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Management of Complex Weed Flora in Peas with Herbicide Mixtures under Lahaul Valley Conditions of Himachal Pradesh

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ABSTRACT

Field experiment was conducted for two consecutive summer seasons (1999 and 2000) at Kukumseri on sandy loam soil to evaluate promising herbicide combinations for weed control in pea. Alachlor at 1.0 kg+pendimethalin at 0.9 kg ha^{-1} and alachlor at 1.0 kg+ isoproturon at 1.0 kg ha^{-1} were statistically similar to alachlor at 1.5 kg ha^{-1}, pendimethalin at 1.2 kg ha^{-1} and hand weeding twice in reducing density and dry weight of weeds. These were significantly superior in reducing weed density and weight as compared to other treatments. Alachlor at 1.0 kg+pendimethalin at 0.9 kg ha^{-1} recorded the highest weed control efficiency of 87.5%. Pendimethalin 1.2 kg ha^{-1} gave highest grain yield which was significantly higher than pendimethalin at 0.9 kg+isoproturon 0.75 kg ha^{-1}, pendimethalin at 0.6 kg+isoproturon at 1.0 kg ha^{-1}, pendimethalin at 0.6 kg+isoproturon at 0.75 kg ha^{-1} and alachlor at 0.75+isoproturon at 0.75 kg ha^{-1}. Alachlor at 1.50 kg ha^{-1} recorded highest marginal benefit cost ratio (MBCR). The combinations of alachlor at 0.75-1.00 with isoproturon at 0.75-1.00 kg ha^{-1} were superior to other herbicide treatments in increasing MBCR.

INTRODUCTION

Pea (*Pisum sativum* L.) has great potential in Himachal Pradesh both for grain and vegetable purposes. In Lahaul Valley, it is the most important cash crop of summer, fetches very high prices for farmers. The weed problem with this crop is very serious (Singh *et al.*, 1991; Sharma, 1993) due to frequent irrigation and higher fertility. Hand weeding, a commonly adopted method of weed control by farmers, is not costly, but also time consuming. The problem assumes added significance due to non-availability of adequate labour during the peak periods of operation. Pendimethalin and alachlor are recommended for the control of weeds in pea but they are not effective against broad-leaved weeds especially *Amaranthus* spp. which are predominant weeds of the valley. Herbicide combinations are, therefore, increasingly recommended to broaden the weed control spectrum (Akobundu *et al.*, 1975). The combinations of herbicides offer possibility of reducing the dose of each of herbicides necessary for weed control. The present investigation was, therefore, undertaken to evaluate low dose combinations of alachlor, isoproturon and pendimethalin.

MATERIALS AND METHODS

Field experiment was conducted for two consecutive summer seasons (1999 and 2000) at the Research Farm of Regional Station, Kukumseri of Himachal Pradesh Krishi Vishvavidyalaya, Palampur. The soil of the experimental field was sandy loam in texture, rich in organic matter (2.6%) with pH 6.8. The soil had available nitrogen 250 kg ha^{-1}, phosphorus 19.6 kg ha^{-1} and potassium 210 kg ha^{-1}. The crop was sown on June 2 and June 1 during 1999 and 2000, respectively. The crop was

sown at 45 cm row spacing and 40 kg seeds ha^{-1}. Variety Azad-P1 was sown during both the years. In all, 16 treatments (Table 1) were tested in randomized block design with three replications. All the recommended package of practices were followed to raise the crop. Pre-emergence application of all the herbicides under test was done immediately after sowing of the crop with manually operated knapsack sprayer fitted with flat fan nozzle using 600 l water per hectare. Data on weeds were recorded at harvest. Yields were harvested from net plot. Economics of the treatments was computed based upon the prevalent market prices.

RESULTS AND DISCUSSION

Digitaria sanguinalis and *Amaranthus* spp. (*A. spinosus* and *A. viridis*) were the predominant weeds constituting 33.45 and 28.67%, respectively, of the total weed flora. These were followed by *Chenopodium* spp. (*C. album* and *C. bonus-henricus*, 12.46%), *Poa annua* (6.25%), *Euphorbia* spp. (5.14%), *Rumex* spp. (4.29%), *Altha ludgwii* (4.19%), *Polygonum* spp. (3.14%) and *Gallinsoga parviflora* (2.40%).

Effect on Weeds

All the weed control treatments reduced the density of *Digitaria* spp., *Amaranthus* spp. and other weeds significantly as compared to the weedy check. Alachlor at 1.0 kg+pendimethalin at 0.60-0.90 kg ha^{-1} and alachlor at 1.0 kg+isoproturon at 1.0 kg ha^{-1} were comparable to alachlor at 1.0 kg ha^{-1} or pendimethalin 1.20 kg ha^{-1} or hand weeding twice in reducing the density of *Digitaria* spp, *Amaranthus* spp. and other weeds (Table 1).

Owing to lower species-wise density, all the weed management treatments significantly reduced the total weed number and dry weight of weeds; thereby resulting in weed control efficiency of more than 75% as compared to weedy check. Alachlor at 1.0 kg+pendimethalin at 0.9 kg ha^{-1} and alachlor at 1.0 kg+isoproturon at 1.0 kg ha^{-1} were statistically similar to alachlor at 1.5 kg ha^{-1}, pendimethalin at 1.2 kg ha^{-1} and hand weeding twice in reducing density and dry weight of weeds and were significantly superior as compared to other treatments. Pre-emergence application of alachlor at 1.0 kg+pendimethalin at 0.9 kg ha^{-1} recorded the highest weed control efficiency of 87.5%.

Effect on Crop

All the herbicide treatments except pendimethalin at 0.6 kg+isoproturon 0.75 kg ha^{-1} during 2000, had significantly higher pod number than weedy check (Table 2). Highest number of seeds pod^{-1} was recorded in pendimethalin at 1.2 kg and alachlor at 1.0 kg+pendimethalin at 0.9 kg ha^{-1} during 1999 and 2000, respectively, which were statistically at par with alachlor at 1.0 kg+ isoproturon at 1.0 kg ha^{-1} and alachlor 1.5 kg ha^{-1} alone. Different weed control treatments did not affect the test weight of pea. Average reduction of 45.1% in seed yield of pea was recorded when weeds were allowed to grow undisturbed till harvest (Table 2). Pendimethalin 1.2 kg ha^{-1} gave highest grain yield which was significantly more than pendimethalin at 0.9+isoproturon at 0.75 kg ha^{-1}, pendimethalin at 0.6+isoproturon at 1.0 kg ha^{-1}, pendimethalin at 0.6+isoproturon at 0.75 kg ha^{-1} and alachlor at 0.75+isoproturon at 0.75 kg ha^{-1} mixtures. Higher grain yields due to effective weed control have been reported by several workers (Singh *et al.*, 1991; Kundra *et al.*, 1993; Sharma, 1993).

Alachlor at 1.00 kg ha^{-1} with pendimethalin at 0.60-0.90 kg ha^{-1} and isoproturon at 0.75-1.00 kg

Table 1. Effect of treatments on weed density (No. m^{-2}) and their dry weight (g m^{-2}) in pea (Data transformed to square root transformation)

Treatment	Dose (kg ha^{-1})	*Amaranthus* sp.		*Digitaria* sp.		Other weeds		Total weed density		Total weed dry weight	
		1999	2000	1999	2000	1999	2000	1999	2000	1999	2000
Alachlor+pendimethalin	1.00+0.90	2.73 (7)	2.54 (6)	2.11 (4)	2.11 (4)	2.27 (4.7)	2.11 (4)	15.5	14.0	43.0	40.0
Alachlor+pendimethalin	1.00+0.60	2.92 (8)	2.72 (7)	2.54 (6)	2.5 (6)	2.19 (4.3)	2.25 (5)	18.5	17.5	51.7	45.1
Alachlor+isoproturon	1.00+1.00	2.54 (6)	2.54 (6)	2.68 (7)	2.34 (5)	2.03 (3.7)	2.11 (4)	16.5	15.0	46.7	44.0
Alachlor+isoproturon	1.00+0.75	2.91 (8)	2.91 (8)	3.08 (9)	2.91 (8)	2.48 (5.7)	2.34 (5)	22.5	21.0	59.7	49.3
Alachlor+pendimethalin	0.75+0.90	2.73 (7)	2.54 (6)	2.91 (8)	2.34 (5)	2.41 (5.3)	3.02 (9)	20.5	19.5	56.0	53.0
Alachlor+pendimethalin	0.75+0.60	2.91 (8)	2.73 (7)	2.91 (8)	2.54 (6)	2.54 (6)	3.02 (9)	22.0	21.8	59.3	59.2
Alachlor+isoproturon	0.75+1.00	2.53 (6)	2.54 (6)	3.07 (9)	3.08 (9)	2.97 (8.3)	2.91 (8)	23.5	23.0	62.3	62.0
Alachlor+isoproturon	0.75+0.75	2.73 (7)	2.89 (8)	3.23 (10)	3.08 (9)	3.02 (8.7)	3.06 (9)	25.5	26.0	65.3	65.3
Pendimethalin+isoproturon	0.90+1.00	2.53 (6)	3.07 (9)	3.06 (9)	2.87 (8)	2.66 (6.7)	1.84 (3)	21.5	20.0	58.0	58.5
Pendimethalin+isoproturon	0.90+0.75	3.08 (9)	3.07 (9)	2.73 (7)	3.23 (10)	3.38 (11.0)	2.51 (6)	27.0	25.0	67.7	61.0
Pendimethalin+isoproturon	0.60+1.00	3.23 (10)	3.23 (10)	2.54 (6)	3.53 (12)	3.81 (14.0)	2.53 (6)	30.0	28.0	70.7	66.2
Pendimethalin+isoproturon	0.60+0.75	3.38 (11)	3.38 (11)	3.06 (9)	3.67 (13)	3.66 (13.0)	2.90 (8)	33.0	32.0	73.3	70.1
Alachlor	1.50	2.54 (6)	2.51 (6)	2.73 (7)	2.34 (5)	1.68 (2.3)	2.72 (7)	15.5	18.0	41.3	52.0
Pendimethalin	1.20	2.73 (7)	2.72 (7)	2.54 (6)	2.53 (6)	2.04 (3.7)	2.46 (6)	16.5	18.5	43.7	55.0
Hand weeding (twice)		2.11 (4)	2.73 (7)	2.34 (5)	2.52 (6)	2.73 (7.0)	2.34 (5)	16.0	18.0	45.3	53.0
Weedy check		4.84 (23)	5.04 (25)	5.52 (30)	5.13 (26)	5.87 (34.0)	5.45 (29)	87.0	80.4	336.0	325.8
LSD (P=0.05)		0.44	0.52	0.43	0.50	0.39	0.59	16.0	1.4	8.6	19.3

Original data are given in parentheses.

Table 2. Effect of treatments on yield attributes and yield of pea

Treatment	Dose (kg ha^{-1})	No. of pods/plant		No. of seeds/pod		Test weight (g)		Seed yield (kg ha^{-1})		Net returns due to weed control	MBCR
		1999	2000	1999	2000	1999	2000	1999	2000		
Alachlor+pendimethalin	1.00+0.90	7.2	7.3	8.8	8.9	290	294	20.1	20.2	42715	16.9
Alachlor+pendimethalin	1.00+0.60	7.0	7.2	8.1	8.6	287	289	18.8	20.0	39465	19.4
Alachlor+isoproturon	1.00+1.00	7.1	7.3	8.5	8.8	288	290	19.1	20.1	40985	27.1
Alachlor+isoproturon	1.00+0.75	6.7	7.1	7.8	8.5	284	288	17.4	19.9	36355	26.1
Alachlor+pendimethalin	0.75+0.90	6.9	7.0	8.0	8.3	286	288	18.6	19.7	37880	16.0
Alachlor+pendimethalin	0.75+0.60	6.8	6.9	7.9	8.0	285	286	17.5	18.0	31380	16.8
Alachlor+isoproturon	0.75+1.00	6.6	6.8	7.4	7.7	282	285	17.2	17.9	30900	22.9
Alachlor+isoproturon	0.75+0.75	6.4	6.6	7.0	7.6	280	284	16.4	17.5	28020	22.8
Pendimethalin+isoproturon	0.90+1.00	6.8	7.0	7.9	8.1	285	287	18.2	18.5	33895	14.4
Pendimethalin+isoproturon	0.90+0.75	6.5	6.7	7.2	8.0	283	285	16.9	18.1	29765	13.3
Pendimethalin+isoproturon	0.60+1.00	6.3	6.5	6.9	7.5	280	283	15.8	17.6	26145	14.1
Pendimethalin+isoproturon	0.60+0.75	6.1	6.3	6.5	7.2	278	282	14.6	16.9	21515	12.4
Alachlor	1.50	7.1	6.9	8.7	8.5	289	288	20.0	19.7	42385	31.1
Pendimethalin	1.20	7.3	7.0	8.9	8.4	295	286	20.3	19.3	41125	17.3
Hand weeding (twice)		7.1	7.0	8.2	8.0	289	285	19.5	19.1	35375	6.3
Weedy check		5.5	5.9	6.5	6.8	275	278	10.8	11.4	-	-
LSD (P=0.05)		0.4	0.5	0.6	0.6	NS	NS	3.3	4.1	-	-

NS–Not Significant.

ha^{-1}, alachlor at 0.75 kg+pendimethalin at 0.90 kg ha^{-1}, alachlor at 1.50 kg ha^{-1} and pendimethalin at 1.20 kg ha^{-1} gave higher net returns due to weed control than hand weeding twice treatment. However, owing to low cost, all the herbicidal treatments gave tremendously higher MBCR (marginal benefit cost ratio) over hand weeding twice. Alachlor at 1.50 kg ha^{-1} recorded highest MBCR. The combinations of alachlor at 0.75-1.00 with isoproturon at 0.75-1.00 kg ha^{-1} were superior to other herbicide treatments in increasing MBCR.

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