoil moisture accounted for the decrease in alfalfa yields as years progressed.

Differential response of alfalfa varieties, grown in pure stands, to various cutting schedules has been investigated. Some reported no evidence of a variety x cutting schedule interaction (6, 16, 20, 29) while others reported an interaction (2, 7, 8, 13, 17, 27). Individual varieties grown in pure stands also showed a differential response to cutting frequency (11, 22).

Differential yield and stand responses of alfalfa varieties grown with grass and cut for hay were reported (15).

Information on differential responses of alfalfas to actual grazing is limited. In a preliminary trial at Brookings, South Dakota, where continuous grazing by sheep was practiced from mid-summer to late fall in three successive years, plots of Teton-type persisted successfully and retained normal vigor, whereas plots of Nomad, Rhizoma, and the standard varieties were almost completely eliminated (1). Preliminary information from several tests of Rambler versus other varieties and synthetics tested under various Saskatchewan, Canada, conditions indicated that: (a) the persistence of Rambler was superior to other materials in pure stands grazed with sheep under supplemental irrigation; (b) the persistence and production of Rambler was superior to other materials in mixtures with several grasses pastured with turkeys under non-irrigated conditions; (c) the persistence and production of Rambler was superior to Ladak in complex grass mixtures grazed with sheep under irrigated conditions (8).

MATERIALS AND METHODS

The origin and characteristics of many of the alfalfas in these tests were previously described (14, 19). Limited descriptions of previously undescribed alfalfas are given in Table 1.

The following seed was furnished by H. O. Graumann, former U.S.D.A. alfalfa project leader, now Agricultural Administrator, Beltsville, Maryland.

A169 F. C. 32075	Rhizoma F. C. 24798
A224 Syn-3 F. C. 32129	Sc 3504 F. C. 32143
Buffalo F. C. 24864	Sc 3513 F. C. 32144
MA5110 F. C. 32142	Sevelra F. C. 24660
Nomad F. C. 32085	Uruguay clone #10 F. C. 23982
Rambler (Sc 34922) F. C. 32145	Vernal F. C. 31983

The source of seed of experimental alfalfas other than those designated in Table 1 and from H. O. Graumann was from Lincoln production in isolated natural crossing plots or stock seed of commercially available varieties.

Five different tests were seeded at the Nebraska Agricultural Experiment Station at Lincoln, Nebraska. All alfalfas were not included in all tests due to limited availability of seed.

The tests were:

Non-irrigated alfalfa-bromegrass

- Test 1 continuously grazed with steers
- Test 2 cut for hay
- Test 3 rotationally grazed with sheep

Irrigated alfalfa-bromegrass

- Test 4 rotationally grazed with dairy cattle

Irrigated alfalfas in pure stands

- Test 5 cut for hay

All alfalfa-bromegrass tests were seeded on fall-plowed land fallowed until seeding date the following year.

A separate randomized block design was used for each test.

Table 1.—Origin and characteristics of the previously undescribed alfalfas tested.

Entry	Origin	Characteristics at Lincoln
Polycross progenies of clones		
37-C53[a]	Nebraska	broad-crowned, wilt-resistant, semi-prostrate growth habit
37-C87	Pennsylvania	"
37-C130	Nebraska	"
37-2703	Nebraska	"
37-2736	Nebraska	"
37-2737	Nebraska	"
37-107298	Turkey	creeping-rooted, semi-prostrate growth habit
37-Sc24714[b]	Canada	"
37-Sc24729[b]	Canada	"
37-Sc24736[b]	Canada	"
37-Sc247106[b]	Canada	"
Experimental synthetics or varieties		
A169	Nebraska	4-clone synthetic, broad-crowned, wilt-resistant, semi-prostrate growth habit
A204 Syn-4	Nebraska	4-clone synthetic, wilt-resistant, standard type[c]
A216 Syn-2	Nebraska	8-clone synthetic, wilt-resistant, standard type
A223	Nebraska	3-clone, wilt-resistant, standard type
A224 Syn-3	Nebraska	4-clone synthetic, broad-crowned, wilt-resistant, semi-prostrate growth habit
A225 Syn-3	Nebraska	6-clone synthetic, wilt-resistant, standard type
A226 Syn-1	Nebraska	4-clone synthetic, wilt-resistant, standard type
A230 Syn-2	Nebraska	"
A234 Syn-2	Nebraska	"
A239 Syn-2	Nebraska	"
A242 Syn-2	Nebraska	6-clone synthetic, wilt-resistant, standard type
A248	Kansas	Composite of F_1 plants selected from 4 crosses,[d] standard type
A253 Syn-1	Utah	7-clone synthetic,[d] standard type
Iowa Syn 2187	Iowa	4-clone synthetic,[d] standard type
MA5110	Canada	Semi-prostrate growth habit
Purdue Syn-C	Indiana	4-clone synthetic,[d] standard type
Sazova Kir[e]	Turkey	Standard type
Sc3484F[b]	Canada	Semi-prostrate growth habit
Sc3504[b]	Canada	"
Sc3513[b]	Canada	"
Uruguay Clone #10	Uruguay	Standard type.

[a] The prefix 37- refers to polycross seed produced at Lincoln in 1953. Polycross seed production nurseries contained randomized replicates of rooted cuttings of clones, 20% broad-crowned or creeping-rooted and 80% narrow-crowned.

[b] Entries furnished by D. H. Heinrichs, Swift Current, Saskatchewan, Canada.

[c] The entry was found to be erect to semi-erect in growth habit and appeared to have narrow crowns.

[d] Information furnished by the originating station.

[e] Furnished by M. C. Bilensoy, Eskisehir, Turkey.

Lincoln bromegrass was seeded by broadcasting in Tests 1, 2, and 4 and by drilling in Test 3. Bromegrass was seeded prior to seeding alfalfas in Tests 1, 2 and 3, and after seeding alfalfas in Test 4. Alfalfa plots were seeded with a broadcast treader-seeder. All alfalfa plots were 4′ x 25′. Each test was rolled with a corrugated roller immediately after seeding was completed.

A different management system was used on each test. However, certain features were common to all or several tests. In general, yields were based on entire plot weights obtained about the time alfalfas as a whole were at the 1/10 bloom stage. Usually 3 cuttings were obtained per year on tests 2-5. Cutting intervals varied from about 30-40 days. The shorter interval was used on Tests 2 and 5 and the longer interval on Tests 3 and 4. All plots were cut with sickle-type mowers at a height of 2-3 inches. In Tests 2, 3, and 4, first and third cuttings generally consisted of a mixture of alfalfa and grass and second cuttings were entirely alfalfa. However, in 1958 all cuttings from these 3 tests consisted of a mixture of alfalfa and grass.

In 1958 in Test 1, and the first 2 cuttings of Tests 3 and 4, a strip 1′ x 25′ was cut down the center of each plot and the forage was weighed to determine yields. Grazing was then started on the remainder. Similarly, a strip 3′ x 4′ was cut across plots in the last 2 cuttings in 1959 and the 3rd cutting in 1960 of Test 4 to determine yields before grazing was initiated.

In all tests green weights of forage were obtained to the nearest 1/20 pound immediately after cutting each plot. Samples for determining moisture were obtained at intervals of ½ to 1 hour, depending on the time of day. The shorter interval was used before 10 a.m. and after 3:00 p.m. Samples were oven-dried at about 180° F. for 48 hours to a moisture-free basis. Forage yields are reported in tons per acre adjusted to 12 percent moisture.

Stands were determined by three methods. All stands are reported as a percentage of the total plot area occupied by alfalfa crowns. On Tests 1 and 2 stands were determined by visual scores verified by frame counts. A piece of steel matting for reinforcing concrete, 30″ x 30″, containing 25 squares each 6″ x 6″ was used as a frame. This frame was placed at random in three positions in plots found by visual observation to have the highest, medium, and lowest density of crowns. A 6″ x 6″ unit was given a total count of 4 if each of the 3″ x 3″ sub-units within the 6″ x 6″ unit contained a crown or a portion of a crown. Thus, if within the 30″ x 30″ frame each 6″ x 6″ unit had crowns in each 3″ x 3″ sub-unit, the total frame score was 100. Visual scores of 1 to 10 were assigned plots of lowest to highest density,

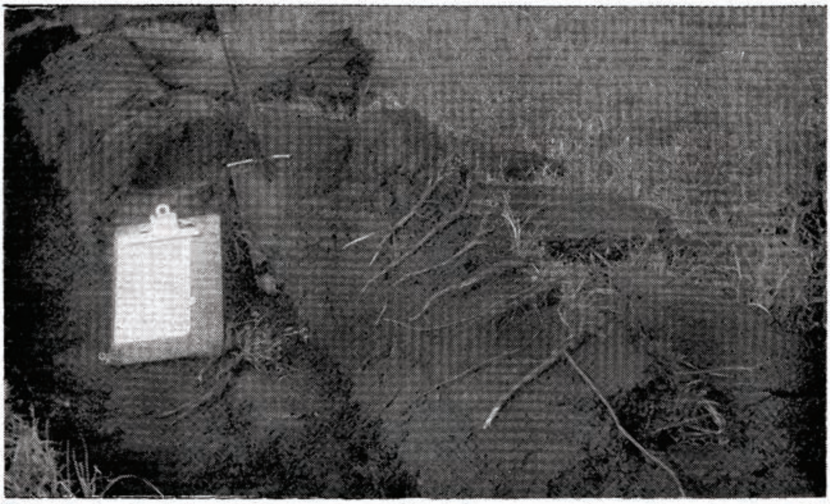

Figure 4.—Stand counts were verified by examining plow furrows in the continuously grazed alfalfa-bromegrass test at the end of the 1962 season.

respectively. Scores were converted to percent stand based on frame counts. Final stands in Test 1 were verified by examining plow furrows, Figure 4.

On Tests 3 and 4 and broadcast plots of Test 5, visual estimates were made of percentage of total plot area occupied by alfalfa crowns. On multiple-row plots in Test 5, the number of 6″ gaps without alfalfa were counted and percent stand was calculated.

The soil type of all tests was Sharpsburg silty clay loam.

Weather data were obtained from the U. S. Department of Commerce Weather Bureau at 901 North 17th Street, Lincoln, Nebraska. Latitude is 40° 49′ N, Longitude 96° 42′ W, and elevation 1,150 feet. Precipitation fluctuated widely.

Year	Inches of precipitation	
	Total	Growing Season (April-Sept. incl.)
1953	18.3	11.8
1954	30.6	24.9
1955	18.2	14.4
1956	23.8	20.1
1957	34.6	23.6
1958	33.9	26.9
1959	32.7	22.4
1960	31.5	24.0
1961	31.6	20.7
1921-1950 "normal"	25.7	18.6

For continuity in presentation and interpretation, more specific information on establishment and management of tests is given under results.

RESULTS

Weed-free stands were obtained in all tests. Bromegrass was uniformly well-established in all alfalfa-bromegrass tests.

Non-irrigated Alfalfa-bromegrass Tests

Test 1, Continuously Grazed with Steers

This test was seeded August 3, 1954. The site was an alfalfa-bromegrass pasture plowed two years before reseeding. Bromegrass was seeded at 12 lbs./acre and alfalfa plots were seeded at 6 lbs./acre of viable seed, 3 replications per entry.

This test was cut for hay once in 1955. Bromegrass and alfalfa were hand-separated and yields were determined. Continuous grazing with steers was initiated in 1956 and continued through 1962, Figure 5. Grazing was deferred until early May and continued until the first week of September each year.

Differential stand establishment was obtained, Table 2. In general, the poorest initial stands were obtained with alfalfas having the associated characteristics of high degree of spring and fall vegetative dormancy, semi-prostrate or prostrate growth habit and slow rate of recovery after cutting. Examples are 37-2703, 37-2736, and Rambler. In general, stands declined as years progressed. Stands of polycross progenies of clones 2703 and 2736 increased, however. Of the experimental synthetics and varieties, initial and final stands were most satisfactory on A169, A224, Ladak, MA5110, and Nomad.

Limited forage yield determinations were made, Table 3, since the main purpose of this test was to determine persistence. The highest bromegrass yields were obtained in plots with the

Figure 5.—Steers in the continuously grazed alfalfa-bromegrass test at the end of the 1962 season.

Table 2.—1955-60 stands obtained on Test 1, alfalfa-bromegrass mixtures continuously grazed with steers.

Entry	Crown or root type[a]	% stand			
		1955	1956	1957	1960
37-C53	b	73	67	60	48
37-C87	b	60	60	73	62
37-C130	b	57	70	67	60
37-2703	b	37	53	63	86
37-2736	b	37	53	57	46
A169	b	90	83	90	58
A224	b	77	77	70	53
A225	n	70	70	67	25
Buffalo	n	67	60	57	10
Du Puits	n	43	43	27	3
Grimm	n	67	57	57	11
Ladak	b	63	70	77	55
MA 5110	b cr	63	73	63	56
Nomad	b,n	73	77	63	56
Rambler (Sc 34922)	b cr	37	60	60	37
Ranger	n	63	67	67	13
Rhizoma	b	57	53	63	44
Sc 3504	b cr	33	65	43	21
Sc 3513	b cr	37	73	47	28
Sevelra	b,n	80	77	77	24
Stafford	n	63	63	67	12
Uruguay Clone #10	n	83	77	77	13
Vernal	b	60	50	53	25

[a] b = broad-crowned
cr = creeping-rooted
n = narrow-crowned

poorest stands of alfalfa. Low yields of certain entries were attributed to poor initial stands, which may have been due to poor competitive ability with bromegrass, or an association between low yield and spring and fall vegetative dormancy. Total alfalfa + bromegrass forage yields were about the same for all entries, which indicated that bromegrass compensated for low alfalfa yields. Yields in 1955 were not considered an index of yield potential under continuous grazing, since the test was not grazed that year. Yields of the alfalfa-grass mixtures in 1958 were similar except for Du Puits.

Test 2, Cut For Hay

This test was seeded August 31, 1954. The site was a grass nursery plowed two years before reseeding. Lime and phosphate were applied in midsummer in accordance with soil-test recommendations. Bromegrass was seeded at 12 lbs./acre and alfalfa plots were seeded at 2 lbs./acre of viable seed, 3 replications per entry.

This test was cut for hay each year. Brome and alfalfa were

Table 3.—1955-58 forage yields obtained on Test 1, alfalfa-bromegrass mixtures continuously grazed with steers.

Entry	Crown or root type[a]	Forage yield (tons/acre)			
		1955 7/13			1958 5/22[b]
		Brome	Alfalfa	Total	
37-C53	b	0.76	0.71	1.47	1.64
37-C87	b	0.78	0.87	1.66	1.71
37-C130	b	0.90	0.69	1.59	1.79
37-2703	b	1.12	0.50	1.62	1.67
37-2736	b	0.97	0.48	1.46	1.82
A169	b	0.73	0.81	1.54	1.88
A224	b	1.07	0.82	1.89	1.69
A225	n	0.79	0.62	1.41	1.97
Buffalo	n	0.80	0.69	1.49	1.55
Du Puits	n	0.66	0.55	1.21	1.25
Grimm	n	0.61	0.61	1.21	1.56
Ladak	b	0.83	1.09	1.92	1.81
MA 5110	b cr	0.97	0.78	1.75	1.57
Nomad	b,n	1.03	0.48	1.52	1.97
Rambler	b cr	0.95	0.66	1.61	1.61
Ranger	n	0.76	0.78	1.55	1.68
Rhizoma	b	0.95	0.74	1.69	1.53
Sc 3504	b cr	1.33	0.66	1.99	1.38
Sc 3513	b cr	1.43	0.51	1.94	1.63
Sevelra	b,n	0.86	0.75	1.61	1.78
Stafford	n	0.84	0.74	1.59	1.40
Uruguay Clone #10	n	0.84	0.84	1.68	1.71
Vernal	b	0.70	0.90	1.60	1.57
L. S. D. at .05		0.27	0.32	N.S.	0.38

[a] b = broad-crowned
cr = creeping-rooted
n = narrow-crowned
[b] Alfalfa + bromegrass

hand-separated in the first cutting of 1955 and yields were determined. No yields were determined in 1956. Yields were determined on only the second cutting in 1957, 1959, and 1960.

Differential stand establishment was obtained, Table 4. In general, the poorest initial stands were obtained on alfalfas with a high degree of spring and fall vegetative dormancy and associated characteristics. Some alfalfas produced better initial stands in Test 2 than in Test 1. Stands declined as years progressed. Stands of 40 percent or larger were considered satisfactory for hay production in 1960. Persistence is reported in Table 11.

Forage yields were determined each year except 1956, Table 5. Yields were generally satisfactory on varieties and experimental synthetics adapted for hay production in pure

Table 4.—1955-60 stands obtained on Test 2, alfalfa-bromegrass mixtures cut for hay.

Entry	Crown or root type[a]	% stand					
		1955	1956	1957	1958	1959	1960
37-C53	b	70	60	70	60	40	38
37-C87	b	70	63	70	77	55	52
37-C130	b	73	63	77	67	55	53
37-2703	b	43	43	53	57	35	37
37-2736	b	67	37	57	57	28	32
37-2737[b]	b	40	30	35	50	20	13
37-107298	b cr	50	50	43	47	35	28
37-Sc 24714	b cr	33	43	50	47	30	32
37-Sc 24729	b cr	23	40	40	30	15	18
37-Sc 24736	b cr	70	63	70	57	37	35
37-Sc 247106	b cr	23	33	37	33	17	20
A169	b	90	77	80	90	62	55
A224	b	70	63	67	53	45	38
A225	n	77	73	70	67	52	45
Buffalo	n	50	67	63	57	52	42
Du Puits	n	57	60	50	40	48	38
Grimm	n	70	73	77	70	60	53
Ladak	b	67	63	67	67	52	45
MA 5110	b cr	50	43	53	43	25	23
Nomad	b,n	60	43	60	53	32	28
Rambler (Sc 34922)	b cr	50	43	60	50	23	28
Rambler (Sc 34922F)	b cr	60	50	60	43	27	28
Ranger	n	67	67	63	60	53	45
Rhizoma	b	57	70	70	70	57	53
Sc 3484F	b cr	70	43	60	50	20	25
Sc 3504	b cr	63	43	60	37	15	20
Sc 3513	b cr	30	33	43	37	13	18
Sevelra	b,n	73	63	63	53	55	45
Stafford	n	67	63	70	60	52	42
Uruguay Clone #10	n	57	67	60	57	48	38
Vernal	b	70	83	77	67	57	53

[a] b = broad-crowned
cr = creeping-rooted
n = narrow-crowned
[b] 2 replications

stands, for example, A225, Ladak, Ranger, and Vernal. Alfalfas with a high degree of spring and fall vegetative dormancy and associated characteristics gave the lowest yields.

Test 3, Rotationally Grazed With Sheep

This test was seeded September 2, 1954. The site was a bromegrass sheep pasture plowed two years before reseeding. Bromegrass was seeded at 14 lbs./acre and alfalfa plots were seeded at 6 lbs./acre of viable seed, 3 replications per entry.

This test involved a combination of rotational grazing and mowing. In general, the first and third cuttings were grazed intensely for about seven to ten days, then mowed uniformly

Table 5.—1955-60 forage yields obtained on Test 2, alfalfa-bromegrass mixtures cut for hay.

Entry	Crown or root type[a]	Forage yield (tons/acre) 1955 7/13	1955 8/30	1957 7/17	1958[b] 3 cuts	1959 7/15	1960 7/11
37-C53	b	0.41	0.13	0.52	3.43	1.00	0.91
37-C87	b	0.54	0.09	0.44	3.57	0.90	0.75
37-C130	b	0.58	0.11	0.48	3.69	0.83	0.75
37-2703	b	0.23	0.04	0.33	2.22	0.68	0.51
37-2736	b	0.29	0.06	0.37	2.49	0.49	0.56
37-2737[c]	b	0.30	0.05	0.24	2.24	0.56	0.49
37-107298	b cr	0.28	0.05	0.33	2.27	0.55	0.56
37-Sc 24714	b cr	0.38	0.14	0.35	2.43	0.71	0.65
37-Sc 24729	b cr	0.41	0.06	0.35	2.37	0.56	0.46
37-Sc 24736	b cr	0.92	0.27	0.49	2.84	0.78	0.71
37-Sc 247106	b cr	0.43	0.08	0.30	2.09	0.50	0.46
A169	b	0.63	0.25	0.58	3.49	1.04	1.02
A224	b	0.59	0.17	0.51	3.18	0.93	0.79
A225	n	0.52	0.30	0.52	3.46	1.07	1.15
Buffalo	n	0.48	0.34	0.38	2.74	1.02	0.89
Du Puits	n	0.35	0.16	0.35	2.70	0.94	0.72
Grimm	n	0.56	0.36	0.57	3.58	1.16	1.24
Ladak	b	1.22	0.23	0.60	3.31	0.96	0.81
MA5110	b cr	0.42	0.08	0.42	2.17	0.51	0.43
Nomad	b,n	0.30	0.09	0.31	2.48	0.64	0.64
Rambler (Sc 34922)	b cr	0.53	0.07	0.47	2.70	0.60	0.53
Rambler (Sc 34922F)	b cr	0.65	0.12	0.48	2.80	0.65	0.59
Ranger	n	0.65	0.20	0.50	2.97	1.09	0.91
Rhizoma	b	0.45	0.14	0.50	3.38	1.03	0.86
Sc 3484F	b cr	0.57	0.09	0.39	2.47	0.42	0.54
Sc 3504	b cr	0.57	0.14	0.30	1.79	0.53	0.45
Sc 3513	b cr	0.29	0.04	0.30	1.86	0.28	0.35
Sevelra	b,n	0.76	0.24	0.42	2.92	1.00	0.92
Stafford	n	0.68	0.32	0.57	3.32	1.08	1.07
Uruguay Clone #10	n	0.54	0.23	0.49	2.90	0.98	0.86
Vernal	b	0.66	0.25	0.64	3.76	1.14	0.93
L.S.D. at .05		0.28	0.15	0.18	0.70	0.24	0.33

[a] b = broad-crowned
cr = creeping-rooted
n = narrow-crowned
[b] Alfalfa + bromegrass
[c] 2 replications.

and the excess forage, if any, was removed. Grazing was initiated at the trace bloom stage. Second cuttings were mowed and yields were determined. No yields were determined in 1956 and 1959.

Initial stands were generally good and uniform except for the single plot of Rambler, Table 6. Stands declined as years progressed with the biggest decline during the last three years except for Du Puits. Stands of 40 percent or larger were considered satisfactory in 1961. Persistence is reported in Table 11.

Table 6.—1955-61 stands obtained on Test 3, alfalfa-bromegrass mixtures rotationally grazed with sheep.

Entry	Crown or root type[a]	% stand						
		1955	1956	1957	1958	1959	1960	1961
37-C53	b	87	73	87	78	62	43	43
37-C87[b]	b	85	80	95	80	38	50	50
37-C130	b	80	70	83	78	68	48	48
37-2703	b	67	55	82	70	45	42	42
37-2736[b]	b	80	55	80	75	60	40	40
A169	b	88	70	88	82	72	60	60
A224	b	78	72	88	75	60	42	42
A225	n	90	78	88	78	67	47	47
Buffalo	n	85	73	82	80	60	47	47
Du Puits	n	92	82	25	20	18	17	17
Grimm	n	82	78	90	73	55	43	43
Ladak	b	90	83	88	73	52	42	42
Nomad	b,n	67	63	73	77	47	40	40
Rambler (SC 34922F)[c]	b cr	15	20	15	5	10	10	10
Ranger	n	78	73	87	78	62	48	48
Rhizoma	b	57	62	72	67	60	42	42
Sc 3484F[c]	b cr	55	70	60	45	25	25	25
Sevelra	b,n	88	78	93	80	63	47	47
Stafford	n	82	77	83	73	52	40	40
Uruguay Clone #10	n	83	75	85	73	43	37	37
Vernal	b	82	77	90	75	62	47	47

[a] b = broad-crowned
cr = creeping-rooted
n = narrow-crowned
[b] 2 replications
[c] 1 replication

Forage yields were determined each year except 1956 and 1959, Table 7. Yield differences were non-significant each year except 1955, when yield level was very low. Stand and yield were not closely related as evidenced by Du Puits and Rambler. Yields were generally satisfactory on varieties and experimental synthetics adapted for hay production in pure stands, as in Test 2.

Supplemental agronomic information on alfalfas in Test 3, which were also included in most other tests, is given in Table 8. Vigor was defined as total vegetative growth. Du Puits and Rambler represented the extremes of the three characteristics scored. The general association of these three characteristics was also exemplified by Du Puits and Rambler.

Irrigated Alfalfa-bromegrass Test

Test 4, Rotationally Grazed with Dairy Cattle

This test was seeded September 3, 1957. The site was a bromegrass dairy cattle pasture plowed two years before re-

Table 7.—1955-61 forage yields obtained on Test 3, alfalfa-bromegrass mixtures rotationally grazed with sheep.

Entry	Crown or root type[a]	Forage yield (tons/acre)				
		1955 8/23	1957 7/18	1958[b] 2 cuts	1960 8/31	1961 7/25
37-C53	b	0.28	1.02	2.74	0.99	0.82
37-C87[c]	b	0.19	1.22	2.77	0.93	0.66
37-C130	b	0.18	0.85	2.42	1.12	0.70
37-2703	b	0.05	0.89	2.29	1.22	1.00
37-2736[c]	b	0.26	0.90	2.76	0.87	0.77
A169	b	0.25	0.97	2.53	1.19	0.65
A224	b	0.11	1.03	2.54	1.10	0.71
A225	n	0.26	1.25	2.53	1.52	0.76
Buffalo	n	0.41	1.12	2.55	1.27	0.78
Du Puits	n	0.42	1.15	2.09	1.08	0.88
Grimm	n	0.26	1.31	2.55	1.48	1.09
Ladak	b	0.28	1.16	2.83	1.38	0.93
Nomad	b,n	0.07	0.93	2.64	1.19	0.83
Rambler[d]	b cr	0.00	0.67	1.95	0.23	0.79
Ranger	n	0.15	1.05	2.65	1.30	0.94
Rhizoma	b	0.13	0.92	2.48	1.06	0.74
Sc3484F[d]	b cr	0.04	0.83	2.37	0.36	0.55
Sevelra	b,n	0.30	1.07	2.67	1.27	0.57
Stafford	n	0.18	1.32	2.85	1.40	0.90
Uruguay Clone #10	n	0.19	1.44	2.52	1.32	0.75
Vernal	b	0.24	0.97	2.48	1.30	0.88
L.S.D. at .05		0.17	N.S.	N.S.	N.S.	N.S.

[a] b = broad-crowned
cr = creeping-rooted
n = narrow-crowned
[b] Alfalfa + bromegrass
[c] 2 replications.
[d] 1 replication.

seeding. Bromegrass was seeded at 12 lbs./acre and alfalfa plots were seeded at 6 lbs./acre of viable seed, 4 replications per entry.

This test involved a combination of rotational grazing and mowing. All cuttings were grazed intensely for five to seven days, then mowed uniformly and the excess forage, if any, was removed, except for the third cutting in 1958 and the first cutting in 1959 when entire plots were cut and weighed for forage yield determinations. Grazing was initiated at the trace bloom stage.

During 1958-59 palatability of alfalfas was studied by observing at 5-minute intervals the number of cattle grazing each plot according to a method previously used on tall fescue (23). The first year, observations were on all replications at one time. The second year, replications were fenced separately and observations were made on one replication at a time.

No stand data were obtained in 1958 due to the uninterrupted vigorous growth of bromegrass. There was some indica-

Table 8.—1954-61 miscellaneous data obtained on Test 3, alfalfa-bromegrass mixtures rotationally grazed with sheep.

Entry	Crown or root type[a]	Miscellaneous data[b]		
		Fall vigor 10/25/54	Growth habit 8/9/60	Rate of recovery 8/7/61
37-C53	b	4.0	4.0	6.3
37-C87[c]	b	6.0	5.5	7.5
37-C130	b	7.0	6.0	8.3
37-2703	b	6.7	6.7	8.3
37-2736[c]	b	5.5	5.0	5.5
A169	b	5.7	5.3	6.7
A224	b	6.3	5.3	6.0
A225	n	2.3	2.3	4.0
Buffalo	n	1.3	2.0	3.0
Du Puits	n	1.3	1.0	1.0
Grimm	n	3.3	2.3	3.3
Ladak	b	5.3	4.7	5.7
Nomad	b,n	6.0	5.3	8.0
Rambler[d]	b cr	9.0	7.0	8.0
Ranger	n	2.3	3.0	3.0
Rhizoma	b	5.0	5.0	5.7
Sc3484F[d]	b cr	7.0	6.0	9.0
Sevelra	b,n	3.7	4.0	4.7
Stafford	n	4.3	2.7	3.3
Uruguay Clone #10	n	2.3	4.3	5.0
Vernal	b	5.0	4.3	5.0

[a] b = broad-crowned
cr = creeping-rooted
n = narrow-crowned
[b] Fall vigor scored 1 = most, 9 = least.
Growth habit scored 1 = erect, 9 prostrate.
Rate of recovery scored 1 = most rapid, 9 = least rapid.
[c] 2 replications.
[d] 1 replication.

tion from 1959 stands, Table 9, that alfalfas such as Ladak, Nomad, Rambler, and Teton, with spring and fall dormancy and associated characteristics, had less competitive ability than other alfalfas. Stands declined as years progressed. There was more mechanical damage to alfalfa crowns from trampling in this than in other grazing tests. Bacterial wilt susceptibility was important in stand decline. Persistence is reported in Table 11. Stands were generally satisfactory on varieties and experimental synthetics adapted for hay production in pure stands.

Forage yields were determined for three years, Table 10. Total season yields in 1958 and 1959 and first cut yields in 1959 contained a bromegrass component. Even with bromegrass contributing appreciably to total yield, Ladak, Nomad, Rambler, Rhizoma, and Teton were particularly low in yield. Yields were generally satisfactory on varieties and experimental synthetics adapted for hay production in pure stands.

Palatability differences among entries were non-significant

Table 9.—1959-61 stands obtained on Test 4, alfalfa-bromegrass mixtures rotationally grazed with dairy cattle.

Entry	Crown or root type[a]	% stand			1961 stand in percent of 1959
		1959	1960	1961	
A169	b	54	32	30	56
A204	n	45	31	19	42
A216	n	54	36	31	57
A223	n	61	36	28	46
A224	b	45	31	16	36
A225	n	48	36	30	62
A226	n	59	41	36	61
A230	n	54	34	27	50
A234	n	52	34	24	46
A239	n	59	43	34	58
A242	n	50	34	18	36
A248	n	51	36	22	43
A253	n	59	43	39	66
Atlantic	n	51	26	14	27
Buffalo	n	44	28	18	41
Culver	n	44	34	26	59
Du Puits	n	48	25	5	10
Grimm	n	41	26	16	39
Iowa Syn 2187	n	40	21	16	40
Ladak	b	31	19	6	19
Lahontan	n	59	40	35	59
Narragansett	b	52	23	15	29
Nomad	b,n	28	16	10	36
Purdue Syn C	n	42	39	29	69
Rambler	b cr	31	23	15	48
Ranger	n	55	38	30	54
Rhizoma	b	52	30	25	48
Sazova Kir	n	38	21	8	21
Sevelra	b,n	51	26	15	29
Stafford	n	50	29	14	28
Teton	b	35	28	25	71
Uruguay Clone #10	n	48	28	19	40
Vernal	b	42	29	24	57
Williamsburg	n	51	31	15	29

[a] b = broad-crowned
cr = creeping-rooted
n = narrow-crowned

each year and for the two-year period. Only one entry (Rambler) ranked in the five most palatable and one entry (A248) in the five least palatable both years. There was no relationship between yield and palatability

Irrigated Alfalfas in Pure Stands

Test 5, Cut For Hay

Results from several tests were grouped and considered as Test 5 for convenience. Seedbeds were prepared in the spring on fall-plowed land. Lime and phosphate were applied in the

Table 10.—1958-60 forage yields obtained on Test 4, alfalfa-bromegrass mixtures rotationally grazed with dairy cattle.

Entry	Crown or root type[a]	Forage yield (tons/acre)					
		1958 3 cuts	1959				1960 8/9
			6/5[b]	7/1	8/6	Total[b]	
A169	b	2.54	2.78	1.40	1.05	5.23	0.64
A204	n	2.50	2.94	0.80	1.07	4.80	0.95
A216	n	2.56	2.76	0.80	0.80	4.36	0.84
A223	n	2.61	3.00	1.24	0.88	5.12	0.80
A224	b	2.48	3.03	0.65	0.94	4.62	0.62
A225	n	2.43	3.00	0.48	0.72	4.20	0.84
A226	n	2.80	2.85	1.14	0.95	4.94	1.11
A230	n	2.53	2.96	0.76	0.75	4.47	0.71
A234	n	2.34	3.06	1.01	1.04	5.11	0.78
A239	n	2.42	2.97	0.72	0.88	4.57	0.76
A242	n	2.42	2.94	0.84	1.06	4.84	0.80
A248	n	2.75	2.70	1.13	0.88	4.72	0.90
A253	n	2.72	2.62	1.41	0.79	4.82	0.88
Atlantic	n	2.49	2.88	0.80	0.59	4.28	0.78
Buffalo	n	2.26	2.78	0.88	1.00	4.66	0.86
Culver	n	2.13	3.09	0.77	1.03	4.89	0.81
Du Puits	n	2.88	3.10	1.22	0.92	5.24	0.88
Grimm	n	2.33	2.69	0.55	1.02	4.26	0.78
Iowa Syn 2187	n	2.23	2.76	0.43	0.82	4.01	0.72
Ladak	b	1.87	2.84	0.49	0.90	4.24	0.41
Lahontan	n	2.58	2.82	1.38	0.85	5.04	0.95
Narragansett	b	2.36	2.97	0.59	0.75	4.31	0.62
Nomad	b,n	1.73	2.83	0.42	0.79	4.04	0.36
Purdue Syn C	n	2.24	2.87	0.58	0.82	4.27	0.94
Rambler	b cr	2.06	2.61	0.38	0.91	3.90	0.64
Ranger	n	2.68	2.87	1.20	0.90	4.97	0.70
Rhizoma	b	2.46	2.66	0.48	0.78	3.91	0.64
Sazova Kir	n	2.53	2.63	1.00	0.79	4.42	0.61
Sevelra	b,n	2.51	2.72	0.73	0.99	4.44	0.73
Stafford	n	2.62	2.82	0.85	0.74	4.41	0.82
Teton	b	1.98	2.84	0.34	0.78	3.95	0.54
Uruguay Clone #10	n	2.43	2.78	0.54	0.90	4.22	0.62
Vernal	b	2.48	2.92	0.84	0.93	4.69	0.82
Williamsburg	n	2.84	2.89	0.78	0.94	4.62	0.74
L.S.D. at .05		0.42	N.S.	0.44	N.S.	0.75	0.26

[a] b = broad-crowned
cr = creeping-rooted
n = narrow-crowned
[b] Alfalfa + bromegrass

spring before planting, in accordance with soil-test recommendations. Seedings were made in late April or early May. Three-row plots 2.5′ x 15′ with rows 9″ apart and plots 12″ apart, or broadcast plots 6′ x 15′ or 4′ x 25′ were used. Alfalfas were seeded at 12 lbs./acre of viable seed. Row plots were seeded with a Vbelt drill. Broadcast plots were seeded with a treader-seeder. Randomized block and lattice designs were used with six to eight replications. Rainfall was supplemented by sprinkler irrigation to assure sustained growth. Cuttings for forage yield determinations were initiated the year after seeding.

The alfalfas were not all tested at the same time, but during the years when the alfalfa-bromegrass tests were conducted. Buffalo and Ranger were included in all tests, thus relative forage yields are reported in percent of the average of these two check varieties. Data on stand and yield were previously reported on individual tests (19). Data reported in Tables 11 and 12 for comparative purposes are averages for several tests, in general 8 to 14 station-years' results.

DISCUSSION

Comparative Persistence

Comparative persistence of alfalfas under five management systems is presented in Table 11. Stands were generally uniform within plots, but there was some within-plot variability which influenced annual stand determinations.

Polycross progenies of clones believed to possibly have special merit for pastures increased in stand when grown in pure stands, Test 5, except for clone 107298. Initial stands of all these progenies were relatively poor, varying from 68 to 83 percent. The increase in stand was attributed to increase in crown size, since these progenies were not observed to have spread by rhizomes or creeping roots. The initial stand of synthetic Sc3484F was 50 percent and it increased to 86 percent by means of an increase in crown diameter. Slight increases in stand of 1 to 6 percent by narrow-crowned synthetics or varieties were also attributed to increase in crown size. Previous work showed that the taproot increased in diameter with an increase in space between plants and that, in similar varieties of alfalfa, taproot size is determined more by space the plant occupies than by its varietal characteristics (12).

Stand increases were apparent in several polycross progenies in Test 1 by 1956 and 1957. The greatest stand increases were in polycross progenies which had the poorest initial stands. The clones whose progenies increased in stand were broad-crowned. The increase in stand was attributed to an increase in crown size. Broad-crowned experimental synthetics and varieties, except Sevelra, persisted better than narrow-crowned types. Of these experimental synthetics and varieties, initial and final

Table 11.—Persistence (final in percent of initial stands) of alfalfas tested under five management systems.

Entry	Crown or root type[a]	Management system				
		Alfalfa-bromegrass mixtures				Pure stands of alfalfa mowed for hay, Test 5
		Grazed continuously Test 1	Mowed for hay Test 2	Grazed and mowed Test 3	Grazed and mowed Test 4	
		%	%	%	%	%
37-C53	b	66	54	49	..[b]	114
37-C87	b	103	74	59[c]	..	116
37-C130	b	105	73	60	..	111
37-2703	b	232	86	63	..	118
37-2736	b	124	48	50[c]	..	..
37-2737	b	..	32[c]	..	..	..
37-107298	b cr	..	56	..	..	96
37-Sc 24714	b cr	..	97	..	..	128
37-Sc 24729	b cr	..	78	..	..	..
37-Sc 24736	b cr	..	50	..	..	..
37-Sc 247106	b cr	..	87	..	..	..
A169	b	64	61	68	56	102
A224	b	69	54	54	36	103
A225	n	36	58	52	62	101
Buffalo	n	15	84	55	41	100
Du Puits	n	7	67	18	10	102
Grimm	n	16	76	52	39	100
Ladak	b	87	67	47	19	104
MA 5110	b cr	89	46	..	..	..
Nomad	b,n	77	47	60	36	106
Rambler (Sc 24922)	b cr	100	56	..	48	90
Rambler (Sc 24922F)	b cr	..	47	67[d]	..	..
Ranger	n	21	67	62	54	100
Rhizoma	b	77	93	42	48	102
Sc 3484F	b cr	..	36	45[d]	..	172
Sc 3504	b cr	64	32	..	..	..
Sc 3513	b cr	76	60	..	..	..
Sevelra	b,n	30	62	53	29	100
Stafford	n	19	63	49	28	102
Uruguay Clone #10	n	16	67	44	40	..
Vernal	b	42	76	57	57	104

[a] b = broad-crowned
cr = creeping-rooted
n = narrow-crowned
[b] A blank indicates the entry was not included.
[c] 2 replications.
[d] 1 replication.

stands were most satisfactory on A169, A224, Ladak, MA5110, and Nomad, Table 2.

No stand increases were observed in Test 2. Persistence of polycross progenies of selected clones was no better on the average than that of narrow-crowned synthetics and varieties. Initial stands of these progenies were poor in many cases, Table 4. Initial and final stands of many narrow-crowned experimental synthetics and varieties were as good or better than those of

Table 12.—Relative forage yields[a] of alfalfas tested under five management systems.

Entry	Crown or root type[b]	Management system: Alfalfa-bromegrass mixtures: Grazed continuously Test 1	Mowed for hay Test 2	Grazed and mowed Test 3	Grazed and mowed Test 4	Pure stands of alfalfa mowed for hay, Test 5
		%	%	%	%	%
37-C53	b	96	92	89	..[c]	102
37-C87	b	117	84	85[d]	..	94
37-C130	b	93	85	81	..	99
37-2703	b	68	55	90	..	84
37-2736	b	65	55	80[d]	..	..
37-2737	b	..	51[d]	..	..	..
37-107298	b cr	..	55	..	..	94
37-Sc 24714	b cr	..	69	..	..	81
37-Sc 24729	b cr	..	57	..	..	..
37-Sc 24736	b cr	..	98	..	..	..
37-Sc247106	b cr	..	55	..	..	..
A169	b	109	109	87	111	100
A224	b	111	92	84	80	95
A225	n	84	110	108	74	102
Buffalo	n	93	96	102	99	100
Du Puits	n	74	78	100	109	94
Grimm	n	82	120	118	85	97
Ladak	b	147	118	107	65	97
MA 5110	b cr	105	58	..	..	..
Nomad	b,n	65	61	86	57	77
Rambler (Sc 24922)	b cr	89	68	48[e]	70	78
Rambler (Sc 24922F)	b cr	..	77	..	..	..
Ranger	n	105	104	98	101	99
Rhizoma	b	100	92	81	68	89
Sc 3484F	b cr	..	62	51[e]	..	70
Sc 3504	b cr	89	62	..	..	..
Sc 3513	b cr	69	39	..	..	..
Sevelra	b,n	101	103	91	88	98
Stafford	n	100	115	108	87	97
Uruguay Clone #10	n	113	96	105	74	..
Vernal	b	122	112	96	93	98

[a] In percent of the average of Buffalo and Ranger.
[b] b = broad-crowned
cr = creeping-rooted
n = narrow-crowned
[c] A blank indicates the entry was not included.
[d] 2 replications
[e] 1 replication.

the better polycross progenies. The average persistence of broad-crowned experimental synthetics and varieties was inferior to that of narrow-crowned types.

No stand increases were apparent in Test 3. There was little indication that persistence of polycross progenies of selected clones and broad-crowned synthetics or varieties was superior on the average to that of narrow-crowned experimental synthetics and varieties.

and varieties tended to produce the highest yields, although yield differences were generally not significant.

Alfalfa yields for two cuttings in 1959 and one cutting in 1960 were reported for Test 4 in Tables 10 and 12. Except for A169, yields of adapted narrow-crowned experimental synthetics and varieties were generally superior to those of broad-crowned types.

Rank of alfalfas for forage yield varied with the management system. Forage yields of A225, Du Puits, Grimm, Ladak, and Rhizoma varied greatly with the management system. A169, Buffalo, Ranger, and Vernal produced well under the wide range of conditions. A224, Sevelra, and Stafford also produced quite well under all management systems.

Much of the yield data on alfalfa-bromegrass tests were obtained from second cuttings because of the time and labor involved in hand-separation of alfalfa and bromegrass in other cuttings. It is recognized that second-cutting data have limitations, particularly with varieties like Ladak and experimental synthetics such as A224 which contribute relatively more toward total season production from first than other cuttings. However, yields from Ladak, A224, and similar types which included the alfalfa and bromegrass components were not superior to yields of other adapted types.

Other Considerations

Rambler was easier to establish either in grass mixtures or in pure stands, provided greater ground cover, and contributed more to the production of mixtures than did Ladak under Swift Current, Canada, conditions (8). Results from the tests reported herein were not in agreement. The data from Lincoln vs. Swift Current indicated a variety x location response.

The methods used to determine stands were believed to accurately report percentage of the total plot area occupied by alfalfa crowns. Stand was not closely related to yield of several entries in Tests 3 and 4. Some previous research showed a relationship between stand and yield in broadcast (24) and drilled row plots (18), while in other research involving broadcast plots stand and yield were not related (13, 24, 28). Age of stand (24) and crown development of alfalfas (14, 26) were also reported as factors in stand *vs.* yield relationships. Stand counts *per se* can be misleading for evaluating stand, as previously reported (12, 26). Stand and yield may not be expected to be closely related under limited moisture conditions which prevent maximum yields by superior genotypes.

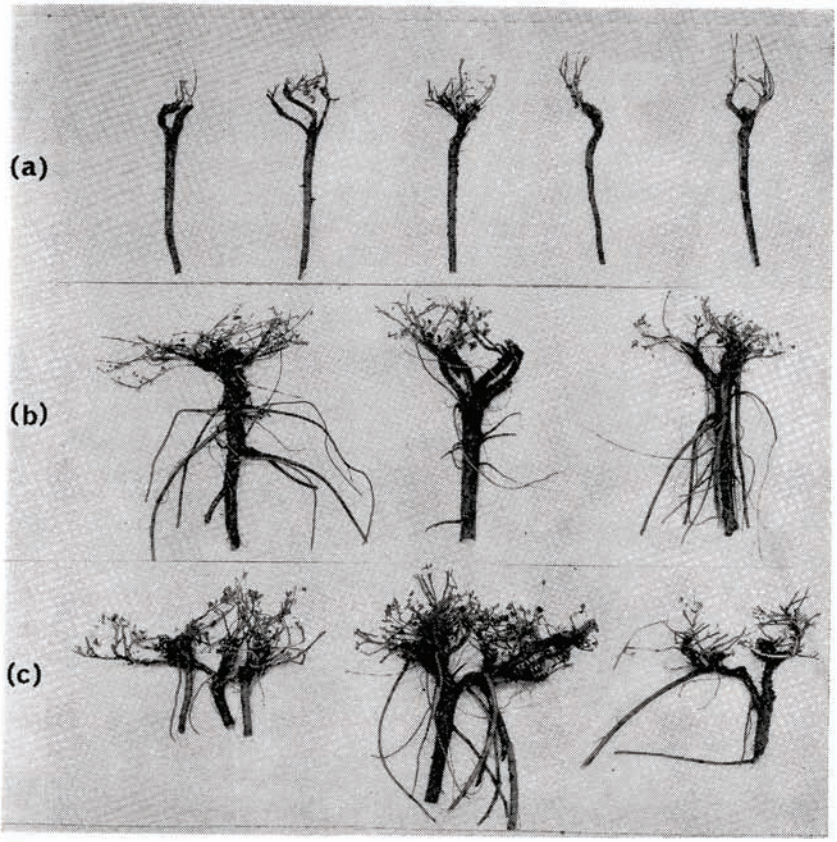

Figure 6.—Alfalfa crowns from plow furrows in the continuously grazed alfalfa-bromegrass test at the end of the 1962 season. (a) Typical crowns of Ranger, (b) typical crowns from polycross progeny of clone 2703, (c) occasional rhizomatous plants from polycross progeny of clone 2703.

There is no sharp distinction between narrow and broad-crowned alfalfas. An alfalfa strain may have a mixture of crown types. Alfalfas are commonly classified for the crown type which prevails under most management systems. Rhizomatous and creeping-rooted types are broad-crowned.

Plant characteristics which contributed to the rank of alfalfas for stand or yield, or both, appeared to be crown type in a non-irrigated test continuously grazed with steers, Figure 6, and bacterial wilt reaction in an irrigated test rotationally grazed with dairy cattle. It was concluded from research in South Dakota (1) that an alfalfa strain in order to persist when continuously grazed, must have the following traits: (a) superior cold resistance, (b) dormancy at critical periods of the season,

(c) low crown with aggressive rhizome production, and (d) bacterial wilt resistance.

Experimental synthetics A169, A224, and the variety Vernal gave good persistence and forage production under the wide range of conditions in these tests. A 169 and A224 had a slight margin of superiority over Vernal for ease of establishment in competition with bromegrass and for persistence under continuous grazing. Polycross progenies of three of the four parental clones of A224, namely, 37-C53, 37-C87, and 37-C130, also gave superior persistence under continuous grazing. Seed of the other parent of A224, C63, was not available.

Since a number of alfalfas of diverse type performed similarly or dissimilarly, depending on the pasture management system, use of the term "pasture" alfalfa should specify the management system under which results were obtained. In rotational grazing, forage removal by animals was shown to be essentially comparable to mowing.

Information on rainfall conditions, latitude, longitude, altitude, and previous cropping history is essential to interpretation of results.

Stand persistence and forage production of alfalfa were dependent on moisture conditions, management system, and strain. Choice of crops and crop varieties is dependent on anticipated net return per acre. Alfalfa returns are commonly measured as hay or animal production. In areas of intense cultivation, forage crops must be competitive with other crops. Thus, persistence and production under a given management system seem essential in choice of an alfalfa. In grassland areas suitable for reseeding, where grazing is the chief source of income, more emphasis may be placed on persistence than on forage production. A persistent alfalfa may be the goal even though it has less than the maximum potential for forage production.

The forage ratio of alfalfa to grass may be critical in reducing the danger of bloat. A 50:50 alfalfa-grass forage mixture has often been suggested as desirable. No bloating was observed in the studies reported in this bulletin.

Under range conditions, alfalfas may have merit for their contribution of nitrogen from nitrogen fixation, if there is sufficient moisture to normally obtain an economic response from inorganic nitrogen. The application of phosphorus fertilizer on native grass subirrigated meadows where legumes are to be seeded or on meadows with established legumes was demonstrated to be economically feasible (5).

Some factors which may restrict the interest of ranchers in seeding alfalfa in native grasslands are: (a) cost of seedbed preparation, (b) danger of loss of native vegetation, (c) danger that alfalfa, if established, may persist only temporarily until subsoil and other moisture is depleted, thus leaving the land in a less-productive condition than before, and (d) loss of production while legumes are being established.

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