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RESPONSE OF CHICKPEA (*Cicer arietinum*) AND *Euphorbia dracunculoides* TO PRE AND POST-EMERGENCE HERBICIDES

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ABSTRACT

A pot trial was conducted at the Agronomic Research Farm, University of Agriculture, Faisalabad, Pakistan in 2007-08 to evaluate nine pre and post emergence herbicides. Subsequently, a field experiment was conducted during winter 2008-09 to study the effect of herbicides selected from pot trial on weeds and growth and yield of chickpea at farmer's field in district Bhakar, Punjab, Pakistan. Stomp-455CS at 1875, 2000mL ha^{-1}, Dualgold-960 EC at 1500 mL ha^{-1}, Buctril super-60 EC at 1125 mL ha^{-1}, Aim-40 DF at 75 g ha^{-1}, Starane-M 60 EC at 1125 mL ha^{-1}, 1250 mL ha^{-1}, Sencor-70 WDG at 375 and Topgrow-90 WDG at 700 g ha^{-1} were applied as pre-emergence spray while aim-40 DF at 75 g ha^{-1} was also applied as pre-emergence sand mix broadcast application. Basagran-48 SL at 1500 mL ha^{-1} was applied as a post-emergence spray. The results revealed that all the herbicides (except Aim-40 DF) applied as sand mixed broadcast application caused 100% crop mortality in pot trial. Generally control of Euphorbia dracunculoides was 30 to 92%. In field trial all herbicides except Dualgold-960 EC gave 82 to 100% control of Asphodelus tenuifolius and control of Carthamus oxycantha ranging from 75 to 100% with all herbicides except Dualgold-960 EC, Starane-M60EC at 1125 mL ha^{-1} both as pre-emergence spray and Aim-40 DF at 75 g ha^{-1} as sand mix broadcast application. Whereas, control of Euphorbia dracunculoides with these herbicides except Dualgold-960 EC was 72 to 100%. Basagran-48 SL at 1500 mL ha^{-1} caused 100% crop mortality followed by 79, 46 and 43% in Sencor-70 WDG at 375 g ha^{-1}, Starane-M60 EC at 1125mL ha^{-1} and 1250 mL ha^{-1}, respectively. Pre-emergence application of Stomp-455 CS, Aim-40 DF and Top grow-90 WDG each as pre-emergence spray recorded more than 40% increase in grain yield of chickpea over check.

Key words: Weed management, herbicides crop injury, chemical control.

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INTRODUCTION

Chickpea (*Cicer arietinum*) the major grain legume of Pakistan, suffers from yield losses of 24-63% (Tanveer *et al*., 1998) and 38% (Aslam *et al*., 2007) on account of infestation with weeds. Yield losses due to weeds in chickpea depend on the level of weed infestation, weed species prevailing, competition duration, management practices and climatic conditions. No doubt cultural and mechanical methods of weed control are effective but can not be adopted on large scale being labour intensive and costly. This necessitates provision of suitable options of herbicides to the farmers that can be cost effective and cope with the scarcity of labour at the time of need. Weed control with herbicides would be advantageous for optimizing input efficiency in a particular crop, by reducing the population of weeds. Substantial control of weeds and significant increase in grain yield of chickpea with different herbicides has been reported by Yadav *et al*. (2006), Malik *et al*. (2001), Marwat *et al*. (2004), Ghosheh and Shatnawi (2005) and Yadav *et al*. (2007).

According to Willoughby *et al.,* (1996) use of herbicides must provide adequate weed control without adversely affecting seedling emergence and survival. Tolerance of seedling to herbicides is dependent on the herbicide dose, cultivar and environmental conditions (VanGessel *et al*., 2000). The earlier research results indicated the option of using pre-emergence pendimethalin (Aslam *et al*., 2007) in chickpea. However, there is a need to identify and test newer herbicides over a wide range of rates for weed control in chickpea. The literature related to the effect of herbicides on weed and growth parameters of chickpea is, however quite meager in Pakistan. *E. dracunculoides* L. (Green Spurge: family Euphorbiaceae) is a much branched annual winter weed. In Pakistan it grows in October-Novembar in rainfed areas of chickpea-chickpea cropping system and matures in April. It is one of the most serious weeds of chickpea in addition to *A. tenuifolius.*

Therefore, an investigation was undertaken to evaluate different herbicides for effective and broad spectrum weed control in chickpea. This information will also help in evaluating the selectivity of a particular herbicide in chickpea.

MATERIALS AND METHODS

A. Herbicide Screening Experiment

A pot experiment was carried out at the Agronomic Research Farm, University of Agriculture, Faisalabad, Pakistan to evaluate the response of chickpea (*Cicer arietinum*) and *E. dracunculoides* to various pre- and post-emergence herbicides. The experiment was laid out in completely randomized design (CRD) with four replications. The variety sown was Bital-98. Ten seeds each of chickpea and *E.*

dracunculoides were sown on 20th November, 2007 in each pot. Pot size was 27.5 cm × 25 cm^2. Herbicides applied along with dose, time and method of application are given in Table-1.

Table-1. Herbicides used, time and their method of application in pot experiment on chickpea.

Herbicide	Dose ha^{-1}	Time of application	Method of application
Weedy check	-	-	-
Stomp-455 CS (pendimethalin)	1875 mL	Pre	Spray
Stomp-455 CS (pendimethalin)	2000 mL	Pre	Spray
Stomp-455 CS (pendimethalin)	1875 mL	Pre	Sand mix Broad
Stomp-455 CS (pendimethalin)	2000 mL	Pre	Sand mix Broad
Dualgold-960 EC (S-metolachlor)	1500 mL	Pre	Spray
Dualgold-960EC (S-Metolachlor)	1500 mL	Pre	Sand mix Broad
Bestrazine-38 SC (atrazin)	1875 mL	Pre	Spray
Bestrazine-38 SC (atrazin)	1875 mL	Pre	Sand mix Broad
Bestrazine-38 SC (atrazin)	1250 mL	Post	Spray
Starane-M 60 EC (fluroxypyr+MCPA)	1125 mL	Pre	Spray
Starane-M 60 EC (fluroxypyr+MCPA)	1125 mL	Pre	Sand mix Broad
Starane-M 60 EC (fluroxypyr+MCPA)	1250 mL	Pre	Spray
Starane-M 60 EC (fluroxypyr+MCPA)	1250 mL	Pre	Sand mix Broad
Buctril-super-60EC (bromoxynil+MCPA)	1125 mL	Pre	Spray
Buctril-super-60EC (bromoxynil+MCPA)	1125 mL	Pre	Sand mix Broad
Sencor-70WDG (metribuzin)	375 g	Pre	Spray
Sencor-70WDG (metribuzin)	325 g	Pre	Sand mix Broad
Top grow- 90 WDG (terbutryn)	700 g	Pre	Spray
Top grow- 90 WDG (terbutryn)	700 g	Pre	Sand mix Broad
Aim-40 DF (carfentrazone ethyl)	75 g	Pre	Spray
Aim-40 DF (carfentrazone ethyl)	75 g	Pre	Sand mix Broad
Basagran-48SL (bentazon)	1500 mL	Post	Spray
Basagran-48SL (bentazon)	2000 mL	Post	Spray

Pre = Pre-emergence, Post = Post-emergence, Broad = Broadcast

Calibration was done to know the exact volume of water and sand to spray and broadcast herbicide, respectively. The area of pot was compared with the area of an acre then the exact volume of herbicide was applied in each pot.

B. Field experiment

The field experiment was conducted during November 2008-May 2009, to study the effect of different herbicides selected from preliminary screening in pot trial, on *E. dracunculoides* and yield of chickpea at farmer's field in district Bhakar. The experiment was quadruplicated in a randomized complete block design measuring a plot size of 4.0 x 1.2 m^2 (Table-2). Chickpea variety Bital-98 was sown in October with a tractor driven drill in 30 cm apart rows.

Table-2. Herbicides used and their time and method of application in field experiment on chickpea.

Herbicide	Dose ha^{-1}	Time of application	Method of Application
Weedy check	-	-	-
Stomp-455 CS (pendimethalin)	1875 mL	Pre	Spray
Stomp-455 CS (pendimethalin)	2000 mL	Pre	Spray
Basagran-48SL (Bentazon)	1500 mL	Post	Spray
Dualgold-960EC (S-Metolachlor)	1500 mL	Pre	Spray
Buctril-super-60EC (Bromoxynil+MCPA)	1125 mL	Pre	Spray
Aim-40 DF (Carfentrazone ethyl)	75 g	Pre	Spray
Aim-40 DF (Carfentrazone ethyl)	75 g	Pre	Sand mix Broadcast
Starane-M 60 EC (Fluroxypyr+MCPA)	1125 mL	Pre	Spray
Starane-M 60 EC (Fluroxypyr+MCPA)	1250 mL	Pre	Spray
Zencor-70WDG (Metribuzin)	375 g	Pre	Spray
Top grow-90 WDG (Terbutryn)	700 g	Pre	Spray

Pre = Pre-emergence, Post = Post-emergence

Statistical Analysis

The data collected were analyzed statistically using Fisher's analysis of variances technique and treatment means showing F-values significant were compared using least significant difference (LSD) test at 0.05 probability level (Steel *et al.,* 1997).

RESULTS AND DISCUSSION

Pot experiment Emergence (%)

Seed emergence is the fundamental necessity for achieving a desirable plant population and ultimately a good yield. Data regarding emergence of chickpea as influenced by different pre and post emergence herbicides at different rates along with their application methods are given in Table-3. It revealed that maximum emergence

(100 %) was recorded in pots where Basagran-48 SL at 2000 mL ha^{-l} was sprayed as post-emergence. It was followed by Stomp-455 CS at 1875 mL ha^{-1} pre-emergence spray, Stomp-455 CS at 2000 mL ha^{-1} pre-emergence spray, Dualgold-960 EC at 1500 mL ha^{-1} pre-emergence spray, Bestrazin-38 SC at 1875 mL ha^{-1} as pre-emergence spray and at 1250 ml ha^{-1} as post-emergence spray and Aim-40 DF at 75 g ha^{-1} as pre-emergence spray. All these treatments showed exactly similar chickpea emergence (97.50%). No chickpea emergence was observed in pots where sand mix broadcast application of herbicides except Aim-40 DF at 75 g ha^{-1} as pre-emergence sand mix broadcast (92.50%) was done. These results are in confirmation with those of Yadav *et al.* (2006) who reported that herbicides affected the germination of chickpea.

***Euphorbia dracunculoides* control (%)**

The data related to control of *E. dracunculoides* are given in Table-3 and demonstrated that all herbicide applications at different stages and rates along with their application methods gave varying control of *E. dracunculoides.* Maximum control (92.50 %) was observed in pot where Bestrazin-38 SC at 1875 mL ha^{-1} was broadcasted after mixing with sand. It was followed by Sencor-70 WDG at 375 g ha^{-1} sand mixed broadcast (90.00 %) and Stomp-455 CS at 2000 mL ha^{-1} sand mixed broadcast (85.00 %), Starane M-60 EC at 1125 mL ha^{-1} pre-emergence spray (85.00 %), Dualgold-960 EC at 1500 mL ha^{-1} sand mixed broadcast (82.50 %), Starane M-50 EC at 1125 mL ha^{-1} sand mixed broadcast (80.00), Topgrow-90 WDG at 700 g ha^{-1} sand mixed broadcast (80.00), and Buctril Super-60 EC at 1125 mL ha^{-1} sand mixed broadcast (77.50 %), Stomp-455 CS at 1875 mL ha^{-1} sand mixed broadcast (77.50 %) and Aim-40 DF at 75 g ha^{-1} pre-emergence spray (75.00 %). Minimum control (30.00 %) of *E. dracunculoides* was recorded in Starane M-60 EC at 1250 mL ha^{-1} pre-emergence spray. Bestrazin-38 SC at 1875 mL ha^{-1} pre-emergence spray and Basagran-48 SL at 1500 mL ha^{-1} as post-emergence spray gave 45 and 60 % control, respectively.

Field experiment

Weed flora encountered in the field was *E. dracunculoides*, *Asphodelus tenuifolius* and *Carthamus oxyacantha* with *E. dracunculoides* as a predominant weed. Application of Basagran-48 SL at 1500 mL ha^{-1} as post-emergence spray showed 100% control of *E. dracunculoides* which was followed by Starane-M-60 EC at 1125 and 1250 mL ha^{-1} as pre-emergence application (85%). In other treatments control of *E. dracunculoides* ranged between 60-82.50%. Control of *A. tenuifolius* was also maximum (100%) with Basagran-48 SL at 1500 mL ha^{-1} as post-emergence spray and minimum (31.46%) with Dual gold-960 EC as a pre-emergence spray. In all other treatments control of *A. tenuifolius* varied from 82 to 89%. Best

(100%) control of *C. oxyacantha* was recorded again with Basagran-48 SL at 1500 mL ha^{-1} as post-emergence spray followed by 88.63% in Stomp-455 CS at 2000 mL ha^{-1}. Minimum control of *C. oxyacantha* (43.18%) was recorded with pre-emergence spray of Starane-M-60 EC at 1125 mL ha^{-1} (Table-4). Application of Stomp-455 CS at 1875 and 2000 mL ha^{-1} and Top-grow at 700 g ha^{-1} both as pre-emergence spray did not affect the plant population of chickpea (Table-5). Whereas all other herbicides caused crop mortality ranging from 0.80 to 100% with maximum (100%) in Basagran-48 SL at 1500 mL ha^{-1} and minimum (0.80) in Aim-40-DF at 75 g ha^{-1} as sand mixed broadcast application compared with weedy check.

The application of Stomp 455-CS at 1815 mL ha^{-1} as a pre-emergence spray gave maximum seed yield of chickpea (2234 kg ha^{-1}) and remained at par with Aim -40- DF at 75 g ha^{-1}, Stomp 455-CS at 2000 mL ha^{-1} and Top-grow both applied as pre-emergence spray with grain yields of 2187, 2192 and 2213 kg ha^{-1}, respectively. These were followed by Aim-40 DF at 75 g ha^{-1}as sand mix broadcast application with grain yield of 2119 kg ha^{-1}. Starane-M-60 EC at 1250 mL ha^{-1} as a pre-emergence spray gave grain yield (1505 kg ha^{-1}) statistically similar to weedy check (1552 kg ha^{-1}). Starane-M-60 EC at 1125 mL ha^{-1} and Sencor-70 WDG at 375 g ha^{-1} as pre-emergence spray significantly decreased grain yield over weedy check and this decrease was 18.12 and 66.76 %, respectively due to significant decrease in plant population of chickpea in these treatments. On the basis of one year results, it could be concluded that application of Stomp-455 CS at 1875, 2000 mL ha^{-1}, Aim-40-DF at 75 g $ha^{-1}$and Top-grow-90 WDG at 700 g ha^{-1} as a pre-emergence spray provide an option to farmers to manage *E. dracunculoides* and other weeds effectively along with improved growth leading to higher grain yield of chickpea.

The weed control achieved through Dualgold-960EC was not adequate. Less effect of Dualgold-960EC could be attributed to its photodecomposition which is a major contributor to its dissipation in the dry field condition (EXTOXNET, 2000). Inadequate control of *C. oxyacantha* with Starane M 60EC at 1125 mL ha^{-1} might be due to lower dose for this weed or erratic behavior of herbicide due to soil moisture compared with other weeds control (Martin, 1995). Severe crop mortality with Basagran-48SL, Starane-M 60EC and Sencor-70WDG might have resulted from drought stress and fluctuating temperatures (Anonymous, 1995). The highest yield from pre-emergence application of Stomp-455CS, Dualgold-960EC, Buctril super-60EC, Aim-40DF and Top grow-90WDG was in accordance with highest values of plant population which is the main yield attributing character, compared with other herbicides. The role of yield attributing factors and enhanced yield on account of chemical control of weeds has been documented earlier (Patel *et al*., 1997; Malik *et al*., 2001, Marwat *et al*., 2004; Ghosheh and Shatnawi,

Table-3. Effect of pre and post-emergence herbicides on emergence (%) of chickpea and control (%) of *Euphorbia dracunculoides* in pot experiment.

Herbicide	Dose ha^{-1}	Time of application	Method of application	Emergence (%) of Chickpea	Control (%) *E. dracunculoides*
Weedy check	-	-	-	95.00	-
Stomp-455CS	1875 mL	Pre	Spray	97.50	55.00
Stomp-455CS	2000 mL	Pre	Spray	97.50	60.00
Stomp-455CS	1875 mL		Sand mix Broad.	0.00	77.50
Stomp-455CS	2000 mL		Sand mix Broad.	0.00	85.00
Dualgold-960EC	1500 mL	Pre	Spray	97.50	62.50
Dualgold-960EC	1500 mL		Sand mix Broad.	0.00	82.50
Bestrazine-38 SC	1875 mL	Pre	Spray	97.50	45.00
Bestrazine-38 SC	1875 mL		Sand mix Broad.	0.00	92.50
Bestrazine-38 SC	1250 mL	Post	Spray	97.50	70.00
Starane-M 60 EC	1125 mL	Pre	Spray	57.50	85.00
Starane-M 60 EC	1125 mL		Sand mix Broad.	0.00	80.00
Starane-M 60 EC	1250 mL	Pre	Spray	80.00	30.00
Starane-M 60 EC	1250 mL		Sand mix Broad.	0.00	82.50
Buctril-super-60EC	1125 mL	Pre	Spray	95.00	72.50
Buctril-super-60EC	1125 mL		Sand mix Broad.	0.00	77.50
Sencor-70WDG	375 g	Pre	Spray	92.50	77.50
Sencor-70WDG	325 g		Sand mix Broad.	0.00	90.00
Top grow-90 WDG	700 g	Pre	Spray	92.50	82.50
Top grow- 90 WDG	700 g		Sand mix Broad.	0.00	80.00
Aim-40 DF	75 g	Pre	Spray	97.50	75.00
Aim-40 DF	75 g		Sand mix Broad.	92.50	72.50
Basagran-48SL	1500 mL	Post	Spray	95.00	60.00
Basagran-48SL	2000 mL	Post	Spray	100.00	70.00

Pre = Pre-emergence, Post = Post-emergence

Table-4. Species wise weed control efficiency (%) as affected by herbicides and application methods.

Treatment	Dose ha^{-1}	Time of application	Method of application	*Asphodelus tenuifolius*	*Carthamus oxyacantha*	*Euphorbia dracunculoides*
Weedy check	-	-	-	-	-	-
Stomp-455 CS	1875 mL	Pre	Spray	89.33	84.09	75.0
Stom-455(CS)	2000 mL	Pre	Spray	86.80	88.63	80.0
Basagran-48SL	1500 mL	Post	Spray	100	100	100.0
Dualgold-960EC	1500 mL	Pre	Spray	31.46	45.45	62.0
Buctril-super-60EC	1125 mL	Pre	Spray	82.36	88.63	72.50
Aim-40 DF	75 g	Pre	Spray	88.38	77.27	75.0
Aim-40 DF	75 g	Pre	Sand mix Broad cast	85.20	65.90	72.50
Starane-M 60 EC	1125 mL	Pre	Spray	86.27	43.18	85.0
Starane-M 60 EC	1250 mL	Pre	Spray	85.85	86.36	85.0
Zencor-70WDG	375 g	Pre	Spray	87.32	77.27	77.50
Top grow- 90 WDG	700 g	Pre	Spray	88.38	75.0	82.50

Pre = Pre-emergence, Post = Post-emergence

Table-5. Plant population and yield of chickpea as influenced by herbicides and application methods under field conditions.

Herbicide	Dose ha^{-1}	Time of application	Method of application	Plant Population (1.2m x 4m)	Crop Mortality %	Grain yield Kg ha^{-1}	% yield decrease (-)/ % yield increase (+) over weedy check
Weedy check	-	-	-	124.50 a	-	1552.0d	-
Stomp-455CS	1875 mL	Pre	Spray	124.75a	-	2234.3a	+ 43.94
do	2000 mL	do	do	125.25a	-	2192.5a	+ 41.26
Basagran-48SL	1500 mL	Post	Spray	0.00g	100	0.00g	-100
Dualgold-960EC	1500 mL	Pre	Spray	122.75b	1.40	1848.8c	+ 19.12
Buctril-super-60EC	1125 mL	do	Spray	121.75c	2.21	1869.5c	+ 20.45
Aim-40 DF	75 g	do	Spray	121.00c	2.81	2187.3a	+ 40.93
do	do	do	Sand mix broadcast	123.50b	0.80	2119.7b	+ 36.58
Starane-M 60 EC	1125 mL	do	Spray	66.25e	46.25	1270.8e	-18.12
do	1250 mL	do	Spray	69.25d	43.50	1505.0d	-3.02
Zencor-70WDG	375 g	do	Spray	25.75f	79.31	515.75f	-66.76
Top grow- 90 WDG	700 g	do	Spray	125.25a	-	2213.3a	+ 42.60
LSD				**0.931**		**49.40**	

Pre = Pre-emergence, Post = Post-emergence
Means sharing the same letter in a column do not differ significantly at $P < 0.05$.

2005; Yadav *et al*., 2006). Decrease in grain yield with pre-emergence application of Basagran-48SL, Starane-M60EC and Sencor-70WDG was due to crop injury which caused severe reduction in plant population. These results are supported by the findings of Singh and Wright (1999) and Ghosheh and Shatnawi (2005).

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