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3 **Application and effects of different herbicides against weed**
4 **flora in wheat crop for sustainable agriculture**
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6
7 **Abstract**

8 The present investigation entitled “Application and effects
9 of different herbicides against weed flora in wheat crop for
10 sustainable agriculture” was carried out during 2020 and 2021 at
11 Agricultural Research Farm, Shri Durga Ji Post Graduate College,
12 Azamgarh (U.P.) The experiment was conducted with the aimed of
13 evaluating the effect of different herbicides against complex weed
14 flora in wheat crop. The experiment was planned and laid out with
15 nine treatments and four replications under randomized block
16 design. The major weeds infesting the wheat crop field were
17 *Anagallis arvensis*, *Chenopodium album*, *Phalaris minor*,
18 *Parthenium hysterophorus* and *Cyperus rotundus*. The post-
19 emergence application of carfentrazone-ethyl 0.025 kg a i/ha at 33
20 days after sowing was most efficient in controlling the weeds (both
21 grassy and non-grassy) among the various applied herbicides.
22 Weed growth suppression effect of carfentrazone-ethyl 0.025
23 resulted significant increase the growth parameters, yield attributes
24 and higher economic yield of wheat over check control in order to
25 promote the sustainability.

26 **Key words: Wheat, Herbicide, Weeds, Bio-efficacy and**
27 **Modern Agriculture**
28

Comment [A1]: What are theses treatments?

29

30 1.Introduction

31 India is the second largest wheat producer (93.51 million
32 tonnes) next only to China (121.72 million tonnes) and it covers the
33 largest area under wheat cultivation (29.65 m ha), which is about
34 13.77 % of the world wheat area (217 million hectare) (FAO,
35 2014).Wheat crops are infested with both grassy and broad-leaf
36 weeds. Competition from weeds throughout the crop season
37 culminates in yield losses ranging from 10 to 70% depending upon
38 time and intensity of weed flora. In eastern Uttar Pradesh,
39 infestation of *Chenopodium album* is increasing at an alarming
40 rate in wheat due to use of high inputs like fertilizers and
41 irrigations. In eastern Uttar Pradesh, wheat crop grown mainly
42 after rice is infested with *Phalaris minor* along with broad-leaf
43 weeds such as *Anagallis arvensis*, *Parthenium hysterophorus*,
44 *Rumex dentatus*, *Convolvulus arvensis* and *Cyperus rotundus*. So,
45 there is urgent need for broad spectrum herbicides which can
46 provide effective control of both grassy as well as broad-leaf
47 weeds in wheat crop. Present study focused on potential role and
48 bioeffacy of different herbicides on Wheat crop.

Comment [A2]: [bioefficacy](#)

Comment [A3]: Mention these herbicides

49 2.Material & Methods

50 The experiment was carried out during 2020 and 2021 at
51 Agricultural Research Farm, Shri Durga Ji Post Graduate College,
52 Azamgarh (U.P.) with the aimed of evaluating the effect of different
53 herbicides against complex weed flora in wheat crop. The

Comment [A4]: In the introduction, not in
Material & Methods

54 experiment was planned and laid out with nine treatments and four
55 replications under randomized block design. The major weeds
56 infesting the wheat crop field were *Anagallis arvensis*, *Chenopodium*
57 *album*, *Phalaris minor*, *Parthenium hysterophorus* and *Cyperus*
58 *rotundus*. The Wheat variety 'HD-2967' was sown in the
59 experimental field with seed rate of 100 kg ha⁻¹ in the row distance
60 (22.5 cm.) during both the years. Fertilizers were given uniformly to
61 all the plots through urea, single super phosphate and muriate of
62 potash at the rate of 120 kg Nitrogen, 60 kg Phosphorus and 40 kg
63 Potassium ha⁻¹ during both the years. Half of the nitrogen and full
64 quantity of phosphorus and potash was given as basal and remaining
65 nitrogen was given in two splits just after day of first and second
66 irrigation in both the years. Observations for weed population and
67 their dry matter accumulation were recorded at 60 DAT with the help
68 of random quadrat (0.5 x 0.5 m) at four places in each plot and then
69 converted into per m². Data was subjected to square root (x+1)
70 transformation to normalize their distribution before analysis. Data
71 on per cent visual control by herbicides recorded on 0-100 scale was
72 transformed by using arcsine transformation method and data on
73 yield attributes and grain yield of wheat was also recorded at harvest
74 which was statistically analyzed using analysis of variance.

Comment [A5]: The authors mention the weeds but did not report the herbicides and their application or concentration

75 2.0 Major Finding

Comment [A6]: Do you mean the result ?
3 not 2

76 2.1 Effects of weed control measures on weed flora and its density.

77 The density of total weeds was significantly influenced due to
78 the application of different weed control measures at 90 days stage of

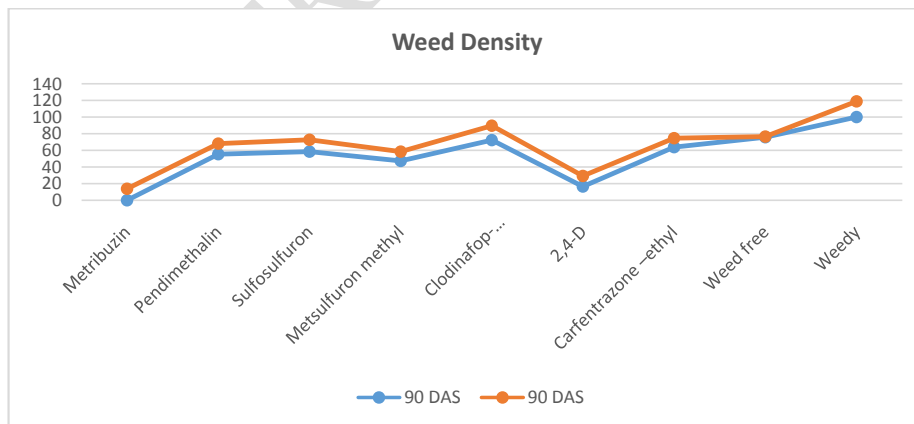
79 crop growth. Total weed population per unit area was increased up to
 80 90 days during both the stages of crop growth, thereafter decreased
 81 days stage in weedy check. The treatment effect was found to be
 82 significant at 90 days stages of crop growth during both the crop
 83 seasons whereas all the weed control methods significantly
 84 suppressed total weed infestation over weedy check. During every
 85 stage of crop growth in both crop seasons, not a single weed was
 86 found in the weed-free plot. At 90 days stage of crop growth and
 87 65.44 to 92.75 per cent and 62.43 to 88.58 per cent in the first crop
 88 season and 64.99 to 90.45 per cent and 60.89 to 84.36 per cent in the
 89 second crop season but it was unable to check the growth of weed
 90 completely as noticed in weed- free plot at this stage in both the crop
 91 seasons as shown in Fig 1. Given table 1 represents the value of weed
 92 density.

93
 94 **Table- 1** Density of total weeds metre⁻² at 90 days' stages of crop
 95 **growth as influenced by different weed management**
 96 **practices**

Treatment		Total weed density	
		90 DAS	
		2019-20	2020-21
T ₁	Metribuzin	13.95(193.50)	13.87(180.50)
T ₂	Pendimethalin	13.46(180.25)	12.87(164.75)
T ₃	Sulfosulfuron	14.99(223.75)	14.52(209.75)
T ₄	Metsulfuron	11.95(141.75)	11.40(129.00)

	methyl		
T₅	Clodinafop- propargyl	18.26(332.25)	17.54(306.50)
T₆	2,4-D	12.87(164.75)	12.66(159.25)
T₇	Carfentrazone – ethyl	11.40(129.00)	10.68(113.00)
T₈	Weed free	1.00(0.00)	1.00(0.00)
T₉	Weedy	19.65(385.00)	19.09(363.25)
SEm(±)		0.35	0.34
C.D. (P=0.05)		1.03	1.00

97 Original values in parentheses and data subjected to square root
 98 ($\sqrt{x+1}$) transformation
 99
 100
 101



102
 103
 104
 105 **Figure- 1 Weed Density metre⁻² at various stages of crop**

106 **growth**

107

108 **3.2 Effects of weed control measures on weed control efficiency.**

109 The data clearly indicate that the effect of weed control methods
110 on weed killing efficiency was significant at 90 DAS in both the crop
111 seasons. Weed free treatment had hundred percent weed killing
112 efficiency at 90 DAS in both the crop seasons. Application of
113 carfentrazone-ethyl 0.025 kg a.i. ha⁻¹ did not differ appreciably with
114 metsulfuron methyl 0.005 kg a.i. ha⁻¹ and both the treatments had
115 significantly higher weed killing efficiency than that of rest chemical
116 method of weed control practices at 90 DAS in both the crop seasons.
117 Application of 2,4-D 0.6 kg a.e. ha⁻¹ also had appreciably higher
118 weed killing efficiency than rest chemical methods of weed control
119 practices at 90 DAS in both the crop seasons. Application of
120 metribuzin 0.3 kg a.i. ha⁻¹ on par with pendimethalin 1.0 kg a.i. ha⁻¹
121 and both the treatments had significantly higher weed killing
122 efficiency than that of sulfosulfuron methyl 0.03 kg a.i. ha⁻¹ and
123 clodinafop-propargyl 0.04 kg a.i. ha⁻¹ and 90 DAS in both the crop
124 seasons. Application of clodinafop-propargyl 0.04 a.i. ha⁻¹ had
125 appreciably lower weed killing efficiency than that of rest chemical
126 method of weed control practices at 90 DAS in both the crop seasons
127 as shown in figure 2. Given table 2 represents the percentage of weed
128 control efficiency

129

Table- 2 Weed control efficiency (%) as influenced by different weed management practices

Treatments		Weed control efficiency (%)	
		90 DAS	
		2019-20	2020-21
T ₁	Metribuzin	55.23	59.03
T ₂	Pendimethalin	58.44	60.85
T ₃	Sulfosulfuron	47.12	49.92
T ₄	Metsulfuron methyl	72.39	76.54
T ₅	Clodinafop- propargyl	16.47	15.39
T ₆	2,4-D	64.01	66.77
T ₇	Carfentrazone ethyl	75.79	76.08
T ₈	Weed free	100.00	100.00
T ₉	Weedy	0.00	0.00
SEm(±)		1.64	1.70
C.D. (P=0.05)		4.79	4.96

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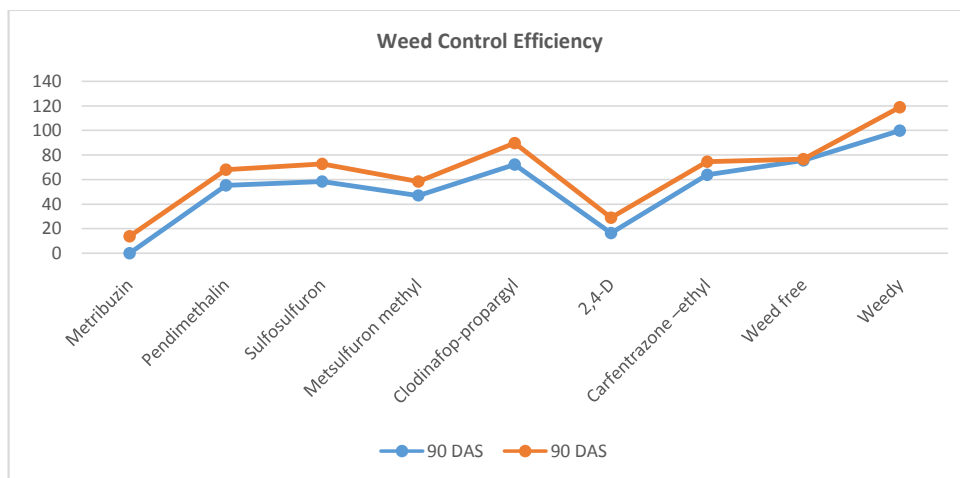


Figure- 2 Weed Control efficiency (%) at 90 stages of crop growth.

4. Discussion

The experimental field was infested by seventeen weed species out of them three grassy, thirteen non-grassy and one sedge were registered in experimental field. The dominant weed in experimental field were *Cyperus rotundus*, *Anagallis arvensis*, *Chenopodium album*, *Cynodondactylon* and *Parthenium hysterophorus*. The crop rotation, tillage and herbicides have pronounced effect on the type of weed flora (Anderson and Beck 2007, Chhokar et al., 2007a). Reduced tillage or no till wheat with high moisture in rice-wheat system favours infestation of *Rumex dentatus* L. and *Malva parviflora* L. (Chhokar et al., 2007a). The probable reason for high density of non-grassy weed over grassy and sedges in experimental plot might be due to fallowing of experimental field in *Kharif* season of 2019-20

and 2020-21, light texture soil and private irrigated pump of experimental field.

The relative density of grassy weed to total weed mass was lowest at all stages of crop growth as compared to non-grassy and sedges. **Paighanet al. (2013)** have also observed lower density of monocot weeds over dicot at 60 days after sowing in the experimental plot at Parbhani, Maharashtra.

The increase in total weed population in weedy plot was observed up to 90 days after sowing thereafter it decreased. This indicates that all weeds emerged during first 90 days, thereafter competition among weeds and with crop plant caused reduction in total weed population. This result was also in conformity of **Kumar et al. (2013)** results in which they reported that higher total weed count per unit area at 90 days stage over at harvest stage of crop growth. The lower weed density with that treatment might be due to inherent ability of weed free to the effect of cell division, cell growth and hampering the germination of weeds. Similar findings reported by **Pandey and Kumar (2005)**. The lowest weed biomass observed with these treatments was due to efficient control of dominant weeds from the beginning of crop growth (**Pandey and Dwivedi 2011**). Similarly, dry weight of weed was also registered significantly lower with weed free treatment at all the stages of crop growth. Hand weeding exhibited significant influence on weed population at all the stages of crop growth. Significantly the lowest weed density was observed with weed free treatment at all the stages of crop growth. This might be

due to timely reduction of weeds below threshold level by inter-cultural tools. The weeds were uprooted and killed. Similar findings were observed by **Pandey *et al.* (1996)**. Weed free treatment recorded lowest weed population metre^{-2} at all the stages of crop growth. Weedy check exhibited appreciably higher biomass metre^{-2} at all the stages of crop growth.

Weed control efficiency was found maximum with weed free treatment due to best control of most of the seed ages besides controlling of broad leaf weeds and grassy weeds. This has registered in significant lower weed population and had also led to very less dry weight of weeds when compared with other treatments. These findings are in close conformity with those of **Singh *et al.* (2002)** and **Singh *et al.* (2013)**. Maximum weed index (%) was recorded with weedy check treatment and it was significantly higher than rest chemical methods of weed control practices. This might be due to the reduction in yield due to presence of weeds in comparison with weed free treatment.

5. Conclusion

From above study it is concluded that, among the different used herbicides, the most effective method of suppressing weeds (both grassy and non-grassy) was the post-emergence treatment of carfentrazone-ethyl 0.025 kg an i/ha 33 days after planting. The application of carfentrazone-ethyl 0.025 to suppress weed development led to a major enhancement of the growth parameters,

yield attributes, and economic yield of wheat in comparison to the check control. Therefore, we can say that this method of weed control is seeming to be helpful in recent promoting quantity and quality of food production. By using these recent technologies, we can achieve the higher levels of food production by reducing environmental damage and results to the more sustainable agricultural systems.

Comment [A7]: What about the residual amount of the nine treatments in wheat?
What about the withdrawal period?

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