RESEARCH ARTICLE

IMPACT OF SOLID AND LIQUID ORGANIC SOURCES ON CONTENT AND UPTAKE OF NUTRIENTS BY FINGER MILLET [*ELEUSINE CORACANA* (L.) GAERTN.] UNDER RAINFED CONDITION OF SOUTH GUJARAT

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Abstract: A field trial was conducted at Krishi Vigyan Kendra, Rajendrapur Farm, Navsari Agricultural University, Waghai to study the "Effect of organics on soil properties, yield and quality of finger millet [*Eleusine coracana* (L.) *Gaertn.*]" during *kharif* season of 2018 and 2019 under rainfed condition of south Gujarat. Treatments were laid out in a randomized block design (factorial concept) with three replications and compared with control recommended practice consisting of 40-20-0 NPK kg/ha. In *kharif* season, treatments were allotted to different experimental units of finger millet through solid organics (Factor - S *viz.*, S_1: 100 % RDN through biocompost, S_2: 75 % RDN through biocompost and S_3: 50 % RDN through biocompost) and foliar application of liquid organics (Factor - L *viz.*, L_1: Enriched Banana Psuedostem sap @ 1 %, L_2: *Jeevamrut* @ 1 %, L_3: *Vermiwash* @ 1 % and L_4: Cow Urine @ 1 %). Significantly higher nutrient content (N, P, K and Ca) in grain and straw were recorded highest in 100 % RDN through biocompost (S_1), which remained at par with the application of 75 % RDN through biocompost but phosphorus and calcium content of straw not to be found significant. Among liquid tested, application of enriched banana psuedostem sap @ 1 % showed highest value of grain and straw content over rest of liquid tested but did not show significant effect among the different treatments. In case of nutrient uptake by grain and straw, application of 100% and 75% RDN through biocompost as well as enriched banana psuedostem sap @ 1 % and Jeevamrut @ 1% recorded best nutrient (N, P, K and Ca) uptake among different treatments under study.

Keywords: Foliar nutrition, *Eleuscine coracana*, Finger millet

INTRODUCTION

In India, finger millet [*Eleusine coracana* (L.) Gaertn.] is cultivated on area of 890.9 thousands ha with production of 1238.7 thousands tones with a productivity of 1390 kg/ha. In Gujarat, finger millet occupies an area about 2.7 thousands ha with production of 3.96 thousands tones with a productivity of 1344 kg/ha (Anon., 2020). The major finger millet growing states are Karnataka, Uttarakhand, Maharshtra, Tamil Nadu and odisha. Where is in Gujarat finger millet cultivated mainly in dry land and tribal area of Dang, Valsad and some parts of Navsari, Surat and Panchmahal districts.

Organic agriculture is a holistic crop production and management system which can be practiced in any situation from lowest rainfall areas to highest rainfall areas to achieve sustainable productivity without the use of external inputs such as chemical fertilizers and pesticides and has many environmental advantages like encouraging conservation and development of on-farm natural resources and their optimum utilization in maintaining the soil fertility status for a long time with enhanced microbial activity. The organically produced food grains, fruits, vegetables, spices, condiments, medicinal and aromatic plant products have showed good keeping quality than products grown with chemical fertilizers. Organic agriculture is adopted with a blend of ecologically safe modern technologies which are acceptable to the farmers (Natarajan, 2002; Pathak and Ram, 2007 and Sreenivasa *et al*., 2009).

Finger millet also known as ragi in India is one of the important cereals occupies highest area under cultivation among the small millets. In Gujarat, finger millet is the staple food of the tribals in Agroclimatic Zone – I, II and III. It is grown under *kharif* rainfed crop in the least fertile soil of South Gujarat.

MATERIALS AND METHODS

The field experiment titled "Effect of organics on soil properties, yield and quality of finger millet [*Eleusine coracana* (L.) Gaertn.]". was carried out by laying out a field experiment on finger millet with combined application of solid organic with foliar application of liquid organics in *kharif* season during 2018 and 2019.

The soil analysis data indicated that the soil of the experimental field was medium in organic carbon (0.60 % and 0.58 %), available nitrogen (270.80 and 274.50 kg/ha), available phosphorus (28.75 and 30.39 kg/ha) whereas high in available potassium (365.25 and 360.55 kg/ha) and neutral in reaction (pH 6.85 and 6.95) with normal electrical conductivity (0.15 and 0.20 dSm^{-1}) during the year 2018 and 2019, respectively.

Treatments were laid out in a randomized block design (factorial concept) with three replications.

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Treatments were compared with control recommended practice consisting of 40-20-0 NPK kg/ha. In *kharif* season, treatments were allotted to different experimental units of finger millet through solid organics (Factor - S *viz.*, S_1: 100 % RDN through biocompost, S_2: 75 % RDN through biocompost and S_3: 50 % RDN through biocompost) and foliar application of liquid organics (Factor - L *viz.*, L_1: Enriched Banana Psuedostem sap @ 1%, L_2: *Jeevamrut*@ 1 %, L_3: *Vermiwash*@ 1 % and L_4: Cow Urine @ 1%).

Well decomposed solid organic manures (biocompost) is applied based on gross plot size and calculated quantities of these organic manures were applied well mixed with soil homogenously in the respective plots one day prior to sowing that particular bed. Before application of organic manures, it was analyzed for NPK content and is represented in Table 1 while, different liquid organics *viz.* enriched banana pseudostem sap, Jeevamrut,vermiwash and cow urine were applied through foliar application at 15, 30 and 45 DAT of finger millet. Before application of liquid organic, it was analyzed for N, P, K content is represented in Table 2. The finger millet variety GNN 6 was sown in june 2018 and 2019. Standard agronomic practices were adopted for raising healthy crop.

RESULTS AND DISCUSSION

Effect of solid organics

From the Table 3 and Table 4 it is clear that the nitrogen content in finger millet grain and straw were significantly influenced due to application of solid organics. Significantly higher with the N, P, K and Ca content in grain (0.81, 0.208, 0.65 and 345.11 %) and straw (0.59, 0.069, 1.33 and 315.89 %) were noticed with the application of 100% RDN through biocompost (S_1) in pooled results respectively, which was remained statistically at par with the application of 75 % RDN through biocompost (S_2) in pooled analysis except P and Ca content of finger millet. While the application of 50% RDN through biocompost (S_3) were observed lowest values of grain and straw of finger millet in pooled analysis.

Based on pooled data analysis application of 100 % RDN through biocompost (S_1) recorded significantly higher N, P, K and Ca uptake by grain (*i.e.* 18.31, 4.73, 14.79 kg/ha and 785.24 g/ha), straw (*i.e.* 29.01, 3.35, 65.51 kg/ha and 1543.28 g/ha) and total uptake (*i.e.* 47.33, 8.08, 80.31 kg/ha and 2328.52 g/ha) of finger millet respectively, which was found statistically at par with the application of 75 % RDN through biocompost (S_2) in pooled analysis except pooled data of N, P and K uptake in straw as well as N, P, K and Ca in total uptake. However, significantly the lowest N, P, K and Ca uptake by grain, straw and total uptake were noted with the treatment S_3: the application of 50 % RDN through biocompost.

Results presented in tables (Table 3 and Table 4) of nutrient content and uptake by finger millet showed discernible influence of different treatments of solid fertilizer on the nutrient content and uptake by finger millet. The organic manures improves soil physico-chemical properties which increase availability of primary and secondary nutrients to the crop and therefore increases its uptake. Also increased crop yield contributed in total uptake of nutrients. The similar findings had been reported on growth parameters obtained under the application using solid organics by Umesh *et al.* (2006), Jagathjothi *et al.* (2010), Aariff khan and Krishna (2016) and Saraswathi *et al.* (2018) in finger millet.

Effect of liquid organics

The data revealed that the nitrogen, phosphorus, potassium and calcium content in finger millet grain and straw were observed to be non significant effect as influenced by different application of liquid organics. The application of enriched banana pseudostem sap @ 1% (L_1) showed higher value of N, P, K and Ca content in grain (0.77, 0.20, 0.65 and 344.40 %) and straw (0.59, 0.07, 1.33 and 315.95 %) were recorded in pooled data respectively.

Application of enriched banana pseudostem sap @ 1% (L_1) recorded maximum N, P, K and Ca uptake by grain (17.69, 4.50, 14.79 kg/ha and 787.24g/ha), straw (27.92, 3.32, 63.71 kg/ha and 1498.47g/ha) and total uptake (45.61, 7.81, 78.50 kg/ha and 2285.71 g/ha) of finger millet in pooled results respectively, which remained statistically at par with treatment L_2: Application of *Jeevamrut* @ 1% during N, P, K and Ca uptake by grain (16.75, 4.32, 14.22 kg/ha and 744.31 g/ha), straw (26.74, 3.09, 60.33kg/ha and 1442.24 g/ha) and total uptake (43.49, 7.41, 74.55kg/ha and 2186.54 g/ha) in pooled analysis. While lowest N, P, K and Ca uptake by grain, straw as well as total uptake of finger millet pooled data analysis under treatment L_4: application of cow urine @ 1 %.

Different liquid organics influenced significantly on primary and secondary nutrient on content and uptake of nutrients by finger millet. Application of enriched banana pseudostem sap and *Jeevamrut* effect observed superior as compared with other liquid fertilizer. The possible reasons for increase in nutrient content and uptake by finger millet may be due to ready assimilation of plant nutrients by crop, these plant liquid organics also contents different plant growth promoting substances which results in good crop growth. These findings are in close agreement with those reported by Shwetha *et al.* (2009), Jakhar *et al.* (2011), Laharia *et al.* (2013), Teja and Murthy (2015), Sandhya Rani *et al.* (2017) and Ananda *et al.* (2018) in finger millet.

Interaction Effect

A perusal of data revealed that the interaction effects between solid and liquid organics on nitrogen, phosphorus, potassium and calcium content and uptake of grain, straw as well as total uptake as

influenced by different treatments did not show significant effect in pooled data analysis among the different treatments.

Control V/s Rest

The data on nitrogen, phosphorus, potassium and calcium content and uptake of grain, straw as well as total uptake of finger millet outlined in Table 3 and 4 showed that they remained unaffected on the rest of the treatments compare with respectively over the control.

Table 1. Nutrient Content of Biocompost

SN	Manures	Nutrient content (%)		
		N	P_2O_5	K_2O
1	Biocompost	1.63	1.15	1.49

Table 2. Chemical composition of liquid organics.

SN	Liquid organic	Content of Nutrient (mg/l)		
		N	P	K
1	Enriched banana pseudostemsap	7570	155	1050
2	Jeevamrut	670	156	51
3	Vermiwash	51.4	4.3	988.5
4	Cow Urine	11600	96.8	2466

Table 3. Effect of solid and liquid organics on Nitrogen & Phosphorus content and their uptake by finger millet (Pooled of 2 Year)

Treatment	Nitrogen content (%)		Nitrogen uptake (kg/ha)			Phosphorus content (%)		Phosphorus uptake(kg/ha)		
	Grain	Straw	Grain	Straw	Total	Grain	Straw	Grain	Straw	Total
S_1	0.81	0.59	18.31	29.01	47.33	0.208	0.069	4.73	3.35	8.08
S_2	0.78	0.57	17.08	26.61	43.69	0.203	0.067	4.45	3.11	7.56
S_3	0.65	0.53	12.23	19.74	31.97	0.167	0.065	3.09	2.40	5.49
S.Em. (±)	0.01	0.01	0.49	0.69	0.87	0.003	0.001	0.10	0.07	0.12
CD at 5%	0.04	0.03	1.40	1.97	2.48	0.007	NS	0.28	0.19	0.35
L_1	0.77	0.59	17.69	27.92	45.61	0.196	0.070	4.50	3.32	7.81
L_2	0.75	0.58	16.75	26.74	43.49	0.194	0.067	4.32	3.09	7.40
L_3	0.74	0.55	14.90	23.82	38.72	0.191	0.066	3.87	2.83	6.70
L_4	0.73	0.55	14.15	22.01	36.16	0.190	0.064	3.68	2.59	6.26
S.Em. (±)	0.02	0.01	0.57	0.80	1.01	0.003	0.001	0.11	0.08	0.14
CD at 5%	NS	NS	1.61	2.28	2.86	NS	NS	0.32	0.23	0.40
Interaction(SxL)										
S.Em. (±)	0.029	0.020	0.98	1.39	1.74	0.005	0.002	0.20	0.14	0.39
CD at 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Treat Mean	0.748	0.567	15.87	25.12	40.99	0.193	0.067	4.09	2.95	7.04
Control	0.717	0.556	15.12	25.97	41.09	0.182	0.066	3.84	3.08	6.92
Control v/s Rest										
S.Em. (±)	0.021	0.01	0.72	1.02	1.28	0.004	0.017	0.15	0.10	0.18
CD at 5%	NS	NS	NS	NS	NS	0.011	NS	NS	NS	NS
CV (%)	9.51	8.57	15.20	13.48	10.42	6.575	8.42	11.87	11.34	8.47

Table 4. Effect of solid and liquid organics on Potassium & Calcium content and their uptake by finger millet (Pooled of 2 Year).

Treatment	Potassium content (%)		Potassium uptake (kg/ha)			Calcium content (%)		Calcium uptake (g/ha)		
	Grain	Straw	Grain	Straw	Total	Grain	Straw	Grain	Straw	Total
S_1	0.65	1.33	14.79	65.51	80.31	345.11	315.89	785.24	1543.28	2328.52
S_2	0.64	1.29	14.08	60.13	74.21	335.59	315.24	736.66	1461.58	2198.24
S_3	0.62	1.23	11.40	45.53	56.94	325.42	305.41	601.98	1125.60	1727.58
S.Em. (±)	0.01	0.024	0.32	1.71	1.78	5.43	8.302	21.11	31.58	33.61
CD at 5%	0.02	0.068	0.92	4.86	5.07	15.44	NS	60.03	89.78	95.56
L_1	0.65	1.33	14.79	63.71	78.50	344.40	315.95	787.24	1498.47	2285.71
L_2	0.64	1.30	14.22	60.33	74.55	336.50	313.11	744.31	1442.24	2186.54
L_3	0.63	1.27	12.68	54.13	66.80	331.71	309.60	666.43	1318.95	1985.38
L_4	0.62	1.25	12.01	50.06	62.08	328.88	310.05	633.86	1247.62	1881.49
S.Em. (±)	0.01	0.03	0.37	1.97	2.06	6.27	3.661	24.38	36.46	38.81
CD at 5%	NS	NS	1.07	5.61	5.85	NS	NS	69.32	103.67	110.34
Interaction(SxL)										
S.Em. (±)	0.01	0.05	0.65	3.42	3.56	10.86	6.341	42.22	63.15	67.21

CD at 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Treat Mean	0.64	1.29	13.43	57.06	70.48	335.37	312.18	707.96	1376.82	2084.78
Control	0.61	1.29	12.94	60.06	73.00	331.00	301.56	701.76	1410.17	2111.92
Control v/s Rest										
S.Em. (±)	0.01	0.04	0.48	2.51	2.62	7.99	4.67	31.08	46.48	49.47
CD at 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
CV (%)	4.39	9.05	11.88	14.61	12.35	7.94	4.99	14.62	11.21	7.89

CONCLUSION

From the results of field experimentation, it can be concluded that application of 75% RDN through biocompost along with foliar application of banana pseudostem sap or Jeevamrut @ 1% at 15, 30 and 45 DAT is suitable for increased nutrient content and uptake by finger millet as well as farmers economy grown under organic farming system in South Gujarat conditions.

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