

# Original Research Article

## Influence of IW/CPE ratio based Irrigation Scheduling on Weeds among Different Sowing Dates in Wheat under Vertisol

Vertisol:

Justification:

### ABSTRACT

An 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., 3<sup>rd</sup> December, 18<sup>th</sup> December and 2<sup>nd</sup> January and four 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 2<sup>nd</sup> January sown date, as compared to 3<sup>rd</sup> December and 18<sup>th</sup> December sown date. Among the irrigation scheduling, 0.7 IW/CPE observed lowest weed density and dry weight than 1.0, 0.9, 0.8 IW/CPE ratio. 3<sup>rd</sup> December sown date exhibited highest grain yield (4637 kg ha<sup>-1</sup>) and straw yield (6788 kg ha<sup>-1</sup>) than 18<sup>th</sup> December and 2<sup>nd</sup> January sown date. Among the irrigation schedule, IW/CPE ratio 1.0 exhibited maximum grain yield (4510 kg ha<sup>-1</sup>) 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:** Weed density and dry weight, sowing date, IW/CPE ratio

### 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 [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]. Moreover, sowing date has pronounced effect on weed density and biomass [5]. The role of irrigation is crucial for sowing window as it may cope up the effect of warm weather conditions for late maturing crop. [6] 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

**Comment [Z1]:** How the person (researcher) who conducted the field experiment managed Vertisols properly, because most of the time the nature of Vertisols is somewhat difficult for farming operations.

**Comment [Z2]:** To publicize more for scientific community, strong justification is a must if the author has that info.

**Comment [Z3]:** Please order the Keywords alphabetically.

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 biomass under different sowing dates and IW/CPE levels of irrigation scheduling in wheat grown at Central Indian conditions.

## 2. MATERIAL 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. 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 treatment and IW/CPE ratio (1.0, 0.9, 0.8 and 0.7) as the sub-plot treatment in three replications. The management practices of wheat (*var.* MP 3336) 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 [7]

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

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<sup>2</sup> quadrat placed two times per plot. 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 [8]. The data were tabulated and analyzed statistically by using ANOVA as suggested by [9] and significant difference between treatment means were compared with critical difference at 5 % levels of probability for F- test.

Software:

**Comment [Z4]:** What type of recent software applied for data analysis?

## 3. RESULTS AND DISCUSSION

### 3.1 Weed Flora

The wheat crop was majorly infested with divergent types of weed flora as *Medicagodenticulata* L., *Chenopodium album* L., *Anagallis arvensis* L., *Alternanthesessilis* L. The other weed species were *Cyperusrotundus* and *Echinochloacolona* in very low density among all the treatments.

### 3.2 Weed Density (No. m<sup>-2</sup>)

Data pertaining to weed density were presented in **Table 1**. Among the sowing dates, maximum total weed density (4.36) was observed in 3<sup>rd</sup> December sowing date, however, it was at par with 18<sup>th</sup> December (4.32) sowing date before herbicide application. At 30 DAHA, total weed density was significantly higher in 3<sup>rd</sup> December (3.68) followed by 2<sup>nd</sup> January (3.52) and 18<sup>th</sup> December (3.50) sowing date. At 60 DAHA, significantly maximum weed density was observed at 3<sup>rd</sup> December (2.40) sown date, however, it was at par with 18<sup>th</sup> December (2.36) sown date. At harvest, it was maximum at 3<sup>rd</sup> December (2.37) sown date as compared to 18<sup>th</sup> December and 2<sup>nd</sup> 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 [5] and [10] that delay in sowing date have profound effect on weed density and biomass.

Among the irrigation schedule, 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 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. [11] 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 ( $\text{g m}^{-2}$ )

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 3<sup>rd</sup> December and 18<sup>th</sup> December sown date than 2<sup>nd</sup> January before herbicide application. At 30 DAHA, it was significantly maximum at 3<sup>rd</sup> December and 18<sup>th</sup> December sown date than 2<sup>nd</sup> 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 [12] that dry weight of weeds significantly affected by irrigation regimes and weed management practices. [5] and [10] also observed increase in weed biomass with the increase in irrigation frequency.

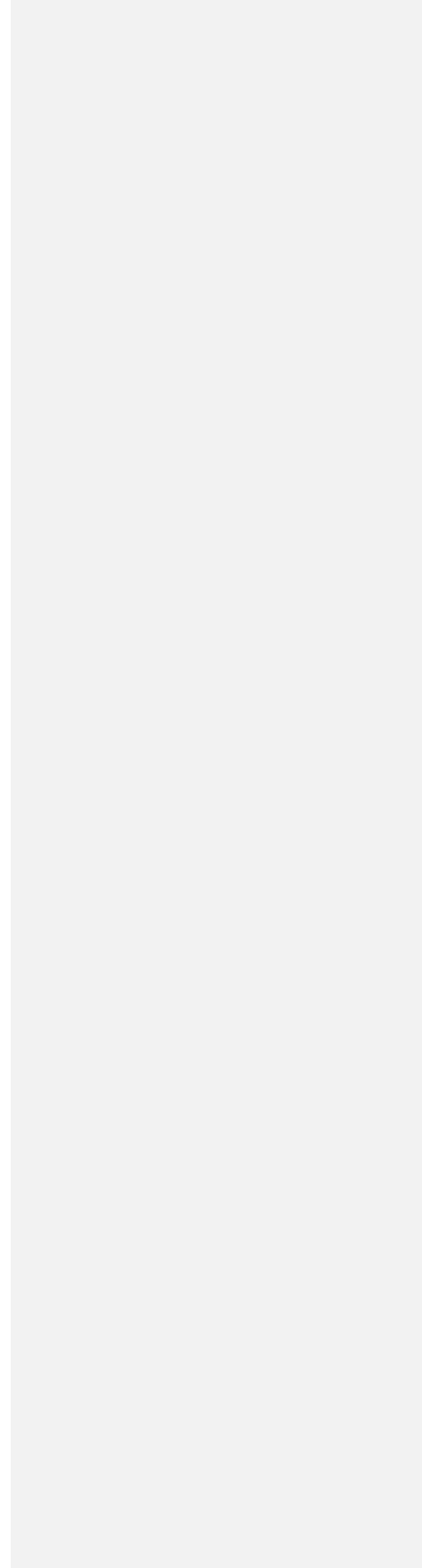
### 3.4 Efficiency to control weeds

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 schedule observed significant different 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 [5] exhibited lowest weed density and dry weight at low frequency of irrigation. [10] 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.

Weeds:

**Comment [Z5]:** What type of weeds identified?  
And their abundance & distribution?

UNDER PEER REVIEW



**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 <sup>-2</sup> )	Dry weight (g)	Density (No. m <sup>-2</sup> )	Dry weight (g)	Density (No. m <sup>-2</sup> )	Dry weight (g)	Density (No. m <sup>-2</sup> )	Dry weight (g)
	(Before herbicide application)		(30 days after herbicide application)		(60 days after herbicide application)		(Harvest)	
<b>Sowing dates</b>								
<b>December 03</b>	4.36 (59.33)	1.81 (4.79)	3.68 (29.08)	2.19 (13.57)	2.40 (22.5)	2.08 (10.56)	2.37 (21.00)	1.94 (7.23)
<b>December 18</b>	4.32 (57.83)	1.78 (4.26)	3.50 (22.75)	2.16 (12.98)	2.36 (20.5)	2.05 (9.83)	2.29 (17.75)	1.89 (6.13)
<b>January 02</b>	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)
<b>SE m±</b>	0.02	0.01	0.02	0.01	0.02	0.01	0.03	0.004
<b>CD (5%)</b>	0.09	0.04	0.08	0.04	0.07	0.05	0.10	0.02
<b>Irrigation levels- IW/CPE ratio</b>								
<b>1.0</b>	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)
<b>0.9</b>	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)
<b>0.8</b>	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)
<b>0.7</b>	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)
<b>SE m±</b>	0.04	0.007	0.04	0.01	0.02	0.006	0.02	0.008
<b>CD (5%)</b>	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**

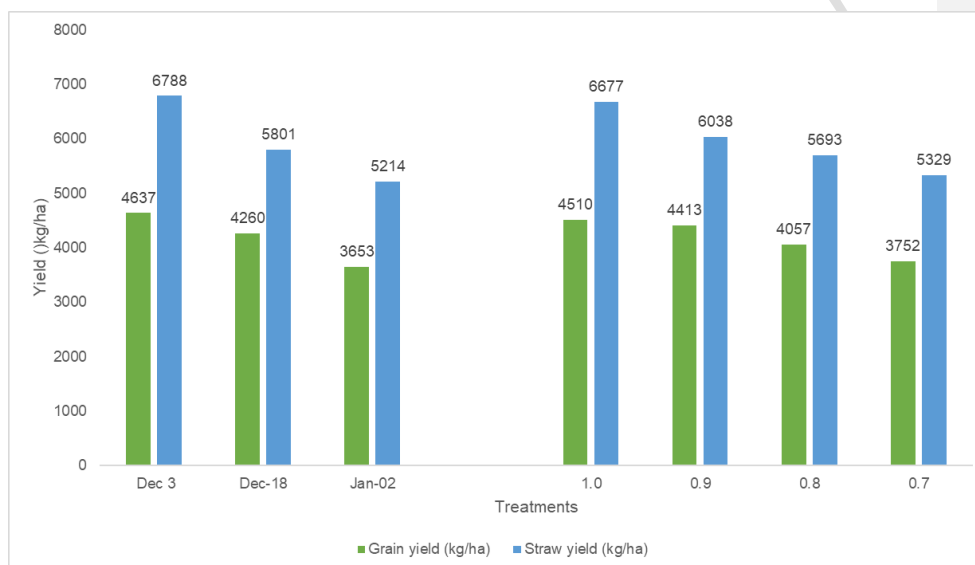
Treatments	30 DAHA				60 DAHA				Harvest			
	Dec 3	Dec 18	Jan 2	Mean	Dec 3	Dec 18	Jan 2	Mean	Dec 3	Dec 18	Jan 2	Mean
<b>1.0</b>	-	-	-	-	-	-	-	-	-	-	-	-
<b>0.9</b>	22.3	23.3	34.0	26.5	30.8	25.3	20.9	25.6	26.2	21.0	25.3	24.2
<b>0.8</b>	30.1	32.3	29.3	30.6	34.2	31.5	27.9	31.2	37.1	34.7	30.1	34.0
<b>0.7</b>	45.4	39.5	37.8	40.9	40.7	42.0	38.5	40.4	41.8	39.0	40.7	40.5
<b>Mean</b>	32.6	31.7	33.7		35.2	32.9	29.1		35.0	31.6	32.0	
<b>Comparing means</b>	<b>SE m±</b>	<b>CD (5%)</b>		<b>SE m±</b>	<b>CD (5%)</b>		<b>SE m±</b>	<b>CD (5%)</b>				
<b>D- Sowing Date</b>	2.63	NS		1.33	NS		3.02	NS				
<b>I- Irrigation levels- IW/CPE ratio</b>	1.53	4.77		0.90	2.81		1.28	4.00				
<b>I at same level of D</b>	4.56	9.71		2.30	NS		5.23	NS				
<b>D at same level of I</b>	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*

### 3.5 Yield

Sowing date 3<sup>rd</sup> December recorded higher grain yield (4637 kg/ ha) and straw yield (6788 kg/ ha) were recorded at 3<sup>rd</sup> December sown date than other sown dates. Among the irrigation schedule, IW/CPE ratio 1.0 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 [13], [5], [14], [10], [15], [16] and [17].

Fig 1 :Graphical Distribution between Yielding crops and Treatments.



### 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.

Significance of the study:

**Comment [Z6]:** What is the practical significance of the study?

### REFERENCES

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