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Performance of growth and yield on under variable moisture regimes at wheat (*Triticum aestivum* L.) cultivars

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Abstract
A field experiment was carried out at Agrometeorology Research Farm, Narendra Deva University of Agriculture & Technology, Narendra Nagar (Kumarganj), Faizabad (U.P.) during Rabi season 2017 to study the “Performance of growth and yield on under variable moisture regimes at wheat (*Triticum aestivum* L.) cultivars.” The experiment consisted of 9 treatment combinations and tested in Randomized block design with three replications. Experiment consisted of three moisture regimes viz. 0.8 IW/CPE ratio, 1.0 IW/CPE ratio and 1.2 IW/CPE ratio and three wheat cultivars Viz. HUW-234, PBW-343 and NW-1012. Wheat cultivar PBW-343 was found suitable for optimum growth and yield of wheat. Highest Consumptive use (67.7 cm) was found in moisture regime of 1.2 IW/CPE ratio and highest water use efficiency (81kg ha^{-1} cm^{-1}) was computed under 0.8 IW/CPE ratio. Among wheat cultivars highest water use efficiency of 74 kg ha^{-1} cm^{-1} was computed in PBW-343 cultivar of wheat.

Keywords: wheat, water use efficiency, light interception yield

Introduction
Irrigated wheat is grown in rotation with rice on 2.6 Mha in the intensive rice–wheat system in north India (GOP, 2006) [6]. However, the sustainability of the rice–wheat system is threatened by declining soil fertility and ground water depletion (Humphreys *et al.*, 2010; Ladha *et al.*, 2007) [7, 8]. Nearly 60% of arable land worldwide is dedicated to cereal production. Fertilizers are constrain factor limiting crop productions such as wheat (Chamara *et al.*, 2003, Derksen *et al.*, 2002, Mohammaddoust *et al.*, 2006) [2, 4, 9]. The demand for wheat by 2020 has been projected to be between 105-109 million tonnes. Most of this increase in production will have to manage from increase productivity as the land area under wheat is not expected to expand. About one third of the developing world’s wheat (*Triticum aestivum* L.) area is located in environments that are regarded as marginal for wheat production because of drought, heat and edaphic factors. Despite these limitations, the world’s dry and difficult cropping environments are increasingly crucial to food security in the developing world. For example, it has been reported that 32% of the 99 million hectares of wheat grown in developing countries experiences varying levels of drought stress (Rajaram *et al.*, 1996) [11]. It is well known that water management is one of the major factors responsible for achieving better harvest in crop production. As more than 90% of the water is used for irrigation. Priority should be fixed for higher WUE in the field. Since water is a precious and scare input and hence it must be judiciously used. It plays a vital role for assured crop production. Without water either through irrigation or rain, plant growth and development will be adversely affected. Since it is essential for the maintenance to turgidity, absorption of nutrients and the metabolic process of the plants. Therefore, it becomes imperative to find out appropriate irrigation schedule in order to maintain the availability of soil moisture throughout the growing season for exploiting yield potential. Among the several recognized criteria of irrigation scheduling, the climatological approach is very scientific and has been identified widely among the scientists and research workers throughout the world. It is well known that evapo-transpiration by a full crop cover is closely associated with the evaporation from an open pan (Dastane, 1967) [3]. Parihar *et al.* (1974) [10] suggested a relatively more practical meteorological approach of IW/CPE, the ratio between a fixed amount of irrigation water (IW) and cumulative pan evaporation minus rains since previous irrigation (CPE) as a basis for irrigation scheduling to crops.

This IW/CPE approach merits special consideration on account of its simplicity of operation and high water use efficiency. Therefore, IW/CPE is taken for applying water to wheat and for comparative study treatments on critical growth stage are also taken. Aggarwal *et al.* (2006) [1] reported that bed-planting system was superior to conventional planting system as it improved water and nutrient use efficiency and also reduced mechanical impedance and enhanced root growth. Fahong and Sayre (2004) [5] also found that nitrogen use efficiency (NUE) could be improved by 10% or more in furrow irrigated bed-planting systems because of improved microclimate due to the reduction in canopy humidity within the field which reduced crop lodging and decreased the incidence of some wheat diseases. Sweeney and Sisson (1998) [12] reported that on poorly drained soils, wheat yields increased when grown on 75 cm raised beds. These researchers also found that soil temperature tended to be higher on the raised beds early in the growing season. Therefore, the main objective of this study was to evaluate the effect of different moisture regimes on the grain yield, WU and WUE of bed planted wheat cultivars. The groundwater table is falling steadily at the rate of about 1 m/year and the main factors leading to this decrease are the expansion of the wheat area to be irrigated with groundwater and the low water-use efficiency (Zhang *et al.*, 2006) [13].

Materials and Methods

An experiment was conducted during Rabi 2017 at the Agrometeorology Research Farm of N.D. University of Agriculture& Technology, Kumarganj, Faizabad (U.P.) on the topic entitled “Performance of growth and yield on under variable moisture regimes at wheat (*Triticum aestivum* L.) cultivars.” The experimental site is located in the main campus of NDUA&T, Kumarganj, (Faizabad) situated at a distance of about 42 km. away from Faizabad district headquarter on Faizabad Raibarelly road. The details of materials and methods employed & techniques adopted during the course of experimentation has been described in this experiment. The experiment was conducted in Randomized Block Design (RBD) and replicated the three times. The different growth parameters studied were wheat as Consumptive use, Water use efficiency, Light interception, Grain yield, Straw yield, Harvest index.

Results

Consumptive use of Wheat crop as affected by moisture regimes and wheat cultivars have been presented in (Table-1). Among different moisture regimes the highest consumptive use (67.75 cm) was recorded in 1.2 IW/CPE ratio followed by 1.0 IW/CPE ratio. Lowest consumptive use (43.75cm) was recorded in moisture regime of 0.8IW/CPE ratio. Among the different cultivars levels tried the highest consumptive (55.75 cm) was recorded in wheat cultivars HUW-234.

Water use efficiency of wheat crop as influenced by moisture regimes and wheat cultivars have been presented in (Table-1). Among different moisture regimes, the highest water use efficiency (81.0 kg ha^{-1} cm^{-1}) was recorded at 0.8 IW/CPE ratio followed by 1.0 IW/CPE ratio. Lowest water use efficiency was recorded at 1.2 IW/CPE ratio. Among the wheat cultivars the highest water use efficiency (69.0 kg ha^{-1} cm^{-1}) was recorded in PBW-343 followed by NW-1012 while Lowest water use efficiency was recorded in HUW-234.

Light interception of wheat crop as influenced by moisture regimes and wheat cultivars have been presented in (Table-2). Among different moisture regimes the highest light interception was recorded at 1.0 IW/CPE ratio followed by 1.2 IW/CPE ratio. Lowest light interception was recorded at 0.8 IW/CPE ratio. Among the wheat cultivars the highest light interception was recorded in PBW-343 followed by NW-1012 while the Lowest light interception was recorded in HUW-234 Variety.

Grain yield (q/ha) as affected by moisture regimes and wheat cultivars have been presented in (Table-3). Perusal of data showed that different moisture regimes influenced significantly to the grain yield. Maximum grain yield (37.85q/ha) was recorded with moisture regime of 0.8 IW/CPE ratio which was significantly superior over 1.2 IW/CPE and 1.0 IW/CPE ratio. The minimum grain yield (35.57 q/ha) was recorded with moisture regimes of 0.8 IW/CPE ratio. The grain yield (q/ha) was significantly affected by different cultivars. Maximum grain yield (40.52 q/ha.) was recorded with PBW-343 cultivars followed by NW-1012 and then HUW-234.

Straw yield (q/ha) as affected by moisture regimes and wheat cultivars have been presented in (Table-3). Perusal of data showed that different moisture regime influenced significantly to the Straw yield. Maximum Straw yield (51.57 q/ha.) was recorded when crop was irrigated with 0.8 IW/CPE ratio which was significantly superior over 1.0 and 1.2 IW/CPE ratio. The minimum Straw yield (48.64 q/ha.) was recorded at 0.8 IW/CPE ratio. The Straw yield was significantly affected by different cultivars. Maximum Straw yield (55.86 q/ha.) was recorded with PBW-343 variety followed by NW-1012 (52.77 q/ha.) and then HUW-234.

Harvest index (%) as affected by moisture regimes and wheat cultivars have been presented in (Table -3). Perusal of data showed that different moisture regime influenced significantly to the Straw yield. Maximum Harvest index (42.94 %) was recorded when crop was irrigated at 1.0 IW/CPE ratio which was significantly superior over 1.2 and 0.8IW/CPE ratio the minimum Harvest index (48.64 %) was recorded at 0.8 IW/CPE ratio. The Harvest index (%) was significantly affected by different cultivars. Maximum Harvest index (42.54 %) was recorded with PBW-343 variety followed by NW-1012 (42.50 %) and then HUW-234.

Table 1: Consumptive use (cm) and Water use efficiency (kg ha^{-1} cm^{-1}), of Wheat as affected by moisture regimes and wheat cultivars.

Treatments	Seed yield (Kg/ ha)	Consumptive use of water (cm)	water use efficiency (kg ha^{-1} cm^{-1})
Moisture regimes			
0.8 IW/CPE ratio	3883	67.75	81.0
1.0 IW/CPE ratio	3785	55.75	69.0
1.2 IW/CPE ratio	3557	43.75	55.0
Cultivars			
HUW-234	3270	55.75	59.0
PBW-343	4043	55.75	74.0
NW-1012	3906	55.75	71.0

Table 2: Light interception (%) as influenced by Moisture regime and Wheat Cultivars.

Treatments	Solar radiation interception %		
	30 DAS	60 DAS	90 DAS
Moisture regimes			
0.8 IW/CPE ratio	50.50	80.85	84.34
1.0 IW/CPE ratio	49.80	77.71	80.02
1.2 IW/CPE ratio	48.47	73.77	75.87
Cultivars			
HUW-234	47.58	71.91	76.87
PBW-343	50.83	81.48	85.39
NW-1012	49.36	72.14	77.25

Table 3: Grain yield, straw yield and harvest index as influenced by Moisture regime and Wheat Cultivars.

Treatments	Grain yield (qha^{-1})	Straw yield (qha^{-1})	Harvest index (%)
Moisture regimes			
0.8 IW/CPE ratio	38.83	52.60	42.94
1.0 IW/CPE ratio	37.85	51.57	42.34
1.2 IW/CPE ratio	35.57	48.64	42.25
SEm±	0.76	0.98	1.08
CD at 5%	NS	NS	NS
Cultivars			
HUW-234	32.67	44.2	42.50
PBW-343	40.52	55.86	42.23
NW-1012	39.07	52.77	42.54
SEm±	0.76	0.98	1.68
CD at 5%	NS	NS	NS

Conclusion

It is concluded that study in highest Consumptive use (67.7 cm) was found in moisture regime of 1.2 IW/CPE ratio and highest water use efficiency (81kg ha^{-1} cm^{-1}) was computed under 0.8 IW/CPE ratio. Among wheat cultivars highest water use efficiency of 74 kg ha^{-1} cm^{-1} was computed in PBW-343 cultivar of wheat.

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