International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2018; 6(3): 2101-2104

Received: 04-03-2018
Accepted: 09-04-2018

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Effect of nutrient management on quality parameter, nutrient uptake, soil fertility and economics of *Rabi* sweet corn (*Zea mays* L. var. *saccharata* sturt)

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Abstract
A field experiment was conducted during *rabi* 2014-15 at Instructional Farm, Department of Agronomy, College of Agriculture, Junagadh Agricultural University, Junagadh to study, *"Nutrient management in rabi sweet corn (Zea mays L. var. saccharata sturt)".* Total 9 treatments comprising of nutrient management practices *viz*., 50% N:P_2O_5:K_2O of RDF + FYM @ 8 t ha^{-1} (T_1), 50% N:P_2O_5:K_2O of RDF + VC @ 4 t ha^{-1} (T_2), 75% N:P_2O_5:K_2O of RDF + FYM @ 8 t ha^{-1} (T_3), 75% N:P_2O_5:K_2O of RDF + VC @ 4 t ha^{-1} (T_4), 100% N:P_2O_5:K_2O of RDF + FYM @ 8 t ha^{-1} (T_5), 100% N:P_2:O_5:K_2O of RDF + VC @ 4 t ha^{-1} (T_6), 125% N:P_2O_5:K_2O of RDF + FYM @ 8 t ha^{-1} (T_7), 125% N:P_2O_5:K_2O of RDF + VC @ 4 t ha^{-1} (T_8), 100% RDF (120:60:60 kg N:P_2O_5:K_2O ha^{-1}) (T_9) were evaluated in randomized block design with three replications. The sweet corn (Sugar-75) was sown in the first week of December and harvested on second week of March.
Among the quality parameters, it could be concluded that different treatments did not exert any significant influence on protein content but significantly the highest protein yield was recorded with 125% N:P_2O_5:K_2O of RDF + VC @ 4 t ha^{-1} (T_8) remained at par with T_7.
Nitrogen, phosphorus and potassium content in the grain and fodder was found non-significant.
Application of 125% N:P_2O_5:K_2O of RDF + VC @ 4 t ha^{-1} (T_8) recorded significantly higher status of available N, P_2O_5 and K_2O in soil after harvest of crop. The highest net realization of 93956 ₹ ha^{-1} with BCR ratio of 2.11 was obtained with application of 125% N:P_2O_5:K_2O + FYM @ 8 t ha^{-1} (T_7) followed by treatment 125% N:P_2O_5:K_2O + VC @ 4 t ha^{-1} (T_8) which gave net realization of (89727 ₹ ha^{-1}) and BCR ratio of 1.99.

Keywords: Sweet corn, FYM, Vermicompost, RDF, Economics

Introduction
Specialty corns (viz., sweet corn, pop corn, baby corn, high-oil corn etc.) assume tremendous market potential not only in India but also in the international market. These specialty corns with their high market value are perfectly suitable to peri-urban agriculture. Thus they promise higher income to maize growers. 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 specifically bred to increase the sugar content (Anand *et al.*, 2013) [1].
Judicious use of fertilizer is a key to bumper maize crop production as they alone contribute 40-60 per cent of the crop yield (Dayanand, 1998) [4]. Continuous use of organics help to build up soil humus and beneficial microbes, besides improvement of soil physical properties. Whereas, chemical fertilizers provide one or more essential plant nutrients which the soil cannot supply in adequate quantities. Thus, judicious combination of organics and chemical fertilizers helps to maintain soil productivity. Although, increased level of production can be achieved by increasing use of fertilizers alone but it may lead to deterioration of yield after a limit, degraded soils and ultimately lead to pollution. This can only be maintained at sustainable level by nutrients via integrated approach. Considering these facts and views, the present experiment has been conducted to study the "Nutrient management in *rabi* sweet corn (*Zea mays L. var. saccharata sturt*)".

Methodology

A field experiment was conducted at College of Agriculture, Junagadh Agricultural University, Junagadh at the instructional farm, Department of Agronomy, College of Agriculture, J.A.U. Junagadh during *Rabi* season of 2014-15.

The experiment comprising nine treatment combinations viz., 50% N:P_2O_5:K_2O of RDF + FYM @ 8 t ha^{-1} (T_1), 50% N:P_2O_5:K_2O of RDF + VC @ 4 t ha^{-1} (T_2), 75% N:P_2O_5:K_2O of RDF + FYM @ 8 t ha^{-1} (T_3), 75% N:P_2O_5:K_2O of RDF + VC @ 4 t ha^{-1} (T^4), 100% N:P_2O_5:K_2O of RDF + FYM @ 8 t ha^{-1} (T_5), 100% N:P_2O_5:K_2O of RDF + VC @ 4 t ha-^{1} (T_6), 125% N:P_2O_5:K_2O of RDF + FYM @ 8 t ha^{-1} (T_7), 125% N:P_2O_5:K_2O of RDF + VC @ 4 t ha^{-1} (T_8), 100% RDF (120:60:60 kg N:P_2O_5:K_2O ha^{-1}) (T_9) were tested in a randomized block design with three replications. Recommended dose of fertilizer (RDF) was 120:60:00 kg N-P-K/ha.

Vermicompost and FYM were applied in furrow before sowing as per the treatments. The treatment wise entire dose of phosphorus was applied by DAP as basal considering nitrogen content For applying half dose of nitrogen, urea was applied and remaining nitrogen was top dressed after 30 days of sowing. Entire dose of potassium was applied as basal in form of muraite of potash.

The sweet corn variety Sugar-75 was used for this study. Gross and net plot size was 5.0 m x 2.7 m and 4.0 m x 1.8 m = 7.2 m^2, respectively. Data on quality parameter, nutirent uptake, soil fertility and economics were recorded.

Results

Data presented in Table-1 indicated that different nutrient management treatments failed to show their significant influence on protein content of grain. A keen observation of data explained that different nutrient management treatments exert their significant influence on protein yield. Treatment T_8 (125% N:P_2O_5:K_2O + VC @ 4 t ha^{-1}) recorded the highest protien yield (187.61 kg ha^{-1}) and it was found at par with the treatment T_7 (125% N:P_2O_5:K_2O + FYM @ 8 t ha^{-1}). Whereas, the lowest protein yield of 115.16 kg ha^{-1} was found under the treatment T_9.

In the present investigation, higher N uptake (Table- 3) were recorded with the above mentioned treatments that lend support to enhance protein content. This could also be explained on the basis of better availability of desired and required nutrients in crop root zone and from its solubilization caused by the organic acid produced from the organic matter and also the increase uptake by sweet corn roots and enhanced photosynthetic and metabolic activity resulting in better partitioning of photosynthates to sinks, which reflected in quality enhancement in terms of protein content.

Table 1: Effect of nutrient management on protein content and protein yield of sweet corn

Treatments	Protein content	Protein yield (kg/ha)
T_1- 50% N:P_2O_5:K_2O of RDF + FYM @ 8 t ha^{-1}	10.40	115.98
T_2- 50% N:P_2O_5:K_2O of RDF + VC @ 4 t ha^{-1}	10.44	119.23
T_3- 75% N:P_2O_5:K_2O of RDF + FYM @ 8 t ha^{-1}	10.57	127.59
T_4- 75% N:P_2O_5:K_2O of RDF + VC @ 4 t ha^{-1}	10.66	135.60
T_5- 100% N:P_2O_5:K_2O of RDF + FYM @ 8 t ha^{-1}	10.76	147.41
T_6- 100% N:P_2O_5:K_2O of RDF + VC @ 4 t ha^{-1}	10.88	151.13
T_7- 125% N:P_2O_5:K_2O of RDF + FYM @ 8 t ha^{-1}	11.56	177.06
T_8- 125% N:P_2O_5:K_2O of RDF + VC @ 4 t ha^{-1}	11.67	187.61
T_9- 100% RDF (120:60:60 kg N:P_2O_5:K_2O ha^{-1})	10.60	115.16
S. Em.±	0.31	8.11
C. D. at 5%	NS	24.32
C. V. %	5.02	9.91

Similar findings were also reported by Saha and Mondal (2006) [10], Dalavi *et al.* (2009) [3] and Singh *et al.* (2010) [11] in maize.

The data presented in Table-2 showed that nitrogen content in the grain and fodder was found non-significant. However, nitrogen uptake by grain and fodder was significantly the highest with application of 125% N:P_2O_5:K_2O of RDF + VC @ 4 t ha^{-1} (T_8). Various treatments failed to express its significant effect on phosphorus content in grain and fodder. While phosphorus uptake by grain and fodder was significantly higher under the treatment 125% N:P_2O_5:K_2O of RDF + VC @ 4 t ha^{-1} (T_8).Potassium content by grain and fodder was observed non-significant. However, potassium uptake by grain and fodder was recorded significantly higher with 125% N:P_2O_5:K_2O of RDF + VC @ 4 t ha^{-1} (T_8).

Higher availability of nutrients enhance root and early vegetative growth which increased photosynthetic activity in plant as evident from increased plant height, which results in higher availability of metabolites from root to shoot and especially in the reproductive organ. This might have promoted growth of root as well as their functional activity resulting in higher extraction of nutrients from soil environment to aerial parts. The nutrient uptake is a function of yield and nutrient concentration in plant. Thus, improvement in uptake of N, P and K might be attributed to their concentration in grain and fodder and associated with higher grain and fodder yields.

The results of present investigation are in close vicinity with the findings of Panwar (2008) [7], Tetarwal *et al.* (2011) [13] and Singh *et al.* (2012) [11] in maize.

Table 2: Effect of nutrient management on nutrient uptake by sweet corn

Treatments	Nutrient uptake by grain (kg/ha)			Nutrient uptake by fodder (kg/ha)		
	N	P	K	N	P	K
T_1-	14.85	5.17	18.70	40.71	11.46	53.78
T_2-	15.20	5.66	19.22	40.84	12.24	55.62
T_3-	15.95	5.39	20.41	41.53	14.09	56.42
T_4-	16.18	5.82	22.20	44.38	14.64	60.45

T_5-	17.12	5.98	23.58	50.04	16.27	66.94
T_6-	17.71	5.91	24.18	52.35	17.81	69.59
T_7-	18.44	6.27	28.33	56.18	19.12	76.48
T_8-	19.04	6.67	31.13	58.73	21.08	80.26
T_9-	16.17	5.52	20.36	42.40	14.07	58.58
S. Em.±	0.60	0.23	1.18	2.14	0.79	3.36
C. D. at 5%	1.80	0.70	3.55	6.43	2.37	10.10
C. V. %	6.25	6.98	8.88	7.83	8.76	9.08

Soil Fertility

Application of 125% N:P_2O_5:K_2O of RDF + VC @ 4 t ha^{-1} (T_8) recorded significantly higher status of available N, P_2O_5 and K_2O in soil after harvest of crop (288.18, 45.74, 270.10 kg/ha respectively). However, status of available N in soil remained at par with the treatments T_7, T_6, and T_5. However, in case of available K_2O and P_2O_5 it remained at par with treatment T_7.

Table 3: Effect of nutrient management on available nutrients in soil after harvest of sweet corn

Treatments	Available nutrient in soil after harvest of crop (kg ha^{-1})		
	N	**P_2O_5**	**K_2O**
T_1- 50% N:P_2O_5:K_2O of RDF + FYM @ 8 t ha^{-1}	220.91	27.86	215.80
T_2- 50% N:P_2O_5:K_2O of RDF + VC @ 4 t ha^{-1}	222.61	29.01	217.74
T_3- 75% N:P_2O_5:K_2O of RDF + FYM @ 8 t ha^{-1}	225.91	28.42	222.91
T_4- 75% N:P_2O_5:K_2O of RDF + VC @ 4 t ha^{-1}	239.80	30.86	236.80
T_5- 100% N:P_2O_5:K_2O of RDF + FYM @ 8 t ha^{-1}	268.93	32.65	242.06
T_6- 100% N:P_2O_5:K_2O of RDF + VC @ 4 t ha^{-1}	273.52	37.18	252.09
T_7- 125% N:P_2O_5:K_2O of RDF + FYM @ 8 t ha^{-1}	276.32	42.54	266.08
T_8- 125% N:P_2O_5:K_2O of RDF + VC @ 4 t ha^{-1}	288.18	45.74	270.10
T_9- 100% RDF (120:60:60 kg N:P_2O_5:K_2O ha^{-1})	221.97	29.51	219.57
S. Em.±	11.36	1.70	11.05
C. D. at 5%	34.06	5.12	33.15
C. V. %	7.91	8.76	8.04

Significant build-up of available N, P_2O_5 and K_2O status under different treatments could be due to organic matter added with addition of FYM, vermicompost which remained longer period in the soil as residual nutrients. Besides, CO_2 and organic acid released during the process of decomposition which increase the availability of nutrients from native as well as applied organic sources. Due to these, there might be more activity of microbes in soil which fix atmospheric nitrogen and convert unavailable form of nutrient in soil to available form for longer period.

These results were also in conformity with those reported by Kumar *et al.* (2002), Zende *et al.*(2009) [14], Kumar *et al.*(2007) [6], Rasool *et al.*(2015) [8] and Chauhan (2010) [2] in sweet corn.

Economics

The data presented in Table-4 revealed that the treatment T_7 (125% N:P_2O_5:K_2O + FYM @ 8 t ha^{-1}) recorded the highest net return over other treatment (93,956 ₹ ha^{-1}). While the lowest net return was found under the treatment T_2 (50% N:P_2O_5:K_2O + VC @ 4 t ha^{-1}) (49,522 ₹ ha^{-1}).

Table 4: Effect of nutrient management on economics of treatments

Treatments	Gross return (₹ ha^{-1})	Cost of cultivation (₹ ha^{-1})	Net return (₹ ha^{-1})	B:C ratio
T_1-	134694	80962	53731	1.66
T_2-	135905	86383	49522	1.57
T_3-	145814	82164	63651	1.77
T_4-	152682	87584	65098	1.74
T_5-	166222	83988	82234	1.98
T_6-	169479	89409	80070	1.90
T_7-	178738	84782	93956	2.11
T_8-	179929	90202	89727	1.99
T_9-	135039	69204	65835	1.95

The highest net realization of 93956 ₹ ha^{-1} with BC ratio of 2.11 was obtained with treatment 125% N:P_2O_5:K_2O of RDF + FYM @ 8 t ha^{-1} (T_7) followed by 125% N:P_2O_5:K_2O of RDF + VC @ 4 t ha^{-1} (T_8) which realized net realization of 89727 ₹ ha^{-1} and BC ratio of 1.99. This was due to comparatively better increase in yield over other treatments. These results are in accordance with the findings of Ravi *et al.* (2012) [9] and Joshi *et al.* (2013) [5] in maize.

The reason is self-explanatory as cost of cultivation was reported higher with more quantity of vermicompost required to supply recommended quality of nutrients which increase the total cost of sweet corn production. While chemical fertilizers are chipper and required less in quantity to supply recommended dose of nutrient, which effect on net realization and cost benefit ratio of the treatments under study. The vermicompost is costly as compared to fertilizer. Kumar *et al.* (2007) [6], Zende *et al.* (2009) [14] and Chauhan (2010) [2] also reported same results in sweet corn.

Conclusion

From the results of one year experimentation, it can be concluded that the fertilizing with 125% N:P_2O_5:K_2O of RDF + FYM @ 8 t ha^{-1} (T_7) or 125% N:P_2O_5:K_2O of RDF + Vermicompost @ 4 t ha^{-1} (T_8) is found beneficial to maintain

soil fertility, improve the the quality parameter (the protein content) give economical returns under under South Saurashtra Agroclimatic condition.

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