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GROWTH AND YIELD OF SWEET CORN GROWN UNDER ORGANIC MANAGEMENT PRACTICES

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ABSTRACT

A field experiment was conducted during kharif season of 2014 at Rajasthan College of Agriculture, Udaipur (Rajasthan) to study the growth and yield of sweet corn (Zea maysL. Ssp. saccharata) grown under organic management practices. Randomized block design was used with three replications comprising control, three organic sources of nutrients with and without intercropping and three liquid sources of nutrient. A significant increase in plant height at silking and at harvest, dry matter at 25, 50 and 75 DAS, leaf area index at initiation of silk, CGR during 25-50 and 50-75 DAS cob girth and cob length at harvest, grain /cob, green cob equivalent yield (10564 kg ha^{-1}), green fodder equivalent yield and biological equivalent yield, were recorded with the application of 6t vermicompost ha^{-1} + intercropping with blackgram + mataka khad 2% + compost tea 5% at 45 and 60 DAS which was found statistically at par with 6t vermicompost ha^{-1} + intercropping with blackgram + BD-500 75 g ha^{-1} + BD-501 2.5 g ha^{-1} and 6t vermicompost ha^{-1} + intercropping with blackgram.

Key words: Sweet corn, organics, growth, economics, yield

INTRODUCTION

In India, maize is cultivated on an area of 92.2 lakh ha with the production of 243.4 lakh tonnes and productivity of 2583 kg ha^{-1}. Rajasthan is one of the major maize growing state in India covering an area of 9.26 lakh ha with the production of 15.02 lakh tonnes and productivity of 1621 kg ha^{-1}, which is less than the national productivity (Annual Report, 2014). At global level India ranks 4th in area and 7th in production of maize. Sweet corn is a special type of maize breed for high sugar content (Kumar *et. al.,* 2012). Its' defined genes (SH) affect starch synthesis in seed endosperm and elevates the level of polysaccharides (sugar) and decrease the starch content. This makes taste of sweet corn much sweeter than normal corn, especially at 18 to 21 days after pollination. The total sugar content in sweet corn ranges from 25 to 30 per cent. Organic agriculture is one among the broad spectrum of production methods that are supportive of the environment and are based on specific standards precisely formulated for food production and aim at achieving agro-ecosystems, which are socially and ecologically sustainable. This is accomplished by using possible, agronomic, biological and mechanical methods, as opposed to using synthetic materials, to fulfill any specific function within the system (Ramesh *et al.,* 2009).Vermicompost helps in enhancing the activity of microorganisms in soils which further enhances solubility of nutrients and their consequent availability to plants. Chadha *et al.,* (2012) reported that use of mataka khad in organic production of agricultural crops to promote the plant growth. Singh (2012) found the use of biodynamic manure BD-500 and BD-501 beneficial in organic farming of crops. BD-500 stimulates micro organisms and in turn increases the availability of nutrients including trace elements. BD-500 is often equated with humus formation and credited with improving soil structure including water holding capacity. BD-500 is applied directly to soil. BD-501 complements BD-500 but works in atmosphere by enhancing photosynthetic activities and increases assimilation of nutrients in plants. Pathak and Ram (2012) also observed that BD-501 helps to stave off fungal diseases, increases dry matter content of fruit and improves fruit flavor, color and post harvest quality. BD-500 and BD-501 also called as bio enhancers are rich source of microbial consortia, macro and micronutrients and plant growth promoting substances including immunity enhancers. In view of this, present study was undertaken to investigate the growth and yield of sweet corn (*Zea mays* L. Ssp. *saccharata*) grown under organic management practices.

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MATERIALS AND METHODS

Field experiment was conducted during *kharif,* 2014 at Instructional Farm, Rajasthan College of Agriculture, Udaipur situated in agro-climatic zone IV a (Sub-humid southern plain and Aravali Hills) of Rajasthan. The region has a semi-arid climate. The soil of the experimental site was clay loam in texture containing 280 kg, 19 kg and 380 kg ha^{-1} available nitrogen, phosphorus and potassium, respectively with pH 8.1 and 6.7 g kg^{-1} organic carbon. The experiment was laid out in randomized block design with three replications comprising 10 treatments with control, three organic sources of nutrients with intercropping (6t Vermicompost ha^{-1} + intercropping with blackgram, 6t vermicompost ha^{-1} + intercropping with blackgram (2:2) + BD-500 75 g ha^{-1} + BD-501 2.5 g $ha^{-1}$and 6t vermicompost ha^{-1} + intercropping with blackgram + mataka khad 2% + compost tea 5% at 45 and 60 DAS), three organic sources of nutrients without intercropping (6t vermicompost ha^{-1}, 6t vermicompost ha^{-1} + BD-500 75 g ha^{-1} + BD-501 2.5 g ha^{-1} and 6t vermicompost ha^{-1} + mataka khad 2% + compost tea 5% at 45 and 60 DAS) and three liquid organic sources of nutrients (BD-500 75 g ha^{-1} + BD-501 2.5 g ha^{-1}, mataka khad 2% + compost tea 5% at 45 and 60 DAS and water spray at 15, 45, 60 DAS).The recommended dose of nitrogen for the crop was 90 kg ha^{-1}. Full dose of vermicompost was incorporated as per treatments (composition on oven dry weight basis :1.3-1.7 % N, 0.91-1.12 % P_2O_5, 0.85-1.32 % K_2O, 22-30.2 mg kg^{-1} Zn, 150-172 mg kg^{-1} Fe and 7.2-7.5 P^H). Similarly, mataka khad contains N (0.95 %), P_2O_5 (0.050 %), K_2O (0.230 %), Fe (350 mg kg^{-1}), Mn (60 mg kg^{-1}), Zn (58 mg kg^{-1}) and Cu (230 mg kg^{-1}). Compost tea also contains N (240 mg kg^{-1}), P_2O_5 (7.6 mg kg^{-1}), K_2O (205 mg kg^{-1}), Ca (80 mg kg^{-1}) Fe (63 mg kg^{-1}) and Zn (5.8 mg kg^{-1}). Similarly, BD-500 has 7.1 pH, 0.31 EC, 26.5 % organic carbon, 1.2 % N, 0.80 % P and 1.40 % K. The liquid organic manures *viz*., mataka kahd, compost tea, BD-500 and BD-501 were applied as foliar spray as per treatments. The sweet corn variety Sugar-75 was sown on 13, July 2014 at 60 cm row to row and 25 cm plant to plant spacing by using recommended seed rate of 8 kg ha^{-1}. All other agronomic practices were kept uniform for all the treatments. Growth and yield attributes and yield were recorded by adopting the standard procedures.

RESULTS AND DISCUSSION

Growth

Results revealed (Table 1 and Fig. 1) that the maximum plant height (223 cm) and dry matter accumulation (128 g) at harvest (75 DAS), maximum CGR (22.46 g m^{-2} day^{-1}) at 50-75 DAS and leaf area index (3.90) at initiation of silk were recorded under 6t vermicompost ha^{-1} + intercropping with blackgram + mataka khad 2% + compost tea 5% at 45 and 60 DAS. However, this treatment was statistically at par with 6t vermicompost ha^{-1}+ intercropping with blackgram (2:2) + BD-500 75 g ha^{-1} + BD-501 2.5 g ha^{-1} and 6t vermicompost ha^{-1}+ mataka khad 2% + compost tea 5% at 45 and 60 DAS. Further, application of 6t vermicompost ha^{-1} + intercropping with blackgram (2:2) + BD-500 75 g ha^{-1} + BD-501 2.5 g ha^{-1} recorded significantly maximum plant height (214.67 cm) at silking,dry matter accumulation (21.07 and 46 g) at 25 and 50 DAS and CGR at 25-50 DAS (6.65 g m^{-2} day^{-1}) over control and liquid organic treatments. However, 6t vermicompost ha^{-1} + intercropping with blackgram + mataka khad 2% + compost tea 5% at 45 and 60 DAS and 6t vermicompost ha^{-1}+ BD-500 75 g ha^{-1} + BD-501 2.5 g ha^{-1} also had more or less similar effects on plant height at silking, dry matter at 25 and 50 DAS and CGR.

The integrated use of vermicompost + intercropping with blackgram + compost tea + mataka khad is important to maintain and sustain higher level of soil fertility and nutrient availability at different stages of crop development. Studies showed that the combination of different sources of organics gave better results and higher productivity than their individual application. When organic manures are applied, nutrients are released slowly, minimizes nutrient losses due to increased absorption of nutrients as a result of increased cation exchange capacity with increased organic matter content, thus plant nutrients are made available for a longer period in adequate quantity. Plants can absorb the required nutrients as per their demand resulting in better growth, development and yield components. Addition of organic matter

improves soil structure, porosity and water holding capacity and decreases the bulk density. Vermicompost contains significant quantities of nutrients, a large beneficial microbial population and biologically active metabolites, particularly gibberellins, cytokinins, auxins and group B vitamins which applied alone or in combination result in better growth of crops (Jack *et al.,* 2011). Naidu *et al.,* (2010) observed that presence of nutrients, microorganisms and plant growth regulators in compost tea causes positive effect on plant growth.

Table 1: Effect of organic management practices on growth attributes of sweet corn

Treatments	Plant height (cm)		Dry matter / plant (g)			Crop growth rate (g m^{-2} day^{-1})		Leaf area index
	At silking	At harvest	At 25 DAS	At 50 DAS	At harvest	25-50 DAS	50-75 DAS	At initiation of silk
T_0	191.7	198.3	18.4	37.3	95.0	5.06	15.39	3.00
T_1	203.0	213.0	19.7	42.0	115.0	5.94	19.48	3.66
T_2	205.7	215.7	20.1	43.0	118.0	6.12	20.01	3.72
T_3	201.0	209.7	18.7	40.0	100.0	5.67	16.01	3.17
T_4	210.0	217.0	20.5	44.3	121.0	6.35	20.46	3.73
T_5	214.7	221.3	21.1	46.0	126.0	6.65	21.34	3.90
T_6	198.0	210.3	18.5	39.0	103.7	5.46	17.25	3.14
T_7	208.7	218.0	19.7	42.2	122.3	5.99	21.38	3.70
T_8	212.3	223.0	20.4	43.8	128.0	6.24	22.46	3.83
T_9	195.7	204.3	18.5	38.0	97.0	5.20	15.74	3.12
SEm±	3.13	3.28	0.34	0.77	1.67	0.19	0.56	0.067
CD (P=0.05)	9.30	9.75	1.03	2.30	4.96	0.58	1.66	0.19

T_0 – Control, T_1 – VC 6 t ha^{-1}, T_2 – VC 6 t ha^{-1} + IC with blackgram (2:2), T_3 – BD-500 75 g ha^{-1} + BD-501 2.5 g ha^{-1}, T_4 – VC 6t ha^{-1} + BD-500 75 g ha^{-1} + BD-501 2.5 g ha^{-1}, T_5 – VC 6 t ha^{-1} + IC + BD-500 75 g ha^{-1} + BD-501 2.5 g ha^{-1}, T_6 – Mataka khad + Compost tea at 45 and 60 DAS, T_7 – VC 6 t ha^{-1} + Mataka khad + Compost tea at 45 and 60 DAS, T_8 – VC 6 t ha^{-1} + IC + Mataka khad + Compost tea at 45 & 60 DAS, T_9 – Water spray at 15, 45 & 60 DAS

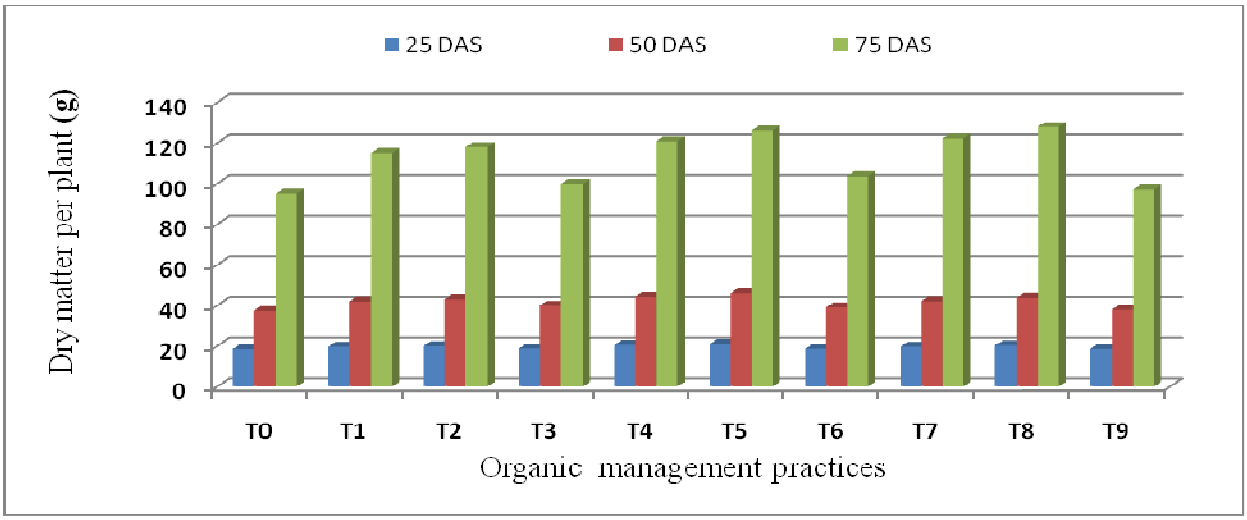

Fig.1: Effect of organic management practices on dry matter of sweet corn at different growth stages

Yield attributes and yield

The yield attributing characters viz., cob girth, cob length and grain $cob^{-1}$of sweet corn increased significantly with the integrated use of 6t vermicompost ha^{-1} + intercropping with blackgram + mataka khad 2% + compost tea 5% at 45 and 60 DAS (T_8) over control and liquid organic treatments followed by 6t vermicompost ha^{-1} + inter-cropping with blackgram + BD-500 75 g ha^{-1} + BD-501 2.5 g ha^{-1}; significantly maximum green cob equivalent yield (10564 kg ha^{-1}), green fodder equivalent yield (21693 kg ha^{-1}) and biological equivalent yield (32257 kg ha^{-1}) of sweet corn were recorded under 6t vermicompost ha^{-1} + intercropping with blackgram + mataka khad 2% + compost tea 5% at 45 and 60 DAS (T_8). The response to diluted mataka khad and compost tea along with

vermicompost was highly significant on yield of sweet corn, which may be due to increased availability of nutrients in the soil BD-500 and BD-501 is expected to supply nutrients and growth promoters in a more continuous manner which increases the growth attributes leading to higher photosynthesis and translocation of photosynthates towards sink as indicated from the yield attributing characters and grain yield. Pfeiffer (2014) and Pathak and Ram (2012) also reported similar results. Highest amount of vegetative biomass produced when legume crops are intercropped with maize. A legume in an intercropping system not only provides nitrogen to the associated crops but also helps to increase the amount of humus in the soil due to decaying of crop residues. Amos *et al.,* (2012) also observed that the increase in grain yield of maize might be resulted from maize + blackgram association due to symbiotic nitrogen fixation by blackgram and current transfer of nitrogen to the associated maize plants.

Table 2: Effect of organic management practices on yield attributes and yields of sweet corn

Treatments	Yield attributes					Yield (kg ha^{-1})		
	Cobs plant^{-1}	Cob girth (cm)	Cob length (cm)	Grains rows cob^{-1}	Grains cob^{-1}	Maize green cob equivalent yield (kg ha^{-1})	Maize green fodder equivalent yield (kg ha^{-1})	Maize equivalent biological yield (kg ha^{-1})
T_0	1.30	12.10	17.33	13.00	376	6821	14507	21329
T_1	1.33	13.70	19.60	13.89	435	8133	17166	25299
T_2	1.33	14.07	19.83	14.00	457	9850 (541.67)	19205 (1096.67)	29055 (1638.34)
T_3	1.31	12.32	17.57	13.66	400	7040	15130	22170
T_4	1.32	14.34	20.00	13.89	472	8404	18366	26771
T_5	1.41	14.57	20.43	14.11	516	10378 (562.76)	20926 (1154.39)	31305 (1717.15)
T_6	1.43	12.40	17.67	13.66	422	7120	15592	22712
T_7	1.30	14.40	20.23	14.00	494	8511	18783	27295
T_8	1.41	14.87	20.80	14.11	526	10564 (586.67)	21693 (1166.67)	32257 (1753.34)
T_9	1.30	12.15	17.40	13.55	389	6900	14766	21667
SEm±	0.161	0.383	0.431	0.212	13.92	294.93	446.99	541.83
CD (P=0.05)	NS	1.137	1.281	NS	41.37	876.30	1328.08	1609.86

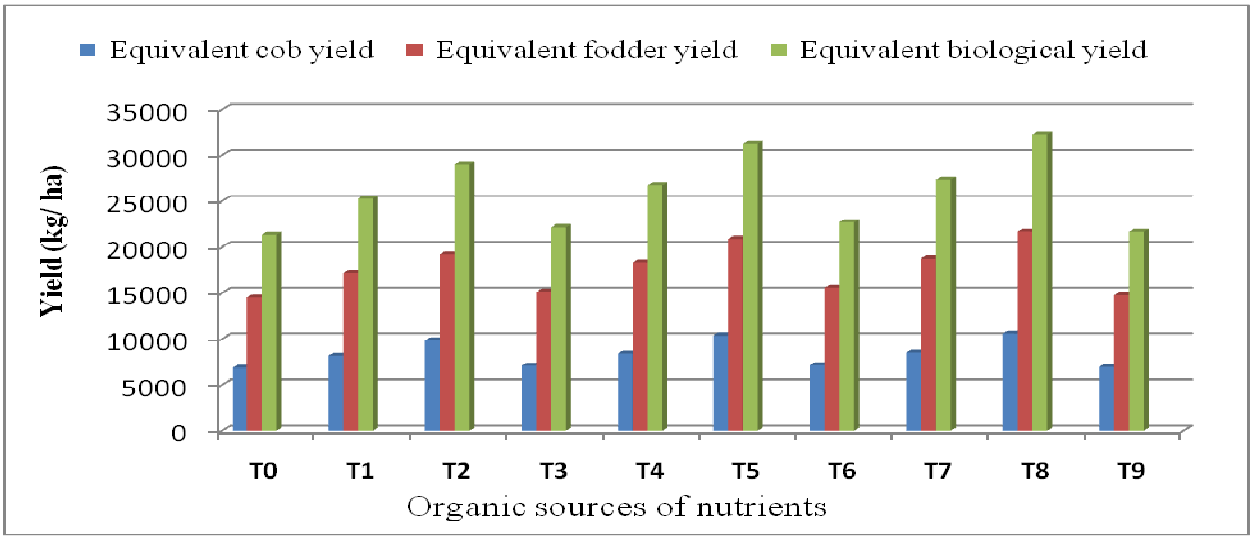

Fig. 2: Effect of organic management practices on equivalent yield of sweet corn

Chadha *et al.,* (2012) observed that due to presence of nutrients, microorganisms and plant growth regulators, compost tea showed the impact on growth and yield. Jack *et al.,* (2011) reported that vermicompost contains significant quantities of nutrients, a large beneficial microbial population and biologically active metabolites, particularly gibberellins, cytokinins, auxins and group B vitamins which applied alone or in combination result in better growth of crops.

It may be concluded from the study that growth, yield attributes and yield of sweet corn was obtained with the application of vermicompost 6 t ha^{-1} + intercropping with blackgram + mataka khad 2% + compost tea 5% at 45 and 60 DAS.

REFERENCES

Amos, R.N., Jens, B.A. and Symon, M. (2012) On farm evaluation of yield and economic benefits of short term maize legume intercropping systems under conservation agriculture in Malawi. *Field Crop Research* **132:** 149-157.

Annual Report (2014) Indian Institute of Maize Research, Pusa Campus, New Delhi-110012 pp. 82.

Chadha, S., Ashlesha, R., Sahi, J.P. and Paul, Y.S. (2012) Sustainable livelihood option for small and marginal farmers. *Indian Journal of Traditional Knowledge* 11(**3**): 480-486.

Jack, A.L.H., Rangarajan, A., Culman, S.W., Sooksa-Nguan, T. and Thies, J.E. (2011) Choice of organic amendments in tomato transplants has lasting effects on bacterial rhizosphere communities and crop performance in the field. *Applied Soil Ecology* 48 (**1**): 94-101.

Kumar, R., Das, A.K., Kaul, J., Karjagi, C.G., Kumar, B., Choudhary, D.P., Sapna, Kumar, R.S., Dass, S., Yadav, A.K., Singh, D. and Kumar, S. (2012) Speciality corn cultivation in India*. Directorate of Maize Research, Technical Bulletin, IARI, New Delhi.*

Naidu, Y., Meon, S., Kadir, J. and Siddiqui, Y. (2010) Microbial starter for the enhancement of biological activities of compost tea. *International Journal of Agriculture & Biology* 12 (**1**): 51-56.

Pathak, R.K. and Ram, R.A. (2012) Bio enhancer: A Potential tool to enhance soil fertility and crop productivity: International Conference on Organic Farming for Sustainable Horti-Agriculture and Trade Fair, organized by Jharkhand State Horticulture Mission, 8-9th November. pp. 84-86.

Pfeiffer, E. (1984) Using the biodynamic compost preparation and sprays in garden. Biodynamic Farming and Gardening Association, Kimberton. pp. 66.

Ramesh, P., Panwar, N.P., Singh, A.B. and Ramana, S. and Subbarao, A. (2009) Impact of organic manure combination on productivity and soil quality in different cropping systems in central India. *Journal of Plant Nutrition and Soil Science,* **172**: 577-585.

Singh, A.V. (2012) Biodynamic farming where sprit matters. *The Canadian Organic Grower, Springer*. pp. 17-18.