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Comparative Effect of Banana Pseudostem Scutching Waste, FYM and Biocompost on Water Stable Aggregate (WSA) and Available Nutrients in Soil after Harvest of Cabbage

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The field experiment was conducted at Soil and Water Management Farm of Navsari Agricultural University, Navsari to study the comparative effect of different organic manures on WSA and available nutrients. The experiment comprised of nine treatment of banana pseudostem scutching waste (SW), FYM and biocompost (BC) with or without combination and applied as FYM @ 10 t ha^{-1} carbon equivalent basis keeping the common dose of recommended inorganic fertilizer. After harvest of the crop there were no significant changes observed with respect to soil pH, EC and organic carbon content of the soil. While, significantly higher values of WSA (1.0 mm and >1.0 mm), available macronutrients (N, P_2O_5, K_2O and S) and micronutrients (Fe, Mn, Zn and Cu) content of soil were found with 100% FYM (O_0) at 0-15 and 15-30 cm depth of soil and this remained statistically at par with treatment O_2 (100% BC) and O_6 (75% FYM + 25% SW) in almost all the cases.

Introduction

Lack of adequate nutrient supply and poor soil structure are the main constraints to agricultural production systems in low-input agriculture. Chemical fertilizers and organic manures play a pivotal role in vegetable production and nutrient supply system is considered as one of the basic factor. It has been established beyond doubt that there is a positive correlation between fertilizer use and crop productivity. Farmers are using excessive chemical fertilizers leading to decline in soil organic carbon. The excessive uses of chemical fertilizers disrupt the structure and other physico-chemical properties of the soil and serious damage to ecology. Therefore, use of chemical fertilizer alone may not keep pace with time in maintenance of soil health for sustaining the productivity. Integrated use of organic and inorganic source of nutrient in vegetables is superior in application to chemical fertilizer alone (Sharma *et al.*, 2012).

The use of organic manures improves soil health and help in maximizing production. It involves utilization of local sources and hence, turned to be rational, realistic and amendment for soil. Integrated application of diverse source of nutrients improve the post-harvest soil fertility and subsequently helps for achieving much desired crop production with sustainable soil health (Chatterjee and Bandyopadhyay, 2014).

Presently, the banana pseudostem (60 to 80 t ha^{-1}) is absolute waste in most of the banana growing states of India. Disposal of pseudostem in a routine ways *i.e.*, dumping on field bunds and burning, disposing in nalla/natural drains *etc*. causing environmental problems (Anon., 2014). Use of banana pseudostem scutching waste (30-35 t ha^{-1}) as an organic for crop production at large scale can solve the problem of disposal of wastes and lack of organic matter in soil. On the other hand, a judicious combination of different organic and inorganic sources of nutrients might be helpful to obtain a good soil health for the subsequent crops.

Materials and Methods

Field experiment was conducted during the *rabi* season of 2015-16 at Soil and Water Management Farm of Navsari Agricultural University, Navsari, Gujarat. The soil of experimental field was clay in texture with $pH_{2.5}$ 8.3, $EC_{2.5}$ of 0.4 ds m^{-1} and organic carbon 0.62%. The experiment soil was low in available nitrogen (246 kg ha^{-1}) and sulphur (6 mg kg^{-1}), medium in available phosphorus (45 kg ha^{-1}) and manganese (8 mg kg^{-1}) and high in available potassium (410 kg ha^{-1}), iron (14 mg kg^{-1}), zinc (1.2 mg kg^{-1}) and copper (3 mg kg^{-1}). The experiment comprised of nine treatments of FYM, biocompost (BC) and banana pseudostem scutching waste (SW) and it's combinations *viz*., 100% FYM (O_0), 100% SW (O_1), 100% BC (O_2), 75% BC + 25% SW (O_3), 50% BC + 50% SW (O_4), 25% BC + 75% SW (O_5), 75% FYM + 25% SW (O_6), 50% FYM + 50% SW (O_7) and 25% FYM + 75% SW (O_8) were applied as basal on 10 t ha^{-1} FYM carbon equivalent basis with common dose of recommended fertilizer (100:50:50 N, P_2O_5, K_2O kg ha^{-1}).

Treatments were evaluated in randomized block design with three replications on cabbage variety "*Golden Acre*". In the experiment fresh banana pseudostem scutching waste was used which consist of pithy matter and cut fibers generated during fiber extraction from banana pseudostem. Chemical compositions of organic manures used in the experiment are given in Table 1. The methods follow for available nutrient estimation in soil samples were given in Table 2. Data pertaining to different parameters were statistically analyzed as per the methods described by Panse and Sukhatme (1967).

Results and Discussion

Water stable aggregates (WSA)

Application of 100% FYM gave significantly higher values of WSA fraction in the range 0.5-1.0 mm (23.3%) and >1.0 mm (59.3%) and was found to be at par with treatments O_2, O_3 and O_6 in case of 0.5-1.0 mm fraction and O_2 and O_6 in case of >1.0 mm fraction of WSA (Fig. 1). The beneficial effect of organic matter on aggregate stability was due to formation of clay-humus complexes (through binding of polyvalent cations adsorbed on clay surface) which would orient the chelating acidic functional group of humic material (carboxylic and phenols) towards the interior of aggregate, leaving aliphatic and aromatic hydrophobic components to face outward. This ultimately leaded to the formation of a water repellent coating with high surface tension, effectively reducing the water infiltration in to the aggregates and thereby improving stability of the aggregates. Angers and Carter (1996), Patel (2010) and Anon. (2013) also reported similar association between organic carbon and WSA.

Table.1 Composition of organics manures used in the experiment

Parameters	FYM	Biocompost	Scutching waste
OC (%)	21.55	25.05	34.45
N (%)	1.20	1.15	0.90
P_2O_5 (%)	0.40	0.35	0.20
K_2O (%)	0.50	0.45	0.59
Fe (mg kg^{-1})	3592	7706	1228
Mn (mg kg^{-1})	531	470	60
Zn (mg kg^{-1})	150	182	6
Cu (mg kg^{-1})	49	89	8
C:N ratio	18	22	38

Table.2 Methods followed for soil analysis

Sr. No.	Parameter analyzed	Method followed	Reference
1.	WSA	Wet sieving	Black (1965)
2	$pH_{2.5}$	Potentiometric	Jackson (1973)
3	$EC_{2.5}$	Conductometric	Jackson (1973)
5	Organic carbon	Walkley and Black titration (Modified)	Jackson (1973)
6	Available N	Alkaline permanganate	Subbiah and Asija (1956)
7	Available P_2O_5	Olsen's method	Olsen *et al.*, (1954)
8	Available K_2O	Extraction with 1 N NH_4OAc (pH 7), Flame photometric	Jackson (1973)
9	Available S	Turbidimetric (extraction with 0.15% $CaCl_2$)	Chaudhary and Cornfield (1966)
10	Fe, Mn, Zn and Cu	Extraction with DTPA and estimation with Atomic absorption spectrophotometer	Lindsay and Norwell (1978)

Table.3 Effect of organic manures on WSA, soil $pH_{2.5}$, $EC_{2.5}$ and organic carbon of cabbage field after harvest

Treatments	0-15 cm			15-30 cm		
	$pH_{2.5}$	$EC_{2.5}$ (dS m^{-1})	OC (%)	$pH_{2.5}$	$EC_{2.5}$ (dS m^{-1})	OC (%)
O_0 : 100% FYM	8.1	0.50	0.77	8.2	0.33	0.53
O_1 : 100% SW	8.3	0.41	0.65	8.3	0.33	0.49
O_2 : 100% BC	8.2	0.45	0.71	8.2	0.33	0.53
O_3 : 75% BC + 25% SW	8.2	0.43	0.76	8.2	0.31	0.48
O_4 : 50% BC + 50% SW	8.2	0.42	0.72	8.2	0.34	0.46
O_5 : 25% BC + 75% SW	8.3	0.40	0.70	8.3	0.30	0.47
O_6 : 75% FYM + 25% SW	8.1	0.50	0.68	8.2	0.32	0.53
O_7 : 50% FYM + 50% SW	8.3	0.41	0.68	8.3	0.28	0.45
O_8 : 25% FYM + 75% SW	8.3	0.42	0.75	8.2	0.32	0.49
SEm±	0.052	0.024	0.037	0.021	0.010	0.026
CD at 5%	NS	NS	NS	NS	NS	NS
CV%	1.10	9.31	8.89	0.45	5.69	9.17

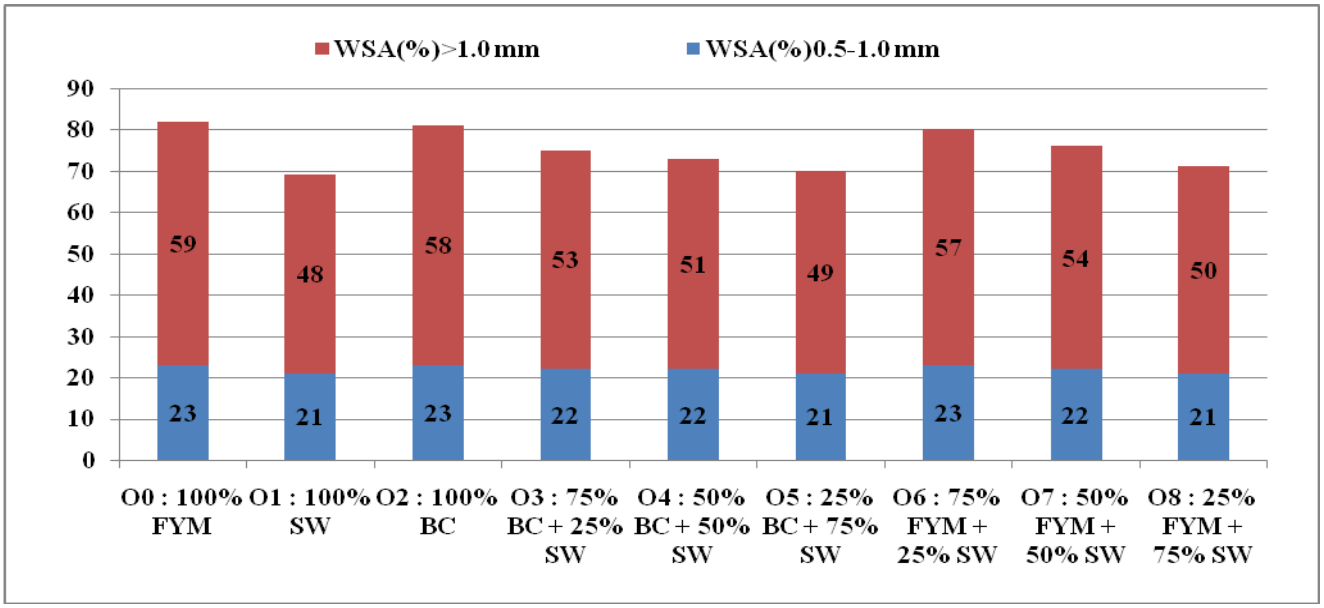
Table.4 Effect of organic manures on available N (kg ha^{-1}), P_2O_5 (kg ha^{-1}), K_2O (kg ha^{-1}) and S (mg kg^{-1}) content of cabbage field after harvest

Treatments	0-15 cm				15-30 cm			
	N	P_2O_5	K_2O	S	N	P_2O_5	K_2O	S
O_0 : 100% FYM	278.33	70.02	480.67	10.17	203.25	53.26	428.24	8.30
O_1 : 100% SW	251.65	45.00	420.88	6.60	169.84	29.76	354.00	4.91
O_2 : 100% BC	268.33	62.67	463.31	10.10	193.45	48.33	410.83	8.02
O_3 : 75% BC + 25% SW	260.67	55.33	449.10	9.27	185.76	40.33	373.33	7.00
O_4 : 50% BC + 50% SW	258.04	55.00	440.40	8.40	179.20	33.26	370.66	6.93
O_5 : 25% BC + 75% SW	257.67	47.68	425.63	6.64	177.92	32.51	368.33	5.70
O_6 : 75% FYM + 25% SW	264.74	60.02	464.30	9.83	197.37	46.92	402.21	8.10
O_7 : 50% FYM + 50% SW	261.74	47.54	448.38	6.79	187.07	36.00	372.93	5.40
O_8 : 25% FYM + 75% SW	253.00	44.61	444.84	7.20	182.04	33.92	362.19	4.97
SEm±	5.043	3.906	10.057	0.503	4.587	2.415	9.487	0.385
C.D. at 5%	15.12	11.71	30.15	1.51	13.75	7.24	28.44	1.15
C.V. %	3.34	12.48	3.88	10.46	4.27	10.63	4.30	10.11

Table.5 Effect of organic manures on available Fe, Mn, Zn and Cu content (mg kg^{-1}) in soil after harvest of cabbage

Treatments	0-15 cm				15-30 cm			
	Fe	Mn	Zn	Cu	Fe	Mn	Zn	Cu
O_0 : 100% FYM	16.76	10.06	1.68	4.62	11.99	8.35	1.05	3.90
O_1 : 100% SW	13.90	6.67	1.00	3.60	9.06	5.97	0.72	2.91
O_2 : 100% BC	15.98	9.32	1.56	4.46	11.95	8.23	0.96	3.72
O_3 : 75% BC + 25% SW	14.90	7.80	1.29	4.28	10.27	7.96	0.89	3.54
O_4 : 50% BC + 50% SW	14.52	7.33	1.19	4.12	10.32	6.87	0.86	3.52
O_5 : 25% BC + 75% SW	13.85	6.80	1.10	3.86	9.39	6.13	0.78	3.33
O_6 : 75% FYM + 25% SW	16.42	9.31	1.55	4.46	11.55	8.23	0.96	3.75
O_7 : 50% FYM + 50% SW	14.42	8.10	1.26	4.08	10.50	7.00	0.83	3.53
O_8 : 25% FYM + 75% SW	13.95	6.87	1.19	4.00	9.81	6.81	0.79	3.47
SEm±	0.299	0.289	0.051	0.105	0.295	0.242	0.036	0.116
C.D. at 5%	0.90	0.87	0.15	0.32	0.89	0.72	0.11	0.35
C.V. %	3.46	6.24	6.79	4.38	4.85	5.75	7.22	5.69

Fig.1 Effect of different organic manures on WSA of soil after harvest of cabbage



Soil pH, EC and organic carbon

The results presented in Table 3 revealed that application of different organic manures were failed to exert any significant effect on soil reaction ($pH_{2.5}$), electrical conductivity ($EC_{2.5}$) and organic carbon (OC) content in soil at both 0-15 and 15-30 cm depth.

Available macronutrients

Application of 100% FYM gave significantly higher value of available N (278.33 and 203.25 kg ha^{-1}), P_2O_5 (70.02 and 53.26 kg ha^{-1}), K_2O (480.67 and 428.24 kg ha^{-1}) and S (10.17 and 8.30 mg kg^{-1}) content at 0-15 and 15-30 cm depths of soil and remained at par with the treatments O_2 and O_6 in case of N, P_2O_5, K_2O at 0-15 and 15-30 cm and in case of S O_2 and O_6 at 0-15 cm and O_2, O_3 and O_6 at 15-30 cm depth of soil (Table 4). This might be due to incorporation of low C: N ratio containing organic manures in soil which hastened the mineralization process. This resulted in conversion of organic form of nutrient into inorganic form and thus nutrient availability in soil increased. These results are corroborating well with the results of Kanwer and Paliyal (2005), Prativa and Bhattarai (2011), Leninraja (2013) and Chatterjee and Bandyopadhyay (2014).

Available micronutrients

Application of 100% FYM (O_0) gave significantly higher value of available Fe (16.76 and 11.99 mg kg^{-1}), Mn (10.06 and 8.35 mg kg^{-1}), Zn (1.68 and 1.05 mg kg^{-1}) and Cu (4.62 and 3.90 mg kg^{-1}) content at 0-15 and 15-30 cm depths of soil. However, the treatment O_0 remained at par with the treatments O_2 and O_6 in case of Fe, Zn and Cu at their respective depths. In case of Mn, O_0 treatment remained at par with O_2 and O_6 at 0-15 cm and O_2, O_3 and O_6 at 15-30 cm depth of soil (Table 5). Micronutrients status of soil in organically treated plots might be due to release of chelating agents from organic matter decomposition which might have prevented micronutrients from precipitation, oxidation and leaching. Almost similar results were also reported by Patel (2010) and Anon. (2013).

On the basis of result obtained in present field investigation, it is concluded that basal application of organic manures in form of 100%

FYM or 100% biocompost or 75% FYM + 25% banana pseudostem scutching waste improves WSA and available nutrients of soil after harvest of cabbage.

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