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Integrated weed management in rainfed chilli (*Capsicum annum* L.)

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Abstract: The field trials were conducted during the *kharif* seasons of 2010, 2011 and 2012 at the Agricultural Research Station, Gadhinglaj District Kolhapur (Maharashtra) to test the feasibility of herbicides alone at recommended doses and with combination of hoeing and hand weeding to develop an effective and viable weed management practice for chilli. The results revealed that pre emergence application of pendimethalin + two hoeings + one hand weeding recorded minimum weed density, weed biomass and weed index as compared to all other treatments. Gross and net returns were significantly higher with pendimethalin + one hoeing + one hand weeding which was on par with butachlor + two hoeings + one hand weeding and superior over rest of the treatments. Higher weed control efficiency and BC ratio were recorded by the same treatments.

Key words: Butachlor, Fenoxaprop- P-ethyl, Hoeing, Pendimethalin

Introduction

Chilli (*Capsicum annuum* L.) is the source of natural pungent compounds (capsaicin), colouring compounds (capsorubin) and vitamin C. It is known for its commercial and therapeutic value. India stands first in chilli cultivation covering 45 per cent area of the world, but the productivity of dry chilli is lower (0.9 t/ha) as compared to world's average (2.0 t/ha). There is tremendous demand for Indian chillies in the International market that provides wide scope to increase export.

Weed problems is severe in chilli and huge losses due to competition are global problem. Weeds interfere with the development of chilli upto 14 weeks after transplanting by competing for moisture, nutrient, light and space. Owing to inherent characteristics of chilli such as upright nature of crop, wide spaced, slow initial growth and less canopy, weeds offer severe competition throughout the crop growth. Control of weeds is vitally important not only to check the losses caused by them but also to increase input use efficiency. To get effective control of composite weed flora, integrated approach of weed management is the best choice. In the present investigation, an attempt was made to test the feasibility of herbicides alone at recommended doses and with combination of hoeing and hand weeding to develop an effective and viable weed management practice for chilli.

Material and methods

The experiment was conducted during the *kharif* seasons of 2010, 2011 and 2012 at the Agricultural Research Station, Gadhinglaj District Kolhapur (Maharashtra) which is geographically situated in sub mountain zone of Maharashtra, It is situated between 16° 13' N latitude, 74° 21' E longitude and at an altitude of about 640.24 m above mean sea level. Average rainfall of this station is 930 mm in 70 rainy days. The experimental site was medium to deep black and clayey in texture, low in organic carbon (0.64%), low in available nitrogen (210.20 kg/ha), medium in available phosphorus (20.83 kg/ha) and higher in available potash (474.87 kg/ha) and pH range was 7 to 7.5. Phule Sai variety of chilli was planted in second fortnight of June at 60 x 45 cm which was used for the study. The experiment was laid out in randomized block design with eight treatments and three replications. The treatments comprised of T_1- Butachlor (50 EC) Pre emergence @ 2.0 kg a.i./ha (Pre emergence application within two days of transplanting), T_2- Fenoxaprop-P ethyl (9.3% w/w) @ 1.0 kg a.i./ha (post emergence application when weeds are in two to three leaves stage), T_3- Pendimethalin (30 EC) Pre emergence @ 0.825 kg a.i./ha (Pre emergence application within two days after transplanting), T_4- Butachlor @ 2.0 kg a.i./ha (Pre emergence) + two hoeings + one hand weeding, T_5- Fenoxaprop-P Ethyl (9.3% w/w) @ 1.0 kg a.i./ha (post emergence application when weeds are in two to three leaves stage) + two hoeings + one hand weeding, T_6- Pendimethalin @ 0.825 kg a.i./ha (Pre emergence) + two hoeings + one hand weeding , T_7- Weed free check, T_8- Weedy check. The gross and net plot size were 5.40 x 4.80 m and 4.50 x 3.60 m, respectively.

Results and discussion

The experimental field was infested with broad leaf and grassy weeds. The prominent weed flora observed in weedy plot of experiment where *Euphorbia hirta* L., *Cynodon dactylon* (L.) Pers., *Cyperus rotundus* L., *Digera arvensis* Forsk., *Phyllanthus niruri* L., *Amaranthus spinosus* L., *Parthenium hysterophorus* L., *Achyranthes aspers* L., *Alternanthera triandra* Lam. Overall the experiment was dominated by dicotyledonous weeds.

The results revealed that (Table 1) different weed control treatments significantly reduced weed density and their biomass accumulation as compared to the weedy check. The weed intensity and biomass accumulation was recorded lowest with the application of pendimethalin + two hoeings + one weeding, which was statistically at par with butachlor + two hoeings + onee weeding and significantly superior over rest of the treatments except weed free check. As would be expected, the weed free check and weedy check recorded significantly minimum and maximum weed density and weed biomass,

Table 1. Effect of weed control measures on weed density, weed biomass and weed control efficiency of chilli

Sl. No.	Treatments	Weed density/m²								Weed Biomass (kg/m²)				Weed Control efficiency (%)			
		2010		2011		2012		Pooled Mean									
		Broad leaf weeds	Grassy weed	Broad leaf weeds	Grassy weed	Broad leaf weeds	Grassy weed	Broad leaf weeds	Grassy weed	2010	2011	2012	Pooled Mean	2010	2011	2012	Pooled Mean
1.	Butachlor 50 EC @ 2.0 kg a.i./ha (Pre)	6.18 (37.66)	2.80 (7.66)	6.09 (36.66)	3.12 (9.33)	6.69 (45.67)	3.44 (11.33)	6.32 (40.00)	3.12 (9.44)	1.07 (0.648)	1.06 (0.625)	1.15 (0.822)	1.09 (0.698)	48.16	53.94	48.63	50.20
2.	Fenoxaprop-P- ethyl (9.3% w/w) @ 1.0 kg a.i./ha (Post)	6.64 (45.66)	4.26 (17.66)	6.67 (43.33)	4.33 (18.33)	7.10 (50.00)	5.07 (25.33)	6.80 (46.33)	4.55 (20.44)	1.14 (0.805)	1.12 (0.763)	1.20 (0.937)	1.16 (0.835)	35.60	43.77	41.44	40.46
3.	Pendimethalin 30 EC @ 0.825 kg a.i./ha (Pre)	4.97 (24.33)	2.70 (7.00)	5.43 (29.00)	2.43 (5.66)	6.32 (39.67)	2.26 (4.67)	5.57 (31.00)	2.46 (5.78)	1.07 (0.636)	1.03 (0.567)	1.09 (0.688)	1.06 (0.63)	49.12	58.22	57.00	55.05
4.	Butachlor @ 2.0 kg a.i./ha (Pre)+ 2 hoeings + 1 weeding	3.98 (12.33)	1.55 (2.00)	4.07 (16.33)	1.68 (2.33)	3.99 (15.67)	2.26 (4.67)	4.01 (14.78)	1.83 (3.00)	0.90 (0.307)	0.89 (0.298)	0.91 (0.330)	0.90 (0.312)	75.44	78.04	79.38	77.78
5.	Fenoxaprop-P-ethyl (9.3% w/w) @ 1.0 kg a.i./ha (Post) + 2 hoeings + 1 weeding	7.54 (56.66)	2.66 (6.66)	7.05 (49.33)	2.41 (5.33)	7.74 (69.67)	2.67 (6.67)	7.44 (58.55)	2.58 (6.22)	0.94 (0.388)	0.94 (0.380)	1.01 (0.520)	0.96) (0.429	68.96	72.00	67.50	69.38
6.	Pendimethalin 30 EC @ 0.825 kg a.i./ha (Pre) + 2 hoeings + 1weeding	3.33 (10.66)	1.77 (2.66)	3.07 (9.00)	1.68 (2.33)	3.56 (12.33)	1.86 (3.00)	3.32 (10.66)	1.77 (2.66)	0.83 (0.188)	0.84 (0.210)	0.83 (0.192)	0.83 (0.197)	84.96	84.52	88.00	85.98
7.	Weed free check	1.85 (3.00)	1.34 (1.33)	1.77 (2.66)	1.34 (1.33)	1.95 (3.33)	1.34 (1.33)	1.85 (03.00)	1.34 (1.33)	0.76 (0.073)	0.76 (0.068)	0.76 (0.071)	0.76 (0.071)	94.16	94.99	95.56	94.96
8.	Weedy check	9.77 (95.33)	5.42 (29.00)	1.26 (105.00)	5.53 (30.00)	10.15 (102.67)	6.01 (35.67)	7.06 (101.00)	5.65 (22.56)	1.32 (1.250)	1.36 (1.357)	1.45 (1.600)	1.38 (1.402)	0.00	0.00	0.00	0.00
	S.Em.±	0.379	0.171	0.252	0.197	0.298	0.136	0.310	0.168	0.087	0.121	0.034	0.081	-	-	-	-
	C.D. (P =0.05)	1.149	0.521	0.742	0.58	0.905	0.412	0.932	0.504	0.26	0.356	0.103	0.240	-	-	-	-

respectively. Weed biomass reflects the growth potential of the weeds and is better indicator of its competitive ability with the crop plants. This might be due to effective control of weeds in early stage by pendimethalin and butachlor in combination with one hoeing and one weeding. The results are analogous to those reported by Arvadiya *et al.* (2012).

Weed control efficiency (Table 1) increased with the adoption of weed control measures over weedy check. Identical increases in weed control efficiency was noted with treatment of weed free check followed by pendimethalin, butachlor and fenoxaprop-P-ethyl in combination with two hoeings and one weeding and herbicides alone in respective manner. Weed index is inversely proportional to weed control efficiency in all the treatments. This is due to lower weed population and reduced dry matter production of weeds during initial stage and effective control of later emerged weeds through hand weeding which ultimately provided weeds free environment to chilli. These results are in accordance with the findings of Mekki *et al.* (2010).

Pendimethalin + two hoeings + one weeding (64.5 cm) being statistically at par with butachlor + two hoeings + one weeding (61.1 cm) resulted in significantly taller plants over rest of the treatments except weed free check (Table 2). This may be ascribed to least competition from weeds due to their effective suppression. Number of branches and fruit length of chilli were not significantly influenced as these are the genetic characters of chilli variety Phule Sai. Number of fruits and fruit weight per plant were significantly superior in pendimethalin + two hoeings + one weeding (37.3) and which was at par with butachlor and fenoxaprop - P-ethyl + two hoeings + one weeding (37.1). Reduced crop weed completion due to effective control of weeds by various integrated weed management practices resulted in better utilization

Table 2. Growth and yield attributing characters influenced by different weed management treatments

Sl. No.	Treatments	Plant height (cm)				No. of branches/plant				Fruit length (cm)				No. of fruits/plant				Fruit weight/plant (g)			
		2010	2011	2012	Pooled Mean	2010	2011	2012	Pooled Mean	2010	2011	2012	Pooled Mean	2010	2011	2012	Pooled Mean	2010	2011	2012	Pooled Mean
1.	Butachlor 50 EC @ 2.0 kg a.i./ha (Pre)	55.9	53.3	57.7	55.6	3.9	3.1	4.1	3.7	7.8	7.3	7.9	7.7	31.9	28.7	33.6	31.4	32.3	29.1	35.4	32.3
2.	Fenoxaprop-P-ethyl (9.3% w/w) @ 1.0 kg a.i./ha (Post)	54.8	53.2	56.8	54.9	3.7	3	4.5	3.7	7.7	7.1	7.9	7.6	30.7	26.9	31.5	29.7	30.8	28.3	33.7	30.9
3.	Pendimethalin 30 EC @ 0.825 kg a.i./ha (Pre)	59.8	58.1	61.5	59.8	4.1	3.7	4.3	4.0	7.8	7.5	8.0	7.8	31.9	27.7	34.8	31.5	32.7	28	36.3	32.3
4.	Butachlor @ 2.0 kg a.i./ha (Pre)+ 2 hoeings + 1 weeding	60.6	60.4	62.2	61.1	4.2	3.9	4.5	4.2	7.9	7.7	8.3	8.0	37.2	34.1	39.9	37.1	37.3	35.4	40.6	37.8
5.	Fenoxaprop- P-ethyl (9.3% w/w) @ 1.0 kg a.i./ha (Post) + 2 hoeings + 1 weeding	60.1	59.6	62.1	60.6	3.9	3.1	4.5	3.8	7.8	7.5	8.1	7.8	35.8	31.5	39.1	35.5	36.3	32.9	41.9	37.0
6.	Pendimethalin 30 EC @ 0.825 kg a.i./ha (Pre) + 2 hoeings + 1 weeding	64.7	63.2	66.6	64.5	4.2	4	4.8	4.3	7.9	7.3	8.4	7.9	37.4	33.9	40.5	37.3	38.4	34.9	43.9	39.1
7.	Weed free check	67.7	65.1	69.5	67.4	4.6	4.1	4.9	4.5	8.1	7.9	8.6	8.2	35.2	35.1	41.8	38.4	38.9	36.1	44.1	39.7
8.	Weedy check	53.3	51.1	55.1	53.2	2.5	2.2	2.9	2.5	7	6.9	7.3	7.1	10.6	8.1	13.4	10.7	10.8	9.3	15.7	11.9
	S.Em.±	1.20	1.11	1.60	1.30	0.88	0.69	0.91	0.83	0.81	0.87	0.93	0.87	1.71	1.39	1.88	1.66	0.72	0.84	1.21	0.92
	C.D. (P =0.05)	3.71	3.37	4.86	3.98	NS	NS	NS	NS	NS	NS	NS	NS	5.32	4.15	5.81	5.09	2.21	2.56	3.36	2.74

of growth factors by crop and this resulted in its better growth and development. This may be ascribed to fact that the effective control of weeds led to the favourable environment for growth and photosynthetic activity of the crop.

All the weed control measures resulted in significantly higher dry red chilli yield than weedy check. Weed free check recorded highest values of dry red chilli yield, may be due to least competition on offered by weeds. Application of pendimethalin + two hoeings + one weeding (1.56 t ha^{-1}) recorded significantly more dry red chilli yield over various herbicides and its combination with mechanical method of weed control, while it was on par with butachlor + two hoeings + one weeding (1.46 t ha^{-1}). Among the herbicides pre emergence application of pendimethalin was found effective for control of weeds in chilli than butachlor as a pre emergence and fenoxaprop- P-ethyl as post emergence spray. This may be due to least competition of weeds with chilli for nutrient, light, moisture and space at crucial growth stages. In pendimethalin + two hoeings + one weeding treatment the rate of NPK absorption cumulatively helped the crop plants to produce more surface area for high photosynthetic rate as well as maximum translocation of photosynthates from source to sink, subsequently resulted in improvement in yields. Kunti and Singh (2012) also reported significant increase in fruit yield of chilli with pendimethalin (1 kg a.i. ha^{-1}) as pre emergence with two hoeings and one hand weeding at 45 days after transplanting over rest of herbicides combination. These finding are in agreement with the results of Deshpande *et al.* (2006) and Mandeep and Walia (2012).

Maximum gross returns (Table 3) were obtained in weed free check which was on par with pendimethalin + two hoeings + one weeding (₹ 106.95x10^3 ha^{-1}) and significantly superior over rest of treatments. However, significantly lower gross returns were obtained from weedy check. Pre emergence application of pendimethalin + two hoeings + one weeding (₹ 57.95 x 10^3 ha^{-1}) gave maximum net returns which was on par with butachlor + two hoeings + one weeding and significantly superior over rest of weed control methods except weed free check. BC ratio was found higher in treatment pendimethalin + two hoeings + one weeding (2.18) followed by butachlor + two hoeings + one weeding (2.05) while lowest values were recorded in the weedy check. Due to excellent control of complex weed flora without any adverse effect on crop growth, weed free treatment registered lower monetary returns and BC ratio due to high cost involved in repeated weedings to keep crop weed free despite having higher dry chilli yield.

The results revealed that pre emergence application of pendimethalin + two hoeings + one hand

Table 3. Effect of weed control measures on weed index, dry red chilli, monetary returns and BC ratio of chilli

Sl. No.	Treatment	Weed Index (%)				Dry red chilli yield (t/ha)				Monetary returns (x 10^3 ₹/ha)								BC ratio			
		2010	2011	2012	Pooled Mean	2010	2011	2012	Pooled Mean	2010		2011		2012		Pooled Mean		2010	2011	2012	Pooled Mean
										Gross	Net	Gross	Net	Gross	Net	Gross	Net				
1.	Butachlor 50 EC @ 2.0 kg a.i./ha (Pre)	37.03	39.93	44.68	40.87	1.04	0.82	1.11	0.99	62.34	20.34	57.61	15.61	83.40	41.40	67.78	25.78	1.48	1.37	1.99	1.61
2.	Fenoxaprop-P-ethyl (9.3% w/w) @ 1.0 kg a.i./ha (Post)	42.00	43.65	51.34	46.18	0.96	0.77	0.98	0.90	57.42	15.42	54.04	12.04	73.35	31.35	61.60	19.60	1.37	1.29	1.75	1.47
3.	Pendimethalin 30 EC @ 0.825 kg a.i./ha (Pre)	29.39	29.78	36.47	32.33	1.17	0.96	1.28	1.14	69.90	27.90	67.34	25.34	95.78	53.78	77.67	35.67	1.66	1.60	2.28	1.85
4.	Butachlor @ 2.0 kg a.i./ha (Pre)+ 2 hoeings + 1 weeding	12.97	13.58	12.29	12.86	1.44	1.18	1.76	1.46	86.16	37.16	82.88	33.88	132.23	83.23	100.42	51.42	1.76	1.69	2.70	2.05
5.	Fenoxaprop- P-ethyl (9.3% w/w) @ 1.0 kg a.i./ha (Post) + 2 hoeings + 1 weeding	20.00	20.07	25.37	22.17	1.32	1.10	1.50	1.31	79.20	30.20	76.65	27.65	112.50	63.50	89.45	40.45	1.62	1.56	2.30	1.83
6.	Pendimethalin 30 EC @ 0.825 kg a.i./ha (Pre) + 2 hoeings + 1 weeding	3.88	11.53	6.57	7.04	1.59	1.21	1.88	1.56	95.16	46.16	84.84	35.84	140.85	91.85	106.95	57.95	1.94	1.73	2.87	2.18
7.	Weed free check	0.00	0.00	0.00	0.00	1.65	1.37	2.01	1.68	99.00	29.00	95.90	25.90	150.75	80.75	115.22	45.22	1.41	1.37	2.15	1.65
8.	Weedy check	61.39	71.31	67.71	66.62	0.64	0.39	0.65	0.56	38.22	22.20	27.51	-8.49	48.68	12.68	38.14	2.14	1.06	0.76	1.35	1.06
	S.Em.±	-	-	-	-	0.098	0.055	0.084	0.079	6.087	6.09	4.68	4.19	3.99	4.09	4.92	4.79	-	-	-	-
	C.D. (P =0.05)	-	-	-	-	0.299	0.163	0.257	0.240	18.46	18.47	13.76	12.28	12.10	12.39	14.77	14.38	-	-	-	-

weeding recorded minimum weed density, weed biomass, weed index and higher weed control efficiency, dry red chilli yield, net monetary returns and BC ratio as compared to all weed control treatments.

References

Arvadiya, L. K., Raj, V. C., Patel, T. U. and Arvadia, M. K., 2012, Influence of plant population and weed management on weed flora and productivity of sweet corn. *Indian J. Agron.*, 57(2): 162-267.

Deshpande, R. M., Pawar, W. S., Mankar, P. S., Bobade, P. N. and Chimote, A. N., 2006, Integrated weed management in rainfed cotton. *Indian J. Agron.*, 551(1): 68-69.

Kunti, G. S. and Singh, H. P., 2012, Weed management practices on growth and yield of winter season brinjal under Chhattisgarah plain conditions. *Indian J. Weed Sci.*, 44(1): 18-20.

Mandeep, K. S. and Walia, U. S., 2012, Effect of land configuration and weed management in onion. *Indian J. Agron.*, 57(3): 275-278.

Mekki, B. B., Faida, A. A. and Kowthar, G., 2010, Effect of weed control treatments on yield and seed quality of some canola cultivars and associated weeds in newly reclaimed sandy soils. *American-Eurasian J. Agric. & Environ. Sci.*, 7(2): 202-209.