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# Weed Control Efficacy of Herbicides in Zero Till Wheat

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## ABSTRACT

Field experiments were conducted at the experimental farm of the Department of Agronomy and Agromet., PAU, Ludhiana, during 2003-04 and 2004-05. The experimental field was sandy-loam in texture with 72.7% sand, 11.7% silt and 15.6% clay and was under rice-wheat sequence from last many years. Wheat sown with zero till technique after the spray of paraquat recorded significantly less dry matter of *Phalaris minor* as compared to conventional till sown crop. Also the dry matter of broadleaf weeds was found to be significantly higher in zero till sown crop without paraquat application than the other tillage treatments. Mesosulfuron+iodosulfuron 12 or 15 g $ha^{-1}$ and sulfosulfuron 25 g $ha^{-1}$ provided effective control of *P. minor* and broadleaf weeds, whereas clodinafop 60 g $ha^{-1}$ and fenoxaprop-p-ethyl 100 g $ha^{-1}$ controlled only *P. minor*. Significantly higher grain yield was recorded in zero till sown crop after spraying paraquat than zero till without paraquat spray as well as conventional tillage treatments and the former treatment gave 15.8% higher yield than the latter ones. On an average of two years, highest grain yield (4266 kg $ha^{-1}$) was recorded in meso+iodo 15 g $ha^{-1}$ and it was followed by sulfosulfuron, fenoxaprop-p-ethyl fb 2, 4-D and clodinafop fb 2, 4-D, respectively.

## INTRODUCTION

Wheat (*Triticum aestivum* L.) occupies the prime position among the food crops of the world, in terms of acreage and production and is second important cereal crop of India (next to rice). Rice-wheat rotation is commonly adopted cropping system of north India in general and Punjab in particular where it is practised on more than 80% of net sown area. In spite of best efforts by the state government for diversification, this cropping system is highly popular among the Punjab farmers due to its more economic returns. *Phalaris minor* is the most dominating weed of this system and the problem of this weed persists for last many years even with the use of selective herbicides, which may be due to many reasons.

A new tillage technology i. e. sowing the wheat crop without seed bed preparatory tillage operations (zero till sowing) is gaining importance in the Indo-Gangetic plains particularly in Haryana and Punjab. In Punjab during **rabi** 2004-05 more than 3.0 lac hectares of wheat were sown with zero till technology and this area may increase in the near future due to reduced cost of cultivation, advanced sowing (10-15 days) of wheat and reduced ill effects of first irrigation on crop particularly in heavy soils. With the widespread adoption of mechanical harvesting with combine harvesters, an enormous quantity of rice straw is left in the field after the harvest of rice crop, which offers a serious problem during sowing of succeeding wheat crop. Most of the farmers burn the rice residues as it is easy and quick alternative for rice straw incorporation. These studies were planned to see the performance of recommended herbicides for conventional till crop in the zero till technology.

## MATERIALS AND METHODS

A field experiment was conducted on the research farm of the Department of Agronomy and Agrometeorology during the **rabi** seasons of 2003-04 and 2004-05. The experimental field was sandy loam in texture with 72.7, 11.7 and 15.6% of sand, silt and clay, respectively. This experiment was laid out in split plot design with three tillage treatments in main plots and eight weed control treatments in sub-plots. The tillage treatments included sowing of

wheat crop after conventional tillage (4 to 5 harrows) and sowing of wheat in zero till field with or without the application of contact herbicide i. e. paraquat at 0.30 kg $ha^{-1}$. The herbicide treatments included alone application of clodinafop at 60 g $ha^{-1}$ and its follow up application with 2, 4-D sodium salt at 0.5 kg $ha^{-1}$, fenoxaprop-p-ethyl at 100 g $ha^{-1}$ alone and followed by 2, 4-D sodium salt at 0.5 kg $ha^{-1}$, sulfosulfuron at 25 g $ha^{-1}$ and mesosulfuron+iodosulfuron at 12 and 15 g $ha^{-1}$. An unweeded (control) was also kept for comparison. The spray of herbicides was done with knapsack sprayer fitted with flat fan nozzle with discharge rate of 250 litres per hectare. 2, 4-D was applied two days after the application of clodinafop or fenoxaprop-p-ethyl.

Sowing of PBW-343 variety of wheat was done on Nov. 17, 2003 and Nov. 3, 2004 at seed rate of 100 kg $ha^{-1}$. Sowing of zero till plots was done with Pantnagar zero till drill, whereas of conventional tillage plots with ordinary seed-cum-fertilizer drill. Sowing of zero till plots was made after sickle harvest of rice. Crop was raised by applying 125 kg N, 62.5 kg $P_2O_5$ and 40 kg $K_2O$ per hectare. Whole of phosphorus, potash and half of nitrogen was applied through the broadcast method at the time of sowing, whereas remaining half dose was given with first irrigation. Dry matter of *P. minor* and broadleaf weeds was recorded separately at the time of harvest from the whole net plot which was 13.5 $m^2$ during first year and 11.25 $m^2$ during second year.

## RESULTS AND DISCUSSION

### Effect on Weeds

Crop sown with zero till technology after spray of paraquat recorded significantly less dry matter of *P. minor* as compared to zero till sown wheat without paraquat application as well as conventional tillage crop (Table 1), which may be due to reason that all the emerged seedlings of weeds were killed by paraquat in the former treatment. The differences in dry matter accumulation by *P. minor* were found to be non-significant in the treatments of zero till without paraquat spray and conventional tillage sown crop. Similarly, Yaduraju and Mishra (2002) as well as Dixit *et al.* (2003) reported minimum total weed count with zero tillage followed by minimum and conventional methods of tillage.

The dry matter of *P. minor* in the wheat crop

Table 1. Dry matter of *Phalaris minor* and broadleaf weeds as influenced by different tillage and weed control treatments

| Treatment | Dry matter of weeds (g $m^{-2}$) | | | |
|---|---|---|---|---|
| | *Phalaris minor* | | Broadleaf weeds | |
| | 2003-04 | 2004-05 | 2003-04 | 2004-05 |
| **Tillage techniques** | | | | |
| Zero tillage with paraquat spray | 35.1 | 27.7 | 33.7 | 31.3 |
| Zero tillage without paraquat spray | 54.2 | 61.6 | 51.2 | 50.6 |
| Conventional tillage | 53.8 | 54.4 | 37.4 | 33.3 |
| LSD (P=0.05) | 11.1 | 12.4 | 9.4 | 11.3 |
| **Weed control treatments** | | | | |
| Clodinafop 60 g $ha^{-1}$ | 14.7 | 17.2 | 93.1 | 79.0 |
| Clodinafop 60 g $ha^{-1}$ fb 2, 4-D | 9.2 | 11.1 | 7.3 | 17.2 |
| Fenoxaprop-p-ethyl 100 g $ha^{-1}$ | 18.2 | 25.2 | 89.0 | 77.3 |
| Fenoxaprop-p-ethyl 100 g $ha^{-1}$ fb 2, 4-D | 16.3 | 20.3 | 14.2 | 21.1 |
| Sulfosulfuron 25 g $ha^{-1}$ | 8.3 | 9.1 | 25.1 | 17.1 |
| Mesosulfuron+iodosulfuron 12 g $ha^{-1}$ | 7.2 | 10.3 | 17.2 | 19.2 |
| Mesosulfuron+iodosulfuron 15 g $ha^{-1}$ | 0 | 7.0 | 5.1 | 11.1 |
| Control (Unweeded) | 308.1 | 283.0 | 75.2 | 65.3 |
| LSD (P=0.05) | 42.5 | 31.7 | 27.7 | 25.9 |

treated with clodinafop at 60 g $ha^{-1}$, fenoxaprop-p-ethyl at 100 g $ha^{-1}$, sulfosulfuron at 25 g $ha^{-1}$ and mesosulfuron+iodosulfuron at 12 or 15 g $ha^{-1}$ was found to be at par among themselves and these values were significantly lower than the unweeded (control) treatment. The dry matter of broadleaf weeds was found to be significantly higher in zero till without paraquat spray treatment during both the years as compared to zero till with paraquat spray and conventional tillage treatments. Alone application of clodinafop/fenoxaprop-p-ethyl resulted in significantly higher dry matter accumulation by broadleaf weeds as compared to when these treatments were integrated with follow up application of 2, 4- D, as these herbicides had absolutely no effect on broadleaf weeds. Singh *et al.* (2003-04) also reported that integration of 2, 4-D with clodinafop helped in controlling *P. minor* as well as broadleaf weeds in wheat and hence a significant increase in grain yield was reported in this treatment as compared to alone application of clodinafop. On the other hand, application of sulfosulfuron or mesosulfuron+ iodosulfuron provided very effective control of broadleaf weeds as the dry matter accumulation by weeds in this treatment was found to be at par with clodinafop/fenoxaprop-p-ethyl followed by 2, 4-D treatment. Clodinafop/fenoxaprop-p-ethyl produced dry matter of broadleaf weeds at par with the unweeded (control) treatment. Parsad *et al.* (2002) reported lower dry matter accumulation by weeds in zero tillage as compared to conventional tillage system of planting wheat.

**Effect on Crop**

Final crop plant height was not influenced significantly with different tillage techniques. During 2003-04 all the weed control treatments, except alone application of fenoxaprop-p-ethyl, produced significantly more plant height than unweeded crop. Similarly, during 2004-05, all weed control treatments, excepting alone application of clodinafop and fenoxaprop-p-ethyl, produced significantly taller plants than unweeded treatment (Table 2). The number of spikes was significantly higher in zero till sown crop after the application of paraquat than the crop sown with other tillage techniques. Crop treated with clodinafop/ fenoxaprop-p-ethyl alone produced significantly less number of spikes as compered to all other herbicide treatments. However, number of spikes in unweeded crop was found to be significantly less than all the herbicide treatments. Spike length was not influenced by any tillage technique significantly. All the weed control treatments resulted in significant increase in spike length as compared to unweeded crop. Among the herbicide treatments, minimum spike length was recorded in alone application of fenoxaprop-p-ethyl during 2003-04 which was significantly less than clodinafop alone or followed by 2, 4-D, fenoxaprop-p-ethyl followed by 2, 4-D and mesosulfuron+ iodosulfuron at 15 g $ha^{-1}$ treatments. During 2004-05, significantly smaller spikes were recorded in alone application of clodinafop and fenoxaprop-p-ethyl as compared to all other herbicide treatments.

Significantly higher grain yield was recorded in zero till sown crop after the application of paraquat as compared to zero till crop without paraquat application and conventional tillage crop. Among herbicide treatments alone application of clodinafop/ fenoxaprop-p-ethyl resulted in significant reduction in grain yield of wheat as compared to all other herbicide treatments. Less yield in clodinafop and fenoxaprop-p-ethyl alone treatments may be due to more population of broadleaf weeds in these treatments. The yield of unweeded crop was significantly lower as compared to herbicide treated crop. On an average of two years, crop sown with zero till technology after the application of paraquat increased the wheat grain yield by 16.3% than zero till without paraquat and 15.8% than conventional tillage crop. Among the weed control treatments, highest grain yield of 4266 kg $ha^{-1}$ was recorded in mesosulfuron+iodosulfuron at 15 g $ha^{-1}$, which was followed by its lower dose i. e. 12 g $ha^{-1}$ and sulfosulfuron at 25 g $ha^{-1}$ and all these treatments increased grain yield by 150.2, 146.3 and 137.5% than unweeded (control), respectively. A follow up application of 2, 4-D with clodinafop and fenoxaprop-

Table 2. Effect of tillage and weed control treatments on yield and yield attributes of wheat

| Treatment | Plant height (cm) | | No.of spikes $m^{-2}$ | | Spike length (cm) | | Grain yield (kg $ha^{-1}$) | | |
|---|---|---|---|---|---|---|---|---|---|
| | 2003-04 | 2004-05 | 2003-04 | 2004-05 | 2003-04 | 2004-05 | 2003-04 | 2004-05 | Mean |
| **Tillage techniques** | | | | | | | | | |
| Zero tillage with paraquat spray | 62.3 | 62.6 | 279.5 | 248.9 | 10.1 | 10.0 | 4410 | 3203 | 3807 |
| Zero tillage without paraquat spray | 61.4 | 61.6 | 230.4 | 251.6 | 9.9 | 9.9 | 3482 | 3070 | 3276 |
| Conventional tillage | 59.3 | 59.7 | 220.5 | 281.3 | 10.0 | 10.1 | 3673 | 2905 | 3289 |
| LSD (P=0.05) | NS | NS | 30.6 | 25.9 | NS | NS | 301 | 126 | - |
| **Weed control treatments** | | | | | | | | | |
| Clodinafop 60 g $ha^{-1}$ | 60.2 | 54.5 | 216.9 | 219.6 | 10.6 | 9.3 | 3201 | 2581 | 2891 |
| Clodinafop 60 g $ha^{-1}$ fb 2, 4-D 0.5 kg $ha^{-1}$ | 62.3 | 64.1 | 279.5 | 293.0 | 10.6 | 10.6 | 4130 | 3580 | 3855 |
| Fenoxaprop-p-ethyl 100 g $ha^{-1}$ | 58.9 | 58.7 | 203.4 | 219.2 | 9.7 | 9.2 | 3692 | 1954 | 2823 |
| Fenoxaprop-p-ethyl 100 g $ha^{-1}$ fb 2, 4-D 0.5 kg $ha^{-1}$ | 62.2 | 64.2 | 286.7 | 301.1 | 10.3 | 10.8 | 3944 | 3797 | 3871 |
| Sulfosulfuron 25 g $ha^{-1}$ | 61.4 | 63.1 | 293.0 | 293.0 | 10.0 | 10.5 | 4551 | 3549 | 4050 |
| Mesosulfuron+iodosulfuron 12 g $ha^{-1}$ | 61.8 | 65.3 | 292.1 | 305.6 | 10.1 | 10.8 | 4622 | 3775 | 4199 |
| Mesosulfuron+iodosulfuron 15 g $ha^{-1}$ | 63.4 | 65.1 | 291.6 | 305.1 | 10.6 | 10.6 | 4720 | 3811 | 4266 |
| Control (Unweeded) | 57.9 | 54.6 | 130.1 | 148.1 | 8.1 | 8.4 | 1983 | 1426 | 1705 |
| LSD (P=0.05) | 2.07 | 6.06 | 41.4 | 24.3 | 0.51 | 0.43 | 562 | 493 | - |

NS–Not Significant.

p-ethyl also resulted in 126.1 and 127.0% increase in grain yield than unweeded (control), respectively. More grain yield of wheat in zero tillage system of wheat sowing as compared to conventional tillage system was also reported by Parsad *et al.* (2002), Yaduraju and Mishra (2002) and Dixit *et al.* (2003).

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