

PRODUCTIVITY OF SOME BULGARIAN SUNFLOWER HYBRIDS UNDER TWO TYPES OF SOIL IN EGYPT

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Abstract

Mahmoud, A.M. 2006. Productivity of some Bulgarian sunflower hybrids under two types of soil in Egypt.

Performance of five Bulgarian sunflower hybrids was detected under two types of soil, i.e., clay soil using surface irrigation and new reclaimed sandy calcareous soil using drip irrigation for two seasons, 2003 and 2004, under Egyptian condition. The obtained results showed that performance for all studied traits of sunflower hybrids under clay soil was higher than under sandy soil, with the exception of oil percentage in kernel, which was high under sandy soil conditions. Hybrids Albena and Super Start surpassed all other hybrids in all studied traits and were recommended for growing under Egyptian's condition. The highest achene yield per ha was obtained from hybrid Albena and recorded 3.7 and 3.4 t/ha in 2003 and 2004 seasons, respectively. On the other hand, the lowest achene yield was obtained from hybrid San Luca which yielded 1.5 and 1.2 t/ha in 2003 and 2004 seasons, respectively. Maximum oil percentage in kernel (65.6 %) was obtained from hybrid Santa Fe over both seasons.

Key words: Sunflower hybrids - Soil type - Egypt

Резюме

Махмуд, А.М. 2006. Продуктивност на някои български хибриди слънчоглед в условията на два почвени типа на Египет

През периода 2003-2004 г. е извършено сравнително изпитване на 5 български хибрида слънчоглед (Албена, Супер Старт, Сантафе, Сан Лука и Зора) в условията на две почвени разновидности в Египет – върху глинеста почва с прилагане на гравитационно напояване и върху пясъклива карбонатна почва с капково напояване. Резултатите показват, че всички хибриди дават по-висок добив на семена в условията на глинеста почва, а при отглеждане върху пясъклива карбонатна почва се формира по-високо съдържание на масло в ядката. Най-подходящи за условията на Египет са хибридите Албена и Супер Старт, като Албена дава максимален добив през двете години от 370 и 340 kg/da. Най-ниски добиви са получени от хибрид Сан Лука – съответно 150 и 120 kg/da. Максимално съдържание на масло в ядката е отчетено при хибрид Сантафе – средно за двете години 65,6 %.

Ключови думи: Хибриди слънчоглед - Почвен тип - Египет

INTRODUCTION

In Egypt, there is a sever shortage in edible oil production. The local production of oil does not exceed 15 % of consumption (Allam et al., 2003) and Egyptian government is pressing to overcome the big gab between production and consumption of oils. Desert land in Egypt consider as the great problem which represented about 96 % of Egypt total area. Therefore, increasing oil production must depend on the cultivation of new oil crops such as sunflower in new reclaimed soils.

Sunflower is an important oil seed crop throughout the world – 23 416 311 ha in the world (FAO, 2005). On the other hand, the area cultivated with sunflower in Egypt decreased from 19500 ha in 2000 to 15650 ha in 2005 (FAO, 2005).

In Egypt, the needs of developing or introduction new cultivars or hybrids of oil crops adapted to new reclaimed soils is a great task to cover the oil consumption. So, sunflower is considered as one of the promising oil crops and its oil characterized in high percentage of unsaturated fatty acids, oilc and linoleic represent 90 % of total fatty acids of sunflower oil (Mahmoud, 2002). The linkage of dietary saturated fatty acids with frequency of cardiovascular disease indicates the importance of fatty acids composition for selection of fats and oils for human consumption.

Many investigators evaluated sunflower genotypes under Egyptian conditions and they found that sunflower genotypes varied significantly in yield and its attributes, oil percentage and oil yield per unit area (Abul-Nass et al., 2000; Basha, 2000; Osman, 2001; Allam et al., 2003).

The aim of the present investigation was to study the performance of some Bulgarian sunflower hybrids for yield and its attributes under two types of soil under Egyptian conditions.

MATERIALS AND METHODS

Five Bulgarian sunflower hybrids developed in Dobroudja Agricultural Institute, General Toshevo, Bulgaria – Albena, Super Start, Santa Fe, San Luca and Zora, were grown under Egyptian conditions during 2003 and 2004 seasons at two locations differed in the soil types. The first location was the Experimental Farm of Faculty of Agriculture, Assiut University, where the soil is clay. The other one was Experimental Farm of El- Wady El- Assiuty, where the soil is sandy calcareous . The surface irrigation was done in the first location and the drip one in the second location.

Table 1. Physical and chemical analysis for two types of soil

First location , Clay soil		Second location , Sandy calcareous soil	
Sand	25 %	<i>Physical properties:</i>	
Silt	29 %	Gravel (more than 2mm)	39.4 %
Clay	46 %	Sand	93.5 %
Soil texture	Clay	Silt	4.3 %
Chemical analysis:		Clay	2.2 %
<u>Exchangeable ions</u>		<i>Chemical properties:</i>	
P ppm	11.3	pH (1:1)	8.1
Mn ppm	17.5	Ece (ds/m)	2.3
Zn ppm	1.1	<i>Soluble cations (meq/L):</i>	
Fe ppm	3.8	Na	4.9
Cu ppm	1.3	K	1.2
pH (1:1)	8.0	Ca	11.3
Organic matter	1.7 %	Mg	5.1
Total nitrogen	0.08	<i>Soluble anions (meq/L):</i>	
Total Ca Co ₃	2.0 %	Co ₃ + HCO ₃	4.8
		Cl	6.0
		SOH	14.8

The experimental design was a Randomized Complete Block Design (RCBD) with three replications. All cultural practices in the two locations were applied as recommended. The plot size was 21 m². Seeds were sown on 20th and 25th of May at Experimental Farm of Faculty of agriculture and El-wady El-Assiuty in 2003 and 2004 seasons, respectively. Sowing was done in drills 60 cm apart and 25 cm within hills. Plants were thinned to secure one plant/hill.

At maturity, a random sample of 20 guarded plants per plot was taken and the data were recorded for plant height (cm), no. of leaves/plant, head diameter (cm), kernel percentage, achene yield/plant (g) and 100-achene weight (g). The achene yield recorded on a plot basis used to estimate the corresponding values per hectare in ton. Kernel oil percentage was determined according to the procedure described by A.O.A.C. (1995).

The homogenates test was done and the combined analysis of two locations (soils) was done according to Snedecor and Cochran (1980). The calculated means for different treatments were compared using L.S.D at 5 % level.

RESULTS AND DISCUSSION

A. The statistical analysis

The combined analysis of variance revealed that highly significant differences between two types of soil for all studied traits, except kernel percentage in 2003 and 2004 seasons (Tables 2 and 3) respectively. Also, differences among hybrids were highly significant for all studied traits in the two seasons. Moreover, the interaction between soils and hybrids was highly significant for all studied traits, except days to heading, head diameter and kernel percentage over two seasons.

Table 2. Mean squares of combined analysis for studied traits of sunflower in 2003 season

S.O.V	df	Days to heading	Plant height	No. of leaves	Head diam.	Yield/ plant	Kernel %	100-achene weight	Oil %In kernel	Yield/ hectare
Soils (S)	1	1656.2**	37152.2**	39.2**	328.1**	5807.2**	0.0010	66.25**	41.93**	23.1**
Error(a)	4	1.00	17.30	0.40	0.45	11.08	0.0020	0.31	0.01	0.19
Hybrids(H)	4	74.50**	732.95**	16.33**	13.63**	965.38**	0.0030*	1.78**	45.17**	3.26**
S x H	4	0.45	708.95**	7.83**	2.18	347.01**	0.0010	0.69**	11.71**	0.99**
Error(b)	16	0.63	8.80	0.28	0.70	8.99	0.0010	0.05	0.24	0.02

Table 3. Mean squares of combined analysis for studied traits of sunflower in 2004 season.

S.O.V	df	Days to heading	Plant height	No. of leaves	Head diam.	Yield/ plant	Kernel %	100-achene weight	Oil %In kernel	Yield/ hectare
Soils (S)	1	1786.1**	33129.8**	36.5**	352.8**	5239.1**	0.0010	60.97**	39.96**	13.73**
Error(a)	4	2.65	26.50	3.65	0.10	10.63	0.0003	0.10	0.35	0.06
Hybrids(H)	4	87.55**	642.38**	13.43**	11.43**	816.52**	0.0030**	2.21**	40.85**	2.92**
S x H	4	1.05	618.93**	4.83**	1.18	314.29**	0.0003	0.65**	11.35**	0.97**
Error(b)	16	0.40	5.75	0.53	0.35	4.01	0.0001	0.05	0.53	0.04

These results revealed that these hybrids of sunflower differ genetically and their performance interacted in different way with type of soil and edaphic conditions (Kluza-Wieloch and Musnicki, 2003). This result reflects the sensitivity of these hybrids to the environmental changes, suggesting the assessment of hybrids under different environments for iden-

tifying the best hybrids for particular environment.

B. Effect of soil type

The obtained data of studied traits under clay soil conditions were significantly higher than under sandy soil conditions, except kernel percentage was not differ significantly between two types of soil. But reverse results was observed about the oil % in kernel, where it was higher in sandy soil than clay soil in both seasons (Tables 4 and 5).

These results due to each soil have its own unique properties. These properties determine how the soil and plants will interact. Sands are formed from ground or weathered rocks such as limestone, quartz, granite and shale. Sandy soils may drain too well. Consequently, they may have trouble holding moisture and nutrients, which leach away with heavy rain or watering. On the other hand, clay soils are often very fertile and the productivity under clay soil is more than sandy soil. Kluza-Wieloch and Musnicki (2003) studied the influence of environmental and agronomic factors on sunflower and they reported that soil type recorded greater effects on the morphology of the crop than weather.

C. Effect of hybrids

Data of sunflower genotypes showed large variation in all studied traits (Table 4 and 5). Hybrids Albena and Super Start surpassed all other hybrids in most studied traits. The highest achene yield/hr was obtained from hybrid Albena which recorded 3.7 and 3.4 t/ha, in 2003 and 2004 seasons, respectively. Hybrid Super Start came in the second rank after Albena, and yielded 3.0 and 2.6 t/ha in 2003 and 2004 seasons, respectively. On the other side, hybrid San Luca gave the lowest values of achene yield per ha which yielded 1.5 and 1.2 t/ha in 2003 and 2004 seasons, respectively. The maximum oil percentage of 65.6 % was obtained from hybrid Santa Fe in both seasons, while the minimum oil percentage of 56.7 and 57.0 % correlated with hybrid Zora in 2003 and 2004 seasons, respectively.

These results showed that the reverse and negative relationship between oil percentage and achene yield in those sunflower hybrids (Allam et al, 2003).

The same results were obtained by Petrov (1995) and he reported that Bulgarian hybrids Albena and Super Start surpassed most hybrids when evaluated in Bulgaria, Europe and in the world. Moreover highly significant differences between sunflower geno-

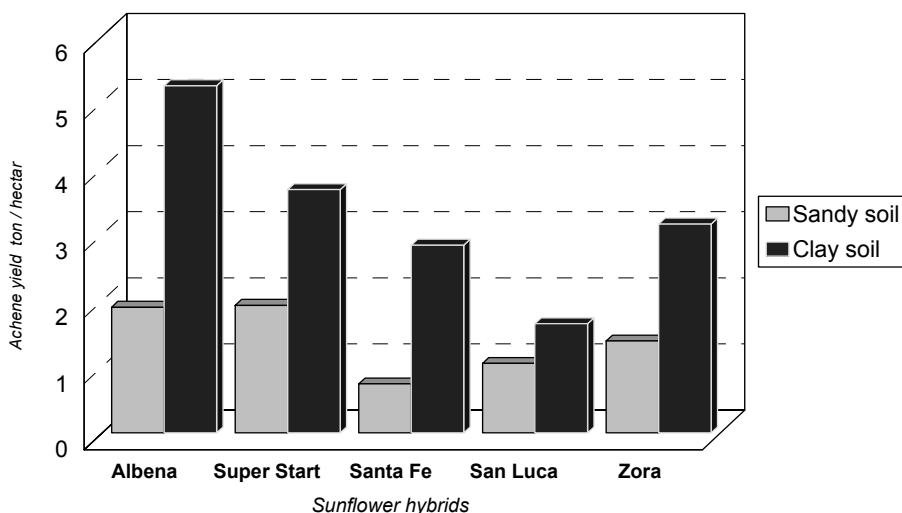


Fig. 1. Achene yield (t/ha) for sunflower hybrids under clay and sandy soil as a mean of two seasons

Table 4. Studied traits for sunflower hybrids under clay and sandy soil in 2003 season

Hybrid	Days to heading			Plant height, cm			No. of leaves			Head diameter, cm			Yield/plant, g		
	clay soil	Sand soil	\bar{x}	clay soil	sand soil	—	clay soil	sand soil	—	clay soil	sand soil	—	clay soil	sand soil	—
Albena	71.5	53.0	62.3	191.5	81.0	136.3	26.5	20.5	23.5	20.5	11.5	16.0	90.3	29.3	59.8
SuperSt.	71.0	53.5	62.3	183.5	82.5	133.0	29.0	28.0	28.5	20.0	11.0	15.5	65.1	28.7	46.9
Santa Fe	61.5	42.5	52.0	152.5	81.0	116.8	26.0	22.5	24.3	16.5	8.0	12.3	43.0	13.3	28.1
San Luca	70.0	52.5	61.2	127.5	81.0	104.3	24.5	25.5	25.0	15.0	9.5	12.3	24.7	15.9	20.3
Zora	69.0	50.5	59.8	182.5	81.0	131.8	29.0	24.5	26.8	19.5	11.0	15.3	55.1	20.6	37.8
Mean	68.6	50.4		167.5	81.3		27.0	24.2		18.3	10.2		55.6	21.5	
L.S.D _{0.05}	Hybrids= 0.96			3.59			0.64			1.01			3.36		
	Soil x Hybrids= n.s			5.08			0.90			n.s			5.14		

Cont. of Table 4

Hybrid	Kernel, %			100-seed weight, g			Oil % in kernel			Yield/ hectar, t		
	clay soil	sand soil	—	clay soil	sand soil	—	clay soil	sand soil	—	clay soil	sand soil	—
Albena	0.68	0.72	0.70	8.3	4.7	6.5	61.0	60.6	60.8	5.5	1.9	3.7
SuperSt.	0.73	0.77	0.75	8.3	4.8	6.5	56.3	60.5	58.4	4.0	2.0	3.0
Santa Fe	0.71	0.72	0.71	6.4	3.6	5.0	65.2	66.0	65.6	2.9	0.8	1.8
San Luca	0.67	0.67	0.67	7.4	4.1	5.7	59.6	61.3	60.5	1.9	1.1	1.5
Zora	0.73	0.71	0.72	7.9	2.9	5.4	52.5	60.8	56.7	3.6	1.4	2.5
Mean	0.70	0.72		7.6	4.0		58.9	61.8		3.6	1.4	
L.S.D _{0.05}	Hybrids= 0.04			0.26			0.59			0.18		
	Soil x Hybrids= n.s			0.37			0.83			0.25		

Table 5. Studied traits for sunflower hybrids under clay and sandy soil in 2004 season

Hybrid	Days to heading			Plant height, cm			No. of leaves			Head diameter, cm			Yield/plant, g		
	clay soil	sand soil	\bar{x}	clay soil	sand soil	—	clay soil	sand soil	—	clay soil	sand soil	—	clay soil	sand soil	—
Albena	70.5	51.5	61.0	177.5	74.5	126.0	25.0	19.5	22.3	19.5	10.5	15.0	83.0	25.5	54.2
SuperSt.	70.5	52.5	61.5	172.5	79.5	126.0	27.0	26.0	26.5	19.0	10.0	14.5	61.8	26.5	44.2
Santa Fe	60.5	40.0	50.3	145.0	78.5	111.8	24.5	21.0	22.8	16.0	7.5	11.8	39.4	11.2	25.3
San Luca	69.5	51.5	60.5	121.0	76.0	98.5	23.0	23.0	23.0	14.5	8.0	11.3	22.5	14.7	18.6
Zora	68.5	49.5	59.0	177.5	78.0	127.8	27.0	23.5	25.3	18.5	9.5	14.0	51.8	18.7	35.3
Mean	67.9	49.0		158.7	77.3		25.3	22.6		17.5	9.1		51.7	19.3	
L.S.D _{0.05}	Hybrids= 0.77			2.91			0.88			0.72			2.43		
	Soil x Hybrids=n.s			4.11			1.24			n.s			3.43		

Cont. of Table 5

Hybrid	Kernel, %			100-seed weight, g			Oil % in kernel			Yield/ hectar, t		
	clay soil	sand soil	—	clay soil	sand soil	—	clay soil	sand soil	—	clay soil	sand soil	—
Albena	0.67	0.70	0.68	8.0	4.5	6.2	61.1	62.0	61.6	5.0	1.9	3.4
SuperSt.	0.71	0.74	0.73	8.0	4.7	6.3	57.6	60.9	59.2	3.4	1.9	2.6
Santa Fe	0.70	0.72	0.71	6.1	3.1	4.6	65.7	65.5	65.6	2.7	0.7	1.7
San Luca	0.66	0.65	0.66	6.7	3.9	5.3	59.8	61.5	60.7	1.4	1.0	1.2
Zora	0.71	0.70	0.70	7.5	2.6	5.0	52.8	61.2	57.0	2.7	1.3	2.0
Mean	0.69	0.70		7.2	3.7		59.4	62.2		3.0	1.4	
L.S.D _{0.05}	Hybrids= 0.02			0.28			0.88			0.24		
	Soil x Hybrids=n.s			0.39			1.25			0.34		

types were reported when evaluated under different conditions (Krizmanic et al., 2001; Osman, 2001; Monotti et al., 2003; Allam et al., 2003).

From this investigation and Fig 1 and 2 we can recommended that Bulgarian sunflower hybrids Albena and Super Start were very suitable for Egyptian conditions under both of old clay soil and new reclaimed sandy soil.

D. The interaction between hybrids and soil type

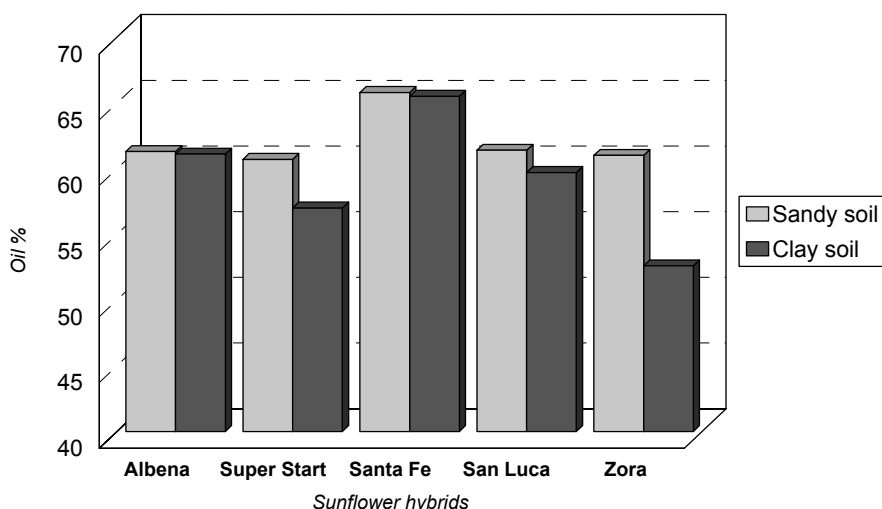


Fig. 2. Oil percentage in kernel for sunflower hybrids under clay and sandy soil as a mean of two seasons

The interaction was highly significant for all studied traits, except days to heading, head diameter and kernel percentage. In general, hybrids Albena and Super Start gave the highest values for most studied traits under both of clay and sandy soil.

Moreover hybrid Super Start slightly surpassed hybrid Albena under sandy soil in plant height , 100-achene weight and achene yield per hectar in 2003 and 2004 seasons. The maximum oil percentage (66.0 %) and the minimum achene yield per hectar (0.70 t/ ha) were obtained from hybrid Santa Fe under sandy soil.

The significant interaction between sunflower genotypes and environment was observed by Allam et al. (2003).

E. Correlation between yield ant its attributes

Data in Table 6 revealed that ,the correlation between yield and each of head diameter and 100-achene weight were positive and highly significant under the two types of soil.

Table 6. Correlation between achene yield / hectar and its attributes under two soil types

Yield attributes	Days to heading	Plant height	No. of leaves	Head diameter	Kernel %	100-seed weight	Oil % in kernel
Achene yield under clay	0.35	0.85**	0.47	0.88**	0.15	0.70**	-0.03
Achene yield under sandy	0.76**	0.06	0.18	0.88**	0.48	0.63*	-0.74**

This result means head diameter and 100-achene weight are very important for increasing yield when sunflower growing under clay and sand soils (Mahmoud, 2002). The correlation between yield and plant height was positive and highly significant under clay soil only and the correlation with days to heading was positive and significantly under sandy soil only. Generally, under sandy soil (stress condition) short growth duration and short plants are desirable traits when plants growing under new reclaimed soils to maximized the utilization of water under these conditions.

CONCLUSIONS

The main conclusion is that Bulgarian sunflower hybrids Albena and Super Start were very suitable for Egyptian conditions under both of old clay soil and new reclaimed sandy soil and could be recommended for cultivation in respective conditions.

REFERENCES

- A.O.A.C. 1995.** Association of Official Analytical Chemists. Official Methods of Analysis, 16th Ed. AOAC International, Washington, D.C., USA.
- Abul-Nass, A.A., E.S. Esmail and A.A. Hassan. 2000.** Production potentiality and seed quality of sunflower as affected by planting date, harvest date and seed drying methods. Menofiya J. of Agric. Res., 25, 81-113.
- Mahmoud, A.M. (2002)** Biological and agronomic characteristics of new hybrids of sunflower and their parental lines. Ph.D, Thesis, Agricultural University, Plovdiv, Bulgaria.
- Allam, A.Y., G.R. El-Nagar and A.H. Galal. 2003.** Response of two sunflower hybrids to planting dates and densities. Acta Agronomica Hungaria, 51 (1) 1-11.
- Basha, H.A. 2000.** Response of two sunflower cultivars to hill spacing and nitrogen fertilizer levels under sandy soil conditions. Zagazig J. Agric. Res., 27, 617-633.
- *** F.A.O. 2004.** Food and Agriculture Organization, Production Yearbook. Rome, Italy.
- Kluza-Wieloch, M. and C. Musnicki. 2003.** Influence of environmental and agronomic factors on formation of some morphological characters of oilseed forms of common sunflower (*Helianthus annuus*) . Rosliny Oleiste, 24 (1): 95-108.
- Krizmanic, M., D. Conti, D. Laureti, A.M. Del Pino, S. Pieri and G. Ridoni. 2001.** Evaluation of sunflower varieties in the environments of central Italy. Information Agrario, 59 (1): 35-41.
- Mononnti, M., D. Conti, D. Laureti, A.M. Del Pino, S. Pieri and G. Ridoni, 2003.** Evaluation of sunflower varieties in the environments of Central Italy. Information Agrario, 59 (11): 35-41.
- Osman, E.B.A. 2001.** Productivity of some sunflower hybrids by using modern systems of irrigation and fertilization under newly reclaimed soil. Ph.D. Thesis, Fac. of Agric. Assiut Univ., Egypt.
- Petrov, P. 1995.** The sunflower hybrids of I.W.S. "Dobroudja" presented in Bulgaria, Europe and in the world. Breeding and Cultivation of wheat, sunflower and legume crops in Balkan countries, Albena. IWS, Bulgaria: 59-61.
- Snedecor, C.W. and W.C. Cochran. 1980.** Statistical Methods. 7th Ed. Iowa State Univ. Press, Ames, Iowa.