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Integrated weed management in chilli under rainfed condition

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ABSTRACT

A field experiment was conducted during *Kharif* 2010, 2011 and 2012 at Agricultural Research Station, Gadhinglaj under rainfed condition in sub-montane zone of Maharashtra. The experiment consisting of eight treatments, *viz*. two pre-emergence and one post-emergence herbicides alone and in combination with one hoeing and one weeding with weed free and weedy check was laid out in randomized block design with three replications. The predominant weed flora observed in the experimental field was dicot weeds. The result revealed that pre-emergence application of pendimethalin + 1 hoeing + 1 hand weeding recorded minimum weed density, weed biomass and weed index as compared with all treatments. Gross and net returns were significantly higher with pendimethalin + 1 hoeing + 1 hand weeding which was at par with butachlor + 1 hoeing +1 hand weeding and superior over rest of treatments. Higher weed control efficiency and B: C ratio were recorded by the same treatments.

Key words: Butachlor, Chilli, Fenoxaprop-p-ethyl, Pendimethalin

Chilli (*Capsicum annuum* L.) is an important commercial crop of India grown for its green fruits as vegetable and riped dried form as spice. It 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% areas of the world, but the productivity of dry chilli is lower (0.9 t/ha) as compared to worlds average (2.0 t/ha). There is tremendous demand for Indian chillies in the international market that provides wide scope to increase export.

Severe weed problems in chilli and huge losses due to weed competition are global problem. Weeds interfere with the development of chilli upto 8 weeks after transplanting by competing for moisture, nutrient, light and space (Amador and Ramirez 2002). 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 complex 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 practices for chilli.

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MATERIALS AND METHODS

A field experiment was conducted during *Kharif* 2010, 2011 and 2012 at the Agricultural Research Station, Gadhinglaj Dist. Kolhapur (M.S.). The area is geographically situated in sub montain zone of Maharashtra. It is situated between 160 13'N latitude, 740 21' E longitude and at an altitude of about 640.24 m above msl. Average rainfall of this station is 930mm in 70 rainy days. The experimental site was medium to deep black and clayey in texture, low in medium in organic carbon (0.64%), low in available nitrogen (210.2 kg/ha) , medium in available phosphorus (20.8 kg/ha) and higher in available potash (474.8 kg/ha) and pH range is 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 treatment comprises of *viz*. butachlor 2.0 kg/ha (50 EC) pre-emergence (pre-emergence application within two days of transplanting), fenoxaprop-p-ethyl 1.0 kg/ha (9.3% w/w) (post-emergence application when weeds are in two to three leaves stage), pendimethalin 0.825 kg /ha (30 EC) pre-emergence (pre-emergence application within two days after transplanting), butachlor 2.0 kg/ha (pre-emergence) + one hoeing + one hand weeding, fenoxaprop-p-ethyl (9.3% w/w). Ec) + one hoeing + one hand weeding, pendimethalin 0.825 kg/ha (pre-emergence) + one hoeing + one hand weeding, weed free check and weedy check. The gross and net plot size were 5.40 x 4.80 m^2 and 4.50 x 3.60 m^2, respectively. Observations on weed

counts (number/m^2) and weed dry weight (g/m^2) were taken by sampling randomly at 5 places with the help of 0.25 m^2 quadrants at 60 days and the data were transformed in arcsine values before statistical analysis.

RESULTS AND DISCUSSION

Effect on weed density and weed biomass

The experimental field was infested with broad-leaf and grassy weeds. The prominent weed flora where *Amaranthus spinosus*, *Parthenium hysterophorus*, *Achyranthes aspera*, *Alternanthera triandra*, *Euphorbia hirta*, *Cynodon dactylon*, *Cyperus rotundus*, *Digera arvensis*, *Phyllanthus niruri*. The experiment was dominated by dicot weeds.

Different weed control treatments significantly reduced weed density and their biomass accumulation compared to the weedy check. Significantly lower weed intensity and biomass accumulation were recorded with application of pendimethalin + 1 hoeing + 1 weeding than other treatments and was on par with butachlor + 1 hoeing + 1 weeding. As would be expected, the weed free check and weedy check recorded significantly minimum and maximum weed density and weed biomass, 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 Rajput *et al.* (2003) and Arvadiya *et al.* (2012)

Weed control efficiency and weed index

Weed control efficiency increased with the adoption of weed control measures over weedy check. Identical increases in weed control efficiency was noted with treatment weed free check followed by pendimethalin, butachlor and fenoxaprop-p-ethyl in combination with one hoeing 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 Singh *et al.* (1997) and Mekki *et al.* (2010).

Dry red chilli yield

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 + 1 hoeing + 1 weeding recorded significantly more dry red chilli yield over various herbicides and its combination with mechanical method of weed

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

Treatment	Weed density/m^2								Weed biomass (kg/m^2)				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
Butachlor 2 kg/ha	6.18 (37.7)	2.80 (7.66)	6.09 (36.7)	3.12 (9.33)	6.69 (45.7)	3.44 (11.3)	6.32 (40.0)	3.12 (9.44)	1.07 (0.65)	1.06 (0.62)	1.15 (0.82)	1.09 (0.70)	48.2	53.9	48.6	50.2
Fenoxaprop-p-ethyl 1 kg/ha	6.64 (45.7)	4.26 (17.7)	6.67 (43.3)	4.33 (18.3)	7.10 (50.0)	5.07 (25.3)	6.80 (46.3)	4.55 (20.4)	1.14 (0.80)	1.12 (0.76)	1.20 (0.94)	1.16 (0.83)	35.6	43.8	41.4	40.5
Pendimethalin 0.825 kg/ha	4.97 (24.3)	2.70 (7.00)	5.43 (29.0)	2.43 (5.66)	6.32 (39.7)	2.26 (4.67)	5.57 (31.0)	2.46 (5.8)	1.07 (0.64)	1.03 (0.57)	1.09 (0.69)	1.06 (0.63)	49.1	58.2	57.0	55.1
Butachlor 2 kg/ha + 1 hoeing + 1 weeding	3.98 (12.3)	1.55 (2.00)	4.07 (16.3)	1.68 (2.33)	3.99 (15.7)	2.26 (4.67)	4.01 (14.8)	1.83 (3.00)	0.90 (0.31)	0.89 (0.30)	0.91 (0.33)	0.90 (0.31)	75.4	78.0	79.4	77.8
Fenoxaprop-p-ethyl 1 kg/ha + 1 hoeing + 1 weeding	7.54 (56.7)	2.66 (6.66)	7.05 (49.3)	2.41 (5.33)	7.74 (69.7)	2.67 (6.67)	7.44 (58.6)	2.58 (6.22)	0.94 (0.39)	0.94 (0.38)	1.01 (0.52)	0.96 (0.43)	69.0	72.0	67.5	69.4
Pendimethalin 0.825 kg/ha +1 hoeing + 1 weeding	3.33 (10.7)	1.77 (2.66)	3.07 (9.00)	1.68 (2.33)	3.56 (12.3)	1.86 (3.00)	3.32 (10.7)	1.77 (2.66)	0.83 (0.18)	0.84 (0.21)	0.83 (0.19)	0.83 (0.20)	85.0	84.5	88.0	86.0
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 (03.0)	1.34 (1.33)	0.76 (0.07)	0.76 (0.07)	0.76 (0.07)	0.76 (0.07)	94.2	95.0	95.6	95.0
Weedy check	9.77 (95.3)	5.42 (29.0)	1.26 (105)	5.53 (30.0)	10.15 (102.7)	6.01 (35.7)	7.06 (101.0)	5.65 (22.6)	1.32 (1.25)	1.36 (1.36)	1.45 (1.60)	1.38 (1.40)	0.00	0.00	0.00	0.00
LSD (P=0.05)	1.15	0.52	0.74	0.58	0.91	0.41	0.93	0.50	0.26	0.36	0.10	0.24	-	-	-	-

Original values are given in parentheses

Table 2. Effect of weed control measures on weed index, dry red chilli, monetary returns and B:C ratio in chilli

Treatment	Dry red chilli yield (t/ha)				Net returns (x10^3 `/ha)				B : C ratio			
	2010	2011	2012	Pooled mean	2010	2011	2012	Pooled mean	2010	2011	2012	Pooled mean
Butachlor 2 kg/ha	1.04	0.82	1.11	0.99	20.34	15.61	41.40	25.78	1.48	1.37	1.99	1.61
Fenoxaprop-p-ethyl 1 kg/ha	0.96	0.77	0.98	0.90	15.42	12.04	31.35	19.60	1.37	1.29	1.75	1.47
Pendimethalin 0.825 kg/ha	1.17	0.96	1.28	1.14	27.90	25.34	53.77	35.67	1.66	1.60	2.28	1.85
Butachlor 2 kg/ha + 1 hoeing + 1 weeding	1.45	1.19	1.76	1.46	37.16	33.88	83.22	51.42	1.76	1.69	2.70	2.05
Fenoxaprop-p-ethyl 1 kg/ha + 1 hoeing + 1 weeding	1.32	1.10	1.5	1.31	30.20	27.65	63.50	40.45	1.62	1.56	2.30	1.83
Pendimethalin 0.825 kg/ha + 1 hoeing + 1 weeding	1.59	1.12	1.88	1.56	46.16	35.84	91.85	57.95	1.94	1.73	2.87	2.18
Weed free check	1.65	1.37	2.01	1.68	29.00	25.90	80.75	45.22	1.41	1.37	2.15	1.65
Weedy check	0.64	0.40	0.65	0.56	2.22	-8.49	12.67	2.13	1.06	0.76	1.35	1.06
LSD (P=0.05)	0.30	0.16	0.25	0.24	18.46	12.28	12.39	14.38	-	-	-	-

control, while it was on par with butachlor + 1 hoeing + 1 weeding. 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. This may be due to least competition of weeds with chilli for nutrient, light, moisture and space at crucial growth stages. In pendimethalin + 1 hoeing + 1 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 photosynthets from source to sink, subsequently resulted in improvement in yields. Kunti *et al*. (2012) also reported significant increase in fruit yield of chilli was recorded with pendimethalin (1 kg/ha) as pre-emergence with one hand weeding at 45 DAT over rest of herbicides combination. These finding are in agreement with the earlier result of Deshpande *et al*. (2006), Rajput (2003) and Saini and Walia (2012).

Economics

Maximum gross returns were obtained in weed free check which was at par with pendimethalin + 1 hoeing + 1 weeding and significantly superior over rest of treatments. However, significantly lower gross returns were obtained from weedy check. Pre-emergence application of pendimethalin + 1 hoeing + 1 weeding gave maximum net returns which was on par with butachlor + 1 hoeing + 1 weeding and significantly superior over rest of weed control methods except weed free check. B:C ratio was found higher in treatment pendimethalin + 1 hoeing + 1 followed by butachlor + 1 hoeing + 1 weeding 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 B:C ratio due to high cost involved in repeated weedings to keep crop weed free despite of having higher dry chilli yield.

It was concluded that for effective and economic weed control in chilli, use of pendimethalin + 1 hoeing + 1 hand weeding or butachlor + 1 hoeing + 1 hand weeding is the best option.

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