

# Effect of weed management practices on growth, yield and productivity of wheat (*Triticum aestivum* L.)

## ABSTRACT

An experiment entitled “Effect of weed management practices on growth, yield and productivity of wheat (*Triticum aestivum* L.)” a field experiment was conducted at Agronomy Research Farm of Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya (Uttar Pradesh) during Rabi season 2018-2019. The experiment was laid out in randomized block design with three replications. There were twelve treatments of weed management practices i.e. T<sub>1</sub>- Sulphosulfuron 25g a.i. ha<sup>-1</sup>, T<sub>2</sub>- Metsulfuron 4g a.i. ha<sup>-1</sup>, T<sub>3</sub>- Clodinafop 60g a.i. ha<sup>-1</sup>, T<sub>4</sub>- Metribuzin 210g a.i. ha<sup>-1</sup>, T<sub>5</sub>- Sulphosulfuron+Metsulfuron (30+2) 32 g a.i. ha<sup>-1</sup>, T<sub>6</sub>- Sulphosulfuron+Metribuzin (25+210) 235 g a.i. ha<sup>-1</sup>, T<sub>7</sub>- Clodinafop+ Metsulfuron (60+4) 64 g a.i. ha<sup>-1</sup>, T<sub>8</sub> - Fenoxaprop-p-ethyl 120 g a.i. ha<sup>-1</sup>, T<sub>9</sub>- Fenoxaprop-p-ethyl + Metsulfuron (120+4) 124 g a.i. ha<sup>-1</sup>, T<sub>10</sub>- Two hand weeding at 20, 40 DAS, T<sub>11</sub> - Weedy check, T<sub>12</sub> - Weed free. All the growth parameters, yield attributes likes higher No. of spike (m<sup>2</sup>), Length of Spike (cm), No. of spikelets Spike<sup>-1</sup>, Grain per ear head (m<sup>2</sup>), and Test Weight (g) and also yields of grain and straw, and as well as higher harvest index. of wheat is obtained significantly higher under weed free treatment (52.50 qha<sup>-1</sup>) followed by under T<sub>7</sub>- Clodinafop+ Metsulfuron @ (60+4) 64 g a.i. ha<sup>-1</sup> obtained yield of wheat is 51.10 qha<sup>-1</sup>. The highest net return (81054.50 Rs. ha<sup>-1</sup>) and benefit cost ratio (2.04) was recorded under T<sub>7</sub>-Clodinafop + Metsulfuron @ (60+4) 64 g a.i. ha<sup>-1</sup>. Thus it may be recommended for effective control of weeds and higher production of grain and straw yield in wheat crops.

**Keywords:** Wheat, Growth, yields, productivity, weed management, herbicides.

## 1. INTRODUCTION

Wheat (*Triticum aestivum* L.) is the second most important cereal crop next to rice and accounts for 36.2% of total food grain basket of the country. It is grown under diverse agro climatic conditions. Wheat is the backbone of food security of India. It is utilized for bread, cakes, cookies, noodles, petri-products and chapatti etc. Wheat grains contains starch 60-68%, protein 8-15%, fat 1.5-2.0%, cellulose 2.0-2.5%, and minerals 1.5-2.0% [1]. The total area of wheat in the world is 217.02 million hectares with production of 764.50 million tonnes and productivity is 35.20 q ha<sup>-1</sup>. The major producer country of wheat in the world is the China followed by, India, United States of America, Russia, France and Australia [2]. In India, U.P. having first rank in production (32.74 million tonnes) and area (9.54 m ha) while in productivity Punjab has first rank with 51.95 q ha<sup>-1</sup> followed by Haryana, Rajasthan and Uttar Pradesh, [2]. Weeds are considered as one of the constraints in wheat cultivation. Wheat crop infested with a number of weeds, they compete with wheat for available resources, therefore, decrease in growth, yield attributes and grain yield. The prominent weeds found in wheat crop are *Phalaris minor*, *Avena ludoviciana*, *Chenopodium album*, *Medicago denticulata*, *Malilotus alba*, *Melilotus indica*, *Fumaria parviflora*, *Vicia hirsuita*, *Vicia sativa*, *Coronopus didymus* and *Reumex acetocela*. Yield reduction due to weeds in wheat ranging from 15-50 %, depending upon the weed density and type of weed flora [3]. observed that the predominant broadleaf weeds infesting wheat more were *Medicago denticulata*, *Cichorium intybus*, *Convolvulus arvensis*, *Chenopodium album*, *Anagallis arvensis*, *Vicia sativa* and *Euphorbia geniculata*. [4]. reported that Metsulfuron-methyl alone and in combination with Clodinafop, fenoxaprop and Sulfosulfuron provided excellent control of broad leaf weeds i.e. *C. album*, *M. indica*, *R. retroflexus* and *C. didymus* except *C. arvensis* and *L. aphaca*. The herbicides Clodinafop and fenoxaprop significantly reduced the population of *Phalaris minor* and *A. ludoviciana* when applied alone. As evident from data on population, efficacy of fenoxaprop and Clodinafop against grassy weeds was reduced when Metsulfuron was used as tank mixture. Magnitude of decrease in efficacy against *Phalaris minor* was more with application of Metsulfuron with fenoxaprop than with Clodinafop. This might be because of the antagonistic effect of Metsulfuron on Clodinafop and fenoxaprop. [5].

## 2. MATERIAL AND METHODS

### 2.1 Experimental site

The experiment was carried out during *Rabi* season 2018-19 at Agronomy research farm, Acharya Narendra Deva University of Agriculture and Technology, Narendra Nagar, Kumarganj, Ayodhya (U.P.). The field was well leveled having good soil condition. Study location is situated at 24° 47' North latitude, 82° 12' East longitudes with an altitude of 113 meters above mean sea level.

### 2.2 Geography and Climate

Geographically, the experimental site falls under sub humid, sub- tropical climate of Indo- gangatic plains (IGP) having alluvial calcareous soil. The weekly minimum and maximum temperature during the crop season ranged from 3.5 °C to 37.5 °C respectively and the rainfall received during crop period was 61.5 mm and average Relative humidity, evaporation and sunshine hours ranged from 53.00 % to 76.6 %, 2.6 to 7.2 mm per day and 3.6 to 9.6 hrs per day respectively.

### 2.3 Experimental Details

An experiment was laid out in Randomized Block Design (RBD) with twelve treatments and three replications. The treatments comprised of weed management practices under study in wheat crop. All herbicides were used as post emergence at 30 DAS. Treatments are as follows: T<sub>1</sub> - Sulfosulfuron @ 25g a.i. ha<sup>-1</sup>, T<sub>2</sub> - Metsulfuron @ 4g a.i. ha<sup>-1</sup>, T<sub>3</sub> - Clodinafop @ 60g a.i. ha<sup>-1</sup>, T<sub>4</sub> - Metribuzin @ 210g a.i. ha<sup>-1</sup>, T<sub>5</sub> - Sulfosulfuron + Metsulfuron (30+2) @ 32 g a.i. ha<sup>-1</sup>, T<sub>6</sub> - Sulfosulfuron + Metribuzin (25+210) @ 235 g a.i. ha<sup>-1</sup>, T<sub>7</sub> - Clodinafop + Metsulfuron (60+4) @ 64 g a.i. ha<sup>-1</sup>, T<sub>8</sub> - Fenoxaprop -p - ethyl @ 120 g a.i. ha<sup>-1</sup>, T<sub>9</sub> - Fenoxaprop-p-ethyl + Metsulfuron (120+4) @ 124 g a.i. ha<sup>-1</sup>, T<sub>10</sub> -Two hand weeding (20 and 40 DAS), T<sub>11</sub> - Weedy check, T<sub>12</sub> - Weed free. The size of each plots was (16.90 m<sup>2</sup>) 6.5 meter in length and 2.6 meter in width. In experiment total number of plots was 36.

### 2.4 Agronomic Practices

Pre-sowing irrigation was applied 7-10 days before sowing of wheat crop is necessary to have optimum moisture level for field preparation and ensure good germination. Field was harrowed twice followed by cultivator and planking to get well pulverized suited to the sowing and germination of wheat crop.

### 2.5 Seed and Sowing

Wheat variety PBW-154 was selected for this study. The seed rate was used as 100 kg ha<sup>-1</sup>. The healthy and clean seeds was sown at 20 cm rows distance with the help of seed drill. The sowing of all plots was done on November 28, during 2018. And wheat crop was harvested when attained the physical maturity.

### 2.6 Fertilizers application

The experimental crop was uniformly fertilized with 120kg N, 60kg P<sub>2</sub>O<sub>5</sub> and 40kg K<sub>2</sub>O ha<sup>-1</sup> through urea, Di-ammonium phosphate and murate of potash, respectively. The application of Half dose of nitrogen and a full dose of phosphorus and potash were given as basal dose and remaining nitrogen applied as a top dressing in two equal splits; 25% at after first irrigation and 25% at after second irrigation was given

### 2.7 Weed management

Weeds were removed manually in two hand weeding at 20 and 40 days after sowing as per treatments and All the herbicides were applied as post-emergence at 30 DAS of wheat, as per treatments, with the help of a knap-sack sprayer fitted with flat-fan nozzle with a spray volume of 250 L ha<sup>-1</sup> water.

### 2.8 Observations Recorded

The observed parameters growth characteristics were as numbers of tillers, plants height, dry matter accumulation, LAI. The observation on yield and yield attributes characteristics were recorded using standard methods as follows Number of spike, Spike length, Number of spikelet's, Number of grains per

spike, Test weight, Grain yield, straw yield, Harvest index had to be determined. The data recorded on different observations were analyzed statistically by using the analysis of variance (ANOVA) technique as suggested by Gomez and Gomez (1984). The standard error of mean for different main effects was calculated with the help of following Formula;  $SEm \pm = \sqrt{2VE/r}$  and The treatments mean were compared using the Critical difference at 5 % probability level by Randomized block design (RBD) model as obtained by Co.stat 6.311, 1998-2005 as statistical programme.

### 3.0 RESULT AND DISCUSSION

#### 3.1 Growth characters:

##### 3.1.1 Plant height (cm):

The result of the presented (Table 1) study indicated that growth characteristics such as plant height. The plant height increased significantly by the different weed management practices at 30, 60, 90 day and harvest stage of crop growth. At 30 DAS maximum plant height recorded under weed free being at par with two hand weeding and significantly higher than herbicidal treatments. It might be due to hand weeding at 20 DAS. Tallest plant (104.50cm) was recorded under weed free which was at par with post emergence application of Clodinafop + Metsulfuron @ 60 +4 g ha<sup>-1</sup> (102.36 cm) and Sulfosulfuron + Metsulfuron @ 30+2 g ha<sup>-1</sup>, (101.74cm). The shortest plants height (87.40 cm) were observed under weedy check at all growth stages. The increase in plant height was due to greater availability of nutrient which resulted profuse growth of plants at various growth stages. Also reported by [6], [7], [8].

##### 3.1.2 Number of tillers (m<sup>-2</sup>):

The number of tillers m<sup>-2</sup> increased up to 90th day stage of crop growth and thereafter, it decreased slightly. The data presented in Table-1. The number of tillers m<sup>-2</sup> increased significantly under various weed management practices as compared to weedy check at all the growth stages except 30 DAS which maximum no of tiller. Weed free treatment recorded significantly higher number of tiller m<sup>-2</sup> than other weed management practices, being at par with two hand weeding, post emergence application of Clodinafop + Metsulfuron @ 60 +4 g ha<sup>-1</sup> and Sulfosulfuron + Metsulfuron @ 30+2 g ha<sup>-1</sup>, and Fenoxaprop-p-ethyl + Metribuzin (120 + 210 g ha<sup>-1</sup>), recorded significantly higher no of tillers.. It may be attributed to the fact that there was better availability of nutrients under well managed plots which resulted in better number of tillers m<sup>-2</sup> than other treatments. Also reported that [9], [10].

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

Dry matter accumulation is shown (Table 2) and the resultant of all the growth and yield attributes viz., plant heights, shoot m<sup>-2</sup> and leaf area. The dry matter accumulation increased significantly with the application of weed management practices at all the growth stages, except at 30 days where dry matter range unaffected. At harvest the highest dry matter accumulation was recorded in weed free (1170.47) which were statistically at par with post emergence application of Clodinafop + Metsulfuron @ 60 +4 g ha<sup>-1</sup> (1154.30) and Sulfosulfuron + Metsulfuron @ 30+2 g ha<sup>-1</sup> and two hand weeding. This might be attributed to more synthesis of food materials in plants under less weedy condition. [11].

##### 3.1.4 Leaf area index:

The leaf area index presented (Table 2). The leaf area increased with increase in age of crop up to 90th day stage and decline thereafter, mainly due to senescence. The leaf area index increased significantly with various weed management practices recording the highest leaf area index in weed free (4.21) statistically superior over rest treatment while at par with two hand weeding Clodinafop + Metsulfuron @ 60 +4 g ha<sup>-1</sup> (1154.30) and Sulfosulfuron + Metsulfuron @ 30+2 g ha<sup>-1</sup> the better leaf area index with these treatments might be due to fact that sufficient moisture and nutrient availability due to less weed density resulted in better growth i.e. leaf number and size leading to increased leaf area and leaf area index. Better LAI with best weed managed reported by plots [6].

#### 3.2 Yield attributes:

The Yield attributes is presented (Table 3) the resultant of all the yield attributes viz. effective tillers m<sup>-2</sup>, length of spike(cm), number of spikelets spike<sup>-1</sup> and grain spike<sup>-1</sup>, increased significantly with weed management practices over weed check. The significantly highest values of all the yield contributing characters were recorded with weed free, which were at par with post emergence application of

Clodinafop + Metsulfuron @ 60 +4 g ha<sup>-1</sup> and Sulfosulfuron + Metsulfuron @ 30+2 g ha<sup>-1</sup>, while significantly higher than rest of the weed management practices. This might be due to better availability of nutrient, moisture, space and light which resulted better growth and development of plants similar finding also represented [12]. Maximum test weight recorded under weed free and Clodinafop + Metsulfuron @ 60 +4 g ha<sup>-1</sup>, it may be due to less competition for different resources resulted more translation of food from source to sink relationship and it is the cumulative function of various growth parameter and yield attribute viz., number of tillers, grain spike<sup>-1</sup>, length of spike and test weight (are the sink components). [13].

### 3.3 Yields:

#### 3.3.1 Grain yield (q ha<sup>-1</sup>)

The result of Grain yield was presented (Table 3) and the maximum grain yield was recorded at Weed free (52.50 q ha<sup>-1</sup>) which was at par with post emergence application of Clodinafop + Metsulfuron @ 60 +4 g ha<sup>-1</sup> (51.10 qha<sup>-1</sup>), Sulfosulfuron + Metsulfuron @ 30+2 g ha<sup>-1</sup> (50.20 qha<sup>-1</sup>) and two hand weeding while significantly superior over rest of the weed Management practices. It might be due to the smothering effect of the respective weed management practices. Which resulted in more translocation of food from source to sink responsibly more yield. Almost similar finding reported by [14], [15], [16].

#### 3.3.2 Straw yield (q ha<sup>-1</sup>)

The highest straw yield (Table-3) of (66.45 qha<sup>-1</sup>) was recorded in weed free which were statistically at par with post emergence application of Clodinafop + Metsulfuron @ 60 +4 g ha<sup>-1</sup> (64.10), Sulfosulfuron + Metsulfuron @ 30+2 g ha<sup>-1</sup>, and two hand weeding while significantly higher than rest of the weed management practices. The above findings may be due to effective control of weeds which contributed to better growth parameters and yield attributes, better vegetative growth coupled with higher yield attributes resulted in higher grain and straw yield over rest of the weed management practices almost similar finding reported by [14], [15].

#### 3.3.3 Biological yield (q ha<sup>-1</sup>)

The biological yields was show in (Table-3) Biological yield is is the sum of grain and straw yield. Maximum biological yield recorded under wed free 118.95 q ha<sup>-1</sup> was at par with post emergence application of of Clodinafop + Metsulfuron @ 60 +4 g ha<sup>-1</sup> (64.10) (114.7o q ha<sup>-1</sup>), Sulfosulfuron + Metsulfuron @ 30+2 g ha<sup>-1</sup>, (114.70 q ha<sup>-1</sup>). This might be due to effective weed control by such as to treatment enhancement more growth and development resulted more biological yield. Similar finding reported by [14], [15].

#### 3.3.4 Harvest index

Harvest index in wheat exhibited a non-significant influence under various weed management treatments. The highest harvest index was noted in Clodinafop + Metsulfuron @ 60 +4 g ha<sup>-1</sup> (44.35), closely followed by weed free (44.33) this might be due to the fact that proper weed management increased the proportionate distribution of photosynthetic sink i.e. grain which resulted increase in harvest index. Similar finding reported by [17].

**Table: 1. Effect of various weed management practices on Plant height (cm) and Number of tillers (m<sup>-2</sup>) of wheat.**

Treatments	Plant height (cm)				Number of tillers (m <sup>-2</sup> )			
	30 DAS	60 DAS	90 DAS	At harvest	30 DAS	60 DAS	90 DAS	At harvest
T <sub>1</sub>	28.00	61.65	95.68	97.64	178.32	361.67	366.50	362.48
T <sub>2</sub>	27.60	61.59	95.29	97.48	181.59	360.96	364.68	360.00
T <sub>3</sub>	28.30	60.42	93.71	95.65	180.12	342.34	361.15	350.81
T <sub>4</sub>	25.54	61.14	94.96	96.85	178.47	344.36	362.15	355.15
T <sub>5</sub>	28.88	63.36	95.92	101.74	181.84	379.58	401.14	390.49
T <sub>6</sub>	28.40	62.50	95.87	97.81	181.23	362.51	378.81	371.19
T <sub>7</sub>	28.35	64.15	97.20	102.36	180.89	382.60	404.31	392.88
T <sub>8</sub>	26.60	60.68	94.18	94.85	179.54	329.26	348.17	336.99
T <sub>9</sub>	29.15	63.10	96.50	99.74	178.99	355.25	381.75	386.12
T <sub>10</sub>	30.57	65.81	99.70	101.37	183.97	382.15	405.00	388.25
T <sub>11</sub>	27.50	59.11	85.01	87.4	183.82	273.85	289.56	277.78
T <sub>12</sub>	31.14	66.96	100.48	104.5	185.98	393.78	415.97	405.47
<b>SEm ±</b>	<b>0.74</b>	<b>1.02</b>	<b>1.10</b>	<b>1.46</b>	<b>2.55</b>	<b>10.33</b>	<b>10.30</b>	<b>6.17</b>
<b>CD (P ≥0.05)</b>	<b>2.32</b>	<b>3.01</b>	<b>3.26</b>	<b>4.32</b>	<b>NS</b>	<b>30.48</b>	<b>30.38</b>	<b>18.19</b>

**Table: 2. Effect of various weed management practices on Dry matter accumulation (g m<sup>-2</sup>) and Leaf area index of wheat.**

Treatments	Dry matter accumulation (g m <sup>-2</sup> )				Leaf area index		
	30 DAS	60 DAS	90 DAS	At harvest	30 DAS	60 DAS	90 DAS
T <sub>1</sub>	94.09	345.20	660.16	1068.66	1.41	3.68	3.75
T <sub>2</sub>	93.75	338.60	652.63	1050.20	1.40	3.61	3.71
T <sub>3</sub>	93.67	285.90	648.36	1028.67	1.38	3.42	3.58
T <sub>4</sub>	94.81	295.50	646.80	1046.54	1.39	3.58	3.67
T <sub>5</sub>	95.50	360.95	792.25	1136.91	1.44	3.79	4.13
T <sub>6</sub>	94.77	347.40	694.20	1086.21	1.41	3.72	3.77
T <sub>7</sub>	94.99	365.60	795.20	1154.31	1.45	3.81	4.14
T <sub>8</sub>	93.54	291.70	647.30	1015.39	1.42	3.31	3.54
T <sub>9</sub>	94.81	357.50	721.36	1087.81	1.43	3.76	3.95
T <sub>10</sub>	95.55	366.50	796.00	1132.43	1.43	3.78	4.14
T <sub>11</sub>	93.42	270.50	556.60	806.42	1.44	2.71	3.14
T <sub>12</sub>	95.60	370.00	728.50	1170.47	1.46	3.87	4.21
<b>SEm ±</b>	<b>0.75</b>	<b>1.57</b>	<b>1.16</b>	<b>13.15</b>	<b>0.15</b>	<b>0.12</b>	<b>0.03</b>
<b>CD (P ≥0.05)</b>	<b>2.35</b>	<b>4.68</b>	<b>3.43</b>	<b>38.85</b>	<b>NS</b>	<b>0.34</b>	<b>0.08</b>

**Table: 3. Effect of various weed management practices on yield attributes and yields (q ha<sup>-1</sup>) of wheat.**

Treatments	No. of spike (m <sup>-2</sup> )	Length of Spike (cm)	No. of spikelets Spike <sup>-1</sup>	Grain per ear head (m <sup>-2</sup> )	Test Weight (g)	Grain yield (q ha <sup>-1</sup> )	Straw yield (q ha <sup>-1</sup> )	Biological yield (q ha <sup>-1</sup> )	Harvest index (%)
T <sub>1</sub>	358.72	8.69	14.17	37.40	34.51	46.20	60.45	106.65	39.96
T <sub>2</sub>	345.49	8.67	14.10	37.00	34.47	45.80	59.10	104.90	43.66
T <sub>3</sub>	335.00	8.51	13.41	36.40	34.47	44.50	58.20	102.70	43.33
T <sub>4</sub>	340.25	8.61	13.65	36.51	34.41	45.00	58.75	103.75	43.37
T <sub>5</sub>	374.82	9.15	16.00	41.70	35.15	50.20	64.50	114.70	43.76
T <sub>6</sub>	362.28	8.87	14.25	38.10	33.43	47.10	61.15	108.25	43.51
T <sub>7</sub>	375.00	9.38	16.05	41.41	35.45	51.10	64.10	115.20	44.35
T <sub>8</sub>	326.85	8.35	12.70	36.00	34.15	43.18	58.65	101.83	42.40
T <sub>9</sub>	375.50	8.90	14.55	38.15	34.97	47.50	61.50	108.65	43.71
T <sub>10</sub>	367.50	9.45	15.98	38.83	35.05	49.80	64.95	114.75	43.39
T <sub>11</sub>	260.10	6.74	12.15	34.31	32.80	32.50	47.90	80.40	40.42
T <sub>12</sub>	379.10	9.73	16.48	43.10	36.32	52.50	66.45	118.95	44.13
<b>SEm ±</b>	<b>1.5</b>	<b>0.41</b>	<b>0.65</b>	<b>1.60</b>	<b>1.06</b>	<b>1.33</b>	<b>1.03</b>	<b>1.48</b>	<b>1.19</b>
<b>CD (P ≥0.05)</b>	<b>4.45</b>	<b>1.21</b>	<b>1.90</b>	<b>4.69</b>	<b>NS</b>	<b>3.98</b>	<b>2.98</b>	<b>4.33</b>	<b>NS</b>

## CONCLUSION

On the basis of results summarized above, it can be concluded that in the field experiment the post emergence application of herbicide Clodinafop + Metsulfuron (60 + 4 g ha<sup>-1</sup>) gave highest plant height at 60, 90 DAS and at harvest as well as higher number of tillers, dry matter accumulation and leaf area index was recorded at all stages of crop growth and recorded higher No. of spike (m<sup>-2</sup>), Length of Spike (cm), No. of spikelets Spike<sup>-1</sup>, Grain per ear head (m<sup>-2</sup>), and Test Weight (g) and also produced higher grain yield, straw yield, biological yields and as well as higher harvest index. The post emergence application of herbicide Clodinafop + Metsulfuron (60 + 4 g ha<sup>-1</sup>) may be recommended for weed management practices and higher production of grain and straw yields in wheat crops.

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