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Research Article

EFFECT OF ORGANIC AND INORGANIC SOURCES OF NUTRIENTS ON FINGER MILLET (*Eluesine coracana* L.) UNDER RAINFED CONDITION OF HIGH ALTITUDE AND TRIBAL (HAT) ZONE OF ANDHRA PRADESH, INDIA

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Abstract: Field experiment was carried out on red sandy loam soils at Agricultural Research Station, Seethampeta, Andhra Pradesh during the year 2019-20 to study the yield response of finger millet with combined application of organic manures and inorganic fertilizers. The experiment consisting of eight treatments, three replications with RBD design. The experimental results indicated that significantly higher grain and straw yields of finger millet were recorded in the treatment with T_5 (50% RDN + 50% N poultry manure) followed by T_2 (100% RDF). The highest available soil macronutrients and uptake of plant macronutrients was also found in the same treatments. In order to sustain the yield level in concurrence with soil health is one of the utmost important subjects in the current situation. In recent years emphasis on conjunctive use of organic and inorganic sources of nutrients has assumed greater dimension.

Keywords: *Finger millet, Nutrient management, Soil available nutrients, Plant Uptake*

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Introduction

Millets are important foods in many underdeveloped countries because of their ability to grow under adverse weather conditions like limited rainfall and high temperatures. Millets are more nutritious and they are non-glutinous and non-acid forming and easy to digest. The millets are the major source of energy and protein for millions of people in Africa. It has been reported that millet has many nutritious and medical functions [1]. Millets are unique among the cereals because of their richness in calcium, dietary fibre, polyphenols, and protein [2].

Finger millet (*Eleusine coracana* L.) is important millet grown extensively in various regions of India and Africa, constitutes as a staple food for a large segment of the population in these countries. It ranks sixth in production after wheat, rice, maize, sorghum and bajra in India. It is a naked caryopsis with brick red-coloured seed coat and is generally used in the form of the whole meal for preparation of traditional foods, such as roti (unleavened breads or pancake), mudde (dumpling) and ambali (thin porridge). Epidemiological studies have demonstrated that regular consumption of whole grain cereals and their products can protect against the risk of cardiovascular diseases, type II diabetes, gastrointestinal cancers, and a range of other disorders [3].

Material and Methods

A field experiment was conducted during 2019-20 under rainfed condition at Agricultural Research Station, Seethampeta, ANGRAU, Andhra Pradesh. The soil of the operational site was red sandy loam in texture, low in organic carbon, available nitrogen and medium in available phosphorus and high in available potassium. The experiment was laid down in randomised block design with eight treatments replicated thrice. The experiment consisted of eight treatments *viz*.,T_1: Control (0% RDF N, P, K), T_2: 100% RDF (N, P_2O_5, K_2O), T_3: 50% RDN + 50% N FYM, T_4: 50% RDN + 50% N vermicompost, T_5: 50% RDN + 50% N poultry manure, T_6: 75% RDN + *Azospirillum*, T_7: 75% RDN + PSB, T_8: 75% RDN + Azosphos. The recommended dose of nutrients (R.D.F.) was 60 kg N, 40 kg P and 30 kg K ha^{-1} which was applied in the form of urea, DAP and muriate of potash. Fertilizer nitrogen was applied as per treatments in two equal splits, half at transplanting and half at 30 days after transplanting. Phosphorus and potash were applied basally, at transplanting as per the treatments. Uniform cultural practices were carried out in all the experimental plots of 3 X 3 m^2 and healthy seeds were sown with a spacing of 30X10 cm^2 in all the plots. During this year of study, finger millet (VR-847) was sown during second fortnight of July and harvested in second fortnight of October.

Growth parameters *viz*., plant height, no. of productive tillers, leaf length, leaf width, ear head length, no. of fingers/ear, straw and grain yields were recorded at the time of harvest. The initial soil samples before sowing of the crop and post-harvest soil samples were analysed for pH, EC, OC, available N, P_2O_5, K_2O and available micronutrients *viz*., Zn, Fe, Cu and Mn as per the standard procedures. The plant samples of both the grain and straw samples were prepared and analysed for both macro and micronutrient uptake with standard procedures.

Results and Discussion

Yield and yield attributing parameters

The growth characters, yield attributes, soil and plant quality parameters were significantly influenced with different nutrient management practices. Higher total dry matter production was also noticed in T_5. This higher total dry matter production was attributed to better plant growth, which resulted in higher dry matter accumulation in leaves and stem at earlier growth stages and better translocation to ear head during later stages. The combined application of organic and inorganic manures significantly increased the growth parameters like plant height (91.3 cm), ear heads per plant (3.6), boot leaf length (37.3 cm), straw yield (68.9 q ha^{-1}) were found highest with T_5 (50% RDN + 50% N poultry manure).

Table-1 Effect on integrated nutrient management on yield and yield attributes (2019-20)

Treatments	Plant height (cm)	Ear heads/plant	Fingers per ear head	Boot leaf length (cm)	1000 Grain weight(gms)	Yield q/ha	Straw yield (q/ha)
T_1 – Control	67.6	1.9	7	29.3	2	17	43.2
T_2 – (RDF) N-P_2O_5-K_2O	85.9	2.8	8	33.3	3.6	22.6	66.5
T_3 – 50% RDN + 50% N FYM	84.2	2.9	7.3	34.3	3	21.1	62.3
T_4 – 50% RDN + 50% N vermicompost	83.8	3	7.3	36	2.8	21.9	65.6
T_5 – 50% RDN + 50% N poultry manure	91.3	3.6	7.7	37.3	3.3	22.9	68.9
T_6 – 75% RDN + *Azospirillum*	76.3	2.4	7.7	31.7	2.5	19.7	55.6
T_7 – 75% RDN + PSB	74.1	2.1	7.7	30.7	2.4	18.9	52.1
T_8 - 75% RDN + Azosphos	77.5	2.5	7.7	32.3	2.7	20.4	59
CD (0.05)	8.95	NS	NS	NS	NS	2.66	12.26
CV (%)	6.41	-	-	-	-	7.49	11.96

Table-2 Effect of integrated nutrient management on soil properties (2019-20)

Treatments	pH (1:2.5)	EC (dS/m)	OC (%)	BD (Mg/m³)	WHC (%)
T_1 – Control	7.88	0.18	0.37	1.41	52.4
T_2 – (RDF) N-P_2O_5-K_2O	8.02	0.21	0.52	1.38	53
T_3 – 50% RDN + 50% N FYM	7.95	0.21	0.49	1.37	53.1
T_4 – 50% RDN + 50% N vermicompost	7.96	0.16	0.51	1.35	54.4
T_5 – 50% RDN + 50% N poultry manure	7.85	0.12	0.54	1.35	56.3
T_6 – 75% RDN + *Azospirillum*	7.96	0.18	0.42	1.38	54.2
T_7 – 75% RDN + PSB	7.84	0.17	0.39	1.39	53.2
T_8 - 75% RDN + Azosphos	7.87	0.17	0.45	1.38	54.1
CD (0.05)	NS	NS	NS	NS	NS
CV (%)	-	-	-	-	-
Initial	7.73	0.31	0.46	1.37	52.3

Table-3 Effect of integrated nutrient management on available macro and micro nutrients (2019-20)

Treatments	N (kg/ha)	P_2O_5 (kg/ha)	K_2O (kg/ha)	Zn (ppm)	Fe (ppm)	Cu (ppm)	Mn (ppm)
T_1 – Control	153	34	220	0.43	4	1.3	2.01
T_2 – (RDF) N-P_2O_5-K_2O	290	57.6	357	0.54	3.6	1.34	2.22
T_3 – 50% RDN + 50% N FYM	198	43.3	296	0.54	5.7	1.45	2.19
T_4 – 50% RDN + 50% N vermicompost	240	46.7	340	0.56	7.2	1.5	2.75
T_5 – 50% RDN + 50% N poultry manure	255	51.9	364	0.65	7.4	1.64	2.99
T_6 – 75% RDN + Azospirillum	281	42.5	232	0.45	4.6	1.27	2.26
T_7 – 75% RDN + PSB	279	51.8	225	0.45	4.5	1.29	2.08
T_8 - 75% RDN + Azosphos	285	48.9	235	0.43	4.7	1.31	2.27
CD (0.05)	19.01	5.68	25.48	NS	0.62	NS	NS
CV (%)	5.49	6.71	5.37	-	6.84	-	-
Initial	226	35.6	258	1.2	5.1	1.1	3.7

Table-4 Effect of integrated nutrient management on nutrient content (%) and plant uptake (kg ha-1) of ragi (2019-20)

Treatments	N	P	K	Zn	Fe	N uptake	P uptake	K uptake	Zn uptake	Fe uptake
	%			ppm		kg ha^{-1}			g ha^{-1}	
T_1 – Control	0.94	0.27	0.75	3.88	19.2	40.5	11.8	32.7	167.9	835
T_2 – (RDF) N-P_2O_5-K_2O	1.28	0.54	1.18	4.02	26.8	96.7	37.7	59.5	246.5	1653
T_3 – 50% RDN + 50% N FYM	1.11	0.38	0.95	4.04	28.3	69.1	23.1	47.1	251.7	1762
T_4 – 50% RDN + 50% N vermicompost	1.22	0.41	1.03	4.48	27.3	80.7	29.1	42.9	295.2	1789
T_5 – 50% RDN + 50% N poultry manure	1.25	0.47	1.16	5.01	30.1	82.5	32.6	54.4	344.9	2070
T_6 – 75% RDN + Azospirillum	1.1	0.37	0.9	4.26	27.2	61.3	17.3	34.7	237.4	1491
T_7 – 75% RDN + PSB	1.02	0.35	0.84	4.08	28.3	53.5	18.6	44.1	212.9	1449
T_8 - 75% RDN + Azosphos	1.05	0.33	0.93	4.22	28.7	62	21.3	32.9	249.3	1691
CD (0.05)	NS	NS	NS	NS	5.1	23.1	6.2	37.6	66.3	330.2
CV (%)	-	-	-	-	10.8	20.3	16.7	52.4	15.1	11.8

This might be due to greater availability and steady release of nutrients from organic manures, which perhaps enabled the plant to grow tall and produce superior growth parameters. Besides, they might have improved the soil aggregation, enhanced soil microbial activity and higher nutrient availability resulting in congenial soil condition. In the same line Govindappa (2003) [4] reported that the high leaf area per plant was responsible for photosynthetic activity which in turn resulted in higher dry matter production.

The grain yield [Table-1] was found highest (22.9 q ha^{-1}) with T_5 (50% RDN + 50% N poultry manure) and it was on par with T_2 (100% RDF) (22.6 q ha^{-1}), T_3 (50% RDN + 50% N FYM) and T_4 (50% RDN + 50% N Vermicompost) due to better translocation of photosynthates from source to sink and higher growth attributing characters like higher plant height, number of leaves and tiller production and its accumulation into different parts of plant and yield attributing characters like panicle length, test weight, panicle weight, no. of filled grains, number of unfilled grains per panicle. The fingers per ear head, 1000 grain weight were higher in T_2 (100% RDF) and lowest was observed with control. The highest straw yield was recorded (68.9 q ha^{-1}) with T_5 (50% RDN + 50% N poultry manure) but on par with T_2, T_3 and T_4 and significant with T_6 and T_7. These results are in accordance with those obtained by Basavaraj Naik (2017) [5].

Conclusion

The physico-chemical properties (pH and E.C) and physical properties (Bulk density and Water holding capacity) have not been significantly influenced with the application of different sources of nutrient management practices [Table-2]. The organic carbon percentage of the soil was also not significantly influenced by different treatments [Table-2]. The soil available Nitrogen, Phosphorus, Potassium and iron [Table-3] were significantly influenced by various treatments of nutrient management. Moreover, zinc, copper and manganese were statistically non-significant with different treatments.

In the soil available macronutrients [Table-3] like soil available nitrogen was highest (290 kg ha^{-1}) in T_2 (100% RDF) followed by T_8 (75% RDN + Azosphos) treatment and T_5 (50% RDN + 50% N poultry manure).

The higher soil phosphorus (57.6 kg ha^{-1}) was recorded with T_2 (100% RDF) followed by T_5 (50% RDN + 50% N poultry manure) and T_7 (75% RDN + PSB). The higher soil potassium (364 kg ha^{-1}) was recorded with T_5 (50% RDN + 50% N poultry manure) followed by T_2 (100% RDF) and T_4 (50% RDN + 50% N Vermicompost). The uptake of macronutrients (N, P and K) [Table-4] were found highest in the treatment 100% RDF (T_2) which was found on par with 50% RDN + 50% N poultry manure (T_5) and 50% RDN + 50% N Vermicompost (T_4). Micronutrient (Fe & Zn) uptake (g ha^{-1}) was higher with 50% RDN + 50% N poultry manure (T_5) and 50% RDN + 50% N Vermicompost (T_4). The lowest uptake of micronutrients was recorded with control (T_1). This was evidenced through higher uptake of nutrients by plants. These findings are obtained with those of Deotale *et al.,* (2008) [6].

Application of research: Study of organic and inorganic sources of nutrients on finger millet (*Eluesine coracana* L.)

Research Category: Nutrient management

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Study area / Sample Collection: High Altitude and Tribal (Hat) Zone of Andhra Pradesh

Cultivar / Variety / Breed name: Finger millet (*Eleusine coracana* L.)

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