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Productivity of direct seeded onion (*Allium cepa*. L.) as influenced by integrated weed management practices

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ABSTRACT

An experiment was conducted to study the efficacy of different herbicides applied alone, integrated approach involving application of lower dose of herbicides in combination with one hand weeding in comparison to manual weeding at different growth stages on the bulb yield of onion. Integrated weed management treatments involving pre-emergence application of herbicides *viz*., oxyfluorfen @ 0.09 kg a.i. ha^{-1}, pendimethalin @ 0.75 kg a.i. ha^{-1} and metolachlor @ 0.75 kg a.i. ha^{-1} in combination with one hand weeding at 45 days after sowing resulted in higher bulb yield of onion (148.91, 147.25 and 146.50 q ha^{-1}, respectively) due to maintenance of weed free condition during initial stages with pre-emergence application of herbicides and control of late emerged weeds as a result of one hand weeding at 45 days after sowing. The weed control efficiency was more than 80 and 95 per cent at 45 days after sowing and at harvest. The weed index values ranged from 8 to 9.49 per cent in integrated treatments as compared to 86 per cent with weedy check indicating least crop weed competition.

Key words : Onion, Integrated weed management, Metolachlor

INTRODUCTION

Onion (*Allium cepa* L.) is a very poor competitor with weeds on account of its inherent characteristic traits such as short stature, non-branching habit, sparse foliage, shallow root system and extremely slow growth in the initial stages, enabling quick and rapid growth of weeds. In competition with weeds the bulb size of onion plant is greatly reduced. The loss of yield is mainly due to decrease in bulb size.

The severity of weed infestation in onion crop varies considerably with the method of establishment *viz*., direct seeding and transplanting (Westra *et al*., 1990). The periodical hand weeding with the help of "*Kurpi*" is the only conventional method widely practiced by the farmers in India. In areas where labour is scarce and expensive during critical period of crop weed competition and at times when field conditions are unfavorable for manual weeding, chemical weed control would be the practical and most economical method. Further, close spacing and shallow root system of onion make the mechanical operations quite ineffective against weeds resulting in sub-optimum plant population (Gajraj Singh and Pandey, 1982). Therefore, chemical method of weed control has shown good promise. With the advancement in agriculture and technology, a good number of herbicides are now available in the market, which can be used effectively and economically. However, an integrated weed management approach involving herbicide at lower doses and cultural practices is not only economically feasible but also ecofriendly. Therefore, an investigation to study the bio–efficacy of different herbicides alone, lower dose of herbicide in combination with one hand weeding and manual weed control at different growth stages was undertaken.

MATERIALS AND METHODS

The experiment was conducted in the farmer field at Kurlahally village of Chickballapur Taluk in Kolar District of Karnataka state during *rabi* - summer seasons of 1997-98 and 1998-99. The soil of the experimental site was sandy loam in texture and moderate in fertility. The soil was neutral in reaction and was high in organic matter, low in nitrogen, medium in available phosphorus and low in available potassium. The experiment consisted of 16 treatments of which 4 were herbicide treatments, 6 were hand weeding treatments, 4 were integrated weed control treatments, one weedy check and weed free check treatment. The experiment was laid out in randomized block design width.

The data on weed count and weed dry weight was subjected to square root transformation using the formula:

$$\check{E}X + 0.5$$

RESULTS AND DISCUSSION

The data on grasses, broad leaved, sedge and total weed population recorded at 30, 45 days after sowing (DAS) and at harvest are presented in Table 1. At 30 and 45 DAS, significantly lowest total weed population was recorded with pre-emergent application of oxyfluorfen @ 0.14 kg a.i. ha^{-1} (26.99 and 36.65 m^{-2}) and pendimethalin @ 1.25 kg a.i. ha^{-1} (29.83 and 34.66 m^{-2}), and these two were at par with metolachlor @ 1.25 kg a.i. ha^{-1}(31.32 and 37.99 m^{-2}). Highest was with butachlor @ 1.25 kg

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Table 1 : Effect of different weed control methods on grasses, broad leaved weeds, sedges and total weed count m^{-2} in direct seeded onion

Treatments	30 DAS				45 DAS				At harvest			
	Grasses	BLW	Sedges	Total	Grasses	BLW	Sedges	Total	Grasses	BLW	Sedges	Total
T_1 : Oxyfluorfen (PE) @ 0.14 kg ai ha^{-1}	3.09	3.97	1.40	5.24	3.86	4.48	1.72	6.09	5.42	5.66	2.37	8.13
	(9.16)	(15.33)	(1.49)	(26.99)	(14.49)	(19.66)	(2.49)	(36.65)	(29.00)	(31.66)	(5.16)	(65.83)
T_2 : Metolachlor (PE) @ 1.25 kg ai ha^{-1}	3.08	4.52	1.62	5.63	3.84	4.62	1.76	6.26	5.51	5.82	2.29	8.28
	(9.16)	(19.99)	(2.16)	(31.32)	(14.33)	(20.99)	(2.66)	(37.99)	(29.99)	(33.50)	(4.83)	(68.33)
T_3 : Pendimethalin (PE) @ 1.25 kg ai ha^{-1}	3.40	4.15	1.50	5.50	3.61	4.21	2.26	5.92	5.54	6.06	2.66	8.54
	(11.16)	(16.83)	(1.83)	(29.83)	(12.66)	(17.33)	(4.50)	(34.66)	(30.33)	(36.33)	(6.66)	(72.50)
T_4 : Butachlor (PE) @ 1.25 kg ai ha^{-1}	4.09	6.74	2.07	8.10	5.65	7.37	2.26	9.53	13.05	9.03	3.02	16.13
	(16.33)	(45.16)	(3.83)	(66.33)	(31.66)	(54.00)	(4.66)	(90.33)	(170.00)	(81.33)	(8.66)	(259.83)
T_5 : One H.W. at 15 DAS	7.89	10.41	1.53	13.11	11.89	11.71	2.63	16.87	13.44	13.35	2.76	19.20
	(57.00)	(107.99)	(1.83)	(171.83)	(141.66)	(136.78)	(6.50)	(284.49)	(180.33)	(177.90)	(10.16)	(368.33)
T_6 : One H.W. at 30 DAS	9.65	12.86	3.07	16.36	3.49	3.25	2.15	5.16	10.20	8.12	2.54	13.25
	(92.83)	(165.33)	(9.00)	(264.66)	(11.83)	(10.33)	(4.16)	(26.33)	(103.66)	(65.66)	(5.99)	(172.83)
T_7 : One H.W. at 45 DAS	9.97	13.04	3.19	16.71	13.98	13.73	3.42	19.77	6.23	5.64	2.19	8.54
	(99.16)	(169.83)	(10.00)	(278.99)	(194.33)	(188.50)	(11.33)	(390.83)	(38.66)	(31.49)	(4.33)	(74.49)
T_8 : Two H.W. at 15 + 30 DAS	7.75	10.52	1.77	13.16	3.88	3.36	1.71	5.48	8.86	6.79	2.36	11.38
	(60.00)	(110.66)	(2.66)	(173.33)	(14.66)	(11.00)	(2.50)	(29.83)	(78.16)	(45.83)	(5.16)	(129.16)
T_9 : Two H.W. at 15 + 45 DAS	8.24	9.56	1.86	12.74	12.01	11.38	2.25	16.67	6.80	5.48	2.07	8.92
	(67.66)	(91.56)	(2.99)	(161.82)	(143.99)	(121.16)	(4.66)	(277.83)	(46.00)	(29.66)	(3.83)	(79.49)
T_{10} : Two H.W. at 30 + 45 DAS	10.29	12.51	2.82	16.03	4.02	3.78	1.46	5.63	5.65	5.25	2.26	7.83
	(105.66)	(156.33)	(7.49)	(256.65)	(15.83)	(13.83)	(1.66)	(31.33)	(31.50)	(23.33)	(4.66)	(60.99)
T_{11} : Oxyfluorfen (PE) @ 0.09 kg ai ha^{-1} – one HW at 45 DAS	3.12	4.66	1.67	5.79	4.44	5.73	2.07	7.48	4.35	4.21	2.10	6.39
	(9.33)	(21.50)	(2.33)	(33.33)	(19.33)	(32.50)	(3.83)	(55.66)	(18.50)	(17.50)	(3.99)	(39.99)
T_{12} : Metolachlor (PE) @ 0.75 kg ai ha^{-1} + one HW at 45 DAS	3.06	5.19	1.85	6.25	4.66	6.27	2.10	8.04	4.69	4.30	1.90	6.58
	(8.99)	(26.66)	(2.99)	(38.65)	(21.33)	(39.00)	(3.99)	(64.33)	(21.66)	(17.83)	(3.16)	(42.99)
T_{13} : Pendimethalin (PE) @ 0.75 kg ai ha^{-1} + one HW at 45 DAS	3.23	4.94	1.85	6.14	4.84	6.05	2.29	8.02	4.27	4.11	2.14	6.23
	(9.99)	(24.00)	(3.15)	(37.31)	(22.99)	(36.16)	(4.83)	(64.00)	(17.83)	(16.49)	(4.16)	(38.49)
T_{14} : Butachlor (PE) @ 0.75 kg ai ha^{-1} + one HW at 45 DAS	4.40	7.97	2.07	9.29	6.57	8.43	2.40	10.92	4.84	4.44	2.07	6.83
	(18.99)	(63.33)	(3.83)	(86.16)	(42.83)	(70.83)	(5.33)	(118.99)	(23.00)	(19.49)	(3.83)	(46.33)
T_{15} : Weedy Check	10.09	13.83	3.04	17.36	13.83	14.84	3.22	20.52	14.70	15.70	3.86	21.83
	(101.66)	(190.99)	(8.33)	(300.98)	(190.83)	(220.33)	(10.00)	(421.16)	(215.99)	(246.33)	(14.50)	(476.83)
T_{16} : Weedy free check	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
S.E. ±	0.10	0.12	0.08	0.13	0.12	0.11	0.11	0.14	0.08	0.09	0.09	0.09
C.D. (P=0.05)	0.29	0.35	0.18	0.37	0.34	0.33	0.32	0.40	0.23	0.25	0.26	0.25

DAS= Days after sowing , H.W = Hand weeding BLW = Broad leaved weeds, PE = Pre - emergence * Figures in the parenthesis indicate original values

a.i. ha^{-1} (66.33 and 90.33 m^{-2}). Among integrated weed control treatments lowest total weed population was observed with oxyfluorfen @ 0.09 kg a.i. ha^{-1} + one HW at 45 DAS (33.33 and 55.66 m^{-2}) and pendimethalin @ 0.75 kg a.i. ha^{-1}+ one HW at 45 DAS (37.31 and 64.00 m^{-2}) followed by metolachlor @ 0.75 kg a.i. ha^{-1}+ one HW at 45 DAS (38.65 and 64.33 m^{-2}).

Among hand weeded treatments at 30 DAS, all the treatments recorded more number of weeds m^{-2} and it ranged from 171.83 m^{-2} (one HW at 15 DAS) to 278.99 m^{-2} (one HW at 45 DAS). But at 45 DAS, among hand weeded treatments, lowest total weed population was noticed with one HW at 30 DAS (26.33 m^{-2}) and was at par with two HW at 15 + 30 DAS (29.83 m^{-2}). At harvest, herbicidal treatments continued to maintain lowest total weed population except butachlor @ 1.25 kg a.i. ha^{-1} (259.83 m^{-2}) and it ranged from 65.83 m^{-2} to 72.50 m^{-2}. Among integrated weed control treatments weed population ranged from 38.49 to 46.33 m^{-2}.

Dry weight of weeds differed significantly at different growth stages and at harvest, due to weed control methods (Table 2). Pooled analysis at 30 and 45 DAS, indicate that all the herbicidal treatments except butachlor @ 1.25 kg a.i. ha^{-1} (6.23 and 24.70 g m^{-2}) were superior in

Table 2 : Effect of different weed control methods on dry weight of weeds (g m^{-2}), bulb yield (q ha^{-1}), weed control efficiency and weed index in direct seeded onion

Treatments	Weed dry weight			Bulb yield (q ha^{-1})	Weed control Efficiency (%)	Weed Index (%)
	30 DAS	45 DAS	At harvest			
T_1 : Oxyfluorfen (PE) @ 0.14 kg ai ha^{-1}	1.31	2.44	4.54	139.05	94.72	14.09
	(1.23)	(5.49)	(20.21)			
T_2 : Metolachlor (PE) @ 1.25 kg ai ha^{-1}	1.33	2.56	4.56	132.13	94.67	18.37
	(1.30)	(5.36)	(20.40)			
T_3 : Pendimethalin(PE) @ 1.25 kg ai ha^{-1}	1.34	2.47	4.65	136.83	94.45	15.46
	(1.32)	(5.67)	(21.24)			
T_4 : Butachlor (PE) @ 1.25 kg ai ha^{-1}	2.59	5.01	9.97	68.16	74.15	57.89
	(6.23)	(24.70)	(98.97)			
T_5 : One H.W. at 15 DAS	3.67	6.61	18.69	28.74	8.70	82.24
	(13.00)	(43.31)	(349.29)			
T_6 : One H.W. at 30 DAS	3.71	1.90	12.06	88.68	62.12	45.21
	(13.29)	(3.50)	(145.00)			
T_7 : One H.W. at 45 DAS	3.87	8.20	5.44	55.74	93.23	65.56
	(14.50)	(66.84)	(29.16)			
T_8 : Two H.W. at 15 + 30 DAS	3.80	2.05	10.22	98.06	72.84	39.42
	(14.00)	(3.72)	(103.55)			
T_9 : Two H.W. at 15 + 45 DAS	3.67	6.43	5.76	77.69	91.43	52.00
	(13.00)	(40.88)	(32.79)			
T_{10} : Two H.W. at 30 + 45 DAS	3.81	2.01	5.35	136.44	92.64	15.71
	(14.07)	(3.54)	(28.16)			
T_{11} : Oxyfluorfen (PE) @ 0.09 kg ai ha^{-1} +	1.49	3.41	4.16	148.91	95.60	8.00
one HW at 45 DAS	(1.74)	(11.17)	(16.84)			
T_{12} : Metolachlor (PE) @ 0.75 kg ai ha^{-1} +	1.47	3.49	3.99	146.50	95.94	9.49
one HW at 45 DAS	(1.67)	(11.73)	(15.51)			
T_{13} : Pendimethalin(PE) @ 0.75 kg ai ha^{-1}	1.44	3.42	4.16	147.25	95.60	9.03
+ one HW at 45 DAS	(1.59)	(11.25)	(16.83)			
T_{14} : Butachlor (PE) @ 0.75 kg ai ha^{-1} +	2.27	4.68	4.04	107.21	95.84	33.76
one HW at 45 DAS	(4.68)	(21.46)	(15.92)			
T_{15} : Weedy Check	4.17	8.30	19.57	22.51	0.00	86.09
	(16.93)	(68.55)	(382.87)			
T_{16} : Weedy free check	0.70	0.70	0.70	161.87	100.00	-
	(0.00)	(0.00)	(0.00)			
S.E. ±	0.02	0.04	0.06	2.55	-	-
C.D. (P=0.05)	0.05	0.13	0.16	7.36	-	-

DAS= Days after sowing , H.W = Hand weeding, PE = Pre - emergence * Figures in the parenthesis indicate original values

controlling weeds and recorded significantly least weed dry weight which ranged from 1.23 to 1.32 g m^{-2} at 30 DAS and 5.36 to 5.67 g m^{-2} at 45 DAS and were at par with each other. Integrated weed control treatments resulted in lowest weed dry weight except butachlor @ 0.75 kg a.i. ha^{-1} + one HW at 45 DAS (4.68 and 21.46 g m^{-2}) and weed dry weight ranged from 1.59 to 1.74 g m^{-2} at 30 DAS and 11.17 to 11.73 g m^{-2} at 45 DAS and were at par with each other. Among, hand weeded treatments the weed dry weight was relatively higher than integrated weed control and herbicidal treatments. At harvest, oxyflurofen @ 0.14 kg a.i. ha^{-1}, metolachlor @ 1.25 kg a.i. ha^{-1} and pendimethalin @ 1.25 kg a.i. ha^{-1} recorded significantly lowest weed dry weight (20.21, 20.40 and 21.24 g m^{-2}) than butachlor @ 1.25 kg a.i. ha^{-1}(98.97 g m^{-2}). Whereas, with integration treatments it ranged from 15.51 to 16.84 g m^{-2} and all were at par with each other. Among hand weeding treatments, twice HW at 30 + 45 DAS and one HW at 45 DAS had lowest weed dry weight (28.16 and 29.16 g m^{-2}, respectively). Weedy check and weed free check recorded highest (382.87 g m^{-2}) and lowest (0.00 g m^{-2}) weed dry weight, respectively.

Inclusion of one hand weeding at 45 DAS with herbicides at lower dose brought about significant improvement in weed control and recorded least weed dry weight as against weedy check. Application of oxyfluorfen @ 0.09 kg a.i. ha^{-1}, metolachlor @ 0.75 kg a.i. ha^{-1} and pendimethalin @ 0.75 kg a.i. ha^{-1} all super imposed with one HW at 45 DAS significantly reduced crop weed competition and recorded least weed dry weight and total weed population at all the stages of crop growth and provided congenial environment for better plant growth by utilizing the resources efficiently. Good to excellent control of weeds with integration was reported by Sharma and Mehta (1994).

Bulb yield varied significantly due to weed control methods (Table 2). Pooled analysis indicated that application of oxyflurofen @ 0.14 kg a.i. ha^{-1} resulted in significantly maximum bulb yield (139.05 q ha^{-1}) followed by pendimethalin @ 1.25 kg a.i. ha^{-1} (136.83 q ha^{-1}) and metolachlor @ 1.25 kg a.i. ha^{-1} (132.13 q ha^{-1}) which were at par with each other. The increased yield with these herbicides was due to effective control of weeds resulting in better plant growth, more number of leaves per plant and plant dry weight. Butachlor @ 1.25 kg a.i. ha^{-1} registered a yield reduction of 57.89 per cent in comparison with weed free check due to poor control of weeds affecting plant growth and plant dry weight. Effective weed control coupled with maximum bulb yield with oxyfluorfen, pendimethalin and metolachlor was also reported by Malik *et al*. (1982), Mustafee (1990) and Anon. (1998).

Among, integrated weed control treatments, highest yield was obtained with oxyfluorfen @ 0.09 kg a.i. ha^{-1} + one HW at 45 DAS (148.91 q ha^{-1}) and was at par with pendimethalin @ 0.75 kg a.i. ha^{-1} + one HW at 45 DAS (147.25 q ha^{-1}) and metolachlor @ 0.75 kg a.i. ha^{-1} + one HW at 45 DAS (146.50 q ha^{-1}). The lower dose of oxyfluorfen @ 0.09 kg a.i. ha^{-1}, metolachlor @ 0.75 kg a.i. ha^{-1} and pendimethalin @ 0.75 kg a.i. ha^{-1} maintained relatively weed free condition during initial stages and when supplemented with one hand weeding at 45 DAS controlled the late emerged weeds as indicated by weed control efficiency of more than 80 per cent at 45 DAS and more than 95 per cent at later stages, and least crop weed competition as indicated by weed index values ranging from 8.00 to 9.49 per cent compared to 86 per cent with weedy check. Anon. (1988), Keeling *et al*. (1990) and Balraj Singh *et al*. (1998) reported similar results.

Two HW at 30 + 45 DAS recorded highest bulb yield (136.44 q ha^{-1}) that was at par with herbicidal treatments. Weed free maintenance throughout the crop growth period resulted in highest yield of 161.87 q $ha^{-1}$and weedy check has recorded lowest yield of 22.51 q ha^{-1}.

Weed control efficiency (WCE) and weed index (WI) varied among different treatments due to weed control methods (Table 2). At 30, 45 DAS and at harvest, weed control efficiency (WCE) was more than 90 per cent with all the herbicidal treatments except butachlor @ 1.75 kg a.i. ha^{-1} (63.2%, 63.94% and 74.15%). All the integration treatments have achieved highest WCE of more than 82.00 per cent except butachlor @ 0.75 kg a.i. ha^{-1} + one HW at 45 DAS (72.35 and 68.69%), at 30 and 45 DAS, respectively.

The weed index (WI) was lowest with the herbicidal treatments which varied from 14.09 to 15.46 per cent except application of butachlor @ 1.25 kg a.i. ha^{-1} (57.89 %). Integrated treatments recorded lower WI ranging from 8.00 to 9.49 per cent except butachlor @ 0.75 kg a.i. ha^{-1} + one HW at 45 DAS (33.76 %). Among hand weeded treatments, lowest WI was observed with two HW at 30 + 45 DAS (15.71 %), while the remaining treatments had highest weed index and ranged from 39.42 to 82.24 per cent.

The study indicated that for effective control of weeds in direct seeded onion, integrated weed management treatments involving pre-emergence application of herbicides *viz*., oxyfluorfen @ 0.09 kg a.i. ha^{-1}, pendimethalin @ 0.75 kg a.i. ha^{-1} and metolachlor @ 0.75 kg a.i. ha^{-1} in combination with one hand weeding at 45

DAS resulted in higher bulb yield of onion (148.91, 147.25 and 146.50 q ha^{-1}, respectively) due to maintenance of weed free condition and control of late emerged weeds as depicted from higher weed control efficiency and least weed index values.

REFERENCES

Anonymous (1988). *Annual Report* for 1987-88. AICRP on weed control, NRCW, Jabalpur, pp.15.

Anonymous (1998). *Annual Report* for 1997-98. AICRP on weed control, NRCW, Jabalpur, pp. 24.

Balraj Singh, B.D., Yadav and Yogesh Kumar (1998). A note on economics of weed control with herbicides in *rabi* onion. *Indian J. Weed Sci.*, **27**(1):59-60.

Gajraj Singh, K.P. and Pandey, U.C. (1982). Effect of weedicides on weed control and yield in onion. *Pesticides*, **16** (10) : 9-12.

Keeling, J.W., Bender, D.A. and Abernathy, J.R. (1990). Yellow nutsedge (*Cyperus esculentus*) management in transplanted onion. *Weed Technol.*, **4** (1) : 68-70.

Malik, Y.S., Singh, K.P. and Pandita, M.L. (1982). Chemical weed control in onion. *Indian J. Weed Sci.*, **14** (1) : 24-27.

Mustafee, T.P. (1990). Effective methods for chemical weeding in close cropping system. *Pesticides*, **24** (1) : 11-15.

Sharma, R. and Mehta, H.M. (1994). Chemical weed control in onion. *Indian J. Weed Sci.*, **26**(1&2): 44-45.

Westra, P., Pearson, C.H. and Ristan, R. (1990). Control of Venice mallow (*Hibiscus trionum*) in corn and onions. *Weed Technol.*, **4** (3) : 500-504.

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