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STUDY ON EFFECT OF DIFFERENT ORGANICS ON YIELD AND QUALITY OF ORGANICALLY GROWN ONION

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ABSTRACT
A field experiment to study the effect of different organic sources of nutrients on growth and yield of drip irrigated onion Cv. Nasik Red was carried out on organic plot (conversion phase) at Coastal Soil Salinity Research Station, Danti-Umbharat (Navsari Agricultural University, Gujarat) during *rabi* 2009-10 to 2011-12. In all seven treatments *viz.,* T_1: FYM, T_2: Bio-compost, T_3: Vermi-compost, T_4: FYM (50 % basal) + Castor cake (50 % top dressing), T_5: Bio-compost (50 % basal) + Castor cake (50 % top dressing), T_6: Vermi-compost (50 % basal) + Castor cake (50 % top dressing) and T_7: IBNM along with one control (INM – outside organic plot) were tested in RBD with four replications. The results revealed that leaf length and average bulb weight as well as bulb yield of onion were significantly higher when FYM, bio-compost and vermin-compost were applied in combination with castor cake than their individual application. With respect to control v/s rest analysis, effect on leaf length was not significant, while control treatment (INM) registered significantly higher average bulb weight of onion as compared to treatment mean. Control v/s rest analysis was not found significant on bulb yield of onion. Organically treated plot recorded significantly lower storage losses as compared to control treatment. After three year of experiment at fixed site, decrease in pH and EC and improvement in soil fertility and finer and coarser fraction of water stable aggregates was recorded in all the treatments received organic sources of nutrients as compared to plots received the INM treatment.

INTRODUCTION

Onion (*Allium cepa* L) is a member of the *Alliaceae* family and its one of the most important vegetables in the world, whose utility is ranked second to tomatoes (Brice *et al.*, 1997). India is the second largest producer of onion in the world, next to China, accounting for 22.18 per cent of the world area and 18.78 per cent of the world production. In India, onion is being grown in an area of 0.83 million hectares with production of 13.57 million tonnes and productivity is 16-30 tonnes per hectare which is low. The leading onion growing states are Maharashtra, Karnataka, Gujarat, Bihar, Madhya Pradesh, Andhra Pradesh, Rajasthan, Uttar Pradesh, Haryana and Tamil Nadu. In Gujarat, onion cultivation has increased from 38.8 thousand hectares in 2009-10 to 62.0 thousand hectares in 2010-11. Accordingly, onion production in Gujarat is almost double to 1.62 million tonnes in 2010-11 as against 1.08 million tonnes in 2009-10 (Pawar *et al.*, 2013). Since, onion being bulbous crop, its cultivation is mostly preferred on light textured soils of Saurastra and middle Gujarat. However, by adopting suitable agro techniques it can be successfully cultivated in heavy soils also (Pawar *et al.*, 2013).

Generally excessive amount of inorganic fertilizers are applied to vegetables in order to achieve a higher yield (Stewart *et al.*, 2005). However, the use of inorganic fertilizers alone may cause problems for human health and the environment (Arisha and Bardisi, 1999). Organic manure can serve as alternative practice to mineral fertilizers (Naeem *et al.*, 2006) for improving soil structure (Dauda *et al.*, 2008) and microbial biomass (Suresh *et al.*, 2004). Therefore, utilization of locally produce manure by vegetable production, operation may increase crop yields. In recent times, consumers are demanding higher quality and safer food and highly interested in organic products. Hence, the aim of this study was to determine cheaper source of organics for onion grown on partially reclaimed coastal salt affected soils.

MATERIALS AND METHODS

A field experiment was conducted with onion Cv. Nasik red on the field which was under *Acacia auriculiformis* plantation for seven years at Coastal Soil Salinity Research Station, Danti, Navsari Agricultural University, Navsari (72°50′ E longitude and 20°83′N latitude. The mean sea level is ranging from 0-2.5m) during *rabi* 2009-10 to 2011-12 to study the effect of different organics on yield and quality of organically grown onion. The soil was slightly saline (EC: 0.79 dS/m) and alkaline (pH 9.34), low in organic carbon (0.39 %), medium in available P_2O_5 (31.2 kg/ha) and high in available K_2O (1320 kg/ha) content. Total of seven organic treatments *i.e.*, T_1: FYM,-100 % basal T_2: Bio-compost- 100 % basal T_3: Vermi-compost- 100 % basal T_4: FYM (50 % basal) + 50 % castor cake (top dressing), T_5: Bio-compost (50 % basal) + castor cake (50 % top dressing), T_6: Vermi-compost (50 % basal) + castor cake (50 % top dressing) and T_7: IBNM (Table 1) along with one control (INM – outside organic plot) were tested in RBD with four replications. Dhanchhia green manuring was followed as common practice and all the organics were applied

on N-equivalent basis (Table 2). During all the three years, 45 days old onion seedlings were transplanted on raised bed at 15 x 10 cm spacing in 3.6 x 3.0 m plot size in the month of December. In organic treatments, irrigation was applied through drip @ 0.6 PEF, while in control plot surface irrigation method at 0.8 IW/CPE ratio, 60 mm depth was practiced. In control treatments inorganic fertilizer was applied @ 80:40:00 NPK kg/ha. Half dose of N and full dose of P was applied as basal, while remaining half dose of N was top dressed at 40 days after transplanting. Five plants were selected randomly and tagged in each plot for recording the observations on plant height, average bulb weight and bulb yield, weight loss after six month were recorded and analysed statistically (Panse and Sukhatme, 1967). Initial and treatment wise soil samples after harvest of last crop were also taken for analysing physic-chemical properties of soil (Richards, 1954).

RESULTS AND DISCUSSION

Growth and yield

Plant height of onion was affected significantly due to different treatments (Table 3). Treatments *viz*., T_5 (Bio-compost + castor cake), T_4 (FYM + castor cake), T_6 (Vermi-compost + castor cake) and T_7 (IBNM) recorded statistically identical plant height but were significantly superior over T_3 (Vermi-compost), T_1 (FYM) and T_2 (Bio-compost). De *et al.*, (2013) also reported increase in growth parameters of onion due to application of sea weed fertilizer (Biozyme). However, difference between control *v/s* rests mean was found non-significant in respect of plant height. Average bulb weight of onion was also affected significantly due to different treatments. Among the treatments T_6, T_4 and T_5 registered statistically equal bulb weight but all the three treatments were found better than treatments T_3, T_7, T_2 and T_1. With respect to control *v/s* rest analysis, the control treatment recorded significantly higher average bulb weight as compared to treatment mean. Similar results were recorded by Singh and Sachan (1998), Naruka and Singh (2002) in garlic and Shanti and Balakrishnan (1989) in aggregatum onion.

Table 1: IBNM treatment details

Item	Soil application /ha (basal)	Foliar application/ ha (40 DAT)
Water	500 litre	500 litre
Cow dung	50 kg	50 kg
Cow urine	25 litre	15 litre
Jeggary	5 kg	-
Butter milk	5 litre	-
Pulse flour	2 kg	-
Undisturbed Banyan tree Earth	2.5 kg	1 kg
Period	2-7 days	48 hours

Table 2: Quantity of organics applied on N equivalent basis

Organics	N content (%) (Dry basis)	Moisture content (%)	Quantity of organics for getting 80 kg N/ha (kg/ha)
Year 2009-10			
Bio-compost	0.94	21	10773
Vermi-compost	1.29	33	9256
FYM	0.57	24	18467
Castor cake	4.30	0	1860
Year 2010-11			
Bio-compost	0.98	24	10741
Vermi-compost	1.35	32	8715
FYM	0.51	19	19366
Castor cake	4.20	2	1944
Year 2011-12			
Bio-compost	0.92	21	11007
Vermi-compost	1.27	35	9691
FYM	0.55	24	19139
Castor cake	4.40	0	1818
Mean			
Bio-compost			10840
Vermi-compost			9220
FYM			18990
Castor cake			1874

The results of bulb yield of onion as affected by different treatments are given in table 4. The results revealed that during 1st year of experiment bulb yield was not affected significantly due to different treatments. During subsequent two years and in pooled results, the bulb yield of onion was affected significantly due to different treatments. In all the cases, treatment T_5 registered significantly higher bulb yield of onion as compared to rest of the treatments, but it remained at par with T_4 and T_6 during 2nd and 3rd year. In pooled results, treatment T_5 was at par with T_4, T_6 and T_7. In treatments, T_4, T_5, T_6 and T_7 the organics were applied in two splits *i.e.*, basal and 40 DAP (Days After Planting). This might have enhanced the bulb yield. With respect to control v/s rest analysis, it was not significant during individual years as well as in pooled results. Jawadagi *et al.* (2012) reported higher bulb yield of onion with application of FYM + Bio-compost + Bio-fertilizer in Karnataka. These findings are also in line with the results reported by Muthuramalingam *et al.* (2000) in sweet pepper and Prabhakarana (2000) in tomato.

Storage loss

Treatment wise samples were kept for period of six months to study the post-harvest losses. The results indicated that minimum weight loss was recorded in treatment T_6 (16.9 %) and next in order were T_5 (17.0 %), T_4 (17.6 %) and T_2 (18.2 %). The maximum loss was recorded in treatment T_1 (21.0 %). The control v/s rest analysis showed that the significantly higher weight loss was recorded with control (22.3 %) as compared to treatment mean (20.3 %).

Soil reaction and salinity

The effect of different treatments on soil pH at both the depths found to be not significant during all the years (Table5). With respect to control v/s rest analysis, the effect on soil pH was found to be significant during 2nd and 3rd year of experiment. During both the years organically treated plots recorded significantly lower soil pH in both the layers as compared to control (INM). After three years of experimentation, irrespective of treatments, pH of surface soil decreased from 9.34 to 8.55. While that of subsurface soil was from 9.21 to 9.02. The corresponding decrease in pH of control plot was from 9.38 to 8.97 in surface layer. The decrease in pH might be attributed to the production of CO_2 and organic acids during decomposition of added organics (Yaduvanshi, 2001, Natarajan and Mahendran, 2005).

The soluble salt content in soil was affected significantly due to organics in surface layer during 2nd year and in both the

Table 3: Leaf length (cm), average bulb weight (g) and per cent weight losses under different treatments

Treatments	Pooled Leaf length (cm)	Av. Bulb weight (g)	Weight loss (%) after 6 months
T_1	38.7	38.5	21.0 (27.6)
T_2	36.9	39.5	18.2 (25.0)
T_3	39.0	41.5	20.2 (27.3)
T_4	41.0	48.6	17.6 (26.5)
T_5	44.8	50.1	17.0 925.6)
T_6	44.0	50.5	16.9 (26.1)
T_7	40.8	41.4	20.3 (26.0)
S.Em+	1.55	2.00	0.84
CD @ 5 %	4.36	5.64	2.38
Control v/s rest			
Treatment mean	40.7	44.3	18.7
Control mean	42.0	47.5	22.3 (26.2)
S.Em+	0.67	0.87	0.37
CD @ 5 %	NS	2.46	1.04
CV %	7.6	8.9	8.8

*Figure in parenthesis are Are sin value

Table 4: Effects of different treatments on bulb yield of onion (t/ha)

Treatments	Year 2009-10	2010-11	2011-12	Pooled
T_1	19.4	20.7	20.3	20.1
T_2	22.4	22.4	21.7	22.2
T_3	21.8	21.9	21.5	21.7
T_4	25.2	27.8	26.5	26.5
T_5	28.9	30.3	29.6	29.6
T_6	27.2	27.6	29.0	27.9
T_7	23.6	24.3	23.5	23.8
S.Em+	2.3	2.1	1.9	2.1
CD @ 5 %	NS	6.2	5.7	5.9
Control v/s rest				
Treatment mean	24.1	25.0	24.6	24.5
Control mean	23.1	24.1	25.9	24.4
S.Em+	0.9	0.8	0.7	0.9
CD @ 5 %	NS	NS	1.04	NS
CV %	19.4	16.9	15.5	16.9
Y x T		NS		

Table 5: Soil reaction (pH) and salinity under different treatments (Initial and after third year)

Treatment	$pH_{1:2.5}$		$EC_{1:2.5}$ (dS/m)	
	0-15 cm	15-30 cm	0-15 cm	15-30 cm
Initial	9.34	9.21	0.79	9.21
T_1	8.57	8.76	0.51	0.66
$T_{28.79}$	8.48	8.84	0.53	0.54
T_3	8.48	8.58	0.61	0.63
T_4	8.40	8.57	0.38	0.40
T_5	8.60	8.62	0.42	0.54
T_6	8.60	8.68	0.40	0.49
T_7	8.74	8.81	0.63	0.68
S.Em+	0.10	0.16	0.03	0.03
CD @ 5 %	NS	NS	0.09	0.10
Control v/s Rest				
Treatment mean	8.55	8.39	0.50	0.56
Control mean	8.97	9.02	0.81	0.98
S.Em+	0.04	0.06	0.01	0.01
CD @ 5 %	0.11	0.18	0.03	0.04
CV %	2.3	3.77	11.29	10.89

depths during 3rd year of experiment (Table 5). In surface layer, treatment T_4 registered significantly lower value of EC than rest of the treatments during 2nd year and during last year treatment T_4, T_5 and T_6 registered significantly lower value of EC than rest of the treatments. While in subsurface layer, treatments T_4 and T_5 recorded significantly lower value of EC than rest of the treatments. In control v/s rest analysis, during 2nd and 3rdyear of experiment, organically treated plots recorded significantly lower values of EC as compared to control plots at both the depths. The decrease in soluble salt content in soil could be due to application of organics facilitating leaching of salts by virtue of improvement of aggregation (Swarup, 1992, Natarajan and Mahendran, 2005).

Soil fertility

Organic carbon content in soil was influenced significantly due to different treatments during all the years at both the depths. In almost all the cases, treatment T_5 and T_6 recorded significantly higher values of organic carbon content in soil as compared to rest of the treatments, but these treatments remained at par with some of the treatments. In all the cases, organically treated plot registered significantly higher values of organic carbon as compared to control (Table 6). Increase in organic carbon content in soil could be due to addition of organics. Similar results are also reported earlier by Karki *et al.* (2005) and Tripathi *et al.* (2009).

During all the three years, available P_2O_5 content in soil after harvest of crop was influenced significantly due to different treatments (Table 6). During 1styear, available P_2O_5 in both the layers was significantly higher in treatment T_4 as compared to rest of the treatments. During 2nd year, it was significantly higher in treatment T_2 in surface layer and in treatment T_3 in subsurface layer in comparison to rest of the treatments. During 3rd years, in surface layer available P_2O_5 content was significantly higher in treatment T_3 and in subsurface layer it was significantly higher with treatment T_2 as compared to rest of the treatments. During all the years, organically treated plots registered significantly higher values of available P_2O_5 as compared to control plot. However, available K_2O content in soil was not affected significantly due to different treatments during all the three years. Similarly, control v/s rest analysis, it was not affected significantly except during 2nd year in surface layer and 3rd year subsurface layer, where in control plot recorded significantly higher values of available K_2O as compared to treatment mean (Table 6). Bandopadhayay *et al.* (2001) and Tripathi *et al.* (2009) also reported improvement in nutrient status of salt affected soils through application of organics.

Water stable aggregates (WSA)

There was marked improvement in aggregation of finer and coarser fractions in organically treated plots after three years of experiment (Table 7). On an average, coarser fraction *i.e.*, e" 1.0 mm size improved by around 10-15 per cent in both the layers. While the improvement in finer fraction *i.e.*, 0.5 to 1.0 mm size WSA was around 7 per cent in surface layer and 8 per cent in subsurface layer. An improvement in aggregation due to addition of organics could be attributed to the binding of clay particles by partially decomposed organic matters (Desai *et al.*, 2009).

From the results, it is concluded that to get higher bulb yield from organically grown drip irrigated onion on coastal salt

Table 6: Soil fertility under different treatments (Initial and after third year)

Treatment	Available P_2O_5 (kg/ha)		Available K_2O (kg/ha)		Organic carbon (%)	
	0-15 cm	15-30 cm	0-15 cm	15-30 cm	0-15 cm	15-30 cm
Initial	31.2	24.6	1320	1278	0.37	0.33
T_1	28.14	22.18	1359	1510	0.65	0.54
$T_{28.79}$	34.73	28.69	1461	1549	0.85	0.76
T_3	37.20	24.34	1445	1509	0.92	0.83
T_4	27.05	23.25	1438	1582	0.98	0.89
T_5	34.73	26.51	1543	1565	0.96	0.84
T_6	29.05	25.96	1521	1541	0.90	0.84
T_7	28.42	26.51	1576	1490	0.77	0.72
S.Em+	1.32	0.83	61.73	62.33	0.04	0.02
CD @ 5 %	3.88	2.43	NS	NS	0.11	0.05
Control v/s Rest						
Treatment mean	31.33	25.35	1478	1535	0.86	0.77
Control mean	36.85	32.75	1481	1790	0.59	0.54
S.Em+	0.51	0.32	23.76	23.99	0.01	0.01
CD @ 5 %	1.47	0.92	NS	69.20	0.04	0.02
CV %	8.25	6.29	8.35	7.96	9.31	4.52

Table 7: Water Stable Aggregates (%) under different treatments (Initial and after third year 2011-12)

Treatment	Depth			
	0-15 cm		15-30 cm	
	e" 1.0 mm	0.5-1.0 mm	e" 1.0 mm	0.5-1.0 mm
Initial	32.40	9.47	25.42	6.89
T_1	44.43	13.21	34.37	12.21
T_2	41.99	13.82	33.58	12.75
T_3	42.48	13.96	34.62	13.00
T_4	42.09	14.94	43.11	13.55
T_5	47.08	16.29	43.36	14.47
T_6	54.46	15.95	42.67	14.90
T_7	53.10	15.00	37.84	14.28
Control	41.83	12.16	30.34	11.48

affected soils of South Gujarat, application of recommended dose of N @ 80 kg/ha of which 50 per cent N through bio-compost as basal and remaining 50 per cent N through castor cake at 40 DAT is essential. Application of organics also decreases salinity of soil and improves organic carbon status of soil. The conventionally cultivated onion (surface irrigation + INM) is also feasible under coastal salt affected soil conditions.

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