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# Influence of Irrigation Scheduling on Weeds among Different Sowing Dates in Wheat under Vertisol

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***Authors' contributions***

*This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.*

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## ABSTRACT

Wheat is an important cereal grain crop and is staple to millions. Weeds are the major constraint that lower the wheat yield. The knowledge of weeds under different sowing dates and Irrigation can assist in controlling weeds. A field experiment was conducted during the *rabi* season of 2020-21 at Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur, M.P. to study the influence of irrigation scheduling on weeds at different sowing dates in wheat. The experiment was laid out in split-plot design with three replications. The main plot consisted of three sowing dates, i.e., 3rd December, 18th December and 2nd January and four Irrigation Water/Cumulative Pan Evaporation (IW/CPE) based irrigation scheduling, 1.0, 0.9, 0.8 and 0.7 in the sub-plots. The results revealed that lowest weed density and dry weight were observed in 2nd January sown date, as compared to 3rd December and 18th December sown date. Among the irrigation schedules, 0.7 IW/CPE observed

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lowest weed density and dry weight than 1.0, 0.9, 0.8 IW/CPE ratio. 3rd December sown date exhibited highest grain yield (4637 kg ha$^{-1}$) and straw yield (6788 kg ha$^{-1}$) than 18th December and 2nd January sown date. Among the irrigation schedules, 1.0 IW/CPE ratio exhibited maximum grain yield (4510 kg ha$^{-1}$) than 0.9, 0.8 and 0.7 IW/CPE ratio. The results of the study concludes that sowing dates and irrigation schedules had crucial role for controlling weeds.

*Keywords: IW/CPE ratio; sowing date; weed density and dry weight.*

## 1. INTRODUCTION

Wheat (*Triticum aestivum* L.) is the major cereal grain cultivated over a large area in the world and consumed as major source of carbohydrate in the human nutrition. It is sown from mid-November to the end of December in the Central India. In recent years, the sowing gets delayed due to the addition of garden pea in the cropping system, as a catch crop after harvesting of *kharif* crops. This delay affects the sowing as it is vulnerable to temperate conditions. Late sowing may lead to reduce crop growth duration as phenological stages were not compatible with late weather conditions. Delayed sowing results in decrease in number of days to attain different growth stages in wheat, Khande et al. [1] and this delay in sowing affects the grain yield of wheat [2]. It also affects the weed density thereby competitiveness with the main crops. Weeds rivalry for reducing the yield of crop as they contend with crop for moisture, light and nutrient. Water management and weed management are the crucial factors affecting the yield of wheat [3]. Uncontrolled weed growth may reduce wheat yield ranging from 15-40 % depending upon magnitude, nature and duration of weed infestation [4]. Jain and Agarwal [5] observed presence of weeds causes reduction in yield. Moreover, sowing date has pronounced effect on weed density and biomass [6]. The role of irrigation is crucial for sowing window as it may cope up the effect of warm weather conditions for late maturing crop. Chouhan et al. [7] observed more yield of wheat at 1.0 IW/CPE ratio. Therefore, different irrigation scheduling based on Irrigation Water: Cumulative Pan Evaporation (IW/CPE) ratio for wheat under different thermal environments is studied. Irrigation scheduling based on climatological approach, IW/CPE ratio method, in which a known amount of water is applied when cumulative pan evaporation reaches a predetermined level. It enables to apply exact amount of water thereby increased the irrigation efficiency. It is anticipated that the impact of late sowing can be alleviated through irrigation regimes upto some extent. However, the role of weeds under thermal environments and irrigation scheduling needs to be assessed out. In view of the above facts, a study was carried out with an objective to assess weed density and weed dry weight under different sowing dates and IW/CPE levels of irrigation scheduling in wheat grown at Central Indian conditions.

## 2. MATERIALS AND METHODS

The research study was conducted during the *rabi* of 2020-21 at Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur (M.P.) situated at 23˚09' N latitude and 79˚58' E longitude and an altitude of 411 above mean sea level. According to U.S.D.A. classification, the soil of this region is broadly classified as "Vertisol". The experimental soil consists of 30 % sand, 20 % silt and 46 % clay with organic matter content of 0.94 % and 7.1 pH. The total rainfall received was 22.0 mm distributed in two rainy days with total sunshine hours of 132.2 hours during whole crop season. The field experiment was laid out in split-plot design with three date of sowing (December 03, December 18 and January 02) as main plot treatment and four IW/CPE ratio based irrigation scheduling (1.0, 0.9, 0.8 and 0.7) as the sub-plot treatment in three replications. Wheat variety, MP 3336 tolerant to heat and suitable for late sowing under irrigated conditions for Madhya Pradesh was selected for the experiment. Irrigation was given prior to land preparation and all the management practices were done as per the prescribed package of practices recommended for this region. For irrigation scheduling, a uniform irrigation was applied immediately after sowing to all the treatments for better germination of the crop. After then, water was applied as per the irrigation schedule based on climatological approach to the experimental plots. The depth of irrigation was fixed as 50 mm for four IW/CPE ratio i.e., 1.0, 0.9, 0.8 and 0.7 as per the formula by Parihar et al. [8]

$$\text{IW/CPE} = \frac{\text{Depth of irrigation (mm)}}{\text{Cumulative pan evapouration (mm)}}$$

There is a difference in the number of irrigations between different IW/CPE treatment. Total weed density and weed dry weight were observed at 30 days after sowing (DAS) but before applying of herbicide; 30 and 60 days after herbicide application (DAHA); and at harvest, using a 0.5 $m^2$ quadrat placed two times per plot. Before analysis of data on weed density and dry weight, it was subjected to square root transformation ($\sqrt{x+0.5}$). The total weed density and dry weight were expressed in no. $m^{-2}$ and g $m^{-2}$, respectively. The herbicide, Clodinafop-propargyl 15 % + Metsulfuron methyl 1%, was applied at 60+4 g/ha at 30 days after sowing wheat. The efficiency to control weeds were analyzed by differentiating between weeds observed in 1.0 IW/CPE (control) and weeds observed in the other 0.9, 0.8 and 0.7 IW/CPE irrigation approaches. The field data obtained was statistically analyzed using OPSTAT software available online at CCS Haryana Agriculture University [9]. The data were tabulated and analyzed statistically by using ANOVA as suggested by Gomez and Gomez [10] and significant difference between treatment means were compared with critical difference at 5 % levels of probability for F- test.

## 3. RESULTS AND DISCUSSION

### 3.1 Weed Flora

The wheat crop was majorly infested with divergent types of weed flora as *Medicago denticulata L., Chenopodium album L., Anagallis arvensis L., Alternanthra sessilis L.* The other weed species were *Cyperus rotundus* and *Echinochloa colona* in very low density among all the treatments.

*Medicago denticulata L., Chenopodium album L., Anagallis arvensis L., Alternanthra sessilis L.* were observed among the broad leaf weeds, *while Cyperus rotundus* among the sedges and *Echinochloa colona* among the grassy weeds were also observed.

### 3.2 Weed Density (No. $m^{-2}$)

Data pertaining to weed density were presented in Table 1. Among the sowing dates, maximum total weed density (4.36) was observed in 3rd December sowing date, however, it was at par with 18th December (4.32) sowing date before herbicide application. At 30 DAHA, total weed density was significantly higher in 3rd December (3.68) followed by 2nd January (3.52) and 18th December (3.50) sowing date. At 60 DAHA, significantly maximum weed density was observed at 3rd December (2.40) sown date, however, it was at par with 18th December (2.36) sown date. At harvest, it was maximum at 3rd December (2.37) sown date as compared to 18th December and 2nd January. This might be because of varying temperature received at different timings of sown date. High temperature received with the delay in sowing might have affected the germination of weed seeds. If germinate, then it is difficult to establish due to non-favorable weather environment for weeds. Furthermore, reduction in weed density might be because of shift in weed flora in delayed sowing. Similar finding has been reported by Thorat et al. [5] and Jain [11] that delay in sowing date have profound effect on weed density and biomass.

Among the irrigation schedules, maximum weed density was observed at 1.0 IW/CPE ratio (4.42) followed by other irrigation schedules before herbicide application (Table 1). At 30 DAHA, maximum weed density was observed in 1.0 IW/CPE ratio (3.72) that was at par with 0.9 schedule while minimum weed density exhibited in 0.7 (0.35). At 60 DAHA, similar results were observed except, 0.9 and 0.8 schedules are non-significant in the population of total weeds. At harvest, maximum weed density observed at 1.0 while minimum in 0.8 and 0.7 IW/CPE ratio. The maximum weed density in 1.0 IW/CPE ratio might be due to sufficient moisture availability of frequent irrigations than 0.8 and 0.7 IW/CPE approach and later on due to congenial weather conditions for good germination and growth of weeds that helped to establish easily. Nadeem et al. [12] reported increase in weed population with the increase in irrigation frequency from 0.6 to 1.0 IW/CPE ratio.

### 3.3 Weed Dry Weight (g $m^{-2}$)

The data regarding weed dry weight at before herbicide application, 30 DAHA, 60 DAHA and at harvest is presented in Table 1. It was observed that weed dry weight was significantly higher at 3rd December and 18th December sown date than 2nd January before herbicide application. At 30 DAHA, it was significantly maximum at 3rd December and 18th December sown date than 2nd January. The similar results were also observed at 60 DAHA and harvest. Among the irrigation schedules, 1.0 IW/CPE recorded significantly higher weed dry weight followed by

0.9 and 0.8, and minimum in 0.7 irrigation schedules. Similar results were also observed at 30 and 60 DAHA. At harvest, 1.0 IW/CPE ratio observed significantly higher weed dry weight at 1.0 than the other IW/CPE ratio. The interaction was found to be non-significant between sowing date and irrigation schedules. This suggested that the total weed dry weight exhibited more at higher irrigation applied than with less irrigation applied in wheat. The results are in confirmatory with Verma et al. [13] that dry weight of weeds significantly affected by irrigation regimes and weed management practices. Thorat et al. [6] and Jain [11] also observed increase in weed biomass with the increase in irrigation frequency.

### 3.4 Efficiency to Control Weeds

The efficiency to control weeds were analyzed between 1.0 IW/CPE as control and other treatments at different sown dates, and is presented in the form of interaction in Table 2. The result exhibited that sown dates were not significantly different. However, irrigation schedules observed significant difference at 30 and 60 DAHA, and harvest. It exhibited that less irrigated schedule (0.7) controls more weeds than the other 0.8 and 0.9 IW/CPE, respectively. This suggested that irrigation schedule is proportional to weed occurrences that were also suggested by Thorat et al. [6] exhibited lowest weed density and dry weight at low frequency of irrigation. Jain [11] also observed effect of irrigation schedule on weed biomass. The interaction between sown date and irrigation schedule observed at the initial stage of crop growth at 30 DAHA, while it was found to be non-significant at later stages of crop growth.

### 3.5 Yield

Sowing date 3rd December recorded higher grain yield (4637 kg/ ha) and straw yield (6788 kg/ ha) were recorded at 3rd December sown date than other sown dates. Among the irrigation schedules, 1.0 IW/CPE ratio recorded significantly higher grain yield (4510 kg/ ha) which was statistically at par with 0.9 IW/CPE ratio and straw yield (6677 kg/ ha) as compared to 0.9, 0.8 and 0.7. This might be because of favourable environment and adequate moisture availability that favoured in gaining more yield and hence more profitable. The results of present investigation were in line with Verma et al. [14], Thorat et al. [6], Buttar et al. [15], Jain [11], Prasad et al. [16], Bhaskar et al. [17] and Lanjhewar et al. [18]. Alam et al. [19].

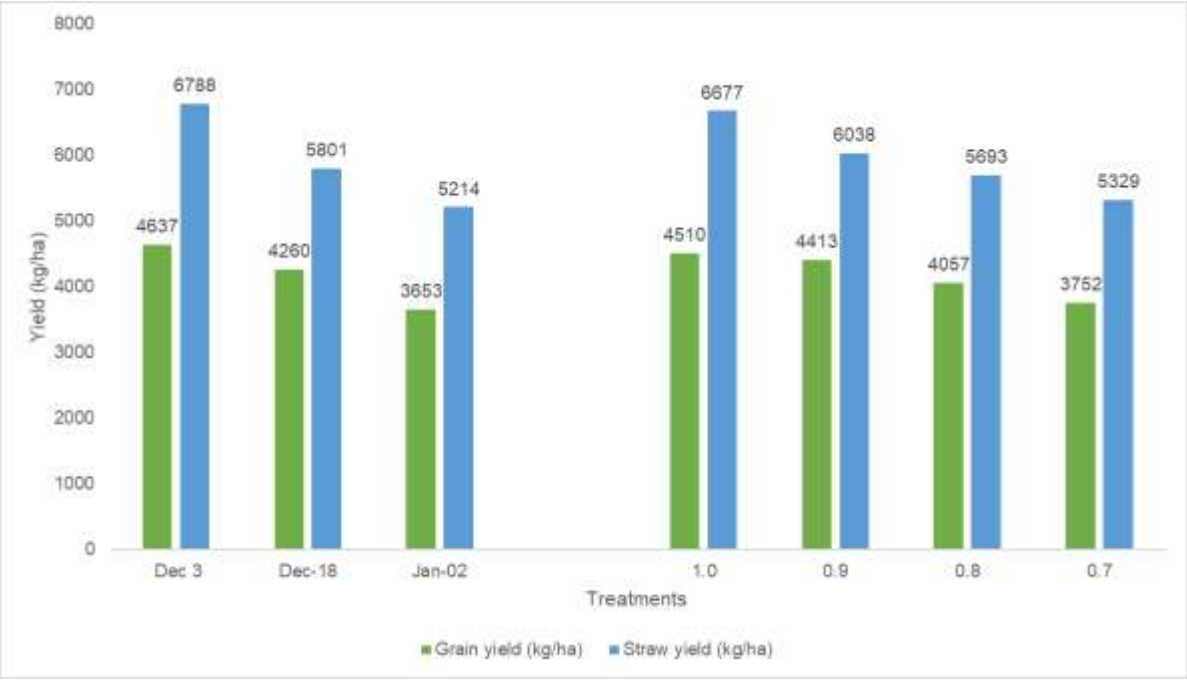


**Fig. 1. Influence of IW/CPE based irrigation scheduling on grain and straw yield among different sowing dates in wheat under Vertisol**

**Table 1. Influence of IW/CPE based irrigation scheduling on weed density and weed dry weight among different sowing dates in wheat under Vertisol**

| Treatments | Density (No. $m^{-2}$) | Dry weight (g $m^{-2}$) | Density (No. $m^{-2}$) | Dry weight (g $m^{-2}$) | Density (No. $m^{-2}$) | Dry weight (g $m^{-2}$) | Density (No. $m^{-2}$) | Dry weight (g $m^{-2}$) |
|---|---|---|---|---|---|---|---|---|
| | (Before herbicide application) | | (30 days after herbicide application) | | (60 days after herbicide application) | | (Harvest) | |
| Sowing dates | | | | | | | | |
| December 03 | 4.36 (59.33) | 1.81 (4.79) | 3.68 (29.08) | 2.19 (13.57) | 2.40 (22.50) | 2.08 (10.56) | 2.37 (21.00) | 1.94 (7.23) |
| December 18 | 4.32 (57.83) | 1.78 (4.26) | 3.50 (22.75) | 2.16 (12.98) | 2.36 (20.50) | 2.05 (9.83) | 2.29 (17.75) | 1.89 (6.13) |
| January 02 | 3.99 (41.08) | 1.72 (3.37) | 3.52 (21.33) | 2.09 (11.09) | 2.30 (18.08) | 2.00 (8.54) | 2.21 (14.58) | 1.82 (4.98) |
| SE m± | 0.02 | 0.01 | 0.02 | 0.01 | 0.02 | 0.01 | 0.03 | 0.004 |
| CD (5%) | 0.09 | 0.04 | 0.08 | 0.04 | 0.07 | 0.05 | 0.10 | 0.02 |
| Irrigation Schedules- IW/CPE ratio | | | | | | | | |
| 1.0 | 4.42 (63.33) | 1.83 (5.03) | 3.72 (29.89) | 2.22 (14.82) | 2.47 (25.77) | 2.11 (11.36) | 2.38 (21.66) | 1.94 (7.23) |
| 0.9 | 4.19 (52.56) | 1.78 (4.19) | 3.67 (26.22) | 2.16 (13.04) | 2.38 (21.33) | 2.06 (10.09) | 2.31 (18.33) | 1.91 (6.61) |
| 0.8 | 4.22 (50.22) | 1.76 (3.88) | 3.53 (22.33) | 2.14 (12.22) | 2.32 (18.77) | 2.03 (9.30) | 2.25 (16.33) | 1.86 (5.60) |
| 0.7 | 4.06 (44.89) | 1.72 (3.47) | 3.35 (19.11) | 2.06 (10.1) | 2.23 (15.55) | 1.97 (7.82) | 2.21 (14.77) | 1.83 (5.00) |
| SE m± | 0.04 | 0.007 | 0.04 | 0.01 | 0.02 | 0.006 | 0.02 | 0.008 |
| CD (5%) | 0.13 | 0.02 | 0.11 | 0.03 | 0.07 | 0.02 | 0.05 | 0.02 |

**Values are $\sqrt{x+0.5}$ square root transformed. Values in parenthesis are original*

**Table 2. Influence of IW/CPE based irrigation scheduling on Efficiency to control weeds among different sowing dates in wheat under Vertisol**

| Treatments | 30 DAHA | | | | 60 DAHA | | | | Harvest | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Dec 03 | Dec 18 | Jan 02 | Mean | Dec 03 | Dec 18 | Jan 02 | Mean | Dec 03 | Dec 18 | Jan 02 | Mean |
| 1.0 | - | - | - | - | - | - | - | - | - | - | - | - |
| 0.9 | 22.3 | 23.3 | 34.0 | 26.5 | 30.8 | 25.3 | 20.9 | 25.6 | 26.2 | 21.0 | 25.3 | 24.2 |
| 0.8 | 30.1 | 32.3 | 29.3 | 30.6 | 34.2 | 31.5 | 27.9 | 31.2 | 37.1 | 34.7 | 30.1 | 34.0 |
| 0.7 | 45.4 | 39.5 | 37.8 | 40.9 | 40.7 | 42.0 | 38.5 | 40.4 | 41.8 | 39.0 | 40.7 | 40.5 |
| Mean | 32.6 | 31.7 | 33.7 | | 35.2 | 32.9 | 29.1 | | 35.0 | 31.6 | 32.0 | |
| Comparing means | SE m± | | CD (5%) | | SE m± | | CD (5%) | | SE m± | | CD (5%) | |
| D- Sowing Dates | 2.63 | | NS | | 1.33 | | NS | | 3.02 | | NS | |
| I- Irrigation Schedules- IW/CPE ratio | 1.53 | | 4.77 | | 0.90 | | 2.81 | | 1.28 | | 4.00 | |
| I at same level of D | 4.56 | | 9.71 | | 2.30 | | NS | | 5.23 | | NS | |
| D at same level of I | 3.41 | | 12.48 | | 1.84 | | NS | | 3.52 | | NS | |

*Efficiency was a difference between IW/CPE of 1.0 (control) with the other irrigated treatments of 0.9, 0.8, and 0.7 at different sowing dates*

## 4. CONCLUSION

From the present research, it can be concluded that sowing dates and IW/CPE based irrigation scheduling had significant role in weed control and grain yield. Thus, adjusting sowing dates and scheduling irrigation could be used to reduce weed and enhance grain yield of wheat under late sowing condition.

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## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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