

Impact of irrigation scheduling, moisture conservation practices and nutrient management on performance of wheat (*Triticum aestivum* L.)

Abstract

A field experiment was conducted during two consecutive *Rabi* seasons 2020-21 and 2021-22 at Students' Instructional Farm of Chandra Shekhar Azad University of Agriculture and Technology, Kanpur, Uttar Pradesh, India, situated at 125.9 meter altitude, 26.49122⁰ North latitude, 80.307012⁰ East longitude, to study "Impact of irrigation scheduling, moisture conservation practices and nutrient management on performance of wheat (*Triticum aestivum* L.)". The experiment consisted three irrigation scheduling *viz*: I₁: two irrigations at CRI and Jointing stage, I₂: three irrigations at CRI, Jointing and Booting stage and I₃: Four irrigations at CRI, Tillering, Booting and Milking stage, two moisture conservation practices *viz*: M₀: without mulching and M₁: Organic mulch @ 10 t ha⁻¹ + Kaolin 6% spray and three nutrient management practices *viz*: N₁: 100% RDF (150:60:40 kg ha⁻¹ NPK), N₂: 85% RDF + FYM @ 5.0 t ha⁻¹ and N₃: 75% RDF + FYM @ 10.0 t ha⁻¹. The experiment was laid out in double split plot design with three replications. On pooled basis of two years experimentation the results indicated that, four irrigations at CRI, Tillering, Booting and Milking stage (I₃) recorded highest value of grain yield (4381.60 kg ha⁻¹), straw yield (6651.15 kg ha⁻¹) and harvest index (39.70 %) with profitability in terms of net return (Rs. 83908.79 ha⁻¹), under moisture conservation practices, organic mulch @ 10 t ha⁻¹ + Kaolin 6% spray (M₁) recorded significantly highest grain yield (4230.40 kg ha⁻¹) and straw yield (6578.57 kg ha⁻¹). Among the nutrient management treatments, 85% RDF + FYM @ 5.0 t ha⁻¹ (N₂) also recorded maximum grain yield (4117.60 kg ha⁻¹) and straw yield (6338.71 kg ha⁻¹) and net return (Rs. 77770.83 ha⁻¹) compared to other treatments.

Key words: FYM, Irrigation scheduling, Kaolin, Moisture conservation practices, Nutrient management, Organic mulch, Wheat.

Introduction:

Wheat (*Triticum aestivum* L.) is the first important and strategic cereal crop for the majority of world's population. Globally, wheat cultivated in 222.21 million hectares area with the production of 779.03 million metric tonnes and productivity of 3.51 metric tonnes per hectare during the year of 2021-22 (Anonymous, 2022, b). In India total area under wheat is 316.15 lakh hectare (31.61 million hectares), with the production of 109.52 million tonnes and productivity of 3464.0 kg ha⁻¹ during the year of 2020-21 (Anonymous, 2021-22, a). India has 18% of world population, having 4% of world's fresh water, out of which 80% is used in agriculture. The judicial

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35 application of water calls for immediate attention and this is possible only by following some
36 scientific basis for water application to the crop. One such scientific approach particularly in water
37 scarcity area is critical crop growth stage approach for scheduling of irrigation. To increase the
38 duration of moisture availability with the existing available moisture, the losses of it from plants
39 (transpiration) and soil (evaporation) have to be reduced. For this antitranspirants and mulches,
40 respectively are being tried under many occasions. Irrigation scheduling is important to maximize
41 crop yields and ensure sustainable water use.

42 Moisture conservation with organic mulch helps to mitigate the drought stress, increase
43 water productivity and reduce the soil degradation, resulting in enhancing the productivity of crops.
44 The spray of kaolin on wheat crop resulted in better growth parameters. They attributed the
45 favourable effect of kaolin spray on plant growth which might be due to reduction in transpirational
46 losses of water due to reflection of part of solar radiation incident on leaf surface, thus making the
47 soil moisture available for better growth over longer period **Thakuria et al., (2004)**. Wheat is
48 generally grown in intensive cropping system with higher use of inorganic NPK fertilizers. Optimal
49 fertilizer management is necessary to maintain sustainable yields, improve nutrient use efficiency of
50 fertilizers and save fertilizer resources. The inclusion of organic manure with inorganic fertilizers
51 may serve as a chelating and complexing agent which prevents the nutrients from precipitation,
52 fixation, oxidation and leaching. Application of organic manures may also improve availability of
53 native nutrients in soil as well as the efficiency of applied fertilizers. FYM is a good source of
54 nutrients and contributed towards build-up of organic matter in soil.

55 **Materials & Methods:**

56 A field experiment was conducted during two consecutive *Rabi* seasons 2020-21 and 2021-
57 22 at Students' Instructional Farm of Chandra Shekhar Azad University of Agriculture and
58 Technology, Kanpur, Uttar Pradesh, India, situated at 125.9 meter altitude, 26.49122⁰ North
59 latitude, 80.307012⁰ East longitude, to study "**Impact of irrigation scheduling, moisture
60 conservation practices and nutrient management on performance of wheat (*Triticum aestivum*
61 L.)**". The experiment consisted three irrigation scheduling *viz.*: I₁: two irrigations at CRI and
62 Jointing stage, I₂: three irrigations at CRI, Jointing and Booting stage and I₃: Four irrigations at
63 CRI, Tillering, Booting and Milking stage, two moisture conservation practices *viz.*: M₀: without
64 mulching and M₁: Organic mulch @ 10 t ha⁻¹ + Kaolin 6% spray and three nutrient management
65 practices *viz.*: N₁: 100% RDF (150:60:40 kg ha⁻¹ NPK), N₂: 85% RDF + FYM @ 5.0 t ha⁻¹ and N₃:
66 75% RDF + FYM @ 10.0 t ha⁻¹. The experiment was laid out in double split plot design with three
67 replications. The variety, HD-2967 was used for sowing in experiment. The soil was moist, well
68 drained with uniform plane topography. The soil of the experimental field was alluvial in origin,
69 sandy loam in texture and slightly alkaline in reaction having pH 7.69 and 7.67 (1:2.5 soil: water

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70 suspension method given by **Jackson, 1973**), Organic carbon percentage in soil is 0.30 and 0.29 per
71 cent (Walkley and Black's rapid titration method given by **Walkley and Black, 1934**), with
72 available nitrogen 181.40 and 179.25 kg ha⁻¹ (Alkaline permanganate method given by **Subbiah**
73 **and Asija, 1956**), available phosphorus as sodium bicarbonate-extractable P was 12.50 and 11.28
74 kg ha⁻¹ (Olsen's calorimetrically method, **Olsen et al., 1954**) available potassium was 170.0 and
75 168.25 kg ha⁻¹ (Flame photometer method given by **Hanwey and Heidel, 1952**) respectively in
76 2020-21 and 2021-22. Mulching was done in respective treatment with paddy straw @ 10 t ha⁻¹.
77 Respective treatments were treated with two spray of kaolin @ 6% solution on 49 DAS (at
78 maximum Tillering stage) and 69 DAS (20 days, after first spray). FYM @ 5 t ha⁻¹ in N₂ and 10 t
79 ha⁻¹ in N₃ treatments were applied before sowing at the time of field preparation. The crop availed
80 sun radiation in terms of daily minimum temperature and maximum temperature during the study
81 period varied between 6.0^oC to 21.3^oC and 4.9^oC to 21.1^oC and 17.0^oC to 39.6^oC and 15.7^oC to
82 40.9^oC during 2020-21 and 2021-22, respectively. During the crop period, a total rainfall of 16.5
83 mm and 63.9 mm was received during the year of 2020-21 and 2021-22, respectively. Over all the
84 climatic condition during both year found congenial for crop growth and development except
85 higher temperature at dough stage during 2021-22 creates hot climatic condition which causes
86 slight shrinkage of grain ultimately reduce yield upto 8.6% compared to 2020-21.

87 **Results and Discussion:**

88 **Growth parameters:**

89 Four irrigations at CRI, Tillering, Booting and Milking stage reported maximum plant
90 height, more number of tillers and number of effective tillers at harvest than that rest of irrigation
91 schedules (Table 1). The better growth under organic mulch @ 10 t ha⁻¹ + Kaolin 6% spray was
92 might be due to properly distribution of adequate available soil moisture and also conserve the soil
93 moisture in the root zone of crop results in increase the nutritional supply throughout the crop
94 duration. Similar findings of present investigation were also reported by **Mishra (1996), Jana et al.**
95 **(2001)** and **Saren et al. (2004)**. Integration of 85% RDF + FYM @ 5.0 t ha⁻¹ being statistically
96 superior compared to other treatments and recorded significantly maximum growth parameters
97 (Table 1). The increment in growth with increase in fertility was due to rapidly transformation of
98 synthesized photosynthates into protein to form more protoplasm, thus increasing the number as
99 well as size of cell which might have increased the plant height. The beneficial effect of FYM
100 might be attributed to increased activities of heterotrophic bacteria and fungi in soil, which in turn
101 increased the activity of soil enzymes responsible for the conversion of unavailable form of
102 nutrients to available form. The similar beneficial effect of nutrient management in wheat are also
103 reported by several scientist **Menka et al., (2007), Sheoran et al., (2017) and Choudhary et al.**
104 **(2022)**.

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105 Yield attributes and Yield:

106 The increases in number of irrigations, provided adequate supply of moisture in soil profile,
107 which play an important role in nutrient uptake resulting in improving yield attributes and
108 ultimately yield of crop. Application of four irrigations at CRI, Tillering, Booting and Milking
109 stage reported an increment of 21.42% in length of ear, 8.66% in weight of ear, 3.45% in test
110 weight and similarly, 22.30% in grain yield, 14.74% in straw yield and 3.98% in harvest index over
111 two irrigations at CRI and Jointing stage (Table 2 & 3) (Jana *et al.* (2001) and Meena *et al.*,
112 (2015). Application of organic mulch @ 10 t ha⁻¹ + Kaolin 6% spray resulted in 12.76% and
113 11.60% higher grain and straw yield, respectively over without mulching. It may be due to
114 mulching increases moisture retention in soil (Sarwar *et al.*, 2013) and kaolin spray reduce
115 evaporation losses of water from plant by reflecting solar radiation from plant leaf surface (Mishra
116 (1996). Integration of inorganic source of nutrients with organic manure (FYM) significantly
117 improved yield attributes and yield of wheat and under 85% RDF + FYM @ 5.0 t ha⁻¹ increased
118 length of spike, weight of ear and test weight by 5.30%, 55.57% and 1.26%, respectively, over 75%
119 RDF + FYM @ 10.0 t ha⁻¹ (Table 2 & 3). The respective treatment also increases to the tune of
120 7.16% in grain yield and 4.37% in straw yield. It might be due to integration of FYM with fertilizer
121 doses improve nutrient use efficiency in soil which ultimately improve plant growth and
122 development in terms of better yield attributing characters and improvement in yield. Singh *et al.*
123 (2021) and Thakur *et al.* (2021).

124 Economics:

125 The benefit: cost ratio are realised from four irrigations i.e. 24.46% higher than that two
126 irrigations treatment (Table 4). The profitability was minimum under two irrigations, due to lower
127 yield on account of extremely moisture stress in root zone. Similar findings were also reported by
128 Thakur *et al.* (2000), Gora *et al.*, (2017) and Niwas *et al.* (2019). Organic mulch @ 10 t ha⁻¹ +
129 Kaolin 6% spray significantly increment evaluated 12.36% in gross return, 20.35 % in net return
130 and fetched about 1.59 times benefit over investment of rupee 1.0 compare to without mulching
131 treatment (Table 4). Similarly, integration of 85% RDF + FYM @ 5.0 t ha⁻¹ also evaluated
132 significantly increment upto 6.19% in gross return, 9.27% in net return and 7.84% in B:C ratio
133 compared to 75% RDF + FYM @ 10.0 t ha⁻¹ which exhibited lowest B:C ratio (1.53). The above
134 finding are in similar trend with the finding of Narolia *et al.*, (2016) and Kumar *et al.*, (2017).

135 Conclusion:

136 On the basis of above findings of result, it is concluded that, four irrigations at CRI,
137 Tillering, Booting and Milking stage, organic mulch @ 10 t ha⁻¹ + Kaolin 6% spray and integration
138 of 85% RDF + FYM @ 5.0 t ha⁻¹ were found significantly superior for increasing growth, yield and
139 also B:C ratio of wheat.

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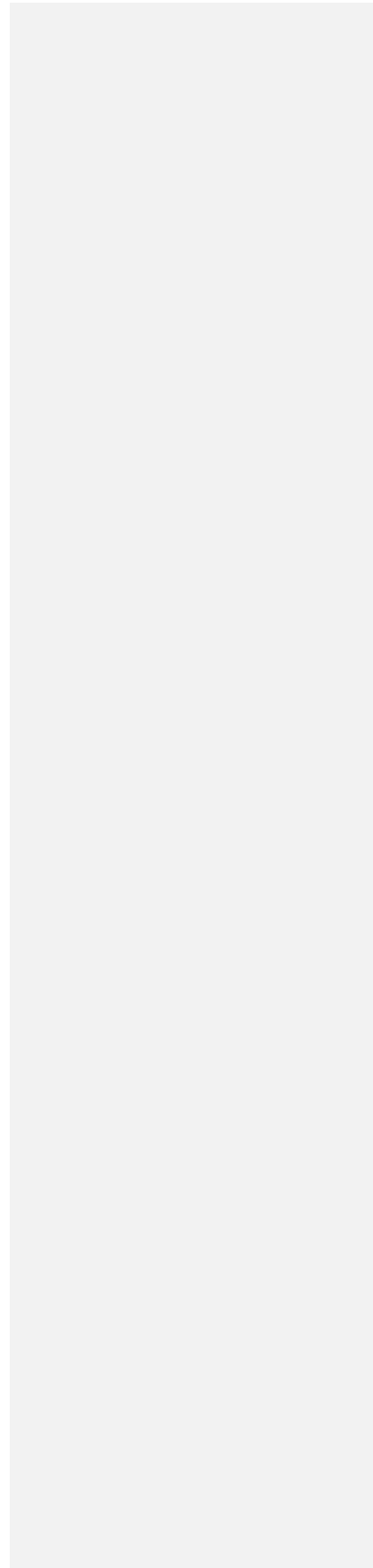
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