Journal of Pharmacognosy and Phytochemistry
Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2019; 8(4): 3115-3117
Received: 07-05-2019
Accepted: 09-06-2019

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Effect of integrated nutrient management on growth, yield and economics of foxtail millet

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Abstract
Field experiments were conducted at Obannavaripalem village, Nagauppalapadu Mandal, Prakasam district, Andhra Pradesh during *kharif* seasons of 2014 and 2015 to study the effect of different integrated nutrient management practices with special reference to N for *kharif* foxtail millet on yield and economics. The results revealed that on clay loamy soils of Krishna Agroclimatic zone of Andhra Pradesh, application of 125% RDN + FYM @ 5 t ha^{-1} recorded the highest foxtail millet Plant height at maturity, grain, stover yield and B:C ratio among the treatments.

Keywords: Foxtail millet, nitrogen management, FYM, yield, economics

Introduction
Foxtail millet is one of the oldest cultivated small millets both for food and fodder. It ranks second in the total world production of millets and it continues to have an important place in world agriculture providing food for millions of people in arid and semiarid regions. It is native to China and regarded as an elite drought–tolerant crop. Andhra Pradesh, Karnataka and Tamil Nadu are the major foxtail millet growing states in India contributing about 79 per cent of the total area (Munirathnam *et al*, 2006) [3].

The yield potential of foxtail millet is low in India compared to the potentially achievable yield because of inadequate application of fertilizers, conventional cultivation of low yielding cultivars and lack of good management practices. Maximum yield potential can be achieved by using higher rates of fertilizer application. The crop is tolerant to drought and mostly grown under marginal soils and waste lands having very low levels of nutrients and organic matter and poor water holding capacity. Although the crop is grown since time immemorial in India and especially in Andhra Pradesh, not much attention was paid to improve the productivity.

Material and Methods
The trial was conducted during *kharif* 2014 and 2015 on clay loam soils at Obennapalem village, Nagauppalapadu Mandal, Prakasam district, Andhra Pradesh. The treatments included five levels of fertilizer *viz.*, Control (T_1), 100% RDN (T_2), 100% RDN + FYM @ 5t ha^{-1} (T_3), 125% RDN (T_4) and 125% RDN + FYM @ 5t ha^{-1} laid out in Randomized Block Design and replicated four times. The foxtail millet variety sreelakshmi was sown in the line opened at 22.5 cm apart. The recommended dose of P_2O_5 @ 20 kg ha^{-1} was applied to all the treatments uniformly. Nitrogen and FYM were applied at the time of sowing. The plant height, drymatter accumulation were recorded at deferent growth stages. The grain and stover yield were recorded at maturity.

Results and Discussion
Growth parameters
An adequate supply of nutrient is necessary for metabolic activity as it finally affects the vegetative as well as reproductive phases. Plant growth greatly depends on drymatter accumulation during growth period with increase in the levels of fertilizers. Plant height at maturity was significantly influenced by nitrogen levels. Among the nitrogen levels, nitrogen applied at 125% RDN + FYM @ 5.0 t ha^{-1} recorded significantly the highest plant height (257 and 238 cm) over 100% RDN (88.9 and 89.4 cm) and was on a par with 125% RDN (90.8 and 93.4 cm) and 100% RDN + FYM @ 5.0 t ha^{-1}. However, applying 100% RDN + FYM @ 5.0 t ha^{-1} was on par with 100% RDN. At all the stages of observation, plant height was found to increase with increased levels of nitrogen and the tallest plants were produced with the application of 125% RDN + FYM @ 5.0 t ha^{-1}, while the plants exhibited the shortest stature with no nitrogen application (Table No 1). It could be attributed to the fact that higher nitrogen levels might have accelerated the synthesis of more chlorophyll and amino acids and

stimulated the cellular activity, which is useful for the process of cell division and meristematic growth Similar results of taller plants at higher nitrogen levels and shorter plants at lower nitrogen was also reported by Intodia (1994) [8], and Saini and Negi (1996) [9]. Kalaghatagi (2000) [4].

At maturity, drymatter production of foxtail millet was found to be significantly higher with the application of the highest nitrogen level of 125% RDN + FYM @ 5.0 t ha^{-1} tried which was followed by 125% RDN. The lowest dry matter production was obtained with no nitrogen application. At all the stages of observation, increasing the nitrogen levels from control to 125% RDN + FYM @ 5.0 t ha^{-1} had resulted in increased drymatter accumulation. This might be due to increased plant height and higher number of tillers m^{-2} which in turn resulting in more photosynthates which accumulated higher quantity of dry matter with levels of nitrogen, as evidenced in this investigation corroborates the findings of Naik *et al*. (1995) [7]. Basavarajappa *et al.* (2002) [1, 5], and Hasan *et al*. (2013) [6].

Grain and biological yield

There was a significant increased in seed yield with increasing N levels. Application of 125% RDN + FYM @ 5.0 t ha^{-1} recorded the highest grain yield of 2701 and 2709 kg ha^{-1} during the first and second years of study respectively, which was significantly superior to the other nitrogen levels tried, followed by 125% RDN. The lowest grain yield was observed with no nitrogen application. Applying 100% RDN gave 1666 and 1719 kg ha^{-1} grain yield during first and second years of the study, respectively and was found significantly the lowest. Application of 125% RDN + FYM @ 5.0 t ha^{-1} increased the seed yield by 38.3 and 36.5 per cent over no nitrogen application in 2014 and 2015 respectively. The improvement in seed yield with enhanced nitrogen application might be attributed to better availability and uptake of nutrients which in turn might have lead to efficient metabolism. Higher levels of biomass accumulation and efficient translocation of photosynthates from source to sink might be responsible for the increased seed yields. The above results are in conformity with the findings of several researchers such as Kalaghatagi *et al.* (2000) [4]. Basavarajappa *et al.* (2002) [1, 5].

Among the nitrogen levels, application of 125% RDN + FYM @ 5.0 t ha^{-1} recorded the highest stover yield (4805 and 4825 kg ha^{-1} during first and second years of study) which was statically on par with application of 125% RDN and was significantly higher than no nitrogen application. Significantly lowest straw yield of foxtail millet (2881 and 3188 kg ha^{-1} during the first and second years of the experimentation, respectively) was obtained with no nitrogen application.

Economics

The highest net returns were registered with application of 125% RDN. The next best treatment was application of 125% RDN + FYM @ 5t ha^{-1}. The lowest net returns were recorded with no nitrogen application. The higher net returns might be due to higher grain and straw yields registered under higher nitrogen levels. Present investigation confirms the results reported by Divya and Maurya (2013) [2].

The net returns and B: C ratio (Table 3) revealed that the highest net monetary returns and benefit: cost ratio were recorded with the treatment where recommended dose of 125% RDN applied through chemical fertilizers than rest of the treatments. This could be due to the manifestation of higher grain and stover yields fetching of higher net returns at increased level of nitrogen. The similar results are reported by Divya and Maurya (2013) [2].

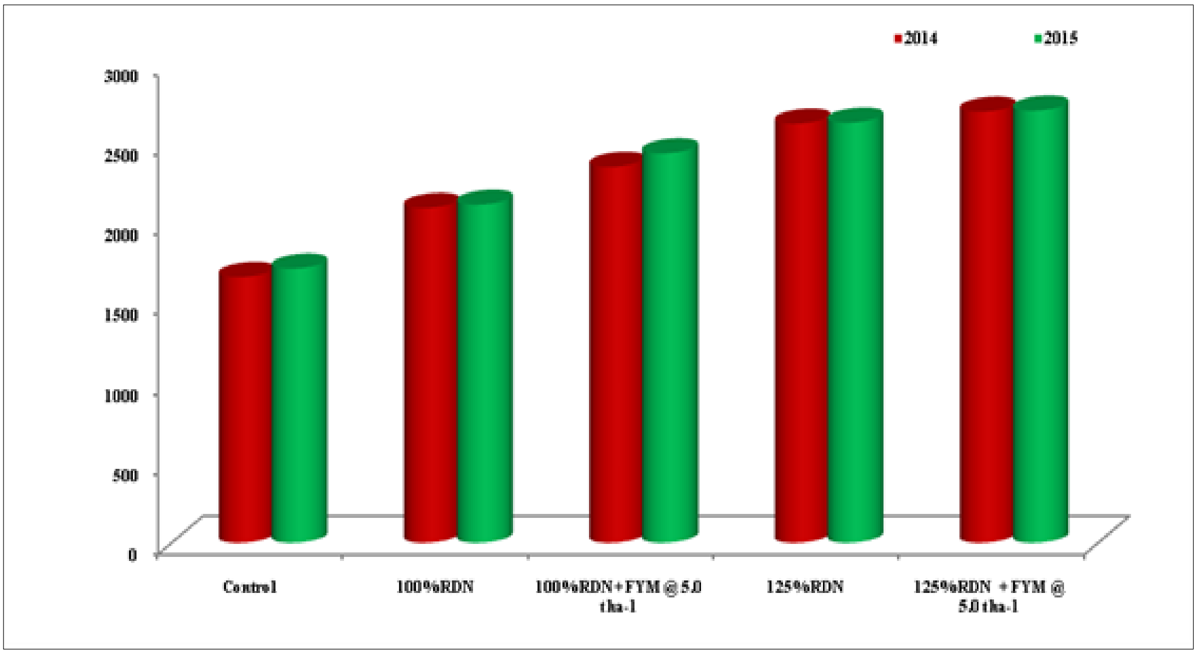

Fig 1: Yield (kg ha^{-1}) of foxtail millet as influenced by integrated nutrient management practices during *kharif* 2014 and 2015

Table 1: Plant height and drymatter accumulation of foxtail millet at maturity stage as influenced by different integrated nutrient management practices during 2014 and 2015 *kharif*

Treatments	2014		2015	
	Plant height (cm)	Drymatter accumulation (kg ha^{-1})	Plant height (cm)	Drymatter accumulation (kg ha^{-1})
Control	59.6	2538	61.4	2563
100% RDN	88.9	3690	89.4	3813
100% RDN + FYM @ 5.0 t ha^{-1}	89.7	3913	91.5	4058
125% RDN	90.8	4682	93.4	4695
125% RDN + FYM @ 5.0 t ha^{-1}	92.1	4840	94.7	4935
SEm(±)	1.4	56.9	0.9	81.8
CD (p=0.05)	4.3	171	2.8	246.7
CV (%)	3.4	4.6	2.2	3.5

Table 2: Grain yield and stover yield of foxtail millet as influenced by different integrated nutrient management practices during 2014 and 2015 *kharif*

Treatments	2014		2015	
	Grain yield (kg ha^{-1})	Stover yield (kg ha^{-1})	Grain yield (kg ha^{-1})	Stover yield (kg ha^{-1})
Control	1666	2881	1719	3187
100% RDN	2099	4167	2120	4262
100% RDN + FYM @ 5.0 t ha^{-1}	2356	4630	2441	4655
125% RDN	2627	4600	2633	4812
125% RDN + FYM @ 5.0 t ha^{-1}	2701	4805	2708	4825
Sem(±)	40.9	111.5	46.3	67.6
CD (p=0.05)	123	157.7	139	203
CV (%)	3.8	4.9	3.9	5.1

Table 3: Gross returns (Rs ha^{-1}), Net returns returns (Rs ha^{-1}) and BC ratio of foxtail millet as influenced by different integrated nutrient management practices during 2014 and 2015 *kharif*

Treatments	2014			2015		
	Gross returns	Net returns	BC ratio	Gross returns	Net returns	BC ratio
Control	41650	22950	1.23	42975	24275	1.30
100% RDN	52475	33250	1.73	53000	33775	1.76
100% RDN + FYM @ 5.0 t ha^{-1}	58900	34675	1.43	61000	36775	1.52
125% RDN	65675	46250	2.38	65750	46325	2.38
125% RDN + FYM @ 5.0 t ha^{-1}	67500	43150	1.77	69500	45150	1.85

Conclusion

Application of 125%RDN along with FYM @ 5 t ha^{-1} recorded the highest foxtail millet Plant height at maturity, grain, stover yield and B:C ratio

Acknowledgement

The authors are grateful to Acharya N.G Ranga Agricultural University (ANGRAU), Andhra Pradesh for providing the facilities for smooth conduct of the experiment.

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