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EFFECT OF SOME HERBICIDES ON WEEDS AND DOWNY MILDEW DISEASE OF MAIZE

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ABSTRACT

Two field trials and one laboratory experiment were carried out during 1996 and 1997 maize growing seasons at El-Gemmeiza Research station, Gharbia governorate. The objective was to investigate the performance of some selective herbicides i.e. Gesaprim 80%, Lasso/atrazine, Starine and Basagran 50% compared with hand hoeing 3 times and Unweeded check, as well as, their effect on maize downy mildew infection caused by *Peronosclerospora sorghi* (Weston and Uppal) C.G. shaw. Laboratory results showed that, Starine was the most inhibiting of used herbicides to both root and shoot systems of maize seedlings until at the lower concentrations. Basagran had phytotoxic effect to both root and shoot at recommended dose. Lasso/atrazine and Gesaprim had no remarkable phytotoxic effects on the shoot system, while its effects on root system were moderate in their phytotoxicity at the lower concentrations. Field data revealed that, the percentages of downy mildew infection were varied with the different treatments under this study. All selected herbicides and hand hoeing showed clear effect on downy mildew incidence when compared with unweeded check. Hand hoeing was the best of all treatments in reducing downy mildew infection percentage followed by Lasso/atrazine, Gesaprim, Basagran and starine, Respectively, Results also indicated that, the post emergence herbicide Starine at 200cm3/Fed and hand hoeing gave the highest percent reduction in fresh weight of broad leafed weed species that surveyed in 1996 season. In contrast, pre-emergence herbicides lasso/atrazine and Gesaprim were effective on broad-leafed and grassy weeds in 1997 season.

INTRODUCTION

Weeds are the most economically of all pests with respect to sales of pesticide and limitations to crop yields (Hoagland, 1990). Yield losses due to the presence of weeds in corn fields estimated by 40 to 80% (Kharawara *et al.,* 1984 and Aliev and Ladanin 1990).

Herbicide sales represent more than two thirds of the $436x10^6$ Kg of pesticides used annually in United States (Pimentel *et al.,* 1991) and almost one half of the 21 billion worldwide pesticde market (Belcher, 1989). Numerous cases where an herbicide treatment influences disease outcome have been studied by plant pathologists as well as weed scientists. The concepts and the literatur on interactions between herbicides, micro-organisms and plant diseases have been extensively reviewed (Altman *et al.,* 1990, Altman and Rovira 1989, Edwards 1989, Griffiths 1981, Heitefuss 1988, Katan and Eshel 1973, Smith 1982 and Willis 1990).

Most of the literatures on herbicides deals with their direct effects on weeds and the effects of weed control on crops. The protection or predisposition of crops to disease that is sometimes observed following the uses of herbicides is of particular interest to plant pathologists.

Obviously, not herbicides shift the host-pathogen interaction toward increased disease. Bruck *et al.,* (1988) found that bentazon, which they applied at low concentrations to improve the efficacy of the rust fungus *Puccinina canaliculata* for biological control of yellow nustedge, actually reduced disease by 50%. Dinitroaniline herbicides applied in soil or on leaves caused a 40-98% reduction in infection of tomato seedlings by the vascular wilt pathogen *Fusarium oxysporum* f.sp. lycopersici compared to control plants (Grinstein *et al.,*1984)

Herbicides might be able to stimulate a disease-resistance response through a mechanism similar to what has been described for the phosphates that induce resistance in plants against pathogens (Descalzo *et al.,* 1990; Gottstein and Kuc 1989).

Hence, there are many reasons for keeping our fields free from weeds, not only because they filch from them the nutrients and minerals required for economic plants, but also because they can harbour pests, plant pathogens and viruses which attack herbiceous plant. For this purpose some herbicide treatments and hand hoeing were tested in the present study for controlling maize weeds as well as their fungitoxic effects on sorghum downy mildew disease (SDM) on maize caused by *Peronosclerospora sorghi* (Weston and Uppal) C.G. Shaw.

MATERIALS AND METHODS

Laboratory experiment and two field trials were conducted at El-Gemmeiza Research Station, Gharbia Governorate during 1996 and 1997 seasons to investigate the effect of selected herbicides and hand hoeing on each of weed species as well as their fungitoxicity on sorghum downy mildew (SDM) disease of maize plants.

Seeds of the highly susceptible maize cultivar, three way cross 310 were used in all trials under this study. Four herbicides i.e. Gesaprim 80%, Lasso/atrazine, Basagran 50% and Starine were tested in both laboratory and under field conditions.

Laboratory test:

Test the phytotoxicity of the selected herbicides on root and shoot system of maize seedlings was carried out according to the methods of El-Nawawy *et al.,* (1972). Germinated maize seeds with their rootlets were immersed slightly in test tubes (one/tube) containing a mixture of plane agar and a selected herbicide with different concentrations. The herbicides were used as recommended, half and double of recommended dose in three replicates. Three tubes with only plane agar were used as a control check. The length of maiza seedling roots and shoots were measured after 7 days. Phytotoxicity effect of the tested herbicides was determined as a percentage of length (I%) of the roots or shoots according to the formula suggested by Topps and Wain (1957).

$$I\% = \frac{A-B}{A} \times 100$$

Where: A= The length of untreated roots or shoots
B= The length of treated roots or shoots.

Field experiments:

Two field trials were conducted at El-Gemmeiza Research Station during the two successive seasons 1996 and 1997 to investigate the effectiveness of some herbicide treatments on maize weeds as well as their fungitoxicity on sorghum downy mildew (SDM) disease on maize.

The trial comprised the following six treatments:

1- Gesaprim 80%, 750 mg/Fed. (Atrazine) applied after planting and before irrigation.
2- Lasso/atrazine 2.5 L/Fed, (Alachlor/Atrazine) ready mixture applied after planting and before irrigation.
3- Basagran 50%, 1.5 L/Fed (Bentazon) applied 21 days after sowing.
4- Starine, 200 Cm3/Fed (Fluroxypyer) applied 21 days after sowing.
5- Hand hoeing 3 times 20,40,60 days after sowing.
6- Unweeded check

Herbicidal treatments were sprayed with knapsack sprayer C.P. 3 with a volume
rate of 200 L/Fed. The experiment was laid out in complete randomize design with four replications. Each of experimental plots measured 21m^2 = 1/200/fed. The corn seeds cv. TWC 310 were sown at the rate of 12 Kg/Fed. The agricultural practices were carried out according to the local recommendation.

The field layout was prepared as follows:

The highly susceptible sudan grass *(Sorghum sudanens);* piper variety, was sown in every third row throughout the field at least three weeks prior to the expected date of planting of tested treatments. Three rows of the surrounding border were also planted with the same Sudan grass variety. Sudan grass rows act as infected plants to help spreading the asexual spores (conidia) to the tested materials and to serve as indicator for the uniform distribution of the disease inoculum throughout the field. After establishing of the infected rows and after the appearance of abundant sporulation of the pathogen by producing downy growth on the leaf surfaces (3-4 weeks), the tested rows were planted. After emergence, seedlings were challenged by conidia needed for infection blown by wind from the infected rows. Sudan grass was cut monthly about 20-25 cm above soil level. This is to increase spore production needed for infection around the tested treatments during the growing season, the following data were recorded:

1- Survey of different weed species and their distribution in the experimental area was conducted.

2- The fresh weight of each weed species was recorded per square meter 60 days after sowing.
3- Disease readings were made two times, one month after planting and one month later. Number of infected plants for each treatment was recorded and the percentage of infection was calculated.
4- Data collected were subjected to statistical analysis according to "F" test and the mean values were compared using least significant difference (LSD) method at the 0.05 level of significance as described by Steel and Torrie (1980).

RESULTS AND DISCUSSION

The tested herbicides were differed in their effects on both root and shoot systems of maize *(Zea mays L.)* seedlings. Results effects depended on both the type of herbicide and its concentration (table 1). Data showed that Starine was the most inhibiting of use herbicides to both root and shoot systems until at the lower concentration (remarkable injury was observed). Basagran had phytotoxic effect to both root and shoot at recommended dose. Lasso/atrazine and Gesaprim had no remarkable phytotoxic effects on the shoot system while its effects on root system were moderate in their phytotoxicity at the lower conentrations. On the other hand, all of Lasso/atrazine, Bazagran and Starine caused damage amounting ranged from 27.17 to 57.43% at higher concentrations on shoot system while Gesaprim was the least one in this respect. The root system was very sensitive to all the tested herbicides at higher concentrations. These results are in conformity with those of Khalifa *et al.,* (1981) and Ismail *et al.,* (1996, 1997). The sensitivity of root system might be due to its physiological properties and/or the direct contact between the root system and the compound. It can be concluded that, the usage of such compounds especially at the higher concentration must be carried out with great care attention particularly, if it will be applied on soil.

Table (1): Phytotoxicity of the tested herbicides on the growth of maize seedlings (TWC 310), in vitro.

Herbicides	Concentrations	Phytotoxicity percent %	
		Shoot	Root
Lasso/atrazine	Half of R.D	2.61	8.76
	R.D	7.69	28.06
	Double of R.D	46.15	64.91
Gesaprim	Half of R.D	6.66	15.78
	R.D	7.69	42.10
	Double of R.D	10.25	42.10
Basagran 50%	Half of R.D	5.21	15.78
	R.D	9.23	46.31
	Double of R.D	27.17	66.13
Starine	Half of R.D	15.38	24.56
	R.D	30.76	47.36
	Double of R.D	57.43	68.42
L.S.D 0.05		8.66	9.22

R= Recommended **D= Dose**

Results in table (2) demonstrate the effect of the selected herbicides and hand hoeing on the downy mildew of maize plants (TWC 310), during 1996 and 1997 growing seasons. The obtained data indicated that the percentages of downy mildew infection were varied with the different treatments. All selected herbicides and hand hoeing showed clear effect on downy mildew incidence when compared with unweeded check. Hand hoeing was the best of all treatments. The reduction percentage on downy mildew infection, exhibited from hand hoeing treatment was 44.06% followed by 42.91, 28.52, 22.27 and 6.33% which obtained from Lasso/atrazine, Gesaprim, Basagran and Starine, respectively.

On the other hand, results clearly showed differences in the average percentage of downy mildew infection due to the effect of the tested herbicides used in this study. All herbicides increased the percentage of downy mildew infection when compared with hand hoeing treatment.

It is generally accepted that herbicide induced weakening of the plant (table 1) can predispose the plant to infection by facultative type pathogens. Current knowledge on mechanisms of disease resistance in plants can be integrated with information on the mode of action of herbicides to better understand the mechanisms of predisposition (Greaves and Sargent, 1986). The obtained data are in conformity with this reported by Szerszen *et al.,* (1998). They found that, the herbicides antidote concept II significantly increased the incidence of sorghum downy mildew in susceptible grain sorghum hybrids inoculated with oospores of *Peronosclerospora Sorghi* pathotype 1 and 3.

However, it is difficult to predict the circumstances under which disease incidence will increase or will be reduced after an herbicide application. It is likely that the result of herbicide disease interactions will specific to certain geographical areas or crop production systems and will depend on fungal populations and herbicides residues (Levesque and Rahe 1992).

Table (2): Effect of some herbicides and hand hoeing on maize downy mildew infection in 1996 and 1997 seasons.

Treatments	Downy mildew infection %			
	1996	1997	Combined data	Reduction %
Losso /atrazine 2.5L/Fed	41.69	34.67	33.81	42.91
Gesaprim 750/Fed.	43.24	41.40	42.32	28.52
Basagran 50% 1.5L/Fed.	48.38	43.67	46.03	22.27
Starine 200 cm3/Fed	52.90	57.94	55.47	6.33
Hand hoeing 3 times	33.28	32.97	33.13	44.06
Unweeded check	53.60	64.83	59.22	-
L.S.D. 0.05	N.S.	8.97	11.34	-

The predominant weed species in the experimental area were *Amaranthus lividus* L. Pig weed and *Xanthium Spinosum* L. Cocklebur as broad leafed weeds and *Dinebra retroflexa* (Frossk) Panz as grassy weed in 1996 growth season. Whereas, *Portiulaca oleracea* L. Common pursulan and *Euphorbia geniculata* Ortega as broad leafed weeds and *Brachiaria evuciformis* (Sinth & Sm.) Griseb. Signal Grass as grass weed were the most wide spread in 1997 Season.

Data in Table (3) Showed that the two herbicides (i.e. Lasso/atrazine and Gesaprim at the rates used) applied pre-emergence were less effective in reducing the fresh weight of weed species that surveyed in 1996 Season. Their respective percentage reductions were 66 and 54 for broad leafed weeds and 79 and 57 for grassy weed. Hand hoeing three times 20,40 and 60 days after sowing (ADS) gave the highest percent reduction 96 followed by 91% for broad leafed weeds. The two herbicides applied post emergence and hand hoeing treatments gave the lowest percent reduction of grassy weed.

In 1997 season, the weed species that surveyed throughout growth season seemed to be susceptible, therefore the effectiveness of the two herbicides applied pre-emergence were excellent. Their respective percentage reduction 96% and 95% for broad leafed weeds and 98 and 88 for grassy weed respectively. The rest three treatments were failed to reduce the fresh weight of weed species 90 days after sowing.

In conclusion, the experimental results indicated that Lasso/atrazine at 2.5 L/Fed gave good to excellent weed control during the two successive seasons. Starine at 200cm3/Fed only effect on broad leafed weeds.

The obtained findings were in harmony with those reported by Abo-El-Kheer *et al.,* (1998), Aliev and Ladanin (1990), Torok (1987) and Hinizsche (1984) they found that repeated use of specific herbicides favoured spread resistante species (i.e. *Xanthim spinosum* and *Amaranthy* Spp.). Further, Sinzar and Stefanvic (1983) and Martinez *et al.,* (1982) reported that no adverse effects on crop growth and yield with atrazine/alachlor mixtures and 3 virus disease was lower on the plots with equidistant spacing.

Table 3

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تأثير بعض مبيدات الحشائش على حشائش ومرض البياض الزغبى فى الذرة الشامية

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أجريت تجربتين حقليتين وتجربة معمليه خلال موسمى 1996 و 1997 بمحطة بحوث الجميزه بمحافظة الغربيه بهدف اختبار فاعلية بعض مبيدات الحشائش وهى جيسابريم 80% ولاسواترازين و بازجران 50% مقارنة بنقاوة الحشائش ثلاث مرات يدويا وكذلك الكنترول.

هذا بالاضافه الى تأثير هذه المبيدات على مرض البياض الزغبى فى الذره الشاميه المتسبب عن الفطر بيرونوسكليرسبورا سورجاى.

أظهرت نتائج التجارب المعمليه أن مبيد ستارين كان الأكثر تثبيطا لكل من المجموع الجذرى والخضرى لبادرات الذره الشاميه حتى التركيزات المنخفضه منه. بينما كان لمبيد البازجران تأثير سمى على كل من المجموع الجذرى والمجموع الخضرى عند استخدامه بالتركيزات الموصى بها فقط. ولم يكن هناك تأثير واضح لكل من اللاسواترازين و الجيساربريم على المجموع الخضرى وكان تأثيرها متوسطا فى سميتها عند استخدامها بالتركيزات المنخفضه.

أكدت النتائج الحقلية على اختلاف نسبة الاصابة بمرض البياض الزغبى باختلاف المعاملات تحت هذه الدراسة.وكان لجميع مبيدات الحشائش المستخدمه وكذلك معاملة نقاوه الحشائش يدويا تأثير واضح فى خفض الاصابه بمرض البياض الزغبى على الذره الشاميه مقارنة بالكنترول.

بينما كانت عملية نقاوة الحشائش يدويا هى أفضل المعاملات فى خفض نسبة الاصابه بالمرض يليها على الترتيب لاسواترازين و جيسابريم و بازجران و ستارين.

وأكدت النتائج أيضا على أن المعامله بمبيد ستارين بتركيز 200سم3/فدان بعد الزراعه وظهور نباتات الذره وكذلك عملية نقاوة الحشائش يدويا أدت الى نقص واضح فى الوزن الغض للحشائش عريضة الأوراق فقط وذلك خلال موسم 1996. بينما كانت مبيدات الحشائش لاسواترازين و جيسابريم والتى استخدمت قبل رية الزراعه أكثر فاعليه على كل من الحشائش عريضة الأوراق والحشائش النجيليه خلال موسم 1997.

Table (3): Influence of selected herbicides and hand hoeing treatments on fresh weight of weed species in 1996 and 1997 seasons.

Treatments	Fresh weight of weed species g/m2											
	1996 season						1997 season					
	Broad leafed weeds				Grassy weed		Broad leafed weeds				Grassy weed	
	A. lividus	X. spinosum	Total	Reduct. %	*D. retroflexa*	Reduct %	P. oleracea	*E. geneculata*	Total	Reduct. %	*B. eruciformis*	Reduct. %
Lasso/atrazine 2.5L/Fed.	11.5	288	299.5	66	65.5	79	20.5	19	39.5	96	10	98
Gesaprim 750g/Fed.	66	337	403	54	135	57	19.5	30	49.5	95	66.3	88
Basagran50% 1.5L/Fed.	146.0	47.5	191.5	78	356.3	-	323	46	419	59	526	-
Starine 200 cm3/Fed	62.3	14.8	77.1	91	274	22	395	27.5	422.5	58	475.3	19
Hand hoeing 3 times	25.5	11.3	36.8	96	-	100	218	15.5	233.5	77	176.5	70
Unweeded check	338	537	875	-	318	-	810	204	1014	-	589	-
L.S.D. 0.05	56	121			77		59	48			130	