

Management of Complex Weed Flora in Seed Potato with Herbicidal Mixtures under Dry Temperate High Hills of Himachal Pradesh

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ABSTRACT

Field experiment was conducted during the summer seasons of 1999 and 2000 at Kukumseri to evaluate some herbicide mixtures for controlling weeds in potato on sandy loam soil. Combinations of atrazine 0.75 kg ha⁻¹ with isoproturon 1.0 kg and pendimethalin 0.9 and 0.6 kg ha⁻¹, atrazine at 1.0 kg ha⁻¹, pendimethalin at 1.2 kg ha⁻¹, hand weeding twice and farmers' practice (earthing up at 80% emergence) being statistically at par, resulted in significantly lower dry weight of weeds than other herbicide mixture and check treatments. However, all the combinations of atrazine 0.75 and 0.5 kg ha⁻¹ with isoproturon 1.0 and 0.75 kg ha⁻¹ and pendimethalin 0.9 and 0.6 kg ha⁻¹ except atrazine 0.50 kg+isoproturon 0.75 kg ha⁻¹ and atrazine 0.50 kg+pendimethalin 0.6 kg ha⁻¹, atrazine at 1.0 ha⁻¹, isoproturon at 1.25 kg ha⁻¹ and pendimethalin 1.2 kg ha⁻¹, hand weeding twice and farmers' practice being statistically similar produced significantly higher tuber yield than weedy check. All herbicide treatments were superior to hand weeding twice and farmers' practice in influencing marginal benefit : cost ratio (MBCR). Highest MBCR (72.2) was resulted following the application of isoproturon at 1.25 kg ha⁻¹ and was followed by atrazine at 1.00 kg ha⁻¹ (69.4).

INTRODUCTION

Himachal Pradesh in general and dry temperate high hills in particular are ideally suited to produce quality seed potato. Of the total area under potatoes, 88% lies in the higher hills. These higher reaches of the State are covered with snow from December to March. Potato is cultivated as a main crop during summer, under long day conditions. The weather is dry but the temperatures are low at planting. As a result of slow initial growth, short stature of the crop and extensive use of organic manures, fertilizers and irrigation, weed problem is of paramount importance under dry temperate high hills. Considerable yield reduction due to weed infestation in potato has been reported by Tripathi *et al.* (1988), Singh (1992) and Lal (1992). Manual weeding is the common practice for controlling weeds. However, non-availability of labour and high labour charges are making this method uneconomical. Most of the presently herbicides provide only a narrow spectrum weed control.

Herbicide combinations are an effective tool to enhance herbicide efficiency, lower the optimum doses of herbicides, arrest weed shifts, prevent herbicide resistance in weeds, and facilitate improvement in overall weed management (Rao, 1993). The present investigation was, therefore, undertaken to evaluate low dose combinations of isoproturon, atrazine and pendimethalin.

MATERIALS AND METHODS

Field experiment was conducted during summer seasons of 1999 and 2000 at the Research Farm of Regional Research Station, Kukumseri of Himachal Pradesh Krishi Vishvavidyalaya, Palampur to standardise the rate of herbicide mixtures application for controlling weeds in potato. The soil of the experimental field was sandy loam in texture having pH 6.2, 0.64% organic carbon, 592 kg available N, 19.8 kg available P and 192 kg available K ha⁻¹. Fourteen treatments of herbicide mixtures of atrazine with its two doses (0.75 and 0.5

kg ha⁻¹) in combination with two doses of isoproturon (1.0 and 0.75 kg ha⁻¹) and pendimethalin (0.9 and 0.6 kg ha⁻¹) along with checks were tested in randomized block design with three replications. The potato variety 'Kufri Chandramukhi' was planted on June 4 and 2 in 1999 and 2000, respectively, on the ridges 40 cm apart at 15 cm spacing and 5 cm depth. Recommended package of practices was followed for raising the crop. All the herbicide treatments were applied as pre-emergence with manually operated knapsack sprayer fitted with flat fan nozzle using 600 l of water ha⁻¹. The potato crop was harvested on 30 and 28 September during 1999 and 2000, respectively.

Weed count and dry weight were recorded at harvest. Yields were harvested from a net plot. Economics of the treatments was computed based upon prevalent market prices.

RESULTS AND DISCUSSION

Digitaria sanguinalis L. Scoop was the predominant weed constituting 44.2% of the total weed flora. *Amaranthus* (*A. viridis* and *A. spinosus*) was the next important weed (16.7%). The other weeds were *Chenopodium album* (15.1%), *Altha ludwigiis* (14.0%) and *Euphorbia* sp. (10.0%) during both the years of experimentation.

Effect on Weeds

All the treatments were significantly superior to weedy check in reducing the density of all the weeds (Table 1). In general, combinations of atrazine at 0.75 kg ha⁻¹ with pendimethalin at 0.60 and 0.90 kg ha⁻¹ and isoproturon at 1.00 kg ha⁻¹ were as good as the standard checks (atrazine at 1.00 kg ha⁻¹, isoproturon at 1.25 kg ha⁻¹, pendimethalin at 1.20 kg ha⁻¹, hand weeding twice and farmers' practice) in reducing the density of *Digitaria* sp., *Amaranthus* sp. and other weeds.

Atrazine at 0.75 kg with isoproturon at 1.0 kg ha⁻¹, pendimethalin at 0.6 and 0.9 kg ha⁻¹ being statistically similar to atrazine at 1.0 kg ha⁻¹,

isoproturon at 1.25 kg ha⁻¹, pendimethalin 1.2 kg ha⁻¹, hand weeding twice and farmers' practice (Earthing up at more than 80% crop emergence) resulted in significantly lower weed dry matter than other herbicide mixtures and weedy check. Highest weed control efficiency of 79.2% was recorded with pre-emergence application of atrazine at 0.75 kg+ pendimethalin at 0.9 kg ha⁻¹ which was quite effective in keeping the weeds below threshold level.

Effect on Crop

Uninterrupted weed growth caused tuber yield reduction to the tune of 49.7% compared to pre-emergence application of atrazine 0.75 kg+ pendimethalin 0.9 kg ha⁻¹.

Plant population, tubers plant⁻¹ and weight tuber⁻¹ increased significantly due to the herbicide combinations comprising atrazine at 0.75 kg with pendimethalin 0.9 and 0.6 kg ha⁻¹ and atrazine at 0.5 kg with pendimethalin at 0.9 kg ha⁻¹ (Table 2). However, these treatments were also statistically at par with standard checks viz., atrazine at 1.0 kg ha⁻¹, isoproturon at 1.25 kg ha⁻¹, pendimethalin at 1.2 kg ha⁻¹, hand weeding twice and farmers' practice in increasing the yield contributing characters. Owing to superior weed control and significant increase in yield contributing characters, all the weed control treatments recorded markedly higher yields over unweeded check. Atrazine 0.75 kg ha⁻¹+ pendimethalin at 0.90 kg ha⁻¹ (Rs. 75517 ha⁻¹) resulted in maximum net returns due to weed control. This was followed by atrazine at 1.00 kg ha⁻¹ and atrazine 0.75 kg+isoproturon at 1.00 kg ha⁻¹. All herbicide treatments were superior to hand weeding twice and farmers' practice in influencing marginal benefit : cost ratio (MBCR). Highest MBCR (72.2) was recorded due to isoproturon at 1.25 kg ha⁻¹ and was followed by atrazine at 1.00 kg ha⁻¹ (69.4). All herbicide combinations were superior to pendimethalin at 1.20 kg ha⁻¹. But due to low cost of application, combinations of atrazine with isoproturon were superior to its combinations with

Table 1. Effect of weed control treatments on weed density (No. m⁻²) and weed dry weight (g m⁻²) in potato (Data transformed to square root transformation)

Treatment	Dose (kg ha ⁻¹)	<i>Amaranthus</i> sp.		<i>Digitaria</i> sp.		Other weeds		Total weed count		Weed dry matter	
		1999	2000	1999	2000	1999	2000	1999	2000	1999	2000
Atrazine+isoproturon	0.75+1.00	2.90 (8.0)	2.72 (7.0)	3.38 (11)	3.21 (10)	3.08 (9)	3.06 (9)	28	26	93.3	89.0
Atrazine+isoproturon	0.75+0.75	3.23 (10.0)	2.90 (8.0)	3.07 (9)	3.53 (12)	3.38 (11)	2.91 (8)	30	28	99.3	96.0
Atrazine+isoproturon	0.50+1.00	3.67 (13.0)	3.80 (14.0)	3.93 (15)	3.53 (12)	2.91 (8)	3.38 (11)	36	37	111.0	109.2
Atrazine+isoproturon	0.50+0.75	3.80 (14.0)	3.39 (11.0)	3.53 (12)	3.23 (10)	3.49 (12)	3.07 (9)	38	30	120.0	115.5
Atrazine+pendimethalin	0.75+0.9	2.72 (7.0)	2.73 (7.0)	3.23 (10)	2.90 (8)	3.07 (9)	2.73 (7)	26	22	80.0	73.4
Atrazine+pendimethalin	0.75+0.6	2.90 (8.0)	2.91 (8.0)	3.08 (9)	3.23 (10)	3.23 (10)	2.71 (7)	27	25	91.7	91.9
Atrazine+pendimethalin	0.5+0.9	3.53 (12.0)	2.91 (8.0)	3.94 (15)	3.38 (11)	2.91 (8)	2.73 (7)	35	26	98.7	97.4
Atrazine+pendimethalin	0.5+0.6	3.67 (13.0)	3.04 (9.0)	3.76 (14)	3.53 (12)	3.24 (10)	2.53 (6)	37	27	113.7	105.0
Atrazine	1.00	2.72 (7.0)	2.53 (6.0)	3.66 (13)	3.53 (12)	3.08 (9)	2.91 (8)	29	26	88.3	88.0
Isoproturon	1.25	3.53 (12.0)	3.23 (10.0)	2.53 (6)	3.39 (11)	3.39 (11)	2.73 (7)	29	28	101.7	90.0
Pendimethalin	1.2	3.23 (10.0)	2.73 (7.0)	3.53 (12)	2.33 (5)	3.22 (10)	3.22 (10)	32	22	88.3	93.3
Hand weeding (twice)		2.53 (6.0)	2.54 (6.0)	3.07 (9)	3.53 (12)	3.53 (12)	2.69 (7)	27	25	87.7	92.0
Farmers' practice		2.73 (7.0)	2.53 (6.0)	3.37 (11)	2.89 (8)	2.91 (8)	3.23 (10)	26	24	96.0	94.0
Weedy check		5.61 (31.0)	5.95 (35.0)	9.13 (83)	9.59 (92)	8.62 (74)	9.02 (81)	188	208	366.7	370.5
LSD (P=0.05)		0.50	0.60	0.62	0.69	0.54	0.61	5.6	4.9	17.4	21.4

Data given in parentheses are the means of original values.

Table 2. Effect of weed control treatments on yield attributes and tuber yield of potato

Treatment	Dose (kg ha ⁻¹)	Plant population ('000/ha)		Tubers plant ⁻¹		Weight tuber ⁻¹ (g)		Potato tuber yield (t ha ⁻¹)		Net returns due to weed control	MBCR
		1999	2000	1999	2000	1999	2000	1999	2000		
Atrazine+isoproturon	0.75+1.00	111	112	8.4	8.9	42.5	43.2	34.0	34.3	73793	53.5
Atrazine+isoproturon	0.75+0.75	109	110	8.1	8.6	41.2	41.9	32.6	33.2	68265	54.2
Atrazine+isoproturon	0.50+1.00	109	110	7.8	8.3	41.0	41.7	32.0	31.9	64045	53.2
Atrazine+isoproturon	0.50+0.75	109	110	7.5	8.0	39.9	40.6	31.0	31.2	60345	55.9
Atrazine+pendimethalin	0.75+0.90	112	113	8.6	9.0	42.8	43.5	34.5	35.0	75517	31.5
Atrazine+pendimethalin	0.75+0.60	111	111	8.3	8.8	41.6	42.2	33.2	33.7	70100	36.9
Atrazine+pendimethalin	0.50+0.90	110	110	8.2	8.7	41.3	42.0	32.8	33.0	67299	30.3
Atrazine+pendimethalin	0.50+0.60	109	110	7.6	8.1	40.4	41.0	31.6	32.0	62850	36.5
Atrazine	1.00	111	112	8.5	8.9	42.4	43.0	34.0	34.5	74525	69.4
Isoproturon	1.25	109	111	8.1	8.5	41.1	41.7	32.6	34.0	70350	72.2
Pendimethalin	1.2	110	111	8.2	8.7	41.5	42.1	33.0	33.5	68725	29.0
Hand weeding (twice)	-	110	111	8.2	8.7	41.6	42.2	33.0	33.7	65925	11.7
Farmers' practice	-	109	110	8.2	8.7	41.9	42.7	33.4	33.3	65550	11.0
Weedy check	-	106	107	6.1	5.8	39.7	40.5	18.5	16.4	-	-
LSD (P=0.05)	-	2.4	2.4	0.5	0.4	1.6	1.6	2.4	3.4	-	-

pendimethalin.

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