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Relation of Seeding Rate to the Lignin Content of Alfalfa

J. W. HIBBS AND J. L. PARSONS[1]

INTRODUCTION

It is well known that as the alfalfa plant matures, lignin encrustation renders the cellulose increasingly less accessible to rumen bacteria for fermentation. This results in lowered cellulose digestion in ruminants. The lowered availability of the energy due to lignification as the plant matures is thus a major factor determining the quality of alfalfa and other forage crops for ruminant feeding. The marked decrease in voluntary forage intake, dry matter digestibility, and milk production with advancing maturity of the forage has been illustrated previously (1).

In this experiment, the effects of different seeding rates and thickness of stand on the lignin content of alfalfa were studied to determine whether alfalfa grown under conditions of high plant population density had lower lignin content at different stages of maturity than plants grown in sparse stands.

EXPERIMENTAL PROCEDURES, RESULTS, AND DISCUSSION

1962

In the spring of 1961, replicated plots of alfalfa were band seeded in 7-inch rows at the following rates: 3, 6, 9, 12, and 15 lb./acre. Weekly samples were obtained between May 14 and June 25, 1962, from three of the plots (3, 9, and 15 lb./acre). Percent lignin was determined (2) on the individual samples. The three replicate samples were then averaged and the results were plotted against cutting date (Figure 1).

Percent lignin increased gradually from about 7 percent on May 14 to approximately 11 percent on June 25. However, no marked differences in percent lignin due to seeding rate were observed. Table 1 shows that there were differences resulting from the seeding rates as measured by: 1) number of plants per linear foot of 7-inch row, and 2) number of tillers per plant.

On June 5, alfalfa from the combined 3 and 6 lb./acre plots and the 12 and 15 lb./acre plots were harvested separately, dried on a barn

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TABLE 1.—Effect of Seeding Rate* on Average Number of Alfalfa Plants and Tillers, 1962.

	Seeding Rate		
	3 lb./acre	9 lb./acre	15 lb./acre
No. plants/linear ft. of 7-in. row	4.2	10.6	15.4
No. tillers/linear ft. of 7-in. row	29.2	36.2	42.7
No. tillers/plant	8.1	3.4	2.9

*Plots band seeded in 7-inch rows, spring of 1961.

drier using hot air ventilation, and baled for use in digestion trials with 16-week-old calves. For the 5-day digestion trial, the hay was chopped and fed in a 4:1 ratio with a simplified grain mixture (4 parts alfalfa hay to 1 part grain).

Cellulose was determined by the method of Crampton and Maynard (3). *In vitro* estimation of dry matter digestibility (Table 2) was carried out by the cellulose and dry matter solubility method of Dehority and Johnson (4). The results of the two digestion trials conducted with each hay sample are also shown in Table 2.

There was only a small difference in the lignin and cellulose content of afalfa from the two seeding rates. The combined results of the

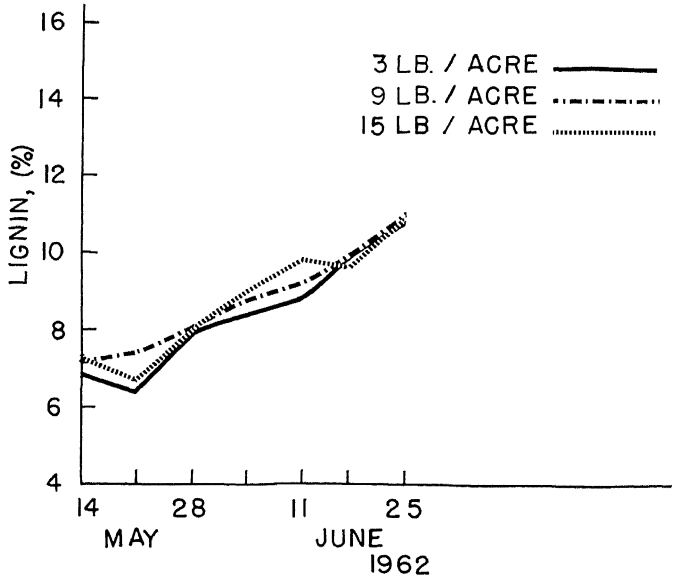

Fig. 1.—Lignin content on different cutting dates of first growth alfalfa band seeded in 7-inch rows at 3, 9, and 15 lb./acre.

TABLE 2.—Effect of Different Seeding Rates on the in vivo and in vitro Digestibility of Alfalfa.

Calf No.	Seeding Rate	Lignin*	Cellulose	In vivo Cellulose Digested	In vivo Dry Matter Digested	In vitro† Estimated Dry Matter Digested
	(lb./acre)	(%)	(%)	(%)	(%)	(%)
J-1500	3-6	8.43	15.89	38.12	54.02	62.65
H-1501	3-6	8.43	15.39	50.48	61.08	63.46
J-1499	12-15	8.98	16.92	52.01	61.83	62.03
J-1497	12-15	8.98	15.16	56.62	63.00	63.66

*Average percent lignin of alfalfa sampled on June 4, 1962.

†Dry matter digestibility = 35.13 + (1.529 x cellulose (in vitro) x dry matter solubility (in vitro)/100 (4).

in vivo and *in vitro* determinations indicated there were no real differences in digestibility of dry matter and cellulose due to seeding rate. The evidence indicates that calf J-1500 did not digest its feed normally for some unknown reason.

From the data obtained in 1962, there was no evidence that seeding rate in the range studied (3, 9, 15 lb./acre) affected the lignin content of alfalfa. It was decided that the possible effects of even higher seeding rates should be investigated and that earlier and later sampling might reveal possible differences in lignin content not detected in 1962. No further digestion trials were planned unless marked differences in lignin content due to seeding rate were found in later experiments.

1963

Beginning on April 25 and continuing until July 11, the same plots used in the 1962 season (3, 9, and 15 lb./acre) were sampled weekly for lignin analysis. The height of the plants was also measured, using representative samples to show the relation between height, lignin content, and date of cutting. These results are shown in Figure 2.

In 1963 the lignin content rose more rapidly after May 16 than it had prior to this date. When plant growth leveled off after June 13, lignin content continued to rise but at a somewhat slower rate than it had between May 16 and June 6.

As in 1962, only minor differences in lignin content were observed due to seeding rate. The percent lignin ranged from about 5 percent in late April to about 13 percent in early July. In accordance with the conclusions reached as a result of the work done in 1962, spring seedings were made in 1963 at rates of 3, 15, 30, and 45 lb./acre.

During the summer, the spring-seeded plots (3, 15, 30, and 45 lb./acre) were mowed. After regrowth had advanced to about 5 inches

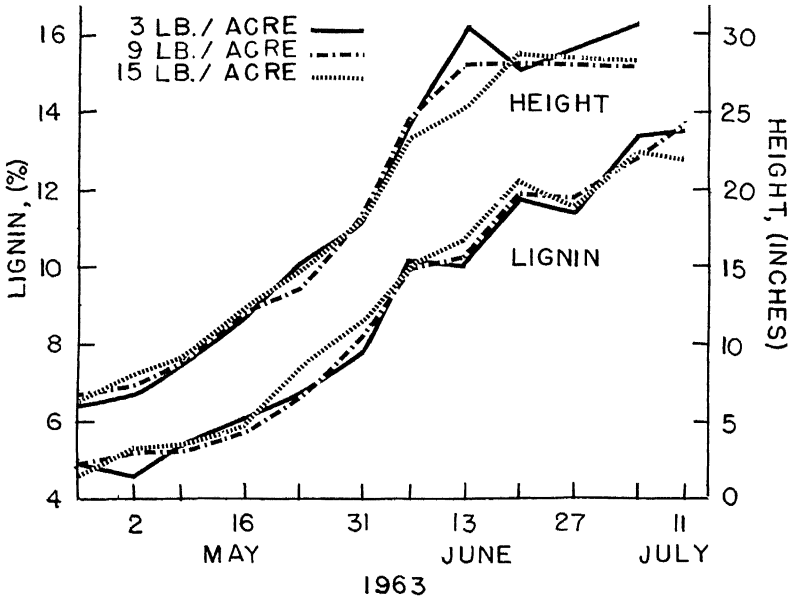

Fig. 2.—Relation of lignin content and plant height on different cutting dates of first growth alfalfa band seeded in 7-inch rows at 3, 9, and 15 lb./acre.

in height, the plots seeded at the higher rates (15, 30, 45 lb./acre) were sampled weekly for lignin analysis and height of the plants beginning August 1 and ending August 29. The results are presented in Figure 3.

It was extremely dry during and prior to the sampling period and little growth occurred. However, the lignin content increased from about 6.5 percent to about 9 percent during the month of August. No consistent differences were found in the percent lignin attributable to the rate of seeding. Plans were made to sample these same plots during the 1964 season.

1964

Beginning on April 30, the three plots seeded in the spring of 1963 (15, 30, and 45 lb./acre) were sampled weekly for lignin analysis and measured for height of the alfalfa plants. Sampling was continued through July 15, when the first growth was harvested. On July 1, 8, and 15, the plot seeded with 3 lb./acre was also sampled for comparison with the other three plots with higher seeding rates.

The results obtained on the first growth are indicated in Figure 4. From April 30 until July 15, the height of the plants increased from about 8 inches to between 41 and 45 inches, with the plants from the

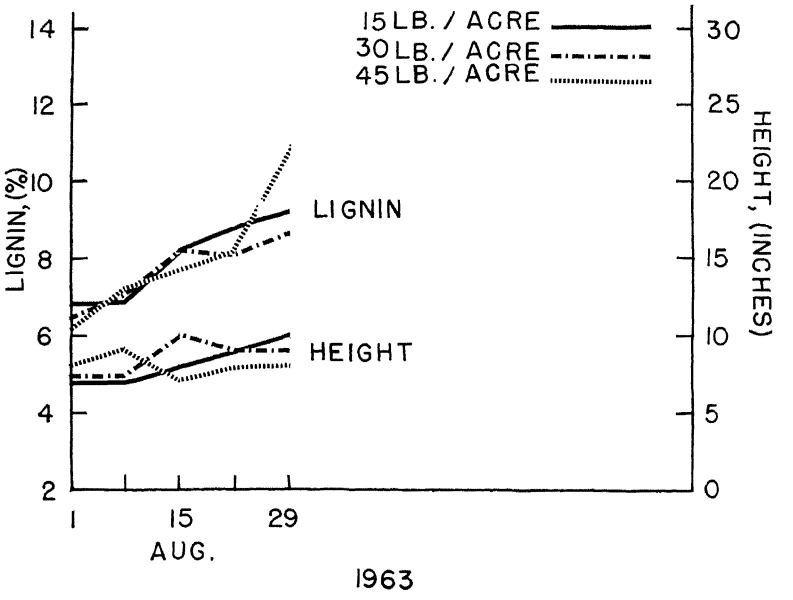

Fig. 3.—Relation of lignin content and plant height on different cutting dates of first growth alfalfa band seeded in 7-inch rows at 15, 30, and 45 lb./acre.

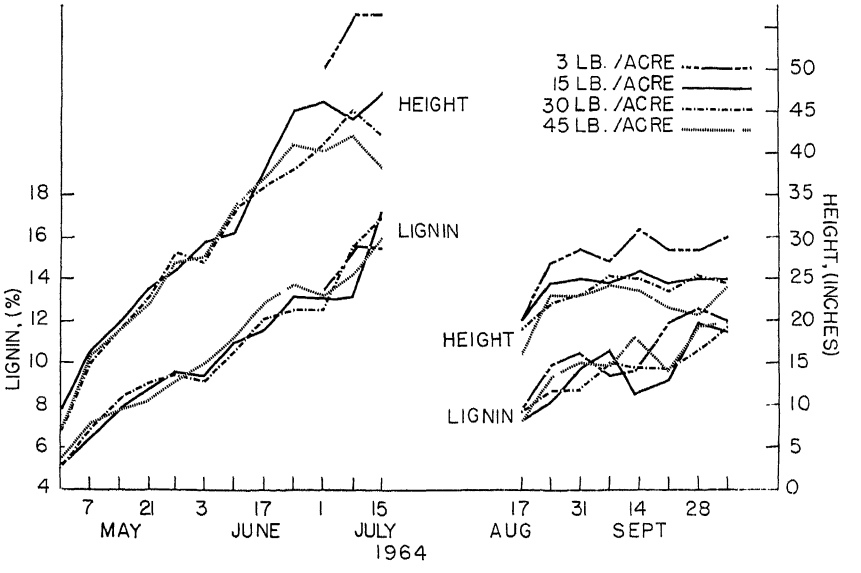

Fig. 4—Relation of lignin content and plant height on different cutting dates of first and second growth alfalfa band seeded in 7-inch rows at 3, 15, 30, and 45 lb./acre.

lower seeding rate (15 lb./acre) being somewhat higher after June 17. Lignin increased rather consistently throughout the period from April 30 to July 15, from about 5.5 percent to about 16.5 percent. Again no marked differences were found in percent lignin among the three seeding rates.

After a month of regrowth beginning on August 17, the same three plots were sampled weekly until October 5. A fourth plot (3 lb./acre seeding rate), which was seeded at the same time in 1963 as the other three, also was sampled during the second growth period. The results observed during the second growth period are also shown in Figure 4.

Height of the alfalfa plants in the plots of the higher seeding rates increased only from about 18½ inches to 24½ inches from August 17 to October 5. The plants in the plots seeded with 3 lb./acre reached about 30 inches. Little growth occurred in any of the plots after August 24 because of dry weather. While the lignin increased from about 7.5 percent on August 17 to 11.5 percent on October 5, no consistent difference was noted which could be attributed to rate of seeding.

Between June 17 and June 23, plant and tiller counts were made in all four plots (3, 15, 30, and 45 lb./acre). As in 1962, the rate of seeding had a marked effect on the number of plants per linear foot of row and number of tillers per plant (Table 3). However, in these seedings the numbers of plants and tillers at the 15 lb./acre seeding rate were about the same as those obtained at the 9 lb./acre seeding rate in 1962 (Table 1).

In addition to differences in numbers of plants and tillers from similar seeding rates in different years, these data show that while there were wide differences in plant population represented in these studies (from 3.6 to 25.2 plants per linear foot of row and from 7.6 to 1.5 tillers per plant), the tillers per linear foot of row did not vary as markedly. Increasing seeding rate from 3 lb./acre to 45 lb./acre increased the number of tillers per linear foot of 7-inch row by approximately 40 percent (Tables 1 and 3). This degree of crowding, although causing an ob-

TABLE 3.—Effect of Seeding Rate* on Average Number of Alfalfa Plants and Tillers, 1964.†

	Seeding Rate			
	3 lb./acre	15 lb./acre	30 lb./acre	45 lb./acre
No. plants/linear ft. of 7-in. row	3.6	10.4	19.6	25 2
No. tillers/linear ft. of 7-in. row	25.0	33.0	38 9	38.3
No. tillers/plant	7.6	3.6	2.1	1 5

*Plots band seeded in spring of 1963 in 7-inch rows.

†Counts were made between June 17 and June 23.

servable difference in fineness of stem, did not alter the lignin content of the plants to any marked degree. It was therefore concluded that high rates of seeding up to 45 lb./acre will not result in alfalfa of lower lignin content.

SUMMARY

A study was made during three seasons to determine if alfalfa grown under conditions of high plant population density (up to 45 lb./acre seeding rate) had lower lignin content at different stages of maturity than plants grown in sparse stands (as low as 3 lb./acre seeding rate.

Increasing the seeding rate from 3 lb./acre to 45 lb./acre increased the number of tillers per linear foot of 7-inch row by approximately 40 percent. This degree of crowding, although causing an observable difference in fineness of stem, did not alter the lignin content of the plants to any marked degree. It was therefore concluded that increasing the seeding rate should not be recommended as a means of producing alfalfa of lower lignin content and higher cellulose digestibility for ruminants.

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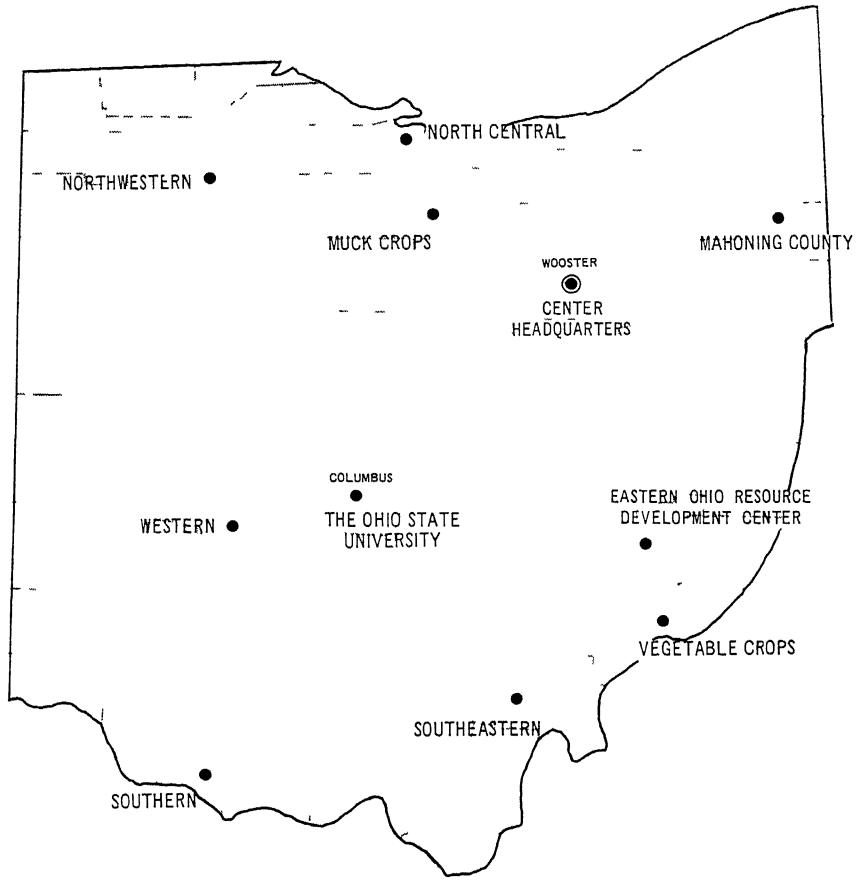

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