Indian Journal of Weed Science **49**(1): 47–50, 2017
DOI: 10.5958/0974-8164.2017.00012.0

Weed management in onion through oxyfluorfen and its effect on soil microflora and succeeding crop of blackgram

R. Poddar*, S. Bera and R.K. Ghosh
Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia, West Bengal 741 252

Received: 8 February 2017; Revised: 17 March 2017

ABSTRACT

A field experiment was carried out to study the bioefficacy and phytotoxicity of oxyfluorfen (23.5% EC) in onion variety '*Sukhsagar*' and its residual effect on the succeeding crop black gram variety '*Basant Bahar (PDU-1)*' in Inceptisol of West Bengal. Pre-emergence application of oxyfluorfen 400 g/ha followed by one hand weeding (HW) at 30 days after planting (DAP) caused significantly lower weed density, weed dry weight and higher weed control efficiency at all the stages. Application of oxyfluorfen 200 g/ha + one HW at 30 DAP kept the weed density and dry weight below the economic threshold level and increased the bulb yield in onion. Though micro flora population at the initial stage was reduced due to application of herbicides but later their population was significantly higher than initial. Succeeding crop blackgram sown immediately after the harvest of onion was not affected by the residues of new formulation of oxyfluorfen at all different doses.

Key words: Chemical control, Effect on succeeding crop, Microflora, Onion, Oxyfluorfen, Weed management

Onion is an important crop grown in *Rabi* season in West Bengal. It has many uses as vegetables, salad *etc*. besides having its medicinal properties. Uncontrolled weed growth reduces the bulb yield up to 40-80% depending upon the nature of intensity and duration of weed competition in onion field (Prakash *et al*. 2000). Hand weeding is becoming costly day by day due to higher wages and non-availability in time at critical crop weed competition stage of onion. Therefore, alternate weed management technology and safer herbicides are one of the better substitutes of costly hand weeding. But herbicides need to be monitored for their ill effect on soil and crop environment not only in the main crop but in succeeding crop also. Oxyfluorfen is one of the pre-emergence selective herbicides for onion, therefore, its different doses were tested alongiwth its effects on soil micorflora and succding crop of blackgram.

MATERIALS AND METHODS

The study was carried out during *Rabi* season 2012-13 and 2013-14 at farm of Bidhan Chandra Krishi Viswavidyalaya, Kalyani. The soil of the experimental field was sandy loam in texture with 6.8 pH and medium fertility status with low water holding capacity. The experiment was laid out with eight treatments consisted of oxyfluorfen 23.5% EC in five doses, *viz.* 150, 200, 250, 300 and 400 g/ha, pendimethalin 30% EC 750 g/ha, hand weeding twice at 15 and 30 DAP and unweeded control, replicated thrice in randomized block design. The herbicides were applied as pre-emergence by using 500 litres of water/ha with knapsack sprayer fitted with flat fan deflector nozzle on third day after planting followed by a hand weeding on 30 DAP. Thirty days old seedlings of onion variety '*Sukhsagar*' treated with *Trichoderma viride* at 4 g/kg were transplanted manually in the experimental field during first week of November 2012 and 2013. Adequate plant protection measures against insects and diseases were followed. Half of the recommended dose (50%) of nitrogen at 100 kg/ha through urea along with full phosphorus through SSP and full potash through MOP; both at 50 kg/ha were applied as basal during final land preparation. The remaining half N was top dressed twice in equal amount (25 kg/ha) *viz.* after the first and second weeding at 25 and 50 DAP, respectively.

After harvesting of onion crop, to know the residual effect of herbicides, without disturbing the layout, each plot was manually prepared for sowing of succeeding crop. Weed density and dry matter of weed was collected at 15 and 30 days after application (DAA) of herbicides. Weed control efficiency (WCE) and weed index (WI) were calculated by using formula as suggested by Misra and Tosh (1979) and Gill and Vijaykumar (1969), respectively.

***Corresponding author:** rpoddar.bckv@rediffmail.com

Soil samples from the experimental plots were collected from the space between the rows at a depth 0–15 cm on different dates, *viz*. initial (pr-treatment), 3, 10, 30 and 60 days after application (DAA) of herbicides or respective treatment. The soil sample taken from respective treatments were mixed together and then requisite composite samples of each treatment were taken for microbial analysis by dilution plating following standard methods. Soil dilutions were prepared in sterile distilled water by constant shaking and plating was done separately in replicates in specific media *viz*. for total bacteria (Thornton's agar medium at 10^{-6} dilutions), fungi (Martin's rose bengal streptomycin agar medium at 10^{-4} dilutions) and actinomycetes (Jensen's agar medium at 10^{-5} dilutions). The enumeration of the microbial population was done on agar plants following serial dilution technique and pour plate method (Pramer and Schmidt 1965). Plates were incubated at 30 °C. The counts were taken at the 3rd day of incubation. The data were subjected to statistical analysis by analysis of variance method (Gomez and Gomez 1984). As the error mean squares of the individual experiments were homogenous, combined analysis over the years were done through unweighted analysis. Data values wherever necessary were transformed into square root as applicable (Panse and Sukhatme 1978).

RESULTS AND DISCUSSION

Among the dominant grassy weeds, *Echinochloa colona* and *Digitaria sanguinalis*, recorded the maximum population. *Cyperus rotundus* among sedge and *Melilotus alba, Amaranthus viridis, Portulaca oleracea*, and *Physalis minima* among broad-leaf weeds showed higher population in comparison to other weed species present in this onion field (**Table 1**).

Pre-emergence application of oxyfluorfen at 200, 250, 300 and 400 g/ha followed by one hand weeding at 30 DAP resulted effective control of broad-leaved weeds, grasses and to some extent sedges due to its broad spectrum action. However, application of oxyfluorfen 400 g/ha resulted more than 75% control of weeds. Kavaliauskaite (2009) reported similar higher effect of oxyfluorfen used as pre-emergence. The left over weeds were controlled by manual weeding on 30 DAP.

Unweeded control treatment gave the highest weed index value (47.5) whereas, oxyfluorfen 400 g/ ha recorded the lowest value (2.01), which was closely followed by oxyfluorfen 300 g/ha (4.92), oxyfluorfen 250 g/ha (6.55) and oxyfluorfen 200 (7.01). Weed index is related with crop yield, so unweeded control produced lowest yield and highest WI, whereas oxyfluorfen 400 g/ha recorded lowest WI because of higher bulb yield (**Table 2)**. Similar results were found by Bera *et al.* 2012.

Table 1. Effect of different weed management practices on total weed density and dry weight in onion (pooled data)

Treatment	Weed density/m^2		Weed dry weight (g/m^2)	
	15 DAA	30 DAA	15 DAA	30 DAA
Oxyfluorfen 150 g/ha + 1HW	10.34 (106.4)	14.01 (195.8)	26.6	34.4
Oxyfluorfen 200 g/ha + 1 HW	8.87 (78.2)	11.62 (134.6)	24.3	31.4
Oxyfluorfen 250 g/ha + 1 HW	8.62 (73.8)	11.09 (122.4)	22.6	30.7
Oxyfluorfen 300 g/ha + 1 HW	8.29 (68.2)	10.26 (104.8)	21.9	27.7
Oxyfluorfen 400 g/ha + 1 HW	7.79 (60.1)	9.38 (87.4)	21.4	26.9
Pendimethalin 750 g/ha + 1 HW	9.97 (99.0)	13.87 (191.9)	26.4	33.1
Hand weeding at 15 and 30 DAP	2.86 (7.7)	3.32 (10.6)	14.1	24.3
Unweeded control	15.85 (250.8)	18.89 (356.3)	92.5	116.0
LSD (p=0.05)	1.24	2.28	2.07	2.65

Figures in the parentheses are original values which were subjected to square root transformation; DAA - Days after application

Effect on crop

Pre-emergence application of oxyfluorfen 200 g/ha recorded higher pooled bulb yield of 25.9 t/ha due to better control of weeds at critical stages thus providing the favourable environment for better growth and development leading to enhanced bulb

Table 2. Effect of different weed management practices on weed control efficiency (WCE%) and bulb yield of onion (pooled data)

Treatment	WCE (%)		WI (%)	Bulb yield (t/ha)	Net production value NPV)
	15 DAA	30 DAA			
Oxyfluorfen 150 g/ha + 1HW	71.19	70.31	26.31	20.56	1.83
Oxyfluorfen 200 g/ha + 1 HW	73.78	72.93	7.01	25.94	2.79
Oxyfluorfen 250 g/ha + 1 HW	75.52	73.55	6.55	26.07	2.66
Oxyfluorfen 300 g/ha + 1 HW	76.29	76.14	4.92	26.52	2.59
Oxyfluorfen 400 g/ha + 1 HW	76.86	76.84	2.01	27.33	2.45
Pendimethalin 750 g/ha + 1 HW	71.45	71.42	21.04	22.02	2.28
Hand weeding at 15 and 30 DAP	84.71	79.01	0.00	27.89	1.98
Unweeded control	0.00	0.00	47.51	14.64	1.11
LSD(p=0.05)	-	-	-	2.48	-

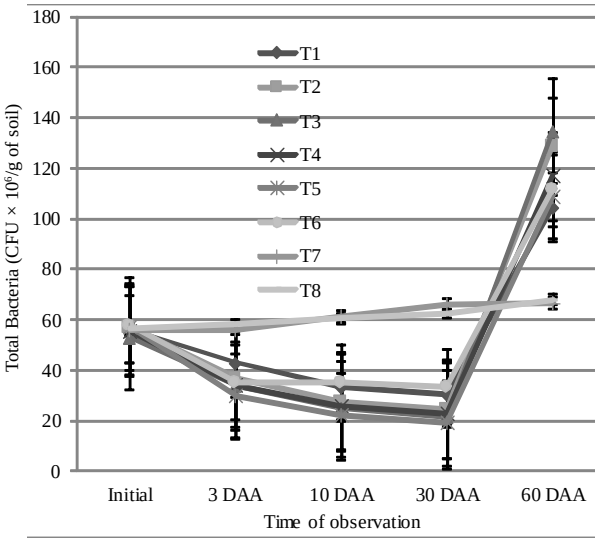
yield. Higher doses of oxyfluorfen at 250, 300 and 400 g/ha showed statistical higher bulb yield in both the years as compared with oxyfluorfen 200 g/ha. Hand weeding at 15 and 30 days was the best treatment compared all doses of oxyfluorfen and recorded highest bulb yield. The productivity of onion is mainly decided by the weed control efficiency of weed management methods as earlier observed by Uygur *et al.* (2010).

Microbial properties

Total bacteria (10^6 cfu/g): At the initial stage, there was no significant influence on the population of total bacteria in rhizosphere of onion. Significant variations of the bacterial population were found between the treated and non-treated plots after application of herbicides and the population decreased up to 30 DAA. After 60 DAA, the population increased considerably in the herbicidal treated plots as compared to hand weeding and untreated control plots (**Figure 1**). At 60 DAA, herbicidal treatments recorded 50.49 to 97.57% higher population of total bacteria than control.

Actinomycetes (10^5 cfu/g): Similar types of variations in actinomycetes population were recorded between the herbicide treated plots and the hand weeding and control plots after application of herbicides (**Figure 2**). At 60 DAA, herbicidal treatments recorded 15.29% to 39.49% higher population of actinomycetes than control. Similar findings were reported by Sapundjieva *et al.* (2008).

Fungi (10^4 cfu/g): Up to one month after application of the herbicides, slight adverse effect on the population of fungi in rhizosphere region was observed. The data showed increase in population and higher than the initial population of the fungi at 60 DAA. Further higher fungi population was recorded in all the herbicide treated plots than hand weeding and untreated control plots (**Figure 3**). Herbicidal treatments recorded 24.5% to 61.8% higher



T_1-Oxyfluorfen 23.5% EC at 150 g/ha + 1 HW, T_2-Oxyfluorfen 23.5% EC at 200 g/ha + 1 HW , T_3-Oxyfluorfen 23.5% EC at 250 g/ha + 1 HW, T_4-Oxyfluorfen 23.5% EC at 300 g/ha+ 1 HW, T_5-Oxyfluorfen 23.5% EC at 400 g/ha + 1 HW, T_6-Pendimethalin 30% EC at 750 g/ha + 1 HW, T_7-Hand weeding at 15 and 30 DAP, T_8-Unweeded control. *Bars represent the standard error.

Fig. 1. Influence of treatments on total bacteria (CFU x 10^6/g of soil)

population of fungi than control at 60 DAA. However total bacteria, fungi and actinomycetes did not vary significantly in all the doses of the herbicide Having the ability to degrade herbicides, microorganisms utilize them as a source of biogenic elements for their own physiological processes. As herbicides have toxic effects on microorganisms; they reduce their abundance, activity and consequently, the diversity of their communities before degradation. Immediately after application, the toxicity of herbicides is normally most severe as their concentration in soil is highest. With advancement of time, microorganisms degraded the herbicides and their concentration and toxic effect gradually declined up to half-life. After that, carbon released from degraded organic herbicide leads to an increase of the soil microflora population (Bera and Ghosh 2013).

Table 3. Residual effect of oxyfluorfen on the plant population and seed yield and stover yield of succeeding crop (black gram) of onion

Treatment	Plant population/m^2 at 30 DAS			Seed yield (t/ha)		Stover yield (t/ha)	
	2012-13	2013-14	Pooled	2012-13	2013-14	2012-13	2013-14
Oxyfluorfen 150 g/ha + 1HW	5.73(32.3)*	5.67(31.7)	5.70(32.0)	1.162	1.168	2.174	2.093
Oxyfluorfen 200 g/ha + 1 HW	5.79(33.0)	5.58(30.7)	5.70(32.0)	1.151	1.179	2.238	2.238
Oxyfluorfen 250 g/ha + 1 HW	5.67(31.7)	5.73(32.3)	5.70(32.0)	1.162	1.199	2.274	2.289
Oxyfluorfen 300 g/ha + 1 HW	5.73(32.3)	5.64(31.3)	5.67(31.7)	1.206	1.258	2.391	2.331
Oxyfluorfen 400 g/ha + 1 HW	5.58(30.7)	5.64(31.3)	5.61(31.0)	1.214	1.269	2.463	2.375
Pendimethalin 750 g/ha + 1 HW	5.79(33.0)	5.79(33.0)	5.79(33.0)	1.166	1.113	2.103	2.063
Hand weeding 15 and 30 DAP	5.58(30.7)	5.73(32.3)	5.67(31.7)	1.345	1.154	2.078	2.166
Unweeded control	5.49(29.7)	5.58(30.7)	5.55(30.3)	1.066	1.061	2.055	2.001
LSD (p=0.05)	NS	NS	NS	NS	NS	NS	NS

Data given in parentheses are original values subjected to square root transformation

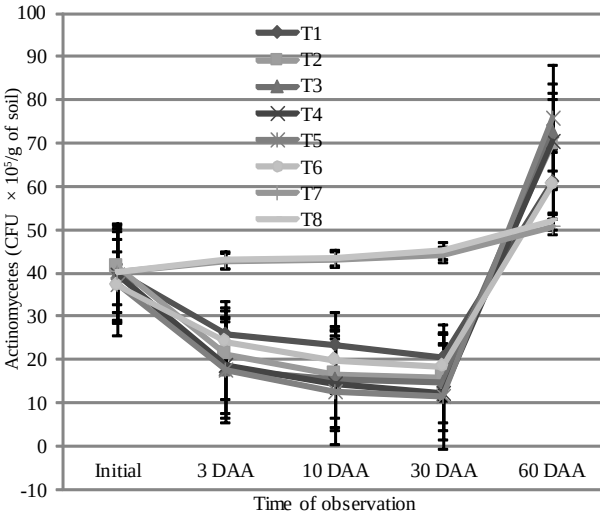


Fig. 2. Influence of treatments on actinomycetes (CFU x 10^5/g of soil)

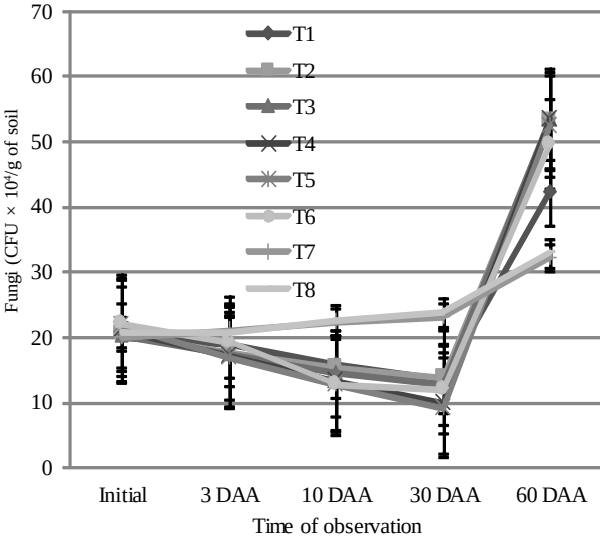


Fig. 3. Influence of treatments on fungi (CFU x 10^4/g of soil)

Net production value (NPV): Highest NPV was noted under oxyfluorfen 200 g/ha coupled with hand weeding at 30 DAP (pooled NPV = 2.79) owing to higher seed yield and comparatively lower cost under this treatment (**Table 2**). Whereas the lowest NPV was noted in control (pooled NPV = 1.11). Though twice hand weeding treatment recorded highest yield but it failed to obtain most profitable result with respect to net production value (pooled NPV = 1.98) due to higher cost of cultivation particularly labour wages.

Effect on succeeding crop: Result revealed that the population of succeeding blackgram recorded at 30 DAS was not significantly affected by residual effect of herbicide applied to irrigated onion. Yield of blackgram showed no distinct variation due to different dose of oxyfluorfen. This was corroborated with the findings of Priya *et al.* (2012).

It was concluded that onion - blackgram crop sequence can be grown in Gangetic uplands of South West Bengal and oxyfluorfen 200 g/ha could be used for the weed management in onion as an alternative of traditional costly hand weeding in spite of 7.54% less yield in this treatment (2.78), which was also superior over the hand weeding twice (1.98) as it gives higher NPV.

REFERENCES

Bera S and Ghosh R K. 2013. Soil physico-chemical properties and microflora as influenced by bispyribac-sodium 10% SC in transplanted *Kharif* rice. *Rice Science* **20**(5). DOI: 10.1016/S1672-6308(13)60148-1.

Bera S, Pal D and Ghosh RK. 2012. Bio-efficacy and phytotoxicity of new molecule herbicides for weed management in soybean. *Journal of Crop and Weed* **8**(2):113-116.

Gill HS and Vijaykumar. 1969. "Weed Index"- a new method for reporting weed control trails. *Indian Journal of Agronomy* **14**(1): 96-98

Gomez KA and Gomez AA. 1984. *Statistical Procedures for Agricultural Research*. 2nd edn. Singapore: John Wiley & Sons.

Kavaliauskaite D. 2009. Influence of herbicides spraying time and frequency on onion crop weeds. pp.105-108. In: *Scientific Works*. Lithuanian Institute Horticulture and Lithuanian University of Agriculture, Sodininkyste Darzininkyste

Misra A and Tosh GC. 1979. Chemical weed control studies on dwarf wheat. *Journal of Research* (Orisha University of Agriculture and Technology) **10**: 1-6.

Panse VG and Sukhatme PV. 1978. *Statistical Methods for Agricultural Workers*. ICAR. New Delhi.

Prakash V, Pandey AK, Singh RD and Mani VP. 2000. Integrated weed management in winter onion (*Allium cepa* L.) under mid-hills conditions of north-western Himalayas. *Indian Journal of Agronomy* **45**: 816-821.

Pramer D, Schmidt EL. 1965. *Experimental Soil Microbiology*. Minneapolis: Burgess Publ. Co.

Priya RS, Manickasundaram P, Chinnusamy C and Babu C. 2012. Influence of oxyfluorfen on weed control and yield of onion and its residual effect and succeeding sunflower and pearlmillet. *Madras Agricultural Journal* **99**(10-12): 782-785.

Sapundjieva K, Kalinova S, Kartalska Y, Naydenov M. 2008. Influence of pendimetalin herbicide upon soil microflora. *Pochvoznanie, Agrokhimiya I Ekologiya* **42**: 49–55.

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 Journal of Biotechnology* **42**: 7037-7042.