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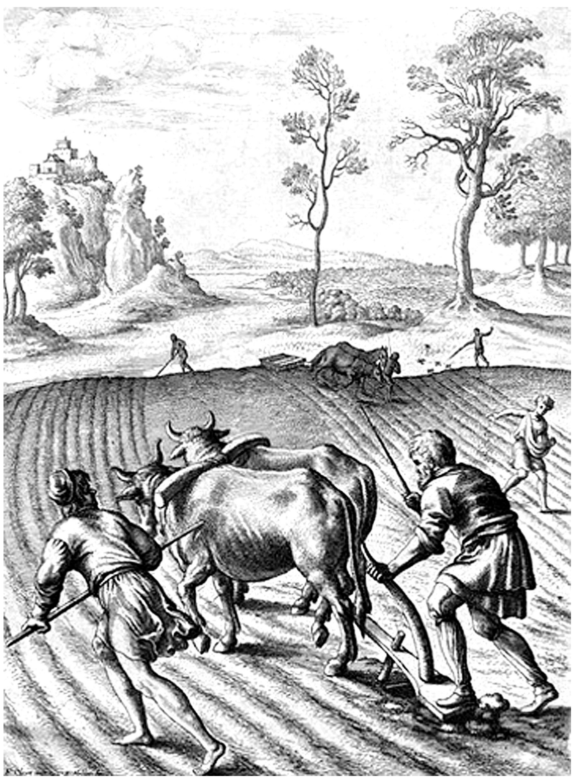

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Plant Spacings cum Nitrogen Management Effects on Forage Yield of Mott Elephantgrass

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Abstract: The main objective of present study was to determine the effect of different levels of nitrogen and plant spacings on yield of Mott grass (***Pennisetum purpareum schum***) at different cuttings. Plant spacings (inter row and intra row spacings) are S_1 = 45 × 45 cm, S_2 = 60 × 60cm and S_3 = 75 × 75 cm and nitrogen levels included N_0 = 0 (control), N_1 = 100 kg, N_2 = 200 kg, N_3 = 300 kg and N_4 = 400 kg ha^{-1}. Production potential of Mott grass was determined on the basis of green fodder and dry matter yield. Application of N at different plant spacings increased both green fodder and Dry matter yield significantly over control in all the three cuttings. Crop fertilized at 300 kg N ha^{-1} produced the maximum green fodder yield 509 t ha^{-1} and Dry matter yield (97 t ha^{-1}) of all the three cuttings at the spacing pattern of 45 × 45 cm.

Key words: Plant spacing, nitrogen, forage yield, mott grass

Introduction

Forages are the major and cheap source of feed for livestock. In Pakistan, about 16% of the total cropped area is put under fodder crops annually, even then regular supply of adequate and quality fodder is not being made. (Hanjra ***et al.***, 1995). This results in lowered production due to under fed animals. There may be many alternatives to overcome the shortage of forage but one of them is the introduction of high yielding crop varieties.

Mott elephantgrass is a vegetative perennial, highly productive, stay for years in the field and maintains its quality over long regrowth intervals. In a field of one acre, a fresh matter yield of 192 tons per year can be produced with improved agronomic practices (Gill and Bhatti, 1996). Mott grass is also important because of its availability during feed shortage period (May and June).

Mott grass was introduced to Pakistan in 1988. Although some of the farmers have started its cultivation yet it success will depend upon the evolution of a comprehensive package of agro-technology compatible with the local agro-climatic conditions. Two vital components of agro-technology for Mott grass are proper plant spacing and adequate nitrogen fertilization which play a key role in the development of quick growing grasses like. Mott that tillers profusely (Bilal ***et al.***, 2000). Percentage of planted stems that produce at least one emerged stems that produce at least one emerged shoot increase linearly from 50 to 88 as nitrogen rate increases from 0 to 400 kg ha^{-1} (Sollenberger ***et al.***, 1988). Therefore, the present study was planned to determine the effect of different plant spacings and nitrogen levels on the yield of Mott grass at various cuttings.

Materials and Methods

In this experiment, effect of different levels of nitrogen and plant spacings on the productivity of Mott grass was studied. The experiment was laid out in a randomized complete block design (RCBD) with a split plot arrangement and three replications. Main plot size was 8x9m. This plot was subdivided into three plots according to row spacings and these were 5 rows of Mott grass in each sub plot. N_2 fertilizer levels were placed in the main and planting methods in the sub plots. Urea (46% N_2) was used as nitrogen source. The experiment was conducted at Research Area of Agronomy, Forage Production Section, Ayub Agricultural Research Institute (AARI) Faisalabad. Experiment comprised the following treatments. Plant spacing S_1 = 45 $\times$ 45 cm, S_2 = 60 $\times$ 60 cm and S_3 = 75 $\times$ 75 cm and nitrogen levels included N_0 = 0 (control), N_1 = 100 kg, N_2 = 200 kg, N_3 = 300 kg and N_4 = 400 kg ha^{-1}. From the specified dose of nitrogen for each treatment 50% N_2 was applied after planting with first irrigation while the remaining 50% was applied 5 weeks after the first application of nitrogen. Similarly after each harvest the same amount of N_2 as per treatment was applied in two equal splits i.e. 50% with first irrigation after the crop harvest and 50% 5 weeks after the first application of nitrogen. All other agronomic practices were kept normal and uniform for all the treatments. Five plants per plot were selected at random (one plant from each row except two aside rows and tagged. These plants were used throughout the production trial. Three cuttings were taken, first after 90 days of planting and sub sequent cuttings with an interval of 60 days each. The data recorded was green fodder and dry matter yield.

Green fodder and dry matter yield ha^{-1}

At harvest, all the plants of a plot were cut at an appropriate height and weighed with the help of a spring balance. Then green fodder yield per plot was converted to green fodder yield per hectare. Green samples from each plot were chopped and dried in hot air oven to a constant weight. The dry matter (DM) percentage was calculated as follows.

$$DM\,\% = \frac{\text{Weight of dried sample}}{\text{Weight of fresh sample}} \times 100$$

DM yield/ha was calculated on the basis of DM percentage. The data were subjected to statistical analysis by using Fisher's analysis of variance technique and the treatments mean were compared by using least significant differences (LSD) test at 0.05 (Steel and Torrie, 1984).

Results and Discussion

Green fodder yield (t ha^{-1})

The data regarding the effect of different plant spacings and nitrogen levels on forage yield ha^{-1} are embodied in Table 1. Forage yield ha^{-1} (FYH) was significantly affected by different spacing patterns in all the three cuttings. In the Ist cutting the crop spaced at 45x45 cm gave the maximum forage yield ha^{-1} against the minimum 55.4 t ha^{-1}) at 75x75 cm. Whereas 60x60 cm intermediate. On the basis of total FYH, the maximum FYH of three cuttings was recorded at narrow spacing and the minimum of 176.21 t at the widest spacing. These results are in consonance with those of Khan and Manghatt (1965) and Saeed ***et al.*** (1996) who reported that green fodder yield of Mott grass decreased as plant spacing was increased.

FYH was increased significantly with the application of nitrogen over control in all the three cuttings. In 1st cut, the crop fertilized at 300 kg N ha^{-1} produced significantly the maximum FYH against the minimum of 52.51 t with no nitrogen. The same trend was observed in case of 2nd and 3rd cutting. Significantly the maximum total FYH of 3 cuttings was recorded at 300 kg N ha^{-1} against the minimum of 165.4 t ha^{-1} with no nitrogen. These findings are in lime with those of Ethredge ***et al.*** (1973), Mathias ***et al.*** (1978) who reported that forage yield of Bermuda grass increased with each successive increase in nitrogen.

Similarly Saeed ***et al.*** (1996) also recorded the promotive effect of N on FYH of Mott grass. The maximum of three cuttings was recorded in case when the crop was planted at 45x45 cm spacing and given 300 kg N ha^{-1}. However, the minimum FYH was recorded when the crop was grown at 75 × 75 cm spacing and no nitrogen was given.

Dry matter yield (t ha^{-1})

The dry matter yield (DMY) decreased significantly with an increase in plant spacing from 45 × 45 cm to 75 × 75 cm (Table 2). However, the maximum DMY was produced in the Ist cutting when the crop was raised at 45x45 cm spacing and was followed by 60x60cm which produced 14.6 t ha^{-1}. Whereas the minimum DMY of 10.47 t ha^{-1} was recorded when the crop was planted at 75 × 75 cm. The same trend was observed in 2^{nd} and 3^{rd} cutting. On the basis of total DMY of three cuttings, the maximum DMY of 79.6 t ha^{-1} was recorded at narrow spacing against the minimum of 33.9 t ha^{-1} at 75 × 75 cm spacing. These findings are in line with those of Cox (1996), Ahmad (1998) and Mohsan (1999).

The different N_2 levels enhanced the DMY significantly over control. Maximum DMY was recorded in Ist cutting when the crop was fertilized at 300 kg N ha^{-1} which was at the par with that fertilized at 400 kg N ha^{-1} against the minimum of 10.69 t ha^{-1} in check. Similar trend was noted in 2nd and 3rd cutting. The total DMY of three cuttings was the maximum when the crop fertilized @300 kg N ha^{-1} against the minimum of 35.22 t ha^{-1} with out nitrogen. Promotive effect of nitrogen application on DMY have also been reported by Bangarwa ***et al.*** (1988), Ahmad (1989) and Dobos and Nagy (1998).

Table 1: Forage yield (t ha^{-1}) as affected by different plant spacing and nitrogen levels

	Cutting No.			
Treatments	1st	2nd	3rd	Total
A. Plant Spacings (cm)				
S_1 (45 × 45)	122.6a*	152.1a	133.2 a	407.9a
S_2 (60 × 60)	74.8b	93.5b	81.2 b	249.5b
S_3 (75 × 75)	55.4c	63.6c	57.2 c	176.2c
LSD (0.05)	2.26	1.75	0.89	3.58
B. Nitrogen levels (kg ha^{-1})				
N_0 = control	52.5e	57.8e	54.7d	165.4e
N_1 = 100	81.5d	90.1d	87.3c	258.9d
N_2 = 200	89.5c	114.0c	98.8b	302.3c
N_3 = 300	101.9a	130.8a	111.7a	344.4a
N_4 = 400	95.9b	122.5b	100.0b	318.4b
LSD (0.05)	2.26	3.42	2.98	4.10
C. Interaction (S × N)				
S_1N_0	78.0e	84.6h	81.3g	243.9i
S_1N_1	122.3c	130.3d	126.9d	379.5d
S_1N_2	126.2c	168.8c	142.2c	437.2c
S_1N_3	146.7a	193.0a	169.3a	509.0a
S_1N_4	139.6b	183.6b	146.2b	469.4b
S_2N_0	46.8h	51.4j	48.5k	146.7m
S_2N_1	70.8f	84.7h	81.3g	236.8e
S_2N_2	80.4e	102.8g	90.4f	273.6h
S_2N_3	92.7d	118.3e	97.1e	308.1f
S_2N_4	83.6e	110.0f	88.8f	282.4g
S_3N_0	32.8i	37.4k	34.4l	104.6n
S_3N_1	51.6h	55.2j	53.8j	160.6l
S_3N_2	61.9g	70.5i	63.8i	196.2k
S_3N_3	66.3fg	81.0h	68.8h	216.2j
S_3N_4	64.4fg	74.0i	65.1i	203.5k
LSD (0.05)	6.67	5.40	8.01	8.01

* Any two means in a column not sharing a letter differ significantly at $P \leq 0.05$

Table 2: Dry matter yield (t ha^{-1}) as affected by different plant spacings and nitrogen levels

Treatments	Cutting No. 1st	2nd	3rd	Total
A. Plant Spacings (cm)				
S_1 (45 × 45)	23.7a	29.2a	26.7a	79.6
S_2 (60 × 60)	14.6b	19.1b	16.7b	50.4
S_3 (75 × 75)	10.5c	12.3c	11.1c	33.9
LSD (0.05)	0.8	1.5	2.4	
B. Nitrogen levels (kg ha^{-1})				
N_0 = control	10.7c	12.6c	12.0c	35.3
N_1 = 100	14.9b	19.2b	17.3b	51.4
N_2 = 200	17.5ab	20.5b	19.5b	57.4
N_3 = 300	19.5a	25.0a	22.3a	66.8
N_4 = 400	18.8a	23.7a	19.9ab	62.4
LSD (0.05)	3.7	2.2	2.7	
C. Interaction (S × N)				
S_1N_0	15.5e	18.6e	18.4	52.6
S_1N_1	21.6c	25.9c	25.1	72.6
S_1N_2	25.0b	30.2b	28.1	83.2
S_1N_3	28.2a	36.3a	32.9	97.1
S_1N_4	28.0a	35.0a	29.1	92.3
S_2N_0	9.8hi	11.7f	10.6	32.1
S_2N_1	13.5f	19.5e	16.3	49.3
S_2N_2	15.8de	18.6e	18.5	53.0
S_2N_3	17.5d	23.9cd	20.3	61.7
S_2N_4	16.5de	21.7de	18.1	56.2
S_3N_0	6.8j	7.6g	7.0	21.3
S_3N_1	9.4i	12.2f	10.6	32.1
S_3N_2	11.5gh	12.6f	11.8	36.0
S_3N_3	12.9fg	14.9f	13.6	41.5
S_3N_4	11.7fg	14.4f	12.6	38.7
LSD (0.05)	0.83	3.4	NS	

Any two means in a column not sharing a letter differ significantly at $P \leq 0.05$

NS = Non significant

The maximum DMY was recorded in S_1N_3 treatment combination i.e. when the crop was planted at 45x45cm and fertilized at 300 kg N ha^{-1} which was at par with S_1N_4. The minimum DMY was recorded in S_3N_0 i.e when the crop was planted at 75 $\times$ 75 cm with no nitrogen.

The interaction between plant spacing and nitrogen level was also significant. Better plant growth of 45x45 cm over other spacing patterns along with N application was associated with their LAIs as a result of which crop plants intercepted more radiation and there by increased crop growth rate. These results corroborate the findings of Ramison and Lucas (1982) and Bangarwa ***et al.*** (1988).

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