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YIELD AND ITS ATTRIBUTES OF TWO MAIZE CULTIVARS AND ASSOCIATED WEEDS AS AFFECTED BY SOME WEED CONTROL METHODS AND NITROGEN FERTILIZER LEVELS

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ABSTRACT

These experiments were performed for two successive summer seasons of 2013 and 2014 at Gemmeiza Agric. Res. Station, Gharbia Governorate, Egypt. The ultimate aim of this work was to evaluate the effect of four weed control methods [1- un-weeded check $W_{1,}$, 2- hand hoeing twice at 18 and 30 days age $W_{2,}$, 3- using Harness herbicide (Acetochlor) 84% Ec at the rate of one liter/fad., sprayed directly after planting and before irrigation,W_3 and at last, 4- using Harness herbicide 84% Ec plus one hand hoeing conducted at 30 days old W_4], three nitrogen levels, *viz*: 90, 120 and 150 kg N/fad., and their interactions on the yield, its attributes, quality of the two maize cultivars, being: 1- white cultivar SC 128 and 2- yellow cultivar SC 168 as well as on the associated weeds. The experimental design was a split-split plot system of three replicates. The obtained results indicated that the four weed control treatments exhibited significant variations in most of the studied characters for both weeds and maize, where the W_4 treatment (using Harness herbicide 84% Ec plus one hand hoeing) produced markedly greater mean averages in each of: weed reduction percentage, maize plant and ear heights, ear length and diameter, number of rows / ear, number of grains/row, grain index, shelling percentage, grain yield / fad, protein content and yield / fad., when compared with W_3, W_2 and the un-weeded check, orderly. But, opposite trend was seen regarding the total weed dry weight (g/m^2), since the un–weeded check was extreme in this regard. Such inclination was clearly manifest in both seasons and over them too. Also, SC 128 maize cultivar was significantly superior to its counterpart SC 168 in all yield attributes and yield/fad., in both trials and across them as well and *vice versa* regarding the total weed dry weight (g/m^2). In addition, the three N levels tested gave significant changes in all the studied traits for both weeds and maize, where the highest N level of 150 kg N/fad was most effective in enhancing such tested characters (except the total weed dry weight in g/m^2) if compared with both 90 and 120 kg N levels/fad. Grain yield/fad., of maize correlated positively and strongly with each of: plant and ear heights, ear length and diameter, rows/ear, grains/row, 100- grain weight, shelling and protein percentages, but weed biomass gave negative and significant relations with grain yield/fad. Such correlation results referred significantly to the effective treatments tested in this study to suppress the competitive ability of weeds and maize grain yield enhancement. Based on this research findings, keeping maize field weed-free by using Harness herbicide (Acedochlor) 84% Ec pre-emergence at the rate of one liter/fad., plus one hand hoeing at 30 days old to control the spread weeds either broad– leaved or grassy as well as adding the appreciable N level of 150 kg N/ fad, especially in low deficient N soil, could be taken into account in depressing the domenant competitive weeds and maximizing the final yields/fad., from grain and protein for the SC 128 cultivar under Gemmeiza location conditions, Gharbia Governorate, Egypt.

Key words: Weed treatment, maize cultivars, nitrogen fertilization, weeds, maize grain yield/fad.

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INTRODUCTION

Maize (*Zea mays* L.) is the third most important cereal crops in the world after wheat and rice in terms of the cultivated area and the total production. It plays an important role in the world agricultural economy. The crop is widely used as a food, fodder, feed and also service as a source of raw materials necessary for some industrial products preparation. In Egypt, maize is grown on an area of 2.36 million faddans with a total production of 8.41 million tones of grains and per fad., yield of 3493 kg grains (24.95 ardab/fad.).

Among other cereal crops, maize has the highest genetic yield potential, therefore it is known as a queen of cereals. Likewise, in Egypt the cultivated area of maize is limited and the grain yield production is still far below to meet the increasing demand of human consumption and animal feeding.

Weeds are misfits (un-desired plants) and one of the major limiting factors of maize production throughout the world. Weeds cause significantly higher maize yield losses worldwide with an average of 12.8% even weed control methods are applied and 29.2% in case of conducting the suitable control methods (Oerke and Steiner, 1996).

Effect of Weed Control Treatments on Weeds and Maize

Weed control methods play an active role on maize weeds as well as maize growth and yields. Some workers pointed out to the reduction of dry weight of maize weeds as well as to the improved growth, yield attributes and yield of maize due to using the effective weed control treatments that used both herbicides and hand hoeing, for example Soliman and Gharib (2011) documented greater reduction in weed dry weight (g/m^2) as well as improved growth, yield and its attributes due to using integrated weed control method of using Acetochlor herbicide 84% Ec (Harness) at the rate of one liter/fad., along with one hand hoeing at 30 days age. Similar results were reported by: Mekky (2001), Mekky *et al.* (2002), Abouziena *et al.* (2008), Ahmed *et al*. (2008), Tahir *et al.* (2009), Pariya *et al.* (2014) and Shaba *et al.* (2015).

Although, several high yielding maize cultivars are developed and released, but still the required potential yield of maize crop could not be achieved. This is mostly due to no or less importance given to weed control practices by the growing farmers. Many workers documented significant cultivar differences in maize yield and its attributes, of them, El-Nagar (2002) showed the superiority of the two white maize cultivars (SC 10 and SC 122) on the other two yellow ones (SC 158 and SC 161) regarding plant height, ear length and diameter, number of rows/ ear, grain number/ row, grain index and grain yield either/ plant or / fad. Similar cultivar variations were given by El-Agamy *et al.* (1999), Soliman *et al.* (2005), Hassan *et al.* (2008), Abdou (2012) and Radma and Dagash (2013). In this concern, published reports with the total weed biomass related with maize cultivar are rather meager.

Effect of Nitrogen Fertilization on Weeds and Maize

The application of N fertilizer to maize plants reflected positive impact on weeds, either broad - leaved or grassy, where the highest N level of 140 kg N/fad., produced greater reduction in the total weed dry weight recorded at 50 days old compared with the lower N level used, being 80, 100, and 120 kg N/fad., and *vice versa* regarding the percent of weed reduction as reported by: Soliman and Gharib (2011). Likewise, other studies have reported that added N enhanced the competitive ability of weeds more than maize crop (Barker *et al.* (2006). In opposite, other workers cited that higher N levels favoured maize growth over weeds (Abouziena *et al.,* 2007).

As for the effect of N fertilization on maize behaviour, El-Sobky (2014) examined the effect of 20, 60 and 120 kg N levels/fad., on some maize characters and he revealed that the 120 kg N/fad., was more effective in raising each of number of ears/ plant, ear length, grains/row, grain index, shelling (%) and the final yields/ fad., from stover, ear, grain and biomass if compared with the other two N levels tested. Similar results were seen by Abd-Alla (2005), El-Nagar (2012), Hoshang (2012), Vanya (2014) and El-Kholy (2015).

Ultimately, this work was conducted to study the effect of some weed control methods and N fertilizer levels on yield and its attributes of the two maize cultivars as well as on the associated weeds, under Gemmeize location, Gharbia Governorate, Egypt.

MATERIALS AND METHODS

This study was executed during the two successive seasons of 2013 and 2014 at Gemmeiza Agric Res. Station, Gharbia Governorate, Egypt. The objective of this work was limited to examine the impact of four weed control methods, three nitrogen levels and their interactions on weeds, yield attributes and yield/fad., of two maize cultivars.

The Studied Factors

Weed control methods

Four weed control methods chosen were:

1. Non-weeding (check), W_1.
2. Hand hoeing twice, at 18 and 30 days after planting, W_2 .
3. Using Harness herbicide 84% (Acetochlor) Ec at the rate of one litre/fad., applied on soil surface directly after planting and before irrigation, W_3.
4. Applying Harness herbicide 84% Ec by the same methods of W_3 with hand hoeing once at 30 days age.

Harness 84% Ec (trade name) as a pre-emergence herbicide was sprayed by Knap - Sack sprayer CP_3 with water volume of 200 liters/fad. The chemical composition of such herbicide is (2- chloro - N - (ethoxymethyl)- N-(2- methyl - 6- methyl phenyle acetamide). The common name of Harness herbicide is Acetochlor 84% Ec.

Maize genotypes (cultivars), V

Two maize genotypes used were:

Single cross SC 128 cultivar (white), V_1, and Single cross SC 168 cultivar (yellow), V_2.

The two above-named cultivars were released by maize Res. Dept., Agric., Res., Centre, Cairo, Egypt.

Nitrogen fertilizer levels N

The three nitrogen fertilizer levels tried were:

90 kg N level/fad., N_1, 120 kg N level/fad., N_2 and 3. 150 kg N level/fad., N_3.

Each nitrogen level was applied at three equal does, just before the first, second and third irrigations, orderly being at 15, 25 and 35 days after planting in the form of urea fertilizer (46.5% N).

Experimental Design

The twenty four treatments tested were distributed in a split-split plot system of four replicates. The main plots included the four weed control methods and the sub - plots were assigned to the two maize cultivars, whereas the sub-sub plots were devoted to the three nitrogen fertilizer levels. The size of the sub-sub plot (experimental unit) was 19.2 m^2 having four ridges each of 80 cm width and 6 m length. The two outside ridges were left to avoid the border effects and the other two central ridges were used for weed parameters, yield and yield attributes of maize.

The soil of this trial was clay in texture with pH 7.5, organic matter 0.95%, available N, P and K 25.1, 50.3 and 160.6 ppm, successively (averages of both seasons at the soil depth of 30 cm). The value of N nutrient is classified as low. Also, the Meteorological data of Gemmeiza District recorded during achieving this study clear that the maximum relative humidity values were 83.8, 84.1, 84.6, 85.1 and 83.7% (averages of June, July, August, September and October months for both seasons). In addition, the maximum degrees of temperature were clearly high, being: 34.8, 36.7, 36.2 , 34.7 and 34.1, for the abovementioned months in both seasons, orderly.

Experimental Details

The proceeding crop was barley in both seasons. The experimental fields of both trials were irrigated and when become freeable, they were ploughed twice, harrowed and compacted suitably to prepare a fine seed–bed. Ridging was practiced as ridge to ridge distance of 80 cm apart for both cultivars according to the local operation used in the experimental station. Also, 25 cm as hill to hill spacing was used in this study. The experiments were hand planted to achieve plant population density of about 30 000 plants/fad. The grains of the two maize cultivars were hand planted on June 6 in both seasons at the rate of 10 kg grains / fad., for SC 128 and SC 168 cultivars, and this rate was calculated on the basis of grain index related to each cultivars. The grains were preprocessed against soil diseases and pests by using the recommended fungicides and pesticides. Likewise, missing or incomplete hills were replanted after the complete emergence (21 days from planting) to keep the standard stand /fad., for both cultivars. Thinning to one plant/hill was done when the plants reached four leaves stage (15 cm height) to maintain inter plant spacing. Weed control treatments were applied as to maize plants per treatments and the associated weeds. To realize a good nutritional status, calcium-super phosphate (15.5% P_2O_5) and potassium sulphate (48 – 52% k_2O) fertilizers were applied overall the entire experimental area during seed-bed preparation at the rates of 15 and 25 kg P_2O_5 and K_2O/fad., orderly. Each nitrogen fertilizer level (90, 120 and 150 kg N/fad., according to the tested N levels used) was applied just before the first, second and third irrigations, respectively in the form of urea fertilizers of 46.5% nitrogen. All other intercultural practices, were manually performed in maize production existed in Gemmeize Station as it when necessary. Lastly, maize crop was harvested manually on Oct. 15 during both seasons.

The Studied Characters (Topics) for Both Maize and Weeds

Weed behavior

The weed infested in maize fields were hand pulled at random from one square meter of each experimental unit at 90 days old, identified and classified to broad-leaved and grasses. Thereafter, the weeds were open air dried for three days, then put in a forced draft oven at 70°C till constant weight, therefore the two weed categories were determined:

1. Total weed dry weight (biomass) g/m^2.

2. The percent of weed reduction, R.

It was calculated using the following formula:

$$R = \frac{A - B}{A} \times 100$$

Where:

A and B allude to dry weight of weeds in the un-treated and treated plots, successively.

In this regard, the major weeds presented in the experimental site included:

Broad-leaved weeds, such as

1- *Corchorus olitorius,* L.

2- *Euphorbia prunifolia,* Jacas.

3- *Portulaca oleracoa,* L.

4- *Sida alba,* L.

5- *Hbiscus trionum,* L.

6- *Chenpodium album,* L.

7- *Chenopodium murale*, L.

8- *Amaranthus retroflexus,* L.

9- *Beta vulgaris,* L.

10- *Conyza linifolia (willd.)* Tackh.

11- *Xanthium brasilicum* (Vrtlozo).

12- *Convolvulus arvensis* (Olleiq).

Grassy weeds (narrow leaved weeds), as

1- *Cyperus longus,* L.

2- *cyperus rotundus*, L.

3-*Cynodon diactylon* (L.) pess.

4- *Dinebra retroflex* (Forssk) Panz.

5- *Echinochloa colonum* (L.) link.

6- *Echinochloa crus-galli* (L.) P Beauv.

7- *Setaria verticillata* (L.) P Beauv.

8- *Sorghum virgatum* (Hack.) Stapf.

Yield and its attributive characters as well as yield quality of maize

At harvesting time and after the physiological maturity, five guarded maize plants were harvested at random from the second ridge in each sub-sub plot of the four replicates, then the following maize yield attributes were set up:

3- Plant height (cm): Was measured using a tap measure from the ground surface to the top of the maize funnel.

4- Height of the first ear (cm). It was measured from the ground level till the highest ear-bearing node.

5- Ear length (cob) cm.

6- Ear diameter (cm).

7- Number of rows/ear.

8- Number of grains per row.

9- 100- grain weight (g).

10- Shelling percentage (%) =

$$\frac{\text{Grain weight / ear in grams}}{\text{Ear weight in gram}} \times 100$$

11- Grain yield/fad., (ardab): The maize plants found in gross area of 4.8 m^2 were harvested from the third ridge in each experimental area for the four replicates in both seasons, then the final grain yield in ardab/fad., was estimated (adjusted to 15.5% moisture content).

12- Protein percentage (content) in maize grains. Total N in maize grains was determined according to the Standard Kiel-Dahl Method. N values were multiplied by 6.25 to calculate protein content.

13- Protein yield/fad., (kg) was calculated by multiplying the final maize grain yield/fad., by the grain protein content (percentage) and dividing by 100.

Simple Correlation Coefficient

On pooled data basis of both trials, a simple correlation coefficient between maize grain yield/fad., and some agronomic characters was calculated using the procedure described by Svab (1973).

Statistical Analysis

The obtained data of both seasons for all traits studied and their integrated data was subjected to the analysis of variance according to standard statistical manner documented by Sokal and Rohlf (1997). Significant different means were separated using Duncan Multiple Rang Test at 1.0 and 0.05% levels of probability (Duncan, 1955).

In addition, the combined analysis of variance was computed for the results of both trials, after establishing by Bartlett,s homogeneous test, since the error variant of the individual seasons was homogeneous. Means having the same letters are not significantly different, In this connection and in interaction Tables, capital and small letters were used for comparison among the means of rows and colomns, orderly. * and ** refer to the significant and highly significant variations, whereas NS denote to the non-significant differences, consecutively.

RESULTS AND DISCUSSION

The results of this work delt with the effect of different treatments, being: weed control methods, cultivars behavior, N fertilizer levels and their interactions on both: weeds and maize characters.

On Weeds

Weed control methods effect

The four weed control treatments detected significant changes in dry weight of both broad-leaved and grassy weeds as well as the percent of weed reduction due to applying such treatments (Table 1).

It is clear that, the W_4 treatment (using Harness herbicide 84% Ec at the rate of one liter/fad., pre-emergence plus one hand hoeing applied at 30 day age) gave the lowest record of total weed dry weight (g/m^2) if compared with the other two treatments used and the un-weeded cheek.Opposite trend was seen as for the percent of weed reduction, since the same treatment was extreme in this regard. Such tendency was clearly shown in both seasons and over them. It could be suggested that, the W_4 treatment proved to be more efficient method on weed depression than the other treatments used. (Table 1). Soliman and Gharib (2011) reported significant reduction in weed dry weight due to using effective weed control regime included Actochlor herbicide 84% Ec pre-emergence (Harness) plus using one hand hoeing conducted at 30 day age. Such results showed a great similarity to those given by Mekky (2001),

Table 1. Total weed dry weight (g/m^2) and percentage of weed reduction (%) of maize as influenced by different treatments during 2013 and 2014 seasons

Main effects and interactions	Total weed dry weight (g/m^2)			Percentage of weed reduction (%)		
	2013	2014	Comb.	2013	2014	Comb.
Weed control method, (W)						
Un-weeded (check), W_1	0.626 a	0.606 a	0.616 a	-----	-----	-----
Hand hoeing twice, W_2	0.409 b	0.451 b	0.430 b	34.66 c	25.58 c	30.12 c
Harness herbicide 84%Ec alone, W_3	0.325 c	0.355 c	0.340 c	48.08 b	41.42 b	44.75 b
Harness herbicide 84%Ec with hand hoeing once, W_4	0.132 d	0.144 d	0.138 d	78.90 a	76.24 a	77.57 a
F. test	**	**	**	**	**	**
Maize cultivar (V)						
SC 128, V_1	0.340 b	0.368 b	0.354 b	45.68 a	39.28 a	42.48 a
SC 168, V_2	0.406 a	0.410 a	0.408 a	35.14 b	32.34 b	33.74 b
F. test	**	**	**	**	**	**
Nitrogen level, (kg N/fad.), N						
90, N_1	0.467 a	0.497 a	0.482 a	25.40 c	18.00 c	21.70 c
120, N_2	0.388 b	0.354 b	0.371 b	38.02 b	41.58 b	39.80 b
150, N_3	0.264 c	0.316 c	0.290 c	57.81 a	47.85 a	52.83 a
F. test	**	**	**	**	**	**
Interactions						
W × V	NS	NS	NS	NS	NS	NS
W × N	NS	NS	NS	NS	NS	NS
V × N	NS	NS	NS	NS	NS	NS

Mekky *et al.* (2002), Abouziena *et al.* (2008), Ahmed *et al.* (2008), Tahir *et al.* (2009) and Pariya *et al.* (2014).

Cultivar differences

Significant cultivar variations were seen between the two maize cultivars as for total weed dry weighs (g/m^2) and the percent of weed reduction in both seasons and in their combined as well. The SC 128 cultivar recorded significantly greater mean values regarding the percent of weed reduction than the SC 168 cultivar. The reveres hold true as for the total weed dry weight, since the former cultivar was superior than the latter one in this concern (Table 1). The variation between the two maize cultivars respecting both weed dry weight (g/m^2) and the percent of their reduction could be attributed to the genetic make up and their interactions with the environmental conditions. In this regard, published researches with the total weed dry weight and the percent of weed reduction of maize cultivars are not available.

Nitrogen fertilizer level effect

Nitrogen levels excerted marked changes, as for the total weed dry weight (g/m^2) and the percent of weed reductions in both trials and in their pooled data as well (Table 1). The highest N level of 150 kg N/fad., gave statistically the lowest mean values respecting the total dry weigh of weeds followed by 120 and 90 kg N levels in a descending order. At the same-time, weed reduction behaved inversely to total weed biomass, being increased due to increasing N level from 90, to 120 and 150 kg N/fad., (Table 1). It could be seen that N level of 150 kg N/fad., gave a rapid and excessive maize growth and stimulated the competitive ability of maize plants rather than the weed plants. In other meaning, maize crop is a C_4 plant and the most infested weeds are C_3 species, therefore maize may be considered as a greater user of higher N nutrient, thereby increased plant vigour and canopy structure giving higher competitive potency to its plants that could be able to suppress weed growth assembled herein as a reduction in total weed biomass in this connection. These results are in accordance with those documented by Abouziena *et al.* (2007) and Soliman and Gharib (2011). In opposite, other workers cited that, added N at higher levels enhanced the competitive power of weeds more than maize crop (Barker *et al.*, 2006).

In this regard, no significant interaction effect was found between any two of the studied factors respecting both dry biomass of weeds and the percent of weed reducton (Table 1) suggesting that the treatments tested were relatively independent in mode of action on such weed variables, therefore the data were discarded.

On Maize Crop

Weed control methods effect

Significant diversities were distinguished between the four weed control regimes as for most of maize yield attributes and the final yields/fad., in both trials and in their pooled dada as well (Tables 2, 3, 4 and 5, orderly). Here, it could be observed that, the W_4 treatment of using Harness herbicide 84% Ec at the rate of one l/fad., pre-emergence together with hand hoeing once at 30 day old proved to be more efficient method than the other two ones and the un-weeded check in terms of the following characters: plant and ear heights, ear length and diameter, number of rows/ear, grain number/ row, 100-grain weight, shelling percentage, grain yield/fad., and both protein percentage and yield/ fad. Such favourable trend was existed in both seasons and confirmed in their integrated data too (Tables 2, 3, 4 and 5, successively). In this respect, the W_4 treatment conducted by using Harness herbicide 84% Ec though one hand hoeing proved to be more efficient in terms of weed suppression and maize yield as well as its attributable variable enhancements. In other meaning, Harness herbicide 84% Ec used in integration with supplementary hand hoeing oncely could minimize weed competition to a greater extent and thereby improved the efficiency of absorbing more necessary nutrients and photosynthate products which accumulated completely inside maize plant organs ending therefore with maximizing the final grain yield/ fad., and its related traits. These results are paralleled with those obtained by other workers, of them: Mekky (2001), Mekky *et al.* (2002), Abouziena *et al.* (2008), Ahmed *et al.* (2008), Tahir *et al.* (2009), Soliman and Gharib (2011), Pariya *et al.* (2014) and Shaba *et al.* (2015).

Cultivar differences

The two maize cultivars, being SC 128 and SC 168 (white and yellow hybrids) varied meaningly in all maize yield and its attributive parameters in both seasons and when their data were statistically analyzed (Tables 2, 3, 4 and 5, respectively). Here, it could be observed that, the former cultivar (SC 128 had the greater mean values than the latter one (SC 168) of the most studied characters, being: plant and ear heights, ear length and diameter, number of rows/ ear, grain number/row, 100- grain weight, shelling (%) and both grain and protein yields/ fad. The reverse hold valid as to maize grain protein content, since the SC 168 cultivar was more prnounced in this regard. These results may be attributed to the variations in growth habit and the response of each cultivars to the environmental conditions during the growing seasons, which are controlled by the genetical factors. These findings are in harmony with those attained by El-Agamy *et al.* (1999), El-Nagar (2002), Soliman *et al.* (2005), Hassan *et al.* (2008), Abdou (2012) and Radma and Dagash (2013).

Nitrogen fertilizer level effect

Tables 2, 3, 4 and 5, orderly clearing the effect of different N levels on all the studied characters of maize crop, where the highest mean averages were substantially given in response to the 150 kg N/fad., followed in arrangement with both 90 and 120 kg N/fad., successively. Such noticement was clearly obvious in both years and across them too. The favourable effect of 150 kg N/fad., was drastically. prone on the coming maize parameters *viz*: plant and ear heights, ear length and diameter, number of rows/ear, number of grains / row, grain index, shelling percentage,

Table 2. Plant height (cm), ear height (cm) and ear length (cm) of maize as influenced by the different treatments during 2013 and 2014 seasons

Main effects and interactions	Plant height (cm)			Ear height (cm)			Ear length (cm)		
	2013	2014	Comb.	2013	2014	Comb.	2013	2014	Comb.
Weed control method (W)									
Un-weeded (check), W_1	228.91d	228.13d	228.52d	126.54d	133.75d	130.15d	17.75d	19.07d	18.39d
Hand hoeing twice, W_2	232.54c	232.28c	232.41c	131.46c	136.45c	133.95c	20.30c	20.98c	20.64c
Harness herbicide 84%Ec alone, W_3	236.66b	234.67b	235.66b	134.38b	140.03b	137.20b	22.04b	21.24b	21.62b
Harness herbicide 84%Ec with hand hoeing once, W_4	238.13a	238.25a	238.19a	136.58a	142.25a	139.42a	23.39a	22.91a	23.15a
F. test	**	*	**	*	**	**	**	**	**
Maize cultivar (V)									
SC 128, V_1	235.48a	235.54a	235.51a	133.50a	139.33a	136.42a	22.75a	22.17a	22.44a
SC 168, V_2	232.64b	231.12b	231.88b	130.98b	136.91b	133.94b	18.99b	19.93b	19.46b
F. test	*	**	**	*	**	**	**	**	**
Nitrogen level (kg N/fad.), N									
90, N_1	231.75c	231.13c	231.44c	130.03c	135.81c	132.92c	18.86c	18.56c	18.69c
120, N_2	233.90b	232.81b	233.35b	131.56b	138.12b	134.84b	20.96b	21.06b	21.00b
150, N_3	236.53a	236.06a	236.29a	135.13a	140.43a	137.78a	22.79a	23.53a	23.16a
F. test	**	*	**	*	**	**	**	**	**
Interactions									
W × V	*	NS	NS	NS	NS	NS	NS	*	NS
W × N	NS	*	NS	NS	NS	NS	*	NS	*
V × N	*	NS	NS	NS	*	NS	NS	NS	NS

Table 3. Ear diameter (cm), number of rows/ear and number of grains/row of maize as influenced by the different treatments during 2013 and 2014 seasons

Main effects and interactions	Ear diameter (cm)			Number of rows/ear			Number of grains/row		
	2013	2014	Comb.	2013	2014	Comb.	2013	2014	Comb.
Weed control method (W)									
Un-weeded (check), W_1	2.45d	2.81d	2.63d	12.68d	13.84d	13.26d	36.80d	40.59d	38.70d
Hand hoeing twice, W_2	3.58c	3.84c	3.71c	13.77c	14.22c	13.97c	40.34c	44.31c	42.32nc
Harness herbicide 84%Ec alone, W_3	5.57b	5.85b	5.71b	15.66b	14.98b	15.32b	42.22b	45.92b	44.07b
Harness herbicide 84%Ec with hand hoeing once, W_4	6.64a	6.86a	6.75a	16.85a	15.36 a	16.10a	43.88a	46.34a	45.11a
F. test	*	*	**	*	**	**	**	*	**
Maize cultivar (V)									
SC 128, V_1	5.55a	5.85a	5.70a	15.59a	15.77a	15.68a	41.06a	45.55a	43.30a
SC 168, V_2	3.57b	3.83b	3.70b	13.89b	13.43b	13.65b	40.56b	43.03b	41.80b
F. test	*	*	*	*	*	*	*	**	**
Nitrogen level (kg N/fad.), N									
90, N_1	3.53c	3.83c	3.68c	13.84c	14.07c	13.94c	39.00c	42.18c	40.59c
120, N_2	4.60b	4.84b	4.72b	14.66b	14.56b	14.61b	40.76b	44.65b	42.71b
150, N_3	5.55a	5.85a	5.70a	15.72a	15.16a	15.44a	42.67a	46.04a	44.35a
F. test	*	**	**	**	*	**	**	*	**
Interactions									
W × V	NS	NS	NS	NS	NS	NS	NS	NS	NS
W × N	*	NS	NS	NS	NS	NS	NS	NS	NS

V × N	*	NS	NS	NS	NS	NS	NS	NS

Table 4. 100-grain weight (g), shelling percentage (%) and grain yield (ardab/fad.) of maize as influenced by the different treatments during 2013 and 2014 seasons

Main effects and interactions	100-grain weight (g)			Shelling percentage (%)			Grain yield (ardab/fad.)		
	2013	2014	Comb.	2013	2014	Comb.	2013	2014	Comb.
Weed control method (W)									
Un-weeded (check), W_1	38.80d	38.00d	38.40d	79.08d	77.98d	78.53d	26.99d	28.63d	27.81d
Hand hoeing twice, W_2	39.66c	39.88c	39.77c	80.49c	80.85c	80.67c	30.71c	30.81c	30.76c
Harness herbicide 84%Ec alone, W_3	41.70b	41.08b	41.39b	83.22b	83.78b	83.50b	32.12b	32.42b	32.27b
Harness herbicide 84%Ec with hand hoeing once, W_4	42.32a	42.56a	42.44a	84.89a	86.75a	85.82a	34.94a	37.38a	36.16a
F. test	**	**	**	**	**	**	**	**	**
Maize cultivar (V)									
SC 128, V_1	42.54a	41.70a	42.12a	82..23a	83.19a	82.71a	32.32a	34.46a	33.39a
SC 168, V_2	38.70b	39.06b	38.88b	81.61b	81.49b	81.55b	30.06b	30.16b	30.11b
F. test	**	*	**	*	*	*	*	**	**
Nitrogen level (kg N/fad.), N									
90, N_1	38.20c	39.44c	38.82c	80.23c	80.96c	80.60c	28.98c	29.94c	29.46c
120, N_2	40.90b	40.44b	40.67b	81.90b	81.83b	81.87b	31.35b	32.83b	32.09b
150, N_3	42.76a	41.26a	42.01a	83.63a	84.23a	83.92a	33.24a	34.16a	33.70a
F. test	**	*	**	**	**	**	**	**	**
Interactions									
W × V	*	NS	NS	*	NS	NS	NS	*	*
W × N	*	*	**	*	NS	NS	**	NS	**
V × N	NS	NS	NS	*	*	**	**	*	**

Ardab = 140 kg

Table 5. Protein percentage and protein yield (kg/fad.) of maize as influenced by the different treatments during 2013 and 2014 seasons

Main effects and interactions	Protein (%)			Protein yield (kg/fad.)		
	2013	2014	Comb.	2013	2014	Comb.
Weed control method (W)						
Un-weeded (check), W_1	7.13d	9.02d	8.08d	192.44d	258.16d	225.30d
Hand hoeing twice, W_2	9.93c	10.73c	10.33c	304.95c	330.49c	317.72c
Harness herbicide 84%Ec alone, W_3	10.13b	11.71b	10.92b	325.38b	379.52b	352.45b
Harness herbicide 84%Ec with hand hoeing once, W_4	11.45a	12.38 a	11.91a	400.11a	462.63a	431.37a
F. test	**	**	**	**	**	**
Maize cultivar (V)						
SC 128, V_1	9.41b	10.50b	9.95b	308.69a	361.73a	335.21a
SC 168, V_2	9.92a	11.42a	10.67a	302.75b	353.67b	328.21b
F. test	*	*	*	*	**	**
Nitrogen level (kg N/fad.), N						
90, N_1	8.89c	9.12c	9.00c	260.88c	277.16c	269.02c
120, N_2	9.47b	10.80b	10.13b	300.04b	348.34b	324.19b
150, N_3	10.62a	12.96 a	11.79a	356.24a	447.60a	401.92a
F. test	**	**	**	**	**	**
Interactions						
W × V	NS	NS	NS	*	**	*
W × N	NS	NS	NS	**	*	**
V × N	NS	NS	NS	NS	*	*

grain yield/fad., protein (%) and yield/fad. It could be observed that the increase in final yield/fad., may be ascribed to the marked increases in all yield attributive parameters, as well as to the pronounced role of N nutrient in stimulating the photosynthesis and other biochemical processes inside maize plant organs, which is responsible much for increasing all the studied traits and their sequence final yields per unit area as well. Identical findings were recorded by Abd-Alla (2005), Soliman and Gharib (2011), El-Nagar (2012), Hoshang (2012), El-Sobky (2014), Vanya (2014) and El-Kholy (2015).

Interaction Affect

On pooled data basis, the maize plants of SC 128 cultivar had greater mean values respecting both grain and protein yields/fad., when the weed control treatment of Harness herbicide along with one hand hoeing was practiced. On the other hand, the latter SC 168 plants gave little mean records as for both yields in case of the un-weeded treatment. Other treatment combinations detected intermediate values respecting such yields (Table 6).

Likewise, the four weed control regimes interacted strongly (according to the pooled data) with the three N levels as for maize ear length, 100-grain weight and both grain as well as protein yields/fad., revealing the superiority of the fourth weed treatment (Harness herbicide 84% Ec plus one hand hoeing) on the other three weed treatments respecting such mentioned traits and when the highest N level of 150 kg N/fad., was considered. At the same-time, the plants of the un-weeded check gave the lowest mean records of such above-named characters when the 90 kg N level/fad., was applied. The other interacting values established between any pairs of the other treatments reflected intermediate records of maize ear length, grain index and both grain as well as protein yields per fad., as documented in Table 7.

Furthermore, on combined data of this study, the two maize cultivars interacted positively with the three N levels tested regarding shelling (%) and both grain as well as protein yields/fad., clearing the supremassy of SC 128 cultivar on its counterpart SC 168 one in such characters in case of using the 150 kg N level. Meanwhile, the SC 168 had mean little values in such above-mentioned traits by considering the 90 kg N level. The other interacting values for the other treatments recorded herein respecting such previous traits laid in between as shown in Table 8.

Finally, it could be concluded from the interacting values of this research that fertilizing maize plants with 150 kg N/fad., and controlling weeds prevailing, either broad-leaved or grassy, in the experimental site by applying the fourth weed treatment assembled as Harness herbicide 84% Ec plus one hand hoeing produced the greatest records of some yield attributes and the sequence grain and protein yields/fad. Such effect was clearly shown in both cultivars, being more noticeable when the SC 128 cultivar (white one) was in the picture.

Simple Correlation Coefficient

The results of simple correlation coefficient between maize grain yield/fad., and some important agronomic characters indicated that such yield was correlated positively and strongly with each of plant and ear heights, ear length and diameter, rows/ear, grains / row, grain index, shelling (%) and at last protein content and yield/ fad. (Table 9).

At the same-time, negative and significant relations were observed between grain yield/ fad., and the total dry weight of weeds. In addition, the latter character (weed biomass) gave negative and close associations with all the above-named characters. Furthermore, positive and significant interrelationships were documented between any pairs of the studied variables (Table 6). Similar observations were seen by other workers, of them: Ghanem (1988), El-Banna and Gomaa (2000), Ash-Shormillesy (2005), Atia (2006), Abdou (2012) and Moraditochaee *et al*. (2012).

The results of simple correlation coefficient of this study allude to the efficacy of the tested treatments in suppressing the spread weeds in maize fields and maximizing the final yields/ fad., of SC 128 cultivar under Gemmeize site conditions, Gharbia Governorate, Egypt.

Table 6. Grain and protein yields/fad., of maize in response to the W × V interactions, pooled data

Weed treatment, W \ Cultivars, V	Grain yield/fad.		Protein yield /fad.	
	SC 128	SC 168	SC 128	SC 168
Un-weeded (check), W_1	A 28.11 d	B 27.51 d	A 230.16 d	B 220.44 d
Hand hoeing twice, W_2	A 33.12 c	B 28.40 c	B 310.10 c	A 325.34 c
Harness herbicide 84% Ec alone, W_3	A 34.15 b	B 30.39 b	A 360.14 b	B 344.76 b
Harness herbicide 84%Ec with hand hoeing once, W_4	A 38.18 a	B 34.14 a	A 440.44 a	B 422.30 a

Table 7. Ear length (cm), grain index (g) and grain as well as protein yields/ fad., of maize as affected by the W × N interactions, pooled data

Weed treatments, W \ N levels (kg N/fad.), N	Ear length (cm)			100-grain weight (g)			Grain yield/fad.			Protein yield/fad.		
	90	120	150	90	120	150	90	120	150	90	120	150
Un-weeded (check), W_1	C 16.00 d	B 18.22 d	A 21.01 d	C 36.10 d	B 39.20 d	A 39.90d	C 26.10 d	B 28.12 d	A 29.21 d	C 200.12 d	B 225.00 d	A 250.78 d
Hand hoeing twice, W_2	C 18.40 c	B 20.60 c	A 22.92 c	C 37.40 c	B 40.20 c	A 41.71 c	C 28.40 c	B 31.16 c	A 32.72 c	C 242.12 c	B 315.14 c	A 395.90 c
Harness herbicide 84% Ec alone, W_3	C 19.80 b	B 21.80 b	A 23.32 b	C 40.60 b	B 41.42 b	A 42.15b	C 31.14 b	B 32.18 b	A 33.49 b	C 300.14 b	B 320.15 b	A 437.06 b
Harness herbicide 84% Ec with hand hoeing once, W_4	C 20.64 a	B 23.42 a	A 25.39 a	C 41.18 a	B 41.86 a	A 44.28 a	C 32.20 a	B 36.90 a	A 39.38 a	C 333.70 a	B 436.47 a	A 523.94 a

Table 8. Shelling (%) and grain as well as protein yields/fad., of maize as affected by the interactions between cultivars and N levels, pooled data

N levels (kg N/fad.), N \ Cultivars, V	Shelling (%)		Grain yield/fad.		Protein yield /fad.	
	SC 128	SC 168	SC 128	SC 168	SC 128	SC 168
90	A 81.12 c	B 80.08 c	A 30.80 c	B 28.12 c	A 272.20 c	B 265.84 c
120	A 82.40 b	B 81.34 b	A 34. 10 b	B 30.08 b	A 328.10 b	B 320.28 b
150	A 84.61 a	B 83.23 a	A 35.27 a	B 32.13 a	A 405.33 a	B 398.51 a

Table 9. Simple correlation coefficients between maize grain yield in ardab/fad., and its related characters, pooled data of 2013 and 2014 seasons

Variables	1	2	3	4	5	6	7	8	9	10	11
Y - Grain yield/fad	0.641**	0.682**	0.931**	0.852**	0.780**	0.813**	0.955**	0.783**	0.556**	0.901**	- 0.437*
1- Plant height (cm)		0.671**	0.705**	0.612**	0.580**	0.677**	0.799**	0.685**	0.540**	0.667**	- 0.433*
2- Ear height (cm)			0.841**	0.701**	0.688**	0.764**	0.801**	0.703**	0.501**	0.801**	- 0.504**
3-Ear length (cm)				0.856**	0.740**	0.833**	0.812**	0.775**	0.564**	0.777**	- 0.499*
4- Ear diameter (cm)					0.691**	0.841**	0.844**	0.688**	0.604**	0.798**	- 0.514**
5- No. of rows/ear						0.698**	0.832**	0.704**	0.581**	0.805**	- 0.488*
6- No. of kernels/row							0.806**	0.890**	0.605**	0.814**	- 0.501**
7- 100-kernel weight								0.888**	0.707**	0.890**	- 0.555**
8- Shelling percentage									0.680**	0.899**	- 0.499*
9- Protein percentage										0.889**	- 0.601**
10- Protein yield/fad											- 0.606**
11-Weed dry biomass (g/m^2)											_

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تأثر المحصول ومساهماته لصنفين من الذرة الشامية والحشائش المصاحبة لبعض طرق مقاومة الحشائش ومستويات السماد النيتروجيني

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أجريت هذه التجربة خلال الموسمين ٢٠١٣ و ٢٠١٤ في محطة البحوث الزراعية – بالجميزة – غربية – جمهورية مصر العربية بغرض دراسة تأثير أربعة طرق لمقاومة الحشائش في الذرة الشامية وهى: بدون مقاومة (W_1)، المقاومة بالعزيق اليدوى مرتين عند ١٨ و ٣٠ يوما من الزراعة (W_2) المقاومة الكيماوية باستخدام المبيد Harness 84% Ec بمعدل واحد لتر/فدان وذلك بعد الزراعة وقبل الري (W_3) وأخيرًا المقاومة المشتركة باستخدام المبيد Harness 84% Ec مع عزقه واحدة عند ٣٠ يوما من الزراعة (W_4)، وأيضًا تم استخدام ثلاث مستويات من السماد النيتروجينى وهى ٩٠، ١٢٠، ١٥٠ كجم ن/فدان، التفاعل بينهما وذلك على المحصول ومساهماته لصنفين من الذرة الشامية: هجين فردى SC 128 وهو صنف ابيض ثم هجين فردى اصفر وهو SC 168 وأيضا على الحشائش المصاحبة، كان التصميم التجريبى المستخدم هو نظام القطع الشقية من الدرجة الثانية ووزعت المعاملات في أربع مكررات أظهرت النتائج وجود اختلافات معنوية في كلا الموسمين وفي التحليل المشترك وذلك على جميع صفات الذرة الشامية، وأيضا صفات الحشائش وهى: ارتفاع النبات، ارتفاع أول كوز، طول وقطر الكوز، عدد السطور/ كوز، عدد الحبوب/ سطر، وزن الـ ١٠٠ حبة، نسبة التفريط، محصول الحبوب/ فدان، ونسبة ومحصول البروتين/ فدان وأخيرا الوزن الجاف الكلى للحشائش ونسبة النقص فيها بسبب المعاملات المختلفة، وأوضحت النتائج تفوق المعاملة W_4 على المعاملتين الأخيرتين ومعاملة المقارنة لجميع صفات محصول الذرة الشامية وأيضا نسبة النقص في الحشائش، بينما تفوقت معنويا المعاملة بدون مقاومة W_1 على المعاملات الثلاث في صفة الوزن الحاف الكلى للحشائش، نتج معنويا عن تسميد نباتات الصنف الأول هجين فردي ١٢٨ بالمستوى ١٥٠ كجم ن/فدان أعلي القيم لمعظم الصفات تحت الدراسة للذرة والحشائش المصاحبة والتي سبق ذكرها بالمقارنة بتسميد الهجين الفردى ١٦٨، وفي نفس الوقت تفوق الصنف هجين فردى ١٦٨ عند تسميد نباتاته بالمستوي ٩٠ كجم ن/فدان على الصنف الأخر في صفة الوزن الجاف الكلى للحشائش، وقد ظهر ذلك بوضوح في كلا الموسمين وفي التحليل التجميعي لهما، أيضاً، كشفت النتائج وجود تداخل فعل معنوى بين المعاملة W_4 والمستوى ١٥٠ كجم ن/فدان على محصولي البروتين والحبوب/فدان، حيث أعطت هذه المعاملة اعلي القيم للمحصولين وذلك في حالة الصنف هجين فردي ١٢٨ بالمقارنة بالصنف الآخر، أوضحت نتائج معامل الارتباط: وجود علاقة موجة ومعنوية بين محصول الحبوب / فدان وكل من : ارتفاع النبات، وارتفاع أول كوز، طول وقطر الكوز، عدد السطور/ كوز، عدد الحبوب / سطر، وزن ١٠٠ حبة، نسبة التفريط ومحصول البروتين/فدان، وتعطى هذه النتائج مؤشر قويا على فاعلية وكفاءة المعاملات تحت الدراسة في زيادة المحصول ومكوناته وفي الحد من نمو الحشائش المصاحبة، أخيرًا، وفي ضوء نتائج هذا البحث: يمكن التوصية بزراعة صنف الذرة الشامية هجين فردى ١٢٨ تحت ظروف محطة البحوث الزراعية - الجميزة بمحافظة الغربية والظروف المشابه لها وذلك بمقاومة الحشائش المنتشرة في حقل الذرة الشامية وذلك بالجمع بين المقاومة الكيماوية باستخدام المبيد الفعال Harness 84%Ec بمعدل واحد لتر/فدان وقبل الظهور مع استخدام طريقة المقاومة الميكانيكية بالعزيق اليدوى مرة واحدة عند ٣٠ يومًا من الزراعة، وقد أعطت هذه الطريقة تثبيطاً قوياً للقدرة التنافسية للحشائش المنتشرة وخفضاً معنوياً للوزن الجاف الكلى للحشائش مع زيادة المحصول النهائي من الحبوب/فدان.

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