

Original Research Article

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Determination of Water Requirement and Response of Wheat Varieties to Different Number of Irrigations

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ABSTRACT

Keywords

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An experiment was conducted to determine water requirement and response of wheat varieties HD-2894 and HD-2967 to irrigation at 50% soil moisture depletion (SMD) level. Moisture contents for irrigation were recorded from a root zone of 90 cm (from five depths viz., 0 – 15, 15 – 30, 30 – 45, 45 – 60 and 60 – 90 cm). Data on meteorological parameters like temperature and rainfall were also recorded. The results indicated that yield was significantly affected by no. of irrigations as well as varieties. Both the varieties gave significant response up to three irrigations (I3) only. The total amount of water applied up to three irrigation was 27.5 cm. The yield obtained at irrigation level (I3) for variety HD-2894 and HD-2967 is 4.4t/ha and 6.0t/ha and the water use efficiency (WUE) was 161.4 kg/ha.cm and 217.8 kg/ha.cm, respectively.

Introduction

India is an agriculture country and wheat (*Triticum aestivum* L.) is the second most important cereal crop after rice. Due to climate change water shortage in the country demands to develop new technologies and methods of irrigation that can be helpful to utilize this precious input in an effective way. Temperature is one of the important weather parameters influencing the phenology and yield of wheat crop (Bishnoi *et al.*, 1995). Mahamed *et al.*, (2011) reported that the treatment (50% of SMD) was superior to the 60% of SMD and 75% of SMD irrigation

levels and produced the greatest plant height, dry matter, yield and yield components at each growth stage. Balasubramanian and Palaniappan (2001) found that water requirement of wheat varies from 180 to 420 mm. Ali *et al.*, (2012) observed that increasing irrigation levels would improve crop growth and thus enable crop to intercept more photosynthetic radiation leading to more biological and grain yield. Molden and Oweis (2007) reported that the current focus on water productivity has evolved to include the benefits and costs of water used for agriculture in terrestrial and aquatic ecosystems. Mushari (2008) investigated that

appreciable grain yield of barley and faba bean seed can be achieved if irrigated at 15% soil moisture depletion. Winter wheat is the largest consumer of irrigation water, improvement strategies for high WUE aiming at wheat crops are in urgent need (Xu-rong *et al.*, 2013). Shirazi *et al.*, (2014) reported that Irrigation regimes have significant effect on yield and growth parameters of wheat. Favorable soil moisture was maintained in the irrigation scheduling treatments of (I3) crown root initiation+ tillering+ flowering+ milking stage (Bathre *et al.*, 2019). Knowledge of precise amount of water required by different crop in a given climatic condition of a region will be helpful in planning of irrigation scheme, irrigation scheduling and management of irrigation system. There is need to save irrigation water by providing minimum no. of irrigations without affecting yield by carrying out practices of irrigation water management to achieve higher water use efficiency (WUE). Therefore, keeping this in view, the present study was conducted to determine water requirement and response of wheat varieties to different no. of irrigations.

Materials and Methods

Experimental details

A field experiment was conducted to determine the water requirement of two wheat varieties viz. HD-2894 and HD-2967 during rabi season of 2013-14 in a sandy loam soil at research farm of Water Technology Centre, IARI, New Delhi. Irrigation treatment consists of (I1-one irrigation), (I2-two irrigations), (I3-three irrigations), (I4-four irrigations) and (I5-five irrigations) based on 50% soil moisture depletion (SMD) which were arranged in split plot design with four replications. The amount of water applied to each treatment was calculated on the basis of the soil moisture contents at the time of irrigation. SMD was determined by estimating soil moisture content. For this

purpose, soil samples were taken from the effective root-zone of the wheat plant which is 0 – 90 cm. The root-zone was divided into five sections viz., 0-15, 15-30, 30-45, 45-60 and 60-90 cm.

Soil samples were collected from these five sections with the help of a sampling tube. The fresh weight of the soil sampled was immediately recorded with the help of a portable weighing balance. After weighing, the samples were stored in tin pans which were then placed in an electric oven for 24h at 100°C and dry weight of the samples were then recorded. Soil moisture contents were then calculated as under

$$\text{Soil moisture content (\%)} = \frac{\text{Dry weight of the sample}}{\text{Fresh weight of the sample}} * 100$$

The amount of water applied to each treatment was calculated on the basis of the soil moisture contents at the time of irrigation by using the following expression.

$$d = M.C \times B.D \times D$$

Where,

d = depth of water to be applied

M.C = moisture content (%)

B.D. = bulk density of the soil

D = depth of root-zone to be irrigated

Water use efficiency was also calculated as the ratio of grain yield and water applied. Data on meteorological parameters like temperature and rainfall were also recorded during the period.

Statistical analysis

The data were statistically analysed for different no of irrigations and yield with the help of OPSTAT software (Sheoran *et al.*, 1998) for estimation of analysis of variance (ANOVA) at a probability level of 0.05.

Results and Discussion

Total water applied during the growing period, WUE and grain yield of IARI wheat varieties are presented in Table.1 and effect of varying levels of irrigation on grain yield is shown in Table.2. The result showed that

yield was significantly affected by no. of irrigations as well as varieties. The interactive effect of variety and no. of irrigation was also found significant. Both the varieties gave significant response up to three irrigations (I3) only.

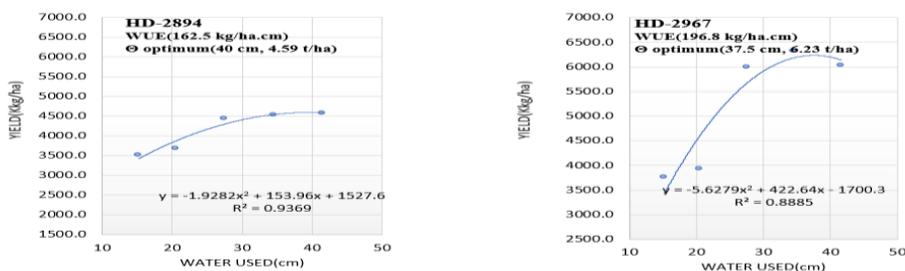
Table.1 Total water applied during the growing period, WUE and grain yield of IARI wheat varieties HD-2894(V1) and HD-2967(V2)

Grain Yield(q/ha)		water applied(cm)	ER (cm)	Total water applied(cm)	WUE(kg/ha.cm)		No. of Irrigations
(V1)	(V2)				(V1)	(V2)	
35.1	37.6	9.5	5.7	15.2	230.6	246.7	I1
36.8	39.4	14.8	5.7	20.5	179.2	191.5	I2
44.4	60.0	21.8	5.7	27.5	161.4	217.8	I3
45.3	63.2	28.8	5.7	34.5	131.2	183.0	I4
45.8	60.3	35.8	5.7	41.5	110.3	145.1	I5

Table.2 Effect of varying levels of Irrigation on grain yield (qt/ha) on IARI wheat varieties at 50 % SMD

	I1	I2	I3	I4	I5	Mean V
V1 (HD-2894)	35.2	36.8	44.4	45.3	45.8	41.5
V2 (HD-2967)	37.6	39.4	60.0	63.2	60.3	52.1
Mean I	36.4	38.1	52.2	54.3	53.1	
Factors			C.D. at 5%		SE(d)	SE(m)
Factor(V)			8.15		2.47	1.75
Factor(I)			5.36		2.58	1.83
Factor(I)at same level of V			9.21		3.65	3.91
Factor(V)at same level of I			10.33		0.00	0.00

Fig.1 Water production function for wheat varieties HD-2894 and HD-2967



The total amount of water applied up to three irrigation was 27.5 cm including pre-sowing irrigation and the corresponding yield was 4.4 t/ha and 6.0 t/ha for variety HD-2894 and HD-2967, respectively. The water use efficiency for varieties HD-2894 and HD-2967 is 161 kg/ha.cm and 217 kg/ha.cm, respectively. The optimum water requirement for both of the varieties is only three irrigations including rainfall in which highest yield was obtained. Mahmood and Ahmad (2005) determined water requirement and response of some wheat cultivars to irrigation at 50% and 70% SMD levels and found that grain yield, harvest index and water use efficiency were greater when irrigation was applied at 50% SMD. The water production function for both the varieties is shown in Fig.1.

In conclusion the present study, water requirement of two wheat varieties was estimated and it was observed that yield was significantly affected by no. of irrigations as well as varieties. Both the varieties gave significant response up to three irrigations (I3) only. This type of study can be useful for precise irrigation in wheat crop where farmers will supply the required amount of water and reduce wastage of water.

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