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Influence of levels and methods of N application on sorghum yield

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Abstract : Response of sorghum Co.26 to different levels of N and various methods of application was studied in two experiments during 1998 and 1999. Application of the required N in three splits either as 25:50:25 or 50:25:25 at basal, 15 and 30 DAS was found to enhance the grain yield up to 10.08 per cent in 1998 and 8.47 per cent in 1999 over the normal recommended two splits as 50:50 per cent at basal and 30 DAS. 90 kg N ha^{-1} was found to be optimum.

Keywords : Sorghum, Split application, N levels.

Introduction

Sorghum is widely grown as a staple cereal crop in Tamil Nadu both under irrigated and rainfed conditions. Improved varieties demand more of applied nutrients. The greater yield response of sorghum to added N has been demonstrated in field experiments by many researchers. Sorghum grain yield has been increased significantly up to 80 kg N ha^{-1} as reported by Ishwar Singh and Choudhary (1993) and Sarma and Ramana (1993). Yield was generally increased with increasing N rate under split application (Verma and Pandy, 1981).

Materials and Methods

One pot culture study and two field experiments were conducted with Co.26 sorghum as test crop to study the influence of graded levels of N and methods of application on the productivity in clay loam soil (Typic Haplustalf) having low available N and P and high K. The pot study comprised of five levels of N (0, 45, 90, 135 and 180 kg ha^{-1}) applied during basal, 15,30 and 45 DAS in seven different proportions, while N was used at three levels (45, 90 and 135 kg ha^{-1}) under three (50:25:25; 25:50:25 and 50:00:50 per cent N at basal, 15 and 30 DAS) and four (50:25:25:00; 25:50:25:00; 50:00:50:00 and 25:25:25:25 per cent N at basal, 15, 30 and 45 DAS) methods of application respectively in the first and second field experiments. Recommended dose of P and K were applied to all the treatments at 45:45 kg ha^{-1}. The field experiments were conducted in Randomized Blocks Design, replicated three times. All the cultural operations were carried out as per the recommendation.

Results and Discussion

Pot culture study

The dry matter production was assessed to study the influence of graded levels of N and methods of application on the productivity of sorghum. Application of the required N in three splits either as 25:50:25 or 50:25:25 per cent at basal, 15 and 30 DAS was found to record higher dry matter production compared to other methods. Among the levels of nitrogen, 90 kg ha^{-1} was found optimum. Further increase in the level of N resulted only in marginal increase in dry matter production (Table 1) indicating the sufficiency of 90 kg N ha^{-1} for irrigated sorghum. Increase in vegetative growth leading to enhanced dry matter production as a consequence of N application is an universal phenomenon particularly in cereals such a sorghum. Khatik *et al.* (1999) reported that promising sorghum genotypes responded well to the application of N up to 80 kg ha^{-1} in Haplustalf soils of Rajasthan.

Field experiment I

The grain yield of sorghum differed significantly among the methods of application and levels of nitrogen. Application of N in three splits either as 50:25:25 or 25:50:25 per cent at basal, 15 and 30 DAS registered significantly higher grain yield than the recommended two splits at 50:50 per cent during basal and 30 DAS (Table 2). Among the three major nutrients, N is more amenable for loss in soil by different mechanisms and hence the N use efficiency is normally low. Split application improves the N use efficiency by reducing the loss to certain extent, meeting the crop demand in the active growth stage. Among the levels of N, 135 kg ha^{-1} although recorded the highest yield of 4630 kg ha^{-1}, it was on par with 90 kg ha^{-1} (4505 kg ha^{-1}) indicating the sufficiency of the normal

Table 1. Dry matter production of sorghum (g pot^{-1})

Method/ N kg ha^{-1}	0	45	90	135	180	Mean
50:00:50:00	50.8	60.0	62.2	65.1	69.5	61.5
50:25:25:00	50.3	55.7	62.7	72.4	71.8	62.6
25:25:25:25	52.9	58.3	64.2	67.4	65.3	61.6
25:50:25:00	51.7	54.1	66.6	71.9	69.8	62.8
25:25:50:00	50.4	55.3	59.4	61.8	62.6	57.9
00:50:25:25	48.2	54.2	58.6	59.4	58.8	55.8
00:25:50:25	51.7	54.1	58.8	62.6	63.1	58.1
Mean	50.8	55.9	61.8	65.8	65.8	

Table 2. Grain yield of sorghum at various N levels and methods (kg ha^{-1})

Methods / N kg ha^{-1} % at 0, 15, 30 DAS	45	90	135	Mean
50:25:25	4327	4673	4842	4614
25:50:25	4125	4596	4645	4455
50:00:50	3916	4245	4404	4188
Mean	4123	4505	4630	4419
CD (P=0.05) : N=200	M=192	NxM=346		

Table 3. Productivity of sorghum (kg ha^{-1}) at various N levels and methods

Methods/ N kg ha^{-1} % at 0, 15, 30 45 DAS	45	90	135	Mean
50:25:25:00	4102	5259	5620	4994
25:50:25:00	4000	5352	5713	5022
50:00:50:00	4129	4889	5129	4716
25:25:25:25	3989	4982	5037	4669
Mean	4055	5121	5375	4850
CD (P=0.05) : N = 217	M = 250	NxM = 434		

recommendation. Earlier, Sharma *et al.* (2000) obtained the highest grain yield in sorghum at 80 kg N ha^{-1} in sandy loam soils of Udaipur. The level at 45 kg N ha^{-1} recorded significantly lower yield (4123 kg ha^{-1})

Field experiment II

To confirm the findings of the pot culture and field study an experiment was conducted with the same set of treatments excepting the introduction of an additional method of application at 25:25:25:25 per cent during basal, 15,

Table 4. Performance of sorghum (kg ha^{-1}) under various methods of N application

% N on 0, 15 and 30 DAS (90 kg N ha^{-1})	1998	1999
50:25:25	4673	5259
25:50:25	4596	5352
50:00:50	4245	4889
% increase over 2 splits 50:25:25	10.08	7.57
25:50:25	8.27	8.47
CD (P=0.05)	192	250

30 and 45 DAS. The influence of both levels of N and methods of application was highly significant on the grain yield of sorghum (Table 3). Application of N in three spits as 50:25:25 or 25:50:25 during basal, 15 and 30 DAS recorded significantly higher grain yield than other methods confirming the findings of the earlier experiment. Successive levels of N produced significant increase in grain yield and the highest yield (5375 kg ha^{-1}) was obtained with 135 kg N ha^{-1}. Response of sorghum to added N in a soil analyzing low available N is anticipated one because it is a cereal crop with high demand of N. Although the difference in yield between 90 and 135 kg N ha^{-1} attained statistical significance, the magnitude of increase was only marginal (254 kg ha^{-1}) whereas, striking difference in yield (1066 kg ha^{-1}) was observed with 45 and 90 kg N ha^{-1}. This is in confirmation with the earlier finding of Hirpara *et al.* (1999) who observed the response of sorghum upto 120 kg N ha^{-1} in medium black soils of Gujarat.

The grain yield of sorghum was found to be 4245 to 4673 kg ha^{-1} and 4889 to 5352 kg ha^{-1} in the first and second crops respectively at the recommended level of N at 90 kg ha^{-1} (Table 4). Application of N in three splits was found to enhance the yield by 8.27 to 10.08 and by 7.57 to 8.47 per cent in the first and second crops respectively over the recommended two splits. This may probably be to the better and continuous availability of N during the active vegetative growth period. The enhanced N use efficiency as a matter of split application corresponding to the demand of crop might have contributed for better growth of plants resulting in higher productivity. The finding is in good agreement with the earlier report of Verma and Pandy (1981) who demonstrated the benefit of split application for enhancing the productivity of sorghum.

It may be concluded that the recommended level of 90 kg N ha^{-1} may be applied to sorghum in three splits either as 50:25:25 or 25:50:25 per cent during basal, 15 and 30 DAS for higher yield.

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