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Influence of Oxyfluorfen on Weed Control and Yield of Onion and its Residual Effect on Succeeding Sunflower and Pearl Millet

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A field investigation was carried out at Agricultural Research Station, Bhavanisagar of Tamil Nadu Agricultural University, during *kharif* 2009 and 2010 to evaluate the new formulation of oxyfluorfen (23.5% EC) on weed control in onion and their residual effect on succeeding crops. Based on two years field experimentation, it was found that pre-emergence application of oxyfluorfen (23.5% EC) at 400 g ha^{-1} gave significantly lower total weed density, weed dry weight and higher weed control efficiency at all the stages. Application of new formulation of oxyfluorfen (23.5% EC) at 200 g ha^{-1} as pre-emergence herbicide kept the weed density and dry weight below the economic threshold level and increased the bulb yield (15940 and 15610 kg ha^{-1}) in onion. Succeeding crops like sunflower and pearl millet sown immediately after the harvest of onion was not affected by the residue of new formulation of oxyfluorfen at all different doses.

Key words: weed density, weed control efficiency, yield, succeeding crops.

Onion is an important commercial vegetable and spice crop on account of its high yield potential, profitability, storability and export qualities. Due to its poor competitive ability with its slow initial growth and lack of adequate foliage makes onion weak against weeds. In addition, their cylindrical upright leaves do not shade the soil to reduce weed growth. Uncontrolled weed growth reduces the bulb yield upto 40-80 per cent depending upon the nature of intensity and duration of weed competition in onion field (Prakash *et al*., 2000). Chemical weed control is a better supplement to conventional methods and forms an integral part of the modern crop production. Thus, use of herbicides is one of the options left with the farmers to eliminate crop weed competition at early growth stage of crop. The common weed management practice for onion is pre-emergence application of selective herbicides like pendimethalin, oxyfluorfen and oxadiazon followed by one hand weeding. Under chemical method of weed management, the rotation of herbicides is more essential to prevent the weeds to develop resistance to herbicides. Beneath these backdrops, newer formulation of herbicides is coming in the market with wide spectrum of weed control efficiency. The new herbicide formulations are to be evaluated for their bio-efficacy of controlling wide range of weed flora, better crop growth and yield of onion.

Materials and Methods

With a view to determine the residual effect of herbicide applied to *kharif* onion on succeeding *rabi* sunflower and pearlmillet crops, the present study was carried out during *kharif* season of 2009 and 2010 at Agricultural Research Station, Bhavanisagar, Tamil Nadu Agricultural University. The soil was red sandy loam in texture with low in available nitrogen (230 kg ha^{-1}), medium in available phosphorus (20 kg ha^{-1}) and high in available potassium (268 kg ha^{-1}) with pH of 6.8. The experiment was laid out in randomized complete block design with ten treatments and replicated thrice. Treatments consisted of pre-emergence application of already registered Oxyfluorfen (goal) at 200 g ha^{-1}, new formulation of Oxyfluorfen (23.5% EC) at 150, 200, 250, 300 and 400 g ha^{-1}, Pendimethalin 0.75 kg ha^{-1} + Hand weeding on 45 DAS, Pendimethalin 0.75 kg ha^{-1} + Rotary weeding on 45 DAS, Hand weeding twice on 25 and 45 DAS and unweeded check. The *kharif* onion variety CO 4 was sown manually at a spacing of 22.5 x 10 cm at 1000 kg ha^{-1} of bulb during first week of June 2009 and 2010. Immediately after sowing the bulb, a light irrigation was given to the crop for uniform germination. The herbicides as per the treatment schedule were applied as pre-emergence on third day after sowing followed by a hand weeding on 45 DAS. Hand operated knapsack sprayer fitted with a flat fan type nozzle (WFN 40) was used for spraying the herbicides adopting a spray volume of 500 litres ha^{-1}. The recommended dose of 100:150:75 kg NPK ha^{-1} in the form of urea, single super phosphate and muriate of potash were applied to all plots uniformly in lines and fifty per cent of the nitrogen was applied as basal while the remaining dose was top dressed on 25 DAS and

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45 DAS in equal splits. The crop was harvested on second week of September during both the years. After harvesting of the onion crop, to know the residual effect of herbicides, without disturbing the layout, each plot was manually prepared for sowing of succeeding crops. Seven rows of each succeeding sunflower and pearlmillet were sown in each plot in *rabi* season. The germination percentage, plant height, dry weight of plants and yield of sunflower and pearlmillet crops were recorded and data were used for analysis.

Results and Discussion

Effect on weeds

Weed flora of the experimental field in onion was predominantly nine species of broad leaved weeds, five species of grasses and a sedge weed. The dominant grassy weed species were *Cynodon dactylon*, *Acrachne racemosa* and *Dactyloctenium aegyptium.* Among the broad leaved weeds, *Boerhaavia diffusa*, *Parthenium hysterophorus* and *Digeria arvensis* were the dominant weeds. *Cyperus rotundus* was the only sedge present in the experimental field.

Pre-emergence application of new formulation of oxyfluorfen at 250, 300 and 400 g ha^{-1} followed by one hand weeding on 45 DAS resulted in effective control of broad leaved weeds, grasses and to some extent sedge due to its broad spectrum action. Thus, broad leaved weeds were effectively controlled with the herbicide. Application of oxyfluorfen at 400 g ha^{-1} resulted in the weed control of more than 90 per cent of weeds, but the herbicide inhibited the crop growth. Noticeable reduction of nearly 90 per cent of broad leaved weeds with the application of oxyfluorfen at 300 g ha^{-1} as pre-emergence was reported by Kavaliauskaite (2009). The left over weeds were controlled by manual weeding on 45 DAS. Several research findings showed that oxyfluorfen has successfully controlled broad leaved weeds in vegetable systems including broccoli (Daugovish *et al*., 2006), cabbage (Hatterman-Valenti and Auwarter, 2007), chilli pepper (Amador-Ramirez *et al*., 2007), cauliflower (Qasem, 2007) and onion (Aegerter, 2006). Pre-emergence application of oxyfluorfen most effectively decreased the number of annual broad leaved weeds in onion and cabbage as reported by Stall and Gilreath (2002) and support to the present findings.

Table 1. Effect of different weed management practices on total weed density in onion

Treatment	Total weed density (No. m^{-2})					
	kharif 2009			*kharif* 2010		
	20 DAS	40 DAS	60 DAS	20 DAS	40 DAS	60 DAS
T_1 - PE oxyfluorfen (Goal) at 200 g a.i ha^{-1}	5.57	8.50	6.97	5.67	8.42	7.88
	(28.97)	(70.21)	(46.54)	(30.14)	(68.94)	(60.13)
T_2 - PE oxyfluorfen at 150 g a.i ha^{-1}	7.09	10.57	9.06	6.78	10.00	9.57
	(48.31)	(109.73)	(80.16)	(43.95)	(97.91)	(89.53)
T_3 - PE oxyfluorfen at 200 g a.i ha^{-1}	6.04	9.34	7.66	5.73	9.13	8.14
	(34.50)	(85.32)	(56.72)	(30.85)	(81.45)	(64.32)
T_4 - PE oxyfluorfen at 250 g a.i ha^{-1}	5.07	7.87	6.78	5.01	8.03	7.34
	(23.71)	(59.95)	(43.97)	(23.10)	(62.45)	(51.80)
T_5 - PE oxyfluorfen at 300 g a.i ha^{-1}	4.48	7.72	5.99	4.15	7.48	6.25
	(18.11)	(57.54)	(33.90)	(15.25)	(54.02)	(37.11)
T_6 - PE oxyfluorfen at 400 g a.i ha^{-1}	3.55	6.34	4.70	3.60	6.15	4.83
	(10.61)	(38.18)	(20.11)	(10.94)	(35.86)	(21.29)
T_7 - Pendi. at 0.75 kg ha^{-1} + HW on 45 DAS	6.95	9.57	6.57	6.64	9.27	6.81
	(46.30)	(89.52)	(41.17)	(42.05)	(83.94)	(44.32)
T_8 - Pendi. at 0.75 kg ha^{-1} + RW on 45 DAS	7.04	9.35	6.52	6.57	9.29	6.79
	(47.50)	(85.39)	(40.45)	(41.18)	(84.38)	(44.12)
T_9 - HW twice on 25 and 45 DAS	14.54(209.38)	8.38(68.29)	7.14(49.00)	13.08(169.14)	9.24(83.29)	7.78(58.55)
T_{10} - Unweeded control	14.25	24.77	11.05	13.67	20.09	10.83
	(201.03)	(611.51)	(120.12)	(184.80)	(438.63)	(115.23)
SEd	0.50	1.30	0.82	0.43	0.80	0.67
CD (P=0.05)	1.05	2.74	1.72	0.90	1.69	1.40

Figures in parenthesis are original values; PE - Pre emergence; HW - Hand weeding; Pendi - Pendimethalin

Effect on crop

In onion, among the weed control treatments, pre-emergence application of oxyfluorfen at 200 g ha^{-1} recorded higher bulb yield of 15940 and 15610 kg ha^{-1}, during 2009 and 2010 respectively, due to better control of weeds at critical stages thus providing favourable environment for better growth and development leading to enhanced bulb yield. This treatment was comparable with oxyfluorfen at 250 g ha^{-1} with a bulb yield of 15120 and 15090 kg ha^{-1} during both the years. Hand weeding twice on 25 and 45 DAS and application of pendimethalin at 0.75 kg ha^{-1} + HW on 45 DAS was the next best treatment compared to new formulation of oxyfluorfen at 200 and 250 g ha^{-1} and recorded higher bulb yield. Onion productivity is mainly decided by the weed control efficiency of weed management methods as earlier observed by Uygur *et al.* (2010) who had noted that, pre-emergence herbicides offer the most practical, effective and economical method of weed control for increasing bulb yield of onion. Higher bulb yield was recorded with pre-emergence

Table 2. Effect of weed management methods on bulb yield, weed index and weed control efficiency of onion

Treatment	*kharif* 2009				*kharif* 2010			
	Bulb yield (kg ha^{-1})	Weed Index (%)	WCE (%) 20 DAS	40 DAS	Bulb yield (kg ha^{-1})	Weed Index (%)	WCE (%) 20 DAS	40 DAS
T_1 - PE oxyfluorfen (Goal) at 200 g a.i ha^{-1}	12540	21.33	88.42	84.01	12650	18.96	86.45	83.06
T_2 - PE oxyfluorfen at 150 g a.i ha^{-1}	13860	17.69	80.38	70.39	13530	15.18	81.88	71.15
T_3 - PE oxyfluorfen at 200 g a.i ha^{-1}	15940	0.00	84.59	80.57	15610	0.00	86.17	81.43
T_4 - PE oxyfluorfen at 250 g a.i ha^{-1}	15120	5.40	90.37	84.94	15090	3.14	90.55	85.26
T_5 - PE oxyfluorfen at 300 g a.i ha^{-1}	14250	10.60	92.68	86.93	14050	9.99	92.72	87.04
T_6 - PE oxyfluorfen at 400 g a.i ha^{-1}	13760	18.01	95.10	89.54	13830	11.40	94.83	90.00
T_7 - Pendi. at 0.75 kg ha^{-1} + HW on 45 DAS	13180	16.69	83.12	78.56	13220	13.32	84.67	77.53
T_8 - Pendi. at 0.75 kg ha^{-1} + RW on 45 DAS	12940	19.51	83.93	77.92	12730	18.45	85.49	77.09
T_9 - HW twice on 25 and 45 DAS	12880	10.16	-	83.25	14680	5.96	-	84.14
T_{10} - Unweeded control	6280	60.60	-	-	6840	56.18	-	-
Sed	688	-	-	-	712	-	-	-
CD (P=0.05)	1384	-	-	-	1432	-	-	-

PE - Pre emergence; HW - Hand weeding Pendi - Pendimethalin

application of pendimethalin at 0.75 kg ha^{-1} + HW on 45 DAS over already registered oxyfluorfen (goal) at 200 g ha^{-1} applied plots and this might due to weed free environment and effective utilization of all above and below ground available resources. Kathepuri *et al*. (2007) has shown that bulb yield reduction in onion is directly related to increasing weed density, dry weight and intensity of weed interference throughout the crop period.

Integrated weed management practice that included pre-emergence application of pendimethalin at 0.75 kg ha^{-1} + RW on 45 DAS registered lower bulb yield compared to other weed control treatments and this might be due to partial

Table 3. Residual effect of oxyfluorfen on the germination (%) and dry matter production (kg ha^{-1}) of succeeding crops of onion

Treatment	Sunflower						Pearl millet					
	rabi 2009			*rabi* 2010			*rabi* 2009			*rabi* 2010		
	Germ (%)	30DAS	60DAS	Germ (%)	30DAS	60DAS	Germ (%)	30 DAS	60 DAS	Germ (%)	30 DAS	60 DAS
T_1 - PE oxyfluorfen (Goal) at 200 g a.i ha^{-1}	68.5	68	159	70.7	65	152	71.4	64	181	70.0	57	176
	(86.6)			(89.2)			(90.3)			(88.3)		
T_2 - PE oxyfluorfen at 150 g a.i ha^{-1}	67.9	65	159	70.0	69	154	71.9	67	171	70.3	61	172
	(85.9)			(88.4)			(90.4)			(88.7)		
T_3 - PE oxyfluorfen at 200 g a.i ha^{-1}	68.4	73	162	71.6	64	153	73.1	69	184	71.2	63	179
	(86.5)			(89.0)			(91.5)			(89.7)		
T_4 - PE oxyfluorfen at 250 g a.i ha^{-1}	69.8	68	172	71.7	65	156	73.2	72	185	70.7	67	184
	(88.1)			(90.2)			(91.6)			(89.1)		
T_5 - PE oxyfluorfen at 300 g a.i ha^{-1}	69.7	68	164	71.6	72	155	73.6	73	174	71.8	70	177
	(88.0)			(90.1)			(92.0)			(90.3)		
T_6 - PE oxyfluorfen at 400 g a.i ha^{-1}	68.1	72	168	70.2	68	153	71.5	71	184	69.8	68	172
	(86.1)			(88.6)			(89.9)			(88.2)		
T_7 - Pendi. at 0.75 kg ha^{-1}+ HW on 45 DAS	68.6	68	160	70.9	65	155	71.7	65	189	69.9	64	177
	(86.9)			(89.4)			(90.1)			(88.3)		
T_8 - Pendi. at 0.75 kg ha^{-1}+ RW on 45 DAS	67.8	67	170	69.8	70	154	73.1	67	170	71.3	64	179
	(85.7)			(88.2)			(91.5)			(89.8)		
T_9 - HW twice on 25 and 45 DAS	68.9	64	162	71.1	65	158	74.2	70	183	72.4	67	177
	(87.1)			(89.6)			(92.6)			(90.9)		
T_{10} - Unweeded control	67.6	65	158	70.6	63	152	71.6	68	182	69.9	65	184
	(85.5)			(89.0)			(90.0)			(88.3)		
SEd	9.2	8.3	18.3	7.8	10.6	15.5	11.6	9.3	22.6	8.3	7.8	20.9
CD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Figures in parthesis are arc sin transformed values; PE - Pre emergence; HW - Hand weeding Pendi - Pendimethalin

or improper removal of *Cynodon dactylon* with rotary weeder, which recorded higher weed density, weed dry weight and higher nutrient removal by weeds. Moreover, this practice is not applicable during rainy season due to wet condition of the soil which does not permit mechanical weeding. Under such surroundings the chemical weed control measures are the alternate to control the weeds (Agasimani *et al*., 2010). Unweeded control accounted for lower bulb yield which was due to higher weed index of 60.6 and 56.1 per cent, respectively during *kharif* 2009 and 2010, due to heavy competition of weeds for nutrients, space and light. Among the weed control methods, higher weed index of 21.3 and 18.9 per cent was recorded in pre-emergence application of oxyfluorfen (goal) at 200 g ha^{-1}, which might be due to greater competition stress with prolific weed growth and higher nutrient removal by weeds.

Table 4. Residual effect of oxyfluorfen on yield (kg ha^{-1}) of succeeding crops of onion

Treatment	Sunflower				Pearl millet			
	rabi 2009		*rabi* 2010		*rabi* 2009		*rabi* 2010	
	Grain	Stalk	Grain	Stalk	Grain	Stover	Grain	Stover
T_1 - PE oxyfluorfen (Goal) at 200 g a.i ha^{-1}	851	967	829	990	688	2701	714	2677
T_2 - PE oxyfluorfen at 150 g a.i ha^{-1}	784	861	762	884	627	2621	658	2597
T_3 - PE oxyfluorfen at 200 g a.i ha^{-1}	871	1032	858	1042	661	2808	688	2643
T_4 - PE oxyfluorfen at 250 g a.i ha^{-1}	897	1011	875	1054	701	2981	702	2905
T_5 - PE oxyfluorfen at 300 g a.i ha^{-1}	883	1047	868	1070	719	2890	725	2866
T_6 - PE oxyfluorfen at 400 g a.i ha^{-1}	805	1018	798	1041	658	2737	674	2713
T_7 - Pendi. at 0.75 kg ha^{-1} + HW on 45 DAS	845	938	833	961	685	2667	721	2643
T_8 - Pendi. at 0.75 kg ha^{-1} + RW on 45 DAS	814	961	785	997	660	2575	676	2559
T_9 - HW twice on 25 and 45 DAS	802	1000	810	1023	690	2721	706	2743
T_{10} - Unweeded control	830	954	808	989	671	2937	687	2913
SEd	62	112	59	108	72	287	64	273
CD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS

PE - Pre emergence; HW - Hand weeding Pendi - Pendimethalin

Bioassay Study

Results revealed that germination of succeeding sunflower and pearlmillet recorded at 10 DAS was not significantly affected by residual effect of herbicide applied to irrigated onion. The plant stand of sunflower ranged from 85 to 90 per cent and pearlmillet from 88 to 92 per cent under all the treatments at 10 DAS. Further, plant height and dry weight of plants recorded at 30, 60 and 90 DAS were also unaffected due to residual effect of different doses of oxyfluorfen applied in onion. Yield of sunflower and pearlmillet showed no distinct variation due to different dose of oxyfluorfen. This result is in line with the results of Jayakumar (2010) who reported that, the pre-emergence application of oxyfluorfen in potato at higher doses of 300 and 400 g ha^{-1} did not leave any residue in the soil and there was no toxic effect beyond 60 days. It might be shown that new formulation of oxyfluorfen with different doses could be very effective against most of the broad leaved and grassy weeds in onion. But residual toxicity of oxyfluorfen cannot be ruled out on sensitive crops such as sunflower and pearl millet in rotation.

Conclusion

The results indicated that pre-emergence application of oxyfluorfen (23.5% EC) at 200 g ha^{-1} can keep the weed density and dry weight reasonably at lower level and enhance the productivity of onion. The new formulation of oxyfluorfen at 150, 200, 250, 300 and 400 g ha^{-1}, oxyfluorfen (Goal) at 200 g ha^{-1} and pre-emergence application of pendimethalin at 0.75 kg ha^{-1} applied in onion was found to be safe on the succeeding crops and this might be due to detoxification of herbicides in soil and do not adversely affect the growth and yield of the succeeding crops in terms of plant height, dry matter production and grain yield of the succeeding sunflower and pearl millet crops.

References

Aegerter, B. 2006. Onion weed control research progress report. Available at: http://ucce.ucdavis.edu/file/filelibrary/2019/33585.pdf. Accessed: October 9, 2007.

Agasmani, C.A., Shanwad, U.K., Aravindkumar, B.N., Shivamurthy, S.D., Ashok Surwenshi and Jalageri, B.R. 2010. Integrated weed management (IWM): A Long term case study in groundnut-wheat cropping system in Northern Karnataka. *Res. J. Agric. Sci.,* **3**: 196-200.

Amador-Ramirez, M.D., Mojarro-Davila, F. and Velasquez-Valle, R. 2007. Efficacy and economics of weed control for dry chilli pepper. *Crop Prot*., **26**: 677-682.

Daugovish, O., Fennimore, S.A., Smith, R., Rachuy, J. and Mochizuki, M. 2006. Weed control for broccoli in coastal California. Calif. Weed Sci. Soc. Annual Meeting, Ventura: 16-18.

Hatterman-Valenti, H.M. and Auwarter, C.P. 2007. Broadleaf weed control in transplanted cabbage. *Hort. Sci*., **42**: 872.

Jayakumar, B. 2010. Efficiency evaluation of oxyfluorfen on weed control in tea and its residual effect on succeeding crop. *M.Sc. Thesis*, Tamil Nadu Agric. Univ., Coimbatore, Tamil Nadu, India.

Kathepuri, J.V., Sankpal, V.Y., Ghadage, H.L. and Jawale, S.M. 2007. Weed management in irrigated onion (*Allium cepa* L.) under plane zone of western Maharastra. *Madras Agric. J*., **94**: 127-130.

Kavaliauskaite, D. 2009. Influence of herbicides spraying time and frequency on onion crop weediness. Scientific works of the Lithuanian Institute Horticulture and Lithuanian University of Agriculture, Sodininkyste Darzininkyste. pp. 105-108.

Prakash, V., Pandey, A.K., Singh, R.D. and Mani, V.P. 2000. Integrated weed management in winter onion (*Allium cepa* L.) under mid-hills conditions of north-western Himalayas. *Indian J. Agron*., **45**: 816-821.

Stall, W.O. and Gilreath, J.P. 2002. Estimation effectiveness of recommended her-bicides on selected common weeds in Florida vegetables. In: W.M. Stall (ed.), Weed Management in Florida Fruits and Vegetables, 2002-2003. Gainesville, FL: IFAS, 59-64.

Uygur, S., Gurbuz, R. and Uygur, F.N.. 2010. Weeds on onion fields and effects of some herbicides on weeds in Cukurova region, Turkey. *African J. Biotechnol*., **42**: 7037-7042.

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