Effect of different irrigation scheduling and nutrient management practices on yield and economics of wheat (*Triticum aestivum* L.)

ABSTRACT

A filed? Meaning old? experiment was conducted during two kharif seasons of 2020-21 and 2021-2022 at Agriculture Research Farm, Rabindranath Tagore University, Raisen, Madhya Pradesh, India, to evaluate the effect of different irrigation scheduling and nutrient management practices on yield and economics of wheat crop in split-plot design with three replications. The irrigation level N_0 - No irrigation, N_1- One Irrigation at CRI meaning CRI? stage, N_2- One Irrigation at CRI & one irrigation before flowering were arranged in main plots whereas nutrient management treatments of N_0 – Control, N_1-100% RDF + FYM @ 2.5 t/ha. + Azotobacter, N_2 - 100% RDF + Vermicompost @ 1.5 t/ha + PSB, N_3 - 50% RDF+ FYM@5.0 t/ha, N_4 -50% RDF+ Vermicompost@2.5 t/ha were used in the sub plots. The results shown that one Irrigation at CRI & one irrigation before flowering along with application of 50% RDF+ FYM@5.0 t/ha found to be best in the terms of grain yield (28.70 and 29.52 q ha^{-1}), straw yield (41.88 and 42.13 q ha^{-1}), biological yield (70.68 and 71.75 q ha^{-1}) and benefit cost ratio during 2020-21 and 2021-22, lowest yield and cost benefit ratio recorded under control plot respectively. I do suggest to re-write this abstract, I am sure it is interesting but really confused.

1. INTRODUCTION

Wheat (*Triticum aestivum* L.) is considered one of the most important cereal not only in India but also in the world. Its importance comes from using its grain as a main food source for human and its straw as feed for livestock. In India it occupies an area of about 30.5 mha with a production of 98.38 mt and with national productivity of 3216 kg ha^{-1}. In state of Madhya Pradesh, it occupies in total 10.8 mha?? area with the production of 30.7 mt and average productivity of 2478 kg ha^{-1} [1]. Wheat is highly sensitive to water stress during the 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. 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. Wheat grows mainly during dry seasons, where irrigation is necessary because precipitation in the growing season is far less than the crop water requirement. However, water resources are usually limited. Hence, irrigation scheduling is used to allocate irrigation water rationally in crop growing stages in order to maximize crop yield, water productivity and profit under the limited conditions [15]. About 30% of wheat production is lost due to lack of irrigation water and 40% yield loss due to lack of nutrient supply and metal contents in soil as well as their availabilities, pollution status of other environmental parameters in the country [16,10]. Proper time of irrigation especially in crown root initiation stage is very important for successful growth of wheat and it has a great impact on higher grain yield [8]. Organic manure with inorganic fertilizers may serve as a chelating and complexing agent which prevents the nutrients from precipitation, fixation, oxidation, and leaching. Application of organic manures may also improve availability of native nutrients in soil as well as the efficiency of applied fertilizers [13]. The role of organic matter is well established in governing the nutrient fluxes, microbial

biomass and improvement in soil physical chemical and biological properties [11]. Maintaining soil health is of utmost important to ensure food and nutritional security of the country [9]. For most efficient use of fertilizers, all nutrients must be used in balance proportion. However, there is a lack of information regarding the performance of FYM and nitrogen in relation to productivity and fertility of soil under wheat cultivation [5].

2. MATERIALS AND METHOD

A field experiment was carried out during the Kharif season of 2020- 2021 and 2021-22 at the Agriculture Research Center, Rabindranath Tagore University, Raisen, Madhya Pradesh to study the relative performance of effect of irrigation level and nutrient management on growth and yield of wheat. The geographical position of experimental filed at 23.134273°N latitude and 77.564305°E latitude. The total rainfall of 131.30 mm was received during the wheat crop growth period of first (2020-21) year, was higher (46.30 mm) than second (2021-22) year. The weekly mean minimum temperature was ranged from 6.2 to 20.9^0 C with an average of 12.8 ^{0} C in 2020-21, and 7.2 to 23.1^0 C with a range with an average of 13.6 ^{0}C in 2021-22 during wheat crop season, respectively. The experiment was laid out in split plot design (SPD) with fifteen as there are 15, isn't it easier to design a table? treatments combination. The irrigation level N_0 - No irrigation, N_1- One Irrigation at CRI stage, N_2- One Irrigation at CRI & one irrigation before flowering were arranged in main plots whereas other treatments of N_0 – Control, N_1-100% RDF + FYM @ 2.5 t/ha. + Azotobacter, N_2 - 100% RDF + Vermicompost @ 1.5 t/ha + PSB, N_3 - 50% RDF+ FYM@5.0 t/ha, N_4 -50% RDF+ Vermicompost@2.5 t/ha were used in the sub plots. Wheat crop variety for experiment was used of SUPER-252. It was suitable for late sown irrigated conditions. The grain and straw yield was weighted in kilogram for each plot after threshing which was then converted in to q ha^{-1}. The treatment means were compared using least significant differences at 5% level of significance [4].

3. RESULTS AND DISCUSSION

3.1 Yield attributes

Perusal of the data (Table-1) showed that, highest effective tillers (131.49 m^{-1} row length), number of spikelet's per ear (28.06), grains ear^{-1} (44.35) and test weight (31.01 g) recorded in I_2 (One Irrigation at CRI & one irrigation before flowering) followed by I_1 (One Irrigation CRI stage.) and lowest yield attributes was recorded in I_0 (No Irrigation), during both of the year of experiment. Whereas, in case of nutrient management practices, maximum yield attributes were recorded under the treatment (N_3- 50%RDF+ FYM@5.0 t ha^{-1}). The results of the present investigation are also in agreement with the findings of [3,14]. Application of nutrient management practices showed varied significant response to different yield attributes parameters, although mostly controlled by genetic factors. Application of (50%RDF + FYM @ 5.0 t/ha) resulted in enhanced test weight of wheat crop [2].

Table 1: Effect of irrigation scheduling and nutrient management practices on yield attributes in wheat.

Treatments	Number of Effective tillers per meter row length		Number of spikelets per ear		Number of grains per ear head		Test weight (g)	
Irrigation Scheduling	**2020-21**	**2021-22**	**2020-21**	**2021-22**	**2020-21**	**2021-22**	**2020-21**	**2021-22**
I_0	94.33	96.53	19.23	19.74	36.52	39.39	26.40	26.96
I_1	115.18	117.05	25.74	24.88	41.23	41.30	27.20	27.60
I_2	131.49	133.69	28.06	27.65	44.35	45.08	31.01	31.04
SEm±	3.19	4.02	1.04	1.06	1.61	1.19	1.20	0.99
CD (0.05)	9.14	11.5	2.15	2.14	4.62	3.42	2.42	2.82
Nutrient management (N)								
N_0	97.42	100.37	18.46	17.66	33.29	36.33	24.49	25.43
N_1	122.22	121.42	21.73	22.85	40.79	40.16	28.54	29.72
N_2	120.28	122.82	24.58	25.94	39.86	42.23	28.36	28.21
N_3	126.96	132.83	27.81	27.60	43.86	44.23	31.48	31.62
N_4	119.14	121.67	25.81	24.42	38.99	41.52	27.30	27.74
SEm±	3.57	4.49	1.12	1.13	1.81	1.33	1.33	1.10
CD (0.05)	10.21	12.86	2.28	2.23	5.17	3.82	3.82	3.16

I_0-No Irrigation, I_1-One Irrigation CRI stage, I_2 –One Irrigation at CRI & one irrigation before flowering, N_0-Control, N_1-100% RDF + FYM @ 2.5 t/ha. + Azotobacter, N_2-100% RDF + Vermicompost @ 1.5 t/ha + PSB, N_3-50%RDF+ FYM@5.0t/ha., N_4-50%RDF+Vermicompost@2.5 t/ha.

3.2 Yield (Kg ha^{-1})

It is obvious from the data given in Table-2 clearly shows that among the productivity parameters viz. grain yield (28.70 and 29.52 q ha^{-1}), straw yield (41.88 and 42.13 q ha^{-1}), biological yield (70.68 and 71.75 q ha^{-1}) and benefit cost ratio significantly recorded under the treatment combination of one Irrigation at CRI & one irrigation before flowering along with application of 50% RDF+ FYM@5.0 t/ha during 2020-21 and 2021-22 of the experiment, lowest yield and cost benefit ratio recorded under control plot respectively Similar findings were reported [10]. [6] reported that irrigation at tillering, stem elongation stage, booting and grain filling stage recorded the higher yield of wheat. Irrigation applied at CRI & one irrigation before flowering height resulting into increased source while application of irrigation at milking might have helped to increase the ratio of bold grain to chaffy grains. This might be helped to increase in test weight, number of grains per spike and harvest index, thus have boosted the final yield.

4. ECONOMICS ATTRIBUTES

A perusal of the data presented in Table 3 reveals that cost of cultivation was recorded to be maximum under the treatment I_2 (One Irrigation at CRI & one irrigation before flowering) where a total expenditure of INR 38747.4 and 40284.81 was recorded during both the year, respectively. Under nutrient management practices, maximum cost of cultivation was recorded under the treatment N_3 (50%RDF+ FYM@5.0t/ha) a value of INR 37251.00 and 39125.35 during both the year, respectively. This was followed by treatment N_4 recording a total cost of cultivation of (INR 38368.00 and 41238.29) during both the year, respectively followed by treatments N_2, N_1 and N_o. Highest gross return 95626.93 and 97895.25 per ha was recorded in scheduling of irrigation at CRI and before Flowering (I_2) during both the years, respectively. After I_2, maximum gross return was recorded in I_1. Lowest gross return was recorded under treatment I_0. Similar trend was found in grass return and net return. Maximum B:C ratio (where do you close this parenthesis? 1.47 and 1.43 was recorded under the treatment I_2 (One Irrigation at CRI & one irrigation before flowering) during both the year, respectively. Under nutrient management practices, maximum B: C ratio was recorded under the treatment N_3 (50%RDF+ FYM@5.0t/ha.) where a B: C ratio (1.61 and 1.70) was recorded respectively. Least B: C ratio of 0.85 and 0.91 was recorded with N_0 during both the year, respectively.

Table 2: Effect of irrigation scheduling and nutrient management practices on yield of wheat

Treatments	Grain Yield (q/ha)		Straw yield (q/ha)		Harvest Index (%)		Biological yield (q/ha)	
Irrigation Scheduling (I)	2020-21	2021-22	2020-21	2021-22	2020-21	2021-22	2020-21	2021-22
I_0	24.3	25.8	35.9	36.6	40.27	41.47	60.2	62.5
I_1	25.9	26.8	38.3	41.1	40.08	39.23	64.2	68.0
I_2	28.7	29.5	41.8	42.0	40.79	41.41	70.5	71.7

SEm±	0.07	0.06	0.07	0.07	0.15	0.17	0.08	0.11
CD (0.05)	0.20	0.19	0.19	0.18	0.45	0.46	0.19	0.25
Nutrient management (N) (N)								
N_0	24.0	25.0	36.2	37.9	39.60	39.59	60.3	63.0
N_1	26.7	27.3	39.1	40.2	40.37	40.46	66.0	67.6
N_2	25.6	27.0	37.0	40.3	40.65	40.04	62.8	67.4
N_3	27.7	29.0	39.2	40.2	41.48	42.02	66.6	69.1
N_4	25.2	26.8	38.9	40.0	39.23	40.42	64.6	67.0
SEm±	0.08	0.07	0.11	0.09	0.14	0.17	0.05	0.07
CD (0.05)	0.21	0.20	0.24	0.21	0.44	0.42	0.13	0.16

I_0-No Irrigation, I_1-One Irrigation CRI stage, I_2 –One Irrigation at CRI & one irrigation before flowering, N_0-Control, N_1-100% RDF + FYM @ 2.5 t/ha. + Azotobacter, N_2-100% RDF + Vermicompost @ 1.5 t/ha + PSB, N_3-50% RDF+ FYM@5.0t/ha., N_4-50% RDF+ Vermicompost@2.5 t/ha.

Table 3: Effect of irrigation scheduling and nutrient management practices on economics attributes in wheat

Treatment combination	Total cost of cultivation (₹ ha $^{-1}$)		Gross return (₹ ha $^{-1}$)		Net return (₹ ha $^{-1}$)		B:C ratio	
	2020-21	2021-22	2020-21	2021-22	2020-21	2021-22	2020-21	2021-22
I_0	31211.4	31342.5	62848.65	64257.26	31637.25	32914.8	1.01	1.05
I_1	38271.4	39258.25	89270.82	92354.26	50999.42	53096	1.33	1.35
I_2	38747.4	40284.81	95626.93	99898.25	56879.53	57610.4	1.47	1.48
N_0	21739	22589.54	40137.74	43256.21	18398.74	20666.7	0.85	0.91
N_1	34892	34256.24	89490.61	91358.25	54598.61	57102	1.56	1.67

N_2	35367	36548.32	88933.2	93684.57	53566.2	57136.3	1.51	1.56
N_3	37251	39125.35	97098.93	105689.25	59847.93	66563.9	1.61	1.70
N_4	38368	41238.29	88263.2	96845.3	49895.2	55607	1.30	1.35

I_0- No Irrigation, I_1- One Irrigation CRI stage, I_2 – One Irrigation at CRI & one irrigation before flowering, N_0- Control, N_1-100 % RDF + FYM @ 2.5 t/ha. + Azotobacter, N_2- 100% RDF + Vermi compost @ 1.5 t/ha + PSB, N_3-50%RDF+ FYM@5.0t/ha., N_4-50% RDF+ Vermicompost@2.5 t/ha.

5. CONCLUSION

On the basis of the results obtained from the experiment, it can be concluded that, the application of one Irrigation at CRI & one irrigation before flowering along with application of 50% RDF+ FYM@5.0 t/ha found to be greatest in the terms grain yield (28.70 and 29.52 q ha -1), straw yield (41.88 and 42.13 q ha -1), biological yield (70.68 and 71.75 q ha -1) and economics attributes during both of the years.

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