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Original Article

OPTIMIZATION OF IRRIGATION AND FERTILIZER FORSWEET CORN (*ZEA MAYS* L. VAR. *SACCHARATA*STURT) UNDER CLIMATE CHANGE CONDITIONS

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ABSTRACT

A field experiment was conducted during *rabi* seasons 2010 and 2011 on clayey soil of Junagadh (Gujarat) to study the response of sweet corn (*Zea mays* L.var. *saccharata*Sturt)to irrigation (0.6, 0.8 and 1.0 IW:CPE) and fertilizer (control, 90-45, 120-60 and 150-75 kg N-P_2O_5/ha). The results revealed that irrigation at 0.8 IW:CPE being at par with 1.0 IW:CPE enhanced growth and yield attributes and thereby green cob and fodder yield along with higher net returns and B:C ratio over irrigation at 0.6 IW:CPE. Application of 120-60 kg N-P_2O_5/ha being at par with 150-75 kg N-P_2O_5/ha improved growth and yield attributes and ultimately higher green cob and fodder yields with higher net returns and B:C ratio over control and 90-45 kg N-P_2O_5/ha. Therefore, irrigation at 0.8 IW:CPE and fertilizer dose of 120-60 kg N-P_2O_5/ha could be applied for higher yield and economical realization from *rabi* sweetcorn along with appreciable saving of water and fertilizer under climate change conditions.

Keywords: *zea mays* l. Var. *Saccharata*sturt , Speciality corns *viz.*, sweet corn, pop corn, baby corn, high-oil corn *etc*.

INTRODUCTION

Speciality 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 speciality corns, sweet corn (*Zea mays* L.var. *saccharata*Sturt)has a big marketpotential. It is a hybridized variety of maize specifically bred to increase the sugar content. Sustainability of scientific sweet corn cultivation practices must be ensured to attain the goal of agricultural sustainability.In order to achieve higher cob yields, irrigation and fertilizers are the most important factors. Thus, there is need to work out an optimum irrigation scheduling in relation to other agronomic factors.Judicious use of fertilizers is a key to bumper maize production as they alone contribute 40-60 per cent of the crop yield (Dayanand, 1998). Maize is an exhaustive crop and requires high quantities of nitrogen and phosphorus. Low soil fertility is one of the bottlenecks to sustain agricultural production and productivity in India. Anthropogenic factors such as inappropriate land use systems, mono cropping, nutrient mining and inadequate supply of nutrients are aggravated the situation.To minimize input costs and environmental damage, farmers have to resort to producing corn with less irrigation and fertilizer in the future.Considering the present trends of global climate change, atmospheric CO_2 and temperature levels are likely to increase in future, which will affect yields, water and fertilizer requirements of the crops in a given region.The agronomic requirements like irrigation and fertilizer for maize crop has been worked out, but the recommended irrigation and fertilizer dose for normal maize may not be applicable to sweet corn. In India much work has not been done so far for the sweet corn (Kumar, 2009). Therefore, the present experiment is conducted to work out irrigation, nitrogen and phosphorus requirement of sweet corn.

MATERIALS AND METHODS

A field experiment was conducted during *rabi* 2010 and 2011 at Department of Agronomy, College of Agriculture, Junagadh Agricultural University, Junagadh (Gujarat). The experimental soil was clayey in texture and slightly alkaline in reaction with pH 7.8 and EC 0.33 dS/m. It was low in available nitrogen (227 kg/ha), available phosphorus (22.5 kg/ha) and medium in available potash (289 kg/ha). The experiment comprised twelve treatment combinations consisting three levels of irrigation (0.6, 0.8 and 1.0 IW:CPE) and four fertilizer levels (Control, 90-45, 120-60 and 150-75 kg N-P_2O_5/ha). These treatments were replicated four times in a split plot design. The sweet corn hybrid 'Sugar 75' was sown during second week of November and harvested during third week of March in 2010 and 2011. The gross plot size was 5.0 m x 3.6 m and net plot sizewas4.0 m x 2.4 m with 60 cm x 15 cm spacing.Flood irrigation each of 5 cm depth was scheduled on the basis of IW:CPE of 0.6, 0.8 and 1.0. The entire dose of phosphorus and half dose of nitrogen were applied as basal application in form of urea and DAP at just before sowing in the furrows. Remaining half dose of nitrogen was top dressed as urea in two equal splits at 30 and 45 DAS.

RESULTS AND DISCUSSION

Growth and yield attributes

The data (Table 1) indicated that irrigation did exert significant influence on growth attributes of sweet corn viz., plant height, leaf area index (LAI) and dry matter per plant. However, number of leaves per plant and stem diameter remained unaffected under various levels of irrigation. Irrigatingthe crop at 1.0 IW:CPErecorded significantly the highest plant height (173 cm) and LAI (3.68) and dry matter per plant (145 g), which was statistically at par with 0.8 IW:CPE. The significant reduction in plant growth with decreasedfrequency of irrigation seems to be the resultant of water stress, which might have reduced the availability and uptake of water and nutrients and inhibited photosynthesis and cell division. The resultsare in close accordance with finding ofGolparvar and Karimi (2011)and Thorat et al.(2011). The irrigation at 1.0 IW:CPE, being at par with 0.8 IW:CPE, recorded significantly the highest number of cobs/plant (1.41), cob length (17.2 cm), cob girth (15.0 cm), fresh weight of cob (129 g), number of kernels/cob (273) and fresh weight of 100-kernels (24.9 g). The enhanced yield components under 0.8 and 1.0 IW:CPE might be due to significant improvement in overall growth of the crop expressed in terms of plant height, leaf area index and dry matter accumulation by virtue of increased photosynthetic efficiency. The present findings are in close agreement with the results obtained byPatilet al.(2012) and Painyuli et al.(2013).

Table1. Effect of irrigation and fertilizer on growth and yield attributes of sweet corn (Pooled over two years)

Treatments	Plant height (cm)	Number of leaves/ plant	Stem diameter (cm)	Leaf area index	Dry matter per plant (g)	Number of cobs/ plant	Cob length (cm)	Cob girth (cm)	Fresh weight of cob (g)	Number of kernels/ cob	100-kernels fresh weight (g)
Irrigation (IW:CPE)											
0.6	160	12.4	1.89	3.39	126	1.14	15.4	13.8	115	246	21.5
0.8	168	12.8	2.09	3.61	139	1.32	16.7	14.9	124	263	23.3
1.0	173	13.1	2.17	3.68	145	1.41	17.2	15.0	129	273	24.9
SEm±	2	0.3	0.04	0.05	3	0.04	0.3	0.3	3	5	0.6
CD (*P=0.05*)	8	NS	NS	0.18	9	0.13	1.1	1.1	9	19	2.0
Fertilizer (kg N-P_2O_5/ha)											
Control	150	10.4	1.85	3.37	122	1.08	15.1	13.6	114	241	21.2
90-45	162	11.1	2.02	3.54	134	1.21	16.2	14.4	119	254	22.3
120-60	176	14.7	2.15	3.62	143	1.41	17.0	15.1	128	271	24.4
150-75	180	14.9	2.17	3.69	148	1.47	17.4	15.2	129	276	25.1
SEm±	2	0.2	0.03	0.04	2	0.04	0.3	0.3	2	4	0.5
CD (*P=0.05*)	6	0.6	0.09	0.11	7	0.11	0.8	0.8	7	12	1.4

Table 2. Effect of irrigation and fertilizer on nutrient uptake, yield and economics of sweet corn

Treatments	N uptake (kg/ha)		P uptake (kg/ha)		Green cob yield (t/ha)		Green fodder yield (t/ha)		Net return (Rs/ha)		B:C	
	2010	2011	2010	2011	2010	2011	2010	2011	2010	2011	2010	2011
Irrigation (IW:CPE)												
0.6	101	106	41	28	7.11	6.82	31.87	30.18	59,424	54,834	2.36	2.26
0.8	111	118	49	35	7.78	7.44	35.95	33.97	69,204	63,824	2.55	2.43
1.0	116	124	53	39	7.84	7.51	36.13	34.11	68,984	63,664	2.51	2.40
SEm±	3	3	2	1	0.15	0.14	1.25	1.17				
CD (*P=0.05*)	10	9	6	5	0.51	0.49	4.25	3.98				
Fertilizer (kg N-P_2O_5/ha)												
Control	53	63	26	16	6.75	6.49	31.45	29.50	62,110	57,560	2.69	2.56
90-45	108	119	44	28	7.52	7.20	33.43	31.78	68,459	63,609	2.70	2.58
120-60	134	139	59	45	8.01	7.67	36.66	35.44	75,645	71,025	2.84	2.73
150-75	142	143	62	47	8.02	7.69	37.15	35.89	75,291	70,731	2.79	2.68
SEm±	3	3	2	1	0.14	0.13	1.08	1.09				
CD (*P=0.05*)	9	8	5	4	0.4	0.39	3.14	3.16				

Selling price: Green cob: Rs. 10.00/kg, Green fodder: Rs. 1.00/kg

The data furnished in Table 1 revealed that significantly the highest plant height (180 cm), number of leaves per plant (14.9), stem diameter (2.17 cm), LAI (3.69) and dry matter per plant (148 g) were recorded with application of 150-75 kg N-P_2O_5/ha, which remained at par with that of 120-60 kg N-P_2O_5/ha. Profound influence of N and P on crop growth seem to be due to congenial nutritional environment of plant system on account of their greater availability from soil media, which might have resulted in greater synthesis of amino acids, proteins and growth promoting substances, which seems to have enhanced the meristematic activity and increased cell division and their elongation. Further application of 150-75 or 120-60 kg N-P_2O_5/ha might have increased interception, absorption and utilization of radiant energy which in turn increased photosynthesis and thereby plant height, stem diameter and finally accumulation of dry matter. The enhanced growth with fertilizers was also reported by Massey and Gaur (2006) and Khazaei et al. (2010).Application of 150-75 kg N-P_2O_5/ha, being at par with that of 120-60 kg N-P_2O_5/ha, significantly enhanced yield attributes viz., number of cobs/plant (1.47), cob length (17.4 cm), cob girth (15.2 cm), fresh weight of cob (129 g), number of kernels/cob (276) and fresh weight of 100-kernels (25.1 g) over application of 90-30 kg N-P_2O_5/ha and control. Fertility levels of 150-75 and 120-60 kg N-P_2O_5/ha did cause about significant improvement in overall growth of the crop by virtue of increased photosynthetic efficiency. Thus greater availability of photosynthatesand nutrients to develop reproductive structures seems to have resulted in increased productive plants, cob girth, cob length and cob weight with these fertility levels. The present findings are within the close vicinity of those reported by Massey and Guar (2006) and Khazaei et al. (2010).

Nutrient uptake

Irrigation at 1.0 IW:CPE registered significantly the highest uptake of N (116 and 124 kg/ha) and P (53 and 39 kg/ha) during 2010 and 2011, however it was at par with 0.8 IW:CPE (Table 2).The significant improvement in uptake of nutrients might be attributed to their respective higher concentration in cob and fodder associated with higher yields. This might also be attributed to better availability of nutrients in the soil under non-competitive environmentwith theseirrigation levels. The results are in close agreement with the findingofPatil et al.(2012).

Application of150-75 kg N-P_2O_5/ha recorded significantly the highest uptake of N (142 and 143 kg/ha) and P (62 and 47 kg/ha) in 2010 and 2011, however it remained at par with that of 120-60 kg N-P_2O_5/ha (Table 2). The increased uptake of N and P might be attributed to their respective higher concentration in cob and fodder with higher cob and fodder yields. This might also be attributed to better availability of nutrients in the soil under these fertility levels. The results are in close vicinity with the report of Kumar (2009).

Crop yield

An appraisal of data (Table 2) showed that different irrigation schedules imparted their significant influence on green cob yield. Significantly the highest green cob yield (7.84 and 7.51 t/ha) and green fodder yield (36.13 and 34.11 t/ha) were recorded with 1.0 IW:CPEduring 2010 and 2011, and it was found at par with irrigation at 0.8 IW:CPE. Averaged over two years, irrigation at 0.8 and 1.0 IW:CPE increased green cob yield by 9.3 and 10.2% and green fodder yield by 12.7 and 13.2% over irrigation scheduled at 0.6 IW:CPE, respectively. Improved individual plant performance under 0.8 and 1.0 IW:CPE ultimately reflected in higher cob and fodder yields over 0.6 IW:CPE. The present findingis in close agreement with the results obtained by Patil et al. (2012) and Painyuli et al. (2013).

Fertilizer dose of 150-75 kg N-P_2O_5/ha recordedsignificantly the highest green cob yield (8.02 and7.69 t/ha) and green fodder yield (37.15 and 35.89 t/ha), however remained at parwith 120-60 kg N-P_2O_5/ha during both the years (Table 2). On an average of two years, application of 120-60 and 150-75 kg N-P_2O_5/ha increased green cob yield by 18.4 and 18.7% and green fodder yield by 18.3 and 19.9%, respectively over control.Significant increase in green cob and fodder yields under these fertility levels appears on account of their influence on growth and development of the crop. The present findingis in close agreement with the results obtained by Massey and Gaur (2006) and Sahoo and Mahapatra (2007).

Interaction between irrigation and fertilizer levels was found to be non-significant in respect of growth, yield attributes, nutrients uptake and yield.

Economics

Irrigating the crop at 0.8 IW:CPEgave maximum net returns ofRs.69,204 and 63,824/ha with B:C ratio of 2.55 and 2.43, followed by 1.0 IW:CPE, which recorded net returns ofRs.68,984 and 63,664/ha and B:C ratio of 2.51 and 2.40 during 2010 and 2011, respectively.Patil et al. (2011) also reported similar results.

Fertilizing the crop with 120-60kg N-P_2O_5/haaccrued maximum net returns ofRs.75,645 and 71,025/ha with B:C ratio of 2.84 and 2.73,closely followed by fertilizer dose of 150-75kg N-P_2O_5/hahaving net returns ofRs.75,291 and 70,731/hawith B:C ratio of 2.79 and 2.68during 2010 and 2011, respectively. Thorat et al.(2011)and Kumar (2009) also reported alike results.

REFERENCES

1. Dayanand. (1998). Principles governing maize cultivation during rainy season. Indian Farming, 48(1):84-87.
2. Golparvar, A.R. and M. Karimi (2011). Effects of drought stress on seed yield and yield components of sweet corn (*Zeamays* L.) cultivars. Research on Crops, 12(2): 346-351.
3. Khazaei, F., M.A. Alikhani, I. Yariand A.Khandan (2010). Study the correlation, regression and path coefficient analysis in sweet corn (*Zea mays* var. *saccharata*) under different levels of plant density and nitrogen rate. Journal of Agricultural and Biological Science, 5(6): 212-216.
4. Kumar, A. (2009). Production potential and nitrogen-use efficiency of sweet corn (*Zea mays*) as influenced by different planting densities and nitrogen levels. Indian Journal of Agricultural Sciences, 79(5): 351-355.
5. Massey, J.X. and B.L.Gaur (2006). Effect of plant population and fertility levels on growth and NPK uptake by sweet corn (*Zea mays* L.) cultivars. Annals Agricultural Research New Series, 27(4): 365-368.
6. Painyuli, A., M.S. Pal, A. Bhatnagarand A.S. Bisht (2013). Effect of planting techniques and irrigation scheduling on productivity and water use efficiency of sweet corn (*Zeamayssaccharata*). Indian Journal of Agronomy, 58(3): 344-348.
7. Patil, S.A., U.V. Mahadkar, S.P. Gosaviand P.G. Parab (2011). Cost economics of sweet corn (*Zea mays saccharata*) as influenced by irrigation and fertigation levels. Journal of Soils and Crops, 21(2): 209-212.
8. Patil, S.A., U.V. Mahadka, N.C. Mohiteand A.H. Karpe (2012). Effect of irrigation and fertigation levels on yield, quality and nutrient uptake of *rabi* sweet corn (*Zea mays saccharata*). Journal of Soils and Crops, 22(1): 100-104.
9. Sahoo, S.C. and P.K.Mahapatra (2007). Yield and economics of sweet corn (*Zea mays*) as affected by plant population and fertility levels. Indian Journal of Agronomy, 52(3): 239-242.
10. Thorat, T.N., R.T. Thokal, U.V. Mahadkarand D.J. Dabke (2011). Effect of irrigation regimes and integrated nutrient management on yield of sweet corn (*Zea mays saccharata*). Journal of Maharashtra Agricultural Universities, 36(1): 18-21.