

Performance of Hybrid Maize Varieties towards Different Levels of Irrigation during Rabi Season of West Bengal

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Abstract—Field experiment was conducted at District Seed Farm, 'AB' Block, Kalyani during two consecutive rabi seasons to study the performance of hybrid maize varieties towards irrigation on growth, yield attributes, yield, Consumptive use, WUE and B: C ratio. The experiment was laid out in split plot design having 4 levels of irrigation in the main plot (I₁- no irrigation, I₂- one irrigation at knee high stage, I₃- two irrigations one each at knee high and tasseling stages & I₄- three irrigations one each at knee high, tasseling and silking stages) and three hybrid maize varieties in subplot (V₁- Pinnacle, V₂- DKC-9081 and V₃- All Rounder) and were replicated thrice. The study revealed that growth attributes were recorded maximum under I₄ irrigation treatment in combination with V₂ varietal treatment. Highest yield attributes, grain yield and stover yield were recorded under I₄ irrigation treatment and produced 59.26% increased yield over control in contribution with V₂ varietal treatment. Consumptive use by the crop was maximum and WUE recorded minimum under I₄ irrigation treatment.

Keywords: - growth attributes, yield, hybrid maize, varieties, Consumptive use, Water use efficiency

1. INTRODUCTION

Maize occupied a pride place among cereals in our country and grows about 8.71 m ha of land with the total annual production of 22.3 mt of grains, given an average yield of 2.55 t ha⁻¹ (ICAR, New Delhi 2014) which is much lower than other maize growing countries. This crop also plays an important role in crop diversification strategy of various states of India to look beyond the paddy, which consumes huge amount of water, fertilizer and power. In addition for staple food for human being and quality food for animals, maize serves a basic raw material as an ingredient to different industrial products

The main constraints to enhance the maize productivity are sub optimal plant density particularly during winter season, inadequate water supply, inadequate fertilizer use and the selection of proper cultivars under given set of environment. Adoption of high yielding suitable hybrids not only improves the grain yield and its quality but also lead to high income per hectare as compared to conventional varieties of maize

(Abbas, 2001). In modern maize hybrids have greater potential as compared with older hybrids (Russel, 1986). Since the yield potential of our existing varieties are deteriorating day by day, selection of good varieties with higher yield together with optimum supply of water at important and critical physiological growth stages are very much essential for higher production of the country. The present experiment was, therefore, planned to identify hybrid maize varieties being grown in rabi season of west Bengal under different irrigation regimes.

2. MATERIAL AND METHODS:

A filed experiment was carried out at district seed farm AB block of Bidhan Chandra Karishi Viswavidyalaya, Kalyani, West Bengal during 2012-13 and 2013-14 in rabi seasons on medium land new alluvial inceptisol with sandy loam in texture having 0.49% organic carbon, 195.56 kg available N ha⁻¹, 21.63 kg available P ha⁻¹, 146.23 kg available K ha⁻¹ and pH 7.2 respectively. The experiment has laid out in split plot design having 4 irrigation treatments in the main plot i.e., I₁- no irrigation, I₂- one irrigation at knee high stage, I₃- two irrigations one each at knee high and tasseling stages and I₄- three irrigation one each at knee high, tasseling and silking stages and 3 hybrid maize varieties in the subplot i.e., V₁- Pinnacle, V₂- DKC- 9081 and V₃- All rounder and were replicated thrice. The crop was sown 23rd Nov and 27th Nov during 2012 and 2013 and harvested during 26th March and 28th March of 2013 and 2014 respectively. N, P₂O₅ and K₂O @ 120, 60 and 60 kg ha⁻¹ were applied to the crop. The crop received 132 mm rainfall with 9 rainy days during 2012-13 and 43.9 mm rainfall with 5 rainy days during 2013-14 respectively. Consumptive use was determined by soil moisture depletion method and water use efficiency was calculated on the basis of grain yield mm⁻¹ water use by the maize crop.

3. RESULTS AND DISCUSSION:

Growth attributes:

The mean data revealed that different levels of irrigation had significant influence on the growth characters (Table-1) of maize varieties except leaf area indices. The height of the plant (harvest), dry matter accumulation (125 days), crop growth rate (101-125 days) and LAI (125 days) were maximum when three irrigations applied (I_4), one each at knee high, tasseling and silking stages followed by two irrigations (I_3), one each at knee high and tasseling stages. However they were statistically at par except dry matter accumulation by the crop. With the increase in level of irrigation at important physiological growth stages favours the crop to put forth better growth attributes. Similar finding was reported by Gubali *et al* (2013).

Table 1: Effect of levels of irrigation and varieties on growth attributes of hybrid maize (mean of two years)

Levels of irrigation	Plant height at harvest (cm)	Dry matter accumulation at 125DAS (g m^{-2})	CGR 101-125 DAS ($\text{g m}^{-2} \text{day}^{-1}$)	LAI 125 DAS
I1	222.58	2499.70	58.60	6.00
I2	233.24	2812.76	62.58	6.31
I3	248.18	3243.14	72.98	6.63
I4	253.30	3308.59	76.88	6.93
SEm \pm	3.77	27.25	6.77	0.22
CD at 0.05	11.24	73.15	19.67	NS
varieties				
V1	240.72	2959.82	67.19	6.48
V2	242.30	3113.40	72.08	6.82
V3	234.96	2824.96	64.01	6.19
SEm \pm	2.93	84.06	4.04	0.26
CD at 0.05	8.75	NS	NS	NS

Growth attributes of different varieties were not significantly influenced by the irrigation treatments, except plant height. However the maximum growth attributes were recorded by V_2 i.e., DKC- 9081 variety followed by the V_1 variety i.e., pinnacle. Three irrigations i.e., I_4 irrigation treatments in combination with V_2 varieties treatments produced maximum growth attributes over other varietal treatments.

Yield attributes and yield:

The mean data showed that Yield attributing characters and yield of hybrid maize varieties were significantly influenced by the different levels of irrigation (Table-2). With the increase the levels of irrigation the yield attributes and yield of different maize varieties increases and maximum yield attributes and yield i.e., number of cobs plant⁻¹, number of grains cob⁻¹, test weight and grain and stover yield were recorded under I_4 i.e., three irrigations applied one each at knee high, tasseling and silking stages followed by I_3 i.e., two

irrigations applied one each at knee high and tasseling stages. I_4 and I_3 treatments were statistically at par in respect of number of grains cob⁻¹, grain and stover yield. These two treatments produced 59.26 and 46.09 percent extra yield over control. Irrigation applied at critical physiological growth stages favoured the crop to produce better growth characteristics as well as increase yield component which in turn yields higher grain yield of the crop. Similar results were observed by Soliman (2006).

Yields attributes and yield of different hybrid maize varieties were not significantly influenced by the irrigation treatments except number of grains cob⁻¹ and test weight. However, the maximum yield attributes and yield were recorded under V_2 i.e., DKC- 9081 varietal treatment followed by V_1 i.e., Pinnacle varietal treatment. Three irrigations applied i.e. I_4 , one each at knee high, tasseling and silking stages in contribution with V_2 i.e. DKC-9081 produced maximum yield attributes and yield of hybrid maize over other varieties.

Net return and B: C ratio

The mean data revealed that the monetary return and Benefit: Cost ratio was maximum when three irrigation i.e. I_4 irrigation treatment applied one each at knee high, tasseling and silking stages to hybrid maize varieties were 2.89 times higher return over control (Table-2). The net return and benefit: cost ratio due to treatment was in the sequence of $I_4 > I_3 > I_2 > I_1$. However, irrigation treatment I_4 in combination with V_2 varietal treatment produced maximum net return and benefit: cost ratio over other treatments, which corroborated the findings of Sabha Jeet *et al.* (2012).

Table 2: Effect of levels of irrigation and varieties on yield attributes and yield of hybrid maize (mean of two years)

Levels of irrigation	number of cobs plant ⁻¹	number of grains cob ⁻¹	test weight (g)	grain yield (t ha ⁻¹)	% increase vs control	Stover yield (t ha ⁻¹)	Net return	B: C ratio
I1	0.98	424.31	256.66	2.43	-	1.75	18106.06	1.43
I2	1.03	435.47	263.72	2.90	19.34	1.97	29739.23	1.64
I3	1.07	456.39	270.56	3.55	46.09	2.31	44984.59	2.02
I4	1.12	469.63	309.24	3.87	59.26	2.49	52355.48	2.16
SEm \pm	0.06	7.07	8.14	0.19	--	0.13	4718.61	0.11
CD at 0.05	N.S	23.62	28.01	0.60		0.41	15009.56	0.36
varieties								
V1	1.02	448.76	276.92	3.14	-	2.14	35312.89	1.80

V2	1.12	474.5 9	285. 85	3.55	-	2.25	44147 .54	1.9 9
V3	1.00	416.0 1	262. 37	2.88	-	2.51	29053 .59	1.6 4
SEm \pm	0.04	8.18	8.65	0.20	-	0.12	5444. 61	0.1 3
CD at 0.05	N.S	25.74	28.7 4	N.S	-	N.S	N.S	N. S

Consumptive use and Water use efficiency

The mean data revealed that with increase the levels of irrigation (Table-3), the total CU value increased due to maximum loss of water by evapo-transpiration. The maximum consumptive use of water (292.86 mm) was recorded under I₄ irrigation treatment followed by I₃ irrigation treatment. This might be due to the most efficient utilization of the applied water by the crop for its growth and development and ultimately produce potential yield. Similar results were observed by Giri and Bandyopadhyay (2009).

Table 3: Effect of levels of irrigation on consumptive use and water use efficiency of hybrid maize (mean of two years)

Levels of irrigation	CU (mm)	WUE (kg ha ⁻¹ mm)
I1	123.87	19.62
I2	202.46	14.32
I3	267.30	13.28
I4	292.86	13.21

Water use efficiency (WUE) is the economic yield of marketable product per unit water loss of CU. Each crop requires optimum water for their growth and development. So, any excess or shortage of water interacts adversely as the crop growth and subsequently the crop yield. In this investigation WUE varies with the levels of irrigation. The maximum value

of WUE was recorded under I₁ irrigation treatment. However, the lowest value of WUE (13.21 Kg ha⁻¹mm⁻¹) was recorded under I₄ irrigation treatment. These experimental results are conformity with findings of Shariot- Ullah *et al.* (2013).

In the light of results summarized above, it may be concluded that three irrigations applied one each at knee high; tasseling and silking stages to hybrid maize variety DKC-9081 gave the best result in respect of potential yield and economics of the crop grown during rabi season.

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