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Effect of Tillage Practices and Nutrient Sources on Yield and Nutrient Uptake by Sweet Corn (*Zea mays* L. ssp. *saccharata*)

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An experiment was carried out during *rabi* seasons of 2015-16 and 2016-17 at Agronomy Farm, College of Agriculture, Dr. B. S. Konkan Krishi Vidyapeeth, Dapoli, Maharashtra to study the effect of tillage practices and nutrient sources on yield and nutrient uptake by sweet corn. The main plot treatments comprised of four tillage practices *viz*., one pass of rotavator (T_1), one pass of cultivator + one pass of rotavator (T_2), one mouldboard ploughing + one pass of rotavator (T_3) and one mouldboard ploughing + one pass of cultivator + one pass of rotavator (T_4), while in the sub plot there were five nutrient sources *viz*., 100% RDF through chemical fertilizers (S_1), 75% RDN through chemical fertilizer + 25% RDN through FYM (S_2), 75% RDN through chemical fertilizer + 25% RDN through vermicompost (S_3), 75% RDN through chemical fertilizer + 25% RDN through poultry manure (S_4) and 75% RDN through chemical fertilizer + 25% RDN through goat manure (S_5). Among the tillage practices, the treatment T_4 recorded 7.73, 5.22 and 2.78% higher green cob yield and 10.21, 6.53 and 3.40% higher green fodder yield, over the treatments T_1, T_2 and T_3, respectively. It also registered 24.55, 15.06 and 7.52% higher total nitrogen uptake, 21.38, 14.06 and 7.41% higher total phosphorus uptake and 12.53, 7.92 and 3.88% higher total potassium uptake over tillage practices T_1, T_2 and T_3, respectively. The combined application of 75% RDN through chemical fertilizer + 25% RDN through vermicompost (S_3) proved significantly superior over rest of the nutrient sources in respect of green cob yield, green fodder yield, biological yield, nitrogen, phosphorus and potassium content as well as uptake of these nutrients. However, it was statistically similar with S_2 for green cob yield and green fodder yield. Nutrient source S_3 registered 8.56, 6.93, 6.18 and 0.71% higher green cob yield with sheath, 6.85, 3.85, 2.03 and 0.89% higher green fodder yield, 24.28, 13.95, 9.30 and 3.82% increase in total nitrogen uptake, 20.29, 13.68, 10.36 and 4.42% increase in total phosphorus uptake and 11.12, 7.51, 5.27 and 1.57% increase in total potassium uptake over nutrient sources S_1, S_5, S_4 and S_2, respectively. The treatment combination T_4S_3 recorded significantly highest green cob yield and biological yield but was at par with T_4S_2, T_3S_3 and T_3S_2 for green cob yield and T_4S_2 and T_3S_3 for total biological yield. Therefore, to obtain higher yields of sweet corn the soil should be prepared by one mouldboard ploughing + one pass of cultivator + one pass of rotavatoralong with nutrient application of 75% RDN through chemical fertilizer + 25% RDN through vermicompost.

(***Key words:*** *Nutrient sources, Nutrient uptake, Sweet corn, Tillage, Yield*)

Sweet corn (*Zea mays* L. ssp. *saccharata*) also known as sugar corn was introduced in India from USA. The origin of sweet corn is considered as Peru, Bolvia and Equador. Among the different types of corn grown, sweet corn is one of the most popular type for human consumption. The productivity potential of sweet corn is higher than wheat and nutritive status superior to rice on account of which it is no longer a 'coarse grain' but a 'nutritious grain' (Batra, 2002).

Sweet corn is gaining popularity both in rural and urban areas because of its high sugar and low starch content (Game *et al*., 2017). It has great market potential and high market value in India. Urban people prefer the roasted sweet corn cobs as these are very tasty and nutritious. Roasted green cobs provide starch, fat, protein, sugar, minerals and vitamins in palatable and digestible form at relatively low cost. In *Konkan* region sweet corn is gaining importance in the hotels and there

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is a good demand for roasted cobs in cities, towns and also by tourists, which has resulted into opening of the counters of roasted cobs. Also after harvesting of crop the left over plant parts as a nutritious and palatable fodder becomes available for milch animals. There are several ways to maximize the sweet corn productivity of which tillage practice and nutrient management are of prime importance.

Tillage is an important aspect in crop production as tillage accounts 30% of the production costs. Now a days, considering the high cost of tillage there is a need to plan a suitable tillage system for profitable crop production. Tillage also exerts adverse effects on soil when it is performed under inadequate moisture conditions, or when inadequate tillage implements are used. Excessive tillage deteriorates the soil environment by way of destroying the soil structure, increasing wind erosion, crust formation and increase cost of production. However, on the other hand zero tillage has been reported to seriously affect the growth and establishment of plant through increased weed competition and poor soil physical condition due to increase in soil bulk density. Reduced tillage has been found to be useful in improving soil physical environment and the yield of crops. Therefore, the researchers and farmers are looking to adopt alternative tillage methods such as reduced tillage or minimum tillage. Since information on the comparative performance of different tillage systems is limited, optimum tillage requirement for sweet corn needs to be standardized.

Beside appropriate selection of tillage practices, the improvement in yield of sweet corn can be obtained through the judicious use of nutrients *i.e.,* it should be supplied with adequate quantities of manures and fertilizers. Now-a-days chemical fertilizers are quite an expensive input and its usage over a long period may deplete the soil fertility. It is also considered that its indiscriminate usage may cause environmental pollution problems, soil sickness, reduce the microbial activities and availability of essential nutrients and deteriorate the product quality. Therefore use of alternative source of plant nutrients is imperative. In several studies, high and sustainable crop yields are only possible with combined use of inorganic fertilizers with organic manure (Singh *et al*., 1999). Keeping this point in the view, the present study was conducted to investigate the effects of tillage and nutrient sources on the yield of sweet corn and its nutrient uptake in Konkan region of Maharashtra.

MATERIALS AND METHODS

A field experiment was conducted during *rabi* seasons of 2015-16 and 2016-17 at Agronomy Farm, College of Agriculture, Dr. B. S. Konkan Krishi Vidyapeeth, Dapoli, Dist. Ratnagiri, Maharashtra. The experiment was laid out in split plot design comprising of twenty treatment combinations replicated thrice. Main plot treatments comprised of four tillage practices *viz*., one pass of rotavator (T_1), one pass of cultivator + one pass of rotavator (T_2), one mouldboard ploughing + one pass of rotavator (T_3) and one mouldboard ploughing + one pass of cultivator + one pass of rotavator (T_4), while in the sub plot treatments there were five nutrient sources *viz*., 100% recommended dose of fertilizer (RDF) through chemical fertilizers (S_1), 75% RDN through chemical fertilizer + 25% RDN through FYM (S_2), 75% RDN through chemical fertilizer + 25% RDN through vermicompost (S_3), 75% RDN through chemical fertilizer + 25% RDN through poultry manure (S_4) and75% RDN through chemical fertilizer + 25% RDN through goat manure (S_5). Sweet corn variety Sugar-75 was used as test crop. The chemical fertilizers and organic manures were applied as per treatments taking into account the recommended dose of fertilizers *i.e*., 200: 60: 60 kg NPK ha^{-1}. The nitrogen, phosphorus and potash were supplied through urea, single super phosphate and muriate of potash, respectively. Treatment wise phosphorus and potash supplied through organic manures were first calculated and then remaining quantity of these nutrients was applied through chemical fertilizers to fulfill the requirement of recommended nutrient dose. Full dose of organic manures were applied as per treatments after the experimental layout and thoroughly mixed in the soil. Basal dose of fertilizers *i.e.,* 50% nitrogen and full dose of phosphorus and potash (through chemical fertilizers and organic manures) was applied at the time of sowing. Remaining dose of nitrogen was applied in two splits *i.e.,* 25% at 30 DAS and 25% at 60 DAS. Five representative plants were randomly selected from the each net plot for recording periodical biometric observations. The periodical dry matter accumulation in crop was recorded by removing two representative plants from the each plot. All the green cobs with sheath and green fodder were harvested from the plot of each treatment to record the yield. The plant samples were analyzed for estimation of N, P, K, uptake using the procedure as described by Jackson (1973). The data of two years were pooled and analyzed statistically for the interpretations of results as per the procedure given by Panse and Sukhatme (1985).

RESULTS AND DISCUSSIONS

Effect of tillage practices

The data presented in Table 1 revealed that tillage practice involving one mouldboard ploughing + one pass of cultivator + one pass of rotavator (T_4) recorded significantly higher green cob yield with sheath (22.58 t ha^{-1}), green fodder yield (26.76 t ha^{-1}) and biological yield (49.34 t ha^{-1}) over rest of the tillage practices except tillage practice T_3 which remained statistically at par for green cob yield with sheath. Tillage practice T_4 recorded 7.73, 5.22 and 2.78% higher green cob yield with sheath, 10.21, 6.53 and 3.40% higher green fodder yield and 9.06, 5.93 and 3.14% higher biological yield over tillage practices T_1, T_2 and T_3, respectively. The higher green cob yield with sheath, green fodder yield and biological yield obtained from tillage practice T4 may be due to significant increase in growth and yield attributes in this treatment. These results are in agreement with the findings of Kumar and Angadi (2014), Mishra *et al*. (2014) and Salem *et al*. (2015).

A perusal of the data presented in Table 1 indicated that significantly higher nitrogen, phosphorus and potassium content in the grain (1.83, 0.489 and 0.366 %, respectively) and fodder (0.887, 0.113 and 1.145 %, respectively) of sweet corn was registered in the treatment T_4 (one mouldboard ploughing + one pass of cultivator + one pass of rotavator). Similarly this treatment also recorded significantly higher uptake of nitrogen, phosphorus and potassium in grain (65.73, 16.11 and 12.06 kg ha^{-1}, respectively) and fodder (95.39, 12.44 and 126.22 kg ha^{-1}, respectively) and total uptake (161.13, 28.56 and 138.28 kg ha^{-1}, respectively) of these nutrients by sweet corn crop (Table 2). However it was statistically on par with the tillage practice T_3 for phosphorus and potassium content in grain and potassium content in fodder. Tillage practice T_4 registered 24.55, 15.06 and 7.52% higher total nitrogen uptake, 21.38, 14.06 and 7.41% higher total phosphorus uptake and 12.53, 7.92 and 3.88% higher total potassium uptake than tillage practices T_1, T_2 and T_3, respectively. The higher content of nitrogen, phosphorus and potassium as well as uptake of these nutrients by sweet corn crop in the treatment T_4 could be due to improved soil physical conditions (reduced mechanical impedance) which facilitated better root growth and proliferation that helped in better absorption of nutrients by the crop plants. Similar results were also reported by earlier workers Agbede and Adekiya (2013) and Mishra *et al*. (2014).

Effect of nutrient sources

The sweet corn grown with combined application of 75% RDN through chemical fertilizers + 25% RDN through vermicompost (S_3) proved significantly superior over rest of the nutrient sources in respect of green cob yield with sheath (22.69 t ha^{-1}), green fodder yield (26.19 t ha^{-1}) and biological yield (48.88 t ha^{-1}). However, it was statistically similar with combined application of 75% RDN through chemical fertilizers + 25% RDN through FYM (S_2) for green cob yield with sheath (22.53 t ha^{-1}) and green fodder yield (25.96 t ha^{-1}) (Table 1). Nutrient source S_3 registered 8.56, 6.93, 6.18 and 0.71% higher green cob yield with sheath, 6.85, 3.85, 2.03 and 0.89% higher green fodder yield and 7.64, 5.23, 3.93 and 0.83% higher biological yield over nutrient sources S_1, S_5, S_4 and S_2, respectively. This might be due to the slow release of nutrients through the vermicompost for longer period, increased absorption and utilization of nitrogen and other nutrients. Vermicompost has the optimum range of pH and improved soil physical conditions, which enhances the availability of most of the nutrients for the proper growth and development of crop. Thus, balanced nutrition under favorable soil environment might have resulted in better root development, which in turn encouraged vigorous growth parameters and yield attributes and ultimately the yield. The results of present investigation are in conformity with the results reported by Keerthi *et al*. (2013) and Rasool *et al*. (2015).

Data furnished in Tables 1 and 2 revealed that significantly higher nitrogen, phosphorus and potassium content in the grain (1.72, 0.459 and 0.341 %, respectively) and fodder (0.807, 0.103 and 1.127 %, respectively) of sweet corn as well as uptake of nitrogen, phosphorus and potassium by grain and fodder and total uptake of these nutrients by sweet corn crop was recorded under nutrient source of 75% RDN through chemical fertilizer + 25% RDN through vermicompost (S_3) over rest of the nutrient sources. Nutrient source S_3 brought about 24.28, 13.95, 9.30 and 3.82% increase in total nitrogen

Table 1. *Effect of tillage practices and nutrient sources on yield and nutrient content in grain and fodder of sweet corn (Mean of 2 years)*

Treatments	Green cob yield with sheath (t ha^{-1})	Green fodder yield (t ha^{-1})	Biological yield (t ha^{-1})	Nitrogen content (%)		Phosphorus content (%)		Potassium content (%)	
				Grain	Fodder	Grain	Fodder	Grain	Fodder
Tillage practices									
T_1 One pass of rotavator	20.96	24.28	45.24	1.65	0.763	0.443	0.100	0.333	1.117
T_2 One pass of cultivator + One pass of rotavator	21.46	25.12	46.58	1.72	0.807	0.460	0.103	0.344	1.129
T_3 One mouldboard ploughing + One pass of rotavator	21.97	25.88	47.84	1.77	0.847	0.477	0.106	0.357	1.139
T_4 One mouldboard ploughing + One pass of cultivator + One pass of rotavator	22.58	26.76	49.34	1.83	0.887	0.489	0.113	0.366	1.145
SEm.±	0.20	0.24	0.29	0.011	0.006	0.005	0.001	0.003	0.003
CD (P= 0.05)	0.63	0.74	0.89	0.034	0.017	0.016	0.002	0.009	0.010
Nutrient sources									
S_1 100% RDF through chemical fertilizers	20.90	24.51	45.41	1.61	0.758	0.445	0.099	0.332	1.117
S_2 75% RDN through chemical fertilizer + 25% RDN through FYM	22.53	25.96	48.48	1.79	0.852	0.478	0.108	0.359	1.138
S_3 75% RDN through chemical fertilizer + 25% RDN through VM	22.69	26.19	48.88	1.84	0.880	0.490	0.113	0.368	1.145
S_4 75% RDN through chemical fertilizer + 25% RDN through PM	21.37	25.67	47.03	1.76	0.833	0.466	0.105	0.351	1.134
S_5 75% RDN through chemical fertilizer + 25% RDN through GM	21.22	25.22	46.45	1.72	0.807	0.459	0.103	0.341	1.127
SEm.±	0.06	0.11	0.13	0.006	0.004	0.001	0.001	0.001	0.002
CD (P= 0.05)	0.16	0.30	0.35	0.016	0.012	0.004	0.002	0.002	0.005

Table 2. *Effect of tillage practices and nutrient sources on nitrogen, phosphorus and potassium uptake by sweet corn*

Treatments	Nitrogen uptake (kg ha^{-1})			Phosphorus uptake (kg ha^{-1})			Potassium uptake (kg ha^{-1})		
	Grain	Fodder	Total	Grain	Fodder	Total	Grain	Fodder	Total
Tillage practices									
T_1 One pass of rotavator	54.13	75.24	129.37	13.38	10.14	23.53	10.08	112.80	122.88
T_2 One pass of cultivator + One pass of rotavator	58.19	81.85	140.04	14.31	10.73	25.04	10.70	117.43	128.13
T_3 One mouldboard ploughing + One pass of rotavator	61.43	88.44	149.86	15.25	11.35	26.59	11.42	121.69	133.11
T_4 One mouldboard ploughing + One pass of cultivator + One pass of rotavator	65.73	95.39	161.13	16.11	12.44	28.56	12.06	126.22	138.28
SEm.±	0.63	0.82	1.33	0.19	0.11	0.27	0.10	0.60	0.65
CD (P= 0.05)	1.95	2.54	4.11	0.60	0.35	0.82	0.32	1.85	1.99
Nutrient sources									
S_1 100% RDF through chemical fertilizers	52.98	75.03	128.01	13.49	10.07	23.56	10.06	113.28	123.34
S_2 75% RDN through chemical fertilizer + 25% RDN through FYM	63.17	90.05	153.23	15.47	11.67	27.14	11.64	123.29	134.93
S_3 75% RDN through chemical fertilizer + 25% RDN through VM	65.26	93.82	159.09	15.99	12.35	28.34	12.02	125.03	137.05
S_4 75% RDN through chemical fertilizer + 25% RDN through PM	60.09	85.47	145.56	14.63	11.05	25.68	11.02	119.18	130.19
S_5 75% RDN through chemical fertilizer + 25% RDN through GM	57.84	81.77	139.61	14.24	10.68	24.93	10.58	116.90	127.48
SEm.±	0.21	0.51	0.59	0.06	0.07	0.10	0.03	0.39	0.41
CD (P= 0.05)	0.59	1.44	1.67	0.17	0.20	0.28	0.10	1.09	1.15

Table 3. *Interaction eff ect of the tillage practices and nutrient sources on green cob yield with sheath biological yield of sweet corn (Mean of 2 years)*

Treatments		Green cob yield with sheath (t ha^{-1})				Biological yield (t ha^{-1})			
		T_1	T_2	T_3	T_4	T_1	T_2	T_3	T_4
S_1		20.34	20.61	21.21	21.45	44.10	44.78	45.93	46.83
S_2		21.63	22.21	22.64	23.63	46.20	47.65	49.05	51.04
S_3		21.70	22.32	23.01	23.72	46.45	48.01	49.54	51.50
S_4		20.59	21.12	21.51	22.26	44.90	46.39	47.64	49.20
S_5		20.53	21.04	21.47	21.87	44.55	46.05	47.05	48.15
Same tillage practice for different nutrient sources	SEm.±	0.11				0.25			
	CD (P= 0.05)	0.32				0.71			
Same nutrient source for different tillage practices	SEm.±	0.48				0.74			
	CD (P= 0.05)	1.17				2.08			

uptake, 20.29, 13.68, 10.36 and 4.42% increase in total phosphorus uptake and 11.12, 7.51, 5.27 and 1.57% increase in total potassium uptake than nutrient sources S_1, S_5, S_4 and S_2, respectively. Slow mineralization of N, P, K and optimum pH of vermicompost enhances the availability of most of plant nutrients which resulted in increased concentration as well as uptakes of nutrients by sweet corn. Similar findings were also reported by Keerthi *et al*. (2013).

Interaction effect

An assessment of data (Table 3) show that the interaction of tillage practice T_4 involving one mouldboard ploughing + one pass of cultivator + one pass of rotavator with nutrient sources S_3 consisting of 75% RDN through chemical fertilizer + 25% RDN through vermicompost recorded significantly highest green cob yield with sheath and biological yield than rest of the interactions except interactions T_4S_2, T_3S_3 and T_3S_2 for green cob yield with sheath and interactions T_4S_2 and T_3S_3 for total biological yield. Similar findings were reported by Yadav (2010) and Memon *et al*. (2013).

On the basis of our results, it can be concluded that sweet corn should be grown in soil prepared by one mouldboard ploughing + one pass of cultivator + one pass of rotavator with combined application of 75% RDN through chemical fertilizer + 25% RDN through vermicompost to obtain higher yields.

REFERENCES

Agbede, T. M. and Adekiya, A. O. (2013). Soil properties and yam yield under different tillage systems in a tropical alfisol. *Archives of Agronomy and Soil Science* **59**: 505-519.

Batra, S. K. (2002). Sweet corn: India shift focus to value added maize. *The Economic Times*, 2nd February, 2002.

Game, V. N., Chavan, S. A., Mahadkar, U. V., Thokal, R. T. and Shendage, G. B. (2017). Response of rabi sweet corn (*Zea mays saccharata* L.) to irrigation and mulching in Konkan region of Maharashtra. *Journal of the Indian Society of Coastal Agricultural Research* **35**(1): 27-30.

Jackson, M. L. (1973). *Soil Chemical Analysis*, Prentice Hall of India Pvt. Ltd., New Delhi, India.

Keerthi, S., Upendra Rao, A., Ramana, A. V. and Tejeswara Rao, K. (2013). Effect of nutrient management practices on cob yield, protein content, NPK uptake by sweet corn and post harvest N, P_2O_5 and K_2O. *International Journal of Advanced Biological Research* **3**: 553-555.

Kumar, B. R. M. and Angadi, S. S. (2014). Effect of tillage, mulching and weed management on performance of maize (*Zea mays*) in Karnataka. *Indian Journal of Dryland Agricultural Research and Development* **29**(1): 57-62.

Memon, S. Q, Mirjat, M. S., Mughal, A. Q. and Amjad, N. (2013). Effect of conventional and non- conventional tillage practices on maize production. *Pakistan Journal of Agriculture, Agricultural Engineering and Veterinary Sciences* **29**: 155-163.

Mishra, J.S., Thakur, N.S., Singh, P., Kubsad, V.S., Kalpana, R., Alse, U.N. and Nemade S.M. (2014). Tillage and integrated nutrient management in rainy-season grain sorghum (*Sorghum bicolor*). *Indian Journal of Agronomy* **59**: 619-623.

Panse V. G. and Sukhatme, P. V. (1985). *Statistical Methods for Agricultural Workers*, Fourth Edition, Indian Council of Agricultural Research, New Delhi, India.

Rasool, S., Kanth, R. H., Hamid, S., Raja, W., Alie, B. A. and Dar, Z. A. (2015). Influence of integrated nutrient management on growth and yield of sweet corn (*Zea mays* L. *saccharata*) under temperate conditions of Kashmir valley. *American Journal of Experimental Agriculture* **7**: 315-325.

Salem, H. M., Valero, C., Muñoz, M. A., Rodríguez, M. G. and Silva, L. L. (2015). Short-term effects of four tillage practices on soil physical properties, soil water potential and maize yield. *Geoderma* **237-238**: 60-70.

Singh, N. P., Sanchez, R. S., Pandey, P. C. and Bishi, R. S. (1999). Effects of decade long fertilizer and manure application on soil fertility and productivity of rice-wheat system in a Mollisol. *Journal of the Indian Society of Soil Science* **47**: 72-80.

Yadav, A. K. 2010. Effect of tillage and integrated nutrient management on sorghum (*Sorghum bicolor* L. Moench) productivity. *Unpublished M. Sc. Thesis*, Maharana Pratap University of Agriculture and Technology, Udaipur, Rajasthan, India.