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Influence of varying moisture conditions and fertility grades on yield and economics of wheat under late sown condition

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Abstract

The field experiment was conducted during *rabi* season of 2020-21 and 2021-22 at Agriculture research farm, Faculty of Agriculture, RNTU, Raisen, (M.P.). Aim of the study is to evaluate the performance of moisture conditions under varying fertility grades. Keeping 4 levels of irrigation (I_0-CRI, late, Jointing, and milking stage, I_1-CRI, late jointing, flowering and milking stage, I_2-Irrigation with (0.8 IW/CPE) and I_3-Irrigation with (1.0 IW/CPE) under main plots and four 4 nutrient practices (F_0-100% RDF+ZnSO4 30 kg, F_1-75% RDF +25% RDN through FYM+$ZnSO_4$ 25 kg/ha, F_2-50% RDF+50% RDN through FYM +$ZnSO_4$ 20 kg/ha and F_3-100 kg+25% RDN through FYM+$ZnSO_4$ 15 kg/ha in sub plot with thrice replications. The experiment was laid out in split plot design. Data revealed that the significant difference was observed with irrigation levels on grain yield (4170.58 and 4152.25 kg/ha) and straw yield (4678.05 and 4703.71 kg/ha) in wheat during 2020-21 and 2021-22, respectively. Application of 75% RDF +25% RDN through FYM+ZnSO4 25 kg/ha gave highest yield of wheat crop which was significantly superior over other treatments. The highest wheat grain yield of 3765.47 and 3902.80 kg/ha and straw yield of 4423.24 and 4531.04 kg/ha during 2020-21 and 2021-22 were recorded with 75% RDF +25% RDN through FYM+ZnSO4 25 kg/ha. Net returns were maximum (Rs. 88079.53) under the treatment I_1 (CRI, late jointing, flowering and milking stage) followed by treatment I_2 ((Irrigation with 0.8 IW/CPE). Minimum net returns (Rs. 72470.91) were recorded under the treatment I_2 (Irrigation with (1.0IW/CPE). Among fertility grades, maximum net returns of Rs. 81758.12 were recorded under the treatment F_1 (100% RDF+$ZnSO_4$ 30 kg).

Key words: irrigation levels, nutrient sources, wheat, economics

Introduction

Wheat *(Triticum aestivum L.)* is an important staple food crop and serves as backbone of food security in the country. In India, it is the second most important cereal after rice contributing substantially to the national food security by providing more than 50 per cent of the calories to the people who mainly depend on it. During last four decades, wheat production and productivity has increased almost 6-fold and it alone contributes about one-third of the total food grain production in India. In era of climate change and increasing biotic and abiotic stresses, maintaining yield up to required level is going to be formidable challenge in coming future. It ranks first in the world cereal area and production. Globally, 748.8 million tonnes of wheat are produced on an area of 220.4 million acres (FAO, 2017).

About 80 to 85% of wheat grains are ground into flour and consumed in the form of chapatis. Soft wheat is used for making chapatis, bread, cake, biscuits, pastry and other bakery products. Wheat straw is mainly used as fodder for livestock. Among the various production inputs, balanced nutrient (N, P and K) and water are considered as the two key inputs, making maximum contribution to crop productivity. Wheat is quite vulnerable to water stress during CRI and flowering, yet excessive irrigation might shorten the reproductive season and cause heavy vegetative growth, which will reduce yield. In order to reduce the number of irrigations and provide an economically viable crop yield, it is possible to time the length of irrigation interval with the stages of crop growth. 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 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. In general, irrigation is being scheduled on the basis of climatologically 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.

Different factors responsible for higher productivity are use of high yielding cultivars, use of fertilizers and irrigation. Grain yield and irrigation frequency have a positive relationship. Irrigation failure during a critical growth stage can drastically reduce grain yield due to lower test weight (Kumar et al., 2015). Efficient water management, as one of the good agronomic management practices, not only leads to increased crop productivity but also reduces susceptibility to disease and insect pests in an environment conducive to the growth of these biotic stressors (Singh et al., 2012). This knowledge enables estimating the earliest date at which the next irrigation should be applied for efficient irrigation with the particular system, before water stress affects crop production. One of the major essential elements for growth and development of plants is nitrogen. Yield increase in wheat was observed up to 120 kg $ha^{-1}$of applied nitrogen (Jat et. al., 2013). Excess nitrogen, in particular, is also not good for wheat crop; it causes an early exhaustion of soil moisture, induces lodging, and reduces resistance to leaf diseases, and delay in maturity.

Methods and materials

The field experiment was conducted in two cropping seasons of 2020-21 and 2021-22 at Agriculture research farm, Faculty of Agriculture, RNTU, Raisen. Field was laid out in split plot design. Treatments consisted of four levels of irrigation (I_0-CRI, late, Jointing, and milking stage, I_1-CRI, late jointing, flowering and milking stage, I_2-Irrigation with (0.8 IW/CPE) and I_3-Irrigation with (1.0 IW/CPE) under main plots and four nutrient practices (F_0-100% RDF+$ZnSO_4$ 30 kg, F_1-75% RDF +25% RDN through FYM+$ZnSO_4$ 25 kg/ha, F_2-50% RDF+50% RDN through FYM +$ZnSO_4$ 20 kg/ha and F_3-100 kg+25% RDN through FYM+$ZnSO_4$ 15 kg/ha in sub plot with thrice replications. The unit plot size was 4.0 m × 5.0 m. Altogether 48 plots were included in the field experimentation. The wheat was direct line sown at the spacing of 20 cm × 3 cm during *rabi* season. Crops were raised with best possible management practices.

Grain yield (kg ha^{-1})

The grain yield per net plot was recorded after winnowing the produce and sun drying with the help of double pan balance. Finally, grain yield of each plot was converted into grain yield kg h^{-1} by multiplying with appropriate conversion factor.

Straw yield (kg ha^{-1})

The straw yield was recorded by deducting the grain yield (economic yield) of each plot from the biological yield (bundle weight) of the same plot. This was later converted into straw yield kg ha^{-1} by multiplying with same conversion factor which was used in case of grain yield kg ha^{-1}.

Net return and B-C ratio

Gross return was calculated by multiplying the total grain and straw yield with prevalent market prices of the items and then presented on per hectare basis as per treatments. Net return was computed by deducting the total cost of cultivation from the gross return as per treatments.

Net return (Rs ha^{-1}) = Gross return (Rs ha^{-1}) – Cost of cultivation (Rs ha^{-1}).

$$\text{B-C ratio} = \frac{\text{Net return (Rs ha}^{-1}\text{)}}{\text{Cost of cultivation (Rs ha}^{-1}\text{)}}$$

Results and discussion

Effect of moisture conditions

Grain yield is a function of interplay of various yield components such as number of productive tillers, panicle length, filled grain and 1000-grain weight (Singh *et al.*, 2019). Results revealed that yield and economics of wheat were significantly affected by irrigation scheduling during both the years 2020-21 and 2021-22 (Table 1). Maximum grain yield (4170.58 and 4152.25 kg ha^{-1}) and straw yield (4678.05 and 4703.71 kg ha^{-1}) was recorded in treatment of irrigation scheduling at CRI, late jointing, flowering and milking stage (I_1), followed by I_2. Lowest grain yield (3429.08 and 3472.87 kg ha^{-1}) and straw yield (4085.71 and 4098.88) was recorded in I_0 treatment during 2020-21 and 2021-22 of wheat, respectively. Application of irrigation at CRI, late jointing, flowering and milking stage resulted in maximum grain yield per ha in wheat. CRI, jointing, flowering and milking stages in wheat are the critical stages of grain filling and retention. Availability of sufficient moisture in the soil results in enhanced quantitative yield characters as evidence from the current study.

A perusal of the data presented in Table 2 reveals that cost of cultivation was recorded to be maximum under the treatment I_1 (CRI, late jointing, flowering and milking stage), where a total expenditure of Rs 36747.40 was recorded. This was followed by treatment I_0 and I_2 where cost of cultivation was worked out to be Rs 35250.40 and Rs 34211.40 ha^{-1}, respectively. After scanning of data during the both years of experiments regarding gross return, net return and B:C, it is noticed that, highest gross return, net return and B:C (Rs. 124826.93, 88079.53 ha^{-1} and 2.40) was recorded in scheduling of irrigation at (CRI, late jointing, flowering and milking stage) (I_1). After I_1, maximum gross return was recorded in I_2. Lowest gross return and net return were recorded under treatment I_3. Kumar *et al.* (2015) reported that application of irrigation at all the critical stages of growth in wheat resulted in highest B:C ratio. Similarly, application of RDF resulted in a B:C ratio. Yadav and Niwas (2022) reported that application of irrigation schedule (I_1 Irrigation at CRI stage and nutrient management

(N_2 (50% RDF+NPK+10 t FYM ha^{-1}) reduces the Total cost of cultivation and increases the gross profit and net profit which ultimately leads to highest Benefit Cost Ratio.

Effect of different fertility grades

Significant influence of irrigation scheduling was recorded on yield of wheat (Table 1). The data reveals that, maximum grain yield (3765.47 and 3902.80 kg ha^{-1}) and straw yield (4423.24 and 4531.04 kg ha^{-1}) during 2020-21 and 2021-22, respectively was recorded with F_1 (75% RDF +25% RDN through FYM+$ZnSO_4$ + 25 kg/ha) treatment which was statistically superior to F_3 (100 kg+25% RDN through FYM+$ZnSO_4$ 15 kg/ha). Lowest grain yield (3392.59 and 34.99.09 kg ha^{-1}) and straw yield (41.27.71 and 4286.71 kg ha^{-1}) was recorded in F_0 during 2020-21 and 2021-22, respectively. Application of nutrient through integration of inorganic and organic source of nutrients resulted in significantly highest grain yield of wheat during both cropping seasons. It may be due to timely supply of sufficient and balanced amount of nutrients to plants. It ultimately produced more number of effective tillers, lengthy earhead and more filled grains/earhead, which ultimately resulted in higher yield. Whereas, minimum yield attributes as well as yield were obtained from control treatment (where no nutrient was applied). This may be due to insufficiency of available nutrient in soil profile causing lower biomass production up to harvest. Similar results were found previously by Mohan et al. (2018) and Fazily et al. (2021).

The maximum cost of cultivation was recorded under the treatment F_0 (100% RDF+$ZnSO_4$ 30 kg) recording a value of Rs 42549.00. This was followed by treatment F_1 recording a total cost of cultivation of Rs 38549.00 followed by treatments F_3, and F_2. Significant variation was recorded in gross return, net return and B:C in INM treatments. Highest gross return, net return and B:C (Rs. 120307.12, 81758.12 ha^{-1} and 2.12) was recorded in treatment which received 75% RDF +25% RDN through FYM+$ZnSO_4$ 25 kg/ha (F_1).

Conclusion

From the results of the present investigation, it can be concluded that Application of 75% RDF +25% RDN through FYM+ZnSO4 25 kg/ha showed the maximum incremental values for growth among all the integrated nutrient management treatments applied on wheat crop. Irrigation scheduling at CRI, late jointing, flowering and milking stage was the most effective treatment for enhanced yield attributes in wheat crop.

References

FAO. (2017). Crop Prospects and Food Situation. Food and Agricultural Organization of the United Nations, Italy: 6.

Fazily, T., Thakral, S.K. and Dhaka, A.K. (2021). Effect of integrated nutrient management on growth, yield attributes and quality of wheat. *International Journal of Advances in Agricultural Science and Technology*, **8**(1): 106-118

Jat, Gajanand, Mujumdar, S.P, Jat N.K and Mazumdar, Sonali P. (2013). Potasium and Zinc fertilization in wheat (*Triticum aestivum* L.) inwestern arid zone of India. *Indian Journal of Agronomy*, **58**: 67-71.

Kumar, B., Dhar, S., Vyas, A. K., & Paramesh, V. (2015). Impact of irrigation schedules and nutrient management on growth, yield and root traits of wheat *(Triticum aestivum*) varieties. *Indian Journal of Agronomy*, **60**(1), 87-91.

Mohan, B., Kumar, P. and Yadav, R. A. (2018). Effect of integrated nutrient management on yield attributes and yield of wheat (*Triticum aestivum* L.). *Journal of Pharmacognosy and Phytochemistry*, **7**(1): 1545-1547.

Singh, S., Mishra, V., Srivastava, U. and Kumar, A. (2012). Impact of irrigation levels on growth, yield and quality of wheat (*Triticum aestivum* L.).*Environment and Ecology*, **30**: 72-77.

Singh, V.; Agrawal K.K. and Jha A.K. (2019). Effect of Forchlorfenuron on growth and yield of rice (*Oryza sativa* L.) during *Kharif* season of Central India. *International Journal of Current Microbiology and Applied Sciences*, **8**(09): 2331- 2338.

Yadav, A. K. and Niwas, R. (2022). Effect of irrigation scheduling and nutrient management on growth and yield of wheat (*Triticum aestivum* L.) in central U.P. *The Pharma Innovation Journal*, **11**(7): 1367-1372.

Table 1: Effect of moisture conditions and fertility grades on yield of wheat

Treatments	**Grain yield (kg/ha)**		**Straw yield (kg/ha)**	
Moisture conditions (I)	**2020-21**	**2021-22**	**2020-21**	**2021-22**
I_0	3429.08	3583.41	4085.71	4158.04
I_1	4170.58	4152.25	4678.05	4703.71
I_2	3584.14	3683.14	4323.28	4615.61
I_3	3468.54	3472.87	4147.23	4098.88
SEm±	**62.79**	**77.23**	**96.40**	**98.69**
CD (P=0.05)	**181.63**	**222.97**	**131.10**	**118.54**
Fertility Grades (F)				
F_0	3392.59	3499.09	4127.71	4286.71
F_1	3765.47	3902.8	4423.24	4531.04
F_2	3670.06	3730.73	4417.49	4518.16
F_3	3563.62	3699.28	4205.37	4515.57
SEm±	**70.32**	**86.46**	**95.25**	**96.25**
CD (P=0.05)	**203.18**	**249.4**	**126.42**	**124.23**

Table 2: Effect of moisture conditions and fertility grades on economics of cultivation in wheat

Treatment combination	Cost of cultivation (₹ ha^{-1})	Gross return (₹ ha^{-1})	Net return (₹ ha^{-1})	B:C ratio
I_0	35250.4	108515.93	73265.53	2.08
I_1	36747.4	124826.93	88079.53	2.40
I_2	34211.4	108470.82	74259.42	2.17
I_3	33250.4	105721.31	72470.91	2.18
F_0	42549	107774.57	65225.57	1.53
F_1	38549	120307.12	81758.12	2.12
F_2	39520	114490.61	74970.61	1.90
F_3	36026.67	103309.44	67282.77	1.87