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Assessment of Nutrient Requirement in Little Millet under Central Dry Zone of Karnataka

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Authors' contributions

This work was carried out in collaboration among all authors. Author BM designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Author ND managed the analyses of the study. Author KVA managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

A field experiment was conducted in Patrehalli, Tiptur taluk, Tumkur district of Karnataka where soil was deficient in available potassium, to study assessment of nutrient requirement in little millet under central dry zone of Karnataka. The experiment was laid out in RCBD design comprising 3 treatments replicated seven times. Treatment details are, T_1: Control, T_2: FYM +NPK (20:20:0 kg ha^{-1}) - UAS Bengaluru, T_3: FYM+ 30:15:15 kg ha^{-1} - UAS Dharwad. The results revealed that significantly higher grain and straw yield (2.14 q ha^{-1} and 15 q ha^{-1}) and also recorded highest nutrient available of nitrogen, phosphorus and potassium (197, 35 and 136 kg ha^{-1}) by little millet was recorded in treatment which received 30: 15: 15 kg N: P_2O_5: K_2O ha^{-1} along with FYM at 6.25 t ha^{-1} as compared to control. The results of the present study evidently concluded that the application of 30: 15: 15 kg N: P_2O_5: K_2O ha^{-1} along with FYM at 6.25 t ha^{-1} under rainfed condition is beneficial for getting higher yield of little millet as well as higher benefit cost ratio (15.00) as compared to the control in low potassium soils of Tumkur district of Karnataka.

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1. INTRODUCTION

The little millet (*Panicum sumatrens* L.) is one among the six small millets is known by many regional names *viz*, kutki, sumei, same, samulu, suan, savi, save and gundii in different parts of the country. This crop is being grown as main as well as mixed crop. This has short duration, having resistance to pest and diseases, can be grown in rainfed, shallow and less fertile soils. It can tolerate to dry weather and grow luxuriantly even in minimum moisture. The crop has been ecologically sound and environment friendly because of negligible use of pesticide in its production. Little millet is an excellent input for contingency crop planning as it is photo insensitivity, drought tolerance ability and quick growing habit. At early growth stage of crop it can be used as green fodder.

In India, millets are cultivated on an area of 5.89 lakh ha producing 3.85 lakh tonnes with a productivity of 654 kg per ha. In Karnataka little millet crop grown in 36,856 ha with a production of 30,841 tonnes with a productivity of 880 kg per ha (Anon., 2015a). Among the small millets, little millet has very good nutritive value containing protein (7.5 to 9.8%), carbohydrate (66.3%), fat (3.54%), crude fibre (7.73%), calcium (21.21 mg 100 g^{-1}) and iron (1.38 mg 100 g^{-1}) [1].

Phosphorus plays a vital role in virtually every plant process that involves energy transformation. Phosphorus is a component of the complex nucleic acid structure of plants, which regulates protein synthesis, important in cell division and development of new tissue and it is also associated with complex energy transformations in the plant. Adding phosphorus to soil, it promotes root growth and winter hardiness, Increases stalk and stem strength, stimulates tillering, and often hastens maturity. Its applications may increase early and more uniform growth even if phosphorus does not increase grain yield. Stimulates root development their by Increases nitrogen fixing capacity of legumes. It is also a central component of DNA and RNA and is necessary for building proteins and other compounds.

Potassium is an essential nutrient element for all living organisms including plants and animals and its importance in Indian agriculture has been increased with intensification of agriculture. It is a monovalent cation found in largest concentration in the cell sap and hence it called as a "Master Cation", is ionic (K^+) free and mobile in plants. Potassium is third most important plant nutrient, vital to many plants by the activation of 60 different enzymes involved in plant growth, important for osmoregulation, cation-anion balance, protein synthesis, water balance, reducing lodging, imparting disease resistance and improving quality and shelf life of crop produce will be increases. Soil test results for K fertility status among Indian agricultural soils are categorized accordingly, 21 per cent low, 51 per cent medium, and 28 percent high. Thus, 72 per cent of India's agricultural area, representing 266 districts, needs K fertilization.

Balanced and adequate fertilization is essential for increasing crop yields and ensuring sustainable agriculture. Little millet being low nutrient demanding crop, but responds well for addition of potassium. Depleted soil potassium status due to higher crop removal as equal as or higher than nitrogen, without application of potassium fertilizers and cultivation of improved varieties of little millet needs balancing of potassium through external fertilizers. The present investigation study was carried out in the farmer's field with the objective of "Assessment of nutrient requirement in little millet under central dry zone of Karnataka".

2. MATERIALS AND METHODS

In order to assessment of nutrient requirement in little millet under central dry zone (Patrehalli, Tiptur taluk, Tumkur district) of Karnataka, The experimental field was located is located in the eastern part of the state, between 12°45' and 14°20' North latitude and 76°20' to 77°31' East longitude from the mean sea level. The initial properties of the experimental soil are presented in the Table 1. Treatment details are, T_1: Control, T_2: FYM +NPK (20:20:0 kg/ha)- UAS Bengaluru, T_3: FYM+ 30:15:15 kg ha^{-1} UAS Dharwad. The soil was sandy loam in texture, acidic in reaction (7.65), electrical conductivity (0.23 ds m^{-1}), low organic carbon content (0.32%) and available N, P_2O_5 and K_2O contents of the soil were 246, 28 and 149 kg ha^{-1}, respectively. Exchangeable calcium and magnesium are 3.5 and 1.7 c mol [p^+] kg^{-1}, available sulphur (4.73 mg kg^{-1}). The soil was in DTPA extractable iron, manganese, copper, zinc and hot water boron (30.06, 13.14, 1.72, 1.28 and 0.47 mg kg^{-1} respectively).

Plate 1. Application of nutrients to the experimental plot and farmers field

Table 1. The initial properties of the experimental soil

Sl. no	Soil property	Value
1.	Particle size analysis	
	a. Sand (%)	77.20
	b. Silt (%)	6.60
	c. Clay (%)	15.10
	Texture	Sandy loam
2.	pH (1:2.5)	7.65
3.	Electrical conductivity (dS m^{-1})	0.23
4.	Organic carbon (%)	0.32
5.	Available nitrogen (kg ha^{-1})	246
6.	Available phosphorus (kg ha^{-1})	28
7.	Available potassium (kg ha^{-1})	149
8..	Exchangeable calcium (c mol [p^+] kg^{-1})	3.5
9.	Exchangeable magnesium (c mol [p^+] kg^{-1})	1.7
10.	Available sulphur (mg kg^{-1})	4.73
11.	Available iron (mg kg^{-1})	30.06
12.	Available manganese (mg kg^{-1})	13.14
13.	Available copper (mg kg^{-1})	1.72
14.	Available zinc (mg kg^{-1})	1.28
15.	Available boron (mg kg^{-1})	0.47

The experiment was laid out in the randomized complete block design with three treatments and seven replications. Test crop taken was little millet, variety OLM 203 and seed rate of 7 kg ha^{-1} with 30 cm inter row and 10 cm intra row spacing under protective irrigated condition for the crop duration of 110 -120 days. The treatments included T_1: absolute control, T_2: FYM +NPK (20:20:0 kg ha^{-1}) - UAS Bengaluru, T_3: FYM+ 30:15:15 kg ha^{-1} - UAS Dharwad. Application of 6.25 tonnes of farm yard manure (FYM) was common to all treatments except absolute control. Treatment wise recommended dose of N, P_2O_5 and K_2O were given in the form of urea, single super phosphate and muriate of potash, respectively as basal dose at the time of sowing and recommended dose of FYM was applied before 15 days of sowing of the crop. Gap filling was done after one week of sowing in places where seeds failed to germinate and where excess seeds were sown thinning was done 15 DAS to maintain intra row spacing (10 cm). Intercultivation was done using blade hoe at 35 DAS with bullock pair and one hand weeding was done manually at 45 DAS. The whole crop of little millet in the net plot was harvested separately from each treatment and was dried separately. Then ear heads of each plot were threshed by beating, winnowed and cleaned separately. The straw in each net plot was harvested separately and sun dried. The grain and straw weight were recorded. Chemical

Plate 2. General view of experimental plot at 60 DAS and at harvest

analysis of soil The post-harvest soil samples were collected from each treatment plot, dried, powdered and used for analysis of pH, EC, OC and available NPK as per the standard procedures.

3. RESULTS AND DISCUSSION

Effect of assessment of nutrient requirement in little millet under central dry zone of karnataka are presented and discussed here under.

The data on growth and yield parameters of little millet crop as influenced by different rates of application of nutrient were given in Table 2. The maximum plant height (83 cm), panicles/plant (9.00), tillers/plant (9.00), yield (15 q/ha) and BC ratio (2.14) were recorded in T_3 (6.25 t of FYM+ 30:15:15 kg ha^{-1}) followed by T_2 (6.25 t of FYM +NPK (20:20:0 kg/ha- UAS(B)) and lower growth and yield parameters were recorded in T_1(absolute control). It could be attributed to the fact that higher level of nitrogen with potassium 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, meristematic growth coupled with cell enlargement, resulting in higher plant height of the crop.

These findings are in confirmation with Jyothi et al. [2]. However, the lowest plant height (74 cm), panicles/plant (6.00), tillers/plant (6.00), yield (13 q ha^{-1}) and BC ratio (1.69) was recorded in T_1 (control) treatment.

The data on assessment of nutrient requirement in little millet on residual available major nutrient content after harvest of little millet as affected by different rates of application of nutrients were given in Table 3. Among different treatments significantly higher the available nitrogen (197 kg ha^{-1}) was recorded in T_3 (6.25 t of FYM+ 30:15:15 kg ha^{-1}) after harvest of the little millet.

Table 2. Growth and yield parameters of little millet crop as influenced by different rates of application of nutrients

Treatments	Plant height(cm)	Panicles/plant	Tillers/plant	Yield (Q/ha)	BC ratio
T_1	74	6.0	6.0	13.00	1.69
T_2	79	8.0	8.0	13.80	2.07
T_3	83	9.0	9.0	15.00	2.14
SEm	0.67	0.53	0.33	0.58	0.01
CD@5%	2.62	2.07	1.31	2.27	0.03

Table 3. Residual available major nutrient content after harvest of little millet as affected by different rates of application of nutrients

Treatments	Available nitrogen (kg ha^{-1})	Available phosphorus (kg ha^{-1})	Available potassium (kg ha^{-1})
T_1	161	22	110
T_2	192	34	128
T_3	197	35	136
SEm	0.82	0.67	0.71
CD@5%	3.21	2.62	2.78

The reason for relatively higher amounts of available nitrogen by these treatments could be ascribed to the increased organic matter content of the soil caused by the combined application of FYM and N fertilizers [3,4].

The highest available phosphorus (35 kg ha^{-1}) was recorded in T_3 (6.25 t of FYM+ 30:15:15 kg ha^{-1}) after harvest of the little millet, this was due to solubilization of soil P by organic acids produced during decomposition or mineralization of added FYM and also due to synergetic effect of N and K on availability of P in soils after harvest of little millet [5].

The available potassium were significantly highest (136 kg ha^{-1}) was recorded in T_3 (6.25 t of FYM+ 30:15:15 kg ha^{-1}) after harvest of the little millet. This was obviously due to addition of increased application of N and K to the soil at higher rates, which might have resulted in retention of unused portion of K in the soil itself, after harvest of the crop. The increase in the K content after harvest of little millet might be due to the direct contribution of potassium to the pool of available K in soil due to addition of FYM and high dose of potassium [6]. These results are in conformity with the findings of Ahmad and Tarence [7] and Abdel Rahman [8] who found that there was an increase in available K content in soil with increased levels of K applied after harvest of wheat crop. The lowest available nitrogen (161 kg ha^{-1}), phosphorus (22 kg ha^{-1}) and potassium (110 kg ha^{-1}) were recorded in T_1 (control) treatment.

4. CONCLUSION

Significantly higher plant height, panicles $plant^{-1}$, tillers $plant^{-1}$, yield and BC ratio was observed in T_3 due to application of 30 kg N +15 kg P_2O_5 + 15 kg K_2O ha^{-1} along with FYM at harvest stage of little millet. However, among the treatments, T_3 (30 kg N+ 15 kg P_2O_5+ 15 kg K_2O ha^{-1} along with FYM) recorded significantly higher available nitrogen, higher available phosphorus and available potassium was recorded in T_3 (30 kg N+ 15 kg P_2O_5+ 15 kg K_2O ha^{-1} along with FYM) compared to T_1 (control).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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