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EVALUATION OF SOME PROMISING SUNFLOWER GENOTYPES FOR YIELD, ITS COMPONENTS AND QUALITY

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ABSTRACT

Two field experiments were carried out at Sakha Agric. Res. Station, during two seasons of ٢٠١٠ and ٢٠١١ to investigate the performance of fifteen sunflower genotypes namely some new open pollinated genotypes (١٢٠, ١٢٥, ٢٣٠, ٢٣٥, ٢٤٠, ٢٤٥, ٣٥٠, ٣٥٥, ٤٦٠, ٤٦٥, ٧٧٠, ٧٧٥, ٨٨٠ and two commercial varieties Giza ١٠٢ and Sakha ٥٣.

Giza ١٠٢ variety gave the lowest values for number of days from planting to ٥٠٪ budding, flowering and maturity (٣٩,٥, ٤٧,٧٥ and ٨٦,٠٠ days, respectively, whereas genotypes ٧٧٥ gave the highest values (٤٧,٨٨, ٥٦,٧٥ and ٩٣,١٣ days, respectively).

Results of the combined analysis of the two seasons showed that significant differences were observed among the sunflower genotypes in all characters of yield and its components, physical properties, germination and seedling vigor. Genotype ٢٤٥ gave the highest value for plant height (١٨٦,٢٥ cm), whereas, Sakha ٥٣ variety gave the highest values for head diameter and stem diameter (١٨,١٣ cm and ٢,٦٣ cm, respectively). Sakha ٥٣ variety ranked first and achieved the highest estimates for seed yield/plant (٤٥,٣٨ gm), seed yield/fed. (١٤٨٣,٧٥ kg) and oil yield/fed. (٥٩٠,٥١ kg). Physical properties of the fifteen tested sunflower seed genotypes varied from one genotype to the other. Genotype ١٢٠ gave the highest values for seed index and relative density (g/cm^{٣}), while genotype ٢٣٥ and genotype ٢٤٠ had the highest volume values of ١٠٠ seeds (cm^{٣}).

Sakha ٥٣ variety exceeded all other genotypes in seed oil content ٣٩,٨١٪ and protein content ranged from ٢٤,٣٠٪ genotype ٣٥٠ to ٢٩,٥٩٪ in genotype ٢٤٠.

Giza ١٠٢ variety gave the highest values of germination percentage and shoot length, while Sakha ٥٣ variety had the highest value of radical length. Dry weight of seedling ranged from ٥٥,١ mg (genotype ٧٧٠) to ٧٣,٨ mg (genotype ٢٣٥). SDS-PAGE showed changes in the protein banding pattern and hand density to different between ١٥ genotypes of sunflower under study.

Positive and highly significant correlation coefficient were found between seed yield/fed. and all related traits, stem diameter, head diameter, seed index, seed yield/plant, oil content and oil yield/fed.

Keywords:*Helianthus annuus* L., flowering and maturity stage, germination and seedling vigor, yield components and quality.

INTRODUCTION

Sunflower (*Helianthus annuus* L.) is one of the most important oil crops that could be grown to cover partially the gap between local production and consumption of edible oils. Sunflower is cultivated at approximately ٢٤ million hectares in ٤٠ countries of the world (FAS, ٢٠١١).

In Egypt, the cultivated area of sunflower is ٨٣٣ ha as sold cultivation with productivity ٢,٤ ton/ha and ٢٥٠٠ ha as intercropped with other field crops and productivity ١,٢ ton/ha (FAO, ٢٠١٠). The local production of edible oils is about ٣-٥٪ only of the total requirements. For increasing the total production of edible oil, the area cultivated with oil crops such as sunflower should be

increased by expanding in the newly reclaimed soil and planting high potential yield cultivars (Hussain *et al*., ٢٠٠٦).

The present investigation is designed to gain some information on the relative variation in yield and its components between fifteen sunflower genotypes. This study could be furnish a satisfactory basis for selection in sunflower breeding programs to achieve high yield and oil quality of sunflower.

Many investigators obtained higher levels of varietal differences in yield and its components of sunflower in many regions of growing sunflower in the world. Ibrahim *et al*. (٢٠٠٦); Abdel-Motagally and Osman (٢٠١٠); Ahmed *et al* (٢٠١٠); Sadak *et al*. (٢٠١٠) and Aml *et al*. (٢٠١١) indicated that sunflower genotypes significantly differed in yield and its components.

Physical properties, oil and protein contents of different genotypes of sunflower seeds were carried out to figure out the natural and quality of sunflower seed samples. Kinman and Earle (١٩٦٤); Marinkoovic *et al*. (٢٠٠٣) and Aml *et al*. (٢٠١١) on germination, seedling vigor and correlation. Many results were obtained by Rondanini *et al*. (٢٠٠٦); Radic *et al*. (٢٠٠٨) and Aml *et al*. (٢٠١١).

The success of electrophoretic procedures depends on the wide ranging polymorphism of seed protein. SDS-PAGE of protein is the most commonly used method to discriminate the varieties. The protein banding pattern is unique for the particular genotype and is independent of seed vigor and physiological seed activity (Kamel *et al*., ٢٠٠٣). Denaturing system provides a simple reproducible technique for cultivar identification as reported by Devi (٢٠٠٠) in sunflower and SDS-PAGE of seed protein was successfully used for both identification and differentiation of sunflower cultivars (Jacques *et al*., ١٩٩٥).

The present study aimed to evaluate the productivity of some new open pollinated sunflower genotypes with two commercial varieties as check varieties, physical properties, oil and protein contents, germination and seedling vigor and electrophoresis of total soluble proteins were evaluated.

MATERIALS AND METHODS

The present investigation was carried out at Sakha Agric. Res. Station, Kafr El-Sheikh, Governorate, Egypt, during the two successive seasons of ٢٠١٠ and ٢٠١١ to evaluate fifteen sunflower genotypes (thirteen open pollinated sunflower genotypes and two commercial varieties Giza ١٠٢ and Sakha ٥٣), as shown in Table (١).

The genotypes were planted in randomized complete black design, with four replications. The proceeding crop was the Egyptian clover in both seasons.

Seeds of each sunflower genotype were sown on May ١٦th and ٢٠th in ٢٠١٠ and ٢٠١١ seasons, respectively. Plot size was ١٢ m^{٢} (٣ x ٤ m) in ٦ ridges each ٤ meters long and ٦٠ cm apart; ٣-٤ seeds per hill were placed with ٢٠ cm between hills. One plant per hill was maintained by thinning of ٢١ days after sowing. The conventional cultural practices of growing sunflower were conducted as recommended at North Delta region.

Number of days from planting to ٥٠٪ budding, flowering and maturity in each plot were recorded.

Two outside ridges were left to avoid border effects and the four inner ridges were used for the determination of seed yield and its components. The heads of four inner ridges in each plot were bagged at the end of pollination and fertilization to avoid damage that could be caused by birds until maturity.

Table ١: Pedigree of the different genotypes used in this study

No.	Genotype	Pedigree
١	Genotype ١٢٠	Mayak x Bulgarian ٢*
٢	Genotype ١٢٥	Mayak x Bulgarian ٣*
٣	Genotype ٢٣٠	Giza ١ x Bulgarian ١*
٤	Genotype ٢٣٥	Giza ١ x Bulgarian ٢*
٥	Genotype ٢٤٠	Bulgarian ٨* x Bulgarian ٣*
٦	Genotype ٢٤٥	Bulgarian ٤* x Bulgarian ٣*
٧	Genotype ٣٥٠	Bulgarian ٤* x Bulgarian ٢*
٨	Genotype ٣٥٥	Bulgarian ٥١* x Bulgarian ٤٩*
٩	Genotype ٤٦٠	Bulgarian ٥١* x Bulgarian ٥٢*
١٠	Genotype ٤٦٥	Bulgarian ٥٣* x Bulgarian ٥٢*
١١	Genotype ٧٧٠	Bulgarian ٥٣* x Bulgarian ٤٩*
١٢	Genotype ٧٧٥	Bulgarian ٥٤* x Bulgarian ٤٩*
١٣	Genotype ٨٨٠	Bulgarian ٥٤* x Bulgarian ٥٢*
١٤	Giza ١٠٢	Giza
١٥	Sakha ٥٣	Mayak x Bulgarian ١

*** A Bulgarian sunflower genotypes.**

For measuring studied plant traits, ten guarded plants were randomly taken from the four inner ridges of each experimental unit at harvest and the following data were recorded: plant height (cm), head diameter (cm), stem diameter (cm) and seed yield per plant (g).

The heads of four inner ridges of each plot were harvested to determine seed yield per feddan. Oil yield (kg/fed.) was estimated by multiplying seed yield (kg/fed.) by seed oil percentage.

Physical properties, oil and protein content:

١. Seed index (١٠٠ seed weight gm).
٢. Volume of ١٠٠ seed was determined by rapeseed displacement according to the methods of Kulp *et al*. (١٩٨٥).
٣. Relative density was calculated according to Kramer and Twigg (١٩٦٢) method and using the following equation:

$$\text{Relative density} = \frac{\text{Weight of 100 seed (gm)}}{\text{Volume of 1000 seed (cm}^3\text{)}} = \text{g/cm}^3$$

٤. Oil and protein contents were determined according to the method described by A.O.A.C. (١٩٩٥).

Germination and seedling vigor:

A standard in vitro germination test (I.S.T.A, ١٩٩٣) was conducted in four replicates of ٥٠ seeds for each seed sample using folded paper towels at ٢٠^{o}C and germination counts for normal seedlings were done after ten days. The length of shoot and radial (cm) of the most ١٥ vigorous seedling of each replicates was measured, then seedling were oven dried at ١٠٥^{o}C to a constant weight.

Seedling vigor:

١. Shoot length (cm)
٢. Radical length (cm)
٣. Seedling dry weight (g)

Measured according to the procedures exported in the seed vigor tested handbook (A.O.S.A., ١٩٩١).

Electrophoresis of total soluble proteins:

Soluble proteins were extracted from the seeds and SDS-PAGE was conducted according to protocol described by Laemmli (١٩٧٠). The resulted protein banding patterns were analyzed in comparison to the protein marker using the computer program (Bio-١D).

Data were statistically analyzed for each season and the homogeneity of experimental error, in both seasons, was tested according to Snedecor and Cochran (١٩٨٢). Then, the combined analysis of the two seasons was done and treatment means were compared by Duncan's multiple range test (Duncan, ١٩٥٥). Correlation was performed according to Singh and Chaudhary (١٩٧٧).

RESULTS AND DISCUSSION

Budding, flowering and maturity stages:

Number of days from planting to ٥٠٪ budding, flowering and physiological maturity of different sunflower genotypes from the combined analysis over two seasons of ٢٠١٠ and ٢٠١١ are presented in Table (٢). Analysis of variance revealed significant differences between means of the fifteen sunflower genotypes for all studied traits. Number of days to ٥٠٪ budding, flowering and maturity are substantially earlier in the sunflower commercial cultivar Giza ١٠٢ which gave ٣٩,٥, ٤٧,٧٥ and ٨٦,٠٠ days from planting, respectively, followed by Sakha ٥٣ that recorded ٤٢,٦٣, ٥٢,٥٠ and ٨٩,٥٠ days, respectively, whereas budding dates were delayed significantly for genotype ٧٧٥ (٤٧,٨٨ days) followed by genotype ٢٤٥ and genotype ٤٦٣.

Table (٢): Number of days from planting to ٥٠٪ budding, flowering and maturity of fifteen sunflower genotypes (combined analysis over the seasons of ٢٠١٠ and ٢٠١١).

Traits / Genotypes	No. of days to ٥٠٪ budding	No. of days to ٥٠٪ flowering	No. of days to ٥٠٪ maturity
Genotype ١٢٠	٤٤,٣٨ f	٥٣,٨٨ ef	٩٢,٣٨ bc
Genotype ١٢٥	٤٤,٦٣ ef	٥٣,١٣ fgh	٩١,٨٨ bcd
Genotype ٢٣٠	٤٥,٠٠ def	٥٣,٨٨ ef	٩١,٢٥ cd
Genotype ٢٣٥	٤١,٧٥ gh	٥٢,٧٥ gh	٩٠,٧٥ de
Genotype ٢٤٠	٤٦,٧٥ abc	٥٣,٧٥ efg	٩٢,١٣ bcd
Genotype ٢٤٥	٤٧,٠٠ ab	٥٦,٠٠ ab	٩٤,٠٠ a
Genotype ٣٥٠	٤١,٢٥ h	٥٤,٢٥ de	٩٢,٧٥ ab
Genotype ٣٥٥	٤٥,٧٥ cde	٥٤,٠٠ ef	٩٢,٣٨ bc
Genotype ٤٦٠	٤٥,٨٨ bcd	٥٥,١٣ bcd	٩٣,٠٠ ab
Genotype ٤٦٥	٤٧,٠٠ ab	٥٤,٧٥ cde	٩١,٧٥ bcd
Genotype ٧٧٠	٤٦,٠٠ bc	٥٥,٧٥ abc	٩٣,٠٠ ab
Genotype ٧٧٥	٤٧,٨٨ a	٥٦,٢٥ a	٩٣,١٣ ab
Genotype ٨٨٠	٤٦,٦٣ bc	٥٦,٣٨ a	٩٤,٠٠ a
Giza ١٠٢	٣٩,٥٠ i	٤٧,٧٥ i	٨٦,٠٠ e
Sakha ٥٣	٤٢,٦٣ g	٥٢,٥٠ h	٨٩,٥٠ e
General mean	٤٤,٨٠	٥٤,٠١	٩١,٨٦

The highest number of days from planting to ٥٠٪ flowering and maturity are recorded by genotype ٨٨٠ (٥٦,٣٠ and ٩٤,٠٠ days), respectively followed by genotype ٢٤٥ (٥٦,٣٨ and ٩٤,٠٠ days, respectively). These results are in the (٢٠٠٩) who found that sunflower genotypes differed in budding, flowering and maturity.

Yield and its components:

Mean values of yield and its components for fifteen sunflower genotypes from the combined analysis over two seasons are presented in Table (٣). Analysis of variance revealed significant differences between means of the fifteen sunflower genotypes for plant height, head diameter, stem diameter, seed yield per plant and per feddan and oil yield per feddan. Genotype ٢٤٥ showed the highest mean value for plant height (١٨٦,٢٥ cm) followed by genotype ٢٤٠ (١٨٥,٠٠ cm), genotype ٤٦٥ (١٨٣,٨٨ cm) and genotype ٧٧٠ (١٨٢,٧٥ cm). On the other hand, two commercial varieties Sakha ٥٣ and Giza ١٠٢ ranked the lowest values (١٦٣,١٣ cm and ١٦٣,٥٠ cm), respectively.

Table ٣: Mean values of yield and its components for fifteen sunflower genotypes (combined analysis over the seasons of ٢٠١٠ and ٢٠١١).

Traits / Genotypes	Plant height (cm)	Head diameter (cm)	Stem diameter (cm)	Seed yield (g/plant)	Seed yield (kg/fed.)	Oil yield (kg/fed.)
Genotype ١٢٠	١٧٧,٠٠ def	١٧,٥٠ ab	٢,٥١ ab	٤٣,٦٣ b	١٣٠٧,٧٥ b	٥١٧,٨٤ b
Genotype ١٢٥	١٧٥,٧٥ ef	١٦,٥٣ bcd	٢,١١ cd	٣٧,٨٨ cd	١١٣٨,١٣ cd	٤٤٥,٠٠ cd
Genotype ٢٣٠	١٧٤.٥٠ f	١٦,٤٨ bcd	٢,٠٤ de	٣٨,٣٨ cd	١١٥٣,١٣ cd	٤٤٤,٥٦ cd
Genotype ٢٣٥	١٧٣,٣٨ f	١٦,٣٥ bcd	٢,٢٠ cd	٣٦,١٣ d	١٠٨٥,٦٣ d	٤٢٠,٠٨ d
Genotype ٢٤٠	١٨٥,٠٠ ab	١٦,٦٥ bcd	٢,١٥ cd	٣٧,٨٨ cd	١١٤٠,٠٠ cd	٤٤٠,٢٨ cd
Genotype ٢٤٥	١٨٦,٢٥ a	١٦,١٥ cd	٢,٢٤ bcd	٤٠,٨٨ bc	١٢٢٨,١٣ bc	٤٧٤,١٢ bc
Genotype ٣٥٠	١٨٢,٥٠ abc	١٦,٧٦ bc	٢,١٥ cd	٣٩,٥٠ cd	١٢٠٥,٠٠ bc	٤٦٠,٢٦ cd
Genotype ٣٥٥	١٧٨,٠٠ c-f	١٦,١٨ cd	٢,١٥ cd	٤٠,٥٠ bc	١٢٢٠,٦٣ bc	٤٦٧,٣٨ c
Genotype ٤٦٠	١٨٠,٣٨ b-e	١٦,٠٦ cd	٢,٢٤ bcd	٣٩,١٣ cd	١١٧٧,٥٠ cd	٤٥٢,٢٩ cd
Genotype ٤٦٥	١٨٣,٨٨ ab	١٦,٤١ bcd	٢,١٨ cd	٣٩,٦٣ cd	١١٩٠,٦٣ cd	٤٥٦,١٧ cd
Genotype ٧٧٠	١٨٢,٧٥ ab	١٧,٠٥ abc	٢,٣٩ abc	٣٨,٢٥cd	١١٥٦,٨٨ cd	٤٥٦,٥٠ cd
Genotype ٧٧٥	١٨١,٨٨ abc	١٥,٤٨ d	٢,٠٩ d	٣٨,٥٠ cd	١١٥٦,٨٨ cd	٤٤٤,٣٠ cd
Genotype ٨٨٠	١٨١,٦٣ a-d	١٥,٨٣ cd	٢,٢٨ bcd	٣٩,٦٣ cd	١١٩٢,٥٠ c	٤٥٨,٥١ cd
Giza ١٠٢	١٦٣,٥٠ g	١٣,١١ e	١,٧٥ e	٢٣,٢٥ e	٦٩٧,٥٠ e	٢٦٢,٢٢ e
Sakha ٥٣	١٦٣,١٣ g	١٨,١٣ a	٢,٦٣ a	٤٩,٣٨ a	١٤٨٣,٧٥ a	٥٩٠,٥١ a
General mean	١٧٧,٩٧	١٦,٣١	٢,٢١	٣٨,٨٣	١١٦٩,٠٠	٤٥٢,٦٦٧

The highest mean values of head diameter (١٨,١٣ cm) and stem diameter (٢,٦٣ cm) were found in commercial variety Sakha ٥٣ followed by genotype ١٢٠ (١٧,٥٠ cm and ٢,٥١ cm, respectively, while Giza ١٠٢ variety had the lowest values (١٣,١١ and ١,٧٥ cm, respectively).

Data revealed that Sakha ٥٣ variety ranked the first and achieved the highest estimates of seed yield/plant (٤٩,٣٨ g), seed yield/fed. (١٤٨٣,٧٥ kg) and oil yield/fed. (٥٩٠,٥١ kg). Meanwhile, the lowest estimates were obtained by Giza ١٠٢ variety (٢٣,٢٥ g/plant), (٦٩٧,٥٠ kg/fed.) and (٢٦٢,٢٢ kg/fed), respectively.

The differences between the tested genotypes could mainly be attributed to the differences in their genetical constitution and their response to the environmental conditions.

Head diameter and seed yield/plant are commonly a major determinant of sunflower yield/feddan. Basha (٢٠٠٠), Abou-Ghazala *et al*. (٢٠٠١), Oad *et al*. (٢٠٠١), Abou-Khadrah *et al*. (٢٠٠٢), Killi (٢٠٠٤) and Ozer *et al*. (٢٠٠٤) found genotypic differences in seed yield and its components under their study.

The superiority of such genotypes could be due to their adaptation and high values of some yield components, i.e. head diameter, stem diameter and seed yield per plant. The results are in harmony with those obtained by Abdel-Motagally and Osman (٢٠١٠) who observed that Sakha ٥٣ significantly surpassed Giza ١٠٢ in head diameter, ١٠٠-seed weight, seed yield/plant and seed yield/ha. The differences between the tested sunflower genotypes could mainly be attributed to the differences in their genetic constitution and their different response to the environmental conditions. Aml *et al*. (٢٠١١) and Iraj *et al*. (٢٠١١) reported varietal differences in their studies for seed yield and its components.

Physical properties, oil and protein contents:

Mean values of physical properties, oil and protein contents of different sunflower genotypes from the combined analysis over the two seasons of ٢٠١٠ and ٢٠١١ are presented in Table (٤). Analysis of variance revealed significant differences between means of the fifteen sunflower genotypes for seed index (١٠٠ seed weight, gm), volume of ١٠٠ seeds (cm^3), relative density (gm/cm^3), oil and protein contents.

The following genotypes ٨٨٠, ١٢٠ and ٢٦٥ had the following highest values of seed index; ١٠,٢٠, ١٠,٠٦ and ٩,٧٩ gm, respectively, followed by genotype ٢٣٠ and genotype ٢٤٥ (٩,٤٨ and ٩,٣٥ gm, respectively). On the other hand, Giza ١٠٢ variety had the lowest value of seed index (٦,٨٨ gm).

Volume of ١٠٠ seed (cm^3) for genotypes ٢٤٠ and ٢٣٥ gave highest values (٢٨,٣٨ and ٢٧,٦٣ cm^3, respectively), whereas genotypes ٤٦٠ and ٧٧٥ gave the lowest values (١٨,٠٠ and ١٨,٢٥ cm^3, respectively).

Table ٤:Mean values of physical properties, oil and protein contents for fifteen sunflower genotypes (combined analysis over the seasons of ٢٠١٠ and ٢٠١١).

Traits / Genotypes	Physical properties			Oil %	Protein %
	Seed index ١٠٠ seed, gm	Volume of ١٠٠ seed (cm^3)	Relative density (g/cm^3)		
Genotype ١٢٠	١٠,٠٦ ab	٢٠,٧٥ cde	٠,٤٩٧ a	٣٩,٥٦ a	٢٦,٠٧ cd
Genotype ١٢٥	٨,٠٥ fg	١٨,٥٠ efg	٠,٤٣١ bcd	٣٨,٥١ b	٢٥,٨٩ d
Genotype ٢٣٠	٩,٤٨ bcd	٢٥.١٣ b	٠,٣٣١ e	٣٨,٥٥ b	٢٥,٧٩ d
Genotype ٢٣٥	٨,٣٧ ef	٢٧,٦٣ a	٠,٣١٣ e	٣٨,٥٠ b	٢٩,٤٤ a
Genotype ٢٤٠	٩,٢٨ cd	٢٨,٣٨ a	٠,٣٣٩ e	٣٨,٥٩ b	٢٩,٨٦ a
Genotype ٢٤٥	٩,٣٥ cd	٢٣,٠٠ bc	٠,٤١٨ cd	٣٨,٥٩ b	٢٩,٥٩ a
Genotype ٣٥٠	٧,٥٤ gh	١٩,٢٥ ef	٠,٤١٤ d	٣٨,٢٠ bc	٢٤,٣٠ e
Genotype ٣٥٥	٨,٥٠ ef	١٨,٢٥ fg	٠,٤٧٧ abc	٣٨,٢٦ bc	٢٥,١٠ de
Genotype ٤٦٠	٨,٨٩ de	١٨,٠٠ fg	٠,٥١١ a	٣٨,٣٩ b	٢٦,٠٠ d
Genotype ٤٦٥	٩,٧٩ abc	٢٢,٠٠ cd	٠,٤٦٥ a-d	٣٨,٣٣ bc	٢٩,٦٤ a
Genotype ٧٧٠	٧,٠٢ h	١٦,٢٥ g	٠,٤٣٧ bcd	٣٩,٤٦ a	٢٧,٠٨ bc
Genotype ٧٧٥	٧,٤٠ gh	١٨,٢٥ fg	٠,٤٠٨ d	٣٨,٤٠ b	٢٩,١٩ a
Genotype ٨٨٠	١٠,٢٠ a	٢١,٧٥ cd	٠,٤٨٩ ab	٣٨,٤٤ b	٢٦,٠٥ d
Giza ١٠٢	٦,٨٨ h	٢٠,٣٨ def	٠,٣٤٠ e	٣٧,٥٦ c	٢٥,٥٤ d
Sakha ٥٣	٩,٠٢ de	٢٢,٠٠ cd	٠,٤٢٠ cd	٣٩,٨١ a	٢٨,٠٥ b
General mean	٨,٦٦	٢١,٣٠	٠,٤١٩	٣٨,٦١	٢٧,١٧

Highest values of relative density were recorded in genotypes ٤٦٠, ١٢٠ and ٨٨٠ (٠,٥١١, ٠,٤٩٧ and ٠,٤٨٩ g/cm^{٣}, respectively), while genotype ٢٣٥ gave the lowest value in this respect (٠,٣١٣ gm/cm^{٣}). These results are in the same trend of those reported by Kinman and Earle (١٩٦٤) who found the bulk density of sunflower seed ranged from ٠,٤ to ٠,٥ gm/ml.

Sakha ٥٣ variety showed the highest mean value of oil content (٣٩,٨١٪), followed by genotypes ١٢٠ and ٧٧٠ (٣٩,٥٦٪ and ٣٩,٤٦٪, respectively). On the other hand, Giza ١٠٢ variety ranked the lowest one in oil content (٣٧,٥٦٪).

Dealing with protein content of sunflower genotypes, it can be seen that genotypes ٢٤٠ and ٢٤٥ contains the highest values ٢٩,٨٦٪ and ٢٩,٥٩٪, respectively followed by genotype ٢٣٥ (٢٩,٤٤٪), while genotype ٣٥٠ ranked the lowest one in protein (٢٤,٣٠٪). Similar results were obtained by Awad and Gharib (٢٠٠٩), who found that sunflower genotypes differed in oil% and protein %, they mentioned that the difference ranged between (٣٧,٨-٣٩,٩ and ٢٦,٧-٢٩,١, respectively.

Germination and seedling vigor:

As shown in Table (٥) significant differences between sunflower genotypes in the percentage of germination, genotype ٨٨٠ and Giza ١٠٢ variety had the highest values, followed by genotype ٢٣٠ (٩٧,٢٥٪) and genotype ١٢٥ (٩٦,٧٥٪), while Sakha ٥٣ and genotype ٧٧٠ gave the lowest values (٨٧,٠٠٪ and ٨٠٪, respectively). Similar findings were reported by Khalil *et al*. (٢٠٠٣), who found that the greatest increase in germination percent took place after oil content reached its maximum.

Table ٥: Germination and seedling vigor for fifteen sunflower genotypes (combined analysis over ٢٠١٠ and ٢٠١١ seasons).

Traits / Genotypes	Germination %	Seedling vigor		
		Shoot length (cm)	Radical length (cm)	Dry weight (mg)
Genotype ١٢٠	٩٠,٢٥ def	٦,٥٠ f	٤,٤٢ g	٦٣,٠٠ ab
Genotype ١٢٥	٩٦,٧٥ a-d	٩,٠٨ b-e	٦,٢٨ f	٦٣,٠٠ ab
Genotype ٢٣٠	٩٧,٢٥ abc	١٠,٧٤ ab	٩,٣٢ bc	٦٣,٠٠ ab
Genotype ٢٣٥	٩٥,٦٣ a-g	١٠,٩٨ ab	١٠,٥٨ ab	٧٣,٨ a
Genotype ٢٤٠	٩١,٠٠ c-f	٩,٨٥ a-d	٦,٧٣ ef	٦٧,٠٠ ab
Genotype ٢٤٥	٩١,٦٣ b-f	٩,٧٥ bcd	٨,٤٣ cd	٦٦,٠٠ ab
Genotype ٣٥٠	٩٦,٢٥ a-e	١٠,٦٥ abc	٩,٩٣ ab	٧١,٠٠ a
Genotype ٣٥٥	٩٥,٣٨ a-e	٩,١٣ b-e	٨,٢٥ cd	٦٩,٠٠ a
Genotype ٤٦٠	٩٠,٢٥ def	٧,١٨ b-e	٩,٢٨ bc	٦٤,٠٠ ab
Genotype ٤٦٥	٨٩,٥٠ ef	٧,٥٠ ef	٨,١٣ cde	٧١,٠٠ a
Genotype ٧٧٠	٨٠,٠٠ g	٨,٥٠ ef	٧,٦٥ def	٥٥,١ b
Genotype ٧٧٥	٩٨,٥٠ ab	٨,١٥ c-f	٧,٦٣ def	٦٢,٠٠ ab
Genotype ٨٨٠	١٠٠,٠ a	٨,٣٥ def	٧,٦٣ def	٦٦,٠٠ ab
Giza ١٠٢	١٠٠,٠ a	١٢,٠٢ a	٩,٩٤ ab	٧٣,٤ a
Sakha ٥٣	٨٧,٠٠ f	١٠,٨٨ ab	١١,٠١ a	٦٣,٠٠ ab
General mean	٩٣,٣٠	٩,٢٨	٨,٣٤	٦٦,٠٠

The results of seedling vigor (shoot length, radical length and seedling dry weight) were significant between genotypes under study. Giza ١٠٢ variety had the highest shoot length (١٢,٠٢ cm), followed by genotype

٤٦٥ and Sakha ٥٣ variety (١٠,٩٨ cm and ١٠,٨٨ cm, respectively). On the other hand, genotype ١٢٠ gave the lowest value (٦,٥٠ cm). Sakha ٥٣ variety gave the highest value of radical length (١١,٠١ cm), followed by genotype ٢٣٥ and Giza ١٠٢ variety (١٠,٥٨ cm and ٩,٩٤ cm, respectively), while genotype ١٢٠ showed the lowest one (٤,٤٢ cm) compared to the other genotypes. Data in Table (٥) indicated that seedling dry weight of sunflower genotypes ranged from ٥٥,١ mg to ٧٣,٨ mg. Genotype ٢٣٥ had the highest value (٧٣,٨ mg), followed by Giza ١٠٢ variety (١٧٣,٤ mg). On the other hand, genotype ٧٧٠ ranked the lowest value (٥٥,١ mg). In this respect, confirmed results were reported by Rondanini *et al*. (٢٠٠٦) and Aml *et al*. (٢٠١١), who found that sunflower genotypes differed in shoot length, radical length and dry weight.

Biochemical analysis by used protein proteins:

SDS-PAGE electrophoresis patterns for water soluble proteins in ١٥ sunflower genotypes are shown in Figure (١) and Table (٦). All markers were scored for presence/absence (+/-) of specific amplified products. A maximum number of ١٨ bands was detected with molecular weights (WM) ranged from ٣٦٠ to ٣٠ KDa. Some genotype were characterized by the appearance of a higher number of brands which found that in genotypes ٦, ٧ and ١٠ (١٦ bands), while the lower number of bands were appeared in genotypes ١٣ and ١٥ (١١ bands).

The variation in number and intensity of the bands might be due to differential extraction or difference in solubility of protein having similar migration rate (Ladizinsky and Hymowitz, ١٩٧٩). Similar observations based on band intensity were reported by Devi (٢٠٠٠) in sunflower, SDS-PAGE was used by Kumar *et al*. (٢٠٠١) for establishing the genetic identity of sunflower hybrids and determining percentage genetic purity of F_1 hybrid.

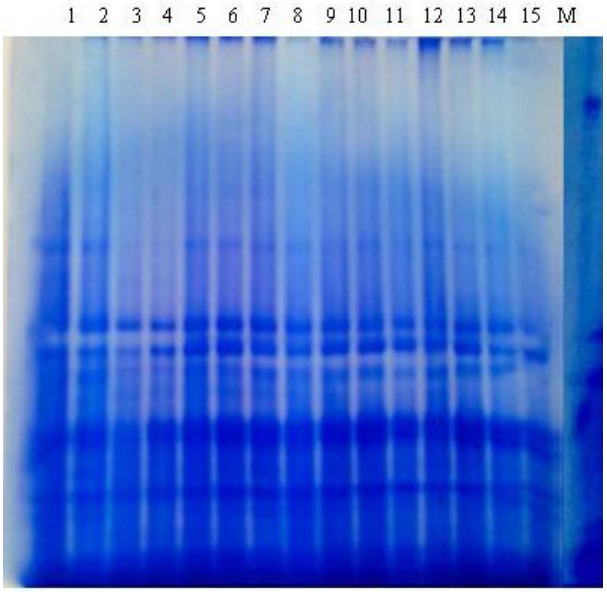

Fig. ١: SDS-PAGE profiles of ١٥ sunflower genotypes.

Table ٦: SDS-PAGE of water-soluble protein extracted from ١٥ sunflower genotypes.

Band number	MW (KDa)	Genotypes														
		١٢٠	١٢٥	٢٣٠	٢٣٥	٢٤٠	٢٤٥	٣٥٠	٣٥٥	٤٦٠	٤٦٥	٧٧٠	٧٧٥	٨٨٠	Giza ١٠٢	Sakha ٥٣
١	٣٦٠	-	-	-	-	+	+	+	-	-	+	+	-	-	-	-
٢	٢٩٠	-	-	-	-	+	+	+	-	-	+	+	+	-	-	-
٣	٢٥٠	+	+	+	+	+	+	+	+	+	-	+	+	+	+	+
٤	٢٤٠	+	-	+	+	-	-	-	-	-	+	-	-	-	-	-
٥	٢٣٠	-	-	-	-	-	-	-	-	-	+	-	+	-	+	-
٦	١٩٥	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
٧	١٩٠	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
٨	١٧٥	+	+	+	+	+	+	+	+	+	+	+	+	+	+	-
٩	١٤٠	+	+	+	+	-	+	+	+	+	+	+	+	-	-	-
١٠	١٢٠	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
١١	١٠٠	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
١٢	٨٥	-	-	-	+	+	+	+	+	-	-	-	-	-	-	-
١٣	٧٥	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
١٤	٦٠	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
١٥	٥٠	+	+	-	-	+	+	+	+	+	+	+	-	-	+	+
١٦	٤٠	-	-	+	+	+	+	+	-	-	+	+	+	+	+	+
١٧	٣٥	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
١٨	٣٠	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+

Correlation coefficients:

Simple correlation coefficients (r-values) among seed yield and its related traits of ١٥ sunflower genotypes from combined data are presented in Table (٧). Positive and insignificant correlation coefficients was found between plant height and each of stem diameter, head diameter, seed index, seed yield/plant, seed yield/fed. and oil yield/fed. On the other hand, a negative and insignificant correlation coefficient was found between plant height and oil content.

Table ٧: Simple correlations coefficients among seed yield and its components of ١٥ sunflower genotypes

	Plant height (cm)	Stem diameter (cm)	Head diameter (cm)	Seed index	Seed yield/ plant	Seed yield/ fed	Oil content	Oil yield/fed.
Plant height (cm)	-	٠,٠٣٦^{NS}	٠,١٠٥^{NS}	٠,١٦٠^{NS}	٠,٠٩٩^{NS}	٠,١٠٨^{NS}	-٠,١٠٤^{NS}	٠,٠٧٣^{NS}
Stem diameter (cm)		-	٠,٥١٠**	٠,٥٨٣**	٠,٦٦٥**	٠,٦٥٩**	٠,٥٣٦**	٠,٦٧١**
Head diameter (cm)			-	٠,٥٧٦**	٠,٧٠٤**	٠,٧١٥**	٠,٤٧٢**	٠,٧٢٤**
Seed index				-	٠,٧٦٦**	٠,٧٦٩**	٠,٤٣٥**	٠,٧٦٤**
Seed yield/ plant					-	٠,٩٩٨**	٠,٥٥٣**	٠,٩٨٩**
Seed yield/ fed						-	٠,٥٥٣**	٠,٩٩١**
Oil content							-	٠,٦٤٠

***, ** and NS: significant at ٠,٠٥, ٠,٠١ probability levels and insignificant at ٠,٠٥ probability level, respectively**

Positive and highly significant correlation coefficients were found between stem diameter and each of head diameter (r = ٠,٥١٠), seed index (r = ٠,٥٨٣), seed yield/plant (r = ٠,٦٦٥), seed yield/fed (r = ٠,٦٥٩), oil % (r = ٠,٥٣٦) and oil yield/fed. (r = ٠,٦٧١).

Head diameter and seed index showed positive and significant correlation coefficients with seed yield/plant (r = ٠,٧٠٤ and ٠,٧٦٦), seed yield/fed. (r = ٠,٧١٥ and ٠,٧٦٩), oil % (r = ٠,٤٧٢ and ٠,٤٣٥) and oil yield/fed. (r = ٠,٧٢٤ and ٠,٧٦٤, respectively).

Data revealed that seed yield/plant was highly significant and positively correlated with seed yield/fed (r = ٠,٩٩٨), oil content (r = ٠,٥٥٣) and oil yield/fed. (r = ٠,٩٨٩). In addition, seed yield/fed was positively and high significantly correlated with both oil content (r = ٠,٥٥٣) and oil yield/fed. (r = ٠,٩٩١). Also, a significant and positive correlation coefficient was obtained between oil content and oil yield/fed. (r = ٠,٦٤٠). These results agreed with those obtained by Radic *et al*. (٢٠٠٩). In conclusion, the results of the present performance of fifteen sunflower genotypes varietal differences are important for improving sunflower with high seed yield and seed oil content via recombination in breeding programs.

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تقييم بعض التراكيب الوراثية المبشرة لعباد الشمس بالنسبة للمحصول ومكوناته وجودته

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أقيمت تجربتان حقليتان بمحطة البحوث الزراعية بسخا ـ محافظة كفرالشيخ خلال موسمى الزراعة ٢٠١٠ ، ٢٠١١ ، وقد إشتملت كل تجربة على ١٥ تركيب وراثى من بعض التراكيب لعباد الشمس المبشرة مفتوحة التلقيح (التركيب الوراثى ١٢٠ ، ١٢٥ ، ٢٣٠ ، ٢٣٥ ، ٢٤٠ ، ٢٤٥ ، ٣٥٠ ، ٣٥٥ ، ٤٦٠ ، ٤٦٥ ، ٧٧٠ ، ٧٧٥) والصنفين التجاريين جيزة ١٠٢ ، سخا ٥٣ بهدف تقييم إنتاجية المحصول ومكوناته والصفات الطبيعية ومحتوى البذور من الزيت والبروتين و نسبة الانبات وقوة البادرة هذا بالإضافة إلى التفريد الكهربى للبروتين وعلاقات التلازم بين المحصول وبعض الصفات الأخرى وقد أوضحت الدراسة ما يلى:

أظهر الصنف جيزة ١٠٢ أقل القيم لعدد الأيام من الزراعة وحتى تكوين ٥٠% من البراعم والازهار والنضج الثمرى (٣٩,٥ ، ٤٧,٧٤ ، ٨٦ يوم على التوالى) بينما نتج عن التركيب الوراثى ٧٧٥ أعلى القيم لهذه الصفات (٤٧,٨٨ ، ٥٦,٢٥ ، ٩٣,١٣ يوم على التوالى).

لوحظ أن هناك اختلافات معنوية بين التراكيب الوراثية لعباد الشمس لكل الصفات التى درست وقد نتج عن التركيب الوراثى ٢٤٥ أعلى القيم لطول النبات (١٨٦,٢٥ سم) بينما كان الصنف سخا ٥٣ الاعلى فى قيم محصول البذرة/للنبات (٤٥,٣٨ جم) ومحصول البذرة/للفدان (١٤٨٣,٧٥ كجم) ومحصول الزيت/فدان (٥٩٠,٥١ كجم).

بمقارنة الصفات الطبيعية للتراكيب الوراثية لعباد الشمس التى تم دراستها وجد أن التركيب الوراثى ١٢٠ أعطى أعلى قيم لوزن ١٠٠ بذرة والكثافة النسبية (جم/ سم^{٣}) بينما أظهرت التركيب الوراثى ٢٣٥ ، ٢٤٠ أعلى قيم لحجم ١٠٠ بذرة (سم^{٣}).

تفوق الصنف سخا ٥٣ فى محتوى البذور من الزيت (٣٩,٨١%) وتراوحت نسبة البروتين ما بين ٢٤,٣٠% للتركيب الوراثى ٣٥٠ ، ٢٩,٥٩% للتركيب الوراثى ٢٤٠.

أعطى الصنف جيزة ١٠٢ أعلى القيم لنسبة الانبات وطول الريشة بينما أظهر الصنف سخا ٥٣ أعلى القيم لطول الجذير وقد تراوح الوزن الجاف للبادرة ما بين ٥٥,١ ملجم للتركيب الوراثى ٧٧٠ الى ٧٣,٨ ملجم للتركيب الوراثى ٢٣٥.

تم استخدام طريقة التفريد الكهربى للبروتين ل١٥ تركيب وراثى من عباد الشمس وأظهرت النتائج اختلافات فى عدد وسمك العلامات الجزيئية من الأصناف المختلفة.

توجد علاقة معنوية موجبة بين محصول البذور/فدان وقطر الساق وقطر القرص ووزن ١٠٠ بذرة ومحصول البذور/نبات ونسبة الزيت ومحصول الزيت/فدان.

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