Int.J.Curr.Microbiol.App.Sci (2017) *6*(7): 2211-2221

EXCELLENT PUBLISHERS

International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 **Volume 6 Number 7 (2017) pp. 2211-2221**
Journal homepage: http://www.ijcmas.com

Original Research Article https://doi.org/10.20546/ijcmas.2017.607.321

Revisiting of Fertilizer Doses in Finger Millet [*Eleusine coracana* (L.) Garten.] Through Targeted Yield and Soil Test Crop Response (STCR) Approach

Y. Sandhya Rani*, U. Triveni, T.S.S.K. Patro, M. Divya and N. Anuradha

Acharya N. G. Ranga Agricultural University, Agricultural Research Station, Vizianagaram – 535 001, A.P., India

**Corresponding author*

Keywords

Finger millet, Targeted yield Approach, STCR, Recommended dose of fertilizer.

Article Info

Accepted:
23 June 2017
Available Online:
10 July 2017

A B S T R A C T

Field experiments were conducted in finger millet for two consecutive *kharif* seasons viz., 2015 and 2016 at Agricultural Research Station, Vizianagaram, Andhra Pradesh with an objective to reschedule the fertilizer doses of finger millet based on Soil Test Crop Response (STCR) and targeted yield approach. The experiment was laid out in Randomized Complete Block Design (RCBD) with three replications. The experimental results revealed that growth characters, yield contributing characters, grain and straw yields and soil available nutrients recorded the highest in the treatment 200% RDN + 100% RDP+ 100% RDK + 25% RDZn + 25% RDS + 25% RDB integrated with 5 t ha^{-1} FYM which was on par with the treatment in which fertilizers were applied based on STCR equation for a targeted yield of 40 q ha^{-1} in soils whose nitrogen levels are low (below 140 kg ha^{-1}), high phosphorus levels and medium potassium levels.

Introduction

Small millets comprising finger millet, kodo millet, foxtail millet, little millet, barnyard millet and proso millet are crops of antiquity known for their drought resistance, resistance to pests and diseases, short growing season as compared to other major cereals and cultivated all-round the year (Devi *et al.*, 2011). Due to all these advantageous characteristics, millet grains are receiving specific attention in the developing countries like India, China and some countries like Africa continent in terms of utilization as food. Millets also contain major and minor nutrients in remarkable amounts.

Finger millet is an important dry land crop, resilient, ability to withstand adverse weather conditions when grown in a variety of soils including sandy, those with high acidity or alkalinity and those having poor water holding capacity.

Finger millet grown on marginal land provides a valuable resource in times of famine. Its grain tastes good and is nutritionally good and rich as it contains high levels of calcium, iron and manganese. The millet straw is also an important livestock feed, building material and fuel. Finger millet contains low glycemic index and has no gluten, which makes it suitable for diabetics and people with digestive problems (Treen Hein, 2005).

Soil fertility deterioration owing to excessive removal of nutrients and their inadequate replenishment through fertilizers and manures is considered one of the major causes behind the undesirable fatigue in production and productivity growth rates of different crops. Due to the changes in soil fertility caused by imbalanced fertilizer use, acidity, alkalinity, salinity and declining in soil organic matter, there is every need to continuously monitor the changes in soil properties and adopt the best management practices for maintenance and enhancement of soil health. For enhancing the soil health and sustaining productivity, fertilizer prescriptions based on STCR's targeted yield approach which take into account nutrient demand of the crops for a targeted yield goal and relative contributions from soil and fertilizer sources under a given set of farming situation, revealed inadequacy of the conventional fertilizer recommendation followed.

Intensive crop rotation and imbalanced fertilizer use have resulted in a wide range of nutrient deficiencies in fields. For intensive cropping systems, the current recommended fertilizer rates need revision upward within balance ratio of vital micronutrients specific to crop to enlarge stagnant yields (Tandon, 1997). By supplying plants with micronutrients, either through soil application, foliar spray or seed treatment improved yield, quality and macronutrient efficiency use was improved upto 50% (Malakouti, 2008). Fertilizer management plays an important role for obtaining satisfactory yield. In order to increase crop productivity nutrient management may be achieved by the involvement of organic sources, bio-fertilizers and micronutrients (Pingali and Pandey, 2005). Micronutrient deficiency can greatly disturb plant yield, quality and the health of domestic animals and humans (Singh *et al.*, 2002). Full exploitation of the genetic potential requires intensive fertilizer application, but it increases the cost of the products. Also about 50% of applied N and 70% of the applied Potassium to the soil remain unavailable to a crop due to a combination of leaching and voltalization. The effective fertilizer recommendation should consider crop needs and nutrients already available in the soil. Among various methods of fertilizer recommendation such as recommended dose of fertilizers (RDF), soil test based recommendation, critical value approach, etc., the soil test crop response (STCR) approach for target yield is unique in indicating both soil test based fertilizer dose and the level of yield that can be achieved with good agronomic practices (Singh *et al.*, 2005).

Although it is suggested that increased application rates of inorganic fertilizers improve finger millet yield and productivity, it is not a practical option for many poor finger millet farmers, as they cannot afford inorganic fertilizer. Therefore, integrated nutrient management (INM) may be a sustainable option for finger millet farmers. The main objectives of INM are improvements in plant performance and resource use efficiency while minimizing negative environmental impacts (Wu and Ma 2015; Chen *et al.*, 2011).

These can be achieved through use of all possible sources of nutrients to meet crop demand, matching soil nutrient availability with crop demand (spatially and temporarily), and minimizing nitrogen losses (Wu and Ma, 2015; Drinkwater and Snapp, 2007). The major advantages of INM are increase in yield, water use efficiency, grain quality, economic returns, and sustainability (Wu and Ma, 2015).

Materials and Methods

The field experiment was conducted at Agricultural Research Station, Vizianagaram, Andhra Pradesh during *Kharif* 2015 and 2016. Composite soil sample was drawn from the experimental site at 0-15 cm depth prior to laying out of the experiment. The soil samples were analyzed by adopting standard procedures. The soil was sandy loam in texture, neutral in reaction, low in organic carbon and available nitrogen, high in available phosphorus and medium in available potassium. The experiment was laid down in Randomized complete block design with following thirteen treatments replicated thrice.

Soil Test Crop Response (STCR) approach was adopted to conduct the field experiment on optimizing of integrated nutrient supply on soil health, growth and yield of finger millet production.

The treatments taken are

T1: 100% RDF + RDZN+ RDS + RDB

T2: T1 + FYM@ 5 t ha^{-1}

T3: Soil test based fertilizer Recommendation

T4: T3 + FYM@ 5 t ha^{-1}

T5: Based on STCR equation for 35 q ha-1

T6: T5 + FYM@ 5 t ha^{-1}

T7: Based on STCR equation for 40 q ha-1

T8: T7 + FYM@ 5 t ha^{-1}

T9: 150% RDN +100% RDP +100% RDK + 25% RDZn + 25% RDS + 25% RDB (90-40-30)

T10:T9 + FYM@ 5 t ha^{-1}

T11: 200% RDN +100% RDP +100%RDK + 25%RDZn + 25%RDS + 25% RDB (120-40-30)

T12: T11+ FYM@ 5 t ha^{-1}

T13: Farmers Practice

The fertilizer adjustment equation developed by AICRP on STCR

$FN = 3.76\ T – 0.28\ S\ N$
$FP_2O_5 = 1.83\ T – 0.36\ S\ P_2O_5$
$FK_2O = 2.17\ T – 0.24\ S\ K_2O$

Using the above fertilizer adjustment equations, the quantity of fertilizer nutrients required for achieving 35 q ha^{-1} grain yield and 15% higher yield (40 q ha^{-1}) of finger millet was worked out

The Recommended dose of fertilizer (RDF) of finger millet in the North Coastal Zone of Andhra Pradesh is 60-40-30 kg NPK ha^{-1}. Soil test based fertilizer recommendation (30% high or less) depending on the initial soil test values was taken in treatment T3 and another treatment T4 with the same fertilizer dose integrated with organic manure (FYM @ 5t $ha^{-1)}$ were taken. The fertilizers doses were applied to the treatment T5 based on STCR equation for achieving a target yield of 35q ha^{-1} and for target yield of 40 q ha^{-1} in the treatment T7. Based on the initial soil test values, if the initial soil available nitrogen was low (<140 kg ha^{-1}) and soil available phosphorus and potassium were medium to high 150% RDN + 100% RDP + 100% RDK + 25% RDZn + 25% RDS + 25% RDB was taken in the treatment T9 and 200% RDN + 100% RDP + 100% RDK + 25% RDZn + 25% RDS + 25% RDB in the treatment T11. The treatments T6, T8, T10 and T12 were duplications of the treatmentsT5, T7, T9 and T11 respectively integrated along with organic manure (FYM @ 5t ha^{-1}).

After layout of experimental site, calculated quantities of fertilizers and FYM @ 5 t ha^{-1} were applied as per the treatment details. Fifty percent of nitrogen through urea and entire quantity of phosphorus through SSP (Single Super Phosphate) and potassium through MOP (Murate of Potash) were applied at the time of transplanting as a basal dose to each plot and remaining fifty percent of nitrogen was applied at 30 days after transplanting as indicated in the treatment details.

Results and Discussion

The growth contributing characters *viz*., the plant height, No. of productive tillers and leaf length showed significant influence between the treatment with 100 % RDF (control) and other treatments. Significantly highest plant height of 134.1 cm was recorded in the treatment 200% RDN + 100% RDP + 100% RDK + 25% RDZn + 25% RDS + 25% RDB integrated with FYM @ 5t ha^{-1} (T12) compared to the treatment with 100% RDF, fertilizers applied with soil test based fertilizer recommendation and farmers practice(T1, T2, T3, T4 and T13).

The leaf length of 35.5 cm was found highest in the treatment T12 which was on par with treatments T11 and T7, T8 in which the fertilizers were applied based on STCR equation for target yield of 40 q/ha and integrated with FYM @ 5t ha^{-1} compared to the other treatments (Table 1). Similar results were recorded by Kumara *et al.,* (2007) and Anil Kumar *et al.,* (2003). The improvement in growth parameters due to application of fertilizers on STCR basis and application of both fertilizers and organic manures may be attributed due to the increased supply of nutrients (Duryodhana *et al.*, 2004).

The yield contributing characters *viz.*, No. of productive tillers/plant, ear head length and No. of fingers/ear were significantly influenced between the treatments (Table 2). No. of productive tillers/plant were significantly found highest in the treatment with T12 with 200% RDN + 100% RDP + 100% RDK + 25% RDZn + 25% RDS + 25% RDB integrated with FYM @ 5t ha^{-1} (4.0) compared to all the other treatments and found on par with the treatment T11.The ear head length was found highest in the treatment T11(9.02 cm) with 200% RDN + 100% RDP + 100% RDK + 25% RDZn + 25% RDS + 25% RDB and was found on par with the treatments T12, T5, T6, T7, T8, T9 and T10. The No. of fingers/ear was found highest in the treatment T12 (10.1) with 200% RDN + 100% RDP + 100% RDK + 25% RDZn + 25% RDS + 25% RDB integrated with FYM @ 5t ha^{-1}which is on par with the treatments T11 and T8 and significantly different from all the other treatments.

The straw and grain yields of finger millet varied significantly due to application of nutrients on the basis of different approaches (Table 3). The straw and grain yields were found significantly highest in the treatment T12 with 200% RDN + 100% RDP + 100% RDK + 25% RDZn + 25% RDS + 25% RDB integrated with FYM @ 5t ha^{-1}(88.5 q/ha and 37.35 q/ha) which was on par with the treatments with T11 and T7, T8 in which the fertilizers were applied based on STCR equation for target yield of 40q/ha and in integration with FYM @ 5t/ha).

Similar results were recorded by Sankar *et al.,* (2011) and Apoorva *et al.,* (2010). The increase in the yield due to application of fertilizers based on different approaches and integrated nutrient supply was attributed to the increase in growth attributes as a consequent of improved nutrient supply and efficiency of applied nutrients in the soil.

The physic chemical properties (pH and E.C) and Organic carbon percentage (Table 4), showed no significant influence with the application of fertilizers through different approaches and integrated nutrient supply (Srinivasarao *et al.*, 2012; Hemalatha and Chellamuthu 2011; Hemalatha and Chellamuthu 2013).

Table.1 Effect of fertilizer levels on growth characters of finger millet

Treatment	Plant height (cm)			Leaf length (cm)			Leaf Width (cm)		
	2015	2016	Mean	2015	2016	Mean	2015	2016	Mean
T1	100.7	122.7	111.7	22.3	33.1	27.7	0.9	0.8	0.85
T2	103.0	131.4	117.2	24.8	33.3	29.1	0.9	1.0	0.95
T3	105.5	133.8	119.7	25.6	35.1	30.4	0.9	0.9	0.90
T4	105.1	134.0	119.6	26.5	36.9	31.7	1.0	1.0	1.00
T5	111.3	134.3	122.8	28.8	35.8	32.3	0.8	1.0	0.90
T6	112.1	135.7	123.9	28.5	36.2	32.4	1.1	0.9	1.00
T7	119.9	138.5	129.2	29.1	36.8	32.9	1.0	1.0	1.00
T8	119.3	139.8	129.6	31.7	37.5	34.6	0.9	0.9	0.90
T9	112.1	133.4	122.8	28.7	34.1	31.4	0.8	1.0	0.90
T10	115.1	135.3	125.2	29.3	34.9	32.1	1.0	1.0	1.00
T11	120.4	138.1	129.3	30.3	36.9	33.6	0.9	0.9	0.90
T12	124.9	143.3	134.1	33.2	37.8	35.5	1.0	0.9	0.95
T13	96.2	130.0	113.1	25.2	34.1	29.7	0.9	0.9	0.90
SEm±	7.02	3.14	4.04	1.24	1.67	1.037	0.08	0.03	0.043
CD (0.05)	20.47	9.18	11.78	3.63	NS	3.03	NS	NS	NS
CV%	10.92	4.04	5.68	7.69	8.16	5.65	14.99	6.02	8.03

Table.2 Effect of fertilizer levels on Yield attributes of finger millet

Treatment	No. of productive tillers/plant			ear head length (cm)			No. of fingers/ear		
	2015	2016	Mean	2015	2016	Mean	2015	2016	Mean
T1	2.6	2.8	2.7	7.4	7.60	7.50	7.8	8.1	7.95
T2	2.8	3.1	2.95	8.0	7.87	7.94	8.1	8.2	8.15
T3	2.9	2.7	2.8	8.2	7.33	7.77	8.4	7.8	8.1
T4	2.8	2.9	2.85	8.4	7.47	7.94	8.3	8.2	8.25
T5	2.9	2.9	2.9	8.5	8.00	8.25	8.6	8.3	8.45
T6	2.7	3.0	2.85	8.3	8.13	8.22	8.5	8.5	8.5
T7	3.5	3.3	3.4	9.1	8.33	8.72	9.2	8.8	9
T8	3.6	3.4	3.5	8.8	8.47	8.64	9.4	9.1	9.25
T9	3.2	3.1	3.15	8.4	8.20	8.30	8.5	8.5	8.5
T10	2.8	3.5	3.15	8.6	8.27	8.44	8.6	8.7	8.65
T11	3.8	3.7	3.75	9.5	8.53	9.02	9.8	9.2	9.5
T12	3.9	4.1	4	9.1	8.87	8.99	10.3	9.9	10.1
T13	2.2	2.7	2.45	7.0	7.53	7.27	7.3	7.2	7.25
SEm±	0.22	0.26	0.149	0.42	0.29	0.281	0.43	0.43	0.317
CD (0.05)	0.64	0.78	0.435	1.23	0.87	0.819	1.24	1.27	0.925
CV%	12.39	14.6	8.29	8.71	6.44	5.91	8.52	8.88	6.39

Table.3 Effect of fertilizer levels on straw and grain yields (q/ha) of finger millet

Treatment	Straw yield (q/ha)			Grain yield (q/ha)			B:C		
	2015	2016	Mean	2015	2016	Mean	2015	2016	Mean
T1	62.7	70.5	66.6	23.8	27.4	25.63	2.10	2.40	2.25
T2	68	73.3	70.7	29.3	31.8	30.53	2.05	2.17	2.11
T3	61.4	74.4	67.9	29.7	27.4	28.56	1.77	2.37	2.07
T4	64.6	77.4	71.0	30.9	28.8	29.87	2.09	1.87	1.98
T5	70.3	78.4	74.4	31.7	32.7	32.17	3.23	3.03	3.13
T6	72.7	79.6	76.2	33.1	34.1	33.59	2.45	2.40	2.43
T7	81.5	85.9	83.7	34.6	35.0	34.78	3.52	3.08	3.30
T8	85.0	88.7	86.9	35.6	37.4	36.46	2.76	2.57	2.67
T9	72.2	75.4	73.8	30.7	32.6	31.69	2.89	2.80	2.85
T10	74.0	83.9	78.9	32.8	33.4	33.11	2.37	2.20	2.29
T11	89.3	81.9	85.6	34.5	36.5	35.55	3.35	3.18	3.27
T12	91.9	85.0	88.5	36.6	38.1	37.36	2.74	2.58	2.66
T13	53.7	68.3	61.0	22	24.5	23.29	1.70	2.03	1.87
SEm±	5.69	2.85	3.105	2.01	1.54	1.198			
CD (0.05)	16.63	8.33	9.061	5.8	4.5	3.498			
CV%	13.54	6.28	7.097	10.7	8.3	6.54			

Table.4 Effect of fertilizer levels on Soil Physico Chemical properties and OC% of finger millet

Treatment	pH			EC			OC%		
	2015	2016	Mean	2015	2016	Mean	2015	2016	Mean
T1	7.0	6.91	6.96	0.13	0.25	0.19	0.39	0.42	0.41
T2	6.9	7.21	7.06	0.09	0.25	0.17	0.42	0.45	0.44
T3	7.0	7.10	7.05	0.10	0.27	0.19	0.40	0.43	0.42
T4	6.9	7.23	7.07	0.11	0.21	0.16	0.44	0.45	0.45
T5	6.8	7.28	7.04	0.15	0.36	0.26	0.41	0.39	0.40
T6	7.0	7.24	7.12	0.15	0.27	0.21	0.47	0.42	0.45
T7	7.1	7.26	7.18	0.12	0.24	0.18	0.45	0.43	0.44
T8	7.1	7.24	7.17	0.14	0.29	0.22	0.47	0.48	0.48
T9	7.2	7.27	7.24	0.13	0.21	0.17	0.43	0.41	0.42
T10	6.9	7.24	7.07	0.14	0.15	0.15	0.48	0.44	0.46
T11	7.1	7.18	7.14	0.13	0.24	0.19	0.47	0.45	0.46
T12	7.1	7.14	7.12	0.14	0.18	0.16	0.48	0.52	0.50
T13	6.9	7.38	7.14	0.14	0.27	0.21	0.41	0.42	0.42
SEm±	0.095	0.094	0.043	0.012	0.027	0.014	0.03	0.04	0.025
CD (0.05)	NS	NS	NS	NS	NS	0.041	0.08	NS	0.073
CV%	2.35	2.28	1.06	17.28	19.33	13.71	11.33	15.93	9.96
Initial value	6.9	7.68	7.29	0.12	0.27	0.19	0.41	0.45	0.43

Table.5 Effect of fertilizer levels on soil available macronutrients (kg/ha) of finger millet

Treatment	Available N (kg/ha)			Available P2O5 (kg/ha)			Available K2O (kg/ha)		
	2015	2016	Mean	2015	2016	Mean	2015	2016	Mean
T1	185	125	155	79	56	68	254	255	255
T2	189	129	159	82	59	71	257	261	259
T3	173	121	147	80	47	64	241	228	235
T4	178	130	154	82	53	68	257	241	249
T5	194	163	179	78	66	72	266	252	259
T6	198	167	183	80	69	75	271	246	259
T7	224	180	202	69	85	77	290	270	280
T8	211	184	198	78	88	83	293	279	286
T9	203	167	185	84	70	77	266	246	256
T10	206	172	189	90	74	82	275	258	267
T11	224	184	204	88	82	85	283	285	284
T12	236	188	212	92	84	88	295	319	307
T13	182	125	154	73	44	59	206	184	195
SEm±	11.16	11.40	8.169	8.30	4.49	4.87	18.05	16.72	13.23
CD (0.05)	32.56	33.27	23.84	NS	13.12	14.21	52.67	48.80	38.61
CV%	9.66	12.60	7.93	17.70	11.53	11.33	11.75	11.33	8.78
Initial value	134	127	131	99	65	8.2	203	253	228

Table.6 Effect of fertilizer levels on Soil available micronutrients (kg/ha) of finger millet

Treatment	Available Zn (ppm)			Available Fe (ppm)			Available Mn (ppm)			Available Cu (ppm)		
	2015	2016	Mean	2015	2016	Mean	2015	2016	Mean	2015	2016	Mean
T1	1.78	0.80	1.29	8.37	5.09	6.73	9.34	5.38	7.36	1.38	2.94	2.16
T2	1.92	0.91	1.42	8.10	5.54	6.82	9.65	6.17	7.91	1.51	1.92	1.72
T3	1.67	0.72	1.20	8.18	5.69	6.94	9.01	6.08	7.55	1.43	2.40	1.92
T4	1.73	1.00	1.37	8.22	5.85	7.04	8.33	7.11	7.72	1.45	1.97	1.71
T5	1.70	0.95	1.33	8.28	6.08	7.18	9.29	7.09	8.19	1.43	3.01	2.22
T6	1.85	0.99	1.42	8.45	5.71	7.08	9.48	7.25	8.37	1.49	3.24	2.37
T7	1.99	0.79	1.39	8.77	5.54	7.16	10.08	8.18	9.13	1.63	3.01	2.32
T8	2.11	0.86	1.49	8.48	6.91	7.70	10.48	8.71	9.60	1.65	3.66	2.66
T9	1.82	0.91	1.37	8.27	5.83	7.05	9.55	7.10	8.33	1.60	2.21	1.91
T10	1.94	0.94	1.44	8.64	6.89	7.77	9.68	7.26	8.47	1.62	2.54	2.08
T11	2.08	1.03	1.56	8.94	5.36	7.15	9.96	7.16	8.56	1.66	3.15	2.41
T12	2.34	1.09	1.72	8.85	6.20	7.53	10.21	7.40	8.81	1.78	3.39	2.59
T13	1.39	0.84	1.12	7.91	5.98	6.95	9.13	5.01	7.07	1.35	1.38	1.37
SEm±	0.16	0.088	0.087	0.40	0.333	0.251	0.46	0.549	0.279	0.15	0.237	0.140
CD (0.05)	0.47	NS	0.254	NS	0.97	NS	1.33	1.60	0.814	NS	0.69	0.409
CV%	14.79	16.77	10.83	8.31	9.78	6.08	8.25	13.75	5.87	17.40	15.39	11.51
Initial value	1.64	0.78	1.21	7.86	5.17	6.515	9.18	6.54	7.86	1.23	3.03	2.13

Table.7 Effect of fertilizer levels on plant macronutrient uptake (kg/ha) of finger millet

Treatment	N Uptake (kg/ha)			P Uptake (kg/ha)			K Uptake (kg/ha)		
	2015	2016	Mean	2015	2016	Mean	2015	2016	Mean
T1	46.0	50.37	48.2	14.5	17.55	16.0	54.93	65.78	60.4
T2	54.1	58.38	56.2	17.3	20.91	19.1	64.58	72.40	68.5
T3	48.0	48.41	48.2	13.5	15.12	14.3	53.85	58.32	56.1
T4	51.6	55.76	53.7	14.8	17.73	16.3	58.36	71.00	64.7
T5	58.9	72.35	65.6	20.2	23.48	21.8	71.73	74.36	73.0
T6	61.8	80.76	71.3	22.2	25.88	24.0	77.52	79.89	78.7
T7	74.8	86.09	80.4	28.3	27.21	27.8	87.45	82.11	84.8
T8	77.7	96.01	86.9	30.4	30.08	30.2	91.46	93.65	92.6
T9	62.3	68.60	65.5	19.0	23.44	21.2	70.45	73.42	71.9
T10	65.9	77.28	71.6	20.1	26.74	23.4	74.61	82.31	78.5
T11	76.8	88.62	82.7	27.2	30.13	28.7	86.47	87.81	87.1
T12	80.9	98.39	89.6	29.6	35.47	32.5	89.53	96.51	93.0
T13	36.5	49.28	42.9	16.7	17.82	17.3	34.83	58.94	46.9
SEm±	3.19	3.34	2.07	1.61	0.995	0.89	6.28	4.08	3.59
CD (0.05)	9.43	9.73	6.07	4.70	2.91	2.60	18.35	11.93	10.47
CV%	9.06	8.07	5.42	13.74	7.20	6.86	15.46	9.24	8.45

Table.8 Effect of fertilizer levels on plant micronutrient uptake (gm/ha) of finger millet

Treatment	Zn Uptake			Fe Uptake		
	2015	2016	Mean	2015	2016	Mean
T1	209.0	207.3	202.4	659	1024	1104.1
T2	238.9	251.2	251.5	814	1240	1375.5
T3	197.4	185.7	179.7	593	944	993.3
T4	209.7	210.7	203.3	663	999	1087.4
T5	235.6	237.1	242.5	804	1112	1300.0
T6	255.1	274.6	281.2	911	1258	1492.7
T7	276.3	320.7	313.4	1031	1309	1572.9
T8	295.0	351.2	343.4	1097	1409	1681.5
T9	277.5	275.7	301.6	964	1075	1460.1
T10	308.1	321.5	352.1	1025	1271	1619.3
T11	349.8	337.7	383.7	1176	1301	1697.2
T12	367.0	369.0	405.9	1282	1441	1828.8
T13	168.4	180.7	149.4	434	944	826.2
SEm±	11.41	14.22	13.35	73.75	54	84.70
CD (0.05)	33.28	41.50	38.97	215.25	158	247.20
CV%	12.80	9.09	8.33	14.49	7.97	10.57

The soil available Nitrogen, Phosphorus and Potassium were significantly influenced by various treatments in which fertilizers were applied based on different approaches and integrated nutrient supply (Table 5). The available Nitrogen in the soil after the harvest of the crop was found highest in the treatment T12 with 200% RDN + 100% RDP + 100% RDK + 25% RDZn + 25% RDS + 25% RDB integrated with FYM @ 5t ha^{-1} (212kg ha^{-1}) on par with T11 followed by T7 and T8 treatments in which fertilizers were applied based on STCR equation for a targeted yield of 40 q ha^{-1} and treatment T10.

The available phosphorus in the soil was found highest in the treatment T12 with 200% RDN + 100% RDP + 100% RDK + 25% RDZn + 25% RDS + 25% RDB integrated with FYM @ 5t ha^{-1} (88 kg ha^{-1}) on par with the treatments T11, T6, T7, T8, T9, T10. The soil available K_2O was found highest in the treatment T12 (307 kg ha^{-1}) which was on par with the treatments T7, T8 and T11. Similar results were reported by Kumara *et al.*, (2014), Saravanane *et al.*, (2011) and Shivakumar *et al.*, (2011).

Among the soil available micronutrients, available Zn, Mn and Cu were significantly influenced by various treatments. The soil available Zn was found highest in the treatment T12 with 200% RDN + 100% RDP + 100% RDK + 25% RDZn + 25% RDS + 25% RDB integrated with FYM @ 5t ha^{-1} (1.72 ppm) which was on par with treatment T11 and T8 in which the fertilizers were applied based on STCR equation for target yield of 40q/ha and integrated with FYM @ 5t/ha. Soil available Mn and Cu was found highest in the treatment T8 (9.60 ppm and 2.66 ppm) in which fertilizers were applied based on STCR equation for a targeted yield of 40 q ha^{-1} integrated with FYM @ 5t ha^{-1} which is on par with T11, T12, T6 and T7. The soil available Fe was not significantly influenced due to the application of nutrients on the basis of different approaches (Table 6).

The uptake of macronutrients by finger millet plant (N, P and K) was significantly influenced by various treatments. The plant uptake of N and P was found highest in the treatment T12 with 200% RDN + 100% RDP + 100% RDK + 25% RDZn + 25% RDS + 25% RDB integrated with FYM @ 5t ha^{-1} (89.6 kg ha^{-1} and 32.5 kg ha^{-1}) which was on par with the treatment T8. The uptake of potassium was found highest in the treatment T12 with 200% RDN + 100% RDP + 100% RDK + 25% RDZn + 25% RDS + 25% RDB integrated with FYM @ 5t ha^{-1} (93.0 kg/ha) which was on par with the treatments T11, T8 and T7 in which the fertilizers are applied based on STCR equation for a targeted yield of 40q ha^{-1} integrated with FYM. The uptake of Zn and Fe was found highest in the treatment T12 (405.9 gm ha^{-1} and 1828.8 gm ha^{-1}) which is on par with the treatments T8 and T11 (Tables 7 and 8). The Benefit cost ratio (Table 3) was found highest in the treatment T7 (3.30) in which the fertilizers were applied based on STCR equation for a targeted yield of 40q ha^{-1} which was very closely followed by treatment T11 (3.27).

In conclusion, these values suggest that soils with low fertility status of available Nitrogen less than 140 kg/ha, increase in the N dose upto 200% along with micronutrients can give yields on par with the nutrient supply using STCR approach. Hence it can be concluded that the targeted yield in finger millet could be achieved with integrated nutrient supply using STCR approach.

The higher productivity of finger millet may be attributed to improved root growth, nutrient uptake, simulation of many different enzymes related to photosynthesis, improved soil properties and increased nutrient use efficiency of applied nutrients.

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How to cite this article:

Sandhya Rani, Y., U. Triveni, T.S.S.K. Patro, M. Divya and Anuradha, N. 2017. Revisiting of Fertilizer Doses in Finger Millet [*Eleusine coracana* (L.) Garten.] Through Targeted Yield and Soil Test Crop Response (STCR) Approach. *Int.J.Curr.Microbiol.App.Sci.* 6(7): 2211-2221.
doi: https://doi.org/10.20546/ijcmas.2017.607.321