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Standardization of dose and time of application of clodinafop -propargyl to manage weeds in wheat

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Abstract

A field experiment was conducted during the winter season of 2000-01 and 2001-02 at Palampur to standardize the dose and time of application of clodinafop propargyl as an alternative herbicide to control grassy weeds in wheat. Four doses of clodinafop-propargyl (45, 60, 75 and 90 g/ha) each at 20 and 35 DAS, isoproturon 1.0 kg/ha + surfactant 0.1% at 20 and 35 DAS, hand weeding twice and weedy check were evaluated for weed control and grain yield of wheat. *Phalaris minor* and *Avena ludoviciana* were the most dominating grassy weeds. Clodinafop 75 g/ha at 20 and 35 DAS and 60 g/ha at 35 DAS, controlled *P. minor* effectively. Clodinafop 90 g/ha at 35 DAS gave significantly lower count of *A. ludoviciana*. Clodinafop was most effective against *Lolium temulentum* and *Poa annua* at all the doses except 45 g/ha applied at 35 DAS. In general build up of broadleaved weeds (*Vicia*, *Anagallis*, *Ranunculus* and *Coronopus*) was observed when the grassy weeds were adequately controlled with the herbicidal treatments. The application of clodinafop in general was better at 35 DAS than at 20 DAS in influencing weed control, yield and returns. Clodinafop at 75 and 90 g/ha (35 DAS) was as effective as hand weeding twice in reducing the total dry matter of weeds. Clodinafop 75 g/ha applied at 35 DAS resulted in significantly higher wheat grain yield and net return. However, MBCR (marginal benefit cost ratio) was highest for isoproturon + surfactant (20 DAS). Uncontrolled weeds reduced wheat grain yield by 49.7 per cent.

Key words: Clodinafop, isoproturon, weed, yield, wheat.

Introduction

Among various components of production technology, heavy infestation of weeds especially grasses is a serious problem for increasing and sustaining the productivity of wheat (*Triticum aestivum*). It is estimated that weeds on an average reduce wheat yield by more than 66 per cent (Singh and Singh, 2002). The existing herbicides do not control some of the weeds. Morphological similarities of grassy weeds with wheat make it difficult to weed them out by manual methods. Moreover, continuous use of isoproturon in Punjab has resulted in development of resistance in *Phalaris minor* (Walia *et al.*, 1997). Therefore, the present investigation was undertaken to standardize the dose and time of application of clodinafop - propargyl as an alternative herbicide to control all grassy weeds effectively and for herbicide rotation to avoid resistance problem.

Material and Methods

A field experiment was conducted during the winter season of 2000-01 and 2001-02 at the Research Farm of Department of Agronomy, CSK Himachal Pradesh Krishi Vishvavidyalaya, Palampur. The soil of the experimental field was silty clay loam in texture, acidic in reaction (pH 5.5), medium in organic carbon (0.7%), low in available N (226.2 kg/ha), medium in available P (17.8 kg/ha) and high in available K (306.5 kg/ha). Four doses of clodinafop-propargyl (45, 60, 75 and 90 g/ha) each at 20 and 35 DAS, isoproturon 1.0 kg/ha + surfactant 0.1% at 20 and 35 DAS, hand weeding twice and weedy check were tested in randomized block design with three replications (Table 1). Wheat variety 'Aradhna' was sown on December 23, 2000 and December 12, 2001 using 100 kg seed/ha. Spray application of the herbicides was made with backpack knapsack power sprayer using 600 litres water per hectare. Except weed control, the crop was raised in accordance with the recommended package of practices. Weed count and dry weight were recorded at 120 DAS. Yields were harvested from net plot. Economics of the treatments was computed based upon the prevalent market prices.

Results and Discussion

Phalaris minor was the most predominant weed constituting 62.0 and 46.6% of the total weed

Table 1. Effect of treatments on weed count (No./m^2) in wheat

Treatments	Dose (g /ha)	Time of application (DAS)	*Phalaris*		*Avena*		*Lolium*	*Poa*	*Vicia*		*Anagallis*		*Ranunculus*	*Coronopus*
			2000-01	2001-02	2000-01	2001-02	2000-01	2001-02	2000-01	2001-02	2000-01	2001-02	2000-01	2001-02
Clodinafop propargyl	45	20	11.1 (126.1)	10.0 (104.0)	6.6 (45.3)	4.0 (20.0)	1.0 (0.0)	2.8 (8.6)	2.9 (8.0)	4.6 (21.3)	1.6 (2.6)	7.8 (61.3)	5.1 (26.6)	5.4 (29.3)
Clodinafop propargyl	45	35	12.7 (161.3)	9.1 (86.6)	9.6 (97.3)	2.7 (9.3)	4.6 (22.6)	2.1 (6.6)	2.1 (6.6)	4.1 (17.3)	2.8 (13.3)	5.5 (33.3)	7.8 (70.6)	5.0 (26.6)
Clodinafop propargyl	60	20	6.6 (49.3)	10.1 (103.3)	4.3 (41.3)	2.0 (5.3)	1.0 (0.0)	1.0 (0.0)	2.2 (5.3)	7.0 (53.3)	5.0 (33.3)	8.0 (64.0)	3.9 (32.0)	4.1 (16.0)
Clodinafop propargyl	60	35	1.4 (1.3)	7.3 (74.0)	1.4 (1.3)	1.0 (0.0)	1.0 (0.0)	1.0 (0.0)	5.6 (30.6)	5.6 (32.0)	5.4 (42.6)	7.8 (69.3)	10.9 (124.0)	6.3 (40.0)
Clodinafop propargyl	75	20	2.4 (6.6)	8.9 (80.0)	2.2 (5.3)	2.3 (5.3)	1.0 (0.0)	1.6 (2.6)	3.3 (13.3)	4.4 (18.6)	5.8 (33.3)	7.5 (57.3)	8.9 (80.0)	4.5 (22.6)
Clodinafop propargyl	75	35	1.0 (0.0)	8.1 (68.0)	1.0 (0.0)	2.4 (6.6)	1.0 (0.0)	1.0 (0.0)	2.8 (13.3)	4.1 (21.3)	4.5 (30.6)	7.5 (57.3)	6.4 (41.3)	5.1 (26.6)
Clodinafop propargyl	90	20	3.5 (12.0)	4.6 (27.0)	2.0 (4.0)	1.4 (1.3)	1.0 (0.0)	1.0 (0.0)	5.6 (30.6)	4.7 (21.3)	7.9 (62.6)	3.0 (16.0)	11.5 (137.3)	5.4 (30.6)
Clodinafop propargyl	90	35	3.6 (25.3)	4.9 (25.6)	1.0 (0.0)	1.0 (0.0)	1.0 (0.0)	1.0 (0.0)	5.0 (25.3)	5.5 (30.6)	6.8 (48.0)	3.0 (16.0)	9.8 (108.0)	6.7 (48.0)
Isoproturon + surfactant	1000 + 0.1%	20	6.1 (41.3)	7.7 (64.0)	5.8 (36.0)	5.6 (32.0)	1.0 (0.0)	2.1 (6.6)	1.6 (2.6)	4.9 (25.3)	1.0 (0.0)	4.5 (20.0)	3.5 (30.6)	2.2 (5.3)
Isoproturon + surfactant	100 + 0.1%	35	5.2 (40.0)	9.4 (88.0)	4.0 (21.3)	4.5 (21.3)	1.0 (0.0)	2.0 (5.3)	2.2 (5.3)	2.9 (9.3)	1.0 (0.0)	4.4 (18.6)	4.8 (53.3)	3.2 (12.0)
Hand weeding		30 & 60	7.9 (64.0)	5.5 (30.6)	8.8 (78.6)	3.1 (10.6)	1.0 (0.0)	1.0 (0.0)	1.0 (0.0)	1.4 (1.3)	1.0 (0.0)	2.1 (6.6)	1.0 (0.0)	3.0 (10.6)
Unweeded			13.0 (172.0)	10.0 (109.3)	9.3 (89.3)	5.4 (32.0)	3.2 (12.0)	2.4 (9.3)	1.8 (4.0)	5.0 (25.3)	1.0 (0.0)	3.5 (14.6)	1.0 (0.0)	5.0 (25.3)
LSD (P=0.05)			2.8	2.3	2.0	2.7	1.3	0.5	1.9	2.1	3.2	3.6	5.9	2.4

DAS-days after sowing; Data transformed to square root ($\sqrt{x+1.0}$) transformation; the data in parentheses are the mean of original values.

flora during 2000-01 and 2001-02, respectively. This was followed by *Avena ludoviciana* with 32.2 and 13.6% of total weed population in 2000-01 and 2001-02, respectively. The other weeds which showed their occurrence in weedy check plots were, *Vicia sativa* (1.5 and 10.8% in 2000-01 and 2001-02), *Anagallis arvensis (6.2% in 2001-02), Lolium temulentum* (4.3% in 2000-01), *Poa annua* (4.0% in 2001-02), *Coronopus didymus* (10.7% in 2001-02), and *Polygonum alatum* (8.0% in 2001-02).

Clodinafop 75 g/ha at 20 and 35 DAS and 60 g/ha at 35 DAS, being on par with clodinafop 90 g/ha at 20 and 35 DAS, reduced *P. minor* significantly over rest of the treatments in 2000-01 (Table 1). Mirkamali (1993) has reported more than 90% control of *P. minor* with clodinafop at 0.8 kg/ha. However, clodinafop at 90 g/ha both at 20 and 35 DAS was superior to all the herbicidal treatments in reducing *P. minor* in 2001-02. Clodinafop 90 g/ha applied at 35 DAS gave significantly lower count of *A. ludoviciana* during both the years. Mirkamali (1993) has reported effective control of *A. ludoviciana* with clodinafop. However, it was at par with clodinafop 90 g/ha at 20 DAS, clodinafop 75 g/ha at 20 and 35 DAS, and clodinafop at 60 g/ha during both the years and clodinafop 60 g/ha at 20 DAS and 45 g/ha at 35 DAS and hand weeding twice during 2001-02. All weed control treatments except clodinafop 45 g/ha were superior to weedy check in reducing the population of *L. temulentum* in 2000-01. Except clodinafop 45 g/ha and isoproturon + surfactant, all the treatments reduced *P. annua* significantly over weedy check in 2001-02.

Table 2. Effect of treatments on weed dry weight, grain yield and economics of wheat

Treatments	Dose (g/ha)	Time of application (DAS)	Weed dry matter ($g\ m^{-2}$)			Grain yield (kg /ha)			Net profit over control	MBCR
			2000-01	2001-02	Mean	2000-01	2001-02	Mean		
Clodinafop propargyl	45	20	169.4	138.0	153.7	1917	2616	2267	5535	3.22
Clodinafop propargyl	45	35	146.8	94.0	120.4	1894	3239	2567	8835	5.14
Clodinafop propargyl	60	20	144.1	150.0	147.1	1940	3029	2485	7453	3.39
Clodinafop propargyl	60	35	117.8	67.0	92.4	2169	3856	3013	13261	6.03
Clodinafop propargyl	75	20	129.4	138.0	133.7	2227	2823	2525	7418	2.77
Clodinafop propargyl	75	35	68.6	52.0	60.3	2433	3948	3191	14739	5.50
Clodinafop propargyl	90	20	79.7	146.0	112.9	2330	2846	2588	7631	2.41
Clodinafop propargyl	90	35	54.5	94.0	74.3	2386	3351	2869	10717	3.39
Isoproturon + surfactant	1000 + 0.1%	20	100.5	109.0	104.8	2261	3213	2737	11678	15.53
Isoproturon + surfactant	100 +0.1%	35	106.5	157.0	131.8	2238	2846	2542	9533	12.68
Hand weeding		30 & 60	36.2	54.0	45.1	2192	2525	2359	1267	0.18
Unweeded			245.6	274.0	259.8	1148	2066	1607	-	-
LSD (P=0.05)			32.5	58.4	40.1	285	697	452		

DAS-days after sowing

The adequate control of grassy weeds owing to herbicidal treatments tended to build up the population of broadleaved weeds as the count of *Vicia*, *Anagallis*, *Ranunculus*, and *Coronopus* was either higher or not affected significantly over weedy check. The population of broadleaved weeds might also have been suppressed due to vigorous competition from grassy weeds.

All the weed control treatments were significantly superior to weedy check in curtailing the total dry matter accumulation by weeds. Hand weeding twice resulted in significantly lower total

dry weight of weeds (Table 2). Clodinafop at 75 and 90 g/ha (35 DAS) was as effective as hand weeding twice in reducing the total dry matter accumulation by the weeds.

The satisfactory reduction in the population of grassy weeds and total weed dry matter accumulation following the application of clodinafop 75 g/ha at 35 DAS tended to yield significantly higher wheat grains. Inspite of reducing the weed dry weight adequately, hand weeding twice was inferior to clodinafop at 75 g/ha (35 DAS) in influencing wheat grain yield probably because of competition with grassy weeds at initial stages. At later stages, the morphological similarity also makes it difficult to weed out grassy weeds in wheat plots. However, clodinafop at 60 g/ha and 90 g/ha (35 DAS) were statistically at par with clodinafop 75 g/ha (35 DAS) in influencing wheat grain yield. Clodinafop 75 g/ha increased wheat grain yield by 98.5% over weedy check and by 35.3% over hand weeding twice treatment. Mirkamali (1993) reported 130% increase in wheat grain yield with clodinafop-propargyl at 0.8 kg/ha. Saini and Singh (2001) have also reported clodinafop at 0.10 and 0.15 kg/ha, the most effective in reducing weed population and dry weight and enhancing the yield and yield components of wheat.

The application of clodinafop in general was better at 35 DAS than at 20 DAS in influencing weed control, yield and returns. The exactly opposite was the response of isoproturon + surfactant, the application of which was better at 20 DAS than at 35 DAS.

The highest net profit over weedy check was obtained with clodinafop at 75 g/ha (35 DAS). This was followed by clodinafop 60 g/ha (35 DAS), isoproturon + surfactant (20 DAS), clodinafop 90 g/ha (35 DAS) and isoproturon + surfactant (35 DAS). The MBCR (marginal benefit cost ratio) was highest following isoproturon + surfactant (20 DAS) due to low cost of the herbicide. This was followed by isoproturon + surfactant (35 DAS), clodinafop 60 g/ha (35 DAS) and clodinafop 75 g/ha (35 DAS).

The findings of the present investigation conclusively inferred that for satisfactory control of grassy weeds, higher yield and returns, clodinafop should be applied at 60-75 g/ha at 35 DAS.

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