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Studies on the Effect of Nitrogen Fertilization on Growth and Yield of Sorghum (*Sorghum bicolor*) Varieties during Post Rainy (*Maghi*) Season

M Madhu Kumar, P Munirathnam and M Srinivasa Reddy
Department of Agronomy, Agricultural College, Mahanandi - 518 502

ABSTRACT

Field experiment was conducted at Regional Agricultural Research Station, Nandyal during post rainy season *(maghi),* 2011 to study the response of Sorghum (*Sorghum bicolor*) cultivars to nitrogen fertilization under I.D. conditions during post rainy (*maghi*) season. The results indicated that significantly higher values for growth parameters *viz.,* plant height and dry matter production were recorded with Kinnera. However, as regards the dry matter production it was on par with NTJ-4 but significantly superior to C-43. Being at par with Kinnera, C-43 produced maximum number of green leaves per plant which was significantly superior to NTJ-4 at all the stages except at 90 DAS. Higher grain weight per panicle, grain (7274 kg ha^{-1}) and straw yields (8923 kg ha^{-1}) were recorded with Kinnera whereas higher value for 1000 grain weight was recorded with NTJ-4. All the growth and yield parameters, grain and straw yield was higher with the application of 180 kg N ha^{-1} but number of leaves produced were on a par with application of 120 and 150 kg N ha^{-1} at 30 and 60 DAS.

Key words : Sorghum, Nitrogen levels, Varieties.

Sorghum (*Sorghum bicolor* (L) Moench) is one of the important staple diet popular among the farmers in the arid and semi-arid tropics of the world. It is the fifth most important cereal crop globally and is the dietary staple for more than 500 million people in 30 countries. The lower yields of *Sorghum* in general, compared to other cereals is mainly due to restricted cultivation mostly confined to dry lands of low fertility status with insufficient moisture availability, lack of improved high yielding cultivars, delayed sowing, low fertilizer use and improper adoption of management techniques. Some of the varieties being cultivated around Nandyal possess high-yielding potentiality and respond more to heavy doses of nitrogen than others under the same set of conditions. In Kurnool district sowings are generally taken up during post rainy season called "*maghi*". More than 80 percent of the soils in the district are medium to deep black cotton soils with low in organic matter and nitrogen content. Therefore, the response to nitrogen on these soils is spectacular and the most effective way to increase the Sorghum yield is through supply of adequate quantity of nitrogen. Hence, the present experiment was conducted to study the effect of nitrogen fertilization on growth and yield of Sorghum (*Sorghum bicolor*) varieties during post rainy (*maghi*) season.

MATERIAL AND METHODS

Field experiment was conducted during post rainy season (*maghi*), 2011 at RARS, Nandyal. The soil of experimental site was clay in texture and it was moderately strong alkaline in reaction with a pH of 8.6; EC of 0.15 dSm^{-1}, low in organic carbon (0.56%), low in available nitrogen (188.2 kg ha^{-1}), medium in available phosphorus (30.2 kg P_2O_5 ha^{-1}) and high in potassium (391.9 K_2O kg ha^{-1}). The experiment was laid out in RBD (Factorial) with three replications and treatment combinations of three varieties and four nitrogen levels making twelve treatments. The treatments consisted of three varieties *viz.,* C-43, NTJ-4 and Kinnera and four nitrogen levels *viz.,* 90, 120, 150 and 180 kg N ha^{-1}. Recommended dose of phosphorus (40 kg ha^{-1}) and potassium (30 kg ha^{-1}) were applied uniformly to all the treatments. Nitrogen was applied in two equal splits. Half of nitrogen along with full dose of phosphorus and potassium were applied as basal at the time of sowing. The remaining quantity of nitrogen was top dressed at knee-heigh stage of crop.

Observations were recorded on growth parameters such as plant height, number of green leaves, dry matter production and yield attributes viz., grain weight per panicle, 1000 grain weight, grain yield, straw yield and harvest index. The total rainfall received during the crop growth period was 8.6 mm in one rainy day as against the decennial rainfall of 775.2 mm in 44.6 rainy days during 2011.

RESULTS AND DISCUSSION

Growth parameters

The data revealed that plant height increased slowly up to 30 days after sowing and thereafter increased rapidly up to 60 DAS. At all stages taller plants were produced by Kinnera which were significantly superior to NTJ-4 and C-43 except at 30 DAS, while significantly shorter plants were produced by the variety C-43 at all stages of crop growth. Dixit *et al.* (2005) and Singh *et al.* (1996) also reported that significant response was observed for plant height in different varieties. Plant height responded significantly to nitrogen at 60 and 90 DAS. Taller plants were produced with the application of 180 kg N ha^{-1} while the shorter plants were produced with the application of 90 kg N ha^{-1}.

C-43 produced significantly higher number of green leaves per plant at all stages of crop growth but at par with Kinnera at 30 and 60 DAS while at 90 DAS, it was found to be on par with NTJ-4. Dixit *et al.* (2005) also observed significant differences in number of green leaves per plant among varieties. Increase in number of green leaves per plant was observed with increase in nitrogen level but the increase was not significant for successive increase in levels of nitrogen.

Dry matter production per plant varied among the varieties. Being at par with each other, varieties NTJ-4 and Kinnera produced significantly higher dry matter at 30 and 60 DAS while the lowest produced by C-43 at all the stages. Significant response among different varieties for dry matter production was also observed by Dixit *et al.*(2005). Regarding to nitrogen levels, Dry matter production increased with successive increase in nitrogen level at 30 and 60 DAS where as at 90 DAS, 180 kg N ha^{-1} was comparable with 150 kg N ha^{-1}. The improvement in morphological as well as physiological parameters due to fertilizer application might have resulted in better interception of radiant energy leading to higher photosynthesis which in turn to higher accumulation of dry matter per plant. Similar observation was also made by Patidar and Mali (2004).

Yield components and yield

Significant variation was observed in grain weight per panicle among varieties and different levels of nitrogen. Kinnera recorded significantly higher compared to NTJ-4 which in turn was significantly higher over C-43. Angadi *et al*. (2004) also reported significant variation in grain weight per panicle among different varieties. The highest grain weight per panicle was recorded with the application of 180 kg N ha^{-1} but was comparable with 150 kg N ha^{-1}. Higher grain weight per panicle might be due to enhancement in the 1000 grain weight. The results obtained are in line with Goud Reddy *et al*. (1989) who reported increase grain weight per panicle might be due to enhancement in test weight and grain number per panicle.

Thousand grain weight was significantly influenced by both varieties and nitrogen levels. NTJ-4 produced higher test weight which was significantly superior to C-43 and Kinnera. Significantly higher thousand grain weight was recorded at higher fertility status i.e. 180 kg N ha^{-1} and lower weight was recorded with 90 kg N ha^{-1}. This increase in 1000 grain weight at higher level might be due to availability of adequate plant nutrients. Similar observation was reported by Paulpandi *et al.* (1998).

Significant variation in grain and stover yields was observed among the Sorghum varieties and also nitrogen levels. Higher grain and stover yields were recorded with Kinnera compared to NTJ-4 while significantly lower was recorded by C-43. The magnitude of increase in grain yield with Kinnera was 23.3 and 5.9 per cent over C-43 and NTJ-4, respectively. The higher grain yield may be attributed to higher growth and yield attributing characters like higher grain weight per panicle. Similar observation was reported by Wani *et al*. (2004) and Dixit *et al.* (2005). Higher stover yield might be owing to more plant height and dry matter production. The same observation was recorded by Dixit *et al*.(2005) and Mulik *et al*.(1996). Significantly higher grain and stover yields were recorded with the application of 180 kg N ha^{-1} and

Table 1. Growth parameters of Sorghum varieties as influenced by different levels of nitrogen.

Treatments	Plant height (cm)			Number of green leaves plant^{-1}			Dry matter plant^{-1} (g)		
	30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS
Varieties									
C-43	61.3	141.2	143.5	13.4	14.0	6.1	16.00	79.69	138.35
NTJ-4	88.0	226.1	226.6	11.3	11.6	5.7	16.79	83.89	144.27
Kinnera	84.6	244.6	246.7	11.9	12.5	4.9	16.64	84.91	146.05
SEm ±	1.8	3.1	2.9	0.5	0.6	0.2	0.13	0.54	0.59
CD (P=0.05)	5.4	9.1	8.6	1.5	1.8	0.5	0.38	1.61	1.72
N-levels (kg ha^{-1})									
90	74.1	188.2	191.3	10.8	10.9	5.0	14.84	76.15	135.36
120	77.1	203.9	204.8	12.0	12.7	5.5	16.22	81.90	142.08
150	78.9	205.1	206.4	12.8	13.1	5.5	17.12	84.93	146.18
180	81.8	218.7	220.0	13.2	14.0	6.2	17.72	88.34	147.93
SEm ±	2.1	3.6	3.4	0.6	0.7	0.2	0.15	0.63	0.68
CD (P=0.05)	NS	10.5	9.9	1.7	2.0	0.6	0.44	1.86	1.99
Varieties x N-levels									
SEm ±	3.6	6.2	5.8	1.0	1.2	0.4	0.26	1.10	1.17
CD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	3.23	NS

Table 2. Yield attributes, grain yield, stover yield and harvest index of Sorghum varieties as influenced by different levels of nitrogen.

Treatments	Grain weight panicle^{-1}	1000 grain weight (g)	Grain yield (kg ha^{-1})	Stover yield (kg ha^{-1})	Harvest index (%)
Varieties					
C-43	47.9	25.3	5895	7957	42.59
NTJ-4	66.7	33.3	6866	8702	44.10
Kinnera	72.7	32.2	7274	8923	44.89
SEm ±	0.67	0.02	34	35	0.13
CD (P=0.05)	1.97	0.07	99	104	0.38
N-levels (kg ha^{-1})					
90	57.3	29.4	6312	8028	44.01
120	60.8	30.1	6610	8396	43.98
150	64.7	30.6	6835	8717	43.86
180	66.8	31.1	6956	8968	43.58
SEm ±	0.77	0.03	39	41	0.15
CD (P=0.05)	2.28	0.08	114	120	NS
Varieties x N-levels					
SEm ±	1.34	0.05	67	71	0.26
CD (P=0.05)	NS	0.14	198	207	0.77

application of 90 kg N ha^{-1} produced significantly lower yields. The magnitude of increase in grain yield with 180 kg N ha^{-1} was 10.2, 5.2 and 1.7 per cent over 90, 120 and 150 kg N ha^{-1}, respectively. Significant improvement in grain yield was due to marked improvement in yield attributes like grain weight per panicle, 1000 grain weight and growth parameters like dry matter production and number of leaves. The present results are in agreement with Dixit *et al.*(2005). Higher stover yield was due to its more plant height, number of green leaves and dry matter production. Dixit *et al*.(2005), Wani *et al*.(2004), Singh *et al.* (1996) and Rajput *et al*.(1983) also made similar observations. Combined effect of varieties and nitrogen levels significantly influenced grain and stover yields. Higher grain yield was produced by Kinnera at 180 kg N ha^{-1} which was on a par with Kinnera at 150 kg N ha^{-1}. On the other hand, lower grain yield was produced by variety C-43 at 90 kg N ha^{-1} which was on par with C-43 at 120 kg N ha^{-1}.

Harvest index

Significantly higher harvest index was recorded by Kinnera than C-43 and NTJ-4. Lower harvest index was recorded by C-43. Higher harvest index might be owing to its better source to sink supply than in other varieties. Similar results were recorded by Dixit *et al.,* (2005). Significant response was not observed for harvest index with increased levels of nitrogen. However, it was significantly influenced by combination of varieties and nitrogen levels.

Variety Kinnera at 150 kg N ha^{-1} produced significantly higher grain and stover yields compared to all other treatments. Therefore it is concluded that variety Kinnera at 150 kg N ha^{-1} can be cultivated for realizing higher yields.

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