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Weed Management in Drilled Onion (*Allium cepa* L.)+Chilli (*Capsicum annuum* L.)+Cotton (*Gossypium herbaceum* L.) Relay Intercropping in Rainfed Vertisols

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ABSTRACT

A field experiment was carried out during 2005 and 2006 at Belvatagi, Karnataka to work out the weed management practices in drill sown onion+chilli+cotton relay intercropping in rainfed Vertisols. Pre-emergence application of oxyfluorfen @ 0.15 kg/ha and pendimethalin @ 1.0 kg/ha reduced the weed growth significantly but oxyfluorfen was toxic to onion and chilli. Pendimethalin @ 1.0 kg/ha with two or more hand weedings resulted in higher onion bulb yield and at par with farmers' practice (88.37 q/ha). Chilli fruit yield was significantly higher with oxadiargyl @ 0.09 kg/ha with hand weeding at 20, 40, 60 and 80 DAS (11.8 q/ha), which was at par with weed free check (12.99 q/ha) and farmers' practice (10.09 q/ha). Seed cotton yield was found better with oxyfluorfen @ 0.15 kg/ha alongwith hand weeding at 20, 40 and 60 DAS. Application of pendimethalin @ 1.0 kg/ha with three hand weedings at 20, 40 and 60 DAS was found better for onion bulb and chilli fruit yield and comparable with farmers' practice for the onion+chilli+cotton relay intercropping system. This resulted in higher net returns (Rs. 64,390/ha) and B : C ratio (3.99).

Key words : Drilled onion, chilli, herbicides, hand weeding, cotton, weeds

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INTRODUCTION

Intercropping of onion (*Allium cepa* L.), chilli (*Capsicum annuum* L.) and cotton (*Gossypium herbaceum* L.) is a traditional practice in Vertisols of northern dry zone of Karnataka. The system is well suited to the weather conditions of the region and is the most economical. Onion is a slow growing crop with short stature, non-branching habit, sparse foliage and shallow root system and competes poorly with weeds resulting in 40-50% reduction in bulb yield. Chilli and cotton are also susceptible to weed competition due to their initial slow growth and wider space between two rows. Hand weeding is the most common practice followed by farmers under dry lands though it is tedious, costly and time consuming. Pre emergence application of pendimethalin @ 1.0 kg/ha with one hand weeding at 45 days after sowing (DAS) has been found as the best weed management practice under rainfed Vertisols (Nadagouda, 1995). However, the management in onion+chilli+cotton relay intercropping under rainfed Vertisols is lacking. Hence, the present investigation was undertaken.

MATERIALS AND METHODS

The field experiment was conducted during 2005-06 and 2006-07 at Water Management Research Centre, Belvatagi (15.60^0 N, 75.23^0 E, and 579 m above mean sea level). The soil was clay (61.20%), medium in organic carbon (0.53%), low in available nitrogen (242 kg/ha), medium in available phosphorus (25.0 kg P_2O_5/ha) and high available potassium (820 kg K_2O/ha) with alkaline reaction (pH 8.2). The experiment was conducted in a factorial randomized block design with herbicides and hand weeding as two factors in three replications. Four weed control treatments (Pendimethalin @ 1.0 kg/ha, oxadiargyl @ 0.09 kg/ha, oxyfluorfen @ 0.15 kg/ha and no herbicide) and six hand weeding (HW) treatments : HW at 20 DAS, HW at 40 DAS, HW at 20 and 40 DAS, HW at 20, 40 and 60 DAS, HW at 20, 40, 60 and 80 DAS and no HW were tested alongwith two controls i. e. weed free check and farmers' practice. The onion variety 'Bellary Red', chilli variety 'Byadagi kaddi' and cotton variety 'Jayadhar' were used. Onion (7.5 kg/ha) and chilli (5.0 kg/ha) were hand drilled in separate rows (5 : 1) in the second week of July in 2005 and last week of June in 2006. Distance between two rows of onion was 15 cm and 90 cm for chilli. Cotton seeds were hand dibbled @ 3 kg/ha during the last week of September 2005 and second week of September in 2006 when both onion and chilli were in grand growth stage. Planting of cotton was done at 45 cm away from

chilli row, while 40 cm was maintained within the row. Recommended dose of fertilizer for onion+chilli (125 : 75 : 50 NPK kg/ha) and cotton (30 : 15 : 15 NPK kg/ha) was applied as basal dose and at 45 DAS in equal splits. In the weed free treatment, weeds were removed by hand weeding frequently as and when the weeds appeared. In the farmers' practice, six hand weedings were done at an interval of 20 days from sowing upto 120 DAS. Weeding operation was not done in no hand weeding treatment. Herbicides were applied a day after sowing of onion+chilli in both the years with a spray volume of 750 l/ha. Onion was harvested in the third week and second week of November in 2005 and 2006, respectively. Picking of chilli was done in the month of January, while cotton was picked in the first week of March in both the years. Total rainfall of 492.1 and 443.0 mm was received during 2005 and 2006, respectively. Weed population (No./m^2) and weed dry weight (g/m^2) were recorded at 20, 40, 60, 80 and 100 DAS but before weeding. The visual toxicity was recorded at 10 and 20 days after spray. Scores were given from 1-5 scale (1–No toxicity, 2–Slight toxicity, 3–Moderate toxicity, 4–Severe toxicity, 5–Toxic), by comparing the crop tolerance to a particular herbicide treatment and weed free check plot. The data on number and dry weight of weeds were subjected to square root transformation $\sqrt{X+0.5}$ before statistical analysis. Weed control efficiency was calculated by using the formula :

$$WCE\ (\%) = \frac{DMC - DMT}{DMC} \times 100$$

Where,

DMC=Dry matter of weeds in unweeded check plot

DMT=Dry matter of weeds in treatment plot

Since the intercropping system had three intercrops, for better and uniform comparison of the treatment combinations the onion equivalent yield was calculated by using the following formula :

Onion equivalent yield (q/ha)=Onion yield (q/ha)+{(Chilli yield x Chilli price)/Onion price)+(Cotton yield x Cotton price)/Onion price)}.

Statistical analysis was done with the help of MSTAT-C software. Two factorial randomized block designs were used for comparing the two factors i. e. herbicides and hand weeding, while single factor randomized block design was used for comparing treatment combinations of herbicides and hand weeding with two controls.

RESULTS AND DISCUSSION

Effect on Weeds

The major weeds associated with crops in the experimental field were *Cynodon dactylon* Pers., *Brachiaria eruciformis* Roem and Schult. and *Dinebra retroflexa* Panz. (grasses), *Abutilon indicum* G. Don., *Acanthospermum hispidum* L., *Ageratum conyzoides* L., *Alternanthera sessilis* L., *Amaranthus viridis* L, *Cynotis cristata* L, *Convolvulus arvensis* L., *Commelina benghalensis* L., *Desmodium diffusum* Dc., *Digera arvensis* L., *Euphorbia hirta.* (L.) Forssk., *Lactuca runcinata* Dc., *Lagasca mollis* Car., *Parthenium hysterophorus* L., *Phyllanthus maderaspatensis* L., *Physalis minima* L., *Portulaca oleracea* L. (broad leaf) and *Cyperus rotundus* L. sedge.

Weed Density

Pre-emergent application of oxyfluorfen @ 0.15 kg/ha and oxadiargyl @ 0.09 kg/ha significantly reduced the weed density (Table 1). Application of pendimethalin @ 1.0 kg/ha was effective upto 40 DAS. Oxyfluorfen @ 0.15 kg/ha has been found to be effective in reducing the weeds in transplanted chilli (Biradar, 1999) and drilled onion (Atre, 2001; Kalyanamurthy, 2002). Interaction of herbicide and hand weeding was found to be significant. Weed density was lowest in oxyfluorfen @ 0.15 kg/ha along with hand weeding at 20, 40 and 60 DAS and was comparable with weed free and farmers' practice. Pendimethalin @ 1.0 kg/ha and oxadiargyl @ 0.09 kg/ha were at par in reducing the weed number.

Weed Dry Weight

Dry weight of weeds increased gradually from 20 to 80 DAS in all treatments. Oxyfluorfen @ 0.15 kg/ha recorded the lowest dry weight compared to other herbicides. Oxyfluorfen @ 0.15 kg/ha alongwith hand weeding at 20, 40, 60 and 80 DAS reduced the weed dry weight significantly and was comparable with weed free and farmers' practice. Combination of any herbicide with hand weeding at 20, 40, 60 and 80 DAS was comparable with weed free and farmers' practice.

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Table 1. Weed density, dry weight, weed control efficiency and crop phytotoxicity at different days after sowing as influenced by different treatments in direct seeded onion + chilli + cotton relay intercropping (Mean of 2005-06 and 2006-07)

Treatments	Weed density (No./m^2)			Weed dry weight (g/m^2)			WCE (%)			Phytotoxicity			
										Onion		Chilli	
	20 DAS	40 DAS	60 DAS	20 DAS	40 DAS	60 DAS	20 DAS	40 DAS	60 DAS	10 DAS	20 DAS	10 DAS	20 DAS
Herbicides													
Pendimethalin 1 kg/ha	5.81 b (42.94)	3.16 b (15.64)	3.59 a (17.00)	7.20 b (54.81)	6.87 b (79.56)	7.62 c (94.38)	56.26	76.48	84.48	1.06	1.07	1.00	1.11
Oxadiargyl 0.09 kg/ha	4.11 c (22.31)	2.56 c (9.89)	3.06 b (12.83)	6.38 c (43.27)	7.37 b (80.30)	9.36 b (122.38)	65.41	76.26	79.88	2.98	1.72	2.52	1.81
Oxyfluorfen 0.15 kg/ha	3.54 c (17.11)	2.27 c (7.94)	2.83 b (11.08)	5.62 c (34.04)	6.35 b (56.99)	7.87 c (88.20)	72.84	83.15	85.50	4.13	2.73	4.03	2.92
No herbicide	8.23 a (79.14)	4.25 a (28.61)	3.82 a (20.55)	10.28 a (112.99)	10.62 a (156.17)	12.47 a (213.61)	9.84	53.84	64.87	1.00	1.00	1.00	1.00
S. Em ±	0.28	0.16	0.19	0.27	0.48	0.43	-	-	-				
Hand weedings													
20 DAS	5.10 ab (33.71)	1.93 c (4.42)	3.53 b (15.63)	7.03 bc (53.01)	9.06 c (119.83)	11.82 b (179.84)	57.71	64.58	70.43				
40 DAS	5.60 a (41.54)	5.01 b (31.29)	2.66 c (7.79)	8.12 a (83.52)	11.20 b (141.31)	9.20 c (100.45)	33.38	58.23	83.48				
20 & 40 DAS	5.87 a (47.46)	2.06 c (5.33)	3.22 bc (14.96)	7.61 ab (62.36)	4.55 d (25.87)	5.18 e (36.87)	50.24	92.36	93.94				
20, 40 & 60 DAS	5.47 ab (41.75)	1.87 c (3.96)	2.54 c (8.79)	7.14 a-c (52.34)	3.88 d (18.06)	4.06 e (22.50)	58.16	94.66	96.30				
20, 40, 60 & 80 DAS	4.48 b (25.42)	1.78 c (4.00)	2.73 c (8.38)	6.51 c (46.73)	4.39 d (29.21)	6.79 d (58.10)	62.68	91.36	90.44				
No hand weeding	6.03 a (52.38)	5.71 a (44.13)	5.29 a (36.67)	7.82 ab (69.70)	13.73 a (225.28)	18.93 a (380.09)	44.37	33.41	37.50				
S. Em ±	0.35	0.19	0.23	0.33	0.59	0.53	-	-	-				
Interaction	S	S	S	S	S	S							
Controls													
Weed free	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	100.00	100.00	100.00	1.00	1.00	1.00	1.00
Farmers' practice	0.71 (0.00)	3.08 (9.83)	2.24 (6.33)	0.71 (0.00)	4.02 (19.07)	4.60 (20.93)	100.00	94.35	96.56	1.00	1.00	1.00	1.00
S. Em ±	0.84	0.46	0.59	0.71	1.13	1.10							
LSD (P=0.05)	2.37	1.29	1.67	2.02	3.22	3.11							

Figures in parentheses are original values.
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Weed Control Efficiency

Weed control efficiency (WCE) increased from 20 to 60 DAS due to decrease in weed dry weight. Maximum WCE (%) was recorded with oxyfluorfen @ 0.15 kg/ha due to very low weed dry weight. Dual action of oxyfluorfen as pre-emergent and post-emergent herbicide might have reduced the number and dry weight of weeds. Two hand weedings at 20 and 40 DAS were highly efficient (93.94%) in comparison to single hand weeding at 20 (70.43%) or 40 DAS (83.48%) at 60 days stage. Similar efficiency was observed at 20 and 40 days stage. Pendimethalin @ 1.0 kg/ha alongwith two hand weedings at 20 and 40 DAS was better (96.84%) and comparable with weed free (100%) for the efficiency. Similar efficiency was observed with oxadiargyl @ 0.09 kg/ha in combination with 20 and 40 DAS (97.41%).

Effect of Herbicides, Hand Weeding and their Interaction on Crops

Phytotoxicity : Onion and chilli were affected by herbicide toxicity (Table 1). Toxicity was higher at 10 days after spray and decreased at 20 days after spray in onion. At 10 days after spray, oxyfluorfen @ 0.15 kg/ha (4.13) onion was more toxic followed by moderate toxicity by oxadiargyl @ 0.09 kg/ha. Similar effect was seen on chilli also. Dubey and Moorthy (2005); however, did not observe any toxic effects. This is contrast to the reports of Dubey and Moorthy (2005) on chilli and of Atre (2201) on onion who reported oxyfluorfen to be safe on these plants.

Effect on onion, chilli and cotton yield : Pre-emergent application of pendimethalin 1 kg/ha resulted in higher onion bulb yield (75.61 q/ha), chilli fruit yield (6.38 q/ha) and seed cotton yield (94.85 kg/ha). Bulb yield was significantly reduced by oxadiargyl 0.09 kg/ha and oxyfluorfen 0.15 kg/ha, while chilli fruit yield was unaffected by these herbicides (Table 2). Seed cotton yield was higher (178.7 kg/ha) with oxyfluorfen but was at par with pendimethalin 1 kg/ha. Hand weeding at 20, 40 and 60 DAS recorded higher onion bulb yield (81.4 q/ha), chilli fruit yield (9.20 q/ha) and seed cotton yield (163.1 kg/ha). This was due to lower weed competition.

Table 2. Onion bulb yield, chilli fruit yield, seed cotton yield, weed index and economics of the intercropping system as influenced by different treatments in direct seeded onion + chilli + cotton relay intercropping (Mean of 2005-06 and 2006-07)

Treatments	Onion bulb yield (q/ha)	Chilli fruit yield (q/ha)	Seed cotton yield (kg/ha)*	Weed index (%)	Gross returns (Rs./ha)	Cost of cultivation (Rs./ha)	Net returns (Rs./ha)
Herbicides							
Pendimethalin 1 kg/ha	75.61 a	6.38 a	8.34 ab (94.85)	41.61	61,180 a	20755	40,430 a
Oxadiargyl 0.09 kg/ha	50.33 c	7.35 a	7.03 b (85.12)	48.37	54,100 c	19851	34,240 b
Oxyfluorfen 0.15 kg/ha	59.40 bc	6.69 a	11.10 a (178.7)	44.25	58,430 b	19854	38,570 a
No herbicide	65.26 b	4.57 b	3.57 c (21.99)	56.91	45,150 d	20335	24,820 c
S. Em ±	3.51	0.42	0.14	-	761.4	-	761.4
Hand weedings							
20 DAS	62.06 b	4.44 c	6.95 b (92.54)	55.94	46,170 d	20110	26,060 d
40 DAS	51.54 b	5.41 c	7.90 ab (78.53)	55.83	46,280 d	21110	25,170 d
20 & 40 DAS	78.51 a	6.94 b	6.47 b (68.93)	37.80	65,180 c	20795	44,390 c
20, 40 & 60 DAS	81.40 a	9.20 a	11.22 a (163.1)	27.29	76,190 b	21035	55,160 b
20, 40, 60 & 80 DAS	90.95 a	10.17 a	11.49 a (166.3)	19.41	84,450 a	21147	63,300 a
No hand weeding	11.43 c	1.34 d	1.01 c (1.53)	90.44	10,020 e	16997	-6,978 e
S. Em ±	4.29	0.53	1.22	-	932.5	-	932.5
Interaction	S	S	S	-	S	-	S
Controls							
Weed free	114.07	12.99	7.18 (73.76)	-	1,04,778	22543	82,235
Farmers' practice	88.37	10.09	14.68 (253.74)	22.75	80,937	22453	58,484
S. Em ±	8.60	1.08	2.44	-	6119	-	6119
LSD (P=0.05)	24.43	3.07	6.94	-	17373	-	17,373

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Table 3. Interaction for onion equivalent yield and net returns at different days after sowing as influenced by different treatments in direct seeded onion+chilli+cotton relay intercropping (Mean of 2005-06 and 2006-07)

Herbicides	Onion equivalent yield (q/ha)					B : C (Rs./ha)				
	Pendimethalin 1 kg/ha	Oxadiargyl 0.09 kg/ha	Oxyfluorfen 0.15 kg/ha	No herbicide	Mean	Pendimethalin 1 kg/ha	Oxadiargyl 0.09 kg/ha	Oxyfluorfen 0.15 kg/ha	No herbicide	Mean
Hand weedings										
20 DAS	111.40 d-f	87.88 fg	106.80 d-f	63.24 gh	92.33 c	2.67 e-g	2.20 gh	2.67 e-g	1.61 hi	2.29 c
40 DAS	126.10 b-e	95.93 e-g	109.90 d-f	38.28 hi	92.55 c	2.89 d-g	2.30 f-h	2.68 e-g	0.89 ij	2.20 c
20 & 40 DAS	139.70 a-d	124.10 c-f	128.50 b-e	129.10 b-e	130.4 b	3.30 a-e	3.07 b-g	3.17 a-f	3.00 c-g	3.14 b
20, 40 & 60 DAS	161.70 a-c	145.30 a-d	157.60 a-c	144.90 a-d	152.40 a	3.78 a-d	3.55 a-e	3.85 a-c	3.33 a-e	3.63 a
20, 40, 60 & 80 DAS	171.90 a	170.0 a	169.70 a	163.90 ab	168.90 a	3.99 ab	4.14 a	4.14 a	3.73 a-d	3.99 a
No hand weeding	23.37 i	25.91 i	28.51 hi	2.36 i	20.04 d	0.66 j	0.76 ij	0.82 ij	0.07 j	
Mean	122.40 a	108.20 a	116.90 a	90.31 b		2.88 a	2.67 a	2.89 a	2.11 b	
S. Em ±	Herbicides	4.82				Herbicides	0.114			
S. Em ±	Hand weeding	5.90				Hand weeding	0.140			
S. Em ±	Interaction	11.80				Interaction	0.28			

Figures in a column or row with same letter (s) do not differ significantly.

Herbicide and hand weeding interactions were significant. Herbicides with hand weeding at 20, 40, 60 and 80 DAS recorded bulb yield, fruit and seed cotton yield at par with farmers' practice.

Onion equivalent yield (OEY) : Application of herbicides significantly increased onion equivalent yield (OEY) as compared to no herbicides; however, differences among herbicides were not significant though OEY was higher (122.40 q/ha) with pendimethalin @ 1.0 kg/ha (Table 3). Three hand weedings at 20, 40 and 60 DAS were as good as four hand weedings at 20, 40, 60 and 80 DAS. Herbicides in combination with hand weeding at 20, 40 and 60 DAS or 20, 40, 60 and 80 DAS produced higher onion equivalent yield due to higher onion and chilli yield.

Economics

Significantly higher gross returns (Rs. 61,180/ha) were obtained with the application of pendimethalin @ 1.0 kg/ha as compared with no herbicides treatment (Rs. 45,150/ha). Hand weeding at 20, 40, 60 and 80 DAS resulted in higher gross returns (Rs. 84,450/ha) compared to no hand weeding (Rs. 10,020/ha) treatment. Net returns obtained in pendimethalin @ 1.0 kg/ha were significantly higher (Rs. 40,430/ha) and were at par with oxyfluorfen @ 0.15 kg/ha (Rs. 38,570/ha). Pendimethalin @ 1.0 kg/ha in combination with hand weeding at 20, 40, 60 and 80 DAS resulted in higher net returns (Rs. 64,390/ha) over farmers' practice (Rs. 58,484/ha) but lower than weed free check (Rs. 81,235/ha). B : C ratio was higher in weed free check (4.65) due to higher gross and net returns. Herbicides in combination with hand weeding at 20, 40 and 60 DAS were better for B : C ratio over farmers' practice.

Thus, it can be concluded that for better weed management in onion+chilli+cotton relay intercropping application of pendimethalin @ 1.0 kg/ha in combination with hand weeding at 20, 40 and 60 DAS was most effective and economical.

REFERENCES

Atre, S. 2001. Chemical weed control in onion. M. Sc. thesis, University of Agricultural Sciences, Dharwad. pp. 153.

Biradar, S. A. 1999. Integrated weed management in transplanted chilli under Northern Transitional Tract of Karnataka. M. Sc. thesis, University of Agricultural Sciences, Dharwad. pp. 141.

Dubey, R. P. and B. T. S. Moorthy, 2005. Sequential application of herbicides in direct seeded onion. *Weed News* **5** : 2.

Kalyanamurthy, K. N. 2002. Investigation on crop-weed competition and weed control methods in direct seeded and transplanted onion (*Allium cepa* L.) under irrigated condition. Ph. D. thesis, University of Agricultural Sciences, Bangalore. pp. 283.

Nadagouda, B. T. 1995. Integrated weed management in drill sown onion (*Allium cepa* L.). M. Sc. thesis, University of Agricultural Sciences, Dharwad. pp. 93.

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