International Journal of Science, Environment and Technology, Vol. 8, No 4, 2019, 816 – 824

ISSN 2278-3687 (O)
2277-663X (P)

EFFECT OF KONKAN ANNAPURNA BRIQUETTES AND ORGANIC MANURES ON DTPA EXTRACTABLE MICRONUTRIENT IN THE SOIL UNDER SWEET POTATO CROP

Anuradha A. Harmalkar, S.B. Dodake and M.C. Kasture
Department of Soil Science and Agril. Chemistry
College of Agriculture, DBSKKV, Dapoli, Dist. Ratnagiri, Maharashtra

Abstract: A field experiment conducted during *Rabi*2016 entitled, "Effect of Konkan Annapurna Briquettes and organic manures on yield and quality of sweet potato" at Central Experiment station, Wakawali. The experiment was laid out in Factorial Randomized Block Design (FRBD) comprising twelve treatment combinations replicated thrice and observations were recorded at 35, 70 and after harvest. The effect of different inorganic fertilizers and organic manures *viz.,* Konkan Annapurna Briquettes, straight fertilizers, FYM and vermicompost either alone or in combinations on growth and yield were studied.The growth and yield parameters showed significant improvement as a consequence of various treatment combinations. It was observed that 75% RDN through Konkan Annapurna Briquettes (KAB), which was, applied 7 briquettes per 10 plants after one month of planting along with vermicompost @ 5 t ha^{-1} prior to planting, which found promising to enhance the available nutrient status of soil DTPA extractable micronutrient content.
Keywords: Konkan Annapurna Briquettes, organic manures, DTPA micronutrients.

Introduction

Sweet potato (*Ipomoea batata*) is the most important tuber crop which originated in Latin America (Horton 1988). It is a vegetatively propagated vegetable. It thrives in marginal soil but improved soil fertility increases its general performance and root yield. It ranks as the fifth most important food crop on fresh weight basis in developing countries after rice, wheat, maize, cassava. Today sweet potato grown in the warmer areas of temperate regions. Major part of sweet potato production takes place in China. In India, sweet potato is grown to an extent of area 126.4 ha with an annual production of 1454.3 MT and productivity of 11.5 MT ha^{-1} (Horticulture at a Glance 2017). Sweet potato, once mostly a directly consumed food crop has now a diversified market. The starchy tubers which serve as staple food in some countries. The tubers of sweet potato are used as animal feed and to a limited extent of raw material for industrial purpose as a source of starch. Sweet potato is a good source of carbohydrate.

The low use efficiency of N and P is because of various reasons such as volatilization, denitrification, surface runoff, leaching losses for nitrogen and fixation in soil for

*Received June 19, 2019 * Published Aug 2, 2019 * www.ijset.net*

phosphorus. Broadcast application of nitrogen as urea resulted in an average 10 times higher amounts of ammonium N in flood water compared to deep placement of KAB briquettes (Kapoor *et al.* 2008). Deep placement of fertilizers reduces volatilization loss (Mildkelson *et al.* 1978). Moreover, deep placement method of fertilizer application is environment friendly and will not decrease the normal fertility of land (BRRI, 2010).

Organic manuring of sweet potato improves soil health (Nedunchezhiyan and Srinivasulu Reddy, 2004). Incorporation of organic manures influences soil enzymatic activity either because of the composition of the added materials themselves or because they increase microbial activity of soil (Goyal *et al*., 1993). Organic material is used to prevent or improve the negative stresses effects in plants and yield decreasing. It is material to decrease soil salinity, increase the organic matter, improve the soil structure and increase water permeability by root developing in soil. It is one the best used fertilizers (Anonymous, 2010; Hassanpanah and Azimi, 2012). In recent years the potential of FYM, Vermicompost and Poultry manure to supply nurients and increasing yield and and quality of both horticultural and field crops being recognized widely. These organic sources influence availability of native nutrients. In absence of fertilizers crop entirely on the mineralization of organically bound nutrients. Organic manures increases yield of crop by supplying almost all nutrients in balanced quantities and prevent loss of nutrients.

The information regarding the effect of briquettes containing N, P, and K *i.e.* Konkan Annapurna Briquettes (34:14:6) and organic manures on DTPA micronutrients under sweet potato crop is not available. For increasing productivity an economical fertilizer package need to be formulated which can provide all the essential elements through both organic and inorganic sources to got good quality, produce with higher production and maintaining soil fertility, keeping the production cost at sustainable level of an average farmer. By keeping all these views in front, the present study was under taken.

Material and methods

A field experiment was conducted during *Rabi* season 2016 at the research farm of the AICRP on Tuber crops, Central Experiment Station Wakawali is situated in the tropical region on MSL $17^0$40’ to $17^0$45’ N and $73^0$16’ to $75^0$19’ E. The height above mean sea level is 167m to 1234m. Tahsil-Dapoli, Dist.-Ratnagiri. The soil of experimental site having pH 5.03, EC 0.21 dS m^{-1}, organic carbon 13 g kg^{-1}, available nitrogen 360.5 kg ha^{-1}, phosphorus 16.21 kg ha^{-1}, potassium 250.68 kg ha^{-1}, exchangeable calcium 4.5 meq.$100g^{-1}$, magnesium

1.9 meq.100g^{-1}, available sulphur 11.25 mg kg^{-1} and DTPA extractable Fe 29.52 mg kg^{-1}, Mn 99.14 mg kg^{-1}, Zn 0.97 mg kg^{-1}, Cu 2.9 mg kg^{-1}.

A field experiment was laid out in factorial randomized block design comprising of twelve treatment combinations with three replications. Sweet potato (*Ipomoea batatas*, (L) Lam.) var.S-56 2 was taken as a test crop during *Rabi* season 2016-2017 with a spacing 20×60 cm. The gross plot size was 2.0 m x 3.0 m. Tubers were planted on 6th December, 2016 and required intercultural operations were carried out time to time.With respect to fertilizer application, the four levels of inorganic fertilizer application viz., F_0- Absolute control, F_1- 100% RDF through straight fertilizers, F_2- 75% RDN through Konkan Annapurna Briquettes, F_3- 50% RDN through Konkan Annapurna Briquettes and three levels of organic manures viz., M_0- Absolute control, M_1- @ 10 t FYM ha^{-1}, M_2- @ 5 t vermicompost ha^{-1}. The recommended dose of fertilizer for sweet potato is 75:50:75 kg N:P_2O_5:K_2O ha^{-1}. In case of straight fertilizers, whole quantity of P and K applied at time of planting and application of N in split doses i.e. 50% N at planting and 50% N after one month of planting. Application of briquettes (75% RDN) i.e. 7 briquettes per 10 plants (50% RDN) i.e. 5 briquettes per 10 plants after 1 month of planting.

Table 1: Total nutrient added in each level of inorganic fertilizers

	N kg ha^{-1}	**P_2O_5 kg ha^{-1}**	**K_2O kg ha^{-1}**
F_0	-	-	-
F_1	75.00	50.00	75.00
F_2	56.25	23.16	9.93
F_3	37.50	15.44	6.61

Briquette preparation

Konkan Annapurna Briquettes were prepared as per ratio of fertilizer combination used with the help of 'Krantibriquetter'. The composition as well as details like average length, breadth, shape of briquettes is given in Table 4.

Table 2: Composition of briquettes

Sr. No.	**Briquette**	**Ratio**	**Avg. length (cm)**	**Avg. breadth (cm)**	**Avg. weight (g)**	**Shape**
1.	KAB	1:1.5	3.15	2.13	2.7	Oval flat

The representative surface soil samples (0–22 cm) were collected from each treatment plot at 35 and 70 days after planting and at harvest stage for analysis of pH, EC (Jackson, 1973), organic carbon by Walkley and Black wet digestion method (Black 1965), available nitrogen by alkaline permanganate (0.32% $KMnO_4$) method (Subbiah and Asija1956), phosphorusby Brays No.1 method (Bray and Kurtz, 1945), potassium by flame photometrically (Jackson 1973), exchangeable calcium and magnesium by determined titrimetrically by using Versenate solution (Chopra and Kanwar, 1978), available sulphur (Chesnin and Yien 1950) and DTPA extractable Fe, Mn, Zn, Cu were determined with Atomic Absorption Spectrophotometer (Lindsay and Norvell, 1978).Data were subjected to statistical analysis following Panse and Sukhatme (1967).

Result and discussion

Effect on DTPA extractable iron in soil

DTPA extractable iron in soil maximum in treatment F_2 (75% RDN through KAB) *i.e.* 32.18 and 26.39 mg kg^{-1} at 35 days after planting and at harvest and at 70 days after planting DTPA extractable iron in soil is non-significant respect to different levels of inorganic fertilizers. In case of organic manures application treatment M_2 (vermicompost @ 5 t ha^{-1}) recorded maximum DTPA extractable iron in soil *i.e.* 33.24, 33.30 and 28.02 mg kg^{-1} at 35, 70 days after planting and at harvest respectively. Interaction effect was showed significant results at 30 days after planting and harvest stage *i.e.* maximum DTPA extractable iron in soil 34.00 and 28.72 mg kg^{-1} respectively were recorded in treatment combination F_2M_2 (75 % RDN through KAB + vermicompost @ 5 t ha^{-1}). According to Kokare (2013) DTPA extractable Fe was highly available due to organic carbon content of soils, use of organic manures, decomposition of organic residues left in the field and climatic condition of the region.

Table 3: Effect on available iron content in soil at 35, 70 and at harvest of sweet potato

	DTPA extractable iron (mg kg^{-1})											
	35 DAP				**70 DAP**				**At harvest**			
	M_0	**M_1**	**M_2**	**Mean**	**M_0**	**M_1**	**M_2**	**Mean**	**M_0**	**M_1**	**M_2**	**Mean**
F0	29.15	31.67	32.43	**31.08**	28.90	32.42	33.18	**31.50**	23.91	26.47	27.25	**25.88**
F1	30.58	32.07	33.67	**32.11**	29.28	31.90	33.52	**31.57**	23.06	26.90	28.47	**26.14**
F2	30.42	32.12	34.00	**32.18**	29.78	32.10	33.82	**31.90**	23.60	26.84	28.72	**26.39**
F3	28.83	32.33	32.85	**31.34**	27.88	32.11	32.69	**30.89**	22.37	27.05	27.65	**25.69**
Mean	**29.75**	**32.05**	**33.24**		**28.96**	**32.13**	**33.30**		**23.24**	**26.82**	**28.02**	
	F	**M**	**F×M**		**F**	**M**	**F×M**		**F**	**M**	**F×M**	

S.E.(m)±	0.86	0.75	1.49	0.83	0.72	1.44	0.16	0.14	0.28
CD (P=0.05)	2.53	2.19	4.38	NS	2.11	NS	0.48	0.42	0.83

Effect on DTPA extractable manganese in soil

From the data, it was observed that in case of application of inorganic fertilizers DTPA extractable manganese in soil maximum in treatment F_1 (100% RDF through straight fertilizers) at 35days after planting i.e. 106.91 mg kg^{-1} and at 70 days after planting and harvest stage treatment F_2 (75% RDN through KAB) was recorded maximum DTPA extractable manganese (105.50 and 101.57 mg kg^{-1}). In case of organic manures application treatment M_2 (vermicompost @ 5 t ha^{-1}) recorded maximum DTPA extractable manganese in soil *i.e.* 111.03, 110.47 and 106.25 mg kg^{-1}at 35, 70 days after planting and at harvest respectively. Interaction effect was showed significant results at 35, 70 days after planting and at harvest *i.e.* maximum DTPA extractable manganese in soil 114.17, 113.60 and 107.98 mg kg^{-1} respectively were recorded in treatment combination F_2M_2 (75% RDN through KAB + vermicompost @ 5 t ha^{-1}). Similar results found by Kokare (2013) in chilli. Raut (2017) recorded highest maximum available Mn status at lateritic soils of Dapoli in treatment receiving 25% RDF + 75% RDN through vermicompost.

Table 4: Effect on available manganese content in soil at 35, 70 and at harvest of sweet potato

	DTPA extractable manganese (mg kg^{-1})											
	35 DAP				**70 DAP**				**At harvest**			
	M_0	**M_1**	**M_2**	**Mean**	**M_0**	**M_1**	**M_2**	**Mean**	**M_0**	**M_1**	**M_2**	**Mean**
F0	96.33	105.72	107.60	**103.22**	93.90	105.32	107.52	**102.25**	89.54	101.55	103.40	**98.16**
F1	99.37	109.00	112.35	**106.91**	96.50	108.70	111.10	**105.43**	91.90	105.03	107.77	**101.57**
F2	98.92	106.83	114.17	**106.64**	96.57	106.32	113.60	**105.50**	92.40	101.90	107.98	**100.76**
F3	94.58	108.33	110.00	**104.31**	92.08	107.80	109.65	**103.18**	87.86	103.56	104.80	**98.77**
Mean	**97.30**	**107.47**	**111.03**		**94.76**	**107.04**	**110.47**		**90.88**	**103.21**	**106.25**	
	F	**M**	**F×M**		**F**	**M**	**F×M**		**F**	**M**	**F×M**	
S.E.(m)±	0.59	0.51	1.03		0.43	0.37	0.74		0.31	0.27	0.90	
CD (P=0.05)	1.74	1.51	3.02		1.25	1.08	2.17		0.90	0.78	1.57	

Effect on DTPA extractable zinc in soil

It was observed that DTPA extractable zinc in soil was non-significant in case of inorganic fertilizers application and interactions at all growth stages of the crop. Only in case of organic manure application was showed significant results *i.e.* treatment M_2 (vermicompost @ 5 t ha^{-1}) recorded maximum DTPA extractable zinc in soil *i.e.* 1.13, 1.33 and 1.23 mg kg^{-1} at 35, 70 days after planting and at harvest respectively. Zn in all surface soils varied from 0.255 to 1.769 mg kg^{-1} with a mean value of 0.607 mg kg^{-1} reported by Mahajan (2011) According to Kokare*et al.* (2013) organic manures increases the available Zn content in soil. Similar results were also reported by Manjunatha B. (2006).

Table 5: Effect on available zinc content in soil at 35, 70 and at harvest of sweet potato

	DTPA extractable zinc (mg kg^{-1})											
	35 DAP				70 DAP				At harvest			
	M_0	M_1	M_2	Mean	M_0	M_1	M_2	Mean	M_0	M_1	M_2	Mean
F0	0.94	1.00	1.08	**1.01**	0.95	1.20	1.28	**1.14**	0.85	1.10	1.18	**1.04**
F1	0.96	1.07	1.16	**1.06**	1.01	1.27	1.36	**1.22**	0.91	1.17	1.26	**1.12**
F2	0.96	1.10	1.16	**1.07**	1.00	1.30	1.37	**1.22**	0.90	1.20	1.27	**1.12**
F3	0.98	1.04	1.10	**1.04**	1.01	1.24	1.31	**1.18**	0.91	1.14	1.21	**1.08**
Mean	**0.96**	**1.05**	**1.13**		**0.99**	**1.25**	**1.33**		**0.89**	**1.15**	**1.23**	
	F	**M**	**F×M**		**F**	**M**	**F×M**		**F**	**M**	**F×M**	
S.E.(m) ±	0.045	0.039	0.078		0.034	0.029	0.059		0.034	0.029	0.058	
CD (P=0.05)	NS	0.114	NS		NS	0.086	NS		NS	0.05	NS	

Effect on DTPA extractable copper in soil

DTPA extractable copper in soil is non-significant respect to different levels of inorganic fertilizers at 35, 70 days after planting and at harvest respectively. Regarding organic manures application treatment M_2 (vermicompost @ 5 t ha^{-1}) recorded maximum DTPA extractable copper in soil *i.e.* 3.63 and 3.47 mg kg^{-1} at 70 days after planting and at harvest respectively and at 70 days after planting DTPA extractable copper in soil is non-significant results. Interaction effect at 35 days after planting was also showed non-significant results and at 70 days after planting and at harvest interaction effect was showed significant results *i.e.* maximum DTPA extractable copper viz. 3.99 and 3.87 mg kg^{-1} in treatment combination F_2M_2 (75% RDN through KAB + vermicompost @ 5 t ha^{-1}). These results are conformity

with results obtained by Kokare (2013). According to Sharma *et al.* (2001) increase in available micronutrient status of soils in organically treated plots due to release of chelating agent from organic matter decomposition which might have prevented micronutrients from precipitation, oxidation and leaching.

Table 6: Effect on available manganese content in soil at 35, 70 and at harvest of sweet potato

	DTPA extractable copper (mg kg^{-1})											
	35 DAP				70 DAP				At harvest			
	M_0	M_1	M_2	Mean	M_0	M_1	M_2	Mean	M_0	M_1	M_2	Mean
F0	3.03	3.00	2.97	**3.00**	2.72	3.10	3.56	**3.12**	2.56	2.94	3.27	**2.92**
F1	2.68	3.13	3.12	**2.98**	2.78	3.10	3.52	**3.13**	2.62	3.07	3.36	**3.02**
F2	2.84	3.09	3.43	**3.12**	2.43	3.29	3.99	**3.24**	2.58	3.13	3.87	**3.20**
F3	2.87	3.13	3.03	**3.01**	2.64	3.23	3.46	**3.11**	2.43	3.07	3.37	**2.96**
Mean	**2.85**	**3.09**	**3.14**		**2.64**	**3.18**	**3.63**		**2.55**	**3.05**	**3.47**	
	F	**M**	**F×M**		**F**	**M**	**F×M**		**F**	**M**	**F×M**	
S.E.(m) ±	0.219	0.189	0.379		0.05	0.05	0.09		0.05	0.05	0.09	
CD (P=0.05)	NS	NS	NS		NS	0.13	0.27		NS	0.13	0.27	

CONCLUSION

In general, it is concluded that the amongst all treatment combinations, F_2M_2*i.e.* application of 75% RDN through KAB + vermicompost @ 5 t ha^{-1} found to be superior for maintaining the soil fertility with respect to the DTPA micronutrient content in the soils under sweet potato crop for sustainable period.

References

[1] Anonymous, (2010) Salt stress new: Focus on form. Retrieved from http://www.armansabz.adinehgroup.com

[2] Anonymous, (2017) Horticultural Statistics at a Glance. www.agricoop.nic.in.

[3] Black, C.A. (1965) Method of Soil Analysis Part-II. *American Society of Agronomy, Madison, Wisconsin, U.S.A.* pp. 1040-41, 1374-75.

[4] Bray, R. H. and Kurtz, L. T. (1945) Determination of total organic and availableforms of phosphate in soil. *Soil Science***59**: 39.

[5] BRRI, (2010) Annual Report of Soil and Fertilizer Management Programme. Bangladesh Rice Research Institute, Joydebpur, Gazipur. 2010, 15-20.

[6] Chopra, S.L. and. Kanwar, J.S. (1978) Analytical Agricultural Chemistry, Kalyani Publisher, Ludhiana, New Delhi, pp. 344.

[7] Goyal, S., Mishra, M.M., Dhankar, S.S., Kapoor, K.K., Batra, R. (1993) Microbial biomass turnover and enzyme activities following the application of farmyard manure to field soils with and without previous long term applications. *Biology and Fertility of Soils* **15**: 60-64.

[8] Hassanpanah, D., Jafar, A. (2012). Evaluation of 'Out Salt' anti-stress material effects on mini-tuber production of potato cultivars under in vivo condition. *Journal of Food, Agriculture & Environment***10** (1): 256-259.

[9] Jackson, M.L. (1973) *Soil Chemical Analysis*. Prentice Hall of India Pvt. Ltd., New Delhi. pp. 134-182.

[10] Kadam, (2016) Effect of Boron and Konkan Annapurna Briquettes on yield and nutrient uptake by okra [*Abelmoschus esculentus* (L.)] M.Sc. (Agri.) Thesis submitted to Dr. B. S. K. K.V., Dapoli. India (M. S) (Unpublished).

[11] Kapoor, V., Singh, U., Patil, S.K., Magre, H., Shrivastava, L.K., Mishra, Das, R.O., Samadhiya, V.K., Sanabria, J. and Diamond, R. (2008) Rice growth , grain yield and floodwater nutrient dynamics as affected by nutrient placement method and rate. *Agronomy Journal* **100**: 526-536.

[12] Kokare, (2013) Comparative efficacy of different fertilizer briquettes and organic manures on chilli (*Capsicum annuum* L. cv. Pusa Jwala) in lateritic soils of Konkan. M.Sc. (Agri.) Thesissubmitted to Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Dist. Ratnagiri, Maharashtra (Unpublished).

[13] Lindsay, W.L. and Norvell, W.A. (1978) Development of DTPA soil test for Zn, Fe, Mn and Cu. *Soil Science Society of America Journal* **42**: 421-428.

[14] Manjunatha, B. (2006) Impact of farmers organic farming practices on soil properties in Northern dry zone of Karnataka, M.Sc. (Agri) Thesissubmitted to University of Agricultural Sciences, Dharwad (India) (Unpublished).

[15] Mildkelson, D.S., De Datta, S.K. and Obcemea, W.N. (1978) Ammonia volatilization losses from flooded rice soils. *Soil Science Society of American Journal***42**: 725-730.

[16] Nedunchezhiyan, M. and Srinivasalu Reddy, D. (2004) Growth, yield and soil productivity as influenced by integrated nutrient management in rainfed sweet potato. *Journal of Root Crops* **30**(1): 41-45.

[17] Panse, V.G. and Sukhatme, P.V. (1967) Statistical methods for agricultural workers, ICAR, New Delhi.

[18] Patil, R.R. (2002) Integrated nutrient management studies on sweet potato in relation to its growth, yield, some quality parameters, nutrient content, nutrient uptake and nutrient availability in lateritic soils of Konkan. M.Sc. (Agri.) thesis submitted to the Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Ratnagiri, Maharashtra (Unpublished).

[19] Raut, S.V. (2017) Effect of organic manure and inorganic fertilizers on growth, yield, biochemical properties of brinjal and soil properties in lateritic soil of Konkan M.Sc. (Agri) Thesis submitted to Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Dist. Ratnagiri, Maharashtra.

[20] Sharma, M.P., Balf, S.V. and Gupta, D.K. (2001) Soil fertility and productivity of rice (*Oryza sativa*)-wheat (*Triticumaestivum*) cropping system in an inceptisol as influencedby Integrated Management. *Indian Journal of Agricultural Science* **71**(2): 82-86.

[21] Shinde (2011) Effect of nutrient management with and without paclobutarozol on growth, yield and nutrient uptake by groundnut var. Konkan Gourav in lateritic Soils of Konkan, M. Sc. (Agri.) Thesis submitted to Dr. B.S.K.K.V., Dapoli, India (M.S) (unpublished).

[22] Singh, G., Singh, O.P., Singh, R.G., Mehta, R.K., Kumar, V. and Singh, R.P. (2006) Effect of integrated nutrient management on yield and nutrient uptake of rice (*Oryza sativa*)-wheat (Triticumaestivum) cropping system in lowlands of eastern Uttar Pradesh. *Indian Journal of Agronomy*, **51**(2): 85-88.

[23] Subbiah, B.V. and G.L. Asija, (1956) A rapid procedure for the estimation of available Nitrogen in Soil. *Current Science* **25**(8): 259-260.