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Effect of Solid and Liquid Organic Manures on Growth, Yield and Economics of Sweet Corn (Zea *mays* L. *Var. Saccharata Sturt*) under south Gujarat condition

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ABSTRACT

A field experiment was conducted during rabi season of 2016-17 at Organic Farm (F block), Aspee College of Horticulture and Forestry Research Station, Navsari Agricultural University, Navsari Gujarat. The experiment was laid out in a Factorial Randomizes Block Design, comprising fifteen treatment combinations. The results indicated that application of 100% RDN through Nadep compost (O1) significantly increased plant height, stem girth, cob length, cob girth, cob weight/plant, green cob (15801 kg/ha) and fodder (19628 kg/ha) yield and was statistically on par with treatment O2 (75% RDN through Nadep compost) except stem girth. Similarly, significantly higher plant height, cob weight/plant, green cob (16145 kg/ha) and fodder (20068 kg/ha) yield; cob length and cob and stem girth were noted with application of Jeevamrut (L1), Panch gavya (L3) and Sanjeevak (L4) @ 600 L/ha, respectively. The protein content in sweet corn grain was not significantly affected either by different levels of Nadep compost or liquid organics. Significantly higher total reducing (3.20%) and non reducing (19.54%) sugar content in sweet corn grain was recorded under the treatment O1 while, in case of liquid organics significantly higher total reducing (3.19%) and non reducing sugar (19.57%) content were recorded under the treatments L3 and L1, receiving Panch gavya and Jeevamrut @ 600 L/ha.

Key words: *Sweet corn, Growth, Yield, Solid, Liquid organics.*

INTRODUCTION

Sweet corn (*Zea mays* L., *Saccharata Sturt*) is a popular multipurpose cereal crop belonging to the family *Poaceae* and is cultivated as an annual field crop all over the world[28]. The productivity potential of sweet corn is higher than that of wheat and nutritive status is superior to rice on account of higher sugar per cent. In context of recent liberalization, WTO, economic policy of Indian government is to boost export trade and food industry where sweet corn production technology promise better for export in the world market and for creating of employment in the agricultural sector through canning industry.

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Indiscriminate use of agro-chemicals, continuous cropping, inadequate replacement of nutrients, burning of crop residues and loss of nutrients through erosion degrade the soil physical, chemical and biological properties[8, 9]. Hence, there is a need to develop the organic crop production technology for sustenance of soil health. Sweet corn is an exhaustive crop and it is harvested at milky stage and requires fertile soils for optimum production. So organic farming is becoming an increasingly important aspect of environmentally sound sustainable agriculture. Organic materials hold a great promise due to local availability as a source of multiple nutrients and ability to improve soil characteristics. In this context, it is worth to study the nutrient management options through organics. The use of organics plays a major role in maintaining soil health due to build-up of soil organic matter, beneficial microbes. To sustain the soil fertility and crop productivity, the role of solid organic manures *viz*. Nadep compost, bio compost, vermi compost and fermented liquid organic manures mainly *Jeevamrut*, *Panchagavya*, *Sanjeevak*, *Amrut pani*, bio-digester liquid and cow urine etc., are very important.

MATERIAL AND METHODS

An experiment was conducted during the year rabi 2016-17 at Organic Farm (F block), Aspee College of Horticulture and Forestry Research Station, Navsari Agricultural University, Navsari. The soil of the experimental field was alkaline in reaction (7.82), medium in salt and DTPA-Zn content (0.55 mg/kg), high in organic carbon, available P_2O_5, K_2O, DTPA-Fe, DTPA-Mn, DTPA-Cu (95.30 kg/ha, 582 kg/ha, 14.24 mg/kg, 13.96 mg/kg and 2.68 mg/kg respectively) and deficient in available N content (232 kg/ha). The experiment was laid out in a Factorial Randomizes Block Design, comprising fifteen treatment combinations, three levels of Nadep compost (**O_1**: 100% RDN through Nadep compost **O_2**: 75% RDN through Nadep compost and **O_3**: 50% RDN through Nadep compost) and five types of liquid organic manures (**L_0**: control- no liquid manure, **L_1**: *Jeevamrut* @ 600 L/ha, **L_2**: *Amrut pani* @ 600 L/ha, **L_3**: *Panch gavya* @ 600 L/ha and **L_4**: *Sanjeevak* @ 600 L/ha which were repeated three times with irrigation. The seeds were inoculated with *Azotobacter*. Sweet corn SUGAR-75 was sown at 10/11/2016 by dibbling two seeds per hill at 60 X 15 cm2 spacing. The observations recorded were tabulated, analyzed and interpreted herein. The data pertaining to growth and yield contributing characters, yield, and quality parameter were statistically analyzed as per the methods described by Steel and Torrie[31].

Table 1: Methods followed for soil, plant and irrigation water sample analysis

Parameters		Methods	References
Soil chemical and Fertility parameters			
i	pH	Potentiometric,	Jackson (1973)
ii	EC	Conductometric	Jackson (1973)
iii	Organic carbon	Wet oxidation	Jackson (1973)
iv	Available N	Alkaline permanganate method	Subbiah and Asija (1956)
v	Available P_2O_5	Spectrophotometric (0.5M $NaHCO_3$, pH 8.5)	Olsen *et al.* (1954)
vi	Available K_2O	Flame photometric (Neutral N NH_4OAc)	Jackson (1973)
vii	DTPA-extractable Fe, Zn, Mn, Cu	Atomic absorption Spectro photometer method (DTPA)	Lindsay and Norvell (1978)
Quality parameters			
i	Crude protein	Total N determined by Wet digestion (Chromic acid) method and Crude Protein(%) was calculated using the formula = Total N X 6.25	Trivedi *et al*. (1999)
ii	Total Reducing Sugar	DNS method	Asana and Saini (1962)
iii	Total Non Reducing sugar	DNS method	Malhotra and Sarkar (1979)
Plant analysis			
i	Total N	Wet digestion (Chromic acid)	Trivedi *et al*. (1999)
ii	Total P, K, Fe, Mn, Zn, Cu	Wet digestion (Diacid) P:Vanedomolybdo yellow color method K: Flame photometry Fe, Zn, Mn, Cu: Atomic absorption Spectrophotometer method	Jackson (1973)

RESULT

Effect on growth, yield attributes and quality parameters:

Data pertaining to growth, yield attributes and quality of sweet corn *viz*., plant height and stem girth, cob length, cob girth, cob weight/plant, green yield and fodder, protein, total reducing and non reducing sugar recorded at harvest as influenced by solid organics (O) and liquid organics (L) and their interaction, solid organics X liquid organics (O x L) are presented in table 2.

The plant height, stem girth, cob length, cob girth, cob weight/plant, green cob and fodder yield, total reducing and non reducing sugar of sweet corn was significantly influenced by application of solid organics. Among the different levels of Nadep compost, treatment O_1 (100% RDN through Nadep compost) significantly higher and was at par with treatment O_2 (75% RDN through Nadep compost) incase of plant height, cob length, cob girth, cob weight/plant, green cob and fodder yield and total non reducing sugar, while, treatment O_3 (50% RDN through Nadep compost) produced significantly the lowest plant height (178.73 cm) of sweet corn.

The plant height, stem girth, cob length, cob girth, cob weight/plant, green cob and fodder yield, total reducing and non reducing sugar of sweet corn was also significantly affected by soil application of different liquid organic manure. Among the applied five liquid organics treatments, application of L_1 treatment (*Jeevamrut* @ 600 L/ha) generated significantly taller plant, cob wieth/plant, green cob and fodder yield and total non reducing sugar and was statistically on par with treatment L_2 and L_3, receiving *Amrut pani* and *Panch gavya* @ 600 L/ha, respectively. Treatment L_4 (Sanjeevak @ 600 L/ha) produced significantly higher stem girth and cob girth, with treatment of *Jeevamrut* and *Panch gavya* at par. By application of (Panch gavya @ 600 L/ha) (L_3) noted significantly higher cob length and total reducing sugar and at par with treatments of *Jeevamrut* and *Sajeevak*. While, the treatment receiving no liquid organic manure (L_0) showed significantly the lowest growth and yield of sweet corn.

Protein:

No significant effect of different levels of Nadep compost, different liquid organics and their interactions were observed on protein content of sweet corn grain (Table 2). However, in case of solid organic levels, slightly higher protein content (11.24%) was noted under the application of Nadep compost @ 50% RDN (O_3) while among the liquid organics, application of *Amrutpani @* 600 L/ha (L_2) gained slightly higher protein content (11.17%).

The interaction between solid organics x liquid organics (O X L) failed to exert any significant effect on growth, yield attributes and quality of sweet corn.

Economics:

In general significant experimental results on growth, yield and quality were only obtained with treatments solid organics (O) and liquid organics (L). With respect to net income, it was found maximum with solid organic treatment O_2 (Rs. 294130/ha) with CBR (4.01), receiving 75% RDN through Nadep compost and that of minimum with treatment O_3 (Rs. 280983/ha) with CBR (4.35), receiving 50% RDN through Nadep compost. While among the soil applied different organic liquids, highest net income of Rs. 331412/ha with CBR (6.41) was realized with treatment L_1, receiving *Jeevamrut* @ 600 L/ha (L_1) and minimum net income (Rs. 272931/ha) by CBR (5.78) with treatment L_0, receiving no liquid organics.

Table 2: Effect of solid organics (O), liquid organics (L) and their interaction (O x L) on growth attributes of sweet corn

Treatments	Plant height (cm)	Stem girth (cm)	Cob length (cm)	Cob girth (cm)	Cob weight /plant (g)	Green cob yield (kg/ha)	Green fodder yield (kg/ha)	Protein content (%)	Total Reducing sugar (%)	Total non reducing sugar (%)
Solid organic manure (O)										
O_1	193.60	2.59	22.79	20.00	306.70	15801	19628	10.96	3.20	19.54
O_2	190.13	2.44	21.70	19.41	298.60	15452	19478	11.09	3.00	19.19
O_3	178.73	2.33	19.87	17.03	288.87	14543	18253	11.24	2.93	18.70
S. Em. ±	**1.61**	**0.04**	**0.43**	**0.47**	**3.60**	**343**	**349**	**0.21**	**0.06**	**0.16**
CD @ 5 %	**4.67**	**0.11**	**1.25**	**1.36**	**10.47**	**995**	**1012**	**NS**	**0.16**	**0.48**
Liquid organic manure (L)										
L_0	182.56	2.36	19.72	16.99	267.11	13489	16791	11.06	2.90	18.02
L_1	191.78	2.48	21.58	19.34	312.78	16145	20068	11.14	3.02	19.57
L_2	187.56	2.40	21.00	18.66	290.44	14829	18774	11.17	2.95	19.48
L_3	190.11	2.50	22.84	18.61	309.67	15985	19910	11.11	3.19	19.12
L_4	185.44	2.59	22.11	20.47	310.22	15879	20052	11.02	3.13	19.46
S. Em. ±	**2.08**	**0.05**	**0.55**	**0.60**	**4.67**	**443**	**451**	**0.28**	**0.07**	**0.21**
CD @ 5 %	**6.03**	**0.13**	**1.61**	**1.76**	**13.52**	**1284**	**1306**	**NS**	**0.21**	**0.62**
Interaction (O x L)										
S. Em. ±	**3.60**	**0.08**	**0.96**	**1.05**	**8.08**	**768**	**781**	**0.49**	**0.12**	**0.37**
CD @ 5 %	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**
CV %	**5.33**	**5.57**	**7.82**	**9.70**	**6.43**	**8.7**	**7.1**	**7.58**	**7.22**	**5.33**

Table 3: Economics of experimental sweet corn crop

Treatments	Grain yield (kg/ha)	Fodder yield (kg/ha)	Gross realization (Rs./ha)	Fixed cost	Treatment cost (Rs/ha)	Total cost of cultivation (Rs/ha)	Net income (Rs/ha)	BCR
Solid organic manure (O)								
O1	15801	19628	374904	47222	34829	82051	292853	3.57
O2	15452	19478	367474	47222	26122	73344	294130	4.01
O3	14543	18253	345619	47222	17414	64636	280983	4.35
Liquid organic manure (L)								
L0	13489	16791	320153	47222	0	47222	272931	5.78
L1	16145	20068	383104	47222	4470	51692	331412	6.41
L2	14829	18774	352902	47222	4470	51692	301210	5.83
L3	15985	19910	379430	47222	14670	61892	317538	5.13
L4	15879	20052	377736	47222	4470	51692	326044	6.31

Note:
Selling price of sweet corn cob: Rs. 20 /kg,
Selling price of fodder: Rs. 3/kg

DISCUSSION

Plant growth and yield attributes:

Plant growth attributes (plant height and stem girth) and yield attributes (cob length, cob girth and cob weight/plant, green cob and fodder yield) of sweet corn were significantly affected by applied solid organics. This might be due to better vegetative growth of the sweet corn under supplementation of 100% RDN through Nadep compost having ideal C: N ratio (19.06) and comparatively higher total N. Application of 100% RDN through Nadep compost has also significantly improved soil chemical (SOC) and fertility (available N, P_2O_5, K_2O, DTPA-Fe, Mn and Zn) which might helped in enhancing plant growth and yield attributing characters. Further, the above treatment might have also positive effect on soil microbial population resulted in better utilization of nutrients by sweet corn crop for its normal metabolic activities. The impact was conspicuous of *Jeevamrut* (L_1), *Panch gavya* (L_3) and *Sanjeevak* (L_4) on growth and yield attributes of sweet corn might be due to their major and micro nutrient content which are rapidly available and easily absorbed form leading to faster growth and development of sweet corn components[2,27]. The similar increase in growth attributes was reported by Pattanashetti *et al*.[22] indicating the enhanced plant vigor growth in terms of plant height, leaf number and leaf area per plant due to higher level of organic inputs which were found to be useful in increasing photosynthetic activities and there by accumulation of more carbohydrates and higher dry matter with higher levels of organic inputs. These, findings are also in close agreement with findings of Verma *et al*.[34] in maize, Khadtare *et al*.[7], Zende[36], in sweet corn and Narolia *et al*.[12] in pearlmillet and incase of yield attributes higher yields of both the components might be by reasons of (i) significantly higher growth and yield attributing character (plant height, stem girth, cob length, cob girth and cob weight/plant) with treatment O_1, which may have positive cumulative effect on yields of sweet corn (ii) steady and higher availability of N, P_2O_5, K_2O, and cationic micronutrients during the crop growth period which have enhanced the growth and yield attributes and finally augmented to better cob and fodder yield (iii) addition of organic manure, enhanced the level of soil enzymes activity and promoted the recycling of soil nutrients in the ecosystem, improve the absorptive power of cations and anions present on soil particle and that may be released slowly during the crop growth and improvement in soil structure to existence of favourable nutritional environment under the influence of organic manures which had a positive effect on vegetative and reproductive growth which ultimately led to realization of higher values for growth attributes leading to higher yield of crop[35]. The application liquid manure increased the cob length cob girth and cob weight of maize as it was supplied the required metabolites to the source and further greater accumulation of assimilates in the sink Shwetha *et al*.[29]. Patel *et al*.[17] reported that especially *Jeevamrut* can release the nutrients in a more synchronized manner as per the need of the crops and also, *Jeevamrut* enhances microbial activity in soil and helps in mobilization of nutrient in soil. Pawar and Tambe[23] indicating the enhanced plant vigor growth due to higher level of organic inputs which were found to be useful in increasing photosynthetic activities and there by accumulation of more carbohydrates and higher dry matter with higher levels of organic inputs. These results are in accordance with Patil and Umdale[19] in sweet corn. Similar results were also reported by Dadgale *et al*. [4] and Patra *et al*. [21], Sindhi *et al*. [30] and Patil and kolambe[20].

Quality parameter

The protein content in grain was not significantly affected by levels of Nadep compost and liquid organic manures. Similar non significant results of solid organics on protein content were reported by Ganjali *et al*.[5] and Nasim *et al*.[13]. Total reducing and non reducing sugar content in sweet corn grain were significantly differed under different levels of Nadep compost and liquid organic manures. Improvement in total reducing of

sweet corn owing to (i) supply of all growth promoting substance like enzymes, hormones, growth regulators through organics (ii) effective regulation of metabolic functions leading better synthesis of proximate constituent by organics and consequent improvement in quality of produce and with soil application of *Jeevamrut*, *Panch gavya* and *Sanjeevak* @ 600 L/ha. Further, these liquid manures (*Panch gavya*, *Jeevamrut* and *Sanjeevak*) provide balanced nutrition to the crops and helped to improve the quality of yield as it provides readily available nutrients, growth hormones and microbes. Moreover, effective microorganisms present in *Panchgavya* can improve the quality, growth and yield of crops by synthesizing phytohormones such as auxins and other plant growth regulators that might stimulate the growth. The results are in close conformity with those of Pawar and Tambe[23], Khan *et al*.[8], Chaudhari *et al*.[3], Patel *et al*.[18] and Patel *et al*[16].

Effect on Economics

Sweet corn economical part *viz*. green cob and fodder yield were found significant only with sole application of Nadep compost (O) and liquid organics (L), economics is calculated only for levels of Nadep compost (O) and different liquid organics (L) treatments. With respect to net income, it was found maximum with solid organic treatment O_2 with second best CBR, receiving 75% RDN through Nadep compost and among the soil applied different organic liquids, highest net income with CBR was realized with treatment L_1, receiving *Jeevamrut* @ 600 L/ha. Similar results on economics were obtained by Rajanna *et al*.[25], Praveen kumar[24], Rao *et al*. [26] and Naveen [14].

CONCLUSION

From the results of the present study, following conclusions are emerged.

For getting higher profitable yield and better quality with improved soil fertility, among the different levels of Nadep compost, soil application of Nadep compost @ 75% RDN/ha found best treatment for organically grown sweet corn in South Gujarat.

For getting higher profitable yield and better quality, among the different liquid organic manures, soil application of *Jeevamrut* @ 600 L/ha found the best treatment for organically grown sweet corn in South Gujarat.

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