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Effect of different levels of fertilizers on growth and yield of little millet (*Panicum sumatrense* Roth ex Roem and Schult)

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ABSTRACT

A field experiment was conducted during 2016 in the agronomy field of College of Agriculture, University of Agricultural and Horticultural Sciences, Shivamogga, Karnataka. The experiment was laid out in a randomized complete block design with twelve treatments having three replications. The treatments comprised combinations of three levels of nitrogen (10, 20 and 30 kg N/ha), two levels of phosphorus (10 and 20 kg P/ha) and two levels of potassium (0 and 10 kg K/ha). Among the different combinations of NPK fertilizers tested application of 30 kg N and 20 kg P_2O_5 with or without 10 kg K_2O performed better for achieving growth and yield components compared to lower levels of fertilizer application. The application of 30:20:10 kg NPK/ha achieved taller plants (71.27 cm), more number of leaves (40.87/plant), more tillers (10.87/plant), higher leaf area (619.44 cm^2/plant) and total dry matter accumulation (24.25 g/plant). Similarly better yield parameters like number of productive tillers/plant (9.40), panicle length (13.43 cm), number of grains/panicle (592) and test weight (3.39 g) were also achieved in the same set of treatment. Application of 30:20:10 kg NPK/ha achieved highest grain (1580 kg/ha) and straw (1603 kg/ha) yields apart from higher profit (Rs 8657) and was found economically feasible over recommended nutrient level of 20:20 kg NP/ha and remained best among the tested treatments.

Keywords: Fertilizer; growth; little millet; yield parameters

INTRODUCTION

In the quest of health concerns nutri-cereals are being given lot of importance. Little millet (*Panicum sumatrense* Roth ex Roem and Schult) is one among the nutri-cereals gaining lot of importance. The crop is rich in nutritive values with respect to carbohydrates, proteins and minerals. It contains 7.7 g of proteins, 67.0 g of carbohydrates, 4.7 g of fats, 12.2 g of dietary fibres, 1.5 g of mineral matter, 17.0 mg of calcium, 220.0 mg of phosphorus and 6.0 mg of iron apart from high antioxidants and is good food for diabetic patients. In India small millets cover an area of 818.5 thousand hectares with production of 729.6 thousand tonnes (Anon 2012a). The potentiality of little millet has not been exploited in India under ideal conditions of normal rainfall situations.

In Karnataka small millets occupy 26 thousand hectares with the production of 12.3 thousand tonnes (Anon 2012b). Little millet occupies a marginal area but is a truthful crop under situations of very late onset of monsoon or prevalence of intermittent drought. Its cultivation is majorly seen in dry belts of Chitradurga, Shivamogga, Haveri and Davanagere districts of the state. It is considered as a coarse grain and is used as food in situations where other food grains generally cannot be raised. The crop is considered as a low status food or food of marginalized communities. Intensification of production and increasing yield on limited arable land are important in securing an adequate food supply apart from extending the area under rainfed situation with suitable package of practices. In fact the crop is trained under low rainfall and unfertile lands in late sown situations. Agronomic practices for this crop need standardization for different ecosystems or locations to exploit its yield maxima. Nutrient management is a key issue in achieving higher biomass of any crop plant and also maintaining soil fertility. Hence in the present study different levels of nitrogen,

phosphorus and potassium were evaluated under transitional tract conditions for achieving better yields.

MATERIAL and METHODS

The study was conducted during kharif season of 2016 at College of Agriculture, Shivamogga, Karnataka (14º0'N to 14º1'N latitude and 75º40'E to 75º42'E longitude) situated in southern transition zone of Karnataka. The soil of the experimental site was sandy loam with shallow depth and acidic in reaction (pH 5.93); contained very low salt (0.29 dS/m) and medium organic content (0.42%); was poor in available nitrogen (152.80 kg/ha), rich in available phosphorus (58.45 kg/ha) and medium in available potassium (232.65 kg/ha). The test variety used was Hiriyur Local. The crop was sown during 2nd fortnight of July spaced at 30 x 10 cm. The experiment was laid out in randomized block design with three replications. Three levels of nitrogen (10, 20 and 30 kg/ha), two levels of phosphorus (10 and 20 kg/ha) and two levels of potassium (0 and 10 kg/ha) formed 12 different treatment combinations of NPK viz 10:10:0, 10:10:10, 10:20:0, 10:20:10, 20:10:0, 20:10:10, 20:20:0 (recommended dose of nutrients), 20:20:10, 30:10:0, 30:10:10, 30:20:0, 30:20:10. Nitrogen (N), phosphorus (P) and potassium (K) were applied in the form of urea, single super phosphate and muriate of potash respectively. A common dose of farmyard manure @ 10 tonnes/ha and lime @ 200 kg/ha was applied uniformly to all plots. Fertilizers were applied as basal at the time of sowing. Apart from the treatments the crop was managed according to package of practices. Along with growth and yield components computed ancillary parameters and additional cost of returns were worked out and statistically analysed.

RESULTS and DISCUSSION

Different levels of NPK fertilizers tested in the study influenced the different growth parameters (Table 1). Compared to lower level applications of 20 kg of N and 20 kg of P_2O_5 per hectare (recommended dose) and above levels performed better for growth parameters and were found statistically at par. The application of highest level of fertilizer (30 kg of N, 20 kg of P_2O_5 and 10 kg of K_2O per hectare) resulted in obtaining better growth parameters such as plant height (71.27 cm), number of leaves (40.87/plant), number of tillers (10.87/plant), leaf area at 90 days after sowing (619.44/cm^2/plant) and total dry matter accumulation (24.25 g/plant). The finding is supported by the fact that higher applications of fertilizers had a positive consequence on growth pattern with betterment of physiological process such as cell division, cell elongation along with timely metabolic processes (Kushwah et al 2014). It is also true that the rainfall pattern in transitional tract which is assured in distribution also supports the channelization of nutrients for plants at right times. The results are in accordance with Bhomte et al (2016). Nitrogen is an essential constituent of protein and chlorophyll pigment encourages leaf production and retention of greenery for a longer period. Its response in poor status of soils is well expected.

Table 1. Effect of different levels of fertilizers on growth parameters of little millet at harvest

Treatment (kg NPK/ha)	Plant height (cm)	Number of leaves/plant	Number of tillers/plant	Leaf area at 90 DAS (cm^2/plant)	Total dry matter accumulation (g/plant)
10:10: 0	66.52	30.73	9.27	523.64	16.76
10:10:10	67.23	31.73	9.40	533.39	17.83
10:20:00	67.65	32.67	9.60	562.34	18.21
10:20:10	68.34	33.07	9.67	571.90	19.14
20:10:00	68.53	34.73	9.93	575.69	19.45
20:10:10	68.82	35.80	10.00	578.35	19.81
20:20:00	69.07	36.93	10.13	581.38	20.65
20:20:10	69.33	37.47	10.20	584.06	21.10
30:10 : 00	70.31	38.60	10.27	587.83	22.49
30:10:10	70.61	38.93	10.33	595.62	23.18
30:20:00	71.02	39.73	10.67	608.94	23.75
30:20:10	71.27	40.87	10.87	619.44	24.25
SEm±	0.96	1.97	0.28	17.36	0.64
$CD_{0.05}$	2.81	5.78	0.83	50.93	1.87

DAS= Days after sowing

Although soils were rich in phosphorus status the applied levels supported initial root growth and better establishment due to its readily available status. Depending on the crop need the response of potash varied in these medium status soils.

Based on leaf area and dry matter accumulation at various stages various growth ancillary functions were computed (Table 2) such as leaf area index (LAI), leaf area duration (LAD) and crop growth rate (CGR). All these growth functions more or less followed the trend wherein at peak period (75 to 90 days) of growth values remained higher with positive response for applied fertilizers. The LAI value varied from 1.380 to 1.577 at 75 days while at 90 days peak values were found varying from 1.746 to 2.065. The leaf functional activity LAD with 23-28 days was found maximum at 75-90 days. These activities paved way for peak rate of dry matter accumulation. The accumulation of dry matter steadily increased from initial stage of growth and reached maxima around 45-60 days (9.664-9.986 g/m^2/day) with slow decline (6.0-9.0 g/m^2/day) further.

Table 2. Leaf area index (LAI), leaf area duration (LAD) and crop growth rate (CGR) at different stages of the crop as influenced by different levels of fertilizers

Treatment (kg NPK/ha)	Computed parameter						
	LAI		LAD (days)		CGR (g/m^2/day)		
	75 DAS	90 DAS	60-75 DAS	75-90 DAS	45-60 DAS	60-75 DAS	75-90 DAS
10:10: 0	1.380	1.746	18.76	23.44	9.986	8.227	6.881
10:10:10	1.409	1.778	19.08	23.90	9.753	8.165	7.017
10:20:00	1.439	1.875	19.39	24.85	9.817	8.408	6.829
10:20:10	1.457	1.906	19.61	25.23	9.811	8.518	7.029
20:10:00	1.462	1.919	19.75	25.36	9.818	8.352	7.393
20:10:10	1.488	1.928	20.04	25.62	9.924	8.389	7.633
20:20:00	1.507	1.938	20.24	25.84	9.866	8.469	7.823
20:20:10	1.517	1.947	20.54	25.98	9.664	8.571	7.823
30:10 : 00	1.532	1.959	20.76	26.19	9.818	8.370	8.189
30:10:10	1.541	1.985	21.09	26.45	9.820	8.855	8.112
30:20:00	1.556	2.030	21.42	26.89	9.805	8.813	8.128
30:20:10	1.577	2.065	21.78	27.31	9.826	8.719	8.333
SEm±	0.038	0.058	0.57	0.57	0.559	0.845	0.971
$CD_{0.05}$	0.112	0.170	1.68	1.66	NS	NS	NS

DAS= Days after sowing

These trends are in line with the findings of Raghavendra Goud (2012).

This trend setting response on growth pattern was reflected on achieving differences in yield components also (Table 3). Application of lower levels of NPK fertilizers viz 10:10:00 or 10:10:10 kg NPK/ha recorded lower growth performance and continued to get lower yield parameters. These treatments recorded lowest number of productive tillers/plant (8.00 to 8.10), panicle length (11.07 to 11.25 cm), number of grains/panicle (310 to 329) and test weight (2.64 to 2.85 g). As a result these treatments ended up with lowest grain yield of 980 and 1060 kg/ha. Progressive increase in levels of NPK application helped to enhance both yield parameters as well as yield levels. Recommended dose of fertilizer with 20:20:00 kg NPK/ha application resulted in moderate yield components (8.8 productive tillers/plant, 12.21 cm of panicle length, 438 grains/panicle and test weight of 3.14 g) and yield (1390 kg/ha). However further increase in the NPK levels achieved increased yield components at a slow phase. The highest dose of NPK (30:20:10 kg/ha) performed better in achieving higher number of tillers (9.40), panicle length (13.43 cm), number of grains/panicle (592) and test weight (3.39 g) by virtue of its better growth components. These variations are reasoned for prolonged supplying ability of nutrients in these red soil conditions at the said quantity which also coincided with need of the crop. These results are in conformity with Anil Kumar (2000). On the similar lines the chosen treatment also resulted to obtain higher grain and straw yields of 1580 and 1603 kg/ha respectively mainly due to even supply of nutrients coinciding with higher growth resulting in better yield components than rest of the

Table 3. Effect of different levels of fertilizers on yield parameters and yield of little millet

Treatment (kg NPK/ha)	Number of productive tillers/plant	Panicle length (cm)	Number of grains/panicle	Test weight (g)	Grain yield (kg/ha)	Straw yield (kg/ha)	Harvest index
10:10: 0	8.00	11.07	310	2.64	980	1077	0.48
10:10:10	8.10	11.25	329	2.85	1060	1141	0.48
10:20:00	8.20	11.47	352	2.92	1140	1192	0.49
10:20:10	8.40	11.67	368	3.05	1250	1282	0.49
20:10:00	8.50	11.87	391	3.10	1360	1397	0.49
20:10:10	8.70	12.14	415	3.13	1290	1333	0.49
20:20:00	8.80	12.21	438	3.14	1390	1423	0.49
20:20:10	8.90	12.45	457	3.17	1440	1474	0.49
30:10:00	9.00	12.53	484	3.22	1470	1526	0.49
30:10:10	9.10	12.73	516	3.24	1500	1538	0.49
30:20:00	9.20	12.85	558	3.31	1520	1564	0.49
30:20:10	9.40	13.43	592	3.39	1580	1603	0.50
SEm±	0.27	0.42	20.32	0.17	53	104	0.02
$CD_{0.05}$	0.79	1.24	59.61	NS	155	304	NS

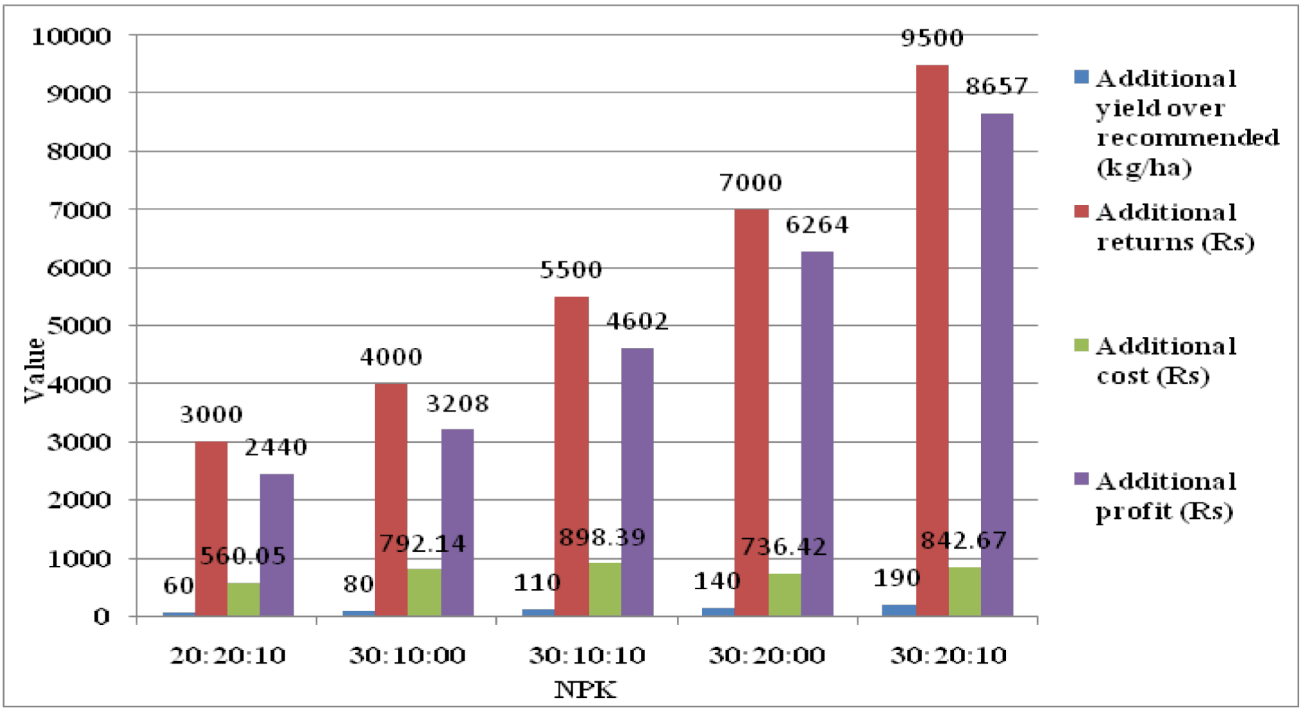

Fig 1. Effect of higher fertilizer levels on yield, returns, cost and profit over recommended fertilizer levels

treatments under test. These findings are in line with the reports of Nigade et al (2011) and Shivakumar (1999).

The treatments NPK 20:20:10 to 30:20:00 remained non-significant with respect to yield. Hence analysis was undertaken for calculating additional profit and benefit-cost ratio by taking recommended fertilizers as base and are presented in Fig 1. Data envisage that the response of additional yield to the tune of 60, 80, 110, 140 and 190 kg/ha was obtained for application of 20:20:10, 30:10:00, 30:10:10, 30:20:00 and 30:20:10 kg NPK/ha respectively compared to recommended fertilizer dose of 20:20:00

kg NPK/ha. These variations led to additional returns for investment of higher levels of fertilizers which is also calculated as additional cost. Accordingly application of 30:20:10 kg NPK/ha recorded higher profit (Rs 8657) with highest benefit-cost ratio.

On the basis of present investigations it is concluded that nitrogen @ 30 kg/ha, phosphorus @ 20 kg/ha and potassium @ 10 kg/ha recorded highest grain yield and can be practiced in transitional tract of Karnataka.

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