Indian Journal of Weed Science **49**(1): 63–66, 2017
DOI: 10.5958/0974-8164.2017.00015.6

Bio-efficacy of fenoxaprop-p-ethyl for grassy weed control in onion and its residual effect on succeeding maize crop

Rohitashav Singh*, Biswajit Pramanick, A.P. Singh, Neelam, Sanjeev Kumar, Akhilesh Kumar and Gajendra Singh

G.B. Pant University of Agriculture & Technology, Pantnagar, Uttarakhand 263 145

Received: 15 January 2017; Revised: 1 March 2017

ABSTRACT

A field experiment was conducted during *Rabi* seasons of 2008 and 2009 at Crop Research Center of GBPUA&T, Pantnagar (Uttarakhand) to study the effect of fenoxaprop-p-ethyl 9 EC for grassy weed management in onion and its residual effect on succeeding maize crop. All treatments reduced the density of major weed species of onion and dry weight of weeds. Yield attributes and bulb yield were increased significantly over unweeded check. Application of fenoxaprop-p-ethyl 78.75 g/ha was the best tretment and subsequently recorded maximum bulb yield of onion as compared to other doses of fenoxaprop-p-ethyl (56.25, 67.50 g/ha) and quizalofop-p-ethyl 37.5 g/ha. This herbicide did not show any phytotoxic effect on onion crop. Similarly, post-harvest study on succeeding crop of maize indicated the absence of no residual phytotoxic effect of fenoxaprop-p-ethyl tested in onion.

Key words: Bio-efficacy, Chemical control, Fenoxaprop-p-ethyl, Onion, Phytotoxicity, Residual effect, Weeds

Onion (*Allium cepa* var. *aggregatum* L.) is one of the prime bulbous vegetable with immense economic significance and extensively cultivated crop all over the world, with particular distribution in the Asian continent and in Europe. It is one of the most important vegetable crops in India accounting for one third of the world production. In India, it occupies an area of 1.02 Mha with production of 14.82 MT and productivity of 14.6 t/ha during 2009-10 (Anonymous 2011). Its poor competitive ability with 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 block weed growth. Uncontrolled weed growth reduces the bulb yield upto 40 – 80% 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 option 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 or use of quizalofop-ethyl as post-emergence (Kalhapure *et al.* 2014, Sinare *et al.* 2014). 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. In view of the above facts, an experiment was done to see the bio-efficacy and phytotoxicity of fenoxaprop-p-ethyl for grassy weed control in onion crop and its residual effect on succeeding crop.

***Corresponding author:** singh.rohitash5@gmail.com

MATERIALS AND METHODS

A field trial was conducted during *Rabi* 2008-09 and 2009-10 at Crop Research Center of GBPUA&T, Pantnagar (Uttarakhand) to evaluate the bio-efficacy of fenoxaprop-p-ethyl for grassy weed control in onion. The experiment comprised of six treatments, *viz.* fenoxaprop-p-ethyl 9 EC 56.25, 67.50 and 78.75 g/ha along with quizalofop-p-ethyl 37.5 g/ha applied at 3-4 leaves stage of grassy weeds, hand weeding at 30 and 55 days after transplanting (DAT) and untreated control for comparison with four replications, was laid out in randomized block design. Onion variety '*Nasik Red*' was transplanted at a spacing of 20 x 10 cm and recommended package and practices were followed to raise the crop. All the herbicides were applied at standard time of their application by using a foot sprayer fitted with flat fan nozzle with spray volume of 375 liters water/ha.

Weeds other than grassy were removed from the field. Observations on density of grassy weeds and their dry weight were taken at 20 and 45 day after herbicide application in onion crop. Onion bulb yield (t/ha) was recorded at the time of harvesting of crop. The data on density and dry weight of grassy weeds were subjected to log transformation by adding 1.0 to original values prior to statistical analysis.

Three separate treatments were also kept for studying the phytotoxicity of fenoxaprop-p-ethyl 78.75 and 157.50 g/ha in onion crop along with weedy check. The parameters on phytotoxicity were taken as stunting, yellowing/chlorosis, necrosis, epinasty and hyponasty. The observations were recorded using 0 -10 rating scale at the interval of 1, 5, 10, 15 and 20th day after application, where 0= no phytotoxicity and 10= complete death of crop plant.

To see the residual effect of fenoxaprop-p-ethyl on succeeding maize crop in the same plots of the trial layout, maize was sown consequently in the *Kharif* season of year 2009 and 2010 after one month of harvesting of onion crop and the crop was raised as per the standard package of practices. Visual observations on phytotoxicity, *viz*. yellowing, stunting, wilting and deformities due to the effect of herbicidal treatments on succeeding crop plants were recorded at 15 and 30 days after sowing by using rating of 0-10 scale where, 0= no effect on plants and 10= complete death of the plant. Similarly percent seed germination at 15 days after sowing and grain yield of succeeding crop at harvest were also recorded during both the years of investigation. Data were analyzed using analysis of variance (ANOVA) following randomized block design (Gomez and Gomez 1984). Differences were considered significant at 5% level of probability.

RESULTS AND DISCUSSION

Phalaris minor and *Avena* spp. were the predominant grassy weeds observed in the weedy plots of experimental field during both the years of study.

Effect on density and dry weight of weeds

All the treatments caused significant reduction in the density of total weeds over weedy cheek during both the years (**Table 1**). The lowest density of total weeds was observed under hand weeding twice at 30 and 50 DAT during both the years of experiment. Amongst the herbicidal treatments, application of fenoxaprop-p-ethyl 67.5 and 78.75 g/ha and quizalofop-p-ethyl 37.5 g/ha exhibited no statistical divergence in the density of total weeds at 20 days after herbicide application (DAA) throughout the study. However, at 45 DAA, fenoxaprop-p-ethyl 78.75 g/ha showed significantly lower density of total weeds than other treatments in the year 2008-09 but in the 2nd year it was at par with fenoxaprop-p-ethyl 67.5 g/ha and quizalofop-p-ethyl at 37.5 g/ha. Similar trends were also observed with the density of *P. minor* with both the herbicides with respective application stages. Application of both the herbicides also reduced the density of *Avena* spp. Fenoxaprop-p-ethyl 78.75 g/ha registered 100% better control of *Avena* spp. over weedy check during both the stages of crop growth in 2008-09 while in 2009-10, it showed 100% and 50% better control of that weed over weedy check during 20 and 45 DAA respectively. In case of controlling *P. minor*, fenoxaprop-p-ethyl 78.75 g/ha exhibited 47-53% better result over weedy check during both the years. The scientific reason behind such reduction in the density of weeds through the application of fenoxaprop-p-ethyl is that this herbicide is very much effective in the inhibition of acetyl CoA carboxylase (ACCase) activity which is very much important in inhibition of beta oxidation or the activation of lipid biosynthesis. Effectiveness of various herbicides against different weed species in onion crop have been previously reported by Angiras and Suresh (2005) and Tripathi *et al.* (2008).

Dry weight of grassy weeds varied significantly due to different weed control measures (**Table 2**). Similar to the weed density, execution of hand weeding twice was again recorded significantly lower dry weight of grassy weeds in comparison to weedy check during both the years of experimentation. As hand weeding twice significantly reduced the total weed density, naturally dry weight was decreased too. Fenoxaprop-p-ethyl 78.75 g/ha being at par with fenoxaprop-p-ethyl 67.5 g/ha caused significant reduction in the dry weight of grassy weeds over fenoxaprop-p-ethyl 56.28 g/ha and quizalofop-p-ethyl at 37.5 g/ha at 20 DAA during both the years. At later stage of herbicide application *i.e.* at 45 DAA, the application of fenoxaprop-p-ethyl 78.75 g/ha recorded significant lower dry weight than other herbicide treatments. The fenoxaprop-p-ethyl 67.5 and 56.25 g/ha and quizalofop-p-ehtyl 37.5 g/ha also proved very effective in reducing the dry weight of grasses. Similar results were also reported by Kolhe (2001) and Ghadage *et al.* (2006).

Effect on bulb yield

Application of herbicides significantly augmented the number of bulbs/m^2 and average bulb weight (g) over unweeded plots (**Table 3**).

Table 1. Weed density as influenced by different treatments in onion crop

Treatment	Dose (kg/ha)	Weed density (no./m^2)											
		20 DAA						45 DAA					
		P. minor		*Avena* spp.		Total		*P. minor*		*Avena* spp.		Total	
		2008-09	2009-10	2008-09	2009-10	2008-09	2009-10	2008-09	2009-10	2008-09	2009-10	2008-09	2009-10
Fenoxaprop-p-ethyl	56.25	3.66 (38)	3.71 (40)	1.79 (5)	1.61 (4)	3.78 (43)	3.81 (44)	3.83 (45)	3.89 (48)	2.08 (7)	1.79 (5)	3.97 (52)	3.99 (53)
Fenoxaprop-p-ethyl	67.5	3.26 (25)	3.18 (23)	1.39 (3)	1.39 (3)	3.37 (28)	3.30 (26)	3.43 (30)	3.64 (37)	1.39 (3)	1.39 (3)	3.53 (33)	3.71 (40)
Fenoxaprop-p-ethyl	78.75	3.00 (19)	2.77 (15)	0.00 (0)	0.00 (0)	3.00 (19)	2.77 (15)	2.64 (13)	2.83 (16)	0.00 (0)	1.10 (2)	2.64 (13)	2.94 (18)
Quizalofop-p-ethyl	37.5	3.40 (29)	3.22 (24)	0.69 (1)	1.39 (3)	3.43 (30)	3.33 (27)	3.76 (42)	3.71 (40)	1.10 (2)	1.61 (4)	3.81 (44)	3.81 (44)
Two hand weeding	-	1.79 (05)	1.39 (3)	0.69 (1)	0.69 (1)	1.95 (6)	1.61 (4)	1.61 (4)	1.39 (3)	0.00 (0)	0.00 (0)	1.61 (4)	1.39 (3)
Untreated control	-	5.88 (357)	5.89 (362)	2.71 (14)	2.48 (11)	5.92 (371)	5.92 (373)	5.53 (252)	5.58 (264)	2.49 (11)	2.20 (8)	5.58 (263)	5.61 (272)
LSD (p=0.05)		0.64	0.64	1.09	1.07	0.69	0.67	0.68	0.74	1.00	1.05	0.73	0.89

Values in parentheses are original value transformed to log $(\sqrt{x+1})$; DAA=Days after application

Table 2. Weed dry weight as influenced by different treatments in onion crop

Treatment	Dose (kg/ha)	Weed dry weight (g/m^2)			
		2008-09		2009-10	
		20 DAA	45 DAA	20 DAA	45 DAA
Fenoxaprop-p-ethyl	56.25	3.42 (29.67)	3.55 (33.78)	3.22 (24.13)	3.85 (45.97)
Fenoxaprop-p-ethyl	67.5	2.85 (16.35)	3.08 (20.69)	2.93 (17.69)	3.52 (32.86)
Fenoxaprop-p-ethyl	78.75	2.46 (10.75)	2.25 (8.47)	2.55 (11.87)	2.45 (10.64)
Quizalofop-p-ethyl	37.5	4.21 (66.04)	3.31 (26.48)	4.33 (75.01)	3.61 (35.97)
Two hand weeding	-	1.90 (5.67)	1.50 (3.48)	2.75 (14.65)	1.56 (3.77)
Untreated control	-	5.45 (232.7)	5.04 (153.87)	5.34 (207.04)	5.11 (164.75)
LSD (p=0.05)		0.47	0.63	0.53	0.78

Values in parentheses are original value transformed to log $(\sqrt{x+1})$; DAA=Days after application

Concerning the number of bulbs/m^2, fenoxaprop-p-ethyl 78.75 and 67.6 g/ha and quizalofop-p-ethyl 37.5 g/ha exhibited statistical similar result with hand weeding twice. Weeds under uncontrolled condition in onion field reduced the bulb yield by 74% than hand weeding twice (**Table 3**). The highest bulb yield *i.e.* 1.30 and 1.36 t/ha were observed with hand weeding twice at 30 and 50 DAT during 2008-09 and 2009-10, respectively. Application of fenoxaprop-p-ethyl at higher rate *i.e.* 78.75 g/ha recorded higher bulb yield being at par with fenoxaprop-p-ethyl 67.5 g/ha during both the years and with quizalofop-p-ethyl 37.5 g/ha during second year only. The higher bulb yields under these treatments were due to more number of bulbs/ m^2 and higher average bulb weight. Because of the favorable environment in the root zone resulting in absorption of more water, nutrients and good control of weeds which resulted into less weed crop competition throughout the growth stage of crop and enhance availability of nutrient, water, light and space which might have accelerated the photosynthetic rate thereby increasing the supply of carbohydrates and overall improvement in vegetative growth, which favorably influenced the bulb diameter, fresh and dry bulb weight and ultimately resulted into increased bulb yield. These findings are in close vicinity in those of Ghadage *et al.* (2006), Chopra (2007), Saraf *et al.* (2007) and Warade *et al.* (2008).

Phytotoxicity and residual effects

There were no phytotoxicity symptoms, *viz.* stunting, yellowing/ chlorosis, necrosis, epinasty and hyponasty after the application of fenoxaprop-p-ethyl either at 78.75 or 157.5 g/ha during the entire onion crop season.

There was no adverse effect of fenoxaprop-p-ethyl at their 1x and 2x doses *i.e.* 78.25 and 157.50 g/ ha on growth and development of succeeding crop

Table 3. Yield attributing characters and fresh bulb yield of onion as influenced by different treatments during 2008-09 and 2009-10

Treatment	Dose (kg/ha)	Number of bulbs/m^2		Avearge bulb weight (g)		Fresh bulb yield (t/ha)	
		2008-09	2009-10	2008-09	2009-10	2008-09	2009-10
Fenoxaprop-p-ethyl	56.25	54	57	22.8	24.5	1.00	0.95
Fenoxaprop-p-ethyl	67.5	60	61	25.1	28.7	1.11	1.14
Fenoxaprop-p-ethyl	78.75	64	62	26.5	30.5	1.21	1.22
Quizalofop-p-ethyl	37.5	57	60	23.6	26.3	1.03	1.07
Two hand weeding	-	67	62	28.8	35.5	1.30	1.36
Untreated control	-	40	42	8.6	8.8	0.33	0.36
LSD (p=0.05)	-	12	11	5.0	4.8	0.10	0.15

Table 4. Effect of fenoxaprop-p-ethyl on seed germination and yield of succeeding maize crop in (mean of four replications)

Treatment	Dose (g/ha)	% germination		Grain yield (t/ha)	
		2009	2010	2009	2010
Fenoxaprop-p-ethyl (Whip Super 9 EC)	78.75	86.8	86.3	0.39	0.39
Fenoxaprop-p-ethyl (Whip Super 9 EC)	157.50	85.6	87.4	0.37	0.37
Untreated control	-	88.3	86.7	0.38	0.38

and there was no phytotoxicity symptoms, *viz*. yellowing, stunting, wilting and deformities observed on the succeeding crop. Percent germination recorded at 15 days after sowing and grain yield of maize were also recorded almost similar (**Table 4**) in all the treatments including untreated check plot during both the years. These findings corroborated the finding of Rathod *et al.* (2014).

It was concluded that the application of fenoxaprop-p-ethyl can keep the grassy weed density and dry weight reasonably at lower level and enhance the productivity of *Rabi* onion resulting in no phytotoxic effect on the crop without affecting the growth and yield of succeeding maize crop.

REFERENCES

Angirias NN and Suresh Kumar. 2005. Studies on efficacy of new herbicides alone and in integration with hand weeding to manage weeds in onion. p. 160. In: *Biennial Conference*, ISWS, PAU, Ludhiana,

Anonymous. 2011. *Economics and Statistics*, Minister of Agriculture, Govt. of India, New Delhi.

Chopra Nisha and Chopra NK. 2007. Production of weed-free mother bulb of onion (*Allium cepa*) through integration of herbicides and weeding. *Indian Journal of Agronomy* **52**(1): 80-82.

Ghadage HL, Kathepuri JV, Sankpal VY and Jawale SM. 2006. Integrated weed management in winter onion (*Allium cepa* L.) under irrigated conditions. *Research on Crops* **7**(1): 275-278.

Kalhapure Aniket, Shete Balasaheb and Dhonde Madhukar. 2014. Weed management in onion by pre-planting and post-emergence herbicides for seed production. *Indian Journal of Weed Science* **46**(2): 142-145.

Kolhe SS. 2001. Integrated weed management in onion (*Allium cepa* L.). *Indian Journal of Weed Science* **33**(1&2): 26-29.

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**(4): 816-821.

Rathod AD, Solanki RM, Modhavadia JM and Padamani DR. 2014. Efficacy of pre-and post-emergence herbicides in onion and their carry over effect on the succeeding crops. *Annals of Agricultural Research New Series* **35**(2): 209-216.

Saraf RK, Tiwari JP and Paradkar VK. 2007. Florastic study of weeds encountered in *Kharif* onion ecosystem in Satpura Planteau of Madhya Pradesh. *World Weeds* **2**(3-4): 191-196.

Sinare BT, Andhale RP and Gautam M. 2014. Weed control in onion with herbicides. *Indian Journal of Weed Science* **46**(2): 192-194.

Tripathi PC, Sankar V and Lawande KE. 2008. Weed management in direct sown onion. p. 146. In: *Isws Biennial Conference on Weed Management in Modern Agriculture: Emerging Challenges And Opportunities*, February 27-28, Bihar Veterinary College, Patna (Rajendra Agricultural University, Pusa, Bihar.

Warade AD, Gonge VS, Bharad SG, Ingole PG and Nandre DR. 2008. Influence of integrated weed management on growth and yield of onion (*Allium cepa* L.). *Plant Archives* **8**(1): 325-328.