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RESEARCH ARTICLE

Yield and quality of sweet corn [*Zea mays* (L.) var. Saccharata] as influenced by planting geometry and fertilizer levels

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SUMMARY

A field experiment was conducted to study the effect of planting geometry and different fertilizer levels on yield and quality of sweet corn [*Zea mays* (L.) var. Saccharata] at All India Co-ordinated Research Project on Water Management, Central Campus, Mahatma Phule Krishi Vidyapeeth, Rahuri, district Ahmednagar during *Kharif*-2009. The soil was medium deep black and uniform in depth. Among the three spacings, sowing of sweet corn with paired row planting of 45-75 x 20 cm significantly improved growth and yield components, resulting in significant increase in cob and green fodder yield of sweet corn. This treatment also gave significantly more uptake of NPK as compared to other spacings. The application of fertilizer as per soil test with paired row planting of 45-75 x 20 cm significantly increased available soil NPK status of soil after harvest of sweet corn crop. The paired row planting at 45-75 x 20 cm recorded significantly higher protein in grain (8.09 %), reducing sugars (3.86 %), sucrose content (8.11 %) and total sugar content (11.98 %) than remaining plant spacings. The uptake of N, P and K was significantly higher due to paired row planting of 45-75 x 20 cm than rest of the treatments.

Key Words : Sweet corn, Fertilizer levels, Planting geometry, Quality

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Maize (*Zea mays*), queen of cereals, has the highest production potential among present day cereals. It is the second most important staple food grain for human, feed for animals and has wide industrial uses. Maize is classified into different groups/types on the basis of endosperm of kernels like sweet corn, dent corn, pop corn, wax corn etc. Sweet corn is the recent form of grain vegetable maize, has got prime importance in diversification, revenue generation and value addition as well as the growth of the processing industry in an Indian agriculture. Among all the types of maize, sweet corn (*Zea mays* Saccharata S.) is one of the commercially used type of maize. It is grown primarily as a food and is harvested at about 70 per cent moisture. It is one of the most popular vegetables in USA, Europe and other advanced countries of the world. Approximately 40 per cent of such corn is frozen and rest is canned while processing. Sweet corn (*Zea mays* L. Saccharata) is a good source of energy. About 20 per cent of the dry matter is sugar, compared with only 3 per cent in dent maize at green ear stage. It is also good source of vitamin C and A. In addition to this, it is also used in production of flavour, starch, carbohydrates, glucose, maltose, fructose and Ayurvedic medicines for making soups, vegetables and salads etc. Besides this, fodder is highly succulent, palatable and digestible which is used for cattle. Hence, it is called as "King of fodder". In Maharashtra, the farmers are following general row to row and plant to plant spacing of maize to sweet corn. In order to obtain yield maximization, it is necessary to find out the optimum plant population in sweet corn by adjusting the spacing. The systematic and detailed research work regarding N, P and K

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requirement of sweet corn has not been carried out in Maharashtra state. Farmers are following the general fertilizer dose of maize to sweet corn. In view of obtaining good quality produce, the experiment was conducted to find out the optimum spacing and dose of fertilizer for sweet corn.

MATERIAL AND METHODS

The field experiment was conducted at All India Co-ordinated Research Project on Water Management, Central Campus, Mahatma Phule Krishi Vidyapeeth, Rahuri, district Ahmednagar during *Kharif* 2009. The soil was medium deep black and uniform in depth.

The experiment was laid out in the Split Plot Design with twelve treatment combinations replicated four times. The Main plot treatments (Spacings - 3) were S_1:45 x 20 cm; S_2:60 x 15 cm, S_3:Paired row planting of 45-75 x 20 cm; while four Sub-plot treatments (Nutrient levels) *viz.*, T_1:125 % GRDF (10 t FYM ha^{-1} + 187.5 + 65.50 + 62.50 kg NPK ha^{-1}); T_2:100 % GRDF (10 t FYM ha^{-1} + 150 + 50 + 50 kg NPK ha^{-1}); T_3:75 % GRDF (10 t FYM ha^{-1} + 112.50 + 37.50 + 37.50 kg NPK ha^{-1}); T_4:As per soil test (10 t FYM ha^{-1} + 187.50 + 50 + 25 kg NPK ha^{-1}) were applied. The fertilization of sweet corn was carried out as per the treatments. The half dose of nitrogen was applied at sowing and remaining half dose of nitrogen was applied one month after sowing through urea. Whereas, basal dose of phosphorus and potassium was applied through single super phosphate and muriate of potash. The cultural practices and plant protection schedule was followed as per recommended package of practices. The fresh cobs of sweet corn were picked up from net plot at 75 days after sowing. The grains of fresh cob of selected five plants were separated and studied for quality parameters. The growth observations were recorded from the readily selected five plants in each net plot at the time of harvesting. Nitrogen percentage was estimated by Microkjeldahl's method (Piper, 1966). Protein percentage of grains was obtained by multiplying the nitrogen percentage with 6.25 as protein contains 16 per cent nitrogen. The grains were extracted by using alcohol and reducing sugars, total sugars were estimated as per the method described in A.O.A.C. (2005). The non reducing sugar (sucrose) content was estimated by substracting the reducing sugar from the total reducing sugars. Total nitrogen Phosphorus and Potassium content in grains on dry weight basis was determined by Microkjeldahl method (Piper, 1966), colorimetric method (Jackson, 1973) and by Flame Photometric method (A.O.A.C., 2005), respectively. The uptake of Nitrogen, Phosphorus and Potassium by plant was calculated from the data content in plant parts and their dry weight. Similarly, uptake per ha was calculated by multiplying dry weight of cob grain and fodder yields with their respective percentage.

RESULTS AND DISCUSSION

The fresh cob yield, green fodder yield and total biomass production of Sweet corn differed with varying levels of plant geometry and fertilizer levels are presented in Table 1. The plant spacing had significant influence on fresh cob yield of sweet corn. Significantly, higher fresh cob yield was recorded under paired row planting at 45-75 x 20 cm than other spacing mainly because of significant improvement in all the growth

Table 1 : Influence of different treatments on mean yield and quality parameters of sweet corn

Treatments	Fresh cob yield (q ha^{-1})	Green fodder yield (q ha^{-1})	Total biomass production (q ha^{-1})	Protein (%)	Reducing sugar (%)	Sucrose (%)	Total sugar (%)
Main plot treatments (Spacings)							
S_1= 45 x 20 cm	139.23	172.78	312.00	7.37	3.74	7.39	11.15
S_2= 60 x 15 cm	142.36	177.85	320.80	7.92	3.76	7.94	11.70
S_3= Paired row planting 45-75x20cm	162.64	194.58	357.20	8.09	3.86	8.11	11.98
S.E. $\pm$	1.78	1.70	3.30	0.025	0.019	0.025	0.033
C.D. (P=0.05)	6.16	5.90	11.6	0.085	0.064	0.085	0.11
Sub plot treatments (Nutrient levels)							
T_1= 125 % GRDF	155.27	188.23	343.50	8.04	3.90	8.07	11.97
T_2= 100 % GRDF	149.61	182.90	332.70	7.81	3.72	7.83	11.56
T_3= 75 % GRDF	120.87	157.73	278.60	7.1	3.54	7.13	10.67
T_4= As per soil test	166.37	198.07	365.30	8.20	4.00	8.24	12.24
S.E. $\pm$	5.20	4.88	9.80	0.084	0.023	0.084	0.089
C.D. (P=0.05)	15.09	14.18	28.50	0.243	0.067	0.243	0.259
Interaction							
S.E. $\pm$	9.01	8.46	17.00	0.145	0.040	0.145	0.154
C.D. (P=0.05)	NS	NS	NS	NS	NS	NS	NS
General mean	148.00	181.73	330.00	7.79	3.79	7.82	11.61

NS=Non-significant

and yield contributing characters. Paired row planting produced 16.8 per cent higher cob yield over 45 x 20 cm spacing and 14.2 per cent over 60 x 15 cm spacing. Application of fertilizer as per soil test significantly increased the cob yield as compared to other fertilizer levels. The increase in fresh cob yield due to application of fertilizer as per soil test was 7.1 per cent higher than the 125 per cent GRDF treatment and 11.2 per cent higher than 100 per cent GRDF.

The green fodder yield differed significantly due to various spacings under study. The paired row planting at 45-75 x 20 cm produced significantly higher green fodder yield (194.58 q ha^{-1}) which was 12.6 per cent higher than 45 x 20 cm. The planting at 45 x 20 cm and 60 x 15 cm were at par with each other. Similar results were also report by Chougale, (2003). The differences were statistically significant due to various levels of fertilizers in respect of green fodder yield. The application of fertilizer as per soil test produced significantly higher green fodder yield (198.07 q ha^{-1}) which was 8.29 per cent higher than the 100 per cent GRDF(182.90 q ha^{-1}). The treatments of application of 125 per cent GRDF and 100 per cent GRDF were at par with each other. These findings are in agreement with the results reported by Jat (2006) who found significant increase in green fodder yield with the application of 100 per cent RDF.

The mean total biomass production of sweet corn was 330.0 q ha^{-1}. The statistically significant differences were observed due to various spacings in respect to the total biomass production. The paired row planting at 45-75 x 20 cm spacing was found to be significantly superior over other treatments and it was 14.49 per cent higher than the planting at 45 x 20 cm spacing. The planting at 45 x 20 cm and 60 x 15 cm spacing were at par with each other. The application of fertilizer as per soil test was found to be significantly superior over 100 per cent GRDF and 75 per cent GRDF and it gave 9.80 per cent higher total biomass yield over 100 per cent GRDF and 31.1 per cent over 75 per cent GRDF. The application of 125 per cent GRDF and 100 per cent GRDF were at par with each other. The interaction due to different spacings and fertilizer levels was found to be non significant in respect of fresh cob yield, green fodder yield and total biomass production of sweet corn.

The differences in respect to protein content, sucrose, reducing sugars and total sugar content in grain of sweet corn in grain due to different spacings were statistically significant. The paired row planting at 45-75 x 20 cm recorded significantly higher protein in grain (8.09 %) than rest of the spacings. The lowest protein content (7.37 %) was recorded in closer spacing of 45 x 20 cm. These findings are in agreement with the results reported by Kar *et al*. (2006) who reported significant increase in protein yield under wider spacing of 60 x 20 cm followed by 45 x 30 cm spacing in sweet corn. The application of fertilizers as per soil test recorded significantly higher protein content (8.20 %) followed by application of 125 per cent GRDF which were at par with each other. The paired row planting of 45 – 75 x 20 cm recorded significantly more reducing sugars (3.86 %) than rest of the spacings. Application of fertilizer as per soil test recorded significantly maximum reducing sugars (4.00 %) than rest of the fertilizer levels. The lowest reducing sugar (3.54 %) was observed under the treatment 75 per cent GRDF. The

Table 2 : Influence of different treatments on nutrient content (%) in plant and total nutrient uptake (kg ha^{-1})

Treatments	Nutrient content in plant (%)			Total nutrient uptake (kg ha^{-1})		
	Nitrogen	Phosphorus	Potassium	Nitrogen	Phosphorus	Potassium
Main plot treatments (Spacings)						
S_1= 45 x 20 cm	1.18	0.18	1.47	147.25	23.59	184.18
S_2= 60 x 15 cm	1.26	0.20	1.50	160.28	26.09	189.58
S_3= Paired row planting 45-75 x 20 cm	1.29	0.23	1.54	167.51	30.26	200.29
S.E. $\pm$	0.004	0.003	0.007	1.06	0.57	1.81
C.D. (P=0.05)	0.01	0.10	0.02	3.68	1.98	6.25
Sub plot treatments (Nutrient levels)						
T_1= 125 % GRDF	1.28	0.22	1.57	166.48	29.00	203.21
T_2= 100 % GRDF	1.25	0.19	1.48	157.52	24.42	186.52
T_3= 75 % GRDF	1.14	0.16	1.37	133.92	19.68	160.90
T_4=As per soil test	1.31	0.25	1.61	175.20	33.48	214.77
S.E. $\pm$	0.01	0.009	0.02	3.67	1.58	5.06
C.D. (P=0.05)	0.04	0.03	0.06	10.65	4.60	14.70
Interaction						
S.E. $\pm$	0.02	0.017	0.037	6.35	2.74	8.77
C.D. (P=0.05)	NS	NS	NS	NS	NS	NS
General mean	1.24	0.21	1.50	158.28	26.65	191.35

NS=Non-significant

mean sucrose content in grain was 7.82 per cent. The paired row planting of 45-75 x 20 cm recorded significantly higher sucrose content (8.11 %) and total sugar content (11.98 %) than remaining plant spacings. The lowest sucrose content (7.39 %) was recorded under 45 x 20 cm spacing. The application of fertilizer as per soil test recorded significantly higher sucrose (8.24 %) and total sugar (12.24 %) than remaining fertilizer levels. The lowest sucrose content (7.13 %) and less total sugar content (10.67 %) was recorded in application of 75 per cent GRDF treatment. The interaction effect due to different spacing and fertilizer levels was found to be non-significant for all the quality parameters studied.

Data in respect of nutrient content (NPK) in plant as influenced by various treatments are presented in Table 2. The mean nitrogen, phosphorous and potassium content in sweet corn plant was 1.24, 0.21 and 1.50 per cent, respectively. The nitrogen, phosphorus and potassium concentration was influenced significantly due to different spacings. Paired row planting of 45-75 x 20 cm recorded significantly more nitrogen, phosphorus and potassium content in sweet corn plant and the lowest was recorded in the planting of 45 x 20 cm spacing. Application of fertilizer as per soil test treatment recorded significantly more N, P and K content than rest of the treatments. However, this treatment was at par with the application of 125 per cent GRDF. The mean total uptake of nitrogen, phosphorus and potassium by sweet corn crop was 158.28, 26.65 and 191.35 kg ha^{-1}, respectively. The uptake of N, P and K was significantly higher due to paired row planting of 45-75 x 20 cm than rest of the treatments. Higher uptake was primarily due to higher cob and green fodder yields. The higher uptake might also be due to better root establishment, translocation of absorbed nutrients from soil, transport of nutrients to seed and higher growth which led to better yields. Similar results were observed by Singh *et al.* (1997), and Chougale (2003). The application of fertilizer as per soil test significantly increased total N, P, K (175.20, 33.48 and 214.77 kg ha^{-1}) uptake as compared to other fertilizer levels. This might be due to significant improvement in most of the growth and yield contributing characters resulted in higher cob and green fodder yield and thus higher nitrogen, phosphorus and potassium uptake. Further, it was noticed that the N, P, K uptake was significantly the lowest with the application of 75 per cent GRDF because of decrease in cob and green fodder yield. Similar results were observed by Mishra *et al.* (1994) and Jat (2006). Application of balanced dose of fertilizers as per the soil test treatment with due consideration to the available soil test values may have resulted in higher uptake of nutrients. Moreover, application of lower dose of potassium may have led in higher uptake of potassium which may be probably due to the phenomenon of priming effect.

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