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HERBICIDES AND THEIR DOSES EFFECTS ON WILD ONION (*Asphodelus tenuifolius* Cav.) IN CHICKPEA

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ABSTRACT

This study aims to determine dose requirements of herbicides for controlling Asphodlus tenuifolius on farmer's field in chickpea during 2005-06 and 2006-07. Five herbicides pendimethalin, s-metolachlor, fenoxaprop-p-ethyl, MCPA and isoproturon with four doses were studied in the trials. MCPA produced phytotoxic effect on both weed and crop and also completely inhibited crop and weed growth. Isoproturon was less effective on A. tenuifolius with less phytotoxicity on crop. Best seed yield (1164 and 1150 kg ha^{-1}) was recorded in pre-emergence herbicides at high dose as compared to fenoxaprop-p-ethyl (1088 kg ha^{-1}). Next year (2006-2007) again the same herbicides were tested while MCPA was replaced by clodinafop propargyl (post-emergence) due to its phytotoxicity on crop. Almost similar results were recorded with the only difference of herbicides clodinafop propargyl. The highest seed yield of 1109 kg ha^{-1} was recorded each for pendimethalin and s-metolachlor while it was statistically similar with the yield of fenoxaprop-p-ethyl (1107 kg ha^{-1}). Lower 0.5x and 1.0X doses of post emergence herbicides produced good results as compared to 1.5X. Pre emergence herbicides were found to be effective only at 1.5X dose.

Key words: Chickpea, *A. tenuifolius*, herbicides, doses, interaction.

INTRODUCTION

Chickpea (*Cicer arietinum* L.) is a major food legume and an important source of protein in many countries in Asia and Africa. This species is the second most consumed and the third most cultivated grain legume in Asia (Dodak *et al.,* 1993). It is an ancient crop and is grown in tropical, subtropical and temperate regions. India, Pakistan and Mexico were recorded as major producers of chickpea (Badshah *et al.,* 2003). In India and Pakistan, chickpeas are consumed locally; furthermore about 56% of the crop is retained by growers. Chickpea is valued for its nutritive seeds with high-protein content 17–22% and 25.3–28.9%, before and after dehulling, respectively (Hulse, 1991; Badshah *et al.,* 2003).

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Weeds are a serious constraint of production and easy harvesting of chickpea. Chickpea, however, is a poor competitor to weeds because of its slow growth rate and limited leaf area development at early stages of crop growth and establishment. Yield losses due to weed competition vary considerably depending on the level of weed infestation and weed species prevailing. Nevertheless, almost all values reflect the seriousness of the weed problem. Yield losses were observed to vary from 40-94% in the Indian subcontinent (ICARDA, 1985; Bhan and Kukula, 1987), 40-75% in West Asia (ICARDA, 1982, 1986), 13-98% in North Africa (El-Brahli, 1988; Knott and Halila, 1988), and 35% in Italy (Calcagno *et al.,* 1987). Effective weed control may increase yield in chickpea by 17-105%.

There are more than 75 weed species that were reported to infest chickpea fields in the Mediterranean region (Calcagno *et al.,* 1987; El-Brahli, 1988). These species are mostly dicotyledonous and belong to 26 different families. Post emergence application of herbicides can be, indeed, substantially reduced if the "minimum dose requirement for a satisfactory efficacy" (MDRE) is known with respect to the most common "herbicide-weed species" combinations (Davies *et al*., 1993, Kudsk, 1989, Onofri *et al*., 1997; Pannacci and Covarelli, 2003). Effective pre-planting and soil incorporated herbicides include fluchloralin, oxyfluorfen, trifluralin and triallate. Whereas effective pre-emergent herbicides are alachlor, chlorobromuron, cyanazine, dinoseb amine, methabenzthiazuron, metribuzin, pronamide, prometryne and terbutryne. Post-emergent herbicides include dinosebacetate, fluazifop-butyl and fenoxprop-ethyl. Post emergent applications need great care with respect to stage of growth and air temperature to avoid phytotoxicity (Bhan and Kukula, 1987).

Chemical weed control with pre-emergence terbutryne at 2.0 kg a.i. ha^{-1} and pronamide at 0.5 kg a.i. ha^{-1} increased yield by 26% and 6% in winter and spring sowing, respectively, compared to control. *Cuscuta campestris* was selectively controlled by pre emergence application of pronamide with chlorthal dimethyl (Graf *et al.,* 1982). Some crops are likely to be more amenable than others to the use of reduced herbicide doses. Kirkland *et al.* (2000) reported that good crop yields and the highest net returns could be attained with a 50% herbicide dose in barley but that a 100% herbicide dose was required to attain the highest yields and net returns in lentil (*Lens culinaris* L.). Keeping in view the economic importance of wild onion infestation in chickpea crop the present studies were conducted to:

1. Figure out the most economical herbicide for the control of *A. tenuifolius.*
2. Test the efficacy of herbicides at varying doses and its effects on crop.
3. Identify the minimum dose requirement of tested herbicides.

MATERIALS AND METHODS

Experiments were conducted in chickpea on farmer's field in district Lakki Marwat, Khyber Pukhtunkhwa Province, Pakistan during rabi season 2005-06 and 2006-07. The experiments were laid out in Randomized Complete Block (RCB) design with split plot arrangements with three replications. The herbicides were assigned to main plots, while herbicides doses were kept in the sub plots. KC-98 chickpea cultivar was seeded during the second week of October, in each year of study. Each sub plot measured 5 × 2 m^2. Two pre-emergence and three post-emergence herbicides each with four doses were used. The herbicidal treatments were the pre emergence application of pendimethalin and s-metolchlor at 0, 0.41 (0.5x), 0.82 (1X) and 1.20 (1.5X). While the post emergence herbicides were isoproturon at 0, 2.0 (0.5x), 4.0 (1X) and 6.0 (1.5X), fenoxaprop-p-ethyl at 0, 0.47 (0.5x), 0.94 (1X) and 1.30 (1.5X), MCPA at 0, 0.28 (½x), 0.56 (1X) and 0.90 (1.5X), and clodinafop propargyl 0, 0.48 (0.5x), 0.98 (1X) and 1.50 (1.5X) and kg a.i. ha^{-1}. MCPA was replaced by clodinafop propargyl in the second season due to its phytotoxic effects on the crop. Herbicides were sprayed using knapsack sprayer. All the weeds in the field except *A. tenuifolius* were manually uprooted.

Data collected from both field experiments were recorded on the following parameters as follow:

Fresh weed biomass (kg ha^{-1})

The plants of *A. tenuifolius* were collected with the help of quadrate of 25 × 25 cm^2 from each treatment and weighed in kg. Three random quadrates were taken in each treatment. The data was subsequently converted to kg ha^{-1}.

100 seed weight (g)

A random sun dried and clean seeds sample of 100 grains from each treatment was taken and weighted (g) using electronic balance.

Seed yield (kg ha^{-1})

Two central rows were harvested in each plot and then the grain yield (kg ha^{-1}) was obtained by the following formula:

$$\text{Grain yield (kg ha}^{-1}\text{)} = \frac{\text{Grain yield (kg)} \times 10000}{\text{Area harvested (m}^2\text{)}}$$

Statistical analysis

The data recorded for each trait was subjected to the ANOVA technique using MSTATC computer software and the means were separated by using Fisher's protected LSD test (Steel and Torrie, 1980).

RESULTS AND DISCUSSION
Season 1 (2005-06)
Fresh weed biomass (kg ha^{-1})

Analysis of variance of the data showed that herbicides, herbicides doses and their interaction had significant effect on the fresh weight of *A. tenuifolius* (Fig. 1). The data exhibited that minimum fresh weight (4.98 kg ha^{-1}) was recorded for MCPA followed by pendimethalin (8.27 kg ha^{-1}), s-metolachlor (8.42 kg ha^{-1}) and fenoxaprop-p-ethyl (8.57 kg ha^{-1})respectively. While maximum fresh weight (11.0 kg ha^{-1}) was recorded in untreated control. Among the doses of herbicides used, the lowest fresh biomass (6.41 kg ha^{-1}) was observed at 1.5X, while maximum fresh weight (11.61 kg ha^{-1}) was recorded in untreated control. In the interaction of herbicides and doses maximum fresh weight (11.61 kg ha^{-1}) was observed in untreated control, followed by isoproturon at all the tested doses while minimum fresh weight (2.5 kg ha^{-1}) in the interaction was observed in MCPA at high dose which was statistically at par with rest of the doses of the same herbicide. Pendimethalin, s-metolachlor and fenoxaprop-p-ethyl produced statistically similar results at 1.5X dose. Herbicides doses have great influence on fresh and dry biomass of wild onion and consequently use in the management of wild onion (Khan *et al.* 2009).

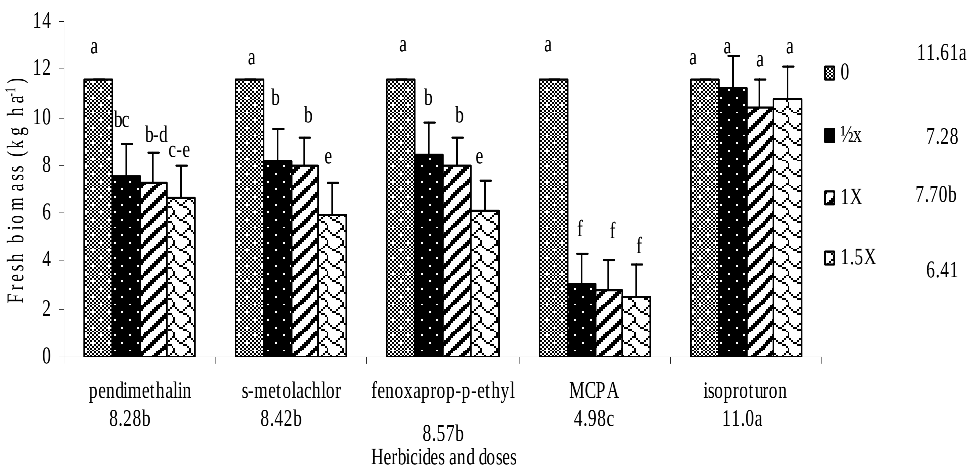

Figure 1. Effect of different herbicides on fresh biomass of *A. tenuifolius* during 2005-06.

Means followed by different letters indicate significant differeces among different doses in the same herbicides (Fisher's protected LSD test, p>0.05). The mean value of 100 seed weight was significantly affected by the herbicides, doses and their interaction (Fig. 2). Among the herbicides maximum seed weight of 26.96 and 26.82g was recorded in the pre-emergence treatment of pendimethalin and s-metolachlor respectively. The minimum 100 seed weight was observed in isoproturon (23.76 g) and fenoxaprop-p-ethyl (24.88 g). Untreated control produced highest seed weight (24.10 g) while 1.5X dose produced lowest one (19.88 g). In the interaction of herbicides and doses highest 100 seed weight was observed in pendimethalin (31.90 g) and s-metolachlor (31.43 g) respectively at 1X dose. While the minimum 100 seed weight was observed in plots treated with isoproturon however, it was statistically at par with the rest of the doses of the same herbicide. MCPA produce 0.00 seed weight due to its phytotoxic effects on the crop.

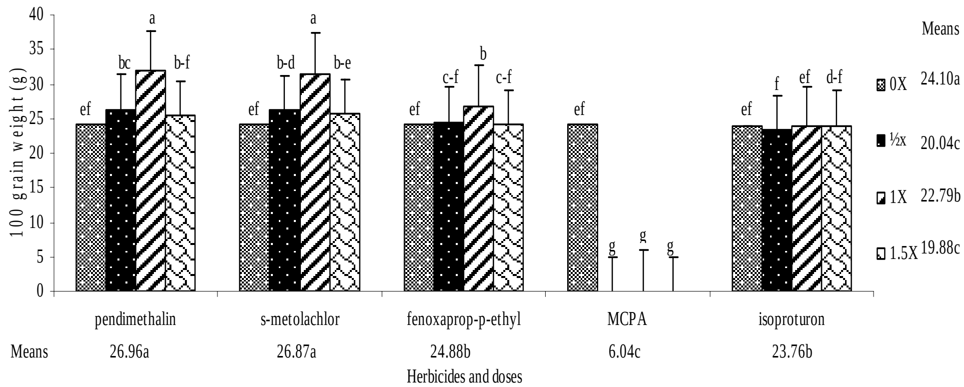

Figure 2. Effect of different herbicides on 100 seeds weight (g) of chickpea during 2005-06.

Means followed by different letters indicate significant differences among different doses in the same herbicides (Fisher's protected LSD test, p>0.05).

Seed yield (kg ha^{-1})

Same as fresh biomass and weight of 100 seeds, seed yield was significantly affected by herbicides, their doses and interaction (Fig. 3). The results indicated that the main effects of herbicides produced 1164 kg ha^{-1} seed yield in pendimethalin treated plots however it was statistically at par with s-metolachlor (1150 kg ha^{-1}) followed by fenoxaprop-p-ethyl (1088 kg ha^{-1}) while minimum yield (991.6 kg ha^{-1}) was recorded in isoproturon and MCPA treated plots. Among the tested doses maximum seed yield of 984.0 kg ha^{-1} was recorded in untreated plots followed by the 1X dose (930.5 kg ha^{-1}) while minimum seed yield (910.0 kg ha^{-1}) was observed at the highest dose (1.5X). In the interaction of herbicides and doses highest yield 1270.0 and 1233.0 kg ha^{-1} were observed in pendimethalin at doses

1.5 and 1X respectively. While the preemergence herbicide s-metolachlor gave almost statistically similar results at all tested doses.

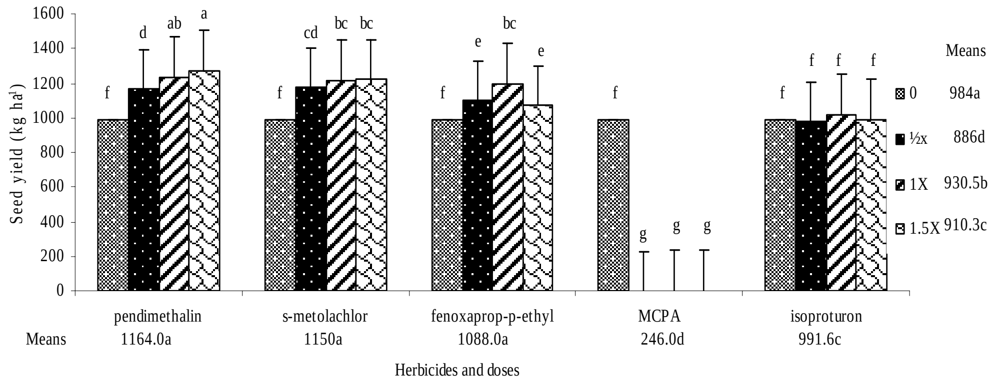

Figure 3. Effect of different herbicides on seed yield kg ha^{-1} of chickpea during 2005-06.

Means followed by different letters indicate significant differences between different doses in the same herbicides (Fisher's protected LSD test, *p*>0.05).

Season 2 (2006-07)

Fresh weed biomass (kg ha^{-1})

Herbicides, herbicide doses and their interactions had different patterns on the fresh biomass of *A. tenuifolius* (Fig. 4). The main effects of herbicides showed that lowest fresh weight (9.47 kg ha^{-1}) was recorded for pendimethalin followed by the s-metolachlor (9.47 kg ha^{-1}), fenoxaprop-p-ethyl (9.69 kg ha^{-1}) and clodinafop propargyl (10.02 kg ha^{-1}) respectively. While highest fresh weight (11.80 kg ha^{-1}) was recorded in plots treated with isoproturon. Among the herbicides doses minimum fresh weight (8.40 kg ha^{-1}) was recorded at the higher dose. Whereas maximum fresh weight (12.50 kg ha^{-1}) was recorded in untreated control. In the interaction of herbicides and doses minimum fresh weight (7.05 kg ha^{-1}) was observed in s-metolachlor at 1.5X dose however it was statistically at par with pendimethalin, fenoxaprop-p-ethyl and clodinafop propargyl at 1.5X dose and pendimethalin at 1X dose as well. While maximum fresh weight (12.63 kg ha^{-1}) was observed in untreated control in all the herbicides followed by isoproturon at all tested doses.

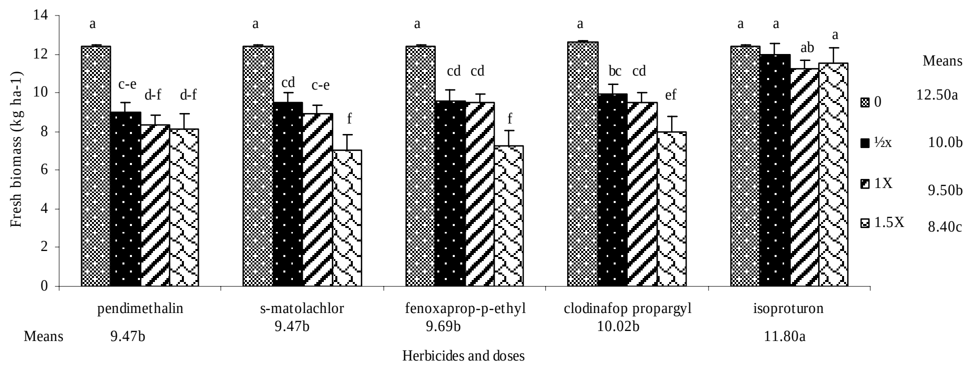

Figure 4. Effect of different herbicides on fresh biomass of *A. tenuifolius* during 2006-07.

Means followed by different letters indicate significant different between different doses in the same herbicides (Fisher's protected LSD test, $p>0.05$).

100 seed weight (g)

The 100 seed weight was significantly affected by the herbicides, herbicide doses and their interaction (Fig. 5). Among the herbicides, maximum seed weight of 26.96 and 26.31 g were recorded in the pre-emergence treatment of s-metolachlor and pendimethalin respectively. The minimum 100 seed weight of 22.18 and 23.14 g were observed in clodinafop propargyl and isoproturon respectively. Among the herbicides doses maximum 100 seed weight (26.41 g) was recorded at 1X dose while the other two herbicide doses produced statistically similar results. In the interaction of herbicides and doses the highest 100 seed weight (31.18 g) was observed in pendimethalin at 1X dose while the minimum seed weight (21.55, 21.70 and 21.85 g) was observed in clodinafop propargyl at all tested herbicidal doses.However, it was statistically at par with the all herbicides doses of isoproturon and all doses of fenoxaprop-p-ethyl except that for 1X dose.

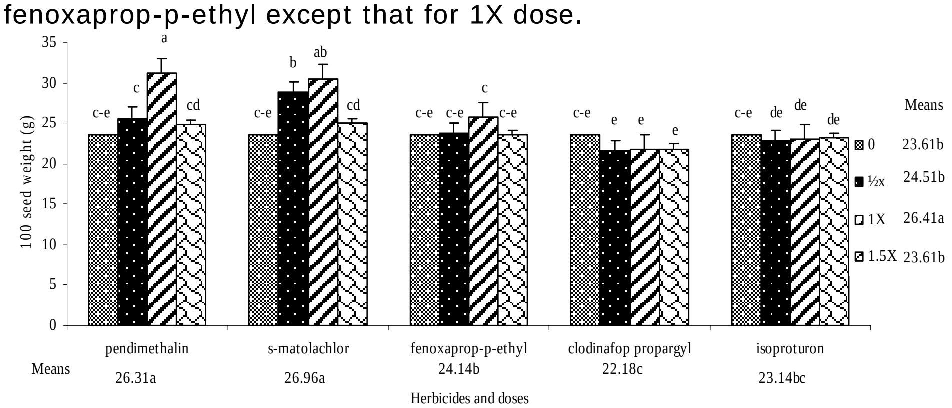

Figure 5. Effect of different herbicides on weight (g) of 100 seeds chickpea during 2006-07.

Seed yield (kg ha^{-1})

Seed yield was also differently affected by herbicides, herbicide doses and their interaction (Fig. 6). The results indicated that among the different herbicides, highest seed yield (1109 kg ha^{-1}) was recorded in pendimethalin and s-metolachlor treated plots, followed by fenoxaprop-p-ethyl (1004.52 kg ha^{-1}) while the minimum yield was recorded in isoproturon (943.4 kg ha^{-1}) and clodinafop propargyl (955.3 kg ha^{-1}). The main effects of herbicides doses indicated that maximum seed yield (1111 kg ha^{-1})was recorded at 1X dose however it was statistically at par with ½x doses (1043 kg ha^{-1}) of the herbicides while minimum seed yield was observed in untreated control (931.3 kg ha^{-1}). In the interaction of herbicides and doses, highest yield was observed in s-metolachlor (1111 kg ha^{-1}) at 1X dose however it was statistically at par with pendimethalin at 1.5X dose.

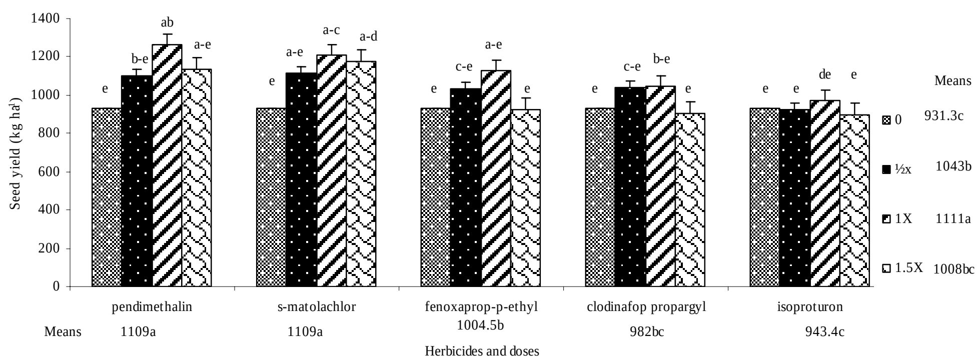

Figure 6. Effect of different herbicides on seed yield kg ha^{-1} of chickpea as during 2006-07.

Means followed by different letters indicate significant different among different doses in the same herbicides (Fisher's protected LSD test, p>0.05).

Herbicides, doses, and their interaction affected almost all the tested parameters during both years of the studies. During the first year, MCPA reduced the fresh and dry biomass of weed more than that of the other herbicides although MCPA had exerted phytotoxic effect on the crop as well. So MCPA was replaced by clodinafop propargyl for the next year. Pre-emergence herbicides pendimethalin and s-metolachlor and the post emergence herbicide fenoxaprop-p-ethyl reduced the fresh weed biomass significantly with no injury to the crop. In case of fresh weed biomass pendimethalin, s-metolachlor and fenoxaprop-p-ethyl were the best without injury to the crop. Malik *et al.,* (2003) reported that herbicides decreased the dry weight of weeds significantly. These results are also in a great analogy with the work of Iqbal *et al.,* (1991) and Poonia *et al.,* (1993). The authors reported that herbicides decreased the dry weight of weed significantly. The probable reason for the positive performance of these herbicides is their efficacious control of *A. tenuifolius.* 100 grain weight (g) and grain yield (kg ha^{-1}) were also increased by the application of the pre-emergence herbicides and the post emergence fenoxaprop-p-ethyl as well. The increments of the 100 seed weight and seed yield in this study were probably due to maximum inhibition of wild onion consequently the crop was flourished and efficiently utilized all the available resources.

In both the experiments 1X and 1.5X doses of pre emergence herbicides produced good results when compared to the lower dose. Whereas in post emergence herbicides dose 0.5x and 1X produced good results when compared to 1.5X dose.

Thus it is concluded that the doses of the pre-emergence herbicides pendimethalin and s-metalchlor could not be curtailed for harvesting good yield of chickpea.

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