E-ISSN: 2618-0618
P-ISSN: 2618-060X

www.agronomyjournals.com
2024; SP-7(6): 235-238
Received: 12-06-2024
Accepted: 22-06-2024

KH Patel
Main Maize Research Station, AAU, Godhra, Gujarat, India

HS Varma
Main Maize Research Station, AAU, Godhra, Gujarat, India

VJ Patel
Main Maize Research Station, AAU, Godhra, Gujarat, India

MB Patel
Main Maize Research Station, AAU, Godhra, Gujarat, India

PK Parmar
Main Maize Research Station, AAU, Godhra, Gujarat, India

DM Rathod
Main Maize Research Station, AAU, Godhra, Gujarat, India

Corresponding Author:
KH Patel
Main Maize Research Station, AAU, Godhra, Gujarat, India

Effect of irrigation scheduling on growth and yield of *Rabi* sweet corn (*Zea mays saccharata* L.)

KH Patel, HS Varma, VJ Patel, MB Patel, PK Parmar and DM Rathod

DOI: https://doi.org/10.33545/2618060X.2024.v7.i6Sd.888

Abstract
The field experiment was conducted during *rabi* season of 2021-22 to 2023-24 at main maize research station, Anand agricultural university, Godhra (Gujarat). The soil of experimental field was clayey in texture having medium in organic carbon content (0.73%), high in available phosphorus (86.21 kg ha^{-1}) and high in available potash (306 kg ha^{-1}). The trial was laid out in randomized block design (RBD) with four replications assigning with 6 treatments T_1 (0.4 IW/CPE), T_2 (0.6 IW/CPE), T_3 (0.8 IW/CPE), T_4 (1.0 IW/CPE), T_5: (critical 3 stage) and T6: (critical 4 stage). Results showed that application of irrigation at 1.0 IW/CPE resulted in the maximum observed sweet corn yield with and without husk (17852 kg ha^{-1} and 11686 kg ha^{-1}) which is statistically at par with the treatment no T_5- critical 3 growth stage (17178 kg ha^{-1} and 11265 kg ha^{-1}), respectively. The higher green fodder yield (28426 kg ha^{-1}) was observed with the application of irrigation at 1.0 IW/CPE. The highest TSS (15.67 Brix) and girth of (14.31 cm) sweet corn cob was observed with the application of irrigation at 1.0 IW/CPE. The highest gross returns (2,92,092 INR/ha), maximum net returns (2,36,358 INR/ha), and B:C ratio (5.24) were obtained with treatment T4 (1.0 IW/CPE) while treatments T5 (3 irrigations at critical stages) and T6 (4 irrigations at critical stages) gave net realizations of Rs. 2,17,454 and Rs. 2,18,158 with B:C ratios of 5.08 and 5.00, respectively.

Keywords: IW/CPE, girth of cob, quality, sweet corn, economics

Introduction
Sweet corn (*Zea mays* L. *saccharata*) is a sugary seeded kind of maize and has great adaptability to wide range of agro-climatic regions. The great advantages are that crop is short duration, high grain and forage yield, high nutritive value and can be grown in all the three seasons *viz*., pre-kharif, kharif and rabi. The kernels of sweet corn taste much sweeter than normal corn especially at 18 to 21 days after pollination. The total sugar content in sweet corn ranges from 25-30%. In addition, fodder derived from harvest may be sold which brings additional income to the farmers. In world, maize occupies an area of 199.9 million ha with the production of 1162.9 million tones and productivity of 5815 kg per ha. In India, maize is grown over an area of 9.56 million ha with the production of 28.76 million tones and productivity is 3006 kg ha^{-1} (Agricultural statistics, 2020) [1]. The area under maize crop in Gujarat is about 0.388 million ha. The production of 0.667 million tones and productivity of 1716.32 kg ha^{-1} (Anonymous, 2023) [2] Irrigation is one of the most essential natural input for agricultural production particularly in arid and semi-arid regions where rainfall is inadequate and erratic. Irrigation has become a primary tool to enhance and sustain agricultural productivity in drought prone area. Plants need it continuously during their life cycle and in huge quantities. It profoundly influences photosynthesis, respiration, absorption, translocation and utilization of mineral nutrients and cell division besides some other processes. Studies carried out across different countries including India have confirmed that irrigation plays a paramount role in increasing the use of inputs and enhancing cropping intensity as well as productivity of crops (Dhawan, 1988; Vaidyanathan *et al*., 1994) [3, 12]. Maize is very sensitive to water stress (Kuscu and Demir, 2013) [6] and Payero *et al*., (2009) [9] reported that water stress can affect growth, development and physiological processes of maize plants, which reduce biomass yield. The peak water requirement of the maize coincides with reproductive period (Farre and Faci, 2009) [4]. The most critical growth stage at which moisture stress has been observed to be the most yield limiting in maize is the two weeks

prior and the two weeks following silking (Singh and Singh, 1995) [10]. Irrigation during the reproductive stages can still produce optimum grain yields and maximize WUE (Pandey *et al*., 2000 and Kang *et al*., 2000) [8, 5].

Materials and Methods

The field experiment was carried out during rabi seasons of 2021-22, 2022-23 and 2023-24 at main maize research station, Anand agricultural university, Godhra (Gujarat). The area is situated in eastern part of Gujarat, which falls under middle Gujarat agro-climatic zone. It lies between the parallels of 22º47'00" N latitudes and 73º39'13" E longitudes with an average elevation of 157 meters above mean sea level. The soil of experimental field was clayey in texture having medium in organic carbon content (0.73%), high in available phosphorus (86.21 kg ha^{-1}) and high in available potash (306 kg ha^{-1}). The trial was laid out in Randomized block design (RBD) with four replications assigning 6 treatment *viz*. T_1 (0.4 IW/CPE), T_2 (0.6 IW/CPE), T_3 (0.8 IW/CPE), T_4 (1.0 IW/CPE), T_5 (critical 3 stage, knee height (35 DAS) tasseling (55 DAS), grain formation (65 DAS) and T_6 (critical 4 stage, knee height, tasseling, grain formation, milking stage (80-85 DAS). Sweet corn (Madhuram) was sown according to 60x20 cm distance with the seed rate of 12 kg ha^{-1}. Fertilizer application given based on the experimental treatments (RDF: 120-60-0 kg N-P-K ha^{-1}). Other cultural operations and plant protection measures were applied as need based. In the period from germination to harvest several plant growth parameters were recorded at frequent intervals along with it after harvest several yield parameters were recorded, those parameters are plant height, cob length (cm), Cob girth (cm), No. of damage plant by FAW, Sweet corn yield with husk (kg ha^{-1}), Sweet corn yield without husk (kg ha^{-1}), Green fodder yield (kg ha^{-1}), TSS% (Total soluble sugar), TSS (Brix), Net Realization (Rs ha^{-1}) and BCR were recorded and statistically analyzed using analysis of variance (ANOVA) as applicable to Randomized Block Design.

Results and Discussion

Plant height, length, girth of cob and plants damaged by FAW

Plant height, cob length, and the number of plants damaged by FAW at harvest were not significantly influenced by irrigation scheduling. The maximum cob girth (14.31 cm) was observed with the treatment T_4 (1.0 IW/CPE) application. Similar results were reported by Sonpure *et al*. (2015) [11] and Maske *et al*. (2020) [7].

Sweet corn yield with husk, Sweet corn yield without husk and Green fodder yield

It was found significant effect of irrigation scheduling on sweet corn yield. The highest sweet corn yield with husk and without husk was observed with the application of irrigation at 1.0 IW/CPE (17852 kg ha^{-1} and 11686 kg ha^{-1}) which is statistically at par with the treatment no T_5- critical 3 growth stage (17178 kg ha^{-1} and 11265 kg ha^{-1}), respectively. The green fodder yield (28426 kg ha^{-1}) was observed with the application of irrigation at 1.0 IW/CPE (Table-2). The results were in accordance with those of Sonpure *et al*., (2015) [11].

Effect on TSS% (Total soluble sugar) and TSS (Brix)

The highest TSS (15.67 Brix) of sweet corn was observed with the application of irrigation at 1.0 IW/CPE. The irrigation given in treatment T_2 (0.6 IW/CPE) and T_3 (0.8 IW/CPE) recorded statistically similar TSS (15.58 Brix) and (15.51 Brix) respectively.

Plants damaged by FAW

Plants damaged by fall army worm was found non-significant with the application of irrigation scheduling.

Nutrients status in soil after harvesting

The O.C, available P_2O_5, K_2O, pH, and EC of soil was found non-significant due to irrigation scheduling.

Economics

The highest Gross returns (2,92,092 INR/ha), Maximum net returns (2,36,358 INR/ha) and B:C ratio (5.24) were obtained with the treatment T_4 (1.0 IW/CPE) which was superior over rest of all treatments, while T_5 (3 irrigation of critical stage) and T_6 (4 irrigation of critical stage) gave Rs.2,17,454 and Rs. 2,18,158 net realization with 5.08 and 5.00 BCR respectively.

Table 1: Effect of irrigation on plant height, cob length and cob girth in rabi season

Treatments	Plant height at harvest (cm)				Cob length (cm)				Cob girth (cm)				Plant stand at harvest/Net plot			
	2021-22	2022-23	2023-24	Pooled	2021-22	2022-23	2023-24	Pooled	2021-22	2022-23	2023-24	Pooled	2021-22	2022-23	2023-24	Pooled
T_1 (0.4 IW/CPE)	204.50	200.00	190.00	198.16	20.42	17.42	16.50	18.11	14.42	13.37	13.01	13.60	92	83	83	86
T_2 (0.6 IW/CPE)	204.25	193.00	196.00	197.75	20.27	17.24	16.91	18.14	14.17	13.29	13.74	13.73	89	87	81	85
T_3 (0.8 IW/CPE)	204.50	203.00	197.00	201.50	20.57	19.37	16.58	18.84	14.27	13.29	14.08	13.88	87	87	83	86
T_4 (1.0 IW/CPE)	202.75	207.00	193.00	200.91	20.80	20.12	17.58	19.50	14.90	13.46	14.58	14.31	89	89	83	87
T_5: (critical 3 stage)	202.50	195.50	194.00	197.33	20.68	19.41	16.66	18.92	14.70	13.08	14.42	14.06	89	80	83	84
T_6: (critical 4 stage)	205.00	203.33	196.25	201.52	21.55	19.04	16.92	19.17	15.07	13.80	13.75	14.21	90	84	81	85
S.Em ±	0.96	3.49	3.54	1.78	0.28	0.61	0.66	1.37	0.30	0.28	0.26	0.26	2.01	1.87	1.49	1.109
CD (P=0.05)	NS	NS	NS	NS	0.85	1.83	NS	NS	NS	NS	0.79	0.73	NS	5.64	NS	NS
CV%	1.94	3.49	3.65	3.02	2.71	6.46	7.88	5.68	4.17	4.23	3.77	4.05	4.48	4.38	3.61	4.20
Year																
S.Em ±	-	-	-	1.19	-	-	-	0.23	-	-	-	0.17	-	-	-	0.736
CD (P=0.05)	-	-	-	NS	-	-	-	NS	-	-	-	NS	-	-	-	NS
Y x T																
S.Em ±	-	-	-	2.93	-	-	-	0.56	-	-	-	0.42	-	-	-	1.803
CD (P=0.05)	-	-	-	NS	-	-	-	1.60	-	-	-	NS	-	-	-	NS
CV%	1.94	3.49	3.65	3.02	2.71	6.46	7.88	5.68	4.17	4.23	3.77	4.05	4.48	4.38	3.61	4.20

Table 2: Effect of irrigation on sweet corn yield with husk, without husk, green fodder yield and No. of damage plant by FAW/Net plot in *rabi* season

Treatments	Sweet corn yield with husk (kg ha^{-1})				Sweet corn yield without husk (kg ha^{-1})				Green fodder yield (kg ha^{-1})				No. of damage plant by FAW /Net plot			
	2021-22	2022-23	2023-24	Pooled	2021-22	2022-23	2023-24	Pooled	2021-22	2022-23	2023-24	Pooled	2021-22	2022-23	2023-24	Pooled
T_1 (0.4 IW/CPE)	19451	14584	12038	15358	11646	10017	8673	10112	28432	30296	23243	27323	2.0	2.0	3.0	2.0
T_2 (0.6 IW/CPE)	18931	15348	13191	15823	11786	9254	9554	10198	26918	22393	24966	24759	2.0	2.0	4.0	2.0
T_3 (0.8 IW/CPE)	19429	15716	13444	16196	11265	10089	9669	10341	24644	22843	25812	24433	3.0	2.0	4.0	3.0
T_4 (1.0 IW/CPE)	21677	16695	15183	17852	13303	10969	10786	11686	29411	28530	27339	28426	2.0	2.0	2.0	2.0
T_5: (critical 3 stage)	22563	14941	14031	17178	13693	10179	9923	11265	26750	21468	26039	24752	2.0	3.0	4.0	3.0
T_6: (critical 4 stage)	21693	14586	14477	16918	12989	9732	10159	10960	28312	22878	26444	25878	1.0	3.0	4.0	3.0
S.Em ±	685	282	589	518	455	220	404	312	981	594	1117	537	0.45	0.26	0.42	0.241
CD (P=0.05)	2064	851	1776	NS	1373	663	1218	983	2958	1790	NS	1525	NS	NS	1.28	NS
CV%	8.64	8.69	8.58	8.63	7.32	6.38	8.26	7.32	6.64	4.81	8.72	6.72	19.1	20.00	20.00	19.8
Year																
S.Em ±	-	-	-	223	-	-	-	152	-	-	-	354	-	-	-	0.158
CD (P=0.05)	-	-	-	NS	-	-	-	NS	-	-	-	NS	-	-	-	NS
Y x T																
S.Em ±	-	-	-	546	-	-	-	373	-	-	-	868	-	-	-	0.388
CD (P=0.05)	-	-	-	1558	-	-	-	1066	-	-	-	NS	-	-	-	NS
CV%	8.64	8.69	8.58	8.63	7.32	6.38	8.26	7.32	6.64	4.81	8.72	6.72	19.1	20.00	20.00	19.8

Table 3: Effect of Irrigation on Total soluble sugar%, TSS (Brix), moisture%, soil nutrient status and economics of sweet corn in *rabi* season

Treatments	TSS% (Total soluble sugar)			TSS (Brix)			Moisture%			OC%	AV P_2O_5 (kg ha^{-1})	AV K_2O (kg ha^{-1})	pH (1:2.5)	EC dsm^{-1}	Gross Realization (Rs ha^{-1})	Net Realization (Rs ha^{-1})	BCR
	2021 – 22	2022 – 23	Pooled	2021 – 22	2022 – 23	Pooled	2021 – 22	2022 – 23	Pooled								
T_1 (0.4 IW/CPE)	7.71	9.26	8.49	14.73	15.58	15.15	66.34	67.10	66.72	0.71	68.90	368	7.17	0.20	262872	210738	5.04
T_2 (0.6 IW/CPE)	9.30	9.15	9.22	15.18	15.98	15.58	66.06	68.61	67.33	0.70	74.25	360	7.19	0.18	257266	203932	4.82
T_3 (0.8 IW/CPE)	7.40	9.15	8.28	15.05	15.99	15.51	64.60	68.68	66.64	0.69	72.85	363	7.20	0.17	259692	205158	4.76
T_4 (1.0 IW/CPE)	9.16	8.95	9.05	15.35	16.00	15.67	64.07	68.06	66.07	0.72	69.12	353	7.20	0.18	292092	236358	5.24
T_5: Irrigation at 3 critical stage	7.64	9.56	8.60	14.48	15.57	15.02	67.93	67.66	67.80	0.71	69.30	340	7.25	0.20	270788	217454	5.08
T_6: Irrigation at 4 critical stage	9.15	9.61	9.38	14.75	15.47	15.11	68.17	66.35	67.26	0.71	67.35	341	7.32	0.21	272692	218158	5.00
S.Em ±	0.07	0.03	0.49	0.13	0.10	0.08	0.60	0.55	1.20	0.04	5.13	11.67	0.23	0.01			
CD (P=0.05)	0.22	0.10	NS	0.38	0.31	0.23	1.81	NS	NS	NS	NS	NS	NS	NS			
CV%	1.74	1.00	1.29	1.68	1.32	1.50	1.82	1.64	1.73	12.44	14.59	6.58	6.37	10.80			
Year																	
S.Em ±	-	-	0.02	-	-	0.05	-	-	0.24								
CD (P=0.05)	-	-	NS	-	-	NS	-	-	NS								
Y x T																	
S.Em ±	-	-	0.06	-	-	0.12	-	-	0.58								
CD (P=0.05)	-	-	0.16	-	-	NS	-	-	1.67								
CV%	1.74	1.00	1.29	1.68	1.32	1.50	1.82	1.64	1.73								

Green cob price@Rs.10/kg., Green fodder@Rs.2.00/kg, Fix cost: Rs.48354/ha

Table 4: Water applied and WUE of various Irrigation treatments

Treatments	Water applied (mm)	WUE (kg/ha-mm)	Treatment cost (Rs/ha)
1	2	3	4
T_1 0.4 IW/CPE	150	130	3780
T_2 0.6 IW/CPE	200	95	4980
T_3 0.8 IW/CPE	250	78	6180
T_4 1.0 IW/CPE	300	72	7380
T_5: Irrigation at 3 critical stage	200	113	4980
T_6: Irrigation at 4 critical stage	250	87	6180

Note: rate of one irrigation Rs.1200/ha. one irrigation 6 hour@Rs.200/hr

Conclusion

It is to be concluded that irrigation at 3 critical stage (knee high-35 DAS, Tasseling stage-55 DAS and Grain formation (65 DAS) gave higher green cob yield (17178 kg/ha) with higher net realization (Rs.2,17,454) and BCR (5.08) so, it is recommended for the farmers where scarcity of water.

References

1. Anonymous. Agricultural statistics at a glance, published by ministry of Agriculture, Govt. of India; c2020.
2. Anonymous. Agricultural statistics at a glance, published by directorate of agriculture krishibhavan, sector-10 A, Gujarat State, Gandhinagar, https://dag.gujarat.gov.in/estimate-guj.htm; c2023.
3. Dhawan BD. Role of irrigation in raising intensity of cropping. Journal of Indian School of Political Economy. 1988;3(4):632-671.
4. Farre I. Faci JM. Deficit irrigation in maize for reducing agricultural water use in a Mediterranean environment. Agricultural Water Management. 2009;96(3):383-394.
5. Kang Shi SW, Zhang J. An improved water-use efficiency for maize grown under regulated deficit irrigation, Field Crops Research. 2000;67(3):207-214.
6. Kuscu H, Demir AO. Yield and Water Use Efficiency of Maize under Deficit Irrigation Regimes in a Sub-humid Climate, The Philippine Agricultural Scientist. 2013;96:32-41.
7. Maske NM, Pramanik K, Asewar BV. Effect of irrigation scheduling and nutrient management on productivity and nutrient uptake by sweet corn (*Zea mays* var. *saccharata*) under vertisols of Marathwada. Annals of Plant and Soil Research. 2020;22(3):310-314
8. Pandey RK, Maranville JW, Admou A. Deficit irrigation and nitrogen effects on maize in a Sahelian environment I. Grain yield and yield components. Agricultural Water Management. 2000;46(1):1-13.
9. Payero JO, Tarkalson DD, Irmak S, Davison D, Petersen JL. Effect of timing of a deficit irrigation allocation on corn evapotranspiration, yield, water use efficiency and dry mass. Agricultural Water Management. 2009;96:1387-1397.
10. Singh BR, Singh DP. Agronomic and physiological responses of sorghum, maize, and pearl millet to irrigation. Field Crops Research. 1995;42(2-3):57-67.
11. Sonpure SB, Khedeka MA, Jondhale PY. Effect of Irrigation Scheduling and Mulching on Growth and Yield of Summer Sweet Corn. Trends in Biosciences. 2015;8(20):5532-5536.
12. Vaidyanathan A, Krishnakumar A, Rajagopal A, Varatharajan D. Impact of irrigation on productivity of land. Journal of Indian School of Political Economy. 1994;6(4):601-645.