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Herbicidal control of *Orobanche aegyptiaca* L. in brinjal (*Solanum melongena* L.)

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Introduction

Egyptian broomrape (*Orobanche aegyptiaca* Pers.) locally known as Margoja/Rukhri/Khumbhi/Gulli is an achlorophyllous, phanerogamic troublesome root parasite that depend completely on host to complete its life cycle. This parasitic plant causes economic damage in field crops and vegetable production worldwide (Parker and riches, 1993; Eizenberg *et al*., 2004).

Brinjal crop in Haryana, crop in Nuh, Ferozepur Jhirka, Nagina, Taoru areas of Mewat, Charkhi Dadri and Loharu of district Bhiwani is found badly infested with *Orobanche aegyptiaca* threatening the cultivation of brinjal crop in the regions mentioned above. Farmers reported 10-25 % loss in fruit yield due to its infestation in brinjal crop depending on intensity of infestation (Punia,*et al*., 2016).A continuous increase in *Orobanche* infestation in these areas has forced farmers to abandon brinjal cultivation and switch over to non profitable crops cultivation.

Orobanche exert their greatest damage prior to emergence of flowering shoot. Therefore, most of the field losses may occur before diagnosis of infection. In such situation, chemical control measures and host resistance appear to be the most appropriate measures when available and affordable. Potential herbicides must be selective for the host plant but phytotoxic to the parasite

Studies conducted earlier in European countries demonstrated effectiveness and selectivity of sulfosulfuron and other ALS inhibiting herbicides to control broomrape in brinjal. The conventional methods of weed control are time consuming, expensive and laborious. In these circumstances, chemical control through herbicides application can be an effective measure for *Orobanche* management. Systemic herbicides such as glyphosate although effective against Orobanche but toxic to brinjal(Jacobson and Levs, 1986). Information on chemical control of *Orobanche* in brinjal under Indian conditions is not available. So, to generate data under Indian context, present investigation was planned to assess the efficacy of various sulfonylurea herbicides against *Orobanche aegyptiaca* in brinjal with following objectives.

1. To study the bio-efficacy of herbicides, neem cake and metalaxyl against *Orobanche* and their effect on growth and yield of brinjal
2. To study the phytotoxic effects of different chemicals on the crop.

Materials and Methods

Brinjal hybrid 707 was planted for on August, 21 2015 at Farm of Arsad s/o Nurdin, Tehsil Nuh Distt. Mewat (Haryana). Brinjal crop hybrid 707 was grown as per university recommended package of practices for brinjal except herbicide treatments. All PRE herbicides were sprayed by knap sack sprayer fitted with flat fan nozzle using 750 litres of water/ha. Quantity of water applied in post emergence treatments was 375 litres/ha. Observations on number of broom rape spikes/m^2 by different treatments was recorded at 60, 90, 120 DAP and at harvest and broom rape visual control (0-100 scale) was recorded at 120 DAP and harvest. Data on plant height, length of broom rape spike were recorded at 120 DAP. Number of fruits/plant was recorded from five tagged plants were averaged to compute values /plant. Brinjal fruits picked in four flushes were weighed and thus total yield/plot was computed. These observations were subjected to ANOVA and means were compared with appropriate Fisher's protected

LSD test at 5% level of probability. Crop phyto-toxicity due to different treatments was assessed at 30, 60 and 120 DAP on a scale of 0-100, where 0 means no injury and 100 = complete mortality of tomato plant. Injury data were arc sin transformed prior to ANOVA but was also expressed in their original form for clarity.

Table 1: Effect of different weed control measures on *broom rape (Orobanche)* population visual control, plant height, crop toxicity and fruit yield of brinjal

Treatment	No. of broom rape spikes/m^2				Visual phytotoxicity (%) on crop		
	60 DAP	90 DAP	120 DAP	Harvest	30 DAP	60 DAP	120 DAP
Neem cake 200 kg/ha at sowing *fb* pendimethalin 1.0 kg/ha at 3 DAP *fb* soil drenching of metalaxyl MZ 0.2 % at 20 DAT	1(0)	2.0(3)	3.5(11.3)	3.6(12)	0(0)	0(0)	0(0)
Neem cake 200 kg/ha at sowing *fb* metribuzin 0.5 kg/ha pre-em, 3 DAP *fb* soil drenching of metalaxyl MZ 0.2% at 20 DAT	1(0)	1(0)	1(0)	1(0)	90(100)	90(100)	90(100)
Neem cake 200 kg/ha at sowing *fb* soil drenching of metalaxyl MZ 0.2% at 20 DAT	1(0)	2.4(5)	3.1(8.7)	3.9(14)	0(0)	0(0)	0(0)
Ethoxysulfuron 25 g/ha (PRE) and 50 g/ha at 45 DAT	1(0)	0(0)	1.3(1)	1.4(1)	47.9(53.3)	46.9(55)	45(50)
Ethoxysulfuron 25 g/ha (PRE) *fb* 50 g/ha as 30 and 60 DAT	1(0)	0(0)	1(0)	1(0)	50.8(55)	47.9(60)	45(50)
Ethoxysulfuron 25 g/ha at 30 and 60 DAT	1(0)	0(0)	1.9(3)	1.7(2)	0(0)	45(50)	47.9(55)
Ethoxysulfuron 25 g/ha at 45 DAT *fb* 50 g/ha 90 DAT	1(0)	0(0)	1(0)	1(0)	0(0)	40.2(40)	42.1(45)
Ethoxysulfuron 25 g/ha at 60 & 90 DAT	1(0)	1.4(1)	1.7(2)	1.4(1)	0(0)	0(0)	33.2(30)
Sulfosulfuron 50 g/ha at 60 and 90 DAT	1(0)	0(0)	1(0)	1.7(2)	0(0)	0(0)	38.2(38.3)
Sulfosulfuron 25 g/ha at 60 and 90 DAT	1(0)	0(0)	1.4(1)	1.7(2)	0(0)	0(0)	18.4(10)
Weedy check	1(0)	2.2(4)	3.9(14)	4.0(15)	0.0	0	0(0)
SEm±	-	0.1	0.2	0.1	0.8	0.8	0.8
LSD(P=0.05)	-	0.3	0.7	0.4	2.4	2.4	2.4

*Original figures in parenthesis related to *broom rape* density were subjected to square root transformation ("X+1) before statistical analysis

Results and Discussion

Broom rape panicles did not appear in any of the treatment up to 60 DAT. Application of neem cake at sowing in combination with pendimethalin or metribuzin followed by soil drenching of metalaxyl MZ 0.2 % at 20 DAT did not cause any inhibition in broom rape (*Orobanche*) emergence as evident from density of broom rape at 90, 120 DAP and harvest (Table 1). Metribuzin applied at 3 DAP proved highly toxic to brinjal resulting in complete mortality. Although excellent control of *Orobanche* was obtained with POST or PRE plus POST treatments of sulfosulfuron and ethoxysulfuron when compared with non treated controls but proved phytotoxic to brinjal crop. *Orobanche* stalks to the tune of 1-3 panicles/m^2 appeared in various herbicide treatments which was significantly less than untreated control. Broom rape spikes which emerged in ethoxysulfuron and sulfosulfuron treatments were very weak and small sized.

Treatments of ethoxysulfuron 25 g/ha (PRE) were more phytotoxic than POST and brinjal exhibited 50-60% growth reduction under pre treatments resulting in cracked and malformed fruits Malformation and splitting of brinjal fruits have been reported with use of Rimsulfuron (Vouzounis & Americanos (1998). Developmental delay in brinjal was observed with ethoxysulfuron applied PRE or 30 DAS at 25 g/ha. Although plants recovered upon maturity but full vigour was not achieved. Only 10% suppression on brinjal plant was recorded with use of post emergence application of sulfosulfuron at 25 g/ha at 60 and 90 DAP (Table 2) resulting in 85% control of *Orobanche*. Crop suppression with use of 25 g/ha sulfosulfuron had reflection on plant height but not number of fruits/ plant and total fruit yield brinjal. Plant height at 120 DAP in ethoxysulfuron treated treatments was approximately 50% to neem cake and weedy check treatments causing severe reduction in number of fruits /plant and fruit yield. Supression in brinjal fruits by use of ethoxysulfuron and sulfosulfuron was also reported by scientists under Mewat conditions of Haryana9 Anonymous, 2017). Maximum fruit yield (32.0 t/ha) was recorded from use of sulfosulfuron 25 g/ha at 60 and 90 DAS, respectively which was which was 22.1 % higher than untreated check and significantly higher than all herbicide treatments (Table 2). Sulfosulfuron at 20 g/ha at 45 and 90 DAP of egg plant brinjal) provides effective control of *Orobanche* but with 5-10% crop suppression(Singh, *et.al*,, 2017)

Maximum B: C ratio (11.1) was obtained with post emergence use of sulfosulfuron 25 g/ha at 60 and

Table 2: Effect of different weed control measures on *broom rape (Orobanche)* visual control, plant height, crop toxicity and fruit yield of brinjal

Treatment	Visual broom rape control (%) 120 DAP	Harvest	Plant height 120 DAP (cms)	No. of fruits/plant	Fruit yield (t/ha)	B:C ratio
Neem cake 200 kg/ha at sowing *fb* pendimethalin 1.0 kg/ha at 3 DAP *fb* soil drenching of metalaxyl MZ 0.2 % at 20 DAT	0(0)	0	110.6	14.0	24.2	7.9
Neem cake 200 kg/ha at sowing *fb* metribuzin 0.5 kg/ha pre-em, 3 DAP *fb* soil drenching of metalaxyl MZ 0.2% at 20 DAT	0(0)	0	0.0	0.0	0.0	0.0
Neem cake 200 kg/ha at sowing *fb* soil drenching of metalaxyl MZ 0.2% at 20 DAT	0(0)	0	112.7	13.0	24.8	8.4
Ethoxysulfuron 25 g/ha (PRE) and 50 g/ha at 45 DAT	64.7(85.0)	82	55.4	14.0	20.6	6.7
Ethoxysulfuron 25 g/ha (PRE) *fb* 50 g/ha as 30 and 60 DAT	90(100.0)	95	52.4	13.3	21.7	7.3
Ethoxysulfuron 25 g/ha at 30 and 60 DAT	68.4(86.3)	80	59.5	12.0	19.8	6.8
Ethoxysulfuron 25 g/ha at 45 DAT *fb* 50 g/ha 90 DAT	79.5(95)	90	53.2	12.7	22.6	7.7
Ethoxysulfuron 25 g/ha at 60 & 90 DAT	66.8(84.3)	85	68.2	16.7	25.7	8.8
Sulfosulfuron 50 g/ha at 60 and 90 DAT	75(90)	90	72.9	18.7	24.8	7.9
Sulfosulfuron 25 g/ha at 60 and 90 DAT	63.5(80)	85	106.4	22.0	32.0	11.1
Weedy check	0(0)	0	111.1	14.3	24.9	8.6
S Em±	3.2		1.7	0.66	0.45	-
LSD(P=0.05)	9.6		5.2	1.97	1.34	-

*Original figures in parenthesis related to on *broom rape* control were subjected to arc sin^{-1} transformation before statistical analysis

90 DAT and minimum (6.7 & 6.8) with use of ethoxysulfuron 25 g/ha (PRE) & 50 g/ha at 45 DAT and ethoxysulfuron 25 g/ha at 30 and 60 DAT, respectively

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