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# Assessment of Pendimethalin, Quizalfop Ethyl and Imazethapyr on Weed Count of Cuscuta and Yield Attribute of Lentil

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**A B S T R A C T**

*Cuscuta campestris* is complete stem parasite and serious problem of lentil. It causes 87% yield loss. Manual removal of Cuscuta is labour intensive and cause high labour cost. Herbicides are the best option for the management of Cuscuta. In present study, impact of Pendimethalin, Quizalfop and Imazethapyr were observed on weed count of Cuscuta and yield attribute of Lentil. In both the year i.e. 2014-15 and 2015-16, Pendimethalin cause maximum reduction in weed count of Cuscuta, highest number of pod per plant and yield of lentil compared to Quizalfop ethyl and Imazethapyr. In the year 2014-15, weed count of Cuscuta was 18, 82 and 88 in Pendimethalin, Imazethapyr and Quizalfop ethyl treatment respectively. Average number of pod was 64, 57 and 54 while Yield was 13.7, 11.2 and 11.1 in Pendimethalin, Imazethapyr and Quizalfop ethyl treatment respectively. Similar trend was observed in the year 2015-16. Hence, Pendimethalin was found to be more effective as compared to Imazethapyr and Quizalfop ethyl for the management of Cuscuta.

## Introduction

*Cuscuta campestris* Yuncker (field dodder) belongs to the member of the Convolvulaceae family and is an annual obligate stem parasite. *C. campestris* is totally dependent on its host plants for assimilates, nutrients and water supply. In India, it is a serious problem in lentil, chickpea, linseed, greengram and blackgram especially in rice-fallows. Yield losses to the tune of 87% in lentil, 85.7% in chickpea and 49.7% in linseed have been reported due to severe infestation of field dodder (Moorthy *et al.,* 2003). Manual removal and frequent inter row cultivation before the parasite attaches the host plant are the usual control measures. However, these methods are laborious and often not effective. Once the parasite is attached to the host it remains parasitic until harvest. In the prevailing widespread infestation and severe yield loss herbicides may be the best option for management of *Cuscuta.*

Several soil-applied herbicides are used for the management of Cuscuta. These herbicides are applied prior or immediately after the emergence of Cuscuta seedlings. It prevents the attachment of Cuscuta from the host and results in selective management of Cuscuta appropriately (Mishra 2009 Cudney *et al.*, 1992; Dawson, 1990a; Orloff and Cudney, 1987). Effective control of Cuscuta with pendimethalin in different crops have been

reported by several workers (Mahere *et al.,* 2000 in linseed; Kumar, 2000 and Mishra *et al.,* 2004 in blackgram; Dawson, 1990 and Orloff *et al.,* 1989 in alfalfa; Rao and Rao, 1993 in onion). Pendimethalin 0.5-1.5 kg/ha applied as pre emergence controlled *Cuscuta* in niger (Mishra *et al.,* 2005), blackgram (Rao and Rao, 1993; Mishra *et al.,* 2004), linseed (Mahere *et al.,* 2000), onion (Rao and Rao, 1993), chickpea and lentil (Mishra *et al.,* 2003). Liu *et al.,* (1990) reported that pendimethalin inhibited the cell division and formation of spindle microtubules in the cells of germinated *Cuscuta* seedlings. Parker (1991) stated that post-attachment control of a parasite is very important in order to reduce its seed production and further spread, although irreversible damage is already done. Post-emergence application of imazethapyr (50 and 100 g/ha) and glyphosate (50 g/ha) inhibited the growth of extended vines of *Cuscuta* and checked its growth upto 25-30 days only. It resulted in maximum seed yield of lentil (4175 and 3407 kg/ha), chickpea (3615 and 2949 kg/ha) and linseed (1994 kg/ha) as recorded in *Cuscuta* free plots (Mishra *et al.,* 2005).

In black gram, imazethapyr at 50-100 g/ha and glyphosate at 1250 g/ha significantly checked the *Cuscuta* infestation as compared to control. Maximum leaf area (848 $cm^2$) and dry matter (4.03 g/plant) obtained from weed-free plot. Pendimethalin, fluchloralin, squadran (PE) and imazethapyr (50 g) application have been reported to cause significant increase in leaf area and plant dry weight as compared to *Cuscuta-infested* plots. Post-emergence application of pendimethalin (500 g), squadran (1500 g) and imazethapyr (100 g) was, however, phytotoxic to blackgram. In green gram, Imazethapyr 100 g/ha at 15-20 DAS inhibited all kind of weed and recorded less dry weight of weeds (52.09 g/m2) and it was closely followed by quizalofop-p-ethyl 100 g/ha at 15-20 DAS. Imazethapyr and Quizalofop-p-ethyl 100 g/ha at 15-20 DAS also recorded higher per cent weed mortality (74.52 and 64.44 %, respectively) and weed control efficiency (84.38 and 83.76 %, respectively). Imazethapyr and Quizalofopp-ethyl 100 g/ha at 15-20 DAS were found equally effective in grain increasing and straw yield over other treatments (Ali *et al.,* 2011).

## Materials and Methods

Field experiments were conducted during rabi seasons of 2014-15 and 2015-16 at the eight different farmers' field (N 25°09', E084°29', 412 m above mean sea level) at Musepur village of Arwal district Bihar. The soil of experiment plots was clay loam (Typic Chromusterts), medium in available nitrogen (261 kg/ha), low in available phosphorus (11.44 P kg/ha) and medium in potassium (172.6 kg/ha), content having organic carbon 0.49% and pH value 7.04. Treatments (1, 2 and 3) were replicated eight times in a randomized block design and the crops were grown with recommended package of practices except weed control. *Cuscuta* seeds were treated with concentrated sulfuric acid for 20 min before broadcasting them in the field to break seed dormancy and to facilitate proper germination. Twenty *Cuscuta* seeds were sown along with the crop in rows 25 cm apart in $1m^2$ micro-plots. All the weeds, except *Cuscuta,* were removed from the plots manually as and when required. Fluchloralin was incorporated in the soil before sowing. Pendimethalin (ready mixture of pendimethalin (30 EC @ 1.0 L a.i. /ha) were applied as pre-emergence herbicides (2days after sowing-DAS). Imazethapyr and glyphosate were applied as post-emergence (30 DAS) as blanket application. Herbicides were applied as a spray by knapsack sprayer fitted with flat fan nozzle at a spray volume of 500 litre per hectare. Population of *Cuscuta* was recorded seven days after application of pre-emergence herbicides and attachment of C. *campestris* to lentil plants was recorded at

30, 60 and 90 DAS. Plant height was recorded at harvest. Crop yields and seed production of *Cuscuta* were determined by harvesting lentil, chickpea and linseed at maturity stage. Two central rows were harvested, threshed, cleaned and weighed. *Cuscuta* seeds were separated during cleaning and weighed separately. Seed number was estimated based on 1000-seed weight (0.80 g) and expressed on $m^{-2}$ basis.

## Results and Discussion

The result of herbicidal treatment of three herbicide namely Pendimethalin, Quizalfop ethyl and Imazethapyr on weed count of Cuscuta, average number of pods per plant and yield of lentil during the year of 2014-15 and 2015-16 are presented in Table1 and Table 2.

## Weed count

In the year 2013-14, all the three treatments showed significant reduction of weed count over the control. Minimum number of Cuscuta weed count was recorded in treatment Pendimethalin ($T_1$) followed by Quizalphop ethyl ($T_3$), Imazethapyr ($T_2$) and control ($T_0$) where no herbicide was applied. Weed count in $T_1$, $T_2$, $T_3$ and $T_0$ were 21, 88, 82 and 105 cuscuta per metre square respectively, at 40 days after sowing (DAS). Weed count in treatment $T_1$ is statistically significant in comparison to $T_0$, $T_2$ and $T_3$ i.e. treatment Pendimethalin caused the maximum weed reduction and performed better than Quizalfop ethyl, Imazethapyr and control. Treatment $T_2$ and $T_3$ were statistically significant in comparison to $T_0$ while they were at par with each other i.e. both the Quizalfop ethyl and Imazethapyr performed better than control and they equally effective in reduction of weed. In the year 2015-16, again all the three treatments resulted in significant reduction in weed count over control. Again, minimum number of weed count was recorded in case of treatment $T_1$ (24) followed by $T_3$ (27), $T_2$ (32) and $T_0$ (43). $T_1$ was statistically significant in comparison to $T_2$ and $T_0$ while statistically at par with $T_3$ i.e. Pendimethalin performed better than Quizalfop ethyl but its efficacy was the same as Imazethapyr. $T_2$ was statistically significant in comparison to $T_0$ and statistically at par with $T_3$. However $T_3$ was statistically at par with both the $T_1$ and $T_2$. In the year 2015-16, the performance of Imazethapyr was equivalent to Pendimethalin and Quizalfop ethyl in terms of weed count.

## Average no. of pods/plant of lentil

In the year 2014-15, maximum number of pods per plant was recorded in $T_1$ (64) followed by $T_3$ (57), $T_2$ (54) and $T_0$ (51). $T_1$ was statistically significant in comparison to $T_2$ and $T_0$ while statistically at par with $T_3$. It implies that Pendimethalin results in better pod formation in comparison to Quizalfop ethyl and control, however, it is the same as Imazethapyr. Treatment $T_2$, $T_3$ and $T_0$ were statistically at par, which signifies that treatment Quizalfop ethyl and Imazethapyr did not result in better pod formation in comparison to control. In the year, 2015-16, $T_1$ and $T_3$ were statistically significant with $T_2$ and $T_0$ whereas $T_1$ and $T_3$ as well as $T_2$ and $T_0$ were statistically at par with each other. Pendimethalin and Imazethapyr were similar but better than control while Quizalfop ethyl is also similar to control in terms of their effect on no. of pod per plant.

## Yield

The maximum yield obtained during 2014-15 was in $T_1$ (13.7 q/ha) followed by $T_3$ (11.2 q/ha), $T_2$ (11.1 q/ha) and $T_0$ (10.5 q/ha). $T_1$ was statistically significant from $T_2$, $T_3$ and $T_0$ i.e. Pendimethalin resulted best in comparison to Quizalfop ethyl, Imazethapyr and control. $T_3$ was statistically significant from $T_0$ but at par with $T_2$.

**Table.1 Assessment of the performance of different pre and post emergence herbicides for control of parasitic weed (*Cuscuta* sp.) in lentil (Rabi 2014-15)**

| Treatments | Weed Count (Cuscuta)/ $m^2$ (40 DAS) | Avg. No. of pods/plant of lentil | Lentil Yield (Q./ha) |
|---|---|---|---|
| $T_1$ (Pendimethalin 30 EC @ 1.0 L a.i. /ha) | $18^{c}$ | $64^{a}$ | $13.7^{a}$ |
| $T_2$(Quizalphop ethyl 30 DAS @ 50g a.i./ha) | $88^{b}$ | $54^{b}$ | $11.1^{bc}$ |
| $T_3$ (Imazethapyr30 DAS @10 % SL 40g a.i/ha) | $82^{b}$ | $57^{ab}$ | $11.2^{b}$ |
| $T_0$ (Control) | $105^{a}$ | $51^{b}$ | $10.5^{c}$ |
| SEM± | 23.9 | 2.86 | 0.71 |
| CD 5% | 15.20 | 7.95 | 0.669 |
| CV | 19.95 | 13.54 | 5.35 |

**Table.2 Assessment of the performance of different pre and post emergence herbicides for control of parasitic weed (*Cuscuta* sp.) in lentil (Rabi 2015-16)**

| Treatments | Weed Count (Cuscuta sp.)/ $m^2$ (40 DAS) | Avg. No. of pods/plant of lentil | Lentil Yield (Q./ha) |
|---|---|---|---|
| $T_1$ (Pendimethalin 30 EC @ 1.0 L a.i. /ha) | $24^{b}$ | $63^{a}$ | $13.5^{a}$ |
| $T_2$(Quizalphop ethyl30 DAS @ 50g a.i./ha) | $32^{bc}$ | $53^{b}$ | $11.7^{bc}$ |
| $T_3$ (Imazethapyr30 DAS @10 % SL 40g a.i/ha) | $27^{c}$ | $60^{a}$ | $12.6^{ab}$ |
| $T_0$ (Control) | $43^{a}$ | $48^{b}$ | $11.1^{c}$ |
| SEM± | 4.6 | 2.8 | 0.49 |
| CD 5% | 5.6 | 6.79 | 1.05 |
| CV | 17.34 | 11.66 | 8.26 |

**Fig.1** Assessment of the performance of different pre and post emergence herbicides for control of parasitic weed (*Cuscuta* sp.) in lentil (Rabi 2014-15)

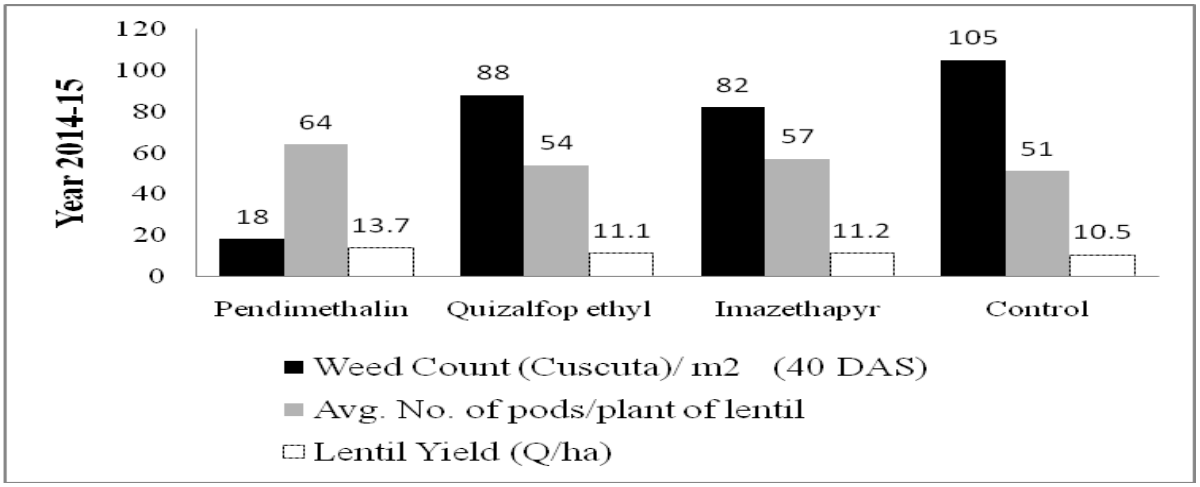
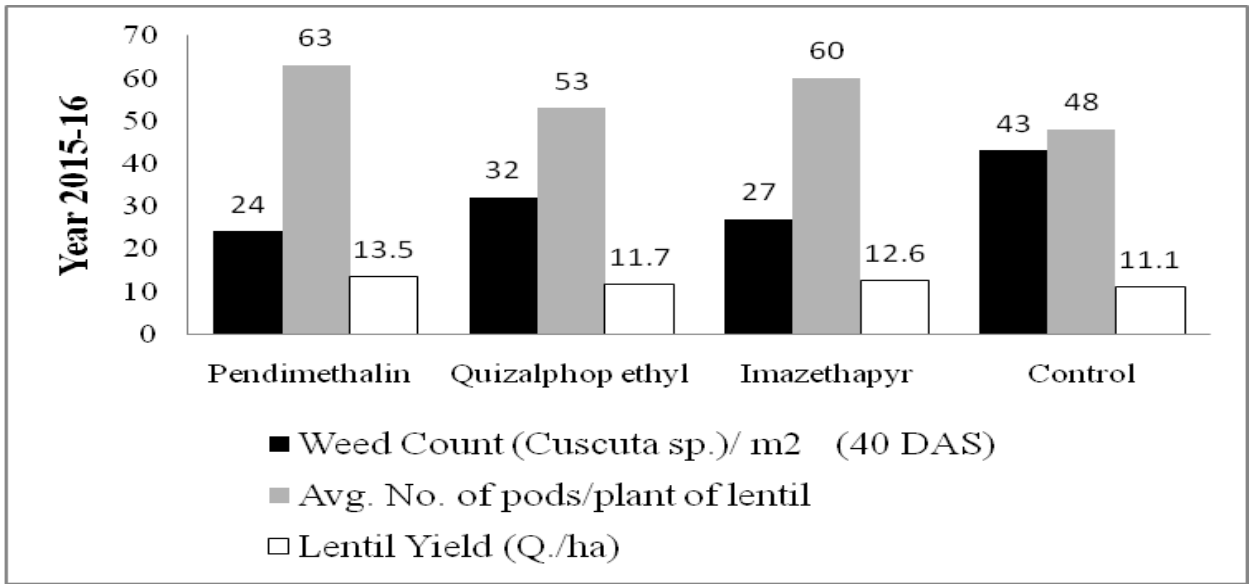


**Fig.2** Assessment of the performance of different pre and post emergence herbicides for control of parasitic weed (*Cuscuta* sp.) in lentil (Rabi 2015-16)




It implies that Imazethapyr was better than control, but its efficacy was the same as Quizalfop ethyl. $T_2$ was statistically at par with $T_0$ i.e. efficacy of the Quizalfop ethyl was the same as control where no herbicide was applied. During the year 2015-16, results were similar to 2014-15. During 2015-16, maximum yield (13.5q/ha) was obtained in $T_1$ followed by $T_3$ (12.6 q/ha), $T_2$ (11.7 q/ha) and $T_0$ (11.1 q/ha). $T_1$ was statistically significant from $T_2$ and $T_0$ but at par with $T_3$. $T_3$ is statistically significant from $T_0$ but at par with $T_2$. During the year 2015-16 also the Pendimethalin performed the best as compared to other herbicide.

In both the years Pendimethalin, Quizalfop-ethyl and Imazethapyr caused significant reduction of Cuscuta weed density in lentil. Pendimethalin inhibited growth of both the narrow and broad leaf leaf weeds in lentil (Chaudhary *et al.*, 2011). In lentil and chick pea, pendimethalin and Imazethapyr application resulted in significant reduction in weed density of Cuscuta (Mishra *et al.*, 2005). In alfa-alfa, significant reduction of Dodder seedlings is achieved by post emergence application of Imazethapyr (Cudney and Lanini, 2000). Selective control of dodder was achieved by Pendimethalin in carrot, onion and alfalfa (Orloff and Cudney, 1987). In green gram, weed density was significantly influenced by Pendimethalin, Imazethapyr and Quizalfop ethyl however the lowest weed density was recorded in case of Pendimethalin but in case of Imazethapyr and Quizalfop ethyl treatments was the same (Ali *et al.*, 2011). In niger also, pendimethalin results in significant reduction in Cuscuta density (Mishra *et al.*, 2009). These results are in conformity with our findings.

In case of Black gram use of Pendimethalin and Imazethapyr enhanced the pod formation of in comparison to Cuscuta infected plots (Mishra *et al.*, 2005). In lentil and chick pea, Pendimethalin at the rate of 1kg/ha increase seed yield significantly (Mishra *et al.*, 2005). Paraxon, Whipsuper, Ronstar and Topstar are herbicidal treatments of lentil and applied after sowing of seed, significantly reduce weed population and increased number of pods per plant as compared to untreated plots (Akhtar *et al.*, 2013). Significantly higher

number of capsules per plant were harvested from herbicide butralin treatment, followed by metosulam, tribenuron-methyl, and fluazifop-p-butyl, respectively in dodder infected flax crop (Soliman and Hamza, 2010). All these findings are in congruency with our findings. In the present investigation, pods per plant increased by Pendimethalin, Imazethapyr and Quizalfop treatments.

Mishra *et al.,* 2007 reported that dodder caused significant yield loss in Niger (85.9% yield loss) followed by greengram (81.6%) sesame (66.8%), soybean (48%), blackgram (27%), pigeonpea (24.8%) and groundnut (17.8%). Pre-emergence application of Pendimethalin and post emergence application of imazethapyr reduces density of Cuscuta and increased yield significantly in chick pea, lentil and linseed whereas Imazethapyr did not result in significant yield increase, rather showed phytotoxic effect (Mishra *et al.,* 2005). In black gram, pre-emergence application of Fluchloralin and Pendimethalin significantly increased yield (Kumar *et al.,* 2000, Mishra *et al.,* 2004), however post emergence application of glyphosate and bentazone did not control Cuscuta weed effectively and there was no significant increase in yield (Kumar *et al.,* 2000). Lentil yield was significantly higher in Pendimethalin treated plots (Chaudhary *et al.,* 2011). All these findings are in conformity with our findings. In present investigation, the maximum yield increase was recorded in Pendimethalin treatment whereas the yield increase by Imazethapyr and Quizalfop ethyl treatments were at par with control.

In this investigation, Pendimethalin caused maximum reduction of weed count in comparison to Imazethapyr and Quizalfop ethyl and control. Average number of pod per plant and yield was also recorded maximum in case of Pendimethalin as compared to Imazethapyr and Quizalfop ethyl and control. Hence, Pendimethalin was found best in management of cuscuta.

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