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Pradeep Kumar
Department of Soil and Water, Conservation, CS. Azad University of Ag & Technology, Kanpur, Uttar Pradesh, India

Balwant singh
Department of Soil and Water, Conservation, CS. Azad University of Ag & Technology, Kanpur, Uttar Pradesh, India

Sarvesh kumar
Department of Soil and Water, Conservation, CS. Azad University of Ag & Technology, Kanpur, Uttar Pradesh, India

Sauhard Dubey
Department of Agronomy, C.S. Azad University of Agriculture and Technology, Kanpur, Uttar Pradesh, India

Prashant Kumar
Department of Agriculture Economics, Narendra Dev University of Agriculture and Tech, Kumarganj, Ayodhya, Uttar Pradesh, India

Corresponding Author:
Sauhard Dubey
Department of Agronomy, C.S. Azad University of Agriculture and Technology, Kanpur, Uttar Pradesh, India

Effect of fertilizers and preceding kharif crops on Growth and Water use efficiency of wheat (*Triticum aestivum L.*)

Pradeep Kumar, Balwant Singh, Sarvesh Kumar, Sauhard Dubey and Prashant Kumar

Abstract
A field experiment entitled "Effect of Kharif crops and fertilizer on wheat (*Triticum aestivum*) production under limited water condition" conducted during Kharif to *Rabi* of 2017-18 to find out performance of drought resistance variety of wheat under different crop sequence at Soil Conservation and Water Management Farm of Chandra Shekhar Azad University of Agriculture and Technology Kanpur-2. Treatment comprises of three crops in Kharif C_1-Maize, C_2-Urdbean, C_3-sesame, Fertilizer dose F_1-100 % RDF (90:60:40), F_2-75 % RDF as well as two irrigation level, I_1-One irrigation, I_2-Two irrigation and thus 12 treatment combination was tested in factorial Randomize Block Design with three replication Soil of experiment plot was sandy loam in texture and having medium fertility with 7.40 pH. Experimental results showed that Wheat variety K-1317, perform well and highest growth and water use efficiency was observed.

Keywords: Fertilizer, replication, wheat

Introduction
Wheat [*Triticum aestivum* (L.) emend. Fiori & Paol.] is one of the most important staple food crops of the world as well as in India. It is cultivated under diverse growing conditions of soil and climate. In India, it is the second most important food crop after rice. Wheat straw is mainly used as fodder for livestock. Among the various production inputs, balanced nutrients and water are considered as the two key inputs, making maximum contribution to crop productivity. For any crop cultivar, to achieve its genetic potential, efficient management of these two costly inputs in appropriate amount, judicious proportion together with the other optimum production factors, is most crucial to keep the green revolution evergreen without degradation of the natural resource base.

As irrigation water is scarce and costly input, its economic and scientific utilization and optimal allocation among the different crops grown becomes quite imperative. Wheat is highly sensitive to water stress during the crown root initiation (CRI) and flowering but excess irrigation may lead to heavy vegetative growth and shortening of reproductive period and ultimately decrease the yield. Thus, timing the length of irrigation interval with the stages of crop growth might bring about a reduction in the number of irrigations and results in an economic crop yield. Our current situation emphasizes the need for use of scientifically sound method of irrigation to field crops. In principle, irrigation should take place while the soil water potential is still high enough to enable soil supply water fast enough to meet the local atmospheric demands without placing the plants under stress that would reduce yield and quality of harvested crop. Although, a high water status throughout the growing season is necessary to maintain unimpaired crop growth and high economic yield, the imposition of some stress by longer irrigation intervals during vegetative or maturation by way of narrowing or widening IW/CPE ratio could attain similar economic yields as well as saving of irrigation water and improving water use efficiency. Singh *et al.* (2012) [11].

In general, irrigation is being scheduled on the basis of climatological approach (IW/CPE ratio) during entire period of crop irrespective of the stage of growth. But proper scheduling of irrigation is necessary at both vegetative and reproductive phases to maintain the optimum moisture regime for better growth and development of crop in the changing climatic scenario where abrupt variation in temperature takes place. Irrigation water is a very precious commodity and its judicious use is essential for maximizing crop yield.

For efficient utilization of irrigation water, it is necessary to find out proper approach for scheduling of irrigation. Whatever work has been done so far for determining the water requirement of this crop was confined mostly to soil moisture deficit, critical growth stages and climatological approach in which climatic parameters at different phases of growth were not considered. Therefore, a modified climatological approach based on ratio between irrigation water (IW) and cumulative pan evaporation (CPE) has been used in this experiment to find out the exact water requirement and scheduling of irrigation at a particular stage.

Materials and Methods

The details of materials used, methods followed and criteria adopted for treatment evaluation during the course of investigation are presented in this chapter.

Geographically, the experimental area lies in Kanpur which is situated at latitude of 26^0 05' North, longitude of 75^0 28' East and at an altitude of 129 meters above mean sea level. The Kanpur district falls under sub- tropical zone having semi-arid climate. The mean annual rainfall of Kanpur district is about 800 m which is mainly received during the monsoon season from the last week of June to mid-September.

The weather data with respect to rainfall, maximum and minimum temperature, relative humidity, wind velocity and evaporation rate for the experimental period as recoded at the meteorological observatory, Soil samples from 0-30 cm depth were collected randomly from five different spots of the experimental field just before the layout during both the crop seasons. A representative homogeneous composite sample was drawn by mixing these samples together and prepared to analyze physico-chemical properties of the soil. All the field operations from ploughing to harvesting were done according to farmers practiced in wheat crop but the results observed were comparatively superior over normal trials.

The treatment effects were evaluated in terms of growth parameters and soil moisture studies. In case of growth characters, three plants were randomly selected in each plot and tagged permanently. Height of main shoot i.e. from the ground surface to base of fully expanded leaf was measured by meter scale and average plant height at each growth stage (30, 60, and 90 DAS and at harvest) was worked out. lant stand per meter row length at 25 DAS and at harvest was recorded from three random spots in each plot and the average was worked out**,** Respective three plants were selected randomly from out of each net plot with three places and cut at ground level weighed for the calculation of average fresh weight of the plant, after recording the fresh weight were dried under sun for 3-4 days and weight per plant calculated. Water use efficiency was calculated as ratio of grain yield (kg ha^{-1}) to the consumptive use of water (cu) in mm and expressed as kg ha^{-1} mm^{-1}. Seasonal consumptive use value as described by Joshi and Singh (1994).

WUE = Y/ET

Result and Discussion

In this study, there were effect of three different treatment combination on wheat observed during experimental period. The effect of Kharif crops on growth characters and water use efficiency are discussed here, the nitrogen from fertilizer helped in the promotion of growth during the early stages and it is considered to be a vitally important plant nutrient.

Effect on growth characters

Height of plant was measured at 30, 60, and 90 DAS of the wheat crop in which urdbean (C_2 plot) has significantly higher plant height at the crop growth stages. The higher plant height measured on urdbean plots might be due to good environment availability of crop, where crop suitable dose of nutrients particularly N.P.K. while crop sown in other plots availability of N.P.K. to plants less due to high exhaustive crops as compere to the urdbean plots.

It is evident from the results it is clear that the various treatments significantly affected the plant height at all the plant growth stage of wheat crop. It is recorded from the results that the treatment C_2 (Plot of black gram grown in Kharif season 2017-18), ($I_{2)}$ two irrigation and 100%RDF dose of fertilizer exhibited taller plants at all the plant growth stage of wheat. Other treatment produce minimum the plant height at almost all the plant growth stages of wheat, It is clear from the results that the highest plant height was recorded under C_2 I_2 F_1 Treatment combination is effective in all the stages of the plant growth stage (30, 60 and 90 DAS).while the minimum plant height was recorded under $C_1I_1F_2$ treatment combination. As reported by Bikramaditya *et al.* (2011), Kumar *et al.* (2015), and Narolia *et al.* (2016) [8].

Growth parameters *viz*., plant height at 60 DAS and 90 DAS (Table 1), number of total tillers per plant were significantly influence by the different nutrient management treatments to wheat. However, different nutrient management treatments did not exhibit their significant impact on plant height at 30 DAS.

Data pertaining to the final plant height as affected by different NPK levels are given in data. The analysis of variance revealed that different levels of NPK differ significantly from each other. Maximum plant height (98cm) was attained when NPK was applied at the rate of 200-150-125 Kg ha-1 against minimum plant height was observed from treatment where no fertilizer was applied. The plant height increased linearly with each successive increase in NPK which was attributed to the gradual increase in plant height. These results are in agreement with Maqsood *et al*., (2001), Ahmad A (2002) [1], Dubey *et al* (2020) [5], Mollah *et al* (2008) [7] and Scagel *et al.* (2011) [10].

Effect on Water Use Efficiency

Ahmad (2002) [1] reported that water use efficiency of wheat was highest (9.19 kg/ha/mm) in the treatment receiving least number of irrigations (2 irrigation) and lowest (5.49 kg/ha/mm) in the treatment receiving 6 irrigations in the black soil of Dharwad (Karnataka).

The growth parameters of wheat was found to be superior under the different irrigation treatment. Height of plant was measured at 30, 60 and 90 DAS of the wheat crop where two irrigation treatment has significantly higher plant height at all crop growth stages. The higher plant height measured on two irrigation plots. Vishuddha *et al*. (2014) [12] also reported that significant increases in water use efficiency of wheat due to various moisture regimes and nutrient sources. The water use efficiency of wheat was significantly increased under 5 irrigations over control.

Table 1: Effect of treatment on plant height of wh**eat**

Treatments	30 DAS	60 DAS	90 DAS
Crop sequence			
C_1-Maize	15.13	57.25	77.58
C_2-Urdbean	16.27	59.47	81.29
C_3-sesame	16.07	58.16	78.92
SE(d)	0.26	0.672	1.102
CD (P = 0.05%)	0.54	1.394	2.285
Fertilizer			
F_1-100% RDF, NPK(90:60:40)	16.09	59.693	80.50
F_2- 75% RDF	15.56	56.905	78.038
SE(d)	0.21	0.549	0.900
CD (P = 0.05%)	0.44	1.138	1.866
Irrigation			
I_1- One irrigation	16.69	57.43	78.068
I_2- Two irrigation	15.96	59.16	80.472
SE(d)	0.25	0.549	0.900
CD (P = 0.05%)	0.51	1.138	1.866

Table 2: Water use efficiency of wheat with effect of different fertilizers and preceding kharif crops

Treatment	Water use(mm)	Water use efficiency (kg/mm)
C_1 I_1 F_1	320	9.48
C_1 I_1 F_2	310	8.68
C_1 I_2 F_1	260	11.52
C_1 I_2 F_2	241	9.60
C_2 I_1 F_1	340	10.23
C_2 I_1 F_2	325	9.26
C_2 I_2 F_1	275	11.53
C_2 I_2 F_2	270	10.49
C_3 I_1 F_1	331	10.19
C_3 I_1 F_2	315	8.81
C_3 I_2 F_1	260	11.33
C_3 I_2 F_2	255	9.67

Summary and Conclusion

The highest plant height was recorded when the crop sown in the urdbean plot (C_2) and the lowest plant height was obtained by maize plot (C_1). Therefore, the better performance of wheat in case of plant height was recorded under the kharif crops. Growth parameters *viz*., plant height at 60 DAS and 90 DAS (Table 1), number of total tillers per plant were significantly influence by the different nutrient management treatments to wheat. However, different nutrient management treatment did not exhibit their significant impact on plant height at 30 DAS. Irrigation also inhibits superiority of growth characters *viz*., height of plant that was measured at 30, 60 and 90 DAS of the wheat crop where two irrigation were given shows significantly higher plant height at all crop growth stages.

On the basis of present investigation sowing of wheat in the urdbean plot (sown in Kharif season), It may be concluded that 100% RDF and two irrigation brought out together results in significant increase in growth parameters and water use efficiency.

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