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A Comparative Study on the Productivity of Two Yellow Maize Cultivars Grown Under Various Weed Control Management

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ABSTRACT

The effect of weed control treatments on yield of yellow maize and weed growth in the sandy soils is not completely understood. Therefore, field experiments were conducted at the Agriculture Experimental Station of National Research Center, Nubaria, Behira Government, Egypt, during 2011 and 2012 summer seasons to investigate the effect of 8 weed control treatments on two yellow maize cultivars productivity and weeds growth under drip irrigation system in sandy soil. The broad leaved weeds were more sensitive than the narrow leaved weeds to the variation in the cultivars growth habit, where S.C.164 *cv* plots had significant lower broad leaved weeds dry weight by 12.6 and 18.3% than that of S.C.166 *cv* at 8 and 12WAS, respectively. All weed control treatments reduced the weeds growing with maize reached 90 to 93% at 12WAS. Cultivar S.C.164 significant had more values of plant height and ear length than S.C.166 cv, while cultivar S.C.166 significant surpassed the other one in the values of ear diameter and weight, grain weight/ear, grain index and biological and grain yields. Weed competition caused a significant reduction in the value of plant height, ear length, ear diameter, number of rows/ear, number of kernels/row, ear weight, grain weight/ear and straw weight by 35.3, 37.5, 14.6, 17.3, 28.3, 27.1, 50.5 and 4o.6 % respectively and consequently decreased the grain yields per feddan by 49.7%. No additional advantages from application the full rate of Fluroxypyr or Fluazof compared to the same herbicide (reduced rate) plus additive, where comparatively higher grain yield were found in plots treated with the reduced herbicide rate than full rate. Sowing S.C.164 *cv* and application of one hoeing at 3WAS + reduced Fluazof rate plus AMS (2%) applied at 6WAS produced the highest grain yield. S.C.164 *cv* had higher protein, oil and carotenoids content than the S.C.166 cv by 7.5, 11.5 and 50.0%, respectively. Uncontrolling weeds caused a significant reduction in protein and total soluble carbohydrates content by 13.5 and 13.9% as well as insignificant increase in total carbohydrates and total free amino acids by 7.0 and 5.7%, respectively, compared to hoeing treatment.

Key words: yellow maize, cultivar, weeds, herbicide rate, carotenoids, yield, herbicide

Introduction

Maize (*Zea mays* L.) considered one of the most three important cereal crops in Egypt. There are more interested towards increasing the yellow maize production in Egypt, whereas it was mainly produce for human and animal consumption. Safawo, *et al*., 2010 reported that vitamin A deficiency affects over 250 million people worldwide and is one of the most prevalent nutritional deficiencies in the developing countries, resulting in significant socio-economic losses. However, this can be alleviated through provitamin A carotenoids biofortification of major crop staples such as maize (*Zea mays* L). They added that maize is also the dominant subsistence crop in much of Asia, Africa and the Americas, where between 17 and 30% of children under age of 5 are vitamin A deficient.

The unique energy capturing capacity and efficient use of CO_2 as C_4 plant have made maize capable of producing maximum grain yield per unit area as compared to all other cereal crops (Hassan *et al.,* 2011). Maize yield varies according to variety sowing (Dahmardeh and Dahmardeh, 2010, Hassan *et al.,* 2011, Salah *et al*., 2011 and Elgamaal and Maswada, 2013). Salah *et al.* (2011) found significant differences among yellow maize varieties in photosynthate partitioning, carbon equivalent for each carbohydrate and protein of vegetative organs, kernels and straw, as well as, oil in kernels.

Weed competition caused a reduction in white maize productivity amounted by 29.7% (El-Metwally *et al.*, 2012). Dalley *et al*. (2006) and Abouziena *et al*. (2007) found 90 and 66% reduction in maize grain yield due to weed infestation, respectively. 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 (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). Pannacci and Covarelli (2009) reported that use of herbicides at reduced doses is one of the most

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important tools to limit herbicide input into the environment according to the integrated weed management system. The critical period of weed control in maize crop based on 5% acceptable yield loss was 20-35 days after sowing (Gomaa *et al.,* 2011). Reduced dosages of post-emergence herbicides provide more consistent and greater levels of weed control when they are applied early, to the youngest weed growth stages possible (DeFelice *et al*., 1989 and Dogan *et al*, 2005).

Productivity of maize was varied according to cultivar sowing (Dahmardeh and Dahmardeh, 2010 and El-Gizawy and Salem, 2010).

The reduction in maize productivity due to weed competition varied according to maize cultivar sowing. Use of aggressive cultivars can be effective cultural practice for weed growth suppression (Seavers and Wright, 1999, Wicks *et al*., 2004 and Mennan and Zandstra, 2005). According to Bussan *et al*. (1997) the competitive ability of crop can be expressed in two ways. First is the ability of the crop to compete with weeds, reducing weed seed and biomass production. The second possibility is having crop tolerate competition from weeds, while maintaining high yields. Hucl (1998) found that the less competitive genotypes suffered a 7-9% greater yield loss than that of the more competitive genotypes. On the other hand, Cardina (1995) concluded that more competitive cultivars are not necessarily higher yielding. However Silva *et al.* (2010) demonstrated that there was no difference in the dry biomass above-ground part of the weeds in the plots of the evaluated cultivars. Farhadi-Afshar *et al*. (2009) reported that the variations of Shimmer and KSC403 in grain yield, 100-grain weight, grain number/row and row number/ear were significant. In addition, Shimmer exhibited superior traits over KSC403 and produced the highest grain yield under weeds fully controlled conditions.

High wages and scarcity of labors at right time make hand weeding difficult and uneconomical day by day, especially in new reclaimed area. Some investigators found positive effect for the interaction between cultivars and weed control treatments on weeds and yield of maize crop (DeFelice *et al.*, 1989).

Therefore, the objective of this study was to investigate the effect of cultivars and weed control treatments as well as their interaction on yellow maize yield and associated weeds under sandy soil conditions.

Materials And Methods

Field experiments were conducted at the Agriculture Experimental Station of National Research Center, Nubaria, Behira Government, Egypt, during 2011 and 2012 summer seasons to study the effect of weed control treatments on productivity of two yellow maize varieties and ambient weeds. The soil was sandy with pH 7.8, organic matter 1.6%, E.C. 1.04 mmohs/cm, $CaCO_3$ 1.56%, total N 0.043%, total P 0.022%, and total K 0.02%. Plot area was 15 m^2 (3 m width by 5 m length), containing 5 ridges spaced 60 cm apart. Maize was sown in constant spaced hills (25 cm apart) on one side of ridge.

The experiment was established with a split-plot design having three replicates. The main plots included the two cultivars *viz* single cross (S.C.) 166 and 164. Subplots were assigned to eight weed control treatments, which consisted of (1) nonweeded check (weeds were allowed to grow); (2) hand hoeing two times at 3 and 6 weeks after sowing (WAS) of maize; (3) fluroxypyr applied at 200 cm^3/fed 15 days (d) after maize sowing + one hoeing at 6 WAS; (4) fluroxypyr at 150 cm^3/fed tank-mixed with ammonium sulphate (AMS) at 2% w/v applied at 15 d after maize sowing + one hoeing at 6 WAS; (5) fluroxypyr at 150 cm^3/fed tankmixed with urea at 1% w/v applied at 15 d after maize sowing + one hoeing at 6 WAS of maize; (6) one hoeing 15 d after maize sowing + Fluazifop-P-Butyl at 1.0 l/fed applied at 6 WAS; (7) one hoeing 15 d after maize sowing + Fluazifop-P-Butyl at 0.75 l/fed tankmixed with AMS at 2% w/v applied at 6 WAS and (8) one hoeing 15 d after maize sowing + Fluazifop-P-Butyl at 0.75 l/fed tank-mixed with urea at 1% w/v applied at 6 WAS.

Maize seeds were sown in 14^{th} May in both seasons, two kernels per hill, then thinning to one plant per hill was done at 21 days after planting. The normal cultural practices for growing maize in sandy soil were applied as recommended, except for weed control measures. After 8 and 12 WAS, weeds were counted on one ridge (0.6 by 5 m = 3 m^2), randomly taken from each plot. Weeds were identified and their dry weights were recorded. All weeds were carefully hand uprooted, stored in polythene bags and dried in oven at 60°C for 48 hours. The dried weeds were weighed again to calculate weed biomass. Weed control efficiency (WCE) of each treatment was calculated using the formula (Thakral *et al*., 1988):

$$\text{WCE \%} = \frac{\text{WDCE} - \text{WDWT}}{\text{WDWC}} \times 100$$

Where WDWC = Weed dry weight in weedy check, WDWT = Weed dry weight in treatment.

At harvest, five maize plants from each plot were taken to determine plant height, ear characters, i.e., length, diameter, number of rows/ear, number of kernels per row, ear weight, grain weight per ear, and grain index (100- kernel weight). Biological and grain yields per feddan (fed = 4200m^2) were determined by harvesting the whole plot area.

Chemical analysis:

Maize grains were dried in oven at 70^O C and then finally ground for determination total nitrogen according to AOAC (1980). N values were multiplied by the factor of 6.25 to obtain protein percentage. Total carbohydrates and soluble were determined according to Dubois *et al*. (1956). Oil (A.O.C.S., 1964), carotenoids (Jacobs, 1961), free amino acid (Plummrer, 1978), total phenols (Danial and Georage, 1972) and total indoles (Bentely, 1961) were determined.

Data were subjected to analysis of variance and least significance difference (LSD) test was performed to demonstrate the treatment effect, where appropriate employing MSTATC computer software.

Results And Discussion

A. *Weed Growth:*

The predominant weeds in the experimental area were lambsquarters (*Chenopodium album* L.), and purslane (*Portulaca oleraceus* L.), field bindweed (*Convolvules arvensis* L.) as broad leaved weeds and bermudagrass [*Cynodon dactylon* (L.) Pers.] and sandbur (*Cenchrus pennisetiformis*, Hochst. & Steud.) as narrow leaved weeds (Tables 1 and 2).

Effect of cultivars:

The effect of yellow maize cultivars on weeds was differed according to the weed species, and the maize cultivar grown. The dry weight of *Chenopodium album* at 8 WAS was significantly decreased in yellow maize S.C.164 *cv* plots by 25.6%, compared to that of *cv* S.C 166 (Table 1), whereas dry weight of *Cynodon dactylon* decreased in the S.C. 166 *cv* plots by 25.6%, in comparison to that weed in S.C 164 cv. The difference in the ability of cultivars to suppress weed growth than the other which may be due to the differential rooting patterns, allelochemicals, higher leaf area index and more light interception, and vegetative growth habit (Seavers and Wright, 1999, Abouziena *et al*., 2008 and Dhima *et al*., 2008).

Table 1: Effect of some weed control treatments on yellow maize weeds at 8 weeks after sowing. (Combined analysis of the two seasons)

Treatments			Cultivars								
			S.C 166	S.C 164	Mean	S.C 166	S.C 164	Mean	S.C 166	S.C 164	Mean
Herbicide	Rate[1]	Additive	*Chenopodium album*			*Portulaca oleraceae*			*Convolvules arvensis*		
Fluroxypyr	200	-	19.3	9.6	14.5	10.0	3.5	6.8	15.5	9.2	12.4
	150	AMS2%	10.0	4.7	7.3	2.0	2.0	2.0	9.4	7.1	8.2
	150	Urea1%	9.4	6.7	8.1	2.2	2.4	2.3	9.4	5.9	7.7
Fluazof	1000	-	0.0	2.1	1.0	2.1	5.7	3.9	7.5	8.0	7.8
	750	AMS2%	11.6	5.2	8.4	2.9	2.5	2.7	11.1	5.6	8.4
	750	Urea1%	9.5	6.4	8.0	3.1	6.4	4.8	7.6	7.1	7.3
Hoeing	-	-	10.4	9.8	10.1	2.2	4.4	3.3	1.1	1.4	1.2
Unweeded	-	-	33.2	32.7	32.9	15.2	17.8	16.5	30.8	39.2	35.0
Mean of cultivars			12.9	9.6		5.0	5.6		11.6	10.4	
LSD 0.05 for			Cu:2.8;7.0; Int; NS			Cu: NS;wt:5.4; Int: NS			Cu:0.7;WC:1.8; Int:NS		
			Broad leaf weeds			*Cynodon dactylon*			*C. pennisetiformis*		
Fluroxypyr	200	-	44.8	22.3	33.6	8.5	6.8	7.7	25.8	18.0	21.9
	150	AMS2%	21.4	13.8	17.6	4.9	8.0	6.5	30.0	16.1	23.1
	150	Urea1%	21.0	15.0	18.0	8.0	6.5	7.3	17.9	10.6	14.3
Fluazof	1000	-	9.6	15.8	12.7	7.5	8.9	8.2	20.9	17.5	19.2
	750	AMS2%	25.6	13.3	19.5	3.0	4.2	3.6	19.6	9.4	14.5
	750	Urea1%	20.2	19.9	20.1	1.5	3.0	2.3	15.6	19.9	17.8
Hoeing	-	-	13.7	15.6	14.7	1.1	1.5	1.3	9.4	2.4	5.9
Unweeded	-	-	79.2	89.7	84.5	14.3	26.7	20.5	63.21	89.4	76.3
Mean of cultivars			29.4	25.7		6.1	8.2		25.3	22.9	
LSD 0.05 for			Cv:3.0;WC:7.2; Int:NS			Cv:1.2;WC:2.9; Int: NS			Cv:2.0;WC:5.1; Int:NS		
			Narrow leaf weeds			Total weeds			Efficacy control%		
Fluroxypyr	200	-	34.3	24.8	29.6	79.1	47.1	63.2	49.5	77.1	63.3
	150	AMS2%	34.9	24.1	29.6	56.3	37.9	47.2	64.1	81.6	72.9
	150	Urea1%	25.9	17.1	21.5	46.9	32.1	39.5	70.1	84.4	77.3
Fluazof	1000	-	28.4	26.4	27.4	38.0	42.2	40.1	75.8	79.5	77.7
	750	AMS2%	22.6	13.6	18.1	48.2	26.9	37.6	69.2	86.9	78.1
	750	Urea1%	17.1	22.9	20.0	37.3	42.8	40.1	76.2	79.2	77.7
Hoeing	-	-	10.5	3.9	7.2	24.2	19.5	21.9	84.6	90.5	87.6
Unweeded	-	-	77.5	116.1	96.8	156.7	205.8	181.3	0.0	0.0	0.0
Mean of cultivars			31.4	31.1		60.8	56.8		69.9	82.7	
LSD 0.05 for			Cv:NS;WC:9.1;Int:NS			Cv:NS;WC:17.6;Int:NS					

[1]Rate:cm^3/fed

Abbreviations: S.C: single cross, *C.*: *Cenchrus*; WC: weed control treatments; CV., cultivars; Int: interaction, AMS: ammonium sulphate

The broad leaved weeds in the experimental area were more sensitive than the narrow leaved weeds to the variation in the cultivars growth habit, where S.C. 164 cv plots had significant lower weed dry weight than that of S.C. 166 *cv* plots by 12.6 and 18.3 % at 8 and 12 WAS, respectively. This result may be due to that S.C. 164 cv was more taller (7.1%) than S.C. 166 cv (Table 3) and under unweeded treatment by 23.4%. This result may explain why the dry weight of most weeds was reduced in the plots of S.C 164 *cv*. Shetty *et al*. (1982) showed that dicots are less shade sensitive than monocots and help explain why monocots are often important tropical weeds. They added that at 90% shading plant height of weeds was reduced to 30% of the control with *Celosia* and *Tridax,* while *Digitaria* and *Dactyloctenium* showed 70 to 80% reductions in leaf area index at 90% shading. They added that dry matter production in *Digitaria*, *Dactyloctenium* and *canthospermum* was reduced up to 80% at higher shading levels.

Data in Table (2) indicated that the effect of maize cultivars on the dry weight of weeds at 12WAS take the same trend of data at 8 WAS, where the broad leaved weeds were significantly reduced in maize cultivar S.C. 164 by 18.3% compared to cv S.C.166. On the other hand, the dry weight of *Cynodon dactylonin* maize cultivar S.C. 166 was (52.9%) of that under cv S.C.164. The total dry weights of the weeds at 8 and 12 WAS were insignificant decreased by 6.6 and 7.9% in cv S.C 164 compared to that in S.C. 166 cv plots, respectively (Tables 1 &2). Similar findings on the effect of maize cultivars on weeds were recorded by Begna *et al*. (2001) and Gurney *et al.* (2002).

Data in Tables 1 and 2 revealed that the cultivars had insignificant effect on the total weed dry weight at 8 and 12 WAS. Oliveira *et al*. (2011) reported that no differences were found between dry matters of the above-ground part of weeds that occurred in plots of the three cultivars tested. Insignificant differences were noticed between the two varieties in dry weight of the weeds presented at 12 WAS except on *Convolvules arvensis, Cynodon dactylon* and *Cenchrus pennisetiformis*, where cultivar S.C.166 had lower dry weight of *C. arvensis* and *C. dactylon* by 38.3% and 47.1% compared to cv S.C.164. While plots of cv S.C.164 had lower dry weight of *C. pennisetiformis* by 16.8%, compared to cv S.C.166 (Table 2).

Effect of weed control treatments:

All weed control treatments reduced dry weight of both broad- and narrow-leaf weeds growing with maize (63 to 88% reduction) at 8 WAS (Table 1) and 90 to 93% reduction at 12 WAS (Table 2). Data recorded at 8 WAS on the dry weight of the weeds revealed that insignificant differences were noticed between hand hoeing and Fluroxypyr + one hand hoeing or one hoeing + Fluazifop-P-Butyl, either at full rate or applied at reduced rate with additive on *C. dactylon, C. pennisetiformis* and narrow leaved weeds (Table 1). Al-khatib *et al*. (1995) reported that weed control with bentazon applied at 0.56 kg ha^{-1} with any adjuvant was equal to weed control with bentazon applied alone at 1.12 kg ha^{-1}. While ,using full rate of Fluroxypyr + one hoeing had less efficacy on *Chenopodium album, Convolvules arvensis,* broad leaf weeds and total weeds in comparison to the other weed control treatment, however this treatment caused a significant reduction in the dry weight of these weeds as shown in Table (1). This may be due to that the additive may increased the efficacy of Fluroxypyr on these weeds. Al-Khatib *et al*. (1995) reported that adjuvant increased the uptake of herbicide by weeds. Abouziena *et al*. (2009) reported that addition of Induce, Kinetic or AMS reduced the bentazon rate from 1.12 kg to 0.84, i.e. 25% to achieve complete control of common cocklebur. The addition of an adjuvant increase herbicidal activity. The minimum rates of herbicide required for effective and consistent control was dependent on the particular combination of weed species, herbicide and its rate of application, growth stage at which the application was made, and adjuvant usage (Bellinder *et al*., 2003; Singh and Singh, 2005).

Concerning the effect of weed control treatments on the dry weight of weed species recorded after 12 WAS, the Data in Table (2) revealed that all weed control treatments significantly reduced the dry weight of the weeds, compared to un-weeded check, however insignificant differences were recorded among the weed control managements on the weed species as well as on total dry weight of broad- and narrow- leaved weeds.

Data in Table (2) also indicated that there was no advantage to using the full rate of Fluroxypyr or Fluazof, where there was insignificant difference recorded among the weed control treatments on weed species, broad and narrow leaf weeds and total weeds, however the weed control management had a pronounced effect on the weed species dry weight, compared to unweeded check treatment. This result mean that it could be use the reduced herbicide rate (75% rate) tank-mixture with additive instead of using the full herbicide rate alone. Similar finding was reported by Bellinder *et al*. (2003), Abouziena *et al*. (2009) and Parwada and Mudimu (2011) and El-Desoki *et al*. (2012). Dogan *et al*. (2005) reported that low rate of nicosulfuron and 2,4-D-amine herbicides mixture with ammonium-sulphate additive provided acceptable weed control during critical period, provided highest grain yield and its efficacy against difficult to control weeds was improved by ammonium-sulphate addition. Parwada and Mudimu (2011) reported that reduced alachlor dosage rates of 75%, 50%, and 25% of full-label application rates can control weeds effectively for the first three weeks after maize crop emergency.

Table 2: Effect of some weed control treatments on yellow maize weeds after 12 weeks after sowing. (Combined analysis of the two seasons)

Treatments			Cultivars								
			S.C 166	S.C 164	Mean	S.C 166	S.C 164	Mean	S.C 166	S.C 164	Mean
Herbicide	Rate[1]	Additive	*Chenopodium album*			*Portulaca oleraceae*			*Convolvules arvensis*		
Fluroxypyr	200	-	6.7	5.0	5.9	4.1	6.0	5.1	0.0	3.8	2..0
	150	AMS 2%	5.4	3.0	4.2	3.2	3.6	3.4	4.8	3.8	4.3
	150	Urea1%	6.8	2.9	4.8	4.2	4.4	4.3	2.2	2.3	2.2
Fluazof	1000	-	7.4	2.4	9.4	4.5	5.3	4.9	3.5	9.0	6.3
	750	AMS2%	7.1	2.8	5.0	0.1	5.8	3.0	4.9	2.4	3.7
	750	Urea1%	7.2	2.7	5.9	5.2	8.0	6.6	4.6	2.6	3.6
Hoeing	-	-	5.8	3.1	4.4	3.3	4.1	3.7	4.1	4.9	4.5
Unweeded	-	-	48.0	68.3	58.1	25.0	23.7	24.4	39.4	73.4	56.3
Mean			11.8	11.3		6.2	7.6		7.9	12.8	
LSD 0.05 for			Cv:NS; Wc:13.9 Int:NS			Cv: NS;WC:4.8; Int: NS			Cv: 3.1; wt:13.3; Int:NS		
			Broad leaf weeds			*Cynodon dactylon*			*Cenchrus pennisetiformis*		
Fluroxypyr	200	-	14.8	10.8	12.8	2.9	4.0	3.5	14.8	9.5	12.2
	150	AMS 2%	10.4	13.4	11.9	2.2	3.2	2.7	13.8	7.5	10.9
	150	Urea1%	9.6	13.2	11.4	0.0	3.7	1.9	14.4	6.0	10.2
Fluazof	1000	-	16.7	15.4	16.1	2.3	4.1	3.2	12.7	11.2	12.0
	750	AMS2%	11.0	12.1	11.6	4.1	1.4	2.7	14.0	6.0	10.0
	750	Urea1%	13.3	17.0	15.2	4.3	0.0	2.2	13.5	5.5	9.5
Hoeing	-	-	12.1	13.2	12.7	4.2	5.3	4.7	23.0	11.3	17.2
Unweeded	-	-	165.4	112.4	138.9	22.8	60.0	41.4	137.1	145.	141.2
Mean			31.7	25.9		5.4	10.2		30.4	25.3	
LSD 0.05 for			Cv:2.7;Wc:11.6;Int:NS			Cv:3.2;WC:13.7;Int:NS			Cv:3.9;WC:16.8; Int:NS		
			Narrow leaf weeds			Total weeds			Efficacy control%		
Fluroxypyr	200	-	17.7	13.5	15.6	32.5	24.3	28.4	90.0	92.3	91.2
	150	AMS 2%	16.0	10.7	13.4	26.4	24.1	25.3	91.9	92.4	92.2
	150	Urea1%	14.4	9.7	12.1	24.0	22.9	23.5	92.6	92.8	92.7
Fluazof	1000	-	15.0	15.3	15.2	31.7	30.7	31.3	90.3	90.3	90.3
	750	AMS2%	14.0	7.4	10.7	25.0	19.5	22.3	92.3	93.9	93.1
	750	Urea1%	13.5	5.5	9.5	26.8	22.5	24.7	91.8	92.9	92.3
Hoeing	-	-	23.0	11.3	17.2	35.1	24.5	29.9	89.2	92.3	90.7
Unweeded	-	-	159.9	205.0	182.5	325.3	317.4	321.4	00.0	00.0	00.0
Mean of cultivars			34.2	34.8		65.9	60.7		79.8	80.9	
LSD 0.05 for			Cv:NS;WC:19.9;Int:NS			Cv:NS;WC:36.4;Int:NS					

[1]Rate:cm^3/fed

Abbreviations: S.C: single cross, WC: weed control treatments; CV., cultivars; Int: interaction, AMS: ammonium sulphate

Effect of interaction between cultivars and weed control treatments:

Data in Tables (1 and 2) indicated that the interaction between cultivars and weed control treatments had insignificant effect on the dry weights of the weed species and broad- and narrow-leaved weeds as well as on the total weeds at 8 and 12 WAS.

B. Maize Yield And Its Components:

Effect of cultivars:

The yield of a crop is a function of a number of factors and processes such as light intercepted by the canopy, metabolic efficiency of plants, translocation efficiency of photosynthates from leaves to economic parts and sink capacity or sink strength amongst others (Doki, 1977) and the genetic makeup of the crops (Ibeawuchi *et al*., 2008). Number of rows/ear, number of kernels per row, straw weight/plant, ear grain weight and biological yield criteria were no significant differed between the two cultivars tested as shown in Table (3). On the other hand, cultivar S.C. 164 had significant more values of plant height and ear length than S.C.166 cv, while the latter cultivar significant surpassed the other one in the values of ear diameter and weight, grain weight per ear, grain index and biological and grain yields (Table 3). Significant differences in grain yield and yield components between yellow maize cultivars were reported by Mehasen and Al-Fageh, 2004, AbdEl-Wahed *et al*., 2006, Ibeawuchi *et al*, 2008, El-Gizawy and Salem (2010), Ahmed and El-Housini, 2012, Sedhom *et al*. (2012) and Elgamaal and Maswada (2013).

The physiological efficiency and ability of a crop for converting the total dry matter into economic yield is known as harvest index (HI) (Sinclair, 1998). Data in Table (3) showed that S.C. 166 *cv* had the maximum HI which was reflected in their slight increase in grain yields by 3.8% than S.C.164 *cv*. Salah *et al*. (2011) reported that yellow maize hybrids varieties differed significantly in photosynthate partitioning, where significant differences were found in yield energy per plant and/or feddan for kernels and straw yields, as well as, above ground biomass and coefficient energy of harvest index were significant. The differences between cultivars in grain and biological yields may be due to the genetical differences among cultivars and different genotypes concerning dry matter partitioning where maize cultivars may differ in carbon equivalent, yield energy per plant and per fedden (Abd El-Gawad *et al*., 1987).

Effect of weed control treatments:

Weed competition caused a significant reduction in the value of plant height, ear length, ear diameter, number of rows/ear, number of kernels per row, ear weight, grain weight per ear and straw weight by 35.3, 37.5, 14.6, 17.3, 28.3, 27.1, 50.5 and 4o.6 % respectively and consequently decreased the grain yield per feddan by 49.7%, compared to hoeing treatment (Table 3). The reduction in maize yield due to weed competition reached 66-90 % (Dalley *et al*., 2006 and Abouziena *et al*., 2007). Gomaa *et al*. (2011) reported that allowing weeds to grow for the whole season of maize markedly decreased ear characters (length, number of grains and weight), 100-grain weight as well as grain yield/plant. Similar results were obtained by Abouziena *et al.* (2008), Shekari *et al*. (2010), Soliman and Gharib (2011), Mehmeti *et al*. (2012) and Simić *et al*. (2012).

The reduction in grain yield due to weeds may be attributed to several factors, e.g., competition between maize and weeds for water and nutrients, especially under sandy soil and allelopathic effects of weeds. 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. Also, Zimdahl (1999) mentioned that competition for water is often considered the most important source of weed–crop competition. Weeds growing 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. Relative to maize that was grown alone, maize root density was reduced from 41 to 87%. The calculated root: shoot ratios as well as the results of shoot dry weight and root density showed that both weed species restricted root growth more than they restricted shoot growth of maize (Britschgi *et al*., 2013).

Controlling maize weeds by the all management treatments resulted in significant increase in all yield criteria tested, and the highest grain yield per feddan was obtained by the application of one hoeing at 3 WAS followed by spraying reduced rate of Fluazifop-P-Butyl tank mixed with AMS at 2% or urea at 1%, where the two superior treatments gave the same yield (3.5 t/fed) as shown in Table (3). Weiner *et al.* (2001) reported that there was a linear relationship between above-ground weed biomass and crop yield, so weed suppression translocated directly into yield. However insignificant differences were recorded among the weed management treatments (Table 3). The data also revealed that no additional advantages from application the full rate of Fluroxypyr or Fluazifop-P-Butyl compared to the same herbicide (reduced rate) plus additive, where comparatively higher grain yield were found in plots treated with the reduced herbicide rate than full rate. These results are in harmony with those obtained with Dogan *et al*. (2005), Parwada and Mudimu (2011), El-Desoki *et al*. (2012) and El-Metwally *et al*. (2012). Kir and Dogan (2009) reported that 50% herbicide rate was efficient as the recommended rate and provided similar maize yield as obtained from plots treated with higher rates or from weed-free control plots. Simić *et al*. (2012) reported that herbicide application induced a significant increase of all maize evaluated parameters in treatments treated at full and half rate of herbicides compared to untreated control.

The unweeded treatment had the minimum harvest index, and the all weed management had the highest values with insignificant differences among them, however treatment of one hoeing +reduced Fluazifop-P-Butyl rate plus urea recorded the maximum HI and increased this trait by 31% than the unweeded treatment (Table 3). These results are in agreement with El-Metwally *et al*. (2012). Dogan *et al*. (2005) reported that low rate of nicosulfuron and 2.4-D-amine herbicides mixture with ammonium-sulphate additive provided highest grain yield.

Effect of interaction between cultivars and weed control treatments:

The interaction between cultivars and weed control treatments had significant effects on most yield criteria, except on harvest index and biological yield as shown in Table (3). The highest number of grains/row, ear weight, ear grain weight were obtained from S.C. 164 cv when grown in the plots weeded by one hoeing at 3 WAS + reduced Fluazifop-P-Butyl rate plus urea applied at 6 WAS. While sowing S.C. 164 cv and application of one hoeing at 3 WAS + reduced Fluazifop-P-Butyl rate plus AMS applied at 6 WAS produced the highest grain yield. This result may be attributed to the highest weed control efficacy of these treatments (Tables 1 and 2).

Table 3: Effect of some weed control treatments on the yield of two yellow maize varieties. (Combined analysis of the two seasons)

Treatments			Cultivars								
			S.C 166	S.C 164	Mean	S.C 166	S.C 164	Mean	S.C 166	S.C 164	Mean
Herbicide	Rate [1]	Additive	Plant height (cm)			Ear length (cm)			Ear diameter (cm)		
Fluroxypyr	200	-	206.7	216.7	211.7	18.7	25.0	21.8	6.0	4.0	5.0
	150	AMS 2%	215.0	233.3	224.2	18.0	26.0	22.0	6.4	3.7	5.0
	150	Urea1%	210.0	220.0	215.0	16.3	23.7	20.0	4.4	4.0	4.2
Fluazof	1000	-	211.7	231.7	221.7	23.0	23.0	23.0	4.2	3.9	4.0
	750	AMS2%	216.7	233.3	225.0	23.7	26.3	25.0	3.7	3.7	3.7
	750	Urea1%	228.3	215.0	221.7	25.7	25.3	25.5	3.7	3.9	3.8
Hoeing	-	-	217.0	225.0	221.0	22.0	24.0	23.0	5.9	4.0	4.8
Unweeded	-	-	128.3	158.3	143.3	16.3	15.0	15.7	4.9	3.4	4.1
Mean			204.2	218.7		20.5	23.5		4.9	3.8	
LSD 0.05 for			Cv:9.5;wt:11.5,int:16.5			Cv:2.3; wt: 2.3; Int:1.6			Cv:0.2;WC:0.4; Int:0.6		
			Number of rows/ear			Number of grains/row			Ear weight (g)		
Fluroxypyr	200	-	12.7	12.0	12.3	39.7	33.7	36.7	136.7	118.3	127.5
	150	AMS 2%	13.3	11.7	12.5	41.7	40.7	41.2	143.3	141.7	142.5
	150	Urea1%	11.7	12.0	11.8	41.0	41.3	41.2	124.0	134.3	129.2
Fluazof	1000	-	12.0	12.0	12.0	43.3	41.3	42.3	143.7	135.7	139.7
	750	AMS 2%	11.0	12.7	11.8	38.0	40.0	39.0	135.0	149.0	142.0
	750	Urea1%	10.3	12.0	11.2	40.0	44.3	42.2	130.7	152.0	141.3
Hoeing	-	-	13.3	12.0	12.7	40.7	40.7	40.7	135.3	138.3	136.8
Unweeded	-	-	11.0	10.0	10.5	30.0	28.3	29.2	115.7	83.7	99.7
Mean of cultivars			11.9	11.8		38.5	38.8		135.6	131.7	
LSD 0.05 for			Cv:NS; WC: 2.9; Int: 2.0			Cv:NS; WC:2.7; Int:3.9			Cv:3.3;WC:13.9, Int:19.6		
			Ear grain weight (g)			Straw weight g plant^{-1}			Grain index g^{-1}		
Fluroxypyr	200	-	126.7	98.3	112.5	262.7	255.0	258.8	24.7	24.3	24.5
	150	AMS 2%	121.7	121.7	121.7	257.7	261.7	259.7	23.3	19.7	21.5
	150	Urea1%	110.0	113.3	111.7	256.7	258.3	257.5	20.7	19.0	19.8
Fluazof	1000	-	121.7	115.0	118.3	261.0	255.0	258.0	21.7	19.0	20.3
	750	AMS 2%	120.0	130.0	125.0	260.7	258.3	259.5	23.3	22.3	22.8
	750	Urea1%	116.7	133.3	125.0	255.0	261.7	258.3	21.3	20.3	20.8
Hoeing	-	-	126.3	118.0	122.2	266.7	253.3	260.0	23.0	19.7	21.4
Unweeded	-	-	71.3	50.8	61.1	149.0	160.0	154.5	21.6	17.3	19.5
Mean of cultivars			114.3	110.1		246.2	245.4		22.5	20.2	
LSD 0.05 for			Cv:NS;WC:11.1;Int:15.8			Cv: NS; WC: 6.2;Int: 8.8			Cv:1.0;WC:1.8; Int:2.5		
			Biological yield g plant^{-1}			Harvest index %			Grain yield t fed^{-1}		
Fluroxypyr	200	-	399.4	373.3	386.4	31.7	26.3	29.0	3.548	2.752	3.150
	150	AMS 2%	401.0	403.4	402.2	30.3	30.2	30.3	3.408	3.408	3.407
	150	Urea1%	380.7	392.6	386.7	28.9	28.9	28.9	3.080	3.172	3.126
Fluazof	1000	-	404.7	390.7	397.7	30.1	29.4	29.8	3.408	3.220	3.314
	750	AMS 2%	395.7	407.3	401.5	30.3	31.9	31.1	3.360	3.640	3.500
	750	Urea1%	385.7	413.7	399.7	30.3	32.2	31.3	3.268	3.732	3.500
Hoeing	-	-	402.0	391.6	396.8	31.4	30.1	30.8	3.536	3.304	3.420
Unweeded	-	-	264.7	243.7	254.2	26.9	20.9	23.9	2.001	1.440	1.721
Mean of cultivars			379.2	377.0		30.0	28.7		3.201	3.084	
LSD 0.05 for			Cv:NS;WC:15.0;Int:NS			Cv:0.8;WC:1.0;Int:NS			0.082;WC:0.189;Int:0.305		

[1]Rate:cm^3/fed

Abbreviations: S.C: single cross, WC: weed control treatments; CV., cultivars; Int: interaction, AMS: ammonium sulphate

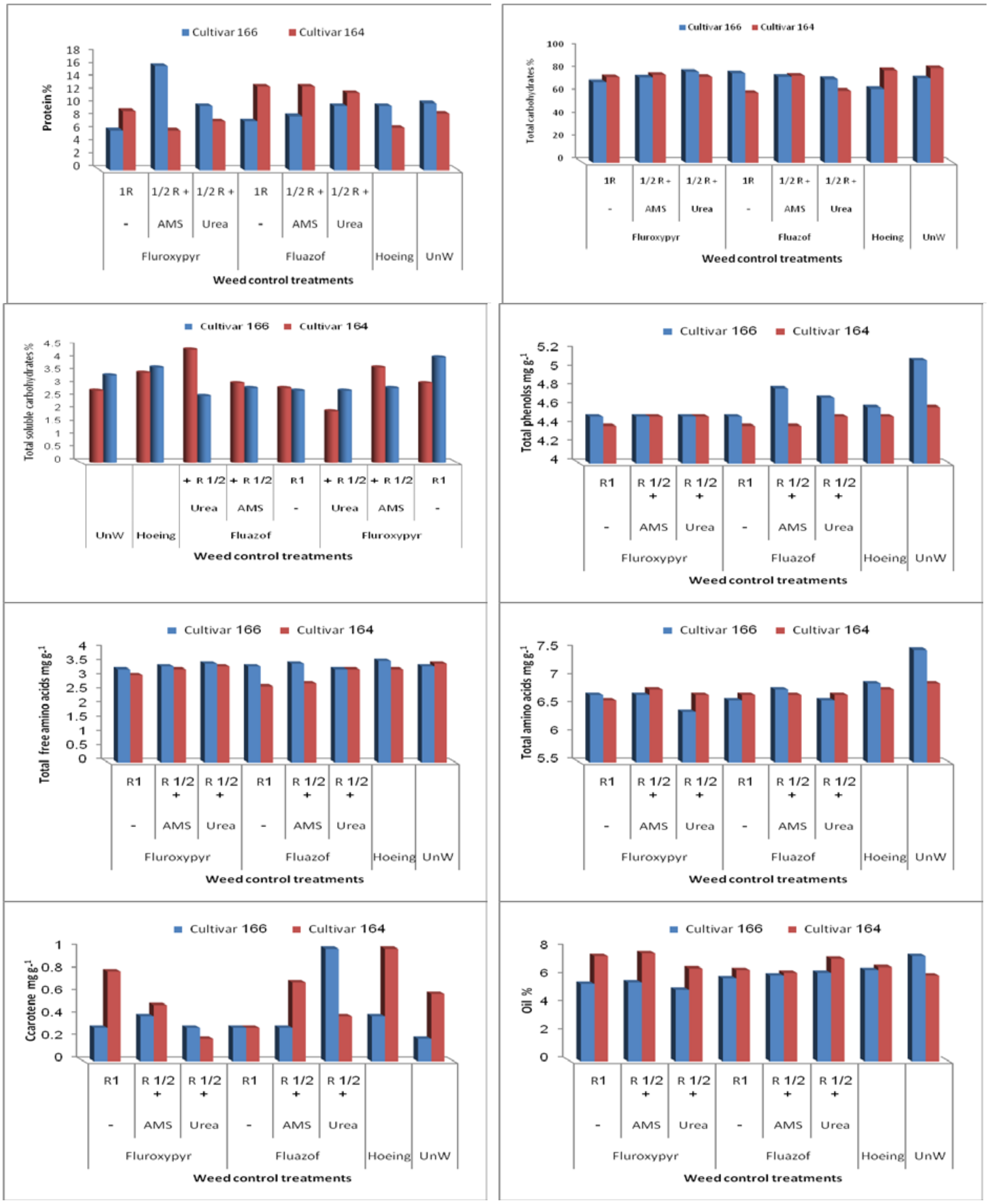
C. Chemical Constituents In Maize Grains:

Effect of cultivars:

Data in Fig (1) indicated that there were insignificant differences between the two cultivars in total carbohydrate, total soluble carbohydrates, total free amino acids, total phenols and total indoles contents in grains. On the other hand ,there was a significant difference between the two cultivars in protein, oil and carotenoids percentages, where S.C. 164 *cv* had higher protein, oil and carotenoids percentage than the S.C 166 *cv* one by 7.5, 11.5 and 50.0%, respectively. The Significant differences in carbohydrate, protein, oil and carotenoids contents between yellow maize cultivars were reported by AbdEl-Wahed *et al*. (2006), El-Gizawy and Salem (2010), Ahmed and El-Housini (2012), Sedhom *et al*. (2012), Elgamaal and Maswada (2013). Salah *et al*. (2011) reported that yellow maize hybrids varieties differed significantly in photosynthate partitioning, where significant differences were found in carbohydrate, protein and oil percentages in kernels.

Concerning the total carotenes, Data in Fig (1) showed that there was a significant difference between the two cultivars in the total carotenoids contents, where S.C. 164 cv had higher carotenoids content than the

S.C.166 *cv* by 50.0%. Menkir and Maziya-Dixon (2004) reported that β-carotene content was strongly influenced by the genotype than by the environment.



LSD at 5% for	Protein	Total carbohydrates	Total soluble carbohydrates	Total free amino acids	Total phenols	Total Indoles	Carotene	Oil
Cultivars	0.2	NS	NS	NS	NS	NS	0.1	0.1
Weed control	0.5	8.5	0.2	1.0	0.3	0.4	0.2	0.2
Interaction	0.8	12.1	0.3	1.4	0.4	0.5	0.2	0.2

Fig. 1: Chemical constituents of two yellow maize cultivars as affected by weed control treatments (R: recommended rate; AMS: ammonium sulphate; UnW: Un-weeded check).

Effect of weed control treatments:

Uncontrolling weeds caused a significant reduction in protein and total soluble carbohydrates content by 13.5 and 13.9% as well as insignificant increase in total carbohydrates and total free amino acids by 7.0 and 5.7%, respectively, compared to hoeing treatment (Fig 1). These reductions may be attributed to the completion between maize plants and weeds on the 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. Our results are in harmony with those obtained by Gomaa *et al*. (2011), El-Desoki *et al*. (2012) and El-Metwally *et al*. (2012). Friesen *et al*. (1960) mentioned that weeds compete very effectively with the crop for available nitrogen to the point that the reductions in yields from weed competition are generally accompanied by reduction in protein content as well.

Carotenoids are derived from the isoprenoid biosynthetic pathway and are precursors of the plant hormone abscisic acid and of other apocarotenoids (Safawo *et al*., 2010). Weed interference for the entire growing season significantly decreased the carotenoids content by 42.9% relative to hoeing treatment (Fig.1). Mohammadi *et al*. (2012) reported that full season weedy condition decreased seed vigour and quality indices including 100-seed weight, seed germination percentage, mean germination rate, radicle dry weight, plumule dry weight, seedling vigour index and seed protein content of the produced seeds by 21.0, 14.2, 10.5, 33.7, 32.2, 40.6 and 9.7% respectively, when compared with the entire weed free condition.

Effect of interaction between cultivars and weed control treatments:

Data presented in Fig (1) indicated that the interaction between cultivars and weed control treatments had significant effects on the chemical constituents of yellow maize grains, where S.C. 166 cv with weed management included hoeing and Fluazifop-P-Butyl + urea had the highest total free amino acids and total carotenoids content, respectively. Also S.C. 166 cv in unweeded plots had higher values of total phenols and indoles. While S.C.164 cv in weed management included hoeing, Fluazifop-P-Butyl +urea and Fluroxypyr +AMS had the highest values of total carbohydrates, total soluble carbohydrates and oil contents, respectively (Fig 1). Simić *et al*. (2012) reported that genotype influenced significantly maize grains and add that the interactions of the hybrid type and the herbicide rate significantly influenced grain yield of maize.

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