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A Summary of

Alfalfa Investigations

Conducted on the

Squaw Butte Experiment Station

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A SUMMARY OF ALFALFA INVESTIGATIONS CONDUCTED ON THE SQUAW BUTTE EXPERIMENT STATION

INTRODUCTION

Hay and pasture production of humid areas of the United States has been significantly increased through the inclusion of alfalfa or other legumes in the hay or pasture mix. Similar increases have been realized on irrigated pastures of the west. Large acreages of hay-type alfalfas are grown on western arable lands, and, when seeded with adapted grasses and grazed by animals, production has been increased above that of lands seeded to grasses alone. It was only natural that with the success of alfalfa elsewhere that attempts be made to establish it alone and with adapted grasses on the more arid portions of the western range. Some of these earlier seedings were successful, others were not; but, like hunting tales, the successes are remembered more often than the failures.

The problems associated with introducing alfalfa onto these arid lands are many. The climate is harsh, typically Mediterranean with dry summers and annual precipitation about 12 inches. The soils are extremely variable in depth, composition, texture, and the vegetation which they support. Occasionally, these variables mesh together and result in a suitable site for alfalfa, yet these areas perhaps represent only a small portion of the total range.

Investigations at Squaw Butte were concerned primarily with the following questions: (1) If successfully established and protected from rodents, will alfalfa persist under prevailing conditions? (2) Which variety of those presently recommended or thought to be adapted is the more protective under the soil and climatic conditions at Squaw Butte? (3) Does stand density or width of row spacing affect yield or other characteristics of alfalfa? (4) Can alfalfa maintain itself in a mixed stand with adapted grasses which are cool-season types when the climate favors the latter? (5) Do any of the commercial fertilizer amendments offer opportunity for increasing the yield or effectiveness of alfalfa on these soils?

LITERATURE REVIEW

As early as 1939 (Stewart, Walker, and Price) alfalfa was recommended for the better sites within the western range area. Similar conclusions were drawn by: Plummer et al.(1955), Rummell and Holscher (1955), Jackman (1956), Hull et al. (1958), and most recently by McLean et al. (1961). The reports are in fair agreement as to what constitutes a better site, and this is characterized by a precipitation amount of 12 inches or more annually. Alfalfa was generally the most recommended legume, but the species or variety varied according to the location. Cornelius and Talbot (1955) and Lavin and Springfield (1955) shared the above conclusions, but indicated that wildlife and rodent grazing in the seedling year caused discouraging establishment results.

The few studies conducted on range areas receiving less that 12 inches of precipitation annually have not been encouraging. In 1946 Stark et al., summarizing seeding studies near Aberdeen, Idaho (an area receiving about 9 inches of precipitation annually), reported that trial plantings of Orestan alfalfa were not successful. Results of experiments with Ladak alfalfa and crested wheatgrass when seeded alone and in mixtures at the Dryland Experiment Station at Lind, Washington, have been reported (Anon., 1948). Over a 4-year study period there was no significant difference in hay yields among mixtures or pure stands. Recognized value from the inclusion of an alfalfa was reported by Douglas et al. (1960) from studies conducted within a 9-inch precipitation zone. However, yield differences between grass-alfalfa and the highest yielding pure grass stand were only 72 pounds per acre.

The status of alfalfa or any other legume on the arid rangeland is perhaps best positioned at the present time by the conclusions of: Schwendiman(1950) "Under less than 10 inches of rainfall even a grass-legume mixture has not produced more feed per acre than grass alone"; Hafenrichter (1958) "Few legumes have been found that produce reliable stands and yields or contribute directly to or through the grasses in mixtures to conservation or forage production on semiarid or arid range lands"; Keller (1959) "Alfalfa has found limited use on some ranges and creeping-rooted types now being developed may prove widely adapted..."; and perhaps that which Harlan (1960) suggested for the Great Plains may also be true for the west, "Our search for a really good legume will fail. Alfalfa will remain the best we have."

EXPERIMENTAL AREA

Location

The Squaw Butte range lies in southeastern Oregon, near Burns, at a mean elevation of 4,600 feet. According to the Physiographic Committee of the Geological Survey, this range is within the Payette section of the Columbia Plateaus.

Precipitation

The median amount of precipitation during the crop year, September 1 through June 30, was 11.3 inches for the past 20 years of record. The precipitation pattern is dominated by winter precipitation in the form of snow and rain. It is important, however, to recognize that about a third of the total precipitation is received as rain during the growing-season months of April, May, and June. Crop-year amounts for the study years are presented in Table 1. The range (5,9 to 16.2 inches) that occurred during the study years also includes the least and the greatest amounts of precipitation recorded at this station.

Table 1. Crop-year precipitation (September 1 to June 30) at Squaw Butte during the study period

Year	Inches of precipitation
1952	11.4
1953	14.0
1954	8.4
1955	5.9
1956	14.3
1957	13.1
1958	16.2
1959	6.1
1960	8.9
20-year median	11.3

1/ Crop-years are identified by the calendar year in which they terminate.

Temperature

The harshness of the climate is quite clearly illustrated when the temperatures of the area are considered (Figure 1). Every month has experienced freezing weather and the average frost-free period has been about 50 days. Evaporation from a free-water surface near Burns in the period April 1 to October 1 averages about 45 inches.

Soils

The soils upon which the studies were conducted are uncorrelated series representing the Brown great soil group. These soils range in depth from 23 to 33 inches and are underlaid with water-worked sands and gravels or silica-lime cemented pans.

The texture varies from loam in the A horizon to a sandy clay loam in the B horizon. A platy structure is found in the A horizon while the primary structural units in the B horizon are moderate prisms, breaking into subangular blocks.

The soils are nonsaline throughout and vary in pH from 6.4 to 7.0 except in the calcium carbonate pan where the pH increases to about 8.0. The organic matter content is low; 2.0 to 2.2% in the A_1 but averaging less than 1% in the surface 6 inches. A moisture content of 17.0 to 20.0% at a tension of one-third atmosphere for the surface 6 inches was determined, and this decreased to 8 to 11% at 15 atmosphers of tension.

Ecology

The study areas are within the habitat type classified by Eckert (1957) as Artemesia tridentata Nutt., Agropyron spicatum (Pursh.) Scribn. & Smith. This type is recognized as being the most extensive within the big sagebrush-bunchgrass range. The studies within the nursery areas (alfalfa varietal trials, row-spacing study, and adaptability test of creeping-rooted clones) are further described as being on the Stipa thurberiana Piper phase of the before-mentioned type.

PROCEDURES

Experiment 1

Sixteen alfalfa varieties were seeded in May 1952, in 3-row plots 20 feet long arranged in a randomized block design with 3 replications. The rows were spaced 2 feet apart. Plots were sprinkle-irrigated to insure stand establishment, but were not irrigated after the seedling year. Good stands were obtained of all varieties with the exception of South Dakota 30114. The seed of this variety was from a 1930 seed crop, and no doubt the poor stand resulted from low seed viability. The plot area was protected by a rodent-proof fence and rodent poisoning as required until 1956. Alfalfa seed was inoculated with Nitrogen AB.

Herbage yields were taken from the center row after the alfalfas had completed their season's growth, which normally terminated in July. In the drier years, growth terminated as early as late June. Yields in all years were obtained with a plot mower. Oven-dry weights of all yield samples were determined and reported as air dry (10%).

Crude-protein determinations of selected varieties were obtained in 1953 and 1954. Visual ratings of frost and rodent damage were made when such was evident.

Experiment 2

Nomad alfalfa was seeded in rows 1, 2, 3, 4, and 5 feet apart on plots 30-feet square in April 1956. The inoculated seed was planted with a single-row, double-disc, cone-type seeder. Treatments were applied in a randomized block design with 3 replications. On 2 of the replications selected at random, bulbous bluegrass (Poa bulbosa L.) was broadcast prior to seedbed firming as a deterrent to cheatgrass invasion. No attempts were made to control rodents.

Herbage yields were taken annually beginning in 1958. Yield samples were hand-clipped from a 48-square-foot area shortly after the alfalfa had begun to bloom (approximately June 20). In the 2 replications seeded with grass, the grass between rows was not included in the yield sample; however, that which was growing in the alfalfa row was included. Yield samples were weighed green, oven-dried, reweighed, and reported in tons per acre with 10% moisture.

In the fall of 1958 the plots were split with fertilizer applications of 0 and 50 pounds P_2O_5 per acre. The treble superphosphate was surface-applied in late fall, and effects of P were measured the following growing season.

Crude protein and phosphorus determinations of the herbage from selected row spacings were obtained in 1959 and 1960.

The 2 replications broadcast to bulbous bluegrass caused large error variance in the straight-forward analysis and precision for testing is lacking. An additional analysis was conducted with only the 2 replications seeded to the annual grass to obtain information on its effect on the yield of alfalfa seeded in 1-, 2-, 3-, 4-, and 5-foot rows.

Experiment 3

Vegetative cuttings from 5 selections of selfed lines of creeping-rooted alfalfa were planted in the fall of 1955 3/. The clones were placed in the soil at 1-foot intervals in rows 5 feet apart. Each row consisted of 25 plants and each alfalfa selection was assigned at random to 2 rows.

Data collection during the period 1956 to 1960 included: herbage yields, measurement of creeping tendencies, herbage crude protein contents, and general observations on adaptability and growth form.

The plot area was fenced with chicken wire to deter grazing by cattle or rabbits but did not exclude gophers and mice.

The origin of the selections was as follows:

Clone number	Origin
Sc. 25392	L* x((LxS)S x(LxS)S)
Sc. 25371	L**x((LxS)S x(LxS)S)
Sc. 25366	L* x((LxS)S x(LxS)S)
Sc. 25350	L**x((LxS)S x(LxS)S)
Sc. 25427	$((LxS)F_2)$ (S(LxS)

L = Ladak. S= Siberian (M. falcata).

L* : A bright purpled, flowered Ladak, strongly creeping-rooted. This is the only creeping Ladak plant ever found.

L**: An inbred Ladak plant giving excellent progenies for creep vigor.

Throughout the rest of the report the creeping-rooted selections will be referred to by the last 2 digits of the clone number.

3/ Acknowledgment is made to J. Ritchie Cowan, Head, Farm Crops Department, Oregon State University, who obtained the creeping-rooted selections as part of a state-wide testing program. The selections were made by D. H. Heinrichs, Experimental Farm, Swift Current, Canada.

Experiment 4

In 1955 experiments were initiated: (1) to find whether selected legumes in alternate row combination with selected bunchgrass would contribute to higher yields of the grasses, (2) to find whether selected combinations of alfalfa-bunchgrass would produce more herbage per acre than the grasses seeded alone, and (3) to measure the total yield of protein produced by the alfalfa-grass mixtures as compared with grasses seeded alone.

The study was planned as a 3x3x2 factorial in split-plot design with 6 replications. Whitmar wheatgrass (Agropyron inerme (Scribn. and Smith) Rydb.), Siberian wheatgrass (Agropyron sibiricum (Willd.) Beauv.), and Sherman big bluegrass (Poa ampla Merr.) were seeded in 12- and 24-inch alternate rows in all possible combinations with alfalfa treatments of none, Nomad, and Alaska falcata. Grasses and inoculated legumes were planted in June 1955. The lateness of seeding plus the drought of the year necessiatated supplemental irrigation to insure stand establishment.

Two years later, with the same objectives in mind, a second study was initiated with modifications. Grasses included in this study were standard crested wheatgrass (Agropyron desertorum (Fisch.) Schult.), Sherman big bluegrass, and pubescent wheatgrass (Agropyron trichophorum (Link)Richt.). Nomad was the only alfalfa used. The 12- and 24-inch row spacing treatments were retained in this study. Plots were seeded in April 1957, without irrigation, and alfalfa seed was inoculated.

Experiment 5

Four acres of standard crested wheatgrass, seeded the previous fall, were drilled to Nomad alfalfa in the spring of 1952. The total area seeded to crested wheatgrass was approximately 200 acres. This area had been a native sagebrush-bunchgrass pasture prior to plowing and seeding. In following years, observational trials included fertilization treatments with zinc sulphate, phosphate, nitrogen, and gypsum.

RESULTS AND DISCUSSION

Establishment

The objectives in the various studies required established stands of alfalfa; therefore, the factors affecting establishment such as seedbed preparation and time, and method of planting were not studied. Nevertheless, good stands of alfalfa were established in 3 different years without supplemental irrigation. In those years, crop-year precipitation was 11.4, 14.3, and 13.1 inches (each above the 20-year median if 11.3 inches), and alfalfa was drilled in the early spring on well-prepared seedbeds.

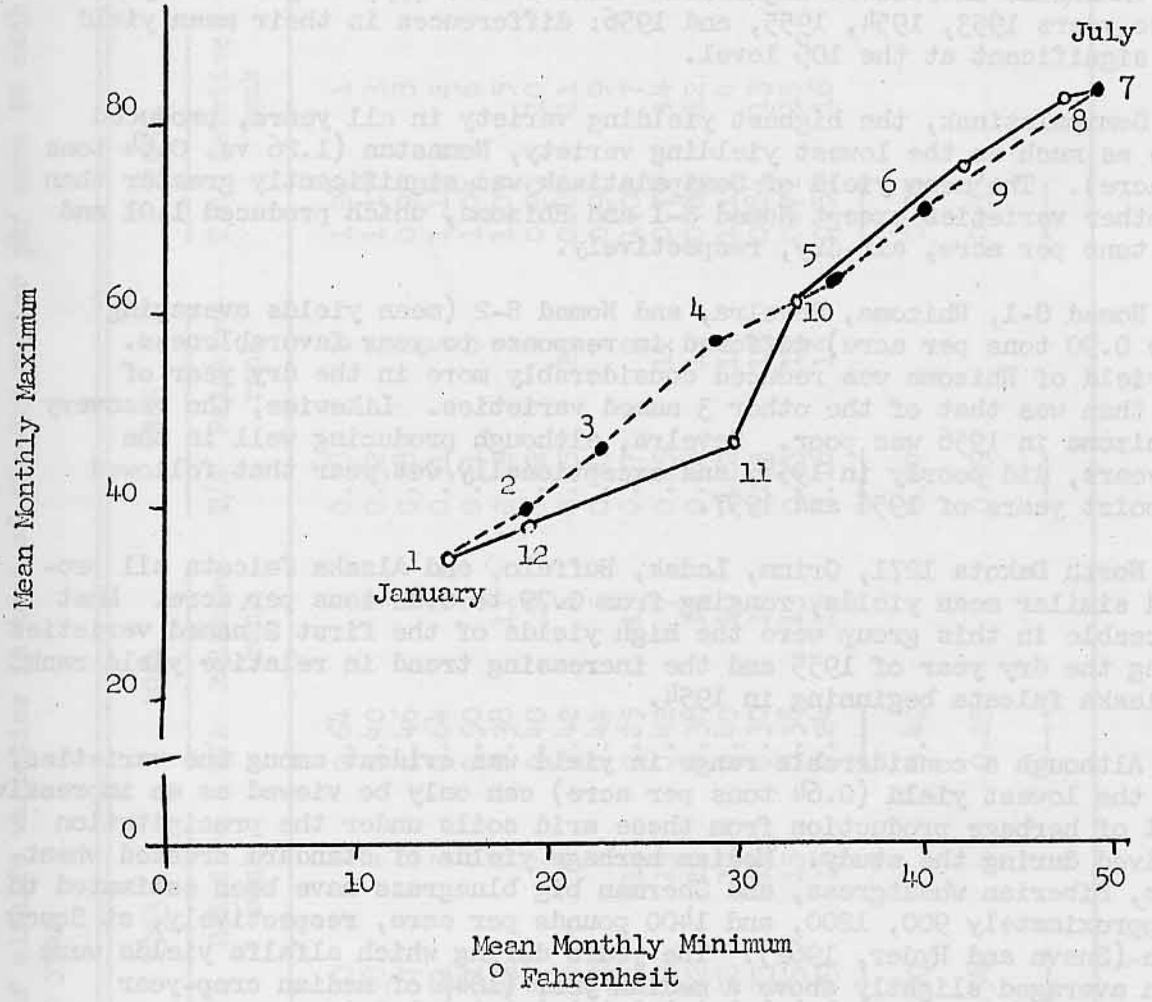

Figure 1. Mean monthly maximum plotted over mean monthly minimum temperatures from 20 years (1938-1957) of record at Squaw Butte.

Herbage yields

YEARS introduced the only significant source of variation (5% level) in the mean yield of 16 alfalfa varieties over a 5-year period (Table 2). Mean yields of the 16 alfalfa varieties were approximately 5 times greater in the wettest year (1958) than in the driest year (1955). Fluctuations in crop-year precipitation were largely responsible for the variation in herbage yields (Figure 2).

VARIETIES introduced significant differences (5%) in yield comparisons in the years 1953, 1954, 1955, and 1956; differences in their mean yield were significant at the 10% level.

Semipalatinsk, the highest yielding variety in all years, produced twice as much as the lowest yielding variety, Nemastan (1.26 vs. 0.64 tons per acre). The mean yield of Semipalatinsk was significantly greater than all other varieties except Nomad S-1 and Rhizoma, which produced 1.01 and 0.98 tons per acre, air-dry, respectively.

Nomad S-1, Rhizoma, Sevelra, and Nomad S-2 (mean yields averaging above 0.90 tons per acre) differed in response to year favorableness. The yield of Rhizoma was reduced considerably more in the dry year of 1955 than was that of the other 3 named varieties. Likewise, the recovery of Rhizoma in 1956 was poor. Sevelra, although producing well in the dry years, did poorly in 1958, and exceptionally wet year that followed the moist years of 1956 and 1957.

North Dakota 1271, Grimm, Ladak, Buffalo, and Alaska falcata all produced similar mean yields, ranging from 0.79 to 0.82 tons per acre. Most noticeable in this group were the high yields of the first 2 named varieties during the dry year of 1955 and the increasing trend in relative yield rank of Alaska falcata beginning in 1954.

Although a considerable range in yield was evident among the varieties, even the lowest yield (0.64 tons per acre) can only be viewed as an impressive level of herbage production from these arid soils under the precipitation received during the study. Median herbage yields of standard crested wheatgrass, Siberian wheatgrass, and Sherman big bluegrass have been estimated to be approximately 900, 1200, and 1400 pounds per acre, respectively, at Squaw Butte (Sneva and Hyder, 1962). The years during which alfalfa yields were taken averaged slightly above a median year (104% of median crop-year precipitation).

ROW SPACING was not a significant factor in effecting differences in yield of Nomad alfalfa. However, the inclusion of bulbous bluegrass on 2 replications of the study decreased the precision for evaluating the effects of row spacing. Yields of alfalfa from the single replication seeded with [out] grass were as follows:

Row Spacing in Feet

	1	2	3	4	5
Three year mean Yield (T/A)	0.63	0.74	0.75	0.51	0.64

Table 2. Hay yields of alfalfa varieties in tons of air-dry matter per acre in each of 5 years and relative rank in each year

Variety or strains	1953 T/A	1953 Relative rank	1954 T/A	1954 Relative rank	1955 T/A	1955 Relative rank	1956 T/A	1956 Relative rank	1958 T/A	1958 Relative rank	Mean
Semipalatinsk	1.80	1	0.64	1	0.38	1	1.24	1	2.23	1	1.26
Nomad S-1	1.38	4	0.40	8	0.32	2	1.17	3	1.78	2	1.01
Rhizoma	1.57	2	0.46	4	0.28	8	0.92	8	1.66	3	0.98
Sevelra	1.51	3	0.64	2	0.31	5	1.18	2	0.96	15	0.92
Nomad S-2	1.31	6	0.50	3	0.31	6	1.04	6	1.37	7	0.91
N. D. 1271	1.23	8	0.38	11	0.32	3	1.07	5	1.10	12	0.82
Grimm	1.27	7	0.40	9	0.32	4	0.90	10	1.22	9	0.82
Ladak	1.36	5	0.42	6	0.25	10	0.87	11	1.15	11	0.81
Buffalo	1.13	9	0.44	5	0.30	7	0.92	9	1.17	10	0.79
Alaska falcata	0.94	12	0.25	15	0.27	9	1.02	7	1.50	4	0.79
Talent	0.93	13	0.42	7	0.25	11	0.76	14	1.41	6	0.75
Pilca Butta	1.12	10	0.38	12	0.18	15	0.85	12	1.09	13	0.72
Ranger	1.08	11	0.40	10	0.22	14	1.11	4	0.79	16	0.72
Arizona Chilean	0.93	14	0.30	14	0.23	12	0.84	13	1.24	8	0.71
S. D. falcata	0.89	15	0.38	13	0.23	13	0.71	15	1.06	14	0.65
Nemastan	0.69	16	0.24	16	0.16	16	0.59	16	1.44	5	0.62
Average	1.20		0.42		0.27		0.95		1.32		
L.S.D. 5% level	0.54		0.25		0.09		0.35		N.S.		N.S.
10% level	-----		----		----		----		----		0.29

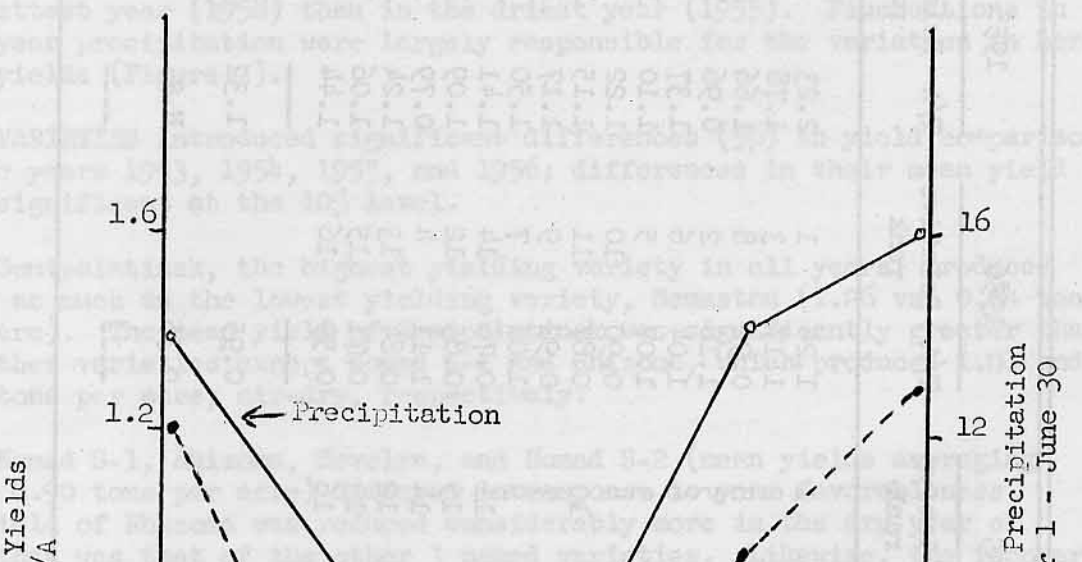

Figure 2. Mean alfalfa yield response of 16 varieties to fluctuations in crop-year precipitation.

PHOSPHORUS FERTILIZER applied to the soil surface did not increase the yield of Nomad alfalfa in an extremely dry year, and there was no visual evidence of improved plant vigor or increased yields in subsequent years. Nomad alfalfa on the 4-acre seeding made no visual response to surface applications of phosphorus, gypsum, nitrogen, sulfur, or combinations of these fertilizers.

CREEPING-ROOTED ALFALFAS, when established, produced yields ranging from 0.02 to 0.16 tons per acre in an extremely dry year (6.1 inches) and from 0.46 to 1.20 tons per acre in a wet year (13.1 inches). Yields in the wet year are somewhat comparable to yields from the varietal trial during the 1956 season, and suggest that the potential yield of some creepers may be as great as that of the hay-types. Yields in the dry year of 1959 were considerably lower than those from the varietal trial in the driest year; however, rodent damage in the plot area of the creeping-rooted selections was a contributing factor to their low production in that year.

Grass-alfalfa mixtures

Alfalfa seeded with either bulbous bluegrass (broadcast) or with drilled, introduced perennial grasses made good growth in the seedling year. However, in only one study did the alfalfa continue to grow and establish adequate stands in following years, and that was with bulbous bluegrass. Perennial grass competition evidently increased considerably by the second growing year as the alfalfa plants did poorly. In subsequent years the alfalfa was reduced still more and the plots abandoned. Nomad, drilled with crested wheatgrass on a 4-acre field plot, was completely eliminated within 4 years. This disappearance of alfalfa was believed due to grass competition and associated grazing pressure.

Drilled Nomad and broadcast bulbous bluegrass established well in the first year; but, the 3-year mean yield of alfalfa from rows spaced 5 feet apart was significantly less than that from rows spaced 1 foot apart. Mean yield for all row spacings are given in the following tabulation:

	Alfalfa Row Spacing in Feet				
	1	2	3	4	5
Three year mean Yield (T/A)	0.64	0.47	0.57	0.37	0.26

Since yields of Nomad in the one replication not seeded to bulbous bluegrass did not show a trend in decreasing yield as row spacing increased, it is inferred that the presence of the grass did decrease alfalfa yield and that this effect increased as the row spacing of alfalfa increased. One should suspect that a perennial such as crested wheatgrass would exert an even stronger competitive effect upon yields of alfalfa. The loss of Nomad from the 4-acre seeding over a 4-year period appeared to result from such a competitive relation. Perennial grass competition was also believed to have caused the alfalfa in the grass-alfalfa plot trials to do poorly in the second growing season. The loss of the alfalfa component from stands seeded to alfalfa and adapted perennial grass at this station appear to agree with the observations made in Russia 40 to 50 years ago. Konstantinov (1922) stated, "Being sowed in a mixture with alfalfa, it (crested wheatgrass) thoroughly crowded out the latter(alfalfa) in the second and third year, and the higher and drier the ground, the more rapid is this process of supplanting." Therefore it appears that the competitive advantage on these soils favors the cool season grasses and, or indirectly a greater competitive advantage can be exerted by the grasses. That this would most likely occur is inferred from fertilization studies on these soils which have resulted in earlier and more rapid depletion of the soil moisture by the grasses (Sneva, Hyder, and Cooper, 1955).

Growth performance

HAY-TYPE ALFALFAS were all of upright-growth form. Nomad and Sevelra, recommended as grazing types, both grew upright. Crown spreading of Nomad was not evidenced in these trials; however, it has been reported that grazing is necessary to induce such spreading in Nomad (Anon., 1955). Extreme prostrate growth was exhibited by Alaska falcata to the extent that it was necessary to lift portions of the stems above the cutter bar in order to assess its yield.

ROW SPACING strongly affected the growth form of Nomad alfalfa. When seeded in 1-foot rows, Nomad was less robust and finer stemmed. In each year at the time of harvest, judged to be one-tenth bloom stage of the alfalfa in rows 2 feet apart, Nomad in rows 1 foot apart had only few blooms and the lower leaves were dry and shattering. The dry-matter content of Nomad herbage at the time of harvest, as influenced by row spacing, is shown in the following tabulation averaged over 1959 and 1960:

	Row Spacing in Feet				
	1	2	3	4	5
Dry matter (%)	59	50	48	45	38

The data suggest that alfalfa grown in rows one foot apart created soil moisture stress earlier than alfalfa grown in wider rows.

Height-growth and flower-bud formation were affected by the extreme dry season of 1959. Nomad in 1-foot rows was about 4 inches high on June 22, had begun to lose green color, and there were no flower buds present. In rows spaced 3 feet apart, plants were browning only at the base and flower buds were exposed. On adjacent plots seeded in 5-foot rows, both flowers and buds were present, and plants showed little evidence of basal-leaf browning. The advantages of more complete maturation and later curing in rows spaced more than 1 foot apart are readily apparent when late-season forage is considered.

EARLY FROST occurred in several years during the varietal trials. Frost damage was random across the study area, and subsequent yields suggested that the damage was not great.

CREEPING-ROOTED SELECTIONS showed as much difference in creeping tendencies as in yields. Table 3 presents root-creeping ability evaluated by frequency percentages of 12-by 12-inch quadrats placed by transects parallel to the original row. The values recorded in the 0-to 6-inch transects centered over the rows, normally an expression of survival, maintenance, or longevity of the original transplants, were in this case more an expression of recovery from rodent damage. Lines 92 and 66 showed remarkable ability to recover.

Creeping was not observed in the first year following transplanting, but there were marked differences by the end of the second growing season. At the close of the third season, all selections had spread beyond the edge of the plot area -- a distance of 2.5 feet. Line 92 again showed strong superiority, the quadrats placed 6 to 18 inches from the rows were 81% occupied, and those at 18 to 30 inches were 72% occupied. Other selections, although creeping as widely, did not show the concentration of shoots as did line 92. Lines 71, 50, and 27 had about the same percentage of quadrats occupied in the 18 to 30 inch zone as in the 6 to 18 inch zone, but this was about half that of line 92. Line 66, although showing high recovery in the center transect, occupied only 11% of the quadrats in the 18 to 30 inch transect.

Table 3. Root-creeping ability evaluated in frequency percentages on 12-by 12-inch quadrats by transects parallel to original rows

	Distance from row center in inches		
	0-6	6-18	18-30
Clone number	Percent of quadrats occupied		
92	94	81	72
71	38	35	40
66	79	45	11
50	19	32	48
27	37	48	32

1/ Frequency measurements were made in 1959; plants were in their 4th growing season.

In 1960, the survival of all lines was extremely poor. It is not known whether this was the result of disease, rodents, winter killing, or the extreme dry year of 1959. The few remaining plants lacked vigor and green color.

Crude protein and phosphorus content

CRUDE-PROTEIN values of selected hay-type alfalfas in 1953 and 1954, and of creeping-rooted selections in 1957, are presented in Table 4. Although there are differences exhibited among the hay-type alfalfas, and somewhat smaller variation among the creeping-rooted selections, the primary interest is the approximate level of crude protein in alfalfa as compared to grasses at about the same calendar date. Crested wheatgrass growing on the Squaw Butte Station on or about June 20 (late head to early flower) has varied from about 6 to 8% crude protein and has contained an average amount of 7% over a period of 6 years (Hyder, 1961).

Table 4, Crude-protein content of alfalfa cut for hay

Variety/selection	Year 1953	Year 1954	Year 1957
		Percent crude protein	
Rhizoma	12.86	12.37	----
Ladak	10.42	10.46	----
Semipalatinsk	10.45	11.56	----
So. Dak. falcata	10.72	-----	----
Nomad	9.34	9.90	----
Alaska falcata	13.09	11.30	----
Sevelra	10.61	10.17	----
Line 92	-----	-----	12.5
Line 71	-----	-----	11.1
Line 66	-----	-----	13.2
Line 50	-----	-----	12.3
Line 27	-----	-----	12.1

Mean crude-protein content of Nomad alfalfa at the time of harvest (early bloom) in 1960 was 13.2, 15.5, 15.0, 14.9, and 17.4, respectively, from rows spaced 1, 2, 3, 4, and 5 feet apart from the replication seeded to Nomad only. Increases in crude-protein contents were found in crested wheatgrass in row spacings of 6, 12, 24, and 36 inches; however, the differences diminished with increasing stand age (Sneva and Hyder, 1963). The lower crude protein content of the alfalfa in the 1-foot rows may be caused by loss of basal leaves which by this time had turned brown and had begun to drop. The higher contents associated with the wider row spacings may be the result of more favorable and longer growing conditions owing to less stress on the soil moisture as indicated by more numerous flowers, greener color, and higher water content.

PHOSPHORUS and crude-protein contents of Nomad alfalfa were not influenced by fall applications of treble superphosphate. The mean crude-protein content of Nomad in 2-foot rows was 16.0%, and that of phosphorus was 0.154% on June 22, 1959, a very dry year.

Rodent damage

HAY-TYPE varieties were severely damaged in the 1959 season following the removal of the protection fence and the discontinuation of poisoning. The intense rodent pressure on this particular trial did not permit any of the alfalfas to exhibit tolerance to or recover from rodent damage.

NOMAD ALFALFA in the row-spacing study was not seriously invaded by rodents, and damaged plants often recovered by sprouting shoots below the damaged parts. This attribute of Nomad has been observed by others (Anon., 1955) and appears to be a very desirable characteristic.

CREEPING-ROOTED ALFALFAS produce a root system that is difficult for rodents to completely eliminate; yet considerable variation was exhibited in recovery of the original crown following extensive crown damage by mice or pocket gophers. Despite total crown destruction, shoots from laterally creeping roots survived and continued to persist. Abnormally high rodent pressure would appear to be necessary to eliminate completely an established stand of creeping-rooted alfalfa.

CONCLUSIONS

1. In 3 years, each with median (11.3 inches) or above precipitation amounts, successful establishment of alfalfa occurred without supplemental moisture. However, in those years the alfalfa was drilled in the early spring upon a well-prepared seedbed.

2. Five-year mean herbage yields of 16 alfalfa varieties ranged from 0.64 to 1.26 tons per acre, air dry. The mean yield of Semipalatinsk was significantly greater (10% level) than that of all other varieties except Nomad S-1 and Rhizoma. Despite the extreme yield range, even the lowest yield can be viewed as favorable production on arid soils with the precipitation amounts which occurred during the study period.

3. Nomad yields over a 3-year period, when drilled alone in rows 1, 2,3, 4, and 5 feet apart, were not different. More complete maturation, later curing, and higher crude-protein content were favored by drilling in wide rows. Bulbous bluegrass broadcast with drilled Nomad alfalfa reduced alfalfa yields when alfalfa was seeded in rows more than 1 foot apart, and the yield reduction increased as the row spacing of the alfalfa increased.

4. Plot trials and small acreages of alfalfa-grass mixtures were short-lived. The disappearance of alfalfa after establishment was attributed to increased competition from the seeded grass and, in one study, associated grazing pressure.

5. Transplants of creeping-rooted alfalfa selections established well and produced good yields for 4 years, then ceased to exist. One line (Sc. 25392) exhibited strong creeping tendencies, was robust, and produced yields comparable to that of hay-type varieties.

6. Recovery at the original crown location of creeping varieties following a high rodent population varied: for 2 varieties approximately 80% or more of the original crowns produced sprouts below the damaged portion. Lateral shoots were not seriously reduced by rodents in the infestation year.

7. Surface applications of phosphorus fertilizer did not increase yields of Nomad, or influence the crude-protein and phosphorus content of the herbage. No visual response was observed in Nomad following surface applications of sulfur, gypsum, or nitrogen fertilizer.

RECOMMENDATIONS

1. Semipalatinsk, Nomad S-1, and S-2, Rhizoma, and Sevelra, all producing 0.9 tons per acre or more of herbage, are suggested for further consideration for these soils. Successful establishment of these varieties will occur most often from early spring seedings in more favorable moisture years when drilled into well-prepared seedbeds. Drill spacings greater than 1 foot appear to be most desirable for late herbage growth. Production and stand life will be adversely affected by rodent damage; protection against rodents may be necessary.

2. Alfalfa-grass combinations established in a contemporary manner on soils similar to those in these studies and managed for a single harvest at maturity are likely to be short lived. Future research should be directed towards: (1) lengthening the stand life of the alfalfa by alleviating grass competition through seeding or grazing techniques, and (2) the continuing search for an earlier growing legume.

3. Creeping alfalfas, although holding a great deal of promise for grazing, are not yet ready for general use on these particular range sites in southeastern Oregon.

SUMMARY

Herbage yields and other physical measurements and observations on a number of studies including alfalfa varieties, alfalfa-grass mixtures, row-spacing influences, and fertilization effects on alfalfa response during the 1952-1960 period are presented and discussed. The study area, receiving less than 12 inches of moisture annually, is considered marginal for alfalfa-grass mixtures as judged by other reports.

Semipalatinsk, Nomad, Rhizoma, and Sevelra, producing 0.9 tons per acre or more air-dry, were the most promising of 16 varieties tested. Successful establishment, without supplemental moisture, occurred only in more favorable moisture years and when alfalfa was drilled in the early spring on well-prepared seedbeds. Row spacings greater than 1 foot apart favored more complete maturation and later curing. The alfalfa in alfalfa-grass mixtures was short-lived. Loss of alfalfa from the stand was believed to be caused by increased grass competition in years subsequent to establishment. No response to surface applications of phosphorus, gypsum, sulfur, or nitrogen fertilizers was noted; however, fertility trials were limited. Creeping-rooted selections established well from transplants, and yield production equaled that of hay-type varieties. Strong differences in creeping tendencies were exhibited and line Sc 25392 was outstanding in all respects. Nevertheless, all selections were lost in 1959-1960, at 4 years of age, owing to unknown causes.

Findings contribute to the limited information now available regarding the adaptability, growth, and performance of alfalfa under semi-arid conditions. The data include support for both attitudes regarding the future of alfalfa on semiarid ranges. Perhaps most of all, the data emphasize the need for continued experimentation with alfalfa and other legumes.

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