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Effects of Different Levels of Irrigation on Growth, Flowering and Bulb Production in Tuberose (*Polianthes Tuberosa* L.)

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Abstract **– Optimum schedule of irrigation in limited water resources is a vital issue for sustainable production of agricultural and ornamental crops. A field investigation was conducted during 2013-2014 in the experimental field of Bidhan Chandra Krishi Viswavidyalaya, West Bengal, India to study the effects of three irrigation levels (I_1: IW/CPE 0.4, I_2 = IW/CPE 0.8, I_3 = IW/CPE 1.0) and three cultivars (V_1: Prajwal, V_2: Calcutta Single, V_3: Calcutta Double) on growth, yield and water use efficiency of tuberose plant (*Polianthes tuberosa* L.). The trial was laid out in a factorial randomized block design with three replications. The results showed that irrigation schedule at IW/CPE 1.0 significantly increased the growth characteristics, yield attributes and yields of plant, which were competitive with IW/CPE 0.8. The corresponding values were found minimum in irrigation at IW/CPE 0.4. Calcutta double cultivar performed better than Calcutta single and Prajwal in promoting growth and yield characteristics and yields at all irrigation levels, the more so in higher irrigation regime than in lower irrigation regime. However, in view of considerable water savings and higher flower and bulb yield returns from tuberose, irrigation schedule at IW/CPE 0.8 with Calcutta double is advocated in the lower Gangetic plain of West Bengal, India.**

Keywords **– Polianthes Tuberosa, Growth Characteristics, Flower and Bulb Yield, Irrigation Schedule.**

I. INTRODUCTION

Tuberose (*Polianthes tuberosa* L.) is one of the most popular bulbous ornamental plants in India from the aesthetic and commercial point of view. It belongs to the family Amarylidaceae, produces attractive, elegant and delightful fragrant white flowers [1] having excellent keeping quality and stand long distance transportation [2]. It is a multipurpose flower, which has great economic demand as a cut flower, loose flower and for its aromatic value in essential oil industry [4, 5]. The flowers are used in wedding ceremonies, garlands, bowl and vase decoration and various traditional rituals [6]. It has great demand in the domestic and international market with high remunerative returns. There are many factors which adversely affect the plant growth, flower yield, quality of flower and bulb production of tuberose. The economic yield of crop can be increased manifold with adoption of proper plant nutrition and judicious water management schedules. Tuberose is a gross feeder and requires a large quantity of NPK, both in the form of organic and inorganic fertilizers [6, 7, 8]. Mineral fertilizers have great influence on growth, flower and bulb production in tuberose [9, 10, 11]. Optimum irrigation has an important role on plant growth and is essential to increase yield and quality of plants. Deficit irrigation, one of the environmental stresses, is the most significant factor restricting the plant growth, yield components and productivity [12], whereas irrigating the plants at regular interval increased the growth, flower and bulb yield [13, 14]. The Indian state of West Bengal occupies the leading position in respect of area and production of tuberose [15]. However, the information relating to the optimum irrigation level for maximum productivity of the crop is still lacking. In view of the above situations in consideration, the present investigation was undertaken to determine the effect of different levels of irrigation on growth, yield and water use efficiency of tuberose in the lower Gangetic plain of West Bengal, India.

II. MATERIAL AND METHODS

This experiment was conducted during the years 2012 to 2013 at the Departmental Experimental Field of Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, West Bengal lying in between 22°56' N latitude and 88°32' E longitudes with an elevation of 9.75 m above the mean sea level. The soil of the experimental was Gangetic alluvium (Typic Fluvaquept) with sandy clay loam in texture (31% clay) having 1.48 Mg/m3 bulk density and 49.1% porosity. The surface soil 6.8 pH (1:2.5), 0.34 dS/m electrical conductivity, 4.6 g/kg soil organic carbon and 14.3 cmol (p^+)/kg) cation exchange capacity. The soil was low in available N (132 mg/kg), medium in available P (15.1 mg/kg) and available K (152 mg/kg). The area represents sub-tropical humid climate. The annual precipitation is 1320 mm of which 75-80% is received during June through September. The potential evapo-transpiration is 1024 mm per year. The monthly rainfall and mean maximum and minimum temperature and relative humidity during the plant growth stage have been depicted in Fig. 1.

There were nine treatments consisted of three irrigation levels (I_1: IW/CPE 0.4, I_2: IW/CPE 0.8, I_3: IW/CPE 1.0) and three tuberose cultivars (V_1: Prajwal, V_2: Calcutta Single, V_3: Calcutta Double) was laid out in a factorial randomized block design (FRBD) with three replications. The net plot size was 1.2 m x 1.0 m leaving 0.5 m bund width and 1.0 m irrigation channel. Well decomposed farm yard manure containing 0.5% N, 0.3% P_2O_5 and 0.5% K_2O on dry weight basis @ 15 t/ha was applied at the time of final land preparation. The recommended doses of 200:200:150 kg/ha

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of N, P_2O_5 and K_2O were administered as urea, single superphosphate and muriate of potash, respectively. Full P and K and one-third of N were applied as basal and remaining N was top-dressed in three splits at 25, 50 and 75 days after planting. The bulbs of three tuberose cultivars with uniform size (2.5-3.0 cm diameter and 15.5-17.7 g weight) were planted on 9 March 2013 at a depth of 5 cm with a spacing of 30 x 30 cm. The number of bulb/plot was 12. Standard cultural practices were followed uniformly. Five representative plants from the inner rows of each plot were labeled and tagged in each replication and were used for recording of phenological, and yield parameters. Data of plant height, number of leaves per plant, length and diameter of spike at harvest, number of spike per plot, number of florets per spike, length of floret, floret diameter at full open stage, spike, and loose flower yield and bulb yield per were recorded from the sample plants during the course of experiment. Flower longevity (days) was counted from the opening of first floret of spike till the last floret faded in color on each sample plant.

The water requirement of tuberose was computed using the following water balance equation,

$$WU = P + I + Cp – Dp – Rf \pm \Delta S$$

Where, WU is the total water use (mm), P the precipitation, Cp the contribution through capillary rise from groundwater, Dp the deep percolation, Rf surface runoff and ΔS the change in soil water storage in the profile between planting and harvest time (mm).

Since the groundwater was very deep (5 to 6 m), Cp was assumed to be negligible. There was no Rf because of low depth of water application and low intensity of rainfall.

So, $WU = P + I – Dp \pm \Delta S$

The irrigation water requirement was computed on the basis CPE, pan factor, crop coefficient and canopy area factor. The evaporation (Epan, mm) data was obtained from a Class A Pan located inside the experimental site on a wooden support at a height of 15 cm above the soil surface and readings were recorded daily. An amount of 30 mm pre-irrigation was applied in all treatments before planting of the bulbs for uniform seedlings emergence and maintenance of soil moisture.

III. Results and Discussion

3.1 Growth characteristics

The application of different irrigation levels had significant effects on growth parameters such as plant height and number of leaves per plant in tuberose (Table 1). These characters consistently increased with increasing moisture regimes. However, the tallest plant with highest number of leaves was obtained with the irrigation schedule at IW/CPE 1.0, which was at par with the irrigation schedule at IW/CPE 0.8. In contrast, significantly the lowest plant growth characters were registered at lower moisture regime of IW/CPE 0.4. These results indicate that optimal irrigation had tremendous effects on plant growth and development in tuberose. The corresponding parameters among the varieties under study, irrespective of irrigation treatments, were significantly influenced. However, maximum plant height was recorded by Prajwal variety, followed by Calcutta single and Calcutta double cultivars, respectively. In case of number of leaves per plant, the reverse trend was observed.

The interaction effects between the irrigation schedule and the varieties on these growth parameters were significant. Maximum plant height was recorded by Prajwal variety with irrigation at IW/CPE 1.0, which was competitive with irrigation at IW/CPE 0.8. Conversely, maximum number of leaves per plant was observed by Calcutta double cultivar with irrigation at IW/CPE 1.0 and was at par with irrigation at IW/CPE 0.8. In contrast, shortest plant by Calcutta double and lowest number of leaves per plant by Prajwal was registered with irrigation schedule at IW/CPE 0.4.

3.2 Flowering characteristics

The floral characteristics viz., spike length, spike diameter, number of spike per plot, number of florets per spike, length of the floret, floret diameter and vase life of tuberose plant were significantly affected by the various irrigation schedules (Tables 1 and 2). Maximum flowering attributes were recorded in the irrigation schedule of IW/CPE 1.0 which was statistically at par with irrigation schedule of IW/CPE 0.8. Significantly the lowest floral attributes were observed with irrigation schedule at IW/CPE 0.4. These indicate that optimal irrigation scheduling in the important growth stages is necessary for increasing the floral characteristics. Similarly, the cultivars examined regardless of different irrigation treatments varied were significantly. Maximum values of the spike diameter, spike per plot and floret diameter were shown by Calcutta double, being at par with Calcutta single, but superior to Prajwa. Similarly, the highest values of florets per spike, length of the floret and vase life were recorded by Calcutta double, which were superior to Pralwal, but competitive with Calcutta single. Maximum length of spike was registered by Prajwal, followed by Calcutta single and Calcutta double, respectively.

The interactions between the irrigation schedules and the varieties on these floral parameters were significant. However, maximum variables excepting spike length were noted by Calcutta double with irrigation schedule at IW/CPE 1.0. However, it was at par with irrigation schedule of IW/CPE 0.8, but competitive with Calcutta single at irrigation schedules of IW/CPE 1.0 and IW/CPE 0.8 with some deviations. The variables were least in Prajwal at all irrigation levels excepting the spike length which was found maximum in higher irrigation regimes as compared with lower irrigation regime.

3.3 Spike, flower and bulb yields

The yields of spike, loose flower and bulb per hectare of tuberose, irrespective of varieties, were significantly influenced by the application of various levels of irrigation (Table 3). Highest yields of these components were obtained with higher irrigation level at IW/CPE 1.0 which was statistically at par with moderate irrigation level at IW/CPE 0.8. Significantly the lowest values were recorded with lower level of irrigation at IW/CPE 0.4. These results are in conformity with Jaimez et al. (2000), Moftah and Al Humaid (2006) and El Naggar and Byari (2009) who found that water shortage in important phonological stages of

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plant adversely affected the number of aborted flowers, bulb size, inflorescence length, and number of floral buds. Water deficit also affects negatively the process of flowering in plant by reducing the fertility of newly formed flowers (18). Similarly, the varieties under scrutiny, irrespective irrigation treatments, also varied significantly. The highest spike, loose flower and bulb yields per hectare were observed in Calcutta double, which was at par with Calcutta single. The performance of Prajwal in promotion of spike, flower and bulb yields was significantly the lowest.

The interactions between the irrigation schedules and the varieties on tuberose yields were significant. However, maximum yields were obtained by Calcutta double with an irrigation schedule of IW/CPE 1.0. These were at par with irrigation schedule of IW/CPE 0.8, but competitive with Calcutta single at irrigation schedules of IW/CPE 1.0 and IW/CPE 0.8. The minimum yields were recorded by Prajwal at all irrigation levels, the more so in lower irrigation level than in higher irrigation level.

It may be concluded from the above study that tuberose grown in the lower Gangetic plain of India responded positively to the application of irrigation at varied levels. However, irrigation to plant at higher regime of IW/CPE 1.0 significantly increased the growth characteristics, yield attributes and economic yields of plant, which were competitive with moderate irrigation regime of IW/CPE 0.8. The growth, yields and yield attributes of plant were found minimum in deficit irrigation schedule of IW/CPE 0.4. The cultivar Calcutta double performed better than Calcutta single and Prajwal in promoting growth and yield characteristics and yields at all irrigation levels, the more so in higher moisture regime than in lower moisture regime. However, in consideration of water savings and yield return, the irrigation schedule at IW/CPE 0.8 with Calcutta double cultivar was advocated for tuberose in this region.

3.4 *Water balance components and water use efficiency*

During the plant growing season of 2013-2014, the contribution of effective rainfall was maximum of about 1024.02 mm, whereas the figures for soil profile contribution was 22.35 to 33.84 mm. Depth of water applied in treatments I_1, I_2, and I_3 were 44, 68, and 88 mm, respectively. Thus the total amount of water use by the plant was 1095.60, 1117.82, 1136.13, and 1055.41 mm for irrigation frequency of I_1, I_2, I_3 and I_4 treatments, respectively (Table 3). It is conspicuous that soil profile moisture contribution was more under unirrigated rainfed condition as compared with the irrigation treatments. The maximum water use efficiency of 0.16 kg/ha-mm was observed in higher irrigation frequency (I_3) and minimum of 0.08 kg/ha-mm in unirrigated rainfed condition. The higher WUE was ascribed to the increasing capsule yield with concomitant increase in irrigation frequency. The organic manuring improved the water use and WUE of plant over no-manuring. The integration of irrigation frequency and organic manuring showed the maximum WUE of 0.17 kg/ha-mm was obtained under three treatment combination of I_2M_2, I_3M_1 and I_3M_2 and the least of 0.06 kg/ha-mm in I_4M_0 treatment. This reveals to the fact that higher irrigation frequency supplemented with organic manuring might have created favorable soil water-nutrient environment for stimulation of plant growth and development of yield attributing characteristics due to more interception of incoming solar radiation and more absorption of water and nutrients through proliferated roots that resulted in higher capsule yield.

IV. Conclusion

1. Growth parameters and yield attributes in tuberose plant (*Polianthes tuberosa* L.) was found higher under irrigation schedule at IW/CPE 1.0 followed by IW/CPE 0.8 and IW/CPE 0.4.
2. Calcutta double cultivar performed better than Calcutta single and Prajwal in promoting growth and yield characteristics and yields at all irrigation levels, the more so in higher irrigation regime than in lower irrigation regime.
3. In view of considerable water savings and higher flower and bulb yield returns from tuberose, irrigation schedule at IW/CPE 0.8 with Calcutta double is advocated in the lower Gangetic plain of West Bengal, India.

Reference

[1] De Hertogh A, Le Nard M [1993]. The physiology of flower bulbs. Elsevier Sci. Pub. pp 811.

[2] Patel MM, Parmar PB, Parmar BR [2006]. Effect of nitrogen, phosphorus and spacing on growth and flowering in tuberose (*Polianthes tuberose* L.) cv. Single. Indian J. Orn. Hort. 9(4): 286-289.

[3] Padaganur VG, Mokashi AN, Patil VS [2005]. Flowering, flower quality and yield of tuberose as influenced by vermicompost, farmyard manure and cowdung, Karnataka J. Agric. Sci. 18:729-734.

[4] Alan O, Gunen Y, Ceylan S, Gunen E [2007]. Effect of nitrogen applications on flower yield, some quality characteristics and leaf mineral content in tuberose (*Polianthes tuberosa* L.). Aegean Agric. Res. Ins. Direc. 17(1): 43-57.

[5] Randhawa GS, Mukhopadhyay A [1986]. Tuberose. In: Floriculture in India. Allied pub. Pvt. Ltd., New Delhi. pp. 425-426.

[6] Singh RS, Motial VS, Singh LB [1976]. Effect of nitrogen, phosphorus and patash fertilizer on tuberose (*Polianthes tuberose* L.). Indian J. Hort. 33(3-4): 289-294.

[7] Amarjeet S, Godara NR [1998]. Effect of nutritional requirement of tuberose (*Polianthes tuberosaI* L) cv. Single on flower yield characters. Haryana Agric.Univ. J. Res. 28(1):15- 20.

[8] Kabir AKMR, Iman MH, Mondal MMA, Chowdhury S [2011]. Response of tuberose to integrated nutrient management. J. Environ. Sci. Natural Res. 4(2): 55-59.

[9] Mitra SN, Munshi PS, Roy S [1979]. Effects of different levels of nitrogen and bulb size on growth and flowering of tuberose (*Polianthes tuberose* L.). Indian Agric. 23(3): 185-188.

[10] Yadav LP, Bose TK, Maity RG [1985]. Response of tuberose (*Polianthes tubersa* L.) to nitrogen and phosphorus fertilization. Prog. Hort. 17(2): 83-86.

[11] Roy U [1992]. Effect of inorganic nitrogen and potash on growth, bulb and flower production in tuberose (*Polianthes tuberose* L.). M.Sc. (Ag.) thesis, Dept. of Hort, BAU, Mymonsingh.

[12] Halepyati, AS, Sujatha K, Prabhakar MM [1996]. Growth, yield, water relations and its use in tuberose (*Polianthes tuberosa*) as influenced by irrigation regime and nitrogen level. Ind. J. Agric. Sci. 65(12): 866-869.

[13] Manoly ND [2001]. Effect of irrigation interval and bulb size on *Polianthes tuberosa* L. The fifth Arabian Hort. Conf., Ismailia, E-

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-gypt. March 24-28.
[14] EL-Naggar AI, Byari SH [2009]. Effects of Irrigation frequency regimes and weed control management on field grown tuberoses (*Polianthes Tuberosa*, L.) in the Saudi Arabian western region: 2. Bulb and bulblet's yield, growth and development and grade qualities. Egypt. J. Hort. 36(1): 119-147.
[15] Biswas GJ, Kumar PN, Bhattacharjee A [2006]. Tuberose. Published by ICAR, New Delhi, vol 1-2.
[16] Jaimez RE, Vielma O, Rada F, Garcia Nunez C [2000]. Effect of water deficient on the dynamics of flowering and fruit production in *Capsicum chinenses* Jacq. in a tropical semiarid region of Venezuela. J. Agron. Crop. Sci. 185: 113-119.
[17] Moftah AE, Al Humaid AI [2006]. Response of vegetative and reproductive parameters of water stressed tuberose plant to vapor grad and kaolin antitranspirants. JKSU 18**:** 127–139.
[18] Slawinska J, Obendorf RL [2001]. Buckwheat seed set in plant and during *in vitro* inflorescence culture: Evaluation of temperature and water deficient stress. Seed Sci. Res. 11**:** 223–233.

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Table 1. Effect of different levels of irrigation on growth and spike characteristics of three varieties of tuberose.

Treatment	Plant height (cm)				Number of leaves/plant				Spike length (cm)				Spike diameter (cm)				Number of spike/plot			
	Variety				Variety				Variety				Variety				Variety			
	V_1	V_2	V_3	Mean	V_1	V_2	V_3	Mean	V_1	V_2	V_3	Mean	V_1	V_2	V_3	Mean	V_1	V_2	V_3	Mean
I_1	89.8	86.3	82.5	86.2	79.2	98.7	112.4	96.8	65.1	63.5	62.7	63.8	0.81	0.84	0.87	0.84	26.4	31.9	33.5	30.6
I_2	92.5	88.5	86.3	89.1	82.5	106.4	118.9	102.6	67.4	64.8	63.6	65.3	0.86	0.88	0.91	0.88	30.8	32.6	33.4	32.3
I_3	93.7	90.2	88.2	90.7	84.0	109.3	122.1	105.1	68.2	65.2	64.5	66.0	0.88	0.92	0.93	0.91	31.9	32.7	34.8	33.1
Mean	92.0	88.3	85.7	-	81.9	104.8	117.8	-	66.9	64.5	63.6	-	0.85	0.88	0.90	-	29.7	32.4	33.9	-
	I	V	I x V		I	V	I x V		I	V	I x V		I	V	I x V		I	V	I x V	
SEm±	0.42	0.42	0.85		1.32	1.32	2.57		0.38	0.38	0.73		0.01	0.01	0.02		0.51	0.51	0.98	
CD (5%)	1.25	1.25	2.54		3.96	3.96	7.65		1.14	1.14	2.16		0.03	0.03	0.05		1.52	1.52	2.93	

I_1 = Irrigation at IW/CPE 0.4, I_2 = Irrigation at IW/CPE 0.8, I_3 = Irrigation at IW/CPE 1.0; V_1 = Prajwal, V_2 = Calcutta Single, V_3 = Calcutta Double

Table 2. Effects of levels of irrigation on floral characteristics of three varieties of tuberose.

Treatment	Number of florets /spike				Length of the floret (cm)				Floret diameter (cm)				Vase life (days)			
	Variety				Variety				Variety				Variety			
	V_1	V_2	V_3	Mean	V_1	V_2	V_3	Mean	V_1	V_2	V_3	Mean	V_1	V_2	V_3	Mean
I_1	29.6	31.5	32.5	31.2	14.3	16.2	14.6	15.0	0.69	0.72	0.74	0.72	13.18	14.32	16.15	14.55
I_2	30.3	31.9	33.5	31.9	15.7	18.1	16.1	16.7	0.73	0.77	0.80	0.77	14.56	15.73	18.13	16.14
I_3	30.8	32.4	34.3	32.5	16.4	19.2	17.1	17.6	0.75	0.78	0.81	0.78	15.67	16.42	19.24	17.11
Mean	30.2	31.9	33.4	-	15.5	17.8	15.9	-	0.72	0.76	0.78	-	14.47	15.49	17.84	-
	I	V	I x V		I	V	I x V		I	V	I x V		I	V	I x V	
SEm±	0.22	0.22	0.43		0.39	0.39	0.76		0.01	0.01	0.02		0.45	0.45	0.87	
CD (5%)	0.65	0.65	1.28		1.16	1.16	2.27		0.03	0.03	0.05		1.34	1.34	2.60	

I_1 = Irrigation at IW/CPE 0.4, I_2 = Irrigation at IW/CPE 0.8, I_3 = Irrigation at IW/CPE 1.0; V_1 = Prajwal, V_2 = Calcutta Single, V_3 = Calcutta Double

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Table 3. Effect of levels of irrigation on spike, loose flower and bulb yield of three varieties of tuberose.

Treatment	Spike yield (‘000/ha)				Loose flower yield (t/ha)				Bulb yield (t/ha)			
	Variety				Variety				Variety			
	V_1	V_2	V_3	Mean	V_1	V_2	V_3	Mean	V_1	V_2	V_3	Mean
I_1	220.00	265.83	279.17	255.00	7.17	9.21	9.98	8.79	17.18	17.91	18.83	17.97
I_2	256.67	271.67	278.33	268.89	8.56	9.54	10.26	9.45	18.42	20.53	21.64	20.20
I_3	265.83	272.50	290.00	276.11	9.01	9.71	10.94	9.89	19.63	21.12	22.47	21.07
Mean	247.50	270.00	282.50	-	8.24	9.49	10.40	-	18.41	19.85	20.98	19.75
	I	V	I x V		I	V	I x V		I	V	I x V	
SEm±	3.28	3.28	6.41		0.18	0.18	0.35		0.41	0.41	0.79	
CD (5%)	9.83	9.83	19.22		0.54	0.54	1.04		1.24	1.24	2.35	

I_1 = Irrigation at IW/CPE 0.4, I_2 = Irrigation at IW/CPE 0.8, I_3 = Irrigation at IW/CPE 1.0; V_1 = Prajwal, V_2 = Calcutta Single, V_3 = Calcutta Double

Table 4. Seasonal water use and water use efficiency of tuberose plant at varied irrigation level

Treatment	Profile contribution (mm)	Rainfall (mm)	Drainage (mm)	Irrigation water (mm)	≠Total water use (mm)	Flower yield (t/ha)	Water use efficiency (kg/ha-mm)
I_1	19.8	1319.0	521.8	272	1119.0	8.79	7.85
I_2	17.2	1319.0	521.8	544	1388.4	9.45	6.81
I_3	14.3	1319.0	521.8	680	1512.5	9.89	6.54

I_1 = Irrigation at IW/CPE 0.4, I_2 = Irrigation at IW/CPE 0.8, I_3 = Irrigation at IW/CPE 1.0, Depth of irrigation @ 30 mm each, ≠ 30 mm pre-planting irrigation water added for uniform seedlings emergence

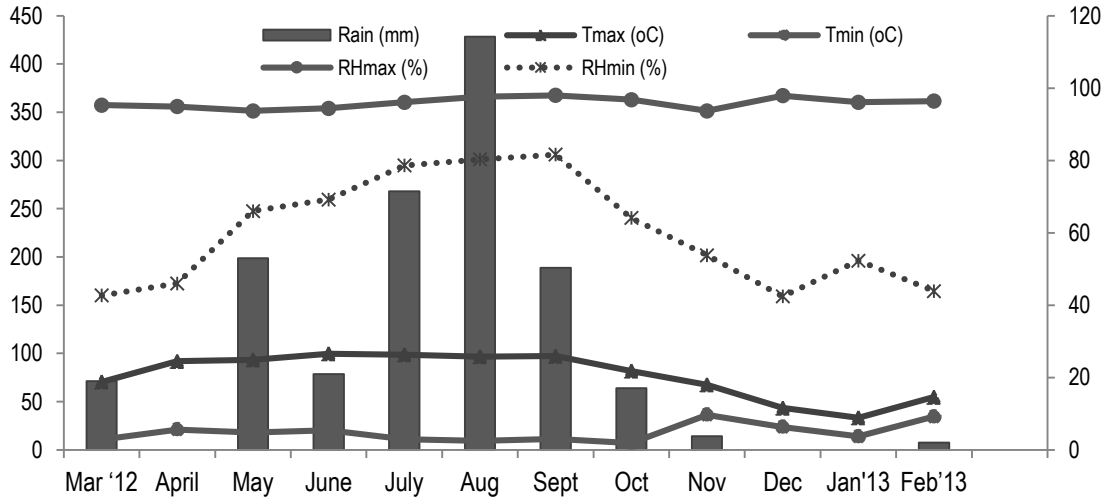

Figure 1. Distribution of rainfall, maximum and minimum temperature and relative humidity during crop season

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