EFFICIENCY OF PLANT POPULATION AND REDUCED HERBICIDES RATE ON MAIZE PRODUCTIVITY AND ASSOCIATED WEEDS

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ABSTRACT

Two field experiments were conducted during the summer seasons of 2010 and 2011 at the Experimental Farm at Kfar El-Khawazim, Talkha district, Dakahlia Governorate, Egypt to study the performance of maize plants and associated weeds to four plant population (20000, 25000, 30000 and 35000 plants/fed) and eight weed management treatments (Acetochlor at 75% of recommended rate, Acetochlor at 750 cm^3/fed (recommended rate), Fluroxypyr at 75% of recommended rate, Fluroxypyr at 200 cm^3/fed (recommended rate), Bentazon at 75% of recommended rate, Bentazon at 750 cm^3/fed (recommended rate), two hoeing and un-weeded check). The results showed that there was a significant reduction in number and dry weight of broadleaved, grass and total weeds at 10 weeks after sowing (WAS) with the increase of plant population. Narrowing the spacing between maize plants from 30 cm to 17 cm caused a significant reduction (21%) in the total weed dry weight. Fluroxypyr was more effective than the other treatments against the broadleaved weeds, while hoeing treatment was more efficient in reducing the number and dry weight of grass. Insignificant differences in weed numbers and weight were recorded when using the reduced herbicide rate compared to the recommended rate. There was a significant interaction between plant population and weed control treatments on the dry weight of broadleaved, grass and total weeds/m^2 after 10 WAS. Planting maize at 35000 plants/fed gave the lowest total dry weight of weeds when Acetochlor herbicide at the rate of 750 cm^3/fed was applied. Sowing maize at 20000 plants/fed (4.76 plants m^2) recorded and the greatest grain yield resulted from sowing maize at 30000 plants/fed (7.14 plants m^2). Uncontrolling weeds caused a significant reduction in the grain yield by 29.7% compared to hoeing treatment. Acetochlor at 750 cm^3/fed, hand hoeing produced the greatest grain yield surpassed the unweeded check by 42.9 and 42.3%, respectively. The results also indicated that the differences among Acetochlor at the full or reduced rates and the two hand hoeing were insignificant in their effect on maize grain yield. Protein and oil percent in maize grains were decreased by 8.0 and 9.2% due to the weed interference. It could be concluded that sowing maize at 30000 plants/feddan (7.14 plants m^2) and controlling weeds mechanically by hoeing or chemically using Acetochlor herbicide at the recommended rate produce the greatest grain yield.

Key words: maize, plant population, herbicide rate, weeds, grain, interaction

INTRODUCTION

Maize is one of the most important strategic cereal crops in Egypt and the world. Increasing grain yield per unit area and increasing the corn cultivated area are recognized as a better solution to solve the gap between consumption and production. Therefore it is important to increase the maize yield. To overcome such deficiency, production per unit area should be maximized through good achievement of some agricultural practices including plant density and effective weed management. Plant density plays an important role in the competitive balance between weeds and maize. Singh and Singh (2006) stated that the weed density and other measures of weed abundance usually decrease as crop density increase. They added that narrow row spacing affects the weeds and increases crop yield.

Modifying maize row spacing and populations has been shown to increase the maize productivity and reducing the weed growth. Widdicombe and Thelen (2002) recorded yield increases up to 10% with reduced row spacing. They added that it is has been hypothesized that narrowing row spacing may increase crop access to available soil moisture because of the more equidistant distribution of crop plants (Dalley *et al*., 2006). A second hypothesis is that narrowing row spacing increases light interception by the crop, particularly in the early growing season, thereby leading to increased crop growth rates and earlier canopy closure (Dalley *et al*., 2004). The earlier canopy closure and increased shading of weeds has been associated with increased crop competitiveness and reduced weed growth. Kumar and Walia (2003) reported that plant population of 90000/ha resulted in lower dry matter accumulation of the weeds than 75000 plants. They added that plant population of 90000/ha resulted in higher leaf area index but lower grain yield compared to a plant population of 75000. Dalley *et al*., 2004). Abouziena *et al*. (2007) mentioned that increasing plant density from 20000 to 28000/fed gave the highest biological and grain yields of maize, while, Van Roekel and Coulter (2012) demonstrate that grain yield can be maximized with plant densities ≥84,500 plants ha^{-1} (35490 plants/fed) in either 51- or 76-cm rows.

Weeds are considered as a major problem in maize fields. They cause serious reduction in productivity. The reduction in maize yield due to weed competition reached 66-90 % (Dalley *et al*., 2006 and Abouziena *et al*., 2007). EL- Metwally *et al*., 2006 and Abouziena *et al*., 2007 found that application of two hand hoeing gave the best control of total weeds and increased maize yield up to 74.5% over the control. Ahmed *et al*. (2008) showed that Fluroxypyr provided the best treatment in controlling broad leaved weeds.

Weed control in maize can be effectively achieved with about half the recommended rate of herbicides, without a loss in yield (Baghestani *et al.* (2007), Kir and Dogan (2009) and Pannacci and Covarelli (2009). Reducing herbicide rates cause a reduction in the production costs and reduce the the risk of side effects of herbicides on the environment (Kudsk, 2008).

The integreated effect between plant density and weed control management had appositive effect on maize grain yield (Acciares and Zuluaga, 2006, Abouziena *et al.,* 2007 and Waheed Ullah *et al.,* 2008). Abouziena *et al*. (2008) stated that the lowest dry weight of total weeds and the highest yield and yield components resulted from hand hoeing twice at the plant population 28000 plants/fed.

Therefore, the objective of this work is to evaluate the combined effect of different plant densities and weed control treatments on maize yield and associated weeds.

MATERIALS AND METHODS

Two field experiments were conducted at Kfar El-Khawazim, Talkha district, Dakahlia Governorate, Egypt, during 2010 and 2011 summer seasons to investigate the effect of plant density and weed control treatments on maize productivity and growth of associated weeds. The soil texture of the experimental site was clay loamy, with 1.2% organic matter, 0.14% total nitrogen and pH of 7.5. The preceding crop was wheat in both seasons.

Maize seeds (cv. single-cross hybrid 10) was sown in the second week of May in both seasons, in constant ridge width (70-cm) and the plot area was allowed to the spaced hills (30, 24, 20 and 17 cm apart) on one side of ridge, at approximately 20000, 25000, 30000 and 35000 plants/fed, respectively. The experiment was established with a split-plot design having four replicates. The main plots included four plant populations and subplots were assigned to eight weed control treatments which consisted of (1) Acetochlor (Harnes 84% Ec) herbicide ((2-chloro-N-ethoxy methyl-6-ethyl aceto-5-toluidide), at 75% of recommended rate (563 cm^3 fed^{-1}); (2) Acetochlor at recommended rate (750 cm^3 fed^{-1}); (3) Fluroxypyr (Starane 20% EC) herbicide [(4-amino-3,5-dichloro-6-floro-2-pyridinyl)oxy]) acetic acid], at 75% of recommended rate (150 cm^3 fed^{-1}); (4) Fluroxypyr at recommended rate (200 cm^3 fed^{-1}) ; (5) Bentazon (Basagran 48% AS) herbicide (3-isopropyl 1H-2,1,3-benzathiadiazin -4-(3H) one 2,2-dioxide) at 75% of recommended rate (563 cm^3

fed^{-1}); (6) Bentazon at recommended rate (750 cm^3 fed^{-1}); (7) hand hoeing two times at 3 and 6 weeks after maize sowing (WAS) and (8) un-weeded check (weeds were allowed to grow). Acetochlor was applied on the soil surface (pre-emergence), while Fluroxypyr and Bentazon herbicides were applied at 3 WAS.

The normal cultural practices for growing maize were applied as recommended, except for plant spacing and weed control measures. At 10 WAS, weeds were counted from one square meter randomly taken from each plot. Weeds were identified and their dry weights were recorded. At harvest, 10 maize plants from each plot were taken to determine ear characters, i.e. (length, diameter, number of rows/ear, number of kernels/row), grain index (100- kernel weight), weight of ears/plant, ear grain weight/plant and shelling percentage [(ear grain weight/cob weight) × 100]. Grain yields per feddan (4200 m^2) were determined by harvesting the whole plot area. Total nitrogen was determined according to A. O. A. C. (1980). N values were multiplied by the factor of 6.25 to obtain protein percentage. Oil percent in maize grains was determined according to procedure of (A. O. A. C., 1980) using soxhlet equipment.

A combined analysis of data for the two seasons was carried out according to the procedure outlined by Gomez and Gomez (1984). For comparison between means, the LSD test at 5% level was used.

RESULTS AND DISCUSSION

A- Weed growth:

The major weeds present on the experimental site included common purslane (*Portulaca oleracea,* L.), nalta jute (*Sida alba,* L.) and cocklebur (*Xanthium brasilicum,* Vellozo) as broadleaf weeds and barnyardgrass (*Echinochloa colonum,* (L.) Link) as grass.

a- Effect of plant population:

There was a significant reduction in the number and dry weight of broadleaf, grass and total weeds at 10 WAS as plant population increased from 20 to 35 thousand plants per feddan (Table 1). Increasing the plant population from 20000 to 25000, from 20000 to 30000 and to 35000 plants/fed significantly decreased the total weed number by 9.1, 20.3 and 30.5% and the total weed dry weight by 9.0, 29.8 and 19.7%, respectively. In unweeded plots, narrowing the distance between maize plants from 30 cm to 17cm caused a significant reduction (21%) in the total weed dry weight. Similar finding was reported by Abd El-Samie (2001); Tharp and Kells (2001) and Abouziena *et al.* (2008). Reduction in weeds growth under high maize –plant density may be attributed to quicker row closure which reduces the light penetration to the weeds emerging below the crop canopy (Begna *et al*., 2001 and Dalley *et al*., 2006). Acciares and Zuluaga (2006) reported that a greater photosynthetic photon flux density interception with a lower weed aboveground dry matter in narrow row arrangement was obtained.

b- Effect of weed control treatments:

All weed control treatments reduced the number and dry weight of broadleaf, grassy and total weeds compared to the unweeded control treatment (Table 1). Hoeing twice was more efficient than other treatments on decreasing the number (82.6% reduction) and dry weight (82.7% reduction) of grassy weed. Insignificant difference was recorded between hoeing treatment and Acetochlor at the two rates used on the number and dry weight of weeds (Table 1). The data also indicated that Fluroxypyr and Bentazon at the two tested rates came in the second order and there was insignificant differences, in most cases among the four treatments were evident in the number and dry weight weeds. Fluroxypyr was more effective than other treatments against broadleaf weeds and reduced the biomass of broadleaf weeds by 83.6 % compared with unweeded check. Similar results were reported by Sharara *et al*., 2005 and Abouziena *et al*., 2007 and 2008. Also the results showed that the per-emergence herbicide (Acetochlor) was more efficient than the two post emergence (Fluroxypyr and Bentazon herbicides) treatments in eliminating maize weeds (Table 1).

Reducing the herbicides rate by 25% did not cause significant differences on number and dry weight of weeds if compared with the full rate of the same herbicide. The reduction of weed dry weight may be due to the inhibition effect of herbicide treatments on growth and development of weeds. Similar findings were reported by Pannacci and Covarelli (2009) and Kir and Dogan (2009) and Hassan *et al*. (2010). Kir and Dogan (2009) reported that weed control in maize can be effectively achieved with about half the recommended rate of foramsulfuron, without a loss in yield.

Table 1: Number and dry weight of maize weeds after 10 weeks from sowing as affected by maize plant population and weed control treatments (Combined analysis of two seasons).

Treatments	At 10 weeks after maize sowing							
	Weed number/m^2				Weed dry weight (g/m^2)			
	Broadleaf	Grass	Total	Reduction %	Broadleaf	Grass	Total	Reduction %.
Plant population								
20000 plant/fed	8.7	10.0	18.7	-	56.3	86.8	143.3	-
25000 plant/fed	7.6	9.4	17.0	9.1	49.3	81.1	130.4	9.0
30000 plant/fed	6.4	8.5	14.9	20.3	41.3	73.8	115.1	19.7
35000 plant/fed	5.3	7.7	13.0	30.5	34.1	66.5	100.6	29.8
F- Test ($P \leq 0.05$)	**	**	**		**	**	**	
LSD 5%	0.4	0.6	1.3		3.7	5.7	12.1	
Weed control:								
Acetochlor 563 cm^3/fed	6.1	3.1	9.2	73.9	35.8	26.0	61.8	75.9
Acetochlor 750 cm^3/fed	5.0	2.7	7.7	78.1	32.5	23.8	56.3	78.1
Fluroxypyr 150 cm^3/fed	4.1	12.8	16.9	52.0	26.8	110.5	137.3	46.5
Fluroxypyr 200 cm^3/fed	3.6	12.4	16.0	54.6	23.5	107.5	131.1	49.0
Bentazon 563 cm^3/fed	5.3	12.5	17.8	49.4	35.5	108.0	143.5	44.1
Bentazon 750 cm^3/fed	4.5	12.1	16.6	52.8	28.8	105.5	134.3	47.7
Hand hoeing twice	5.7	2.3	8.0	77.3	37.3	20.0	57.3	77.7
Unweeded	21.9	13.3	35.2	--	141.8	115.0	256.8	-
F- Test ($P \leq 0.05$)	**	**	**		**	**	**	
LSD 5%	0.8	0.5	2.1		5.4	3.1	6.9	

c- Effect of interaction between plant population and weed control treatments:

The results in Table 2 indicated that there was a significant interaction between plant population and weed control treatments on dry weight of broadleaved, grass and total weeds/m^2 after 10 weeks from sowing. Acetochlor, Fluroxypyer and Bentazon herbicides varied in their weed control efficacy according to maize plant population. Fluroxypyer at 150 cm^3/fed succeeded in elimination of the broadleaved weeds with the lowest dry weight under plant population at 30000 plant/fed by 89.7% compared to the unweeded check (Table 2). The lowest dry weight of grassy weed resulted from hand hoeing twice at sowing maize of 35000 plants/fed. Plant population at 35000 plants/fed gave the lowest total dry weight of weeds when Acetochlor herbicides at 750 cm^3/fed was applied. Vice – versa, unweeded treatment with sowing maize of 20000 plant/fed recorded the highest dry weight of broadleaved, grass and total weeds/m^2 at 10 WAS. Johnson & Hoverstad (2002) reported that enhancing the competitive ability of the crop by modifying plant arrangement may allow for the use of reduced herbicide rates. Earlier canopy closure and increased shading of weeds has been associated with increased crop competitiveness and reduced weed growth in some situations (Dalley *et al*., 2004 and Abouziena *et al*., 2008).

Table 2: Effect of the interaction between maize plant population and weed control treatments on the dry weight of broadleaf weeds, grass and total weeds after 10 weeks from maize sowing (Combined analysis of two seasons).

Plant population	Weed control treatments (rate/fed)							
	Acet 563 cm^3	Acet 750 cm^3	Fluro 150 cm^3	Fluro 200 cm^3	Bent 563 cm^3	Bent 750 cm^3	Hand hoeing twice	Un-weeded
	Broadleaf weeds (g/m^2)							
20000 plant/fed	49	41	39	36	46	43	40	156
25000 plant/fed	43	37	32	26	35	31	40	150
30000 plant/fed	35	30	21	16	27	23	37	141
35000 plant/fed	28	22	15	16	22	18	32	120
LSD 5%	2.4							
	Grassy weed (g/m^2)							
20000 plant/fed	35	33	123	120	118	116	24	125
25000 plant/fed	29	25	117	114	112	109	23	120
30000 plant/fed	21	20	107	105	104	101	19	113
35000 plant/fed	19	17	95	91	98	96	14	102
LSD 5%	5.7							
	Total weeds (g/m^2)							
20000 plant/fed	84	74	162	156	164	159	64	281
25000 plant/fed	72	62	`49	140	147	150	63	270
30000 plant/fed	56	50	128	121	131	124	56	254
35000 plant/fed	47	39	110	107	120	114	46	222
LSD 5%	8.5							

Abbreviations: Acet;Acetochlor, Fluro;Fluroxypyer, Bent;Bentazon

B- Maize yield and its components:

a- Effect of plant population:

According to the results in Table (3) and Fig. (1) yield and yield components of maize plants were significantly affected by plant population except the number of rows/ear criteria. Plant population at 20000 plants/fed produced the highest values of ear criteria studied. Planting maize at 35000 plants/fed gave the highest shelling percentage. The highest grain yield resulted from sowing maize at 30000 plants/fed (equal = 7.14 plants m^2) which exhibited increments of grain yield by 32.8, 14.1 and 8.3% than that of 20000, 25000 and 35000 plants/fed, respectively (Table 3 and Fig. 1). Similar findings were reported by Guevara-Escobar *et al*. (2005) and Acciares and Zuluaga (2006). Widdicombe and Thelen (2002) reported that narrow corn row spacing has been shown to increase yield in some environments. It has been hypothesized that narrowing row spacing may increase crop access to available soil moisture because of the more equidistant distribution of crop plants Dalley *et al*., 2006). A second hypothesis is that narrowing row spacing increases light interception by the crop, particularly in the early growing season, thereby leading to increased crop growth rates and earlier canopy closure (Dalley *et al*., 2004). This earlier canopy closure and increased shading of weeds has been associated with increased crop competitiveness and reduced weed growth. However, Bavec and Bavec (2002) reported that increasing plant population from 4.5 to 13.5 plants per m^2 significantly changed ear characters i.e, cob characteristics, weight of 1000 kernels, cob length, number of kernel rows and number of kernels per row.

Table 3: Yield, yield components of maize plants and oil and protein percent in grains as affected by maize plant population and weed control treatments (Combined analysis of two seasons)

Treatments	Ear length (cm)	Ear diameter (cm)	Number of rows/ear	No. of kernels/row	100 kernel weight (g)	weight of ears (g/plant)	Ear grain weight (g/plant)	Shelling (%)	Grain yield (ton/fed)	Protein (%)	Oil (%)
Plant population:											
20000/fed	18.9	4.9	14	43.1	32.1	223.7	196.7	87.9	3.54	8.14	4.73
25000/fed	18.3	4.6	14	42.8	31.7	217.9	183.2	84.1	4.12	8.03	4.70
30000/fed	17.9	4.5	14	41.3	31.6	206.0	147.2	84.6	4.70	7.96	4.61
35000/fed	16.0	4.4	12	39.7	29.1	155.6	137.8	88.6	4.34	7.89	4.57
F- Test ($P \leq 0.05$)	**	**	NS	**	**	**	**	**	**	NS	NS
LSD 5%	0.2	0.2	-	0.8	0.6	17.1	11.2	0.5	0.12	-	-
Weed control treatments:											
Acetochlor 563 cm^3/fed	18.1	4.7	14	41.9	31.9	217.5	191.9	86.8	4.43	8.12	4.75
Acetochlor 750 cm^3/fed	18.6	4.8	14	43.4	33.3	223.7	198.7	86.9	4.70	8.20	4.78
Fluroxypyr 150 cm^3/fed	18.0	4.7	14	41.0	31.3	199.8	172.6	86.4	4.19	8.02	4.66
Fluroxypyr 200 cm^3/fed	17.8	4.6	14	42.8	31.3	201.7	175.1	85.9	4.36	8.07	4.70
Bentazon 563 cm^3/fed	17.8	4.5	14	41.3	29.7	190.5	158.2	83.0	3.83	7.88	4.62
Bentazon 750 cm^3/fed	17.8	4.7	14	42.2	30.7	192.0	164.7	85.8	3.95	7.96	4.64
Hand hoeing twice	18.3	4.8	14	43.0	32.2	226.0	199.4	85.4	4.68	8.23	4.78
Unweeded	16.1	4.2	12	38.2	28.8	152.5	126.3	82.8	3.29	7.57	4.34
F- Test ($P \leq 0.05$)	**	**	NS	**	**	**	**	**	**	**	**
LSD 5%	0.5	0.1	-	1.3	0.9	9.7	8.4	0.3	0.19	0.12	0.07

Previous research stated that corn grain yield typically exhibits a quadratic response to plant density, and a gradual decrease in the rate of yield increase relative to density increase (Barbieri *et al*. (2000); Shapiro and Wortmann (2006) and Waheed Ullah *et al*. (2008). Data in Table (3) and Fig. (1) showed that the lowest and highest plant populations (4.76 and 8.3 plants m^2) i.e. wider and narrow spacing between plants (30 and 17 cm) recorded the lowest grain yield. Similar trend was obtained by Abo-Shetaia *et al*. (2002), while, Van Roekel, and Coulter (2012) demonstrated that grain yield can be maximized with plant densities ≥84500 plants ha^{-1} either in 51 cm or 76 cm rows. However they reported that stalk diameter, intercepted photosynthetically active radiation (IPAR) and leaf area index (LAI) at silking, was not affected by row width root as well as stalk lodging, grain yield, and yield components, did not affect by plant density. Ali *et al*. (2003) reported that the competition between maize plants for light, soil fertility and other environment factors was markedly increased in case of the highest population.

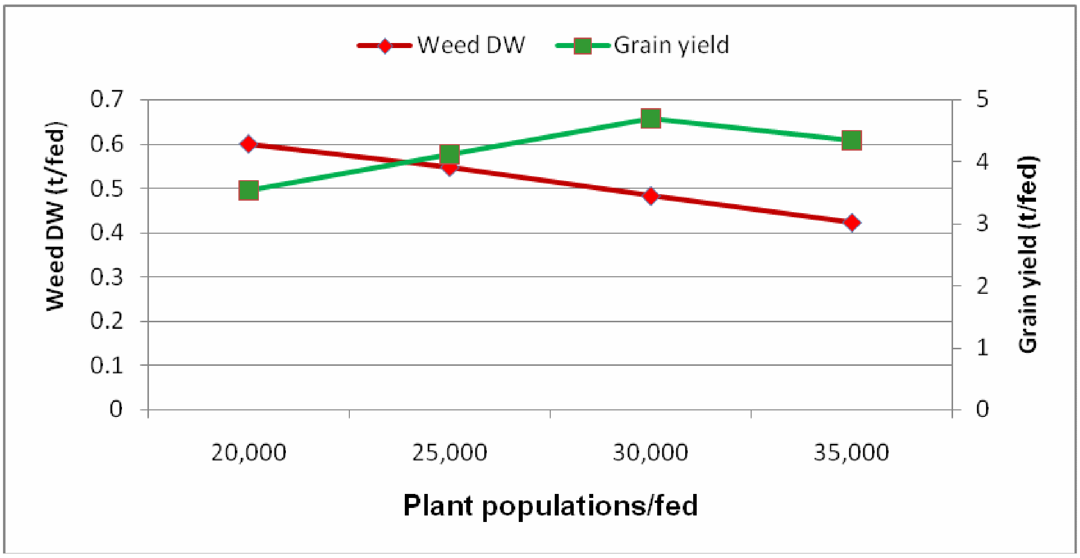

Fig.1 Effect of maize plant populations on the total dry weight at 10 weeks after sowing and grain yield (t/fed). (Combined analysis of two seasons)

b- Effect of weed control treatments:

According to results in Table (3) yield and yield components of maize plants were significantly affected by weed control treatments, except no. of rows/ear. Uncontrolling weeds caused a significant reduction in the grain yield by 29.7%, compared to hand hoeing treatment (Fig. 1). Dalley *et al*. (2006) and Abouziena *et al*. (2007) found 90 and 66% reduction in maize grain yield due to weed infestation, respectively. Reduced grain yield due to weeds may be attributed to several factors, e.g., competition between maize and weeds for water, nutrients and allelopathic effects of weeds. Zimdahl (1999) mentioned that competition for water is often considered the most important source of weed–crop competition. Growing weeds with a crop have been shown to reduce soil moisture, although the depth of additional water extraction depends on the specific combination of crop and weeds present. Reductions in soil moisture have been related to increases in weed density or the length of time weeds remain present with the crop (Dalley *et al*., 2006).

Acetochlor at 750 cm/fed surpassed the other treatments for increasing ear length, kernels number/row, 100 kernel weight and shelling percentage. Meanwhile, hand hoeing gave the highest values of ear diameter, weight of ears/plant and ear grain weight/plant. Acetochlor at 750 cm^3/fed, and the two hand hoeing treatments significantly produced the greatest grain yield and exceeded the unweeded check by 42.9 and 42.3%, respectively. The results also indicated that no significant differences between Acetochlor at the rate of 750 cm/fed, two hand hoeing and Acetochlor at 75% of recommended rate on grain yield/fed. These results are in harmony with those obtained by Eleftherohorinos and Kotoula-Syka (1995) who reported that herbicide treatments doubled maize yields in comparison with the weed infested control.

Insignificant differences were recorded in the grain yield between Fluroxypyr and Bentazon herbicides at 75% and 100% of the recommended rates. Kir and Dogan (2009) reported that the 50% rate was as efficient as the recommended rate and provided similar maize yield as obtained from plots treated with higher rates or from weed-free control plots.

c- Effect of interaction between plant population and weed control treatments:

The results in Fig. (2) showed that there was a significant interaction between sowing maize and weed control treatments on grain yield/fed. The highest grain yield was obtained from from sowing maize at 30000 plant/fed with hand hoeing treatment followed by same density combined with with Acetochlor at the recommended rate (750 cm^3/fed) or Acetochlor at 75% of recommended rate without significant difference among these treatments. On the other hand, the lowest grain yield was recorded from the unweeded treatment with sowing maize at 20000 plants/fed. Merotto *et al*. (1997) reported that the use of high plant population can mitigate weed competition. The results also indicated that there is no significant differences between Acetochlor at the recommended rate, two hand hoeing and Acetochlor at 75% of recommended rate on grain yield/fed under maize sowing at 30000 plant/fed. On the other hand, the lowest grain yield was recorded from the unweeded treatment with sowing maize at 20000 plants/fed. These results are in good harmony with those of Acciares and Zuluaga (2006), Abouziena *et al*. (2008) and Waheed Ullah *et al.* (2008).

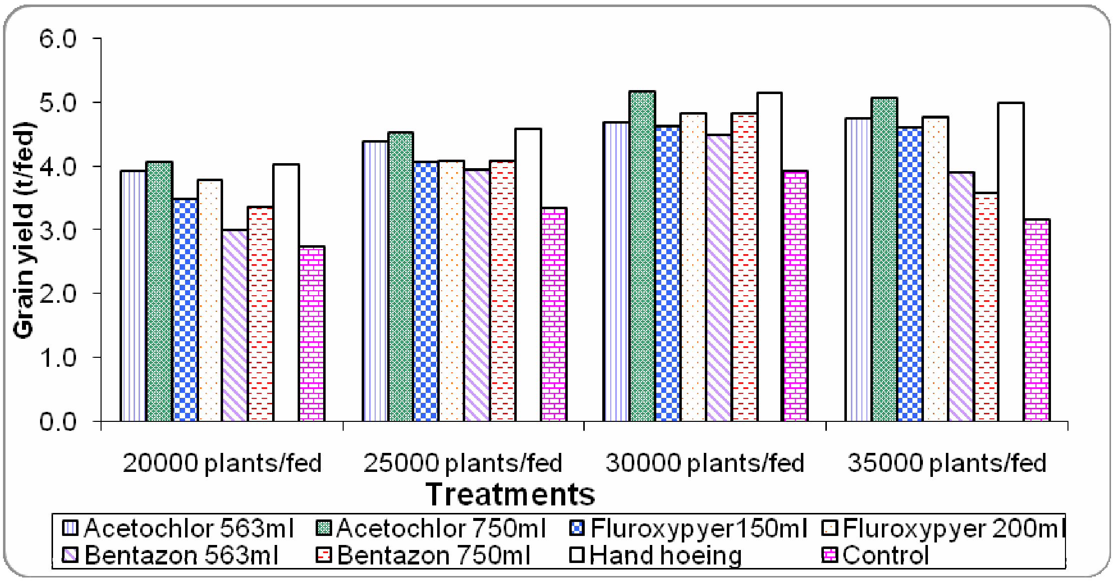

Fig. 2: Effect of the interaction between plant populations and weed control treatments on the grain yield(t/fed). (combined analysis of two seasons)

C- Chemical composition of maize grains:

a- Effect of plant population:

Data in Table (2) indicate that there was insignificant effect on the contents of oil and protein percentage of maize grain due to different plant populations.

b- Effect of weed management:

Data presented in Table (3) showed that controlling maize weeds significantly increased the concentrations of oil and protein percentage in maize grains in comparison to unweeded control. Hoeing treatment and Acetochlor at 750 cm/fed exceeded the rest of other weeded practices for enhancing oil and protein percentage. There is no significant difference between hand hoeing and the recommended rate of Acetochlor treatment. The lowest values of oil and protein percentage in maize grains were recorded in unweeded treatment. These results may be due to the less competition for nutrients, water and light through limiting weeds infestation with herbicidal and hand weeding treatments due to increasing the uptake of different nutrients. Hussein (1996) reported that controlling weeds in maize field could save 75, 11, and 54 kg/ha of N, P, and K and 90, 1029, and 99 g/ha of Zn, Fe, and Mn, respectively. Similar results were obtained by Sinha *et al*. (2005), Ahmed *et al*. (2008) and EL-Metwally *et al*. (2009).

c- Effect of interaction between plant population and weed management:

The interaction treatment between maize plant population and weed control treatments had insignificant effect on the protein and oil percent in maize grain as shown in Table (3).

Similar results were obtained by Sinha *et al*. (2005), Ahmed *et al*. (2008) and EL-Metwally *et al*. (2009).

CONCLUSION: It could be concluded from this study that sowing maize at 30000 plants per feddan and controlling weeds mechanically by hand hoeing twice or chemically using Acetochlor herbicide with the reduced rate (75% of the recommended rate) produce the greatest grain yield. Also the results show that the per-emergence herbicide used was more efficient than the post emergence herbicide treatment in eliminating weeds in maize fields

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كفاءة الكثافة النباتية ونقص معدل المبيدات على إنتاجية الذرة الشامية والحشائش المصاحبة له.

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أقيمت تجربة حقلية بقرية كفر الخوازيم بمركز طلخا – محافظة الدقهلية خلال موسمي ٢٠١٠ ، ٢٠١١ لدراسة كفاءة الكثافة النباتية وكانت (٢٠٠٠٠ ، ٢٥٠٠٠ ، ٣٠٠٠٠ ، ٣٥٠٠٠ نبات / فدان) بينما استخدمت ثمانية معاملات لمكافحة الحشائش هي اسيتوكلور ، الفلوروكسيبير ، البنتازون بنسبة ٧٥ و ١٠٠ % من المعدل الموصي به بالإضافة إلي المعدل الموصي به والعزيق مرتين ومعاملة الكنترول.

أظهرت النتائج أن زيادة الكثافة النباتية أدى الى نقص جوهري في العدد والوزن للحشائش العريضة والضيقة الأوراق والكلية بعد ١٠ أسابيع من الزراعة. خفض مسافات الزراعة بين نباتات الذرة الشامية من ٣٠ سم إلي ١٧ سم تسبب في انخفاض كبير بلغ (٢١ %) في الوزن الجاف الكلي للحشائش. مبيد الفلوروكسيبير كان أكثر كفاءة عن باقي المعاملات الاخري في مكافحة الحشائش عريضة الأوراق ، بينما العزيق اليدوي كان أكثر كفاءة في خفض العدد والوزن الجاف للحشائش. لم يظهر فرق معنوي بين استخدام المبيدات بالمعدل المنخفض مقارنة بالمعدل الموصي به.

أوضحت النتائج وجود تأثير معنوي للتفاعل بين الكثافة النباتية ومعاملات مكافحة الحشائش على الوزن الجاف للحشائش العريضة والضيقة الأوراق والكلية / م٢ بعد ١٠ أسابيع من الزراعة. حيث أدى استخدام الكثافة النباتية ٣٥٠٠٠ نبات/ فدان إلى الحصول على أقل وزن جاف كلي للحشائش عند استخدام مبيد اسيتوكلور بالمعدل الموصى به ٧٥٠ سم[3]/ فدان. سجلت الزراعة بالكثافة النباتية ٣٠٠٠٠ نبات/ فدان (٧،١٤ نبات / م٢) أعلي محصول حبوب عن الكثافة النباتية ٢٠٠٠٠ نبات/ فدان (٤،٧٦ نبات / م٢). عدم مكافحة الحشائش أحدث نقصا في محصول الحبوب بنسبة ٢٩،٧ % مقارنة بمعاملة العزيق اليدوي. أدي استخدام مبيد اسيتوكلور بالمعدل الموصى به ٧٥٠ سم[3]/ فدان والعزيق اليدوي إلي زيادة محصول الحبوب بنسبة ٤٢،٩ و ٤٢،٣ % علي التوالي بالمقارنة بمعاملة الكنترول.

أظهرت النتائج إلي أن الاختلافات بين معدلات مبيد اسيتوكلور الموصي بها والمنخفضة وكذلك العزيق مرتين غير مؤثرة علي محصول الحبوب في الذرة الشامية. وانخفاض البروتين ونسبة الزيت في حبوب الذرة بنسبة ٨،٠ و ٩،٢ % نتيجة تداخل الحشائش.

يمكن أن نخلص إلي أن تزرع الذرة الشامية ٣٠٠٠٠ نبات/ فدان (٧،١٤ نبات / م٢) ومقاومة الحشائش ميكانيكيا بالعزيق اليدوي أو باستخدام مبيد اسيتوكلور بالمعدل الموصي به لإنتاج أعلي محصول حبوب.