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## Weed management practices for enhancing growth and productivity of timely-sown wheat (*Triticum aestivum* L.)

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### ABSTRACT

**Abstract:** A field experiment was conducted during the 2019-20 in Rabi season at the Agronomy Research Farm of Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya, Uttar Pradesh. The objective was to evaluate the effect of various weed management practices on weed density and dry matter accumulation in timely-sown wheat (*Triticum aestivum* L.). Ten weed management treatments were evaluated, including the individual and combined application of Metsulfuron, Clodinafop, carfentrazone, and sulfosulfuron, alongside weed-free and weedy (check) controls. Weed density was recorded at 30, 60, and 90 days after sowing (DAS), while dry matter accumulation was assessed at 30, 60, and 90 DAS and at harvest. Weed management practices significantly influenced weed density at all stages of observation. The weed-free treatment recorded the lowest weed density (0.71) at 30, 60, and 90 DAS, whereas the weedy check recorded the highest densities of 8.48, 10.05, and 11.24, respectively. Among the herbicide treatments, the application of Clodinafop + Metsulfuron resulted in the lowest weed density (3.77 and 3.95, respectively) at 60 and 90 DAS, followed by sulfosulfuron + Metsulfuron. Dry matter accumulation was not significantly affected at 30 DAS, but significant variations were observed at 60 DAS, 90 DAS, and at harvest. The highest dry matter accumulation was recorded in the weed-free treatment, while Clodinafop + Metsulfuron was the best-performing herbicide treatment. The study indicates that effective weed control using the right herbicide combination improved dry matter accumulation in the crop.

**Keywords:** Wheat, Weed management, Clodinafop, Metsulfuron, Sulfosulfuron, Weed density, Dry matter accumulation

### Introduction

Wheat (*Triticum aestivum* L.) is a vital cereal crop and a cornerstone of the agricultural production system in the Indo-Gangetic Plains. Wheat grain contains starch (60-68%), protein (6-21%), fat (1.5-2.0%), cellulose (2.0-2.5%), minerals (1.8%) and vitamins (Das, 2008) [1]. Timely sowing creates favorable conditions for crop growth and development; however, the crop faces competition from weeds at various growth stages. Weeds compete with wheat plants for essential growth resources-such as nutrients, moisture, light, and space-thereby impacting crop growth and dry matter accumulation. Consequently, effective weed management is a crucial component of wheat production.

Chemical weed management has emerged as a significant strategy in wheat cultivation, as herbicides can effectively suppress weeds and reduce reliance on manual weeding. Different herbicides possess varying weed-control capabilities, and their combinations can offer broader spectrum weed control. In particular, combinations of grass-controlling herbicides and broad-spectrum herbicides have been evaluated to enhance weed management in wheat.

Sudha *et al.* (2016) [2] reported that the application of *sulfosulfuron* + *Metsulfuron*, followed by *Clodinafop* + *Metsulfuron*, reduced weed density and weed biomass compared to the untreated weedy check. Similarly, Paswan *et al.* (2012) [3] observed higher dry matter production under herbicide-treated conditions compared to the untreated weedy check.

New herbicide molecules like *Clodinafop propargyl*, *fenoxaprop-p-ethyl*, *iodosulfuronmethyl-sodium* and *mesosulfuron-methyl* was very effective for weed control (Baghestani *et al.* 2008 and Barros *et al.*, 2009). Kumar *et al.* (2011) [4], Singh (2012) [5], Malik *et al.* (2013) [6] and Chitband *et al.* (2013) [7] *Phalaris minor*, *Avena fatua*, *Chenopodium album*, *Melilotus* spp., *Medicago denticulata*, *Vicia sativa*, *Rumex* spp., *Coronopus didymus*, *Lathyrus aphaca*, *Polygonum plebejum*, sedges, and *Clodinafop* + *Metsulfuron* with and without surfactant offered good control of *Phalaris minor* and many other weeds with higher grain yield of wheat.

Selecting the right weed management strategy is crucial, as prolonged weed competition can hinder crop growth and dry matter accumulation. Controlling weeds during the crop growth period enables wheat plants to utilize available resources more effectively, potentially leading to improved biomass production. This ex

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periment compared the individual application of *Metsulfuron*, *Clodinafop*, *carfentrazone*, and *sulfosulfuron* with their combinations. Weed-free and weedy check treatments were also included to assess the wheat crop's response to varying levels of weed presence.

## Materials & Methods

The experiment was conducted at the Agronomy Research Farm, Acharya Narendra Deva University of Agriculture & Technology, Kumarganj, Ayodhya (U.P.) during Rabi season of 2019-20. The farm is situated in the main campus of university on Ayodhya-Raibareilly road at the distance of 42 km from Ayodhya district head quarter. The experimental site falls under sub-humid subtropical zone in indo-gangetic plains and situated at 26.470N latitude, 82.120E longitude and an altitude of 113 meters above mean sea level. The experimental field was well leveled having good irrigation and drainage facilities. The source of irrigation was tube well. The meteorological observation like maximum and minimum temperature, relative humidity and rainfall and sunshine hours during the crop season was recorded at the meteorology observatory of the university situated in the main campus of Acharya Narendra Deva University of Agriculture & Technology, Kumarganj, Ayodhya. Weekly minimum and maximum temperature during the crop season ranged from 5.30C to 36.8 °C respectively and average Relative humidity, evaporation and sunshine hours ranged from 50.4 % to 86.1 %, 2.6 to 7.2 mm per day and 1.5 to 9.3 hrs per day respectively. Rainfall received during crop period was 61 mm.

## Result & Discussion

### Weed density in wheat

Significant effects of various weed management methods on weed density in wheat were observed at 30, 60, and 90 days after sowing (DAS) (Table 1). At 30 DAS, weed density ranged from 0.71 to 8.48; the lowest density was recorded in the weed-free treatment ( $T_9$ ) and the highest in the weedy check ( $T_{10}$ ). Among the herbicide treatments, weed density ranged from 8.21 to 8.42. The values recorded for *Metsulfuron*, *Clodinafop*, *Carfentrazone*, *Carfentrazone + Sulfosulfuron*, *Sulfosulfuron*, *Clodinafop + Metsulfuron*, *Sulfosulfuron + Metsulfuron*, and *Clodinafop + Carfentrazone* were 8.21, 8.33, 8.38, 8.36, 8.40, 8.22, 8.42, and 8.26, respectively. Weed density in

the weedy check was recorded at 8.48, whereas the lowest density of 0.71 was observed in the weed-free treatment.

At 60 DAS, greater variation in weed density was observed among the treatments. The lowest weed density was recorded in the weed-free treatment (0.71), while the highest density was observed in the weedy check (10.05). Among the herbicide treatments, the lowest weed density was recorded with *Clodinafop + Metsulfuron* (3.77), followed by *Sulfosulfuron + Metsulfuron* (3.99) and *Carfentrazone + Sulfosulfuron* (4.81). In the remaining treatments, weed density was recorded as 5.20, 5.55, 5.83, 6.05, and 6.39 for *Clodinafop + Carfentrazone*, *Sulfosulfuron*, *Clodinafop*, *Metsulfuron*, and *Carfentrazone*, respectively.

A similar trend was observed at 90 DAS. Weed density was lowest (0.71) in the weed-free treatment and highest (11.24) in the weedy check. Among the herbicide treatments, the lowest weed density was recorded with *Clodinafop + Metsulfuron* (3.95), followed by *Sulfosulfuron + Metsulfuron* (4.13) and *Carfentrazone + Sulfosulfuron* (5.12). Weed densities of 5.51, 5.86, 5.99, 6.24, and 6.66 were recorded for *Clodinafop + Carfentrazone*, *Sulfosulfuron*, *Clodinafop*, *Metsulfuron*, and *Carfentrazone*, respectively. [Deshmukh et al. \(2020\) \[8\]](#) also reported effective weed suppression with *Clodinafop*-propargyl + *Metsulfuron*-methyl and *sulfosulfuron + Metsulfuron*-methyl combinations in wheat.

The data indicate that weed density in the weedy check generally increased with the progression of the crop period, rising from 8.48 at 30 DAS to 10.05 at 60 DAS and 11.24 at 90 DAS. In contrast, herbicide treatments maintained lower weed densities at 60 and 90 DAS, particularly the *Clodinafop + Metsulfuron* and *Sulfosulfuron + Metsulfuron* combinations. The better performance of *Clodinafop + Metsulfuron* and *sulfosulfuron + Metsulfuron* in reducing weed density is in agreement with earlier findings. [Sudha et al. \(2016\) \[2\]](#) reported lower weed density and weed biomass with *sulfosulfuron + Metsulfuron* followed by *Clodinafop + Metsulfuron* compared with the weedy check. The weed-free treatment maintained a constant value of 0.71 across all three observations. Statistical analysis revealed that the effect of treatments on weed density was significant.

The  $SE_{m\pm}$  values at 30, 60, and 90 DAS were 0.34, 0.23, and 0.254, respectively, while the corresponding CD values at the 5% level were 1.00, 0.68, and 0.755. Thus, the differences among weed management treatments were statistically significant at all three stages of crop growth.

**Table 2.** :- Effect of various weeds management practices on weed density in wheat

| S. No. | Treatment                                                       | Total weeds |        |        |
|--------|-----------------------------------------------------------------|-------------|--------|--------|
|        |                                                                 | 30 DAS      | 60 DAS | 90 DAS |
| 1      | Metsulfuron @ 4 ga.i. ha <sup>-1</sup>                          | 8.21        | 6.05   | 6.24   |
| 2      | Chodinafop @60g a.i.ha <sup>-1</sup>                            | 8.33        | 5.83   | 5.99   |
| 3      | Carfentazone @20g a.i.ha <sup>-1</sup>                          | 8.38        | 6.39   | 6.66   |
| 4      | Carfentazone + Sulphosulfuron@ 20ga.i.+25ga.i. ha <sup>-1</sup> | 8.36        | 4.81   | 5.12   |
| 5      | Sulphosulfuron @ 25 a.i. gha-l                                  | 8.40        | 5.55   | 5.86   |
| 6      | Chodinafop + Metsulfuron @ (60+4)64gha-l                        | 8.22        | 3.77   | 3.95   |
| 7      | Sulphosulfuron + Metsulfuron@ (30+2)32gha-l                     | 8.42        | 3.99   | 4.13   |
| 8      | Clodinafop + Carfentazone@(60 ga.i.+20ga.i.) ha <sup>-1</sup>   | 8.26        | 5.20   | 5.51   |
| 9      | Weedfree                                                        | 0.71        | 0.71   | 0.71   |
| 10     | Weedy check                                                     | 8.48        | 10.05  | 11.24  |
|        | $SE_{m\pm}$                                                     | 0.34        | 0.23   | 0.254  |
|        | CD at5 %                                                        | 1.00        | 0.68   | 0.755  |

### Dry matter accumulation (g.m<sup>-2</sup>)

Data on dry matter accumulation presented in [Table-2](#), indicate that weed management practices significantly influence dry matter accumulation at all crop growth stages, except at 30 DAS (days after sowing).

At 60 and 90 DAS and at harvest, the highest dry matter accumulation was recorded in the 'weed-free' treatment. This accumulation was statistically on par with the '*Clodinafop + Metsulfuron*' (60+4) 64 g/ha and '*Sulfosulfuron + Metsulfuron*' (30+2) 32 g/ha treatments. Among the herbicides, the highest dry matter accumulation was recorded with '*Clodinafop + Metsulfuron*' (60+4) 64 g/ha.

This was statistically comparable to 'Sulfosulfuron + Metsulfuron' (30+2) 32 g/ha, 'Clodinafop + Carfentrazone' (60 g a.i. + 20 g a.i.)/ha, and 'Carfentrazone + Sulfosulfuron' (20 g a.i. + 25 g a.i.)/ha, while being significantly higher than the other herbicides.

Dry matter accumulation is a result of various growth and yield-related attributes, such as plant height, number of shoots per square meter, and leaf area. The adoption of weed management practices signif-

icantly increased dry matter accumulation at all growth stages, except at the 30-day stage, where the quantity of dry matter remained unaffected. This may be attributed to the fact that, except at 30 DAS, reduced weed pressure facilitated better photosynthetic activity (food production) in the plants. [Paswan et al. \(2012\)](#) <sup>[3]</sup> have also reported that the use of herbicides leads to an increase in dry matter production compared to the weedy check (untreated control).

**Table 2.** Effect of various weeds management practices on Dry matter accumulation ( $\text{g.m}^{-2}$ ) at different growth stage

| S. No. | Treatments                                                      | Days after transplanting |       |         |            |
|--------|-----------------------------------------------------------------|--------------------------|-------|---------|------------|
|        |                                                                 | 30                       | 60    | 90      | At harvest |
| 1      | Metsulfuron @ 4 ga.i. $\text{ha}^{-1}$                          | 79.0                     | 510.4 | 850.6   | 1012.6     |
| 2      | Chodinafop @60g a.i. $\text{ha}^{-1}$                           | 79.5                     | 530.0 | 883.3   | 1051.5     |
| 3      | Carfentazone @20g a.i. $\text{ha}^{-1}$                         | 78.4                     | 492.5 | 820.8   | 977.2      |
| 4      | Carfentazone + Sulphosulfuron@ 20ga.i.+25ga.i. $\text{ha}^{-1}$ | 80.3                     | 609.1 | 1015.15 | 1208.5     |
| 5      | Sulphosulfuron @ 25 a.i. gha-1                                  | 79.5                     | 562.0 | 933.5   | 1115       |
| 6      | Chodinafop + Metsulfuron @ (60+4)64gha-1                        | 81.1                     | 636.5 | 1060.9  | 1263       |
| 7      | Sulphosulfuron + Metsulfuron@ (30+2)32gha-1                     | 80.6                     | 629.8 | 1049.6  | 1249.5     |
| 8      | Clodinafop + Carfentazone@(60 ga.i.+20ga.i.) $\text{ha}^{-1}$   | 80.0                     | 587.9 | 979.85  | 1166.5     |
| 9      | Weedfree                                                        | 82.2                     | 675.4 | 1125.6  | 1340.0     |
| 10     | Weedy check                                                     | 77.5                     | 442.0 | 735.0   | 875.0      |
|        | SEm $\pm$                                                       | 1.62                     | 18.99 | 42.71   | 38.76      |
|        | CD at5 %                                                        | NS                       | 56.45 | 126.89  | 115.15     |

## Conclusion

Different weed control methods applied to a timely-sown wheat crop significantly influenced weed population and dry matter accumulation. The weed-free treatment recorded the lowest weed count, whereas the weedy check showed the highest count at 30, 60, and 90 DAS. Among the herbicide treatments, the application of 'Clodinafop + Metsulfuron' resulted in a lower weed population and higher dry matter accumulation compared to the use of a herbicide alone. The highest dry matter accumulation was observed in the weed-free treatment during the crop's later growth stages and at harvest. Overall, effective weed control was associated with superior dry matter production in the crop.

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