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Integrated weed management in capsicum (*Capsicum annuum*) under mid-hill conditions of north-western Himalayas

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ABSTRACT

A field experiment was conducted at Experimental Farm, Hawalbagh, Vivekananda Parvatiya Krishi Anusandhan Sansthan, Almora, during 1997 and 1998, to evaluate the efficacy of integrated weed-control method in capsicum (*Capsicum annuum* L.). All the weed-control treatments except pendimethalin at 1.0 kg/ha and fluchloralin at 1.0 or 2.0 kg/ha significantly reduced weed density and weed biomass which in turn increased yield significantly compared with weedy check in both the years. The highest fruit yield of 201.3 q/ha was recorded under repeated weeding. Among the herbicidal treatments, application of alachlor at 3.0 kg/ha, followed by hand-weeding at 45 days after transplanting proved the best in terms of yield (168.5 q/ha), net returns (Rs 73,326/ha), the lowest weed index (16.2) and the highest weed-control efficiency.

Key words : Integrated weed management, *Capsicum, North–western Himalayas*

Capsicum is an important off-season vegetable in Uttaranchal state of North-Western Himalayas. It is grown in summer as well as rainy seasons to fetch high market price in plains. Weed infestation is the major limiting factor in realizing potential yield of capsicum, resulting in heavy reduction in the yield as high as 78.0% (MoA, 1983) and Singh *et al.* (1991). Manual weeding is costly, time consuming and sometimes not possible due to non-availability of labour. Under such a situation, chemical weed control offers a better alternative to manual weeding during early stage. Hence present study was undertaken to find out the most effective integrated weed-management practice in *Capsicum* under agro-climatic condition of north-western Himalayas.

MATERIALS AND METHODS

A field experiment was conducted at Experimental Farm, Hawalbagh, Vivekananda Parvatiya Krishi Anusandhan Sansthan, Almora, during summer season of 1997 and 1998. The soil was sandy loam in texture, neutral in reaction (pH 6.6) and medium in available N (420.5 kg/ha), P (19.5 kg/ha) and K (203.8 kg/ha). The experiment consisting of 12 weed-control treatments (Table 1) was laid out in randomized block design with 3 replications. Fluchloralin was applied 1 day before transplanting as pre-plant soil incorporation, whereas pendimethalin and alachlor were applied on the next day of transplanting as pre-emergence. Each dose of herbicides was integrated with 1 hand-weeding at 45 days after transplanting. Herbicides were applied with the help of knapsack foot sprayar using flat-fan nozzle. The seeds of *Capsicum* cv. 'California Wonder' was sown in well-prepared nursery bed. Thirty-five days old seedlings were transplanted at a spacing of 60 cm × 45 cm in the second fortnight of April in both the years. Farmyard manure (FYM) @ 20 tonnes/ha was applied uniformly at the time of field preparation. In addition, the crop was also fertilized with 100 kg N, 50 kg P_2O_5 and 50 kg K_2O/ha. Half the N and full P and K were applied at transplanting and remaining N was top-dressed in 2 equal splits, 45 and 60 days after transplanting. Light irrigation was provided just after transplanting and others were given as and when required. Recommeded plant-protection measures were followed to raise the healthy crop. Weeding was performed manually with the help of hand tool *kutla*. Weed counts and their dry weights were recorded in 25 cm × 25 cm quadrate at 2 random places in each plot at harvest. Weed-control efficiency (WCE) and weed index were calculated as per Mani *et al.* (1973) and Gill and Kumar (1969) respectively.

RESULTS AND DISCUSSION

The major weeds infested the crop in the experimental field were *Galinsoga parviflora, Ageratum conyzoides, Cyperus* spp., *Oxalis latifolia, Echinochloa crus-galli* and *Commelina benghalensis.*

Effect of weeds

Weed population and weed dry weight were significantly reduced due to all the weed-control treatments except pendimethalin and fluchloralin alone each at 1.0 kg/ha over weedy check during both the years (Table 1). The weed-control efficiency ranged from 7.6 to 88.0, being maximum under repeated weeding (88.0) and minimum in pendimethalin alone (7.6). Weed index varied from 16.2 to 98.1, being the lowest and highest under alachlor 3.0 kg/ha along with hand-weeding (HW) at 45 days after transplanting (DAT) and unweeded check respectively. In herbicidal treatments, alachlor at 3.0 kg/ha, followed by HW at 45 days after transplanting (DAT) recorded the highest weed-control efficiency (WCE) (70.1–74.9) and minimum weed index (15.8–16.2), closely followed by alachlor 2.0 kg/ha HW 45 DAT.

Effect on yield and yield attributes of crop

Significant improvement in plant height, number of fruits and fruit weight/plant was registered due to all weed-control measures except alone application of pendimethalin at 1.0 kg/ha and fluchloralin at 1.0 or 2.0 kg/ha in both the years. The highest plant height (71 cm), fruits/plant (12.4) and fruit weight/plant (551) were recorded under repeated weeding, followed by alachlor 3.0 kg/ha + HW 45 DAT. Season-long crop–weed competition reduced the average fruit yield by 98.1% compared to repeated weeding. All the weed-control treatments except

Table 1. Effect of different treatments on density and dry weight of weeds, weed-control efficiency and weed index in capsium

Treatment	Dose (kg a.i./ha)	Weed density (No./m²)		Weed dry weight (g/m²)		Weed-control efficiency (%)		Weed index	
		1997	1998	1997	1998	1997	1998	1997	1998
Pendimethalin	1.0	560.0	641.6	641.6	720.0	5.0	10.2	97.2	96.4
Pendimethalin+HW 45 DAT	1.0	328.0	468.0	225.6	600.0	66.6	25.1	77.2	94.6
Alalchlor	2.0	393.6	432.0	520.0	563.2	23.0	29.7	79.9	72.6
Alalchlor	3.0	376.0	400.0	456.0	480.0	32.5	40.1	75.7	63.7
Alachlor + HW 45 DAT	2.0	278.4	342.4	201.6	273.6	70.1	65.9	37.4	21.4
Alachlor + HW 45 DAT	3.0	260.8	308.8	169.6	240.0	74.9	70.1	16.6	15.8
Fluchloralin	1.0	544.0	625.6	656.0	737.6	2.8	8.0	97.7	96.8
Fluchloralin	2.0	480.0	560.0	608.0	680.0	9.9	15.2	95.8	93.1
Fluchloralin + HW 45 DAT	1.0	323.2	369.6	224.0	297.6	66.8	62.9	92.3	65.2
Fluchloralin + HW 45 DAT	2.0	292.8	355.2	211.2	291.2	68.7	63.7	48.2	47.1
Repeated weeding		155.2	177.6	73.6	105.6	89.1	86.8		
Weedy check		593.6	688.0	675.2	801.6			98.0	98.1
CD (P=0.05)		137.7	133.2	129.3	131.4				

HW, Hand-weeding; DAT, Days after transplanting

Table 2. Yield and yield attributes of capsicum as influenced by weed-control treatments

Treatment	Dose (kg a.i./ha)	Plant height (cm)		Fruits/ plant		Fruit yield/ plant (g)		Fruit yield (q/ha)	
		1997	1998	1997	1998	1997	1998	1997	1998
Pendimethalin	1.0	62	45	1.5	1.3	49	26	6.7	5.9
Pendimethalin+HW 45 DAT	1.0	70	50	4.6	3.1	188	135	54.9	48.8
Alachlor	2.0	67	55	3.0	3.0	135	134	48.3	44.4
Alachlor	3.0	70	57	4.6	3.3	202	180	58.6	58.8
Alalchlor + HW 45 DAT	2.0	74	60	11.2	6.7	454	338	150.7	127.2
Alalchlor + HW 45 DAT	3.0	76	62	11.6	7.7	563	412	200.7	136.2
Fluchloralin	1.0	55	44	0.9	0.6	29	25	5.6	5.1
Fluchloralin	2.0	60	50	2.6	1.5	92	56	10.0	11.1
Fluchloralin + HW 45 DAT	1.0	68	58	5.0	3.8	235	154	66.7	56.3
Fluchloralin + HW 45 DAT	2.0	74	60	10.6	4.0	407	226	124.8	85.6
Repeated weeding		78	64	15.7	9.0	673	428	240.7	161.8
Weed check		40	35	1.3	0.4	25	20	4.8	3.0
CD (P=0.05)		10	11	1.3	2.4	73.5	65.7	19.9	24.9

HW, Hand-weeding; DAT, days after transplanting

Table 3. Effect of weed-control treatments on monetary returns in capsicum (mean data of 2 years)

Treatment	Dose (kg a.i./ha)	Gross return (Rs/ha)	Net return (Rs/ha)	Net profit/rupee invested on WM
Pendimethalin	1.0	3150	–1,116	–0.5
Pendimethalin + HW 45 DAT	1.0	22,950	14,844	1.62
Alachlor	2.0	23,200	19,622	12.1
Alachlor	3.0	29,350	25,266	11.8
Alachlor + HW 45 DAT	2.0	69,500	59,082	7.0
Alachlor + HW 45 DAT	3.0	84,250	73,326	8.2
Fluchloralin	1.0	2700	–1,026	–0.6
Fluchloralin	2.0	5,300	414	–0.1
Fluchloralin + HW 45 DAT	1.0	30,750	20,184	2.3
Fluchloralin + HW 45 DAT	2.0	52,600	40,874	4.2
Repeated weeding		100,650	79,890	4.2
Weed check		1,950		
CD (P=0.05)				

WM, Weed management; HW, hand-weeding; DAT, days after transplanting

pendimethalin and fluchloralin (1.0 kg/ha each) resulted in significantly higher fruit yields than weedy check in both the years (Table 2). Highest fruit yield was registered under repeated weeding; however, among the herbicidal treatments, alachlor 3.0 kg/ha in combination with HW 45 DAT proved to be the best in terms of fruit yield in both the years. It was attributed mainly to better control of weeds owing to integration of herbicide with manual weeding, as the pre-emergence application of herbicide controlled the weeds effectively during early stage of crop growth and weeds emerged at subsequent stages were removed manually. Application of pendimethalin or fluchloralin alone each at 1.0 kg/ha failed to provide satisfactory fruit yield. This might be due to their poor incorporation in soil, resulting higher dissipation and volatilization losses.

Monetary returns

The repeated weeding treatment recorded the highest net return (Rs 79,890/ha), followed by alachlor 3.0 kg/ha + HW 45 DAT (Rs 73,326/ha). However, later treatment provided more net profit/rupee invested (Rs 8.2) than former treatment (Rs 4.2). Application of alachlor 2.0 kg/ha alone proved the best from net profit/rupee investment point of view (Rs 12.1). Singh *et al.* (1991) also reported superiority of chemical weed control to traditional manual weeding with respect to benefit : cost ratio. Based on 2 year's findings, alachlor 3.0 kg/ha followed by HW 45 DAT may be recommended for controlling the weeds in *Capsicum* under mid-hill conditions of north-western Himalayas.

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