

Original Research Article

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Growth and Yield of Foxtail Millet [*Setaria italica* (L.)] Varieties to Different Nitrogen Levels

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ABSTRACT

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A field trial was conducted to find out the suitable foxtail millet variety and optimum nitrogen level for coastal Andhra Pradesh on sandy clay soil of Agricultural College Farm, Bapatla, during *kharif*, 2018 with four varieties of foxtail millet in combination with four nitrogen levels. The results revealed that, among the varieties, Prasad and application of 60 kg N ha⁻¹ among the nitrogen levels, recorded the highest plant height, drymatter accumulation at all the growth stages, tillers m⁻², yield attributes and grain and stover yield.

Introduction

“Millets are named as ‘nutraceuticals’ as they provide dietary fibres, minerals, vitamins, proteins, antioxidants, and energy which benefit the health status of human”. These small millets aid and confront the people of arid and semi-arid regions in making sound and stable management under increasing evidence of low seasonal rainfall, increase in temperature and frequent occurrence of extreme weather conditions.

They are the poor man’s food particularly in the dry regions of the world and also supply a large amount of soft straw for the milch and draught animals. The present climatic

conditions and the added advantages of small millets necessitate the exploitation of the underutilized crops *viz.*, foxtail millet, finger millet, proso millet, barnyard millet and little millet. Foxtail millet contains a high amount of protein (11%) and fat (4%). The protein fractions are represented by albumins and globulins (13%), prolamins (39.4%), and glutelins (9.9%).

It is thus recommended as an ideal food for diabetics. It also contains significant amounts of potential antioxidants like phenols, phenolic acids, and carotenoids (Saleh *et al.*, 2013; Zhang and Liu, 2015). Millets are therefore, consumed as multi-grains to reap the collective health benefits of nutrients.

Foxtail millet (*Setaria italica*), known as Italian millet, is confined to lower Deccan plateau including highlands of Karnataka, Andhra Pradesh, Uttarakhand and Tamil Nadu accounting for 90% area in the country. According to the recent studies, newly developed varieties of foxtail millet are more responsive to nitrogenous fertilizers (AICSMIP, 2013). The maximum yield potential can be achieved by growing high yielding varieties with effective nitrogen management.

Materials and Methods

Experiment was carried out on sandy clay soils of Agricultural College Farm, Bapatla during *kharif*, 2018. The soil was neutral in soil reaction, very low in available nitrogen and medium in organic carbon and available phosphorus, very high in available potassium. The experiment was laid out in randomized block design with factorial concept. The treatments consisted of four varieties Prasad (V₁), Narasimharaya (V₂), SiA 3156 (V₃) and CO-2 (V₄) and four nitrogen levels *viz.*, 0 kg N ha⁻¹ (N₁), 20 kg ha⁻¹ (N₂), 40 kg ha⁻¹ (N₃) and 60 kg ha⁻¹ (N₄) replicated thrice.

The crop was sown at 30 cm and 10 cm inter and intra row distance on 06.09.2018, respectively and adopted all the standard package of practices. A total of 187.2 mm rainfall was received in 14 rainy days during the crop growth period. The entire dose of phosphorus@ 20 kg ha⁻¹ was applied uniformly to all plots as basal. The scheduled nitrogen was applied in two equal splits as per the treatments *viz.*, half as basal and remaining half as top dressing at 30DAS. The data on plant height, drymatter accumulation, tillers m⁻², yield attributes and yield were recorded as per standard procedures. The data was analyzed by following the analysis of variance (ANOVA) for randomized block design with factorial concept.

Results and Discussion

Plant height at different stages (cm)

At 30 DAS, plant height of different foxtail millet varieties *viz.*, Prasad (V₁), Narasimharaya (V₂), SiA 3156 (V₃) and CO-2 (V₄) could not reach the level of significance. Narasimharaya variety (V₂) resulted in significantly taller plants (118.2 cm) over SiA 3156 variety (V₃) which had the shortest plants (103.1 cm). However, the plant height of Narasimharaya (V₂) was statistically on par with the remaining two varieties *i.e.*, Prasad (V₁) and CO-2 (V₄) at 60 DAS. At harvest, significantly taller plants with equal plant height (126.3 cm) was found in both the varieties *i.e.*, Narasimharaya (V₂) and Prasad (V₁) over SiA 3156 variety (V₃) which produced the shortest plants. However, V₂ and V₁ varieties were on par with V₄ variety (Table 1). This variation in plant height of different foxtail millet varieties could be attributed to difference in genetic makeup of the varieties. The results reported are in conformity with the findings of Radha Kumari *et al.*, (2017), Shanthi *et al.*, (2017) and Mahajan *et al.*, (2017). Increase in nitrogen levels from 0 to 60 kg ha⁻¹ resulted in increased plant height. However, statistical significance was not found among the nitrogen levels tried at 30 DAS. The highest nitrogen level *i.e.*, 60 kg ha⁻¹ (N₄) resulted in production of maximum plant height (121.2 cm) which was significantly superior over 0 kg N ha⁻¹ (N₁) level, which produced the shortest plants (97.3 cm). However, plant height of N₄ was on par with N₃ and N₂ application at 60 DAS (Table 1). The least plant height (104.2 cm) was produced with 0 kg N ha⁻¹ (N₁) which was significantly inferior over 60 kg N ha⁻¹ (N₄) (129.8 cm). However, the plant height at N₄ was statistically on par with N₃ (127.9 cm) and N₂ (125.8 cm) at harvest. Increase in plant height with increase in nitrogen levels from 0 to 60 kg ha⁻¹ might

be due to boosting of cellular division, production of growth promoting hormones, meristematic activity combined with increase in length and size of cells and intercellular spaces producing longer plants. The results are in consonance with the findings of Ramyasri (2018), RadhaKumari *et al.*, (2017) and Shanthi *et al.*, (2017).

Number of tillers m⁻² at different stages

There was significant increase in number of tillers m⁻² produced with advancement of crop upto 60 DAS and then decrease in number of tillers m⁻² was noticed at harvest, which was due to senescence of the crop. Among the four varieties, number of tillers m⁻² of Prasad (V₁) (41.3) was significantly superior over the remaining varieties *viz.*, Narasimharaya (V₂), SiA 3156 (V₃) and CO-2 (V₄) at 30 DAS, the least (35.2) were produced by CO-2 variety (V₄). At 60 DAS and harvest, irrespective of the variety chosen, number of tillers m⁻² were statistically non-significant (Table 2). Prasad variety (V₁) was found to be the highest total tiller producer at all growth stages and this variation in tiller production might be attributed to difference in genetic potential of the varieties. These results were reported in similar way by Ramyasri (2018), RadhaKumari *et al.*, (2017) and Mahajan *et al.*, (2017).

Nitrogen levels had significant influence on number of tillers m⁻², with increase in nitrogen levels from 0 (N₁) to 60 kg (N₄) ha⁻¹. Application of higher dose of nitrogen *i.e.*, 60 kg ha⁻¹ (N₄) resulted in the maximum tillers m⁻² during the entire crop growth. At 30, 60 DAS and at harvest, N₄ treatment produced significantly more number of tillers m⁻² (46.1, 112.3 and 105.1, respectively) over the remaining nitrogen levels *viz.*, 40 kg ha⁻¹ (N₃), 20 kg ha⁻¹ (N₂) and 0 kg ha⁻¹ (N₁). Significantly, least number (29.0, 72.2 and 60.9 at 30, 60 DAS and at harvest,

respectively) were produced with no nitrogen application (N₁). Irrespective of growth stages, the produced number of tillers was the least with no nitrogen application (N₁) (Table 2). Nitrogen role in increased supply of auxins, synthesis of growth promoting hormones like cytokinin enhanced the production and activation of tiller buds of all the shoot nodes might be the reason for production of significantly more number of tillers m⁻² with the maximum nitrogen application of 60 kg N ha⁻¹ (N₄). These findings are in consonance with Ramyasri (2018) and Raundal and Patil (2017).

Drymatter accumulation at different stages (kg ha⁻¹)

As the initial plant growth was very slow, variation in drymatter accumulation of four foxtail millet varieties was non-significant at 30 DAS. Irrespective of the foxtail millet varieties and nitrogen levels, there was steep increase in drymatter accumulation from 30 DAS to 60 DAS. Drymatter accumulation of Prasad (2427 kg ha⁻¹) was significantly superior over CO-2 (1705 kg ha⁻¹), which accumulated the lowest drymatter. However, the drymatter accumulation of Prasad was on par with Narasimharaya (2418 kg ha⁻¹) and SiA 3156 (2046 kg ha⁻¹) at 60 DAS. At harvest, maximum drymatter accumulation (4024 kg ha⁻¹) was noticed in Prasad (V₁) which was significantly superior to Narasimharaya (V₂), SiA 3156 (V₃) and CO-2 (V₄), which accumulated the lowest drymatter (2829 kg ha⁻¹). However, the drymatter accumulation of Narasimharaya was on par with SiA 3156 (Table 3). Maximum drymatter accumulation in Prasad variety (V₁) might be attributed due to production of more number of tillers and genetic character for higher photosynthetic capacity. The results were in conformity with the findings of Raundal and Patil (2017) and Jyothiet *et al.*, (2016).

Table.1 Plant height (cm) of foxtail millet varieties as influenced by varieties and nitrogen levels

Treatments	30 DAS	60 DAS	At harvest
Varieties			
V ₁ – Prasad	53.8	117.3	126.3
V ₂ – Narasimharaya	57.4	118.2	126.3
V ₃ - SiA 3156	55.1	103.1	111.8
V ₄ - CO – 2	53.6	114.0	123.4
SEm±	1.94	2.56	3.77
CD (P=0.05)	NS	7.4	10.8
Nitrogen levels (kg ha⁻¹)			
N ₁ - 0	52.2	97.3	104.2
N ₂ - 20	55.1	116.4	125.8
N ₃ – 40	56.1	117.8	127.9
N ₄ – 60	56.5	121.2	129.8
SEm±	1.94	2.56	3.77
CD (P=0.05)	NS	7.4	10.8
Interaction (V × N)			
SEm±	3.87	5.12	7.54
CD (P=0.05)	NS	NS	NS
CV%	12.2	7.8	10.7

Table.2 Number of tillers m⁻² and effective tillers m⁻² of foxtail millet varieties as influenced by nitrogen levels

Treatments	Number of tillers m ⁻²			Number of effective tillers m ⁻²
	30 DAS	60 DAS	At Harvest	
Varieties				
V ₁ – Prasad	41.3	97.4	87.7	43.5
V ₂ – Narasimharaya	37.6	92.8	84.2	39.0
V ₃ - SiA 3156	36.2	91.1	83.3	35.6
V ₄ - CO – 2	35.2	89.7	82.1	33.5
SEm±	0.70	2.55	1.09	0.81
CD (P=0.05)	2.0	NS	NS	2.3
Nitrogen levels (kg ha⁻¹)				
N ₁ - 0	29.0	72.2	60.9	24.5
N ₂ - 20	33.9	85.4	75.6	37.1
N ₃ – 40	41.4	101.1	95.8	43.5
N ₄ – 60	46.1	112.3	105.1	46.0
SEm±	0.70	2.55	1.09	0.81
CD (P=0.05)	2.0	7.3	3.1	2.3
Interaction (V × N)				
SEm±	1.39	5.09	2.18	1.62
CD (P=0.05)	NS	NS	NS	NS
CV%	10.8	9.5	7.4	7.5

Table.3 Drymatter accumulation (kg ha⁻¹) of foxtail millet varieties as influenced by nitrogen levels

Treatments	30 DAS	60 DAS	At harvest
Varieties			
V ₁ – Prasad	694	2427	4024
V ₂ – Narasimharaya	662	2418	3613
V ₃ - SiA 3156	670	2046	3451
V ₄ - CO – 2	644	1705	2829
SEm±	12.2	135.5	138.8
CD (P=0.05)	NS	391	401
Nitrogen levels (kg ha⁻¹)			
N ₁ - 0	653	1539	2364
N ₂ - 20	661	2266	3480
N ₃ – 40	672	2367	3950
N ₄ – 60	685	2424	4122
SEm±	12.2	135.5	138.8
CD (P=0.05)	NS	391	401
Interaction (V × N)			
SEm±	24.3	270.9	277.7
CD (P=0.05)	NS	NS	NS
CV%	16.3	18.5	13.8

Table.4 1000 grain weight (g), grain and stover yield (kg ha⁻¹) of foxtail millet varieties as influenced by nitrogen levels

Treatments	1000 grain weight (g)	Grain yield (kg ha ⁻¹)	Stover yield (kg ha ⁻¹)
Varieties			
V ₁ – Prasad	3.65	1609	2405
V ₂ – Narasimharaya	3.11	1402	2201
V ₃ - SiA 3156	3.55	1366	2075
V ₄ - CO – 2	2.98	860	1959
SEm±	0.161	69.5	93.5
CD (P=0.05)	0.46	200	270
Nitrogen levels (kg ha⁻¹)			
N ₁ - 0	3.02	741	1612
N ₂ - 20	3.34	1336	2134
N ₃ – 40	3.39	1514	2426
N ₄ – 60	3.55	1645	2467
SEm±	0.161	69.5	93.5
CD (P=0.05)	NS	200	270
Interaction (V × N)			
SEm±	0.322	138.9	187.0
CD (P=0.05)	NS	NS	NS
CV%	16.7	18.4	15.0

Increase in drymatter accumulation with increase in nitrogen levels from 0 to 60 kg ha⁻¹ was observed but at 30 DAS drymatter accumulation could not reach the level of significance. Nitrogen level@ 60 kg ha⁻¹ resulted in accumulation of maximum drymatter (2424 kg ha⁻¹) which was significantly superior over 0 kg N ha⁻¹ level (1539 kg ha⁻¹). However, minimum drymatter accumulation at 60 DAS was with 0 kg N ha⁻¹. Drymatter accumulation of N₄ treatment was on par with N₃ (2367 kg ha⁻¹) and N₂ (2266 kg ha⁻¹). At harvest, the highest nitrogen level *i.e.*, 60 kg ha⁻¹ resulted in maximum drymatter accumulation (4122 kg ha⁻¹) which was significantly superior over 20 kg N ha⁻¹ and 0 kg N ha⁻¹ levels, which resulted in minimum drymatter accumulation (2364 kg ha⁻¹) (Table 3). However, drymatter accumulation of N₄ treatment was on par with N₃. Drymatter accumulation with 60 kg N ha⁻¹ was higher by 4.4%, 18.4% and 74.4% over 40 kg N ha⁻¹, 20 kg N ha⁻¹ and no nitrogen application, respectively. Increase in drymatter accumulation with increase in nitrogen levels from 0 to 60 kg ha⁻¹ might be due to production of more number of nitrogenous compounds like amino acids, proteins, protoplasm, photosynthates at higher N level. These results were in consonance with the findings of Nagarajan *et al.*, (2018) and Jyothi *et al.*, (2016).

Yield Attributes

Significantly higher number of effective tillers m⁻² (43.5) (Table 2) and 1000 grain weight (3.65 g) (Table 4) were recorded by Prasad, while the minimum (33.5 and 2.98 g, respectively) were registered with CO-2. Maximum number of effective tillers m⁻² (46.0) were produced with higher N@ 60 kg ha⁻¹ which was significantly superior over all the remaining N levels, while the minimum was noticed with no nitrogen application. Nitrogen levels could not reach the level of

significance with regard to 1000 grain weight (g).

Yield (kg ha⁻¹)

Among the varieties, Prasad variety (V₁) gave significantly higher grain yield (1609 kg ha⁻¹) and shown its statistical supremacy over the remaining three varieties. The lowest grain yield was recorded by CO-2 (860 kg ha⁻¹). Nitrogen@ 60 kg ha⁻¹ resulted in maximum grain yield (1645 kg ha⁻¹) and was significantly superior over 20 kg N ha⁻¹ and no nitrogen levels (741 kg ha⁻¹). However, it was on par with grain yield@ 40 kg N ha⁻¹ (Table 4).

With respect to stover yield, Prasad variety (2405 kg ha⁻¹) produced maximum and was significantly superior over SiA 3156 and CO-2 varieties, which recorded the lower stover yield (1959 kg ha⁻¹). However, stover yield of Prasad was on par with Narasimharaya. Among the nitrogen levels, the maximum stover yield was produced with 60 kg N ha⁻¹ application (2467 kg ha⁻¹) which was significantly superior over 20 kg N and 0 kg N ha⁻¹, which resulted in significantly lower stover yield (1612 kg ha⁻¹) (Table 4). However, stover yield obtained with N₄ treatment was statistically on par with N₃ treatment.

Significant superiority of Prasad variety for both grain and stover yields might be due to its genetic constitution of yield attributing morpho-physiological parameters and maximum drymatter content. Similar results were also expressed by Ramyasri *et al.*, (2018), Shanthiet *al.*, (2017) and Jyothi *et al.*, (2016).

There was no interaction effect between varieties and nitrogen levels for all parameters studied. It can be concluded that Prasad variety of foxtail millet performed well

resulting in highest drymatter accumulation, yield parameters and yield and among the nitrogen levels, 60 kg N ha⁻¹ resulted in higher yields. However, it was on par with 40 kg N ha⁻¹.

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