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Efficacy of clodinafop, isoproturon and their sequential application on *durum* wheat as influenced by fertilizer application

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ABSTRACT

Field experiments were conducted in Safsaf area in Libya during growing season of 2009-10 and 2010-11. The field infested with many weeds of mixed flora was used to investigate the efficacy of clodinafop, isoproturon and their sequential application in '*Zorda'* cultivar of *durum* wheat during different crop growth stages that is seedling, tillering and elongation in the presence or absence of diammonium phosphate (DAP) at 2.5 t/ha. Results revealed that all weed control treatments reduced weed density and dry weight recorded at 60 days of sowing. The least weed density was recorded from sequential application of clodinafop and isoproturon compared to weedy check. Herbicide application at seedling stage of crop growth in the absence of DAP was more effective in reducing weeds density and their dry weight. Crop height, effective tillers, biological yield, grain and straw yield, seed and harvest index increased due to sequential application of clodinafop and isoproturon during seedling stage in the presence of DAP compared to weedy check and elongation stage in the absence of DAP.

Key words: Clodinafop, Chemical control, *Durum* wheat, Isoproturon, Sequential application

Durum wheat (*Triticum durum* L.) occupies prime position among the food crops of Libya which is grown in the Jabal El-Akhdar in an area of 42,000 ha with an average production of 1.2 t/ha (Tayyeb 2003). It is usually grown in areas where irrigation facilities are comparatively less (rainfed farming). The better grain yield realization is not possible without proper weed management in this crop, because weeds compete with the crop for nutrient, water, space and sunlight. The yield reduction in *durum* wheat depends upon the type and density of associated weed flora (Singh *et al*. 1997, Singh and Yadav 1998, Bhat *et al*. 2006). Among the grass weeds, wild oat (*Avena fatua*) can cause yield reduction from 15-50% (Singh *et al*. 1995a, Walia and Brar 2001, Anon. 2009).

There are several weed species infesting wheat (Singh *et al*. 1995b) with large potential to lower crop yields due to severe competition. Weed stage, herbicide rates and fertilizers application impact weed control and crop-weed competition (Singh *et al*. 1995a, Singh *et al*. 1997, Balyan *et al*. 2000, Bhat *et al.* 2006). Herbicide efficacy can be increased by tank mixing, if compatible (Sharma *et al*. 2002, Singh *et al*. 2011) or their sequential application (bromoxynil and diclofop-methyl) for effective control of weed flora in wheat (Tayyeb 2012). Compatibility of herbicides depends on mixture partners (Yadav *et al*. 2009), but isoprouron has been found compatible with both grassy and broad-leaved herbicides (Singh *et al*. 1993) and can be used as tank mix or in sequence. Clodinafop which is effective against wild oat and isoproturon for grasses and broad-leaved weeds have recently been introduced in Libya. The present experiment was conducted to study the effect of sequential application of clodinafop and isoproturon in managing weeds of rain-fed *durum* wheat when applied at different crop stages in the presence or absence of fertilizer.

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MATERIALS AND METHODS

The experiments were conducted at the research farm of Agriculture Research Center in Safsaf (22° 46´ N, 32° 39´ E, 490 MSL), Libya during 2009-10 and 2010-11. The soil of the experimental field was deep silty loam, typic lithic xerochrepts, low in organic carbon and slightly alkaline (pH 7.8). The region has a cold winter suited for wheat. Average annual rainfall was 521 to 561 mm. The experiment field was infested with mixed population of *Avena fatua*, *Bromus tectorum*, *Lolium multiflorum*, *Medicago* sp., *Brassica tournefortii*, *Chenopodium album*, *Anagallis arvensis* and *Convolvulus arvensis*. The weed control treatments were clodinafop at 280 g/ha, isoproturon at 1.2 kg/ha and their sequential application at the above rates along with weedy check treatment. Spraying was done at the 2-3 leaf stage of crop (S1), tillering stage (S2) and elongation stage (S3) in the presence of diamonium phosphate (DAP) fertilizer at 250 kg/ha (F1) or without fertilization (F0).

The experiment was conducted in a split plot design with four replications. The durum wheat cultivar '*Zorda*' [Gerardo V Z 469 – AA "S" – CM 363 – 5M - 4Y – 3M – 0Y] was sown using 90 kg/ha seed on 11 and 15 November in 2009 and 2010, respectively. The herbicides were in the main plots, time of herbicidal application in the subplots and fertilizer in the sub-sub-plot in a plot size of 5.2 x 2.4 m. The data on weed density were recorded 60 days after sowing (DAS) using 50 x 50 cm quadrant. The plant height, effective tillers/m, biological yield, grain and straw yield (t/ha), harvest index, weed dry matter of both grass and broad-leaved weeds were recorded at the time of harvest. Data were submitted to analysis of variance with least significant differences test ($P < 0.05$).

RESULTS AND DISCUSSION

Weed density

All weed control treatments reduced weed density significantly at 60 DAS than the weedy check (Table 1). The minimum grass weed density was recorded in sequential application during both the seasons compared to the control. Effect of time of application during different crop growth stages was not significantly different on the grassy weed density during the first season, however, during the second season, highly significant differences were apparent due to sequential application when applied at the seedling stage. Moreover, grassy weed density was significantly reduced by herbicides in the presence of DAP fertilizer. The interaction of herbicides and crop growth stages was highly significant during both the years. There was a highly significant difference in grassy weed density due to interaction of stage of crop growth and fertilizer for grassy weeds density during 2009-10 and 2010-11, and a highly significant effect of interaction of herbicide x stage of crop growth x fertilizer on grassy weed density in the season 2010-11.

The broad-leaved weeds density recorded significant variations due to herbicidal treatment. Sequential application gave the least density in the first season, but there was no significant effect in the broad-leaved weeds density due to different crop growth stages in both the seasons (Table 1). The fertilizer (DAP) significantly increased broad-leaved weeds density compared to no fertilization during both the seasons. The interaction of herbicide and fertilizer in the first season was highly significant. Good broad-leaved weeds control was also reported by Sharma *et al.* (2002) by tank mix applications of isoproturon with chlorsulfuron.

Weeds dry weight

Total weeds (grassy + broad-leaved) dry weight was significantly decreased due to weed control treatments. The least dry weight of 0.54, 0.01 kg/m^2 was recorded from sequential application of clodinafop and isoproturon compared to the weedy check (1.63, 2.33 kg/m^2) for both the seasons (Table 2). Minimum weed dry weight 0.51 kg/m^2 was statistically significant due to weed control at seedling stage in 2nd season. However, weedy dry wet was statistically on par with all stages of crop growth in the first season (Table 2). Total weed dry weight was not affected by the application of fertilizer during both the seasons, which might be due to poor control of broad-leaved weeds in the herbicide treated plots. Meanwhile, the interaction (herbicides x time of application) effect in weed dry wet was independent because of significant differences and only herbicide x stage of application was significant during the first season.

Effect on crop

Crop plant height was significantly more in the first year of study due to application of herbicides over weedy check, but the differences were non-significant during second year (Table 2). Similarly, application of herbicides at the seedling stage resulted in taller plants, but only dur-

Table 1. Weeds density as affected by herbicidal treatments at different wheat crop growth stages in the presence or absence of DAP fertilizer

Treatment	Grass weeds (no./m^2)		Broad-leaved weeds (no./m^2)	
	2009-10	2010-11	2009-10	2010-11
Herbicides (H)				
Clodinafop	3.5	3.0	9.2	8.4
Isoproturon	7.0	6.8	3.2	8.2
Clodinafsop *fb* isoproturon	2.2	2.9	2.5	8.5
Weedy check	11.2	12.8	9.7	8.9
LSD (P=005)	0.9	0.6	2.3	NS
Time of application (stage of growth) (S)				
Seedling	6.8	6.2	8.5	8.8
Tillering	7.3	5.8	8.3	8.4
Elongation	6.9	5.4	7.9	8.3
LSD (P=0.05)	NS	0.54	NS	NS
Fertilization by DAP (F)				
Unfertilized	8.1	6.4	7.5	9.5
Fertilized	5.9	5.3	4.8	7.5
LSD (P=0.05)	1.4	0.1	0.4	0.2
Interactions				
H X S	*	**	NS	NS
H X F	**	**	**	NS
S X F	*	NS	NS	**
H X S X F	NS	**	NS	NS

Table 2. Effect of herbicides, stage of spraying and DAP fertilization on crop and weeds

Treatment	Plant height (cm)		Total weed dry weight (t/ha)		Effective tillers (no./ m^2)	
	2009-10	2010-11	2009-10	2010-11	2009-10	2010-11
Herbicides						
Clodinafop	44.5	59.0	8	3	73	66
Isoproturon	44.9	62.8	6	1	81	76
Clodinafop *fb* isoprooturon	40.6	63.5	5	0	96	88
Weedy check	31.8	61.6	16	23	66	51
LSD (P=0.05)	7.93	NS	2	2	9	9
Crop growth stage at spraying						
Seedling (S1)	48.5	57.1	8	5	1.1	80
Tillering (S2)	37.3	63.5	8	6	68	73
Elongation (S3)	35.5	58.6	10	10	68	51
LSD (P=0.05)	6.6	NS	1	1	9	6
Fertilization						
Unfertilized	42.9	62.2	7	6	75	58
Fertilized	38.0	61.1	7	7	83	77
LSD (P=0.05)	NS	NS	NS	NS	5	5

fb = followed by, NS=Not Significant; * =Significant (P<0.05); ** = Highly significant (P<0.01).

ing the first season. Effect of DAP fertilization was non-significant on plant height in both the seasons (Table 2). Two or three way interactions were non-significant except herbicide x stage during the first season.

Effective tillers are the main yield attributing characters which were significantly influenced by the weed control treatments. Maximum tillers density of 96 and 88 was recorded in the sequential application of clodinafop followed by isoproturon compared to 66 and 51 in the check (Table 2). Among herbicides, lowest tillers were recorded with alone application of clodinafop which may be due to no control of broad-leaved weeds. Time of herbicidal application significantly effected the effective tillers in both the years of study, highest being at seedling stage. DAP fertilizer increased tillers significantly compared to no fertilizer application. All the interactions were significant except fertilizer and stage of application.

The biological yield was highly significant due to herbicided treatments and time of application in the two seasons of the study (Table 3). Maximum bio-yield 1.84, 3.3 t/ha were recorded due to sequential application compared to the check treatments 1.5 and 0.9 t/ha during 2010 and 2011, respectively. Herbicide application at seedling stage produced 1.8 and 3.2 t/ha biological yield compared to spraying at elongation stage (1.5 and 0.9 t/ha during 2010 and 2011, respectively). The DAP fertilization was not effective in the biological yield during both the years of study. All the treatments of clodinafop, isoproturon and their sequential application and the check were statistically at par with each other in respect of grain yield during the second year which was observed during first year. The same response regarding to the effect of the time of herbicides application in the presence or absent of DAP and the trial factors interaction was recorded in both the seasons. Whereas, straw yield under herbicidal treatments and time of application was significantly more than the check treatment when applied at 2-3 leaves stage of crop stage. The higher straw yield in sequential herbicidal application might be due to better weed control which ultimately increased the yield attributes without no effect of DAP application on the straw yield in 1st and 2nd year of the study.

Harvest index was significantly affected due to varying herbicides treatment and time of application in 2nd season. Harvest index was higest by sequential application of clodinafop and isoproturon at the S1 stage of crop growth without effect of DAP application in both the seasons. Sequential application of clodinafop 280 g in 500 l water/ha and isoproturon 1.2 l in 500 l water/ha was compatible and there was no adverse effect on efficacy of both the herbicides against complex weed flora and grain yields of wheat, however, these herbicides alone or sequential will not be effective where resistance weeds are prevalent.

Table 3. Effect of herbicides, stage of spraying and DAP fertilization on wheat yield

Treatment	Biological yield (t/ha)		Grain yield (t/ha)		Straw yield (t/ha)		Harvest index (%)	
	2009-10	2010-11	2009-10	2010-11	2009-10	2010-11	2009-10	2010-11
Herbicides								
Clodinafop	1.6	2.8	0.50	0.62	1.1	2.1	29	22
Isoproturon	1.9	2.9	0.41	0.66	1.5	2.2	21	23
Clodinafop *fb* isoproturon	1.8	3.3	0.42	0.74	1.4	2.9	23	22
Weedy check	1.5	1.9	0.43	0.21	1.1	0.6	27	11
LSD (P=0.05)	0.1	0.4	NS	0.20	NS	0.6	0.0	0.1
Crop growth stage at spraying								
Seedling	1.8	3.2	0.45	0.74	1.4	2.5	24	23
Tillering	1.8	2.9	0.43	0.58	1.4	2.4	23	19
Elongation	1.5	0.9	0.39	0.30	1.1	0.6	25	32
LSD (P=0.05)	0.0	0.3	NS	NS	0.0	0.8	NS	8
Fertilization								
Unfertilized	1.7	2.4	0.43	0.83	1.3	1.6	25	33
Fertilized	1.7	2.7	2.76	0.84	1.3	1.9	26	30
LSD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS

REFERENCES

Anonymous. 2009. Workshop on weed risk assessment, 22-25 March, 2009, El-Baida, Libya.

Balyan RS, Samunder Singh, Malik RK and Dhankar RS. 2000. Rate and time of application of chlorsulfuron for broad-leaved weed control in wheat. *Indian Journal of Weed Science* **32**: 173-176.

Bhat MA, Mahal SS, Kumar Krishnan and Mahey RK. 2006. Effect of nitrogen levels, irrigation regimes and weed control methods on competitiveness of bed planted *durum* wheat (*Triticum durum* Desf.) with *Phalaris minor* Retz. *Indian Journal of Weed Science* **38**: 233-236.

Sharma R, Pahuja SS, Balyan RS and Malik RK. 2002. Effect of sulfonylurea herbicides applied alone and tank mix with metribuzin on weeds and their residual effect on succeeding crop of sorghum. *Indian Journal of Weed Science* **34**: 178-183.

Singh Kuldeep, Malik RS, Kumar Satish and Panwar RS. 1997. Effect of sowing dates and herbicides in controlling weeds in *durum* wheat. *Indian Journal of Weed Science* **29**: 205-206.

Singh Samar, Malik RK, Bishnoi LK and Singh Samunder. 1993. Effect of tank mixture of isoproturon and tralkoxydim on the control of *Phalaris minor* in wheat. *Indian Journal of Weed Science* **25**: 11-13.

Singh Samunder, Malik RK, Balyan RS and Singh Samar. 1995b. Distribution of weed flora of wheat in Haryana. *Indian Journal of Weed Science* **27**: 114-121.

Singh Samunder, Malik RK, Panwar RS and Balyan RS. 1995a. Influence of sowing time on the winter wild oat (*Avena ludoviciana*) control in wheat (*Triticum aestivum*) with isoproturon. *Weed Science* **43**: 370-374.

Singh Samunder, Punia SS, Yadav Ashok and Hooda VS. 2011. Evaluation of carfentrazone-ethyl + metsulfuron-methyl against broad-leaved weeds of wheat. *Indian Journal of Weed Science* **43**: 12-22.

Singh Tejinder and Yadav SK. 1998. Effect of irrigation and herbicides on weed control and yield of *durum* wheat. *Indian Journal of Weed Science* **30**: 136-140.

Tayyeb FH. 2003. Effect of planting methods on growth and yield of wheat crop in El-Gabal Akhdaar, Libya. *Journal of Advanced Research Alex* **8**(4): 829-843.

Tayyeb FH. 2012. Compatibility sequential application of brominal with Illoxan to control a complex weed flora in *durum* wheat. *Journal of Agricultural Research Alex.* (in press).

Walia US and Brar LS. 2001. Competitive ability of wild oat and broad leaf weeds in relation to crop density and nitrogen levels. *Indian Journal of Weed Science* **33**: 120-123.

Yadav DB, Kumar Ashok, Singh Samunder and Lal Roshan. 2009. Compatibility of fenoxaprop-P-ethyl with carfentrazone ethyl and metsulfuron-methyl and 2,4-D for controlling complex weeds of wheat. *Indian Journal of Weed Science* **41**: 157-160.