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Plant growth parameters and yield as influenced by integrated nutrient management in sweet corn

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Abstract
A field experiment was conducted during *kharif* season of 2019 at Department of Agronomy College of Agriculture, Latur to study the effect of integrated nutrient management in sweet corn (*Zea mays* L. var. *saccharata sturt*).The objective of experiment was to study the effect of integrated nutrient management on sweet corn. The experiment was laid out in randomized block design with seven treatments and replicated thrice. Treatments were 100% RDF, 100% RDF + FYM @ 5 t ha^{-1}, 75% RDF + FYM @ 5 t ha^{-1}, 100% RDF + Vermicompost @ 2.5 t ha^{-1}, 75% RDF + Vermicompost @ 2.5 t ha^{-1}, 100% RDF + FYM @ 5 t ha^{-1} + Vermicompost @ 1.25 t ha^{-1}+ *Azospirillum* and 75% RDF + FYM @ 5 t ha^{-1} + Vermicompost @ 1.25 t ha^{-1} + *Azospirillum*. The result revealed that the application of 100% RDF + FYM @ 5 t ha^{-1} + Vermicompost @ 1.25 t ha^{-1}+*Azospirillum* increased the growth characters *viz*., plant height (200 cm), number of functional leaves (17.60), dry matter accumulation (128.33 g), leaf area (76.35 dm^2). Green cob yield (10621 Kg ha^{-1}) and green fodder yield (21824 Kg ha^{-1}) of sweet corn were highest with the application of 100% RDF + FYM @ 5 t ha^{-1} + Vermicompost @ 1.25 t ha^{-1} + *Azospirillum*.

Keywords: Bio-fertilizers, growth characters, integrated nutrient management, sweet corn, yield

Introduction

Maize (*Zea mays* L.) is one of the largest producing cereal crops in the world grown in more than 150 countries. In India, it is cultivated on an area of 9.0 million ha with a production of 26.0 million tonnes of grain and productivity is 2710 kg ha^{-1} (Anonymous, 2017) [1]. Maize is considered as the "Queen of Cereal". Being a C_4 plant, it is capable to utilize solar radiation more efficiently even at higher radiation intensity. The immature ears are used after roasting. For this, cultivars with enhanced sugar content are most suitable and are preferred. Out of various specialty corns, sweet corn is a mutant type with one or more recessive alleles in homozygous condition that enable the endosperm to accumulate twice the sugar content as that of seed corn. Out of the various specialty corns, sweet corn (*Zea mays* L. var. *saccharata sturt*) has a big market potential. It is a hybridized variety of maize specially bred to increase the sugar content. The urban people have great interest in consuming green cobs. In sweet corn best nutritional quality depends on moisture (72.7%) and total solids (22.3%) comprising of carbohydrate (81%), protein (13%) and lipids (3.5%). Approximately 40% of such corn is frozen and rest canned while processing. Sweet corn is a good source of energy. About 20% dry matter is sugar, compared with only 3 percent in dent maize at green stage. It is also good source of vitamins C and A. In addition to this, it is also used in the production of flavor, starch, carbohydrates, glucose, maltose, fructose and Ayurvedic medicines for making saups, vegetable and salad etc. Amongst various agricultural inputs, fertilizer is and will remain as a chief source in achieving the food production targets. For higher productivity, there is a need for the application of higher dose of fertilizers. But the increased application of high analysis fertilizers and use of high yielding cultivars demanding more secondary and micro nutrients for enhancing food grain production which resulted in their deficiencies and declined growth and productivity of crop due to continuous removal of nutrients from soil. Due to escalating cost of chemical fertilizers and objective of minimizing environmental pollution, the search of alternative source of plant nutrients is imperative. The integrated plant nutrient supply envisages conjunctive use of inorganic and organic sources of plant nutrients for crop productivity besides sustaining soil health.

Application of organic materials along with inorganic fertilizers in the soil leads to sustained productivity and also vermicomposting technology involves the bio-conversion of organic waste into vermicasts and vermiwash utilizing earthworms. Vermicompost is a nutrient rich organic fertilizer and soil conditioner. By addition of vermicompost in soil it increases the soil physical, chemical as well as bio logical properties. Bio fertilizers play an important role in increasing the availability of nitrogen and phosphorus. Among several bio agent *Azospirillum* is known to fix atmospheric nitrogen and increases about 10-15% grain yield in maize.

Materials and methods

The field experiment was conducted during *kharif* season of 2019-20, at Agronomy Section Farm, College of Agriculture, Latur (Maharashtra). The soil of experimental plot was clay in texture color with good drainage. The topography of experimental field was uniform and fairly leveled. The representative soil samples from 0 to 30 cm depth were taken from randomly selected plots all over the experimental field before laying out the experiment. A composite soil sample of about half kg was taken and analyzed for the determination of various physical and chemical properties of soil. The data showed that the soil of experimental plot was clayey in texture with chemical composition such as low in available nitrogen (125.3kg ha^{-1}), medium in available phosphorous (18.20kg ha^{-1}) and very high in available potassium (498.58kg ha^{-1}). The soil was moderately alkaline in reaction having pH (7.7). The experiment was laid out in a randomized block design with seven treatments and replicated thrice. The treatments were 100% RDF, 100% RDF + FYM @ 5 t ha^{-1}, 75% RDF + FYM @ 5 t ha^{-1}, 100% RDF + Vermicompost @ 2.5 t ha^{-1}, 75% RDF + Vermicompost @ 2.5 t ha^{-1}, 100% RDF + FYM @ 5 t ha^{-1} + Vermicompost @ 1.25 t ha^{-1}+ *Azospirillum* and 75% RDF + FYM @ 5 t ha^{-1} + Vermicompost @ 1.25 t ha^{-1} + *Azospirillum*. A popular sweet corn hybrid in the region, Sugar-75, which is golden yellow in colour released by M/S Syngenta India Limited, Pune, Maharashtra, was used in the present study. It is a short duration hybrid matures in 80 to 90 days and suitable for both *kharif* and *rabi* cultivation in Maharashtra. The seed are treated with *Cyantraniliprole* + *Thiamethoxam* @ 5 ml kg^{-1} seeds and bio fertilizer *Azospirillum* treatment was given to seed as per treatments. Organic manures *viz*., FYM and vermicompost were applied to the respective plots ten days before sowing. The Biofertilizer *Azospirillum* obtained from the Biofertilizers Production Unit, VNMKV, Parbhani was applied one day before sowing @ 10 ml kg^{-1}. The FYM and vermicompost was applied uniformly to all the plots as per treatments. As per treatments, half dose of nitrogenous fertilizers and full dose of phosphatic and potassic fertilizers were applied. The next half dose of nitrogen fertilizer was applied in bands as top dressing one month after sowing. The sources of nitrogen, phosphorus and potash were urea, single super phosphate (SSP) and muriate of potash (MOP), respectively. The data was statistically analyzed by adopting Fishers methods of analysis of variance as outlined by Gomez and Gomez (1984) [2]. The biometric observation of five randomly selected plants from each net plot were recorded. The tags were fixed to observational plants for their easy location. Plant from 15 x 30 cm area from each end of the rows and one row from both the sides were considered as border plants. The remaining plants were considered as plants from the net plot. Five plants were randomly selected from each net plot for recording periodic biometric observation. The observations were recorded on these selected five plants from each sub-sub plot treatment.

Results and Discussion

Plant height

Plant height was significantly influenced by different treatments at all growth stages of sweet corn Table 1. An application of 100% RDF + FYM @ 5 t ha^{-1} + Vermicompost @ 1.25 t ha^{-1} +*Azospirillum* (T_6) produced significantly taller plant height and it was at par with application of 75% RDF + FYM @ 5 t ha^{-1} + Vermicompost @ 1.25 t ha^{-1} +*Azospirillum* (T_7). Similar result were reported by Kumar and Thakur (2004) [5], Messy and Gaur (2006) [3].

Table 1: Mean plant height (cm) of sweet corn as influenced by different treatments at various growth stages of crop

Treatments	Days After Sowing (DAS)				
	30	45	60	75	AH
T_1-100% RDF	18.60	39.40	150.40	159.67	171.67
T_2 - 100% RDF + FYM @ 5 t ha^{-1}	18.80	40.00	153.67	162.80	173.67
T_3 -75% RDF + FYM @ 5 t ha^{-1}	15.73	36.53	141.67	152.00	159.33
T_4 -100% RDF + Vermicompost @ 2.5 t ha^{-1}	19.77	40.33	158.13	169.67	185.00
T_5 -75% RDF + Vermicompost @ 2.5 t ha^{-1}	17.80	38.60	142.40	156.67	166.67
T_6 -100% RDF + FYM @ 5 t ha^{-1} + Vermicompost @ 1.25 t ha^{-1} + *Azospirillum*	22.13	47.67	176.87	188.33	200.00
T_7 -75% RDF + FYM @ 5 t ha^{-1} +Vermicompost@ 1.25 t ha^{-1} + *Azospirillum*	20.53	45.00	168.60	182.17	194.00
SE±	0.91	2.16	7.48	7.79	8.37
CD at 5%	2.79	6.65	23.06	23.99	25.78
General Mean	19.05	41.08	155.96	167.33	178.62

Functional leaves

The maximum number of functional leaves (Table 2) was 5.90, 10.00, 15.67 and 15.87 were recorded during 30, 45, 60, 75 DAS and at harvest respectively. An application of 100% RDF + FYM @ 5 t ha^{-1} + Vermicompost @ 1.25 t ha^{-1} + *Azospirillum* (T_6) recorded significantly maximum number of functional leaves at all growth stages of sweet corn. However it was at par with application of 75% RDF + FYM @ 5 t ha^{-1} + Vermicompost @ 1.25 t ha^{-1} +*Azospirillum* (T_7) and it was found to be significantly superior over rest of treatments at 30, 45, 60, 75 DAS and at harvest. Similar result were reported by Jat (2006) [3], Kurne *et al.,* (2012) and Thorat (2016) [8].

Mean dry matter

An application of 100% RDF + FYM @ 5 t ha^{-1} + Vermicompost @ 1.25 t ha^{-1} +*Azospirillum* (T_6) recorded significantly higher dry matter accumulation $plant^{-1}$at all growth stages of sweet corn (Table 2) which was at par with 75% RDF + FYM @ 5 t ha^{-1} + Vermicompost @ 1.25 t ha^{-1} + *Azospirillum* (T_7) and it was found to be significantly superior over rest of treatments at 30, 45, 60, 75 and at harvest. Similar result were reported by Kumar and Thakur (2004) [5], Messy and Gaur (2006), Jat (2006) [3], Jadhav and Shelke (2012) [4], Kurne *et al.*, (2012) and Thorat (2016) [8].

Table 2: Mean number of functional leaves plant^{-1} of sweet corn as influenced by different treatments at various growth stages of crop

Treatments	Days After Sowing (DAS)					Dry matter
	30	45	60	75	AH	AH
T_1-100% RDF	4.93	8.00	12.67	14.67	14.67	107.40
T_2-100% RDF + FYM @ 5 t ha^{-1}	5.73	8.33	13.40	14.93	14.93	110.10
T_3-75% RDF + FYM @ 5 t ha^{-1}	4.50	7.33	12.27	13.37	13.37	98.03
T_4-100% RDF + Vermicompost @ 2.5 t ha^{-1}	5.80	8.67	13.53	15.07	15.07	111.37
T_5-75% RDF + Vermicompost @ 2.5 t ha^{-1}	4.53	7.67	12.33	13.93	13.93	100.13
T_6-100% RDF + FYM @ 5 t ha^{-1} + Vermicompost @ 1.25 t ha^{-1} +*Azospirillum*	5.90	10.00	15.67	17.60	17.60	128.33
T_7-75% RDF + FYM @ 5 t ha^{-1} + Vermicompost @ 1.25 t ha^{-1} + *Azospirillum*	4.87	9.00	15.33	15.87	15.87	116.67
SE±	0.33	0.42	0.69	0.74	0.74	5.33
CD at 5%	1.01	1.30	2.11	2.29	2.29	16.42
General Mean	5.18	8.43	13.60	15.06	15.06	110.29

Green cob yield

The green cob yield of sweet corn (Table 3) was significantly influenced by different treatments at harvest. Significantly highest green cob yield (10621 kg ha^{-1}) was produced by application of 100% RDF + FYM @ 5 t ha^{-1} + Vermicompost @ 1.25 t ha^{-1} +*Azospirillum* (T_6) which was at par with 75% RDF + FYM @ 5 t ha^{-1} + Vermicompost @ 1.25 t ha^{-1} +*Azospirillum* (T_7) and found to be significantly superior over rest of treatments. Significantly lowest green cob yield 7846 kg ha^{-1} of sweet corn was obtained from 75% RDF + FYM @ 5 t ha^{-1}(T_3). Similar results were reported by Sahoo and Mahapatra (2004), Massey and Gaur (2006) and Kurne *et al.*, (2012).

Green fodder yield

The green fodder yield of sweet corn (Table 3) was significantly influenced by different treatments at harvest. Significantly highest green fodder yield (21482 kg ha^{-1}) was produced by application of (T_6) 100% RDF + FYM @ 5 t ha^{-1} + Vermicompost @ 1.25 t ha^{-1} +*Azospirillum* which was at par with (T_7) 75% RDF + FYM @ 5 t ha^{-1} + Vermicompost @ 1.25 t ha^{-1} +*Azospirillum* and found to be significantly superior over rest of treatments. Significantly lowest green fodder yield (16898 kg ha^{-1}) of sweet corn was obtain from (T_3) 75% RDF + FYM @ 5 t ha^{-1}. Similar results were reported by Jadhav and Shelke (2012) [4] and Thorat (2016) [8].

Table 3: Green cob yield (kg ha^{-1}), green fodder yield (kg ha^{-1}) and harvest index (%) of sweet corn as influenced by different treatments at harvest

Treatments	Green cob yield (kg ha^{-1})	Green fodder yield (kg ha^{-1})	Harvest index (%)
T_1-100% RDF	7946	17300	31.47
T_2-100% RDF + FYM @ 5 t ha^{-1}	8570	18507	31.65
T_3-75% RDF + FYM @ 5 t ha^{-1}	7846	16898	31.71
T_4-100% RDF + Vermicompost @ 2.5 t ha^{-1}	8867	18771	32.08
T_5-75% RDF + Vermicompost @ 2.5 t ha^{-1}	7866	17099	31.51
T_6-100% RDF + FYM @ 5 t ha^{-1} + Vermicompost @ 1.25t ha^{-1} +*Azospirillum*	10621	21482	33.08
T_7-75% RDF + FYM @ 5 t ha^{-1} + Vermicompost @ 1.25t ha^{-1} + *Azospirillum*	9596	19312	31.47
SE±	568	868	-
CD at 5%	1751	2675	-
General Mean	8759	18450	31.84

Conclusion

Based on the result it can be inferred that significantly superior growth characters and higher yield were produced by application of 100% RDF + FYM @ 5 t ha^{-1} + Vermicompost @ 1.25 t ha^{-1} +*Azospirillum.*

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