ISSN 1110-0419

Annals Of Agric. Sc., Moshtohor,
Vol. 42(1): 1-13, (2004).

EVALUATION OF SIX SUNFLOWER CULTIVARS IN PHOTOSYNTHATE PARTITION AND MIGRATION, GROWTH, YIELD AND ITS COMPONENTS IN NEWLY CULTIVATED LAND

BY

Afifi, M. H. M and Ahmed, M. A.
Field Crop Research Dept., National Research Centre, Dokki, Cairo, Egypt.

ABSTRACT

Two field experiment were carried out in newly cultivated sandy lands at new Salheyia Regions, Sharkia Governorate in summer season of 2001 and 2002 to study the partition and migration of photosynthates in six sunflower cultivars (i.e. Hy-Sun 354, Vedock, Mayak, Pioneer - 6480, Euroflour, and Hybrid – 94). The main results were :-

1- Sunflower cultivars differed significantly in growth parameters at 50, 65 and 80 days after sowing (except SLW at 50 days age), as well as yield and its components except crop index.
2- The six sunflower cultivars differed significantly in photosynthates partitioning whereas significant differences were found in carbohydrates and protein percentage in the vegetative organs, seeds and straw, as well as, oil % in seeds. In addition, glucose required for synthesis of different chemical constituents of each vegetative organs, seeds (except protein) and straw and in carbon equivalent was significantly differed among the six sunflower cultivars under investigation. Furthermore, cultivar differences in yield energy per plant and per fed. of the seeds and straw and the above ground biomass (i.e. total), as well as, energy differences in energy coefficient for crop index and harvest index were significant .
3- Harvested sunflower yield can be increased by growing Vedock, Hybrid – 94, Euroflour and Pioneer – 6480 cultivars that characterized by highest efficiency in partitioning of photosynthates toward economic yield compared with the other two cultivars Hy – Sun 354 and Mayak.

Key words: Sunflower, cultivars, carbohydrate, protein, oil, energy, partition, migration.

INTRODUCTION

Production of vegetative oil in Egypt is fall below requirements for local consumption. It is noteworthy to mention that there is an increase in consumption per capita amounting to about 2 pounds per person every five years in the world. This necessitate an increase in total production of edible oil in the world.

Edible oil can be obtained from different oil crops. In Egypt sunflower (*Helianthus annus* L.) is one of the important promising oil crops in new reclaimed soils. The oil production can be increased horizontally by increasing area of oil crops and/or vertically by increasing total yield of seeds and the concentration of oil in the seeds.

The yield potential of sunflower crop can be defined as the total biomass produced or the agricultural important part of the crop. The yield potential of sunflower could be regulated through alternation of genetic make up and reconstitution of genetical structure through breeding programs by modification of crop environment through improving cultural treatments. However, sunflower cultivars may differ in their assimilating capacity and distribution could be referred as source and sink relation. In this study, the growth and development of the sunflower plant was studied in fifteen days intervals starting from 50 days up to 80 days after sowing to determine how the yield components are developed. It is hoped that through our results the area of possible improvement may be shown which in turn could help plan breeders sunflower to develop in the future higher yielding sunflower cultivars.

MATERIALS AND METHODS

Six sunflower cultivars, i.e. Hy – Sun 354, Vedock, Mayak, Pioneer – 6480, Euroflour and Hybrid – 94 were cultivated in two field experiments in newly cultivated sandy soils at New Salheyia region, Sharkia Governorate in a complete randomized block design with six replications in summer seasons of 2001 and 2002. there replication were adapted for vegetative growth studies and the rest for the determination of the yield and its components. The soil type was sand texture with PH value 7.9, contained 0.492 % organic matter and contain 47 p.p.m available N, 10.83 p.p.m available P and 138.98 p.p.m available K. The experimental unit contained seven ridges, five meter long and 60 cm apart. Planting was done in hills spaced 15 cm along, three seeds per hill. Thinning to one plant per hill was done at 21 days after planting. The normal cultural practices of sowing sunflower were followed.

Samples of five guarded plants were taken at random (from each plot for the three replicates) to study growth characters, where, plant height " cm ", number of internodes/stem, number of leaves / plant, stem diameter " cm ", dry weight of stem/plant, dry weight of leaves/plant, and dry weight of head / plant. Leaves area (LA) " cm^2 / plant " was computed as Bremner and Taha (1966) where, leaf area index (LAI) was determined according to Watson (1952) and specific leaf weight (SLW) " mg /cm^2 " was calculated as Pearce et al., (1969). The growth measurements were done in three dates at fifteen days intervals starting from 50 days after planting (i.e. 50, 65 and 90 days).

At harvest a sample of five plants from every treatment in three replications were chosen at random where plant height " cm ", stem diameter " cm ", head diameter " cm ", total weight of head " g ", number of seeds / head, seed index (100 seed weight " g "), seed yield / plant, straw yield / plant and above ground biomass " g / plant ". All plants of each plot were harvested to estimate seed yield " kg / fed ", straw yield " ton / fed " and above ground biomass " ton / fed ". In addition, relative photosynthetic potential (RPP), i.e. efficiency of leaf area in seed dry matter formation and vegetative and biological dry matter formation was calculated according to Vidovic and Pokorny (1973) where RPP_{seed} = seed yield per plant / LAI, RPP_{bio} = above ground biomass per plant / LAI and $RPP_{reg} = RPP_{bio} - RPP_{seed}$. Meanwhile, crop index (seed yield per fed. / above ground biomass / fed.) and harvest index (seed yield per fed. / straw yield per fed.) were calculated according to Abdel- Gawad *et al.*; (1988).

To study the photosynthetic partitioning in the tested previous six sunflower cultivars, crop growth rate (CGR mg / cm^2 / day) was determined by multiplying NAR × LAI according to Abdel-Gawad *et al.*, (1988). In addition, the percentages of carbohydrate and protein were estimated in vegetative organs, seed and straw and the percentage of oil was determined in seeds. Although plant composition may changes with the age, these values may be fairly enough to provide an estimate of the partitioning coefficient. To calculate the photosynthates required to produce the different constituents, carbon equivalent was determined as shown by Hanson *et al.*, (1960). The production value (PV for the previous plant components was determined according to Penning De Vries *et al.*, (1974). The conversion factor to estimate carbon equivalent, production value, glucose required for synthesis, stored gram atoms, work carbon required in synthesis for carbohydrate, protein, and oil in the different plant components was used as reported by Hanson *et al.*, (1960), as well as, energy coefficient of crop index and energy coefficient of harvest index were calculated according to Abdel-Gawad *et al.*, (1988).

The total carbohydrate (%) in the different organs was determined according to the methods shown by Dubois *et al.*, (1956). Total nitrogen (%) was determined according to A. O. A. C. (1984) and was multiplied by 6.25 to obtain protein (%). Crude oil (%) was determined using the method described by A. O. C. S (1984). In addition, energy yield per plant and per feddan at harvest was calculated using caloric conversion factors according to Hanson *et al.*, (1960). Combined analysis was made for the two growing season due to the similatory of the results in both season according to Snedecor and Cochran (1982). For comparison between means, L.S.D test at 5 % level was used.

RESULTS AND DISCUSSION

A – Growth analysis :-

The results reported in Table (1) show significant differences among the six sunflower cultivars under study, i.e. Hy- Sun 354, Vedock, Mayak, Pioneer – 6480, Euroflour and Hybrid – 94 in growth characters (except SLW at 50 days after sowing which failed to reach the significant level). Moreover, plant height, number of internodes / stem, number of leaves / plant, stem diameter, dry weight of stem / plant and dry weight of head / plant tended to increase with advancing in plant age up to 80 days after sowing, meanwhile, dry weight of leaves / plant, LA, LAI and SLW for all cultivars tended to increase with advancing in plant age up to 65 days after sowing and there after decreased.

It is noteworthy to mention that Vedock cultivar produced the highest significant plant height, number of internodes / stem, number of leaves / plant, stem diameter, dry weight of stem / plant, dry weight of leaves / plant, dry weight of head / plant, LA and LAI at 50,65 and 80 days after sowing, meanwhile, HY – Sun 354 significantly surpassed other five sunflower cultivars in SLW at 50,65 and 80 days after sowing.

Cultivar differences in growth characters in this study may be due to the differences in genetic structure, and to the widely differences between genotypes for mineral element concentrations (Clarck *et al.*, 1977) and to the cultivar differences in partitioning of photosynthates among plant organs (Tables 3 and 4) and to the cultivars differences in migration coefficient, $RPP_{seed,}$ RPP_{bio} and $RPP_{veg.}$ (Table 2) Furthermore, it is clear that cultivar differences in growth characters are in good agreement with the results obtained by Rashed (1990), Keshta *et al.*, (1993), El – Hity *et al.*, (1994 a), El – Baz (1995), Sary *et al.*, (1995), El – Karamity and El – Serogy (1997), Badr (1998), El – Essawy and Mohamed (1998) and Hassanein *et al.*, (2001).

B- Yield and its components :

There were significant differences between the six sunflower cultivars under study Hy–Sun 354, Vedock, Mayak, Pioneer–6480, Euroflour and Hybrid 94 in plant height, stem diameter, head diameter, total weight of head, number of seeds / head, seed index, seed yield / plant, straw yield / plant, above ground biomass / plant, seed yield / fed., straw yield / fed, above ground biomass/fed., $RPP_{seed,}$ $RPP_{bio,}$ RPP_{veg} harvest index and migration coefficient (Table 2). On the other hand differences between sunflower cultivars in crop index failed to reach the significant level at 5 %. Moreover, data reported in the same previous table showed that Hy–Sun 354 cultivar significantly outweighed other five sunflower cultivars under study in RPP_{bio} and RPP_{veg} . With respect to plant height, stem diameter, head diameter, seed index, total weight of head, seed; straw and above ground biomass yields per plant and or / per fed. Vedock cultivar significantly surpassed Hy–Sun 354, Mayak, Pioneer–6480, Euroflour and Hybrid 94 cultivars. On the other hand Hybrid–94 cultivar characterized by the greatest number of seeds / head, $RPP_{seed,}$ harvest index and oil yield Kg / fed. (Table 2).

Cultivar differences between the six sunflower cultivars may be due to differences in growth characters in Table (1). The cultivar differences in photosynthates partitioning may be contributed in this respect (Tables 3 and 4) that previously indicated by Abdel-Gawad *et al.*, (1988) Moreover, the present results are in full agreement with those obtained by Rashed (1990), Keshta *et al.*, (1993), El-Hity *et al.*, (1994), El-Baz (1995), Badr (1998), El-Essawy and Mohamed (1998), Mekki *et al.*, (1999) and Hassanein *et al.*, (2001).

C- Photosynthates partitioning :-

The partitioning coefficient is defined as the percent of the total available photosynthate which is partitioned into the component of the plant (Mc-

Graw, 1997 and Abdel-Gawad *et al.*, 1988). Spiertz (1974) mentioned that the partitioning coefficient may be influenced by environmental factors. The partitioning would be determined by the capacity of the photosynthetic capacity by the head (i.e., the ability of the head to utilize photosynthate as compared to the other plant components. When plants reached the final weeks of the filling period the partitioning coefficient may increase. Evidence for this is shown by the very rapid decline in the canopy in the final weeks and the possible scavenging of nutrients from the vegetative plant parts (Abdel-Gawad *et al.*, 1988).

There were significant differences between sunflower cultivars in crop growth rate (Table 2) and total weight of head (Tables 1 and 2) . Moreover Vedock cultivar significantly the other five ones in head dry weight (Tables 1 and 2), whereas, crop growth rate of the six sunflower cultivars shows significant differences at 50 – 65 and 65 – 80 days after sowing (Table 2). Also, Vedock cultivars significantly exceeded other five cultivars under study in CGR at the two previous growth stages. It is noteworthy to mention that CGR values of vegetative organs reflect the total amount of photosynthates partitioned into the yield components. The partitioning coefficient can not be approximated from a simple ratio of the slope of crop growth rate since more photosynthates is required to produce a given amount of head than the same amount of vegetative material. The additional photosynthates is required to produce the additional protein and oil in seeds (Hanson *et al.*, 1960, Penning Devries *et al.*, 1974, Mc Graw, 1977 and Abdel-Gawad *et al.*, 1988). To estimate the amount of photosynthates needed to produce a quantity of head vs. the same quantity of vegetative material, the relative quantities of oil, protein and carbohydrate should be detected. Significant differences were found among the six sunflower cultivars in carbohydrate and protein percentages in vegetative organs, seeds and straw, as well as, in oil percentage on seeds (Table 3) Data illustrated in Table (3) show that Hybrid – 94 exceeded significantly the other five sunflower cultivars, i.e. Hy-Sun 354, Mayak, Vedock, Pioneer- 6480 and Euroflour in carbohydrate and protein per vegetative organs and straw, whereas, Vedock cultivar characterized by the highest significant values for carbohydrate and protein in seeds compared with Hy-Sun 354, Mayak, Pioneer – 6480, Euroflour and Hybrid – 94. on the other hand Hy-Sun cultivar produced the high significant value from oil percentage in seeds compared with other five cultivars under study.

Data reported in Table (3) show that glucose required for synthesis of the chemical compounds by the various sunflower cultivars components. Differences were found among sunflower cultivars in the amount glucose required for synthesis of carbohydrate and protein in vegetative organs, seeds and straw was significant except in glucose required for synthesis of protein in seeds was not significant. Hybrid – 94 cultivar required more glucose for synthesis of carbohydrate and protein in vegetative organs and straw, whereas, Vedock cultivar required more glucose for synthesis of carbohydrate and protein in seeds, meanwhile, Hy-Sun 354 cultivar required more glucose for synthesis of oil in seeds.

With respect of carbon equivalent, according to Hanson *et al.*, (1960) carbon equivalent is defined as the gram atoms of sugar carbon required to produce product including both gram atoms of work carbon lost in the synthesis and gram atoms of carbon stored in the product. Data in Table (3) shows significant differences among the six sunflower cultivars in carbon equivalent for carbohydrate and protein of vegetative organs, seeds and straw, as well as, oil in seeds. Further more Hy-Sun 354 cultivar significantly surpassed the other five sunflower cultivars under study in high carbon equivalent in carbohydrate in vegetative organs meanwhile, Hybrid-94 characterized with a high carbon equivalent for protein in vegetative organs and straw and for carbohydrate in straw. On the other hand, Vedock characterized by the greatest value of carbon equivalent in carbohydrate and protein in seeds, whereas, Vedock cultivar characterized with a high carbon equivalent for oil in seed compared with other five cultivars under study.

Table (4) show that there were significant differences among the tested six sunflower cultivars in yield energy per plant and per feddan, where, sunflower cultivars were significantly differed in energy yield for carbohydrate, protein and oil per seeds and straw. Moreover, Vedock cultivar significantly surpassed the other five sunflower cultivars under study in yield energy of carbohydrate and protein in seeds per plant and per feddan, also energy yield of carbohydrate in straw per plant and or / fed., as well as energy yield of protein in straw per fed. on the other hand, Mayak cultivar gave the highest significant value from energy yield of oil in seeds per plant, however, Hybrid – 94 exceeded other five cultivars under study in energy yield of oil in seeds per feddan. Furthermore, Vedock cultivar characterized by the greatest value from total energy yield in seeds and straw per plant and per feddan.

It is note worthy to mention that data reported in Table (4) show that Hybrid-94 cultivar significantly surpassed Hy-Sun 354, Mayak, Vadock, Pioneer-6480 and Euroflour in energy coefficient for crop index and in energy coefficient for harvest index.

Thus, it is could be concluded that the present results are in harmony with the results obtained by Abdel-Gawad *et al.*, (1988), where they found that sunflower cultivars differed in partitioning and migration of the total available photosynthates to the economie yield in carbon equivalent for vegetative matter, seeds and straw, yield energy of seeds and straw per plant and / or per fed. and energy coefficient of crop index and harvest index.

Again, as mentioned before, harvested sunflower yield can be increased by sowing Vedock, Hybrid – 94, Euroflour and Pioneer – 6480 cultivars that characterized by highest efficiency in partitioning of photosynthates towards economic yield.

Table (1) :Effect of varietal differences on growth characters of six sunflower cultivars.(Average of 2001 and 2002 seasons)

Cultivars / Plant age (day)	Hy-Sun 354	Mayak	Vedock	Pioneer 6480	Euoflour	Hybrid 94	L.S.D. at 0.05 level	Hy-Sun 354	Mayak	Vedock	Pioneer 6480	Euoflour	Hybrid 94	L.S.D. at 0.05 level
	Plant height (cm)							dry weight of stem "g/plant "						
50	54.80	59.00	64.25	56.10	61.42	57.34	0.56	6.00	7.16	7.87	6.24	7.48	6.73	0.22
65	72.58	80.55	94.30	74.13	86.50	78.60	1.15	13.25	17.60	19.54	15.00	18.59	16.12	0.73
80	110.70	117.40	126.10	112.17	119.00	115.10	1.91	15.59	19.03	21.05	17.40	20.36	18.40	0.56
	Stem diameter (cm)							LA cm^2/plant						
50	0.88	1.03	1.14	0.95	1.07	1.00	0.04	516.04	675.10	751.0	537.00	709.7	593.32	15.50
65	1.49	1.64	1.82	1.54	1.74	1.58	0.07	911.90	1233.01	1337.0	988.00	1297.0	1153.01	19.32
80	1.84	2.08	2.37	1.96	2.16	2.00	0.12	887.00	1112.00	1197.0	982.05	1139.0	1039.00	17.01
	Dry weight of head (g/plant)							No. of leaves/plant						
50	-	-	-	-	-	-	-	10.90	12.00	15.00	11.00	13.75	11.80	1.02
65	5.29	6.96	7.73	6.00	7.24	6.21	0.13	18.50	21.10	24.50	19.15	22.50	20.00	1.17
80	16.00	20.03	25.40	17.52	21.16	19.20	2.01	20.00	25.90	28.00	21.70	27.30	23.95	0.50
	Specific leaf weight (SLW) "mg/cm^2"							Dry weigh of leaves " g/plant"						
50	3.31	3.02	2.90	3.31	2.51	3.32	n.s.	1.71	2.04	2.18	1.78	2.05	1.97	0.09
65	4.27	3.77	3.78	4.07	3.69	4.03	0.08	3.89	4.65	5.05	4.03	4.78	4.65	0.18
80	4.17	3.73	3.73	4.05	3.65	3 05	0.11	3.70	4.15	4.46	3.98	4.16	4.00	0 20
	No. of internodes/stem							LAI						
50	6.00	7.12	8.11	6.70	7.85	7.00	0.24	0.57	0.75	0.83	0.60	0.79	0.66	0.03
65	7.00	9.00	10.30	7.80	9.20	8.20	0.59	1.01	1.37	1.49	1.10	1.44	1.28	0.05
80	10.60	14.70	17.00	11.50	15.00	13.70	1.06	0.99	1.24	1.33	1.04	1.27	1.15	0.02

Table (2) : Sunflower cultivar differences in ,yield/fed at harvest yield components. and crop growth rate "mg/cm^2".
(Average of 2001 and 2002 seasons)

Cultivars / Yield and its components	Hy-Sun 354	Mayak	Vedock	Pioneer 6480	Euoflour	Hybrid 94	L.S.D. at 0.05 level
Plant height (cm)	134.94	147.20	173.90	135.72	152.08	145.07	7.32
Stem diameter (cm)	2.09	2.27	2.30	2.10	2.07	2.04	0.01
Head diameter (cm)	18.87	19.97	21.90	17.01	19.00	18.75	1.48
Total weight of head (g)	68.89	81.09	120.11	76.50	81.82	95.90	18.76
No. of seeds/head	894.80	985.55	907.47	995.17	1006.00	1027.00	17.50
Seed index (100 seeds wt./g)	6.41	6.92	10.13	6.76	7.01	8.09	1.78
Seed yield/plant (g)	57.35	68.19	91.95	67.25	70.53	83.12	3.05
Straw yield/plant (g)	161.27	188.96	207.10	120.13	137.65	143.45	13.40
Above ground biomass (g/plant)	2.08.62	247.15	298.05	187.38	208.18	226.57	21.01
RPP_{seed} (g/LAI)	56.78	49.77	61.71	61.14	49.98	64.94	2.02
RPP_{bio} (g/LAI)	206.55	180.40	200.03	170.35	144.57	117.01	3.45
$RPP_{veg.}$ (g/LAI)	149.77	130.63	138.32	109.25	94.59	112.07	8.74
Seed yield (kg/fed.)	689.39	759.70	1133.00	830.20	973.00	1010.00	46.10
Straw yield (Ton/fed.).	1.950	2.100	3.056	2.328	2.092	2.067	0.018
Above ground biomass (ton/fed.)	2.639	2.860	4.189	3.158	3.065	3.077	0.022
Crop index	0.260	0.270	0.270	0.263	0.317	0.328	n.s.
Harvest index	0.350	0.362	0.371	0.357	0.465	0.489	0.019
Migration coefficient	0.330	0.328	0.403	0.408	0.398	0.423	0.008
Oil yield kg/fed.	255.42	282.53	337.41	293.06	331.79	354.31	13.250
Crop growth rate (mg/cm^2/day)							
50-65 days after sowing	5.09	5.40	8.36	5.43	6.40	7.49	0.21
65-80 days after sowing	3.38	4.00	5.75	4.13	4.61	5.08	0.15

Table (3) : Sunflower cultivar differences in chemical components, glucose required for synthesis and carbon equivalent. (Average of 2001 and 2002 seasons)

Plant organs \ Cultivars	Hy-Sun 354	Mayak	Vedock	Pioneer 6480	Euoflour	Hybrid 94	L.S.D. at 0.05 level
	Carbohydrate, protein and oil percentages						
Vegetative organs :							
Carbohydrate	67.40	64.90	63.62	67.48	68.54	69.63	1.01
Protein	12.56	11.78	11.59	12.75	12.98	19.04	0.05
Seeds :							
Carbohydrate	29.56	29.02	32.38	30.44	30.87	28.65	1.52
Protein	16.87	16.45	18.89	17.01	17.24	16.85	1.19
Oil	37.05	37.19	29.78	35.30	34.10	35.08	1.36
Straw :							
Carbohydrate	65.48	63.97	63.01	66.21	67.32	68.55	0.86
Protein	10.11	9.98	9.77	10.52	10.83	11.00	0.16
	Glucose required for carbohydrate, protein and oil synthesis						
Vegetative organs :							
Carbohydrate	0.790	0.760	0.746	0.791	0.804	0.816	0.008
Protein	0.203	0.190	0.187	0.206	0.209	0.210	0.001
Seeds :							
Carbohydrate	0.347	0.34	0.38	0.357	0.362	0.336	0.019
Protein	0.272	0.265	0.305	0.274	0.278	0.272	n.s.
Oil	1.056	1.06	0.848	1.006	0.972	0.999	0.006
Straw :							
Carbohydrate	0.768	0.749	0.739	0.776	0.789	0.804	0.011
Protein	0.163	0.161	0.158	0.170	0.175	0.177	0.002
	Carbon equivalent						
Vegetative organs :							
Carbohydrate	28.96	25.96	25.45	26.99	27.42	27.85	0.29
Protein	9.87	9.26	9.11	10.02	10.20	10.25	0.03
Total	38.83	35.22	34.56	37.01	37.62	38.10	0.26
Seeds :							
Carbohydrate	11.82	11.61	12.95	12.18	12.35	11.46	0.42
Protein	13.26	12.93	14.85	13.37	13.55	13.24	0.58
Oil	42.31	42.47	34.01	40.31	38.94	40.06	0.13
Total	67.39	67.01	61.81	95.86	64.84	64.76	0.18
Straw :							
Carbohydrate	26.19	25.59	25.2	26.48	26.93	27.42	0.25
Protein	7.95	7.84	7.68	8.27	8.51	8.65	0.13
Total	34.14	33.43	32.88	34.75	35.44	36.07	0.38

Table (4) : Sunflower cultivar differences in energy yield per plant and per fed. at harvest.
(Average of 2001 and 2002 seasons)

Plant organs \ Cultivars	Hy-Sun 354	Mayak	Vedock	Pioneer 6480	Euoflour	Hybrid 94	L.S.D. at 0.05 level
	Yield energy / plant at harvest k-cals.						
Seeds :							
Carbohydrate	66.96	78.17	118.00	80.86	86.00	94.06	10.02
Protein	44.21	51.26	79.00	52.28	55.57	64.01	9.51
Oil	199.73	238.38	257.00	223.15	226.08	274.09	7.37
Total	310.90	367.81	454.00	356.29	367.65	432.16	8.01
Straw :							
Carbohydrate .	417.12	477.47	515.45	314.18	365.98	388.42	15.26
Protein	74.51	86.18	79.92	57.75	68.13	72.11	5.60
Total	491.63	563.65	595.37	371.93	434.11	460.53	17.52
	Yield energy / fed at harvest 10^6 k-cals.						
Seeds :							
Carbohydrate	0.805	0.871	1.449	0.998	1.190	1.143	0.120
Protein	0.531	0.571	0.978	0.645	0.767	0.778	0.006
Oil	2.401	2.656	3.172	2.754	3.119	3.330	0.087
Total	3.737	4.098	5.599	4.397	5.076	5.251	0.123
Straw :							
Carbohydrate	5.044	5.306	7.606	6.088	5.563	5.597	1.003
Protein	0.901	0.958	1.364	1.119	1.036	1.039	0.023
Total	5.945	6.264	8.970	7.207	6.599	6.636	0.902
	Energy coefficient						
Energy coefficient of crop index	0.386	0.395	0.387	0.379	0.435	0.442	0.002
Energy coefficient of harves index	0.629	0.654	0.624	0.61	0.769	0.791	0.013

REFERENCES

Abdel-Gawad, A. A.; Saleh, S. A.; Ashoub, M. A.; Ahmed, M. A. and El-Gazzar, M. M. (1988): Partition of photosynthates in some sunflower cultivars. Egypt. J. Agron., 13 (1 – 2): 73 – 86.

A. O. A. C. (1984): Official Methods of Analysis . 12th Ed. Association Official Analysis Chemists, Washington, D. D., U. S. A.

Badr, N. M. A.(1998): Productivity of sunflower crop (*Helianthus annus* L.) under irrigation with salinized water conditions. Ph. D. Thesis. Agric. of Moshtohor, Zagazig Univ.

Bremner, P. M. and Taha, M. A. (1966): Studies in potato agronomy. The effect of variety, seed size and spacing on growth, development and yield. J. Agric. Sci., 66 : 241 – 252.

Dubois, M.; Gilles, K.A.; Hamilton, J.; Rebers, R. and Smith F. (1956): Colorimetric methods for determination of sugar and related substances Anal. Chem., 28 : 350.

El- Baz, M. G. A. (1995): Effect of planting density on productivity of some sunflower varieties. Ph. D. Thesis, Fac. Agric., Ain Shams Univ., Cairo, Egypt.

El-Essawy, I. I.; and Mohamed, A. A. E. (1998): Response of some sunflower cultivars to nitrogen fertilization. J. Agric. Res., Tanta Univ., 24 (1) : 36 – 44.

El-Hity, M. A.; Zahran, M.; El-Aishy, S. M. and El-Zayat, M. (1994 a): Effect of plant population density and nitrogen rate on two sunflower cultivars. I- Growth analysis and attributes. J. Agric. Res., Tanta Univ., 20 (3) : 472 – 479.

El-Hity, M. A.; Zahran, M.; El-Aishy, S.M. and El-Zayat, M. (1994 b): Effect of plant population density and nitrogen rate on two sunflower cultivars. II- Yield and its components. J. Agric. Res., Tanta Univ., 20 (3) : 480 – 489.

El-Karamity, A. E. and El-Serogy, S. T. (1997): Response of some sunflower genotypes to tillage system and row spacing. J. Agric. Sci., Mansoura Univ., 22 (2) : 329 – 340.

Hanson, W.D.; Leffel, R.C. and Howell, R.W. (1960): Genetic analysis of energy production in soybean. Crop Sci., 1 : 121-126

Hassanein, M.S.; Rashad, El-Sh. M. and Shalaby, Magda. A.F. (2001): Physiological response of sunflower (*Helianthus annus* L.) cultivars to some growth retardants in newly cultivated sandy lands. Ann. of Agric. Sci., Moshtohor, 39 (4) : 1887-1905.

Keshta, M. M.; El-Wakil, A. M., and Serour, W. A. I. (1993): Response of some sunflower entries to hill spacing. J. Agric. Sci., Mansoura Univ., 18 (3) : 620 – 627.

Mc-Graw, R.L. (1977): Yield dynamics of florunner peanut (*Arachis hypogeae* L.): M.Sc. Thesis, Florida Univ. 28, USA.

Mekki, B. B.; El-Kholy, M. A. and Mohamed, E. M. (1999): Yield, oil and fatty acids contents as affected by water deficit and potassium fertilization in two sunflower cultivars. Egypt. J. Agron., 21 : 67 – 85.

Pearce, R. B.; Carlson, G. E.; Barnes, D. Y. and Hanon (1969): Specific leaf weight and photosynthesis in alfalfa. Crop Sci., 9 : 423-426.

Penning De Vries; F.W.T, Brunsting, A.H.M. and Van Lear, H.H. (1974): Product, requirement and efficiency of biosynthesis a quantitative approach. J. Theor. Biol., 45 : 339-377.

Rashed, R.H. (1990): Comparison between some sunflower varieties under different planting dates. Proc. 4th Conf. Agron. Cairo, (2) : 209-219.

Sary, E. S.; Salem, M. F.; El-Zeiny, H. A.; Kortam, M. A. and Badr, N. M. (1995): Leaf character and seed constituents of some sunflower varieties as influenced by salinity. Annals of Agric. Sci. Moshtohor, 33 (1) : 39 – 58.

Snedecor, G. W., and Cochran, W. G. (1990): "Statistical Methods". 8th Ed. Iowa State Univ. Press Ames, Iowa, U.S.A.

Spiertz, J.H.J. (1974): Grain growth and distribution of dry matter in the wheat plant as influenced by temperature, light energy and ear size. Neth. J. Agric. Sci., 22: 207-220.

Vidovic, J. and Pokorny, V. (1973): The effect of different sowing densities and nutrient levels on leaf area index, production and distribution of dry matter in maiz. Biologia. Planta., 15: 374-382.

Watson, D. J. (1952): The physiological basis of variation in yield. Adv. Agron., 4 : 101 – 145.

تقييم ستة أصناف من عباد الشمس فى توظيف وهجرة نواتج عملية التمثيل الضوئى ، النمو ، المحصول ومكوناته بالأراضى الرملية حديثة الاستزراع

محمد حسن محمد عفيفى و محمد عبد المنعم أحمد
قسم بحوث المحاصيل الحقلية – المركز القومى للبحوث – الدقى – جيزة – مصر

أجريت تجربتان حقليتان فى أرض رملية حديثة الاستزراع بمنطقة الصالحية الجديدة – محافظة الشرقية خلال موسمى الزراعة الصيفية ٢٠٠١ / ٢٠٠٢ لتقييم ستة أصناف من عباد الشمس (Euroflour ، Pioneer-6480، Mayak، Vedock، Hy-Sun354 ، Hybrid-94) فى توظيف وهجرة نواتج التمثيل الضوئى ، النمو والمحصول ومكوناته بالأراضى حديثة الاستزراع.

وتتلخص أهم النتائج كما يلى :-

١- تختلف أصناف عباد الشمس معنويا فى قياسات النمو المختلفة (ما عدا الكثافة النوعية للورقة عند عمر ٥٠ يوما) وكذلك فى المحصول ومكوناته (عدا دليل المحصول).

٢- اختلفت الأصناف الستة من عباد الشمس معنويا فى توزيع نواتج عملية التمثيل الضوئى حيث وجد اختلافا معنويا فى النسبة المئوية للكربوهيدرات والبروتين فى أجزاء النمو الخضرى ، البذور والقش وكذلك النسبة المئوية للزيت فى البذور. بالإضافة إلى احتياجات الجلوكوز لعملية التمثيل لمختلف المكونات الكيميائية للأعضاء الخضرية ، البذور (عدا البروتين) والقش ، وأيضا المكافئ الكربونى قد اختلف معنويا فى أصناف عباد الشمس الستة تحت الدراسة. هذا

وقد وجد اختلافا معنويا بين الأصناف فى محصول الطاقة بالنسبة للنبات وكذلك بالنسبة للفدان لكل من الحبوب والقش ومعامل الطاقة لدليل المحصول ومعامل الطاقة لدليل الحصاد.

٣- يمكن زيادة إنتاجية محصول عباد الشمس بزراعة الأصناف Vedock ، Hybrid-94 ، Euroflour ، 6480–Pioneer والتى تميزت بكفاءتها العالية فى توظيف ناتجات التمثيل الضوئى باتجاه المحصول الاقتصادى مقارنة بالصنفين الآخرين Hy-Sun 354 ، Mayak .