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# Effect of planting patterns and weed control treatments on *Phalaris minor* growth and productivity of wheat (*Triticum aestivum*)

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## ABSTRACT

An experiment was conducted at Ludhiana, during *rabi* 2006-07 and 2007-08 to study the effect of different planting patterns and weed control treatments on the control of *Phalaris minor* Retz. and productivity of wheat (*Triticum aestivum* L. emend. Firori & Paol). The experiment was laid out in strip plot design with planting patterns of wheat in horizontal blocks and weed control treatments in vertical blocks. Among the planting patterns, zero till sowing with Happy seeder recorded least population and dry matter accumulation of *P. minor* at 60 days after sowing and at harvest, which was statistically at par with other planting pattern treatments *i.e.* zero till sowing, bed planting and conventional tillage. Growth parameters, yield attributes and yield of wheat were not significantly influenced by planting patterns. Population and dry matter accumulation of *P. minor* were significantly reduced with post-emergence application of sulfosulfuron 25 g/ha, mesosulfuron + iodosulfuron 12 g/ha and pinoxaden 50 g/ha when compared with unweeded control during both years of investigation. Significantly more grain and biological yield were recorded in all herbicidal treatments as compared to unweeded control.

***Key words*:** *Phalaris minor*, Productivity, Rice, Weed control, Wheat

Rice (*Oryza sativa* L.) - wheat (*Triticum aestivum* L. emend. Fiori & Paol) is the predominant cropping system of North India in general and Punjab in particular, contributing towards food security of the country to a large extent. Severe competition from weeds is one of the important factor determining productivity and sustainability of the system. Weeds cause yield reduction to the tune of 15 to 50% or sometime more depending upon the weed density and type of weed flora (Jat *et al*., 2003). Wheat fields in North India are badly infested with wide range of grassy and non-grassy weeds in general and *Phalaris minor* Retz. in particular. Weeds can be effectively controlled with the use of selective herbicides. However, due to continuous use of these herbicides there are chances of shift in weed flora and development of resistance. Use of herbicides can be effectively integrated with different planting patterns like zero till sowing with Happy seeder, zero till sowing in standing stubbles, zero till sowing with complete or partial burning of stubbles and bed planting to allow the competition in favour of wheat.

Presently, crop residues in combine-harvested rice fields are being burnt causing a serious atmospheric pollution. Mostly farmers resort to the burning practice as it is easy and quick alternative. This practice leads to tremendous annual loss of plant nutrients *i.e*. 85 to 95, 25.5 to 28.5 and 425 to 475 thousand tonnes of N, P and K, respectively (Anonymous, 2009). Happy seeder combines the stubble mulching and seed drilling functions into the one machine. Zero till sowing of wheat saves time and energy whereas considerable amount of these valuable resources are spent on preparing the land for wheat cultivation. The raised bed planting of wheat, a new technology, permits use of mechanical hoeing with tractor which improves agro-ecosystem and encounters with lesser population and dry weight of weeds as compared to conventional flat sown wheat (Dhillon *et al*., 2005). Keeping this in view, the present study was made to assess the impact of planting pattern and weed control treatments on *Phalaris minor* control and wheat performance.

## MATERIALS AND METHODS

A field experiment was carried out in loamy sand soil, low in organic carbon (0.39%) and available nitrogen (198 kg/ha), high in available phosphorus (25.6 kg/ha) and medium in potassium (143 kg/ha) at 0-15 cm soil depth during *rabi* 2006-07 and 2007-08, at the Students' Research Farm, Department of Agronomy, Punjab Agricultural University, Ludhiana. The experiment consisting of 5 planting patterns viz., zero till sowing (ZTS) with Happy seeder (combine harvested), ZTS in standing stubbles

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(loose straw removed), ZTS (complete burning of rice straw), bed planting, BP (rice straw removed) and conventional tillage, CT (partial burning of rice straw) in horizontal blocks. Weed control treatments, viz. sulfosulfuron 25 g/ha, mesosulfuron + iodosulfuron 12 g/ha, pinoxaden 50 g/ha and unweeded control in vertical blocks was laid out in strip plot design with four replications. The gross sub-plot size was 9 m × 3.25 m and net plot harvested was 5.3 m × 2.1 m.

The sowing of 'PBW 502' wheat was done on 31 October, 2006 and 9 November, 2007 with tractor drawn drill as per treatment using seed rate of 100 kg/ha. Light planking was given in order to cover the seeds properly with soil after sowing. However, in bed planting treatment, a seed rate of 75 kg/ha was used. Recommended doses of N (125 kg/ha), P (27.5 kg/ha) and K (25 kg/ha) were applied through urea, diammonium phosphate and muriate of potash (MOP), respectively. Whole diammonium phosphate, MOP and half of N was applied at the sowing and remaining N was applied with first irrigation.

The wheat crop was sown after raising non-experimental crop of rice by managing rice straw according to different planting patterns. Sowing of wheat in standing stubbles was done with Happy seeder, which combines the stubble mulching and seed drilling functions into the one machine. The strip of stubble in front of the sowing tynes is cut, lifted up and placed behind the drilled row as mulch. The sowing tynes therefore engages bare soil. A strip tillage rotor was placed in between the straw managing unit and furrow openers to provide better soil pulverization to enhance the soil and seed contact. There are few added advantages of crop residue also. Sowing of wheat in standing stubbles was done with zero till drill after removing the loose straw. In other treatments, crop was directly sown in the field with zero till drill after complete burning of rice straw. In bed sowing, field was prepared as per conventional tillage (CT) technique followed by preparation of beds with bed planter which were 67.5 cm wide (37.5 cm bed top and 30 cm furrow) and sowing of wheat was done in two rows 20 cm apart on the bed top.

**Table 1.** Periodic population ($m^{-2}$), dry matter accumulation ($g/m^2$) of *Phalaris minor* and weed control efficiency as influenced by various planting pattern and weed control treatments

| Treatment | Population | | | | Dry matter accumulation | | | | Weed control efficiency (%) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 60 DAS | | At harvest | | 60 DAS | | At harvest | | 60 DAS | At harvest |
| | 2006-07 | 2007-08 | 2006-07 | 2007-08 | 2006-07 | 2007-08 | 2006-07 | 2007-08 | 2006-07 | 2007-08 |
| *Planting pattern* | | | | | | | | | | |
| ZTS with Happy seeder | 3.8 (27.6) | 3.3 (22.5) | 4.0 (30.1) | 4.1 (31.1) | 2.3 (9.3) | 2.1 (6.8) | 8.9 (134.3) | 8.4 (116.0) | 72.51 | 72.52 |
| ZTS in standing stubbles | 3.9 (27.9) | 3.3 (23.5) | 4.1 (30.5) | 4.1 (31.8) | 2.4 (10.3) | 2.2 (7.9) | 9.0 (136.9) | 8.5 (118.7) | 71.97 | 71.88 |
| ZTS after burning | 4.7 (32.1) | 4.4 (28.8) | 4.8 (36.0) | 4.8 (36.7) | 3.4 (13.7) | 3.2 (12.2) | 12.0 (142.7) | 10.5 (124.5) | 70.79 | 70.50 |
| Bed planting | 4.4 (30.0) | 4.2 (27.7) | 4.2 (32.3) | 4.3 (33.3) | 2.8 (11.4) | 2.2 (8.2) | 9.2 (138.7) | 9.0 (121.5) | 71.61 | 71.21 |
| CT after partial burning | 4.7 (32.2) | 4.5 (29.1) | 4.9 (36.8) | 4.9 (37.1) | 3.6 (14.5) | 3.2 (12.0) | 13.0 (143.9) | 11.5 (126.7) | 70.54 | 69.98 |
| SEm± | 0.1 | 0.2 | 0.1 | 0.1 | 0.2 | 0.3 | 0.1 | 0.1 | | |
| CD (P= 0.05) | NS | NS | NS | NS | NS | NS | NS | NS | | |
| *Weed control treatment* | | | | | | | | | | |
| Sulfosulfuron | 1.6 (1.5) | 1.4 (1.1) | 1.8 (2.4) | 1.8 (2.1) | 1.1 (0.2) | 1.2 (0.4) | 4.6 (20.1) | 4.4 (18.1) | 95.86 | 95.71 |
| Mesosulfuron + iodosulfuron | 1.5 (1.3) | 1.4 (1.0) | 1.8 (2.1) | 1.7 (1.9) | 1.1 (0.3) | 1.1 (0.2) | 4.5 (18.9) | 4.3 (17.9) | 96.13 | 95.75 |
| Pinoxaden | 1.7 (1.9) | 1.5 (1.1) | 1.9 (2.7) | 1.9 (2.8) | 1.1 (0.3) | 1.2 (0.4) | 4.9 (22.7) | 4.7 (20.7) | 95.35 | 95.09 |
| Unweeded control | 10.4 (107.0) | 9.6 (92.0) | 10.9 (118.0) | 11.0 (122.0) | 6.2 (40.0) | 5.3 (30.0) | 22.1 (489.0) | 20.5 (422.0) | | |
| SEm± | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.2 | 0.1 | 0.2 | | |
| CD (P= 0.05) | 0.4 | 0.4 | 0.5 | 0.3 | 0.4 | 0.5 | 0.5 | 0.5 | | |

DAS, Days after sowing

Data is transformed to $\sqrt{x+1}$; Values in the parenthesis are original values

**Table 2.** Yield attributes of wheat as influenced by planting pattern and weed control treatments

| Treatment | Effective tillers (per meter row length) | | Ear length (cm) | | Grains/ ear | | 1,000-grain weight (g) | |
|---|---|---|---|---|---|---|---|---|
| | 2006-07 | 2007-08 | 2006-07 | 2007-08 | 2006-07 | 2007-08 | 2006-07 | 2007-08 |
| *Planting pattern* | | | | | | | | |
| ZTS with Happy seeder | 83.4 | 95.9 | 9.09 | 9.26 | 48.7 | 49.1 | 41.8 | 44.7 |
| ZTS in standing stubbles | 83.0 | 93.4 | 8.91 | 9.18 | 48.3 | 48.4 | 40.8 | 44.3 |
| ZTS after burning | 76.5 | 89.3 | 8.74 | 8.96 | 46.9 | 48.0 | 39.9 | 43.3 |
| Bed sowing | 81.6 | 92.5 | 8.85 | 9.09 | 47.5 | 48.3 | 40.6 | 43.7 |
| CT after partial burning | 74.1 | 87.6 | 8.70 | 8.89 | 46.8 | 47.9 | 39.9 | 43.2 |
| SEm± | 3.1 | 3.5 | 0.13 | 0.12 | 0.6 | 0.4 | 0.6 | 0.4 |
| CD (P= 0.05) | NS | NS | NS | NS | NS | NS | NS | NS |
| *Weed control treatment* | | | | | | | | |
| Sulfosulfuron 25 g/ha | 83.1 | 92.5 | 9.06 | 9.59 | 50.8 | 49.7 | 41.4 | 46.9 |
| Mesosulfuron + iodosulfuron 12 g/ha | 83.9 | 94.9 | 9.21 | 9.57 | 51.9 | 50.9 | 42.0 | 48.1 |
| Pinoxaden 50 g/ha | 81.0 | 92.0 | 9.07 | 9.32 | 49.6 | 49.4 | 41.0 | 45.8 |
| Unweeded control | 70.1 | 78.1 | 8.08 | 7.81 | 38.3 | 41.8 | 37.9 | 34.5 |
| SEm± | 2.9 | 3.3 | 0.22 | 0.16 | 0.8 | 0.6 | 0.7 | 0.8 |
| CD (P= 0.05) | 9.5 | 10.2 | 0.72 | 0.51 | 2.4 | 1.8 | 2.4 | 2.4 |

Ordinary drill was used for sowing of wheat in CT treatment after partial burning of rice straw.

Herbicides were applied as post emergence (after first irrigation) 35 days after sowing with the help of knapsack sprayer fitted with flat fan nozzle using 250 liters of water/ha. Blanket application of metsulfuron at 5 g/ha was made 4-5 days after the spray of pinoxaden herbicide as well as in unweeded (control) plots to control non-target weeds i.e. broad leaf weeds from the experiment. Population and dry matter of *Phalaris minor* was recorded 60 days after sowing and at harvest from a quadrate measuring 25 $cm^2$. Weed Control Efficiency (WCE) was worked as follows:

$$WCE = DMC - DMT \div DMC \times 100$$

DMC – Dry matter of weeds in control (unweeded) treatment, DMT – Dry matter of weeds in a treatment.

Note: Original dry matter values were taken to calculate WCE.

## RESULTS AND DISCUSSION

### *Effect on Phalaris minor*

The results revealed that population and dry matter accumulation (DMA) of *P. minor* were not significantly influenced by different planting patterns during both the years (Table 1). However, at 60 days after sowing and at harvest, ZTS with Happy seeder recorded numerically less population and DMA by *P. minor* when compared with other treatments. Dash and Varma (2003) also reported reduced weed population when residues were present as mulch.

Among weed control treatments, during both years, maximum WCE was observed with mesosulfuron + iodosulfuron being at par with sulfosulfuron, and pinoxaden recorded the least population and DMA of *P. minor* than the unweeded control treatment at 60 DAS and at harvest. Similar results were also reported by Brar *et al.* (2007). The interaction effects were found to have non-significant impact on population and dry matter of *P. minor*.

### *Effect on wheat*

All the planting patterns were found to be at par with respect to production of effective tillers, number of grains/ ear and test weight during both the years of study (Table 2). Similar findings were also reported by Dixit *et al.* (2003). The non-significant differences among treatments for yield attributes was reflected on yield also (Table 3). However, ZTS with Happy Seeder gave numerically higher grain yield than other planting patterns during both years. Similar results have been reported by Mishra *et al.* (2005),Walia *et al.* (2005) and Kaur *et al.* (2007).

Amongst the various weed control treatments, all the herbicidal treatments were found to be significantly superior to unweeded control treatment with respect to production of above yield attributes, (Table 2) biological and grain yield (Table 3) during both years of study. Similar findings were also reported by Kaur (2005). The results are in confirmity with those of Singh (2007). The interaction effect between planting techniques and weed control treatments for grain and biological yield were found to be non-significant.

The highest net return (mean of 2 years) was recorded with ZTS with Happy seeder, followed by ZTS in standing stubbles, bed sowing, ZTS after burning and CT after

**Table 3.** Influence of planting pattern and weed control treatments on grain yield, biological yield and net returns

| Treatment | Grain yield (t/ha) | | Biological yield (t/ ha) | | Net returns (Rs/ha) | |
|---|---|---|---|---|---|---|
| | 2006-07 | 2007-08 | 2006-07 | 2007-08 | 2006-07 | 2007-08 |
| *Planting pattern* | | | | | | |
| ZTSwith Happy Seeder | 4.54 | 4.77 | 11.35 | 11.91 | 37,215 | 39,174 |
| ZTS in standing stubbles | 4.49 | 4.72 | 11.29 | 11.81 | 36,715 | 38,674 |
| ZT S after burning | 4.36 | 4.59 | 11.02 | 11.54 | 35,425 | 37,504 |
| Bed sowing | 4.44 | 4.69 | 11.14 | 11.76 | 36,581 | 38,900 |
| CT after partial burning | 4.32 | 4.54 | 10.91 | 11.45 | 35,005 | 36,913 |
| SEm± | 0.10 | 0.08 | 0.23 | 0.16 | | |
| CD (P=0.05) | NS | NS | NS | NS | | |
| *Weed control treatments* | | | | | | |
| Sulfosulfuron 25 g/ha | 5.09 | 5.11 | 12.59 | 12.63 | 42,665 | 42,614 |
| Mesosulfuron + iodosulfuron 12 g/ha | 5.14 | 5.16 | 12.68 | 12.65 | 43,165 | 43,114 |
| Pinoxaden 50 g/ha | 5.03 | 5.09 | 12.48 | 12.64 | 42,115 | 41,844 |
| Unweeded control | 2.47 | 3.29 | 6.81 | 8.84 | 16,485 | 24,434 |
| SEm± | 0.1 | 0.08 | 0.24 | 0.11 | | |
| CD (P= 0.05) | 0.31 | 0.27 | 0.77 | 0.35 | | |

partial burning, respectively (Table 3). All the weed control treatments have higher net return when compared with unweeded control. On an average, mesosulfuron + iodosulfuron, sulfosulfuron and pinoxaden treatments gave additional net profits of Rs 22,680, 22,180 and 21,520/ha respectively when compared with unweeded control treatment.

From the 2 years study it is concluded that zero till sowing with Happy seeder and herbicides usage is effective for *Phalaris minor* management and high productivity and profitability of wheat.

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