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Influence of Planting Techniques and Weed Control Treatments on Nutrient Uptake by *P. minor* Retz. and Broadleaf Weeds in Wheat (*Triticum aestivum* L.)

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ABSTRACT

Field study conducted at experimental farm of Punjab Agricultural University, Ludhiana (India) during **rabi** seasons of 2004-05 and 2005-06 revealed that nutrient uptake by *Phalaris minor* as well as broadleaf weeds were significantly reduced with zero till sowing in standing stubbles, zero till sowing after partial burning and bed planting techniques as dry matter accumulation by weeds was significantly less in these treatments as compared to conventional tillage and zero tillage techniques (without stubbles). Post-emergence application of clodinafop 60 g/ha f. b. 2, 4-D 0.5 kg/ha, sulfosulfuron 25 g/ha and mesosulfuron+iodosulfuron 12.0 g/ha significantly reduced the dry matter accumulation by all weeds and hence significantly reduced uptake of N, P and K by both *P. minor* and broadleaf weeds, whereas clodinafop 60 g/ha alone reduced dry weight and nutrient uptake of *P. minor* only as compared to control (unweeded) crop.

INTRODUCTION

Uncontrolled weed growth may reduce wheat yield ranging from 15-40% depending upon magnitude, nature and duration of weed infestation (Jat *et al.*, 2003). Weeds usually absorb nutrients faster and in relatively larger amounts than crop and, therefore, may decrease crop yield even at higher rate of fertilizer application. Herbicides can be effectively integrated with different planting techniques, like zero tillage without stubbles, with stubbles, with partially burnt stubbles and bed planting, to allow the competition in favour of wheat. Among the herbicides, isoproturon is a commonly used herbicide for the control of grass weeds and 2, 4-D is effective against broadleaf weeds. However, their continuous use has either resulted in shift in weed flora or emergence of resistance strains in some species (Yadav *et al.*, 1996). This calls for the use of other broad spectrum herbicides either independently or in combination for the management of complex weed flora of wheat to avoid perceptible change in weed flora. The present study was, therefore, undertaken to assess the efficacy of herbicides against weeds which have direct effect on the uptake of major nutrients viz., N, P and K by *P. minor* and broadleaf weeds infesting wheat crop under different planting techniques.

MATERIALS AND METHODS

The field experiment was conducted during **rabi** seasons of 2004-05 and 2005-06 at experimental farm of Department of Agronomy, Agrometeorology and Forestry, PAU, Ludhiana. The soil of the experimental field was loamy sand in texture, normal in soil reaction (7.3) and electrical conductivity (0.26 dS/m), medium in organic carbon (4.2 g/kg), available phosphorus (18.6 kg/ha) and potassium (150 kg/ha) and low in available nitrogen (230 kg/ha). The experiment was laid out in split plot design with three replications. Five planting patterns were kept in the main plots and these were : conventional tillage, zero till sowing (without stubbles), zero till sowing in standing stubbles, zero till sowing after partial burning (farmers' practice) and bed planting. Sub-plots (weed control treatments) comprised post-emergence application (35 days after sowing) of clodinafop 60 g/ha, clodinafop 60 g/ha f. b. 2, 4-D 0.5 kg/ha, sulfosulfuron 25 g/ha, mesosulfuron+iodosulfuron 12.0 g/ha (formulated herbicide) and control (unweeded).

After harvesting paddy crop, field was ploughed twice with disc harrow and once with cultivator followed by planking in case of conventional tillage and bed planting. After pre-sowing irrigation again two ploughings followed by planking were given to facilitate the preparation of fine seed bed. The crop was directly sown in zero tillage treatments after rice harvest with sickle, in 1.0 to 1.5′ standing stubbles, without stubbles and after partial burning of rice straw. In case of bed planting treatment, beds were prepared with bed planter, which were 67.5 cm wide (37.5 cm bed top and 30 cm furrow).

The sowing of wheat was done on October 30, 2004 and November 3, 2005 with tractor drawn zero till/ ordinary drill as per treatment using seed rate of 100 kg/ ha. Sowing of bed planting treatment was done with tractor drawn bed planter (two rows/bed) using 75 kg seed/ha. Crop was raised with recommended package of practices. Nitrogen (125 kg/ha) and P_2O_5 (60 kg/ha) were applied through urea and diammonium phosphate (DAP), respectively. Half the dose of nitrogen and whole of phosphorus were applied at the time of sowing, while the remaining half dose of N was applied as broadcast after first irrigation.

Herbicides (clodinafop 60 g/ha, sulfosulfuron 25 g/ha and mesosulfuron+iodosulfuron 12.0 g/ha) were applied as post-emergence (after first irrigation) 35 days after sowing and 2, 4-D (sodium salt) 0.5 kg/ha one week thereafter at their respective doses. Spraying was done with the help of knapsack sprayer fitted with flat fan nozzle.

Weed samples were taken at the time of harvest from each plot. For recording dry matter, weeds were removed with the help of quadrant measuring 50 x 50 cm and were sun-dried and then in oven at 60°C upto complete dryness. Later on oven-dried weed samples were ground with electric grinder and chemically analysed for nitrogen, phosphorus and potassium contents. For nitrogen, weed sample weighing 0.5 g was digested in concentrated H_2SO_4 and selenium dioxide. Nitrogen was determined by using autoanalyser. To determine total phosphorus and potassium, the weed samples were digested in triple acid mixture (HNO_3, $HClO_4$ and H_2SO_4) in ratio of 9 : 3 : 1 as outlined by Piper (1966). Total phosphorus was determined by the Vanadomolybdate phosphoric yellow colour method in nitric acid system as described by Jackson (1967) and intensity of colour was measured by Spectronic-20 colorimeter at 470 m micron wavelength. Total potassium content was determined on flame photometer. The N, P and K uptake by weeds was calculated by multiplying per cent nutrient content with their respective dry matter values and expressed as kg/ha.

RESULTS AND DISCUSSION

Dry Weight of Weeds

Least dry matter accumulation by *P. minor* as well as by broadleaf weeds was observed under zero till sowing in standing stubbles followed by bed planting and zero till sowing after partial burning treatments (Table 1) which were statistically at par with each other and these three treatments resulted in significant reduction in dry matter accumulation by weeds than zero tillage (without stubbles) and conventional tillage treatments.

Table 1. Effect of planting techniques and weed control treatments on dry matter accumulation by weeds and grain yield of wheat

Treatment	Dry matter accumulation by *P. minor* (g/m^2)*		Dry matter accumulation by broadleaf weeds (g/m^2)*		Grain yield of wheat (kg/ha)	
	2004-05	2005-06	2004-05	2005-06	2004-05	2005-06
Planting techniques						
Conventional tillage	6.57 (42.1)	7.89 (61.3)	6.60 (42.5)	6.75 (44.6)	4454	4156
Zero till sowing (without stubbles)	6.05 (35.6)	7.28 (52.0)	6.67 (43.4)	6.93 (47.1)	4518	4238
Zero till sowing (in standing stubbles)	4.32 (17.7)	5.25 (26.5)	4.73 (21.4)	4.81 (22.1)	4885	4637
Zero till sowing after partial burning (Farmers' practice)	4.63 (20.9)	6.04 (35.6)	5.09 (25.0)	5.50 (29.3)	4806	4586
Bed planting	4.37 (18.1)	5.52 (29.5)	4.87 (22.7)	5.18 (25.9)	4634	4383
LSD (P= 0.05)	1.38	1.57	1.21	1.24	282	338
Weed control treatments						
Clodinafop 60 g/ha	3.38 (10.4)	6.11 (36.3)	8.18 (66.0)	8.53 (71.7)	4607	4331
Clodinafop 60 g/ha f. b. 2, 4-D 0.5 g/ha	3.55 (11.6)	6.34 (39.1)	2.66 (6.1)	2.46 (5.0)	5312	4783
Sulfosulfuron 25 g/ha	3.29 (9.9)	3.59 (11.9)	2.84 (7.1)	2.92 (7.5)	5373	5238
Meso + iodo 12.0 g/ha	2.21 (3.9)	2.26 (4.1)	2.04 (3.2)	1.88 (2.5)	5091	5023
Control (unweeded)	9.98 (98.7)	10.69 (113.4)	8.59 (72.8)	8.93 (78.7)	2914	2624
LSD (P= 0.05)	2.23	2.41	2.04	2.08	287	236

*Data weretransformed to $\sqrt{x+1}$. Values in parentheses are original values.

Weeds were reduced under zero till sowing in standing stubbles as rice straw acted as mulch, in partial burning treatment due loss of viability of weed seeds due to high temperature generated during burning and in bed planting due to drying of bed tops which reduced the germination of weeds and hence dry weight was also less under these treatments. Due to less soil disturbance under zero tillage, *P. minor* germination usually remained 30-40% less as compared to conventional tillage. Rahman *et al.* (2005) and Dhillon *et al.* (2005) also reported reduced dry weight of weeds with standing stubbles, partial burning and bed planting techniques.

Among the different weed control treatments, during both the years, control (unweeded) treatment registered significantly higher dry matter of *P. minor* than all other herbicidal treatments. During the first year, all the herbicidal treatments were statistically at par with each other, however, during the second year, amongst the different herbicides, clodinafop 60 g/ha alone and clodinafop 60 g/ha f. b. 2, 4-D 0.5 kg being statistically at par among themselves produced significantly higher dry matter by *P. minor* than sulfosulfuron 25 g/ha and mesosulfuron+iodosulfuron 12.0 g/ha treatments. During second year, clodinafop 60 g/ha provided poor control *P. minor*. Regarding broadleaf weeds, control (unweeded) treatment registered significantly higher dry matter than all the herbicidal treatments. Among the herbicidal treatments, clodinafop 60 g/ha alone recorded significantly higher dry matter of broadleaf weeds than other herbicidal treatments as this herbicide did not control broadleaf weeds. However, all other herbicidal treatments were effective against broadleaf weeds due to which less dry weight of broadleaf weeds was recorded. All the weed control treatments were equally effective against weeds under different planting techniques. Walia *et al.* (2005) also reported lower dry weight of weeds in herbicide treated crop than control (unweeded) under zero tillage.

Nutrient Content in *P. minor* and Broadleaf Weeds

The data presented in Table 2 indicate that neither the planting techniques nor the weed control treatments influenced the nitrogen, phosphorus and potassium content of *P. minor* as well as broadleaf weeds significantly during both the years. Non-significant differences in nutrient content of weeds were also reported by Walia (1994).

Nutrient Uptake by *P. minor*

During the first year, among the different planting techniques, zero till sowing in standing stubbles recorded the lowest N, P and K uptake by *P. minor* (Table 3) which was statistically at par with bed planting and zero till sowing after partial burning (farmers' practice) treatments and these three treatments recorded significantly lower N, P and K uptake by *P. minor* than conventional tillage and zero tillage (without stubbles) treatments. During the second year, regarding P uptake same trend was observed as that of first year, whereas in case of N and K, zero till sowing in standing stubbles treatment again recorded the least N and K uptake by *P. minor* which was statistically at par with bed planting technique and recorded significantly lower uptake than all other treatments. Further, zero till sowing after partial burning and bed planting techniques were statistically at par with each other and recorded significantly less uptake than zero tillage (without stubbles) and conventional tillage treatments. Higher N, P and K uptake in zero tillage (without stubbles) and conventional tillage treatments was mainly due to more dry matter of weeds in these treatments. Pandey *et al.* (2001) also reported higher uptake of nutrients as weed dry matter was higher.

Nutrient (N, P and K) uptake by *P. minor* was also significantly influenced by various weed control treatments during both the years (Table 3). During the first year, mesosulfuron + iodosulfuron 12.0 g/ha recorded significantly less N, P and K uptake than all other herbicidal treatments which were statistically at par with each other. Further, all the herbicidal treatments registered significantly lesser N, P and K uptake by *P. minor* than control (unweeded) treatment. During the second year, mesosulfuron+iodosulfuron 12.0 g/ha again recorded significantly lower N, P and K uptake than all other treatments. Further, sulfosulfuron 25 g/ha recorded significantly lower N, P and K uptake than clodinafop 60 g/ha, clodinafop 60 g/ha f. b. 2, 4-D 0.5 kg/ha and control (unweeded) treatments. Post-emergence application of clodinafop 60 g/ha alone and clodinafop 60 g/ha f. b. 2, 4-D 0.5 kg/ha was statistically at par with each other and both treatments registered significantly lower N, P and K uptake than control (unweeded) treatment. Pandey *et al.* (2001) also reported more nutrient uptake by weeds under unweeded control than herbicidal treatments.

Table 2. Effect of planting techniques and weed control treatments on nitrogen, phosphorus and potassium content in *P. minor* and broadleaf weeds

Treatment	Nutrient content (%) in *P. minor*						Nutrient content (%) in broadleaf weeds					
	N		P		K		N		P		K	
	2004-05	2005-06	2004-05	2005-06	2004-05	2005-06	2004-05	2005-06	2004-05	2005-06	2004-05	2005-06
Planting techniques												
Conventional tillage	1.24	1.24	0.27	0.27	1.14	1.10	1.32	1.30	0.30	0.27	1.18	1.19
Zero till sowing (without stubbles)	1.26	1.23	0.28	0.28	1.15	1.11	1.33	1.31	0.31	0.28	1.20	1.18
Zero till sowing (in standing stubbles)	1.36	1.43	0.27	0.36	1.19	1.22	1.34	1.32	0.31	0.31	1.21	1.10
Zero till sowing after partial burning (Farmers' practice)	1.34	1.40	0.31	0.30	1.29	1.21	1.35	1.33	0.31	0.29	1.20	1.20
Bed planting	1.37	1.39	0.29	0.30	1.23	1.23	1.31	1.31	0.32	0.32	1.22	1.18
LSD (P= 0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Weed control treatments												
Clodinafop 60 g/ha	1.28	1.37	0.30	0.29	1.20	1.16	1.32	1.30	0.28	0.28	1.18	1.32
Clodinafop 60 g/ha f.b. 2, 4-D 0.5 kg/ha	1.31	1.34	0.29	0.29	1.19	1.17	1.32	1.32	0.32	0.29	1.20	1.32
Sulfosulfuron 25 g/ha	1.34	1.26	0.30	0.30	1.20	1.17	1.35	1.35	0.34	0.31	1.23	1.35
Meso + iodo 12.0 g/ha	1.37	1.47	0.31	0.33	1.24	1.22	1.37	1.36	0.33	0.32	1.22	1.37
Control (unweeded)	1.26	1.24	0.26	0.28	1.17	1.15	1.31	1.29	0.28	0.30	1.18	1.31
LSD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

NS–Not Significant.

Table 3. Effect of planting techniques and weed control treatments on nitrogen, phosphorus and potassium content in *P. minor* and broadleaf weeds

Treatment	Nutrient content (kg/ha) in *P. minor*						Nutrient content (kg/ha) in broadleaf weeds					
	N		P		K		N		P		K	
	2004-05	2005-06	2004-05	2005-06	2004-05	2005-06	2004-05	2005-06	2004-05	2005-06	2004-05	2005-06
Planting techniques												
Conventional tillage	22.02	37.00	4.61	7.67	20.00	32.23	32.20	38.68	7.26	8.41	29.05	34.99
Zero till sowing (without stubbles)	20.18	33.69	4.22	7.08	18.09	28.99	33.11	40.84	7.46	8.88	29.08	36.94
Zero till sowing (in standing stubbles)	12.57	20.33	2.71	4.50	11.14	17.81	17.05	19.69	3.91	4.22	15.38	17.84
Zero till sowing after partial burning (Farmers' practice)	14.96	24.14	3.11	5.09	13.37	21.20	19.34	25.79	4.31	5.62	17.45	23.22
Bed planting	13.15	22.03	2.83	4.73	11.85	19.11	17.83	22.32	4.02	4.91	16.09	20.16
LSD (P= 0.05)	2.44	2.63	0.51	0.61	2.27	2.42	2.48	2.65	0.43	0.51	2.37	2.52
Weed control treatments												
Clodinafop 60 g/ha	6.99	30.66	1.62	6.56	6.43	26.23	51.07	64.11	11.52	13.95	46.08	57.99
Clodinafop 60 g/ha f. b. 2, 4-D 0.5 g/ha	7.58	32.33	1.68	7.02	6.75	28.19	4.61	4.36	1.04	0.95	4.16	3.94
Sulfosulfuron 25 g/ha	6.78	10.30	1.51	2.22	5.94	9.29	5.40	6.37	1.23	1.39	4.90	5.76
Meso + iodo 12.0 g/ha	3.98	4.39	0.91	1.01	3.33	3.24	2.72	2.34	0.60	0.51	2.42	2.12
Control (unweeded)	57.55	50.02	11.76	12.76	52.00	52.39	55.72	70.13	12.57	15.26	50.28	63.44
LSD (P= 0.05)	2.59	2.77	0.58	0.66	2.64	2.76	2.69	2.77	0.53	0.56	2.64	2.76

Nutrient Uptake by Broadleaf Weeds

Regarding nutrient (N, P and K) uptake by broadleaf weeds, during both the years, zero till sowing in standing stubbles registered the least N, P and K uptake followed by bed planting and zero till sowing after partial burning and these three treatments were statistically at par with each other but recorded significantly lower N, P and K uptake than conventional tillage and zero tillage (without stubbles) planting techniques (Table 3). Further, zero till sowing after partial burning recorded significantly higher N, P and K uptake than zero till sowing in standing stubbles and bed planting techniques. N, P and K uptake by broadleaf weeds in planting techniques varied due to variable dry matter accumulation by weeds under different planting techniques.

Significant differences regarding N, P and K uptake by broadleaf weeds in different weed control treatments were observed during both the years (Table 3). Amongst weed control treatments, during first year, mesosulfuron + iodosulfuron 12.0 g/ha recorded least N and K uptake by broadleaf weeds which was statistically at par with clodinafop 60 g/ha f. b. 2, 4-D 0.5 kg/ha and sulfosulfuron 25 g/ha and these three treatments recorded significantly lower N and K uptake by broadleaf weeds than clodinafop 60 g/ha alone and control (unweeded) treatment. Regarding P uptake, mesosulfuron + iodosulfuron 12.0 g/ha was statistically at par with clodinafop 60 g/ha f. b. 2, 4-D 0.5 kg/ha and recorded significantly lower P uptake than sulfosulfuron 25 g/ha and these three treatments recorded significantly lower P uptake than clodinafop 60 g/ha alone and control (unweeded) treatment. Clodinafop 60 g/ha alone again recorded significantly lower N, P and K uptake by broadleaf weeds than control (unweeded) treatment.

During the second year, mesosulfuron + iodosulfuron 12.0 g/ha was statistically at par with clodinafop 60 g/ha f. b. 2, 4-D 0.5 kg/ha and recorded significantly lower N, P and K uptake by broadleaf weeds than all other treatments. Further, sulfosulfuron 25 g/ha recorded significantly less N, P and K uptake than clodinafop 60 g/ha alone and control (unweeded) treatments. Clodinafop 60 g/ha alone again recorded significantly less N, P and K uptake than control (unweeded) treatment. All other herbicidal treatments recorded significantly lower N uptake than clodinafop 60 g/ha alone as this herbicide only controlled *P. minor* and did not control the broadleaf weeds which ultimately increased the N, P and K uptake. Other herbicidal treatments effectively controlled the broadleaf weeds and thus less dry matter was produced by these treatments and hence lesser N, P and K uptake by weeds. Similar types of results were also reported by Pandey *et al.* (2001).

Effect on Crop

The highest grain yield of wheat was registered with zero till sowing in standing stubbles (Table 1) which was statistically at par with zero till sowing after partial burning and bed planting treatments. Further, zero till sowing in standing stubbles and after partial burning treatments recorded significantly more grain yield than zero tillage (without stubbles) and conventional tillage treatments during both the years. However, bed planting, zero tillage (without stubbles) and conventional tillage treatments were statistically at par with each other. Higher yield under zero till sowing in standing stubbles, in partial burning and bed planting treatments was due to less weed infestation (Table 1). Bacon and Cooper (1985) also reported higher grain yield in zero till sowing in standing stubbles and after partial burning than conventional tillage.

Among the weed control treatments, during the first year, application of sulfosulfuron 25 g/ha recorded the highest yield that was statistically at par with clodinafop 60 g/ha f. b. 2, 4-D 0.5 kg/ha and mesosulfuron + iodosulfuron 12.0 g/ha and these three treatments were significantly better than clodinafop 60 g/ha alone and control (unweeded) treatments. Further, all the herbicidal treatments were found to be significantly superior over control (unweeded). During the second year, clodinafop 60 g/ha treated plots recorded significantly lower yield (Table 1) than other herbicidal treatments as it failed to control *P. minor* as well as broadleaf weeds efficiently which reduced the yield of crop. Herbicide treated crop registered higher yield due to reduced weed growth. Walia *et al*. (2005) also reported higher grain yield of wheat in herbicidal treated crop than control (unweeded).

REFERENCES

Bacon, P. E. and J. L. Cooper, 1985. Effect of rice stubble and nitrogen fertilizer management techniques on yield of wheat sown after rice. *Field Crops Res*. **10** : 241-250.

Dhillon, S. S., A. Prashar and S. Thaman, 2005. Comparative studies on the effect of weed management practices on

Phalaris minor in bed and conventionally planted wheat (*Triticum aestivum* L.). *Ind. J. Ecol.* **32** : 72-75.

Jackson, M. L. 1967. *Soil Chemical Analysis*. Prentice Hall of India Pvt. Ltd., New Delhi.

Jat, R. S., V. Nepalia and P. D. Chaudhary, 2003. Influence of herbicides and methods of sowing on weed dynamics in wheat (*Triticum aestivum* L.). *Ind. J. Weed Sci.* **35** : 18-20.

Pandey, I. B., S. L. Sharma, S. Tiwari and V. Bharati, 2001. Effect of tillage and weed management on grain yield and nutrients removal by wheat (*Triticum aestivum*) and weeds. *Ind. J. Weed Sci.* **33** : 107-111.

Piper, C. S. 1966. *Soil and Plant Analysis*. Hans Publishers, Bombay, India.

Rahman, M. A., J. Chikushi, M. Saifizzaman and J. G. Lauren, 2005. Rice straw mulching and nitrogen response of no-till wheat following rice in Bangladesh. *Field Crops Res.* **91** : 71-81.

Walia, S. S. 1994. Effect of crop residue management systems on the efficacy of herbicides in wheat under rice-wheat sequence. M. Sc. thesis, Punjab Agricultural University, Ludhiana, India.

Walia, U. S., M. Singh and L. S. Brar, 2005. Weed control efficacy of herbicides in zero till wheat. *Ind. J. Weed Sci.* **37** : 167-170.

Yadav, A., R. S. Balyan, V. K. Garg and R. K. Malik, 1996. Resistance against isoproturon in different biotypes of little seed canary grass. *Test of Agrochemicals and Cultivars (AAB)* **17** : 34-35.