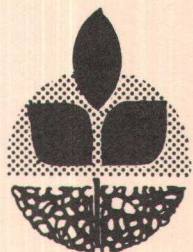


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The Influence of Seeding Rates on Quality of Alfalfa in Oregon's Willamette Valley

**Station Bulletin 651
August 1981**



**Agricultural Experiment Station
Oregon State University, Corvallis**

ABSTRACT

Non-irrigated alfalfa seeding rates (7.5 to 20 pounds per acre), row spacings (3 to 12 inches) and oversown orchardgrass had no influence on leafiness or crude protein content of Vernal or DuPuits cultivars. Stem size was reduced slightly with increased seeding rates or closer row spacing during the first two cuttings of the first year. Vernal had smaller stems than DuPuits, but leafiness and crude protein content were similar in both cultivars. With each successive cutting during the season, stem size decreased in both cultivars.

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THE INFLUENCE OF SEEDING RATES ON QUALITY OF ALFALFA IN OREGON'S WILLAMETTE VALLEY

W. S. McGuire

INTRODUCTION

Introduction of the Flemish types and cultivars of alfalfa, beginning with DuPuits in the early 1960s, resulted in cultivars with noticeably larger stems, particularly in the first cutting. This raised questions among growers about quality and utilization of these new types of alfalfa. There were suggestions that, when using the larger-stemmed cultivars, increased seeding rates from the usual 10 to 12 pounds per acre to 20 or more pounds per acre would provide more plants per unit area. The expectation was that reduced stem size would result in improved hay quality.

An experiment was designed to measure yield and quality factors under variable seeding rates, drill row spacings, and grass association. The results for yield and stand maintenance have been reported previously (4). Results are reported here for stem size, weight, stems per plant, leafiness, and crude protein content.

LITERATURE REVIEW

Most studies with alfalfa seeding rates have dealt with yield and stand rather than with quality factors. In one study of factors affecting tillering in alfalfa, Cowett and Sprague (1) found that tillering of young plants was increased by a long photoperiod and tillering of established plants was increased by a short photoperiod. Thus, during the establishment year, stem numbers should increase with successive cuttings, and after full establishment, third or fourth cuttings should have more stems per plant than earlier cuttings.

After an additional study (2), they concluded that stem numbers per plant decreased with increase in stand density and that size of the crown at one harvest accounted for more than one-third of the number of stems per plant at the following harvest. They also reported that stem production per plant was not always associated with yield.

Sund and Barrington (5) also showed that a more dense stand had fewer stems per plant, with near equal numbers of stems per unit area for the different seeding rates and plant populations. They stated that this probably accounted for the similarity in dry matter yields among various rates of seeding.

At initiation of the test reported here, there was no information regarding influence of seeding rates on quality. Subsequently, Van Keuren (6) reported no effect of seeding rates (3-48 pounds per acre) on lignin, dry matter digestibility, or cellulose content. In the study by Sund and Barrington (5), seeding rates of 6 to 36 pounds per acre resulted in no significant change in total root non-structural carbohydrates (TNC). When root weights were considered, there were more total TNC stored in individual roots of the plants with lower seeding rates, but this was due to larger root size from lower seeding rates. No differences due to seeding rates were found in percent leaves, total nitrogen, crude protein concentration, or protein yield per acre. Additionally, seeding rates did not influence cell wall constituents (CWC), acid-detergent fiber (ADF) or acid-detergent lignin (ADL).

EXPERIMENTAL PROCEDURE

The experiment was on a deep, well-drained Woodburn soil on the Hyslop Agronomy Farm near Corvallis, Oregon. It was limed and fertilized according to soil test recommendation. Further details of the soil and test site were reported previously (4).

Vernal alfalfa, representing the smaller size stem, and DuPuits, representing the larger-stemmed Flemish alfalfa, were sown in June, 1962, and irrigated once in July. After removal of a small hay crop in September, S-143 orchardgrass was oversown in three treatments. Thereafter, the test was non-irrigated.

The eight treatments were various combinations of seeding rates and drill row widths, including the oversown grass treatments. The treatments are shown in all the data tables.

At each cutting for two years, 10 stems were selected randomly from each plot. The lower 10-inch length of the stems was used for measurement of relative stem size by volume displacement in a graduate cylinder of water. The stems were then oven-dried for dry weight determinations.

Percent leaves was obtained by separation of a subsample of the swath of each plot into leaves and stems and oven-drying.

Crude protein analyses were by the Kjeldahl method.

RESULTS AND DISCUSSION

Stem Size

Seeding rate and row spacing effects: The results for relative stem size measurements are shown in Table 1. They are the combined averages for the two cultivars.

In the first production year, the first and second cuttings showed a trend to smaller stem sizes with increased seeding rate or with closer row spacing, with the smallest stems at 15 pound seeding rate with 3-inch spacing and with seeding rate of 20 pounds with 6-inch row spacing. The difference was significant only in the second cutting. This effect was not maintained, however, during the third cutting or during the second year of the test.

It is possible that the 10 stems were an insufficient number for the adequate evaluation. Examination of the data shows considerable variation, with more uniformity for Vernal than for DuPuits.

Cultivar and cutting effects: Although, as suggested, sample size might have been insufficient to measure treatment differences, the relative stem sizes of the two cultivars are readily apparent. The values, averaged for all treatments, are shown in the lower part of Table 1.

For each cutting and both years of production, DuPuits had larger stems than Vernal. The relative stem size was easily distinguished when the cultivars are grown in adjacent plots.

Stem size decreased as the season advanced (Table 1). Stems were smaller with each successive cutting, with the third cutting having finer stems than the first or second, a situation recognized by producers and consumers.

Stem Weight

Seeding rate and Spacing effects: Oven-dry stem weights were determined on the same stems used to obtain stem size measurements. No significant differences in stem weight were observed due to seeding rate or row spacing in the first or second cutting (Table 2). Reduced weights were associated, however, with the 15 pound-3 inch spacing treatment. Oversowing of orchardgrass also seemed to reduce stem weight in the first cutting with the 15 pound-12 inch and the 7.5 pound-6 inch spacing treatments. A significant difference was found due to treatment during the third cutting, but stem size and weight are not serious problems in third cutting alfalfa.

Cultivar and cutting effects: The stem weights for cultivars by cutting are shown in Table 2. In all cases Vernal had smaller stem weights

than DuPuits. The differences for stem weight were of less magnitude than for stem size, presumably because of the hollow or pithy nature of the larger stems of DuPuits.

Successive cuttings showed stems of less weight than the previous cutting, much the same trend as shown for stem size.

Stems per Plant

Seeding rate and spacing effects: The number of stems per plant for the eight rate and spacing treatments were combined and averaged for the two cultivars (Table 3). No significant differences among the eight treatments were observed and there was no significant cultivar-treatment interaction.

In the first three treatments, which differed only by increased rate of seeding, the number of stems per plant decreased as seeding rate increased. Plant populations reported previously (4), showed increased plant numbers with increased seeding rates, extending through the second year of production. Apparently, a thicker stand allows for fewer tillers per plant. The differences in number of tillers per plant or number per unit area, however, had no influence on dry matter yield (4).

Cultivar and cutting effects: Vernal and DuPuits had similar numbers of stems per plant during the two years with the exception of the second cutting of the second year (Table 3). Concurrent study on cutting management of alfalfa (3) showed that the first cutting of alfalfa in the Willamette Valley should be based on crown bud development or full light interception rather than flowering stage to obtain suitable quality in the first harvest. Cuttings of the second year were then based on crown bud development for first harvest and either crown bud development or early boom, which occur together, for the second and third harvests. The

two cultivars were harvested according to crown bud development in May, differed in harvest date by eight days. The reduced tillering of Vernal at second harvest is unexplained. In the previous and subsequent cuttings, Vernal tillered very much the same as DuPuits. Even with the differential tillering in the second cutting, the cultivars did not differ significantly in yield of dry matter per unit area (4).

Stems per plant increased with successive cuttings in 1963, likely a reflection of crown growth and development during the first year of production. Plant numbers decreased during the growing season, particularly in the first production year, which would allow for crown development of remaining plants. The increased tiller production with advance of the season was not nearly so apparent in the second year.

Although the number of stems per plant increased with successive cuttings in the first year and remained fairly constant in the second production year, stem size and weight decreased (Tables 1 and 2). The decrease in stem size and weight and the visibly reduced height of growth in successive cuttings apparently account for the reduced yield of dry matter per acre with successive cuttings, most noticeable in third cutting which is normally the lowest in yield. No significant correlation was found between yield of dry matter and number of plants per unit area, number of stems per plant, stem size, or stem weight.

Percent Leaves

Seeding rate and row spacing effect: Treatments of 12-inch spacing oversown with orchardgrass had the highest per cent leaves during the first cutting of 1963. The significant differences among the treatments at second cutting indicate a higher percent leaves for alfalfa in 12-inch

drill rows (Table 4). After the first two cuttings of the first year, results were much more uniform and no differences in leafiness could be measured.

Cultivar and cutting effects: Cultivars were similar in leafiness for the two years with the exception of the third cutting. Vernal tended to be leafier also at first cutting. The cultivars were cut on the same date in May, however, with Vernal typically at a more immature stage than DuPuits.

In the first year, the second cutting was less leafy than either first or third cuttings. In the second year, the first two cuttings were similar in leafiness and the third cutting was leafier.

Percent leaves in alfalfa is influenced mainly by stage of maturity and yield of dry matter. A previous study (3) showed a significant reduction in leafiness (and protein content) from about May 15 at full light interception to May 25 at crown bud development. Misjudgment of the stage of maturity by even 2 to 3 days can account for a difference in leafiness. The results reported here, in agreement with results from the previous study, indicate that if first cutting is taken at the crown bud development stage and before early flowering, leafiness should be 40 to 45 percent. The second cutting, taken at crown bud or early flower stage, should be similar to first cutting. The third cutting, taken at the same stage of maturity, is typically leafier with over 45 percent leaves.

Protein Content

The crude protein content was not influenced by seeding rates or row width during the two years (Tables 5 and 6). Results were variable

for the first cutting of the first year, and then were more uniform for the remainder of the test period.

The two cultivars were similar in protein content with the exception of the second cutting of the first year. Reference to the other tables shows no difference between the cultivars in leafiness for that cutting. Stems of DuPuits were larger and heavier than those of Vernal; yet DuPuits was considerably higher in protein content. The previous report on yields (4) showed that for second cutting Vernal was 20 percent more productive than DuPuits, likely a reflection of the cutting management used for the first year. The simple correlation coefficient between crude protein content and yield of dry matter for the second cutting was -0.82 and highly significant.

Crude protein content in alfalfa varies inversely with advancing stage of maturity and the accompanying increased yield of dry matter. In the Willamette Valley, if the first cutting is taken in early June at the early flower stage, it is lowest in protein of the three cuttings (3). If the first cutting is taken in late May at crown bud development stage, the protein content is equal to or often higher than in subsequent cuttings. The common conception that first cutting is the poorest quality and that third cutting is the best quality is not always true, based on protein content of this and the previous test.

SUMMARY AND CONCLUSIONS

Seeding rate and row spacing variables were imposed on Vernal and DuPuits alfalfa in pure stand and with orchardgrass on a well-drained Woodburn soil near Corvallis, Oregon. During the first two production

years, data were obtained for stem size and weight, stems per plant, leafiness and crude protein content.

There was a small reduction in stem size during the first two cuttings of the first year with higher rates of seeding or with closer row spacing. In the third cutting of the first production year, there was a trend to larger stems in alfalfa sown in 12-inch rows or grown in association with orchardgrass, resulting in significantly heavier stems for those treatments. In the second production year, there was no influence from seeding rates, row spacing or oversown orchardgrass on alfalfa stem size, stem weight or number of stems per plant.

Seeding rates or row spacings had little influence on leafiness or crude protein content of alfalfa.

This study also provided an opportunity to compare the two cultivars during the two years. DuPuits consistently had larger and heavier stems than Vernal for all cuttings for the two years. In the first year, Vernal was leafier than DuPuits at third cutting, and in the second cutting of the same year. DuPuits had higher protein content than Vernal.

Stem size and weight decreased as the season advanced for each cutting for both cultivars. Stems per plant increased with each cutting during the first year. The increase was less pronounced during the second year.

With the cutting management applied, the first cutting, at crown bud development, was as high or higher in crude protein than the subsequent cuttings. Third cutting was leafier than previous cuttings.

On the basis of results obtained, there is no advantage of increased rate of seeding above the presently recommended 10 to 12 pounds per acre.

Larger stemmed cultivars retain their relatively large stems, regardless of seeding rate and row spacing. The larger stems are no disadvantage in regard to leafiness or crude protein under proper management.

Table 1. The influence of seeding rate, row spacing, and cultivar on stem size (ml volume displacement of 10 stems)

Treatment		1963 Cuttings			1964 Cuttings		
Spacing (in.)	Rate (lbs)	1	2	3	1	2	3
6	10.0	35	28	16	36	26	19
6	15.0	33	27	15	35	23	20
6	20.0	29	24	16	37	27	20
3	15.0	30	22	17	40	25	20
12	15.0	31	26	21	40	28	18
12*	7.5	31	26	19	39	27	21
12*	15.0	34	27	19	37	24	21
6*	7.5	31	25	18	35	24	18
Vernal Av.		26	22	15	32	20	17
DuPuits Av.		37	29	20	42	30	22
LSD (.05) Cultivar		4.1	2.6	2.9	3.3	2.5	2.2
LSD (.05) Treatment		N.S.	5.2	N.S.	N.S.	N.S.	N.S.

*Orchardgrass oversown at 3.6 pounds per acre in late September of the establishment year.

Table 2. The influence of seeding rate, row spacing, and cultivar on grams dry weight of 10 stems

Treatments		1963 Cuttings			1964 Cuttings		
Spacing (in.)	Rate (lbs)	1	2	3	1	2	3
6	10.0	8.8	5.8	3.9	6.2	5.6	4.3
6	15.0	7.7	5.7	3.5	6.2	5.2	4.5
6	20.0	7.8	5.4	3.7	6.2	6.1	4.8
3	15.0	6.9	5.3	4.1	7.1	5.9	4.6
12	15.0	7.0	5.8	5.5	7.3	6.6	4.8
12*	7.5	7.5	5.8	5.0	6.6	6.6	5.2
12*	15.0	7.2	5.9	4.5	6.7	5.6	5.4
6*	7.5	7.2	5.2	4.3	6.2	5.3	4.1
Vernal Av.		6.4	5.2	3.7	5.6	5.3	4.2
DuPuits Av.		8.5	6.0	4.9	7.5	6.4	5.2
LSD (.05) Cultivar		1.6	N.S.	1.1	0.6	0.6	0.5
LSD (.05) Treatments		N.S.	N.S.	2.1	N.S.	N.S.	N.S.

*Orchardgrass oversown.

Table 3. The influence of seeding rate, row spacing, and cultivar on number of stems per plant

Treatments		1963 Cuttings			1964 Cuttings		
Spacing (in.)	Rate (lbs)	1	2	3	1	2	3
6	10.0	2.7	4.6	5.0	4.6	4.4	5.5
6	15.0	2.6	4.1	4.8	3.8	4.5	4.3
6	20.0	2.0	3.3	3.9	4.2	4.1	4.0
3	15.0	2.6	3.6	4.7	4.8	4.7	4.5
12	15.0	2.0	3.9	5.2	4.8	4.5	5.0
12*	7.5	2.6	4.2	5.6	4.7	4.3	5.4
12*	15.0	2.2	4.0	5.5	4.1	4.6	4.9
6*	7.5	3.0	3.9	6.5	5.1	4.4	5.0
Vernal Av.		2.6	4.0	5.1	4.7	3.8	4.9
DuPuits Av.		2.2	3.9	5.2	4.3	5.1	4.8
LSD (.05) Cultivars		-	-	-	-	0.7	-
Treatments not significantly different.							

*Orchardgrass oversown.

Table 4. The influence of seeding rate, row spacing, and cultivar on percent leaves in alfalfa

Treatments		1963 Cuttings			1964 Cuttings		
Spacing (in.)	Rate (lbs)	1	2	3	1	2	3
6	10.0	43	40	47	42	40	46
6	15.0	43	38	46	42	40	45
6	20.0	44	40	44	39	38	45
3	15.0	45	38	46	38	40	44
12	15.0	43	41	44	42	41	45
12*	7.5	48	41	48	42	40	45
12*	15.0	48	43	44	42	39	45
6*	7.5	44	38	45	41	41	45
Vernal Av.		46	40	48	41	39	46
DuPuits Av.		43	39	43	40	41	44
LSD (.05) Cultivars		-	-	2	-	-	-
LSD (.05) Treatments		-	3	-	-	-	-

*Orchardgrass oversown.

Table 5. The influence of seeding rate, row spacing, and cultivar on crude protein content, 1963

	Treatment		Cutting		
	Spacing (in.)	Rate (lbs.)	25 May	18 July	3 September
<u>Vernal</u>	6	10.0	17.8	20.3	19.0
	6	15.0	16.7	21.6	19.2
	6	20.0	15.9	20.7	18.8
	3	15.0	17.5	22.5	20.1
	12	15.0	16.9	22.8	17.3
	12*	7.5	18.3	21.9	19.1
	12*	15.0	22.3	22.5	18.5
	6*	7.5	20.1	22.2	19.9
Average			18.2	21.8	19.0
<u>DuPuits</u>			<u>25 May</u>	<u>9 July</u>	<u>26 August</u>
	6	10.0	17.0	25.7	19.8
	6	15.0	18.8	25.4	17.8
	6	20.0	19.3	25.8	18.0
	3	15.0	20.5	23.2	18.7
	12	15.0	19.6	24.8	17.5
	12*	7.5	20.5	25.3	16.5
	12*	15.0	19.8	24.5	18.5
Average			19.6	24.9	17.9
LSD (.05) Cultivars			N.S.	1.6	N.S.
LSD (.05) Treatments			N.S.	N.S.	N.S.

*Orchardgrass oversown.

Table 6. The influence of seeding rate, row spacing, and cultivar on crude protein content, 1964

	Treatment		Cutting		
	Spacing (in.)	Rate (lbs.)	29 May	20 July	9 September
<u>Vernal</u>	6	10.0	19.0	15.5	16.3
	6	15.0	19.2	15.6	16.1
	6	20.0	19.2	15.2	15.9
	3	15.0	18.8	14.8	15.0
	12	15.0	18.9	16.1	16.0
	12*	7.5	18.8	14.7	16.3
	12*	15.0	19.3	15.1	15.5
	6*	7.5	19.1	17.1	16.9
Average			19.0	15.5	16.0
<u>DuPuits</u>			<u>22 May</u>	<u>9 July</u>	<u>31 August</u>
	6	10.0	18.6	15.9	16.0
	6	15.0	18.5	17.3	16.4
	6	20.0	18.7	14.8	16.5
	3	15.0	18.5	17.5	16.2
	12	15.0	18.4	15.7	15.6
	12*	7.5	19.3	15.4	16.5
	12*	15.0	19.4	15.1	16.6
Average			18.8	16.0	16.3

No significant differences between cultivars or among treatments.

*Orchardgrass oversown.

LITERATURE CITED

1. Cowett, E.R. and M.A. Sprague. 1962. Factors affecting tillering in alfalfa. *Agronomy Journal* 54:294-297.
2. Cowett, E.R. and M.A. Sprague. 1963. Effect of stand density and light intensity on the microenvironment and stem production of alfalfa. *Agronomy Journal* 55:432-434.
3. McGuire, W.S. 1978. Alfalfa management in the Willamette Valley of Oregon - influence of rate of seeding on yield and stand. *Oregon Agricultural Experiment Station Bulletin*. 631.
4. McGuire, W.S. 1981. The influence of seeding rates on yield and stand of alfalfa in Oregon's Willamette Valley. *Oregon Agricultural Experiment Station Bulletin*. 649.
5. Sund, J.M. and G.P. Barrington. 1976. Alfalfa seeding rates: their influences on dry matter yield, stand density and survival, root size and quality. *University of Wisconsin Research Bulletin*. R2786.
6. Van Keuren, R.W. 1973. Alfalfa establishment and seeding rate studies. *Ohio Forage Report* 58(2):52-54.