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EFFECT OF SOIL APPLIED HERBICIDES ON JIMSONWEED *(Datura stramonium)* AND MAIZE *(Zea mays)* DEPENDS ON SOWING DEPTH

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ABSTRACT

Greenhouse trials were conducted during 2005 to investigate the effect of soil applied herbicides on jimsonweed (Datura stramonium) sown at 4 and 7 cm and potential maize crop injury by the same herbicides. Efficacy of all investigated herbicides was excellent, regardless of the depth, and generally coefficient of efficacy ranged between 95.8 to 100.0% to all herbicides. Many of the herbicides had no significant phytotoxic effect on maize plant density, height and fresh weight, except Atranex -90WDG and Cyatral-SCZ which caused serious maize injury (33% and 37%, respectively) at 7 cm depth. This injury significantly reduced height and fresh weight of maize at the same depth.

Key words: *Datura stramonium, Zea mays*, herbicides

INTRODUCTION

Datura stramonium (jimsonweed) is erect (30 to 150 cm tall) summer growing annual of the family Solanaceae. Its status as a weed in many summer crops, particularly maize, cotton, peanuts and soybean is generally attributed to its ability to compete with crops for moisture, nutrients and light. Beside this, all its plant parts, including seeds, contain a large number of alkaloids, principally scopolamine and hyosciamine with atropine and meteloidine present in smaller amounts, which is detrimental to animals (Aplin, 1976 cited by Lovett *et al.*, 1981). Therefore, a whole consignment of corn will be rejected if only one seed of this species is found per 10 kg of corn (Ciba-Geigy, 1975 cited by Malan *et al.*, 1982). Also *D.stramonium* seeds may remain viable in the soil for several years (Kozlowski, 1972, Kostov, 1994). Because of these characteristics *D.stramonium* is one of the most serious and troublesome weed in cultivated field crops in Macedonia.

Competition from this weed has been studied in cotton (Felton, 1974), soybean (Hagood *et al.*, 1981, Kirkpatrick *et al.*, 1983, Weaver, 1986; Henry and Bauman, 1991) and tomato (Monaco *et al.*, 1981). In these crops higher densities of *D. stramonium* have been major cause for significant reduction in one or more vegetative or reproductive growth parameters evaluated.

However, competition from *D. stramonium* has rarely been studied in maize crop (Williams *et al.*, 1995; Cavero *et al.*, 1999). Its importance is particularly greater in semiarid maize crop production regions in the world. In these areas, high solar radiation

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high temperatures and frequent irrigation are favourable condition for the growth of this weed (Patterson and Flint, 1983). However, these are favourable condition for maize growth, as well. Basically, maize yield losses increased as the time between crop and weed emergence decreased (Cavero *et al.*, 1999). Berti and Santin (1994) found an economical threshold level for chemical control of 5.5 plants m^{-2} when *D. stramonium* competed with a spring sown maize crop. Whereas Cavero et al. (1999) stated maize yield and its biomass production decreased by 14–63% and 11-35%, respectively, when 8.33 plants of *D. stramonium* competed with the crop.

Taking into consideration all these facts, control of *D. stramonium* is very important segment of profitable maize production system in Macedonia. For its control there are many postemergence herbicides, but the aim of this work was to find out whether soil applied herbicides can be effective in controlling *D. stramonium* when its emergence from different depths.

MATERIALS AND METHODS

Trials were conducted during 2005 under greenhouse conditions at Agriculture Institute, Skopje. The trial was laid out in randomized complete block design with four replications. 10 seeds of the maize variety 'ZP-677' and 20 seeds of *D. stramonium* were planted in each 17 x 25 x 11 cm plant growing container in 2 different depths (4 and 7 cm). Each container contained alluvial soil with 2.0 % organic matter and pH 6.7, which was taken from fields, usually intended for maize production. The following treatments were included in the study (Table-1).

Table-1. Detail of treatments used in studies at Macedonia.

Treatment	Depth	Active Ingredient (%)	Common Names	Rate kg/L ha^{-1}
Weedy check	4 cm	--------------------	-------------------------	------------
	7cm			
Atranex-90WDG	4 cm	90	atrazine	1.4
	7cm			
Inacor-T	4 cm	34 + 16	atrazine + prometryn	3.0
	7cm		linuron	
Liron S-50	4 cm	50 %		3.0
	7cm		atrazine + flufenacet	
Aspect 500-SC	4 cm	30 + 20		3.0
	7cm		flurochloridone	
Racer 25-EC	4 cm	25		1.5
	7cm		cyanazine + atrazine + alachlor	
Cyatral-SCZ	4 cm	13.5 + 13.5 + 36		7.0
	7cm			

The herbicidal treatments were applied immediately after sowing with a CO_2-pressurized backpack sprayer with 550 l ha^{-1} water. Irrigation as in field condition and removal of non target plants were activities during all study period. Plant density, height and fresh weight of the maize and at the same time, herbicide efficacy was estimated 21 DAT by the maize crop and weed plants counting. Coefficient of herbicide efficacy was calculated by equation:

$$C_E = \frac{Wc - W_T}{Wc} \times 100$$

where

C_E coefficient of efficacy

W_C- number of weeds in the check plots

W_T- number of weeds in the treated plots

Maize plant height and fresh weight, as well as percent maize plant injury were rated 21 DAT The scale used for percent injury ranged from 0 (no visible injury) to 100 (complete death) The injury was visually rated by determining the average percentage of deformation plant stunting, chlorosis, or necrosis (or all) occurring in treated maize plants when compared with nontreated plants The data were finally subjected to statistical analysis applying LSD-test.

RESULTS AND DISCUSSION

Visible Maize Injury

Injury to maize plants at both depths (4 and 7cm) occurred with several herbicides, mainly those which contained atrazine as active ingredient. Injury was expressed as leaf chlorosis, deformation and plant stunting. Injury to maize plants caused by Inacor-T, Liron S-50, Aspect 500-SC, Cyatral-SCZ and Atranex-90WDG (depth 4 cm), and Inacor-T and Racer 25-EC (depth 7 cm), respectively, was often reflected as minor plant stunting, but later recovered (Sumich, 1963). Most serious plant injury, particularly expressed as deformation and plant stunting followed by chlorotic and necrotic tissue on the leaf edges, were recorded at second depth (7 cm) to variants treated with Atranex-90WDG (33%) and Cyatral-SCZ (37%). High percent of injury to maize plants in variants treated with Atranex-90WDG and Cyatral-SCZ, probably was due to low content of organic matter in the soil, (Johnson *et al.*, 2003) and regular irrigation (Janjic, 1985), that caused herbicides leaching and accumulation deeper in the soil. Injury caused by Atranex-90WDG and Cyatral-SCZ was directly reflected on significant height and fresh weight reduction

Maize density

Statistical analysis of the data (Table-2) revealed that maize density, regardless of the depth, was not significantly affected by soil applied herbicides. Generally, the number of maize plants per growing container ranged between 9.0 (Liron S-50 at 4 cm, and Atranex-90WDG at 7 cm) and 10 (Inacor-T and Cyatral-SCZ at 4 cm, and Liron S-50 ans Aspect 500-SC at 7 cm). These results are in conformity with the findings of Sumich (1963; 1966). He reported that linuron did not cause reduction in crop vigour and crop

Table-2. Effect of pre-emergence herbicide treatments on maize density and visible maize plant injury.

	Maize plants per container					
	4 cm			7 cm		
Treatments	**Total**	**Healthy**	**injury**	**total**	**healthy**	**injury**
		---------%---------			---------%-------	
Weedy check	9.5	100	0	9.5	100	0
Atranex-90WDG	9.5	95	5	9.0	67**	33**
Inacor-T	10	95	5	9.5	95	5
Liron S-50	9.0	95	5	10	100	0
Aspect 500-SC	9.5	95	5	10	100	0
Racer 25-EC	9.5	100	0	9.5	95	5
Cyatral-SCZ	10	95	5	9.5	63**	37**
$LSD_{0.05}$	**NS**	**NS**	**NS**	**NS**	4.80	5.32
$LSD_{0.01}$					6.58	7.29

(*) Significant level $p<0.05$ (**) Significant level $p<0.01$ NS (non significant)

Height of maize plants (cm)

At the first depth (4 cm) the height of the maize plants was found statistically non significant (Table-3).However, the highest maize plants were recorded in growing containers treated with Racer 25-EC (43,4 cm), followed by Aspect 500-SC (42,6 cm) and Cyatral-SCZ (42,5 cm), while the lowest maize plants were recorded in the Atranex-90WDG treated containers (40.2 cm).The height of the maize plants was significantly reduced by Atranex-90WDG and Cyatral-SCZ, only at second depth (7 cm). At the second depth (7 cm) the highest maize plants (43,2 cm) were detected in growing containers treated with Aspect 500-SC. The lowest maize height plants (32,3 cm and 34.7 cm, respectively) were detected in the containers treated with Cyatral-SCZ and Atranex-90WDG, respectively.

Fresh weight of the maize plants (g)

Fresh weight was proportionally dependent on previous parameters: density and height of maize plants. No significant reduction in the fresh weight was caused by the herbicides treatment at the first depth (4 cm). Maximum fresh weight (46.5 g) was measured in Racer 25-EC treated containers, while the next closest treatment was Aspect 500-SC treated growing containers (45.2 g) [Table-3]. Minimum fresh weight (38.0 g) was measured in Atranex-90WDG treated containers. Significant reduction in the fresh weight was observed at the second depth (7 cm) in Cyatral-SCZ and Atranex-90WDG treated containers (24.5 g and 29.4 g, respectively).

Table-3. Effect of pre-emergence herbicide treatments on maize plant height and fresh weight.

Treatments	Height of the maize plants (cm)		Fresh weight of the maize plants (g)	
	4 cm	**7 cm**	**4 cm**	**7 cm**
Weedy check	41.3	39.8	40.6	36.8
Atranex-90WDG	40.2	34.7**	38.0	29.4**
Inacor-T	40.8	40.3	41.5	39.1
Liron S-50	41.4	41.3	39.8	40.1
Aspect 500-SC	42.6	43.2	46.5	41.2
Racer 25-EC	43.4	40.0	43.5	40.7
Cyatral-SCZ	42.5	32.3**	41.6	24.5**
$LSD_{0.05}$	**NS**	3.54	**NS**	5.45
$LSD_{0.01}$		4.85		7.46

(*) Significant level $p<0.05$ (**) Significant level $p<0.01$ NS (non significant)

Herbicide efficacy

The absolute criterion for herbicide efficacy was taken as the percentage weeds that are controlled by any particular treatment. The data regarding herbicide efficacy presented in Table-4, it is observed that all investigated herbicides had significant (P <0.01) effect on *D.stramonium* control, regardless of the depth. Generally, coefficient of efficacy ranged between 95.8 and 100.0 among all herbicides. Similar results were reported by Sumich. (1963; 1966), McPhail, (1968) and Woon (1970). From the present findings it is clear that *D.stramonium* is very susceptible to all the investigated herbicides and could easily be controlled. Although, *D.stramonium* can be controlled effectively by a large number of soil applied herbicides, the actual reason why it is considered problem weed in maize probably lie in the fact that its seed may remain viable for many years in the soil (Kozlowski, 1972; Kostov, 1994) and could germinate at any suitable time during maize vegetation evading standard control measures (Malan *et al.*, 1982).

Table-4. Herbicide efficacy in *D. stramonium* control.

Treatments	Density per container		Coefficient of efficacy	
	4 cm	7 cm	4 cm	7 cm
Weedy check	12.5	12.0	---------	----------
Atranex-90WDG	0.0**	0.0**	100	100
Inacor-T	0.0**	0.0**	100	100
Liron S-50	0.5**	0.0**	96.0	100
Aspect 500-SC	0.5**	0.0**	96.0	100
Racer 25-EC	0.0**	0.0**	100	100
Cyatral-SCZ	0.0**	0.5**	100	95.8
$LSD_{0.05}$	0.51	0.53		
$LSD_{0.01}$	0.70	0.73		

(*) Significant level $p<0.05$ (**) Significant level $p<0.01$ NS (non significant)

REFERENCES CITED

Berti G.A. and M. Santin. 1994. Estimation of Economic thresholds for weed control in maize in Northern Italy. Proc. 5th EWRS Mediterranean Symposium, pp 51-58.

Cavero, J., C Zaragoza, M.L.Suso, and A. Pardo.1999. Competition between maize and *Datura stramonium* in an irrigated field under semi-arid conditions. Weed Res. 39:225-240.

Felton, W.L. 1974. Control of *Datura stramonium* L. with oxidiazon under simulated spray and furrow irrigation. Weed Res. 14:209-213.

Hagood, E.S., T.T.Bauman, J.L.Williams and M.M.Schrieber. 1981. Growth nalysis of soybeans (*Glycine max*) in competition with Jimsonweed (*Datura stramonium* L.). Weed Sci.29:500-505.

Henry, W.T. and T.T.Bauman. 1991. Interference between soybean (*Glycine max*) and Jimsonweed (*Datura stramonium* L.) in Indiana. Weed Tech. 5:759-764.

Janjic, V. 1985. Herbicides, Scientific Book, Belgrade.

Jonhson, B., G.Nice and T.Bauman. 2003.Herbicide related corn injury. Perdue University Extension Weed Science

Kirkpatrick B.L., L.M.Wax, and E.W.Stoller. 1983. Competition of Jimsonweed in soybean. Agron. J. 75:833-836.

Kostov, T. 1994) Principles of Field Crop Production (Practicum), Skopje

Kozlowski, T.T. 1972. Seed Biology, Vol. 2, Academic Press, New York.

Lovett, L.V., A Levitt, M.Duffield and N.G. Smith. 1981. Allelopatic potential of *Datura stramonium* L. (Thorn-apple). Weed Res. 21:165-171.

Malan, C., J.H.Visser, and N. Grobbelaar. 1982. Control of problem weeds of maize on the Transvaal Highveld (South Africa). II. *Datura stramonium* L. Weed Res. 22:101-105.

McPhail, D D 1968 The use of atrazine for weed control in maize and sweet corn. Proc. 21th NZ Weed Control Conference.

Monaco T J , A.S.Garyson, and D.C.Sanders. 1981. Influence of four weed species on the growth. yield, and quantity of direct-seeded tomatoes (*Lycopersicon esculentum*). Weed Sci. 29:394-397.

Patterson. D T , and E.P.Flint. 1983. Comparative water relations, photosyntesis, and growth of soybean (*Glycine max*) and seven associated weeds. Weed Sci. 31:522-527.

Sumich. F.N 1963. Linuron. Proc. 16th NZ Weed Control Conference.

Sumich, F.N. 1966. New developments with linuron. Proc.19th NZ Weed Control Conference.

Weaver, S E 1986 Factors affecting threshold levels and seed production of Jimsonweed (*Datura stramonium* L.) in soybeans (*Glycine max* (L.) Merr.). Weed Res 26 215-225.

Williams, M., N. Jordan and C.Yarkes .1995. The fitness cost of triazine resistance in jimsonweed (*Datura stramonium* L.). American Midland Naturalist 133:131-137.

Woon. G W 1970. A New herbicide for weed control in maize. Proc.23th NZ Weed and Pest Control Conference.