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Influence of Planting Date on Response of Forage Sorghum to Nitrogen and Phosphorus

T. C. Knowles and B. W. Hipp

Summary

Research was conducted to determine the influence of 0 and 100 lb/acre of nitrogen (N) and 0 and 50 lb/acre of phosphorus (P_2O_5) fertilizer applications on forage sorghum at four planting dates. Planting dates were 15 March, 1 April, 15 April, and 1 May at a soil temperature range from 50.5 to 64.4 °F at planting. Applications of N and P significantly increased forage yield of sorghum compared with unfertilized plots. Yield response to P applications was highest at the 15 March and 1 April planting dates. Planting on these two dates and applying N and P fertilizers resulted in maximum forage yield. Forage protein concentrations were lowest at the second harvest of the 15 March and 1 April planting dates and were significantly less than protein levels at the second harvest of the 15 April and 1 May planting dates. Thus, we predict forage sorghum planted before 1 April could benefit from split N applications at planting and then after the first harvest. One adequate N application at later planting dates would result in high protein levels through two harvests of forage sorghum grown in the Texas Blackland. Forage yield increases caused by the application of P fertilizer at planting dates after 1 April may be inadequate to offset the cost of P fertilizer, unlike P applications to colder soils at earlier planting dates.

Introduction

Forage sorghum hay production is widely used to provide supplemental winter feed for livestock in the north Texas Blacklands. Forage sorghum grown in the area often responds to N and to a lesser extent to P fertilizer applications. Nitrogen is essential for maximum yield and high protein content of hay. Phosphorous application at planting often increases forage yield when forage sorghum is planted early in relatively cold soils. These low soil temperatures in early spring often provide unfavorable growing conditions, resulting in poor sorghum stands and subsequent low forage yield. The objective of this research was to determine the effects of planting date, N, and P fertilizer applications at planting on forage yields of forage sorghum.

Keywords: soil temperature / fertilizer / haygrazer.

Procedure

An experiment was conducted during 1992 at the Texas A&M Research and Extension Center at Dallas on an Austin silty clay soil (fine-silty, carbonatic, thermic, Udorthentic Haplustoll). The previous crop was winter wheat, and nitrate-N and TAEX-P of the preplant soil (0- to 6-in. depth) were 18 and 145 ppm, respectively. The soil test resulted in suggested fertilizer application rates of 100 lb N/acre and 0 lb P_2O_5/acre. The experimental plot was not irrigated, and rainfall was 3.37, 1,80, 9.22, 5.05, 2.56, and 1.32 in. during March, April, May, June, July, and August, respectively.

The planting dates were 15 March, 1 April, 15 April, and 1 May at soil temperatures of 50.5, 57.6, 62.6, and 64.4 °F, respectively. 'Dekalb FS-25e' forage sorghum was planted at a seeding rate of 80 lb/acre in 12-ft drill rows with an 8-in. row spacing. Nitrogen rates were 0 and 100 lb N/acre, broadcast at each planting date as ammonium nitrate (34-0-0). Phosphorous rates were 0 and 50 lb P_2O_5/acre, banded with the seed at each planting date as triple superphosphate (0-46-0). The experimental design utilized a 4 by 2 by 2 factorial arranged in a strip-split plot design with four planting dates as the vertical factor, two nitrogen rates as the horizontal factor, and two phosphorous rates as the subplot factor in four replications. Each subplot was one drill width (12 ft) by 45 ft long. No pesticides were applied.

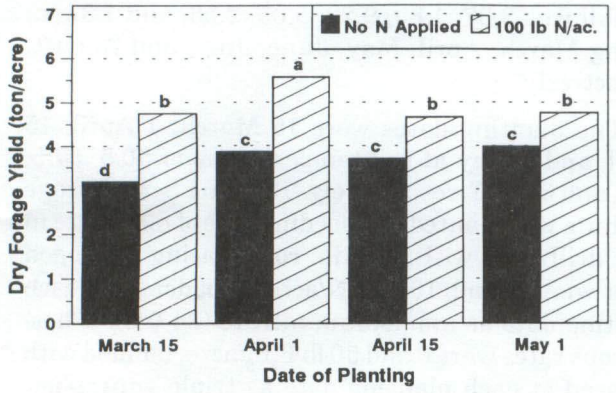
Dry forage yield, protein content, plant height, and leafiness ratings were determined when sorghum reached the boot growth stage. Plots were hand-harvested from a middle four-row swath (32 in.), 20 ft long at each harvest. The first harvest was made on 8 June, 15 June, 1 July, and 8 July for the 15 March, 1 April, 15 April, and 1 May planting dates, respectively. The second harvest occurred on 24 August for the 15 March and 1 April planting dates, then on 28 August for the 15 April and 1 May planting dates. Subsamples were dried at 140 °F for 48 hr to determine dry matter. Protein percentages were determined by the Kjeldahl method. Plots were mowed

off immediately following the first cutting. Mean separation was calculated by routine ANOVA techniques using SAS to determine the least significant difference (LSD) at the 0.05 level of probability protected by a significant F-test.

Results and Discussion

Maximum hay yield (5.57 ton/acre) at the first harvest was obtained by applying 100 lb N/acre plus 50 lb P_2O_5/acre at the 1 April planting date (Fig. 1). Both N and P fertilizer applications significantly increased hay yield at all four planting dates at the first harvest (Figs. 1 and 2). Maximum protein concentration (10.9%) was observed with the application of N and P on the 15 March planting date (Fig. 3). Plant heights for the treatments resulting in maximum hay yield ranged from 61 to 65 in., and plants showed acceptable leafiness.

Effect of Nitrogen (N) on First Cut Forage Sorghum Yield



Effect of Nitrogen (N) on Second Cut Forage Sorghum Yield

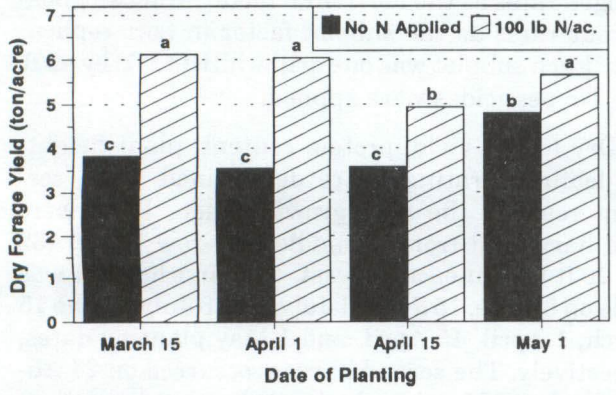
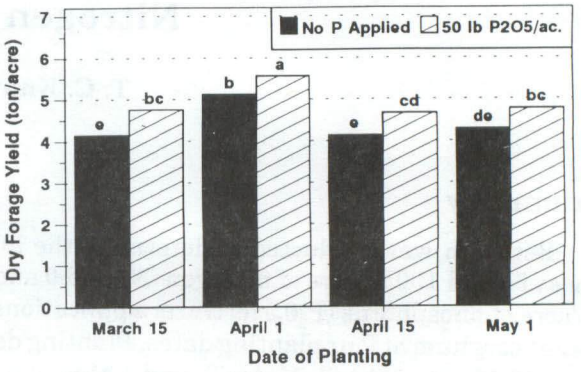


Figure 1. Effect of planting date and nitrogen (N) fertilizer applications on dry matter yield of forage sorghum harvested in two hay cuttings.

Effect of Phosphorus (P) on First Cut Forage Sorghum Yield



Effect of Phosphorus (P) on Second Cut Forage Sorghum Yield

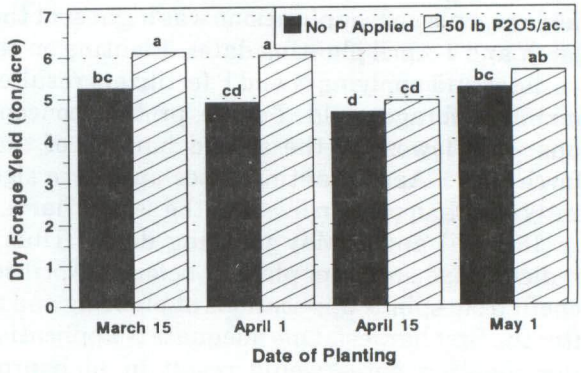
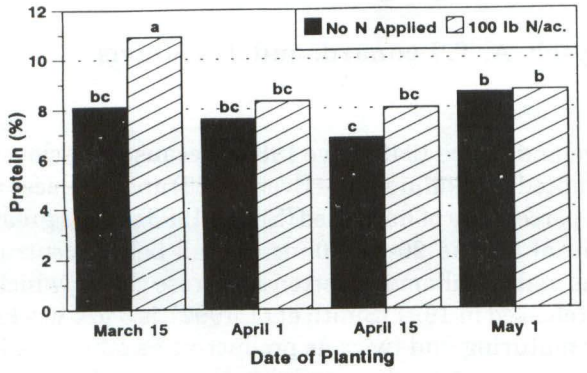


Figure 2. Effect of planting date and phosphorus (P) fertilizer applications on dry matter yield of forage sorghum harvested at two hay cuttings.

Maximum hay yields (6.04 to 6.12 ton/acre) of regrowth at the second harvest were obtained with the application of 100 lb N/acre plus 50 lb P_2O_5/acre at the 15 March and 1 April planting dates. Nitrogen fertilizer applications significantly increased hay yield at all four planting dates; however, P increased hay yield of the regrowth only at the 15 March and 1 April planting dates (Figs. 1 and 2). Maximum protein concentrations (8.7 to 9.1%) were observed with the application of N and P on the 15 April and 1 May planting dates (Fig. 3). Plant heights for the treatments resulting in maximum hay yield ranged from 65 to 69 in., and plants showed superior leafiness.

Maximum total hay yields (10.87 to 11.61 ton/acre) were obtained with the application of 100 lb N/acre and 50 lb P_2O_5/acre at the March 15 and April 1 planting dates (Fig. 4). Protein concentrations at the second cutting were somewhat low because much of

Effect of Nitrogen (N) on First Cut Forage Sorghum Protein



Effect of Nitrogen (N) on Second Cut Forage Sorghum Protein

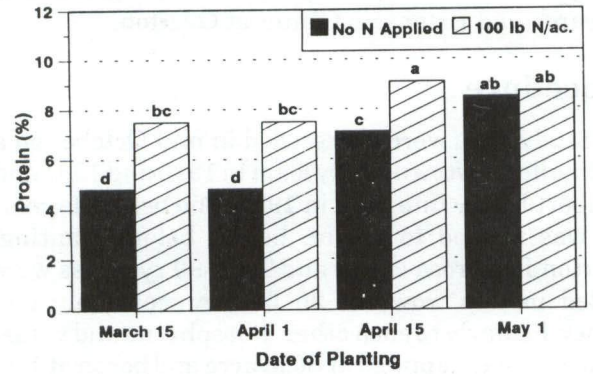
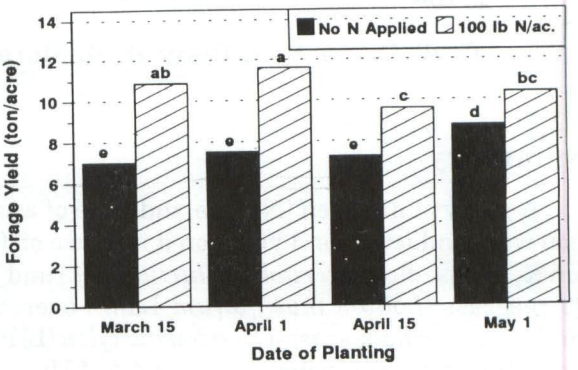


Figure 3. Effect of planting date and date of nitrogen (N) fertilizer application on forage sorghum protein concentration at two hay cuttings.

the N fertilizer applied at planting on 15 March and 1 April was removed by forage sorghum before the first cutting. Low protein concentrations at the first cutting for the later 15 April and 1 May planting dates indicate decreased availability of late applied N fertilizer to sorghum plants in the short time between planting and the first cutting. These planting dates had the highest protein concentrations at the second cutting 7 weeks later, when N fertilizer had time to become positionally available to plant roots. Split N fertilizer applications at planting and after the first cutting could help maintain higher protein concentrations through both hay cuttings.

Overall, the 15 March and 1 April planting dates plus application of both N and P fertilizer resulted in the highest hay yields. Some years, however, planting on or before March 15 could result in poor stands because of cold, moist soils. Therefore, an optimum

Effect of Nitrogen (N) on Total Forage Sorghum Dry Matter Yield



Effect of Phosphorus (P) on Total Forage Sorghum Dry Matter Yield

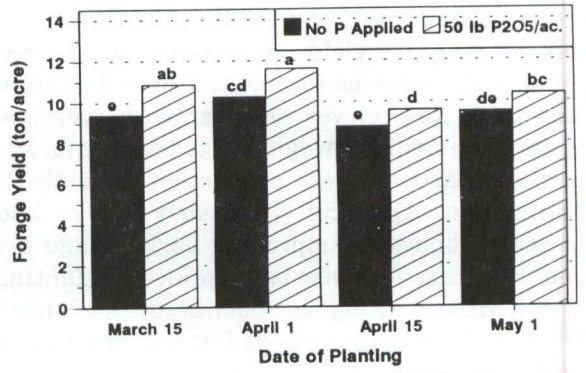


Figure 4. Effect of planting date, nitrogen (N), and phosphorus (P) fertilizer applications on dry matter yield of forage sorghum harvested in two hay cuttings.

planting date for two hay cuttings would be closer to 1 April. Half the N fertilizer should be applied at preplant stage and half following the first cutting to maintain high protein content at both cuttings. We expect that earlier planting dates (before 1 April) would be more responsive to P fertilizer applications because forage sorghum is subject to colder soils early in the season, which often decreases plant P uptake and availability of P in the soil. Additionally, the Texas Agricultural Extension Service suggests that grazing be deferred at least 1 week after top-dressing N fertilizer to mowed-off forage.

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