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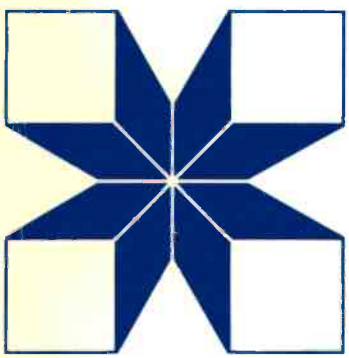

CANADA

# OIL CROPS: SESAME AND SUNFLOWER SUBNETWORKS

PROCEEDINGS OF THE JOINT SECOND WORKSHOP HELD IN CAIRO, EGYPT, 9–12 SEPTEMBER 1989

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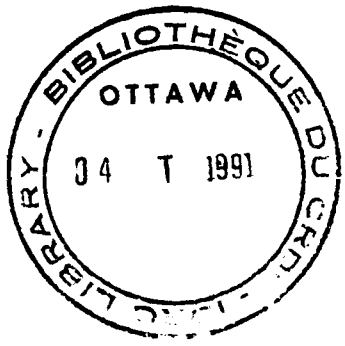
# OIL CROPS:
# SESAME AND SUNFLOWER SUBNETWORKS

## Proceedings of the Joint Second Workshop held in Cairo, Egypt, 9–12 September 1989

**Edited by**
Abbas Omran
Technical Adviser, Oil Crops Network

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# FOREWORD

In September 1989, the Sunflower and Sesame subnetworks held their bi-annual meetings in Cairo, Egypt. The meetings were well attended and papers, presented in these proceedings, provide a very informative overview of some of the cropping systems, management practices, production constraints and research highlights for both crops in several countries.

Chronic edible oil deficit is a major problem facing many developing countries in Africa and Asia where most countries are forced to import large quantities to satisfy the requirements of their growing populations. With the present rates of population increase and the improvement of nutrition standards it is likely that the consumption of edible oil will rise over the years, increasingly drawing on scarce foreign exchange for the importation of this vital food staple. For this reason, several countries have opted to increase self-sufficiency in edible oil.

Production deficits are due to a number of factors, among which neglect in oilcrops research, in both developed and developing countries has been a major one. This is particularly true for minor crops such as sesame. In the context of the IDRC oilcrops network, initiated in 1981, the interchange of information and the sharing of results between scientists have proved to be very useful and beneficial for the generation of scientific knowledge and the stimulation of research in this important area. It is hoped that conclusions and recommendations of this meeting will stimulate further research and development in the future.

A second important reason for limited national production has been the exceptionally low levels of world prices for oils and fats in the 1980's and the comparative advantage of importation over production for developing countries. The description of a case study using a system's approach to analysis the Vegetable Oil/Protein System of Kenya has stirred much interest during the Cairo meetings and it is hoped that similar work can be carried out in other countries in the future.

The Cairo meetings will also unfortunately be remembered as the one which has witnessed the diagnosis of the fatal disease of late Dr. Hiruy Belayneh, Chairman of the Brassica Subnetwork. We will all regret his absence.

On behalf of IDRC and of all participants, I would like to thank the Government of Egypt for its hospitality, the organizers for the excellent arrangements and all those who contributed to the success of these meetings by their presentations and discussions.

Eglal Rached,
Senior Program Officer,
IDRC, Cairo

# CONTENTS

# SOME ASPECTS TOWARDS OVERCOMING VEGETABLE OILS INSUFFICIENCY IN EGYPT : PRODUCTION OF SUNFLOWER AND ITS IMPROVMENT IN SUEZ CANAL REGION

**Abdel-Fattah Mohmed Abdel-Wahab**

(Part of a Report, Supreme Council of Universities, University Linkage Project No. 842052. US Counterparts Dr. K.J. Frey and C.F. Curtiss, Agronomy Department, Iowa State Univ., U.S.A.)

To overcome vegetable oil insufficiency in Egypt, it has become very urgent to expand indigenous oil production through increasing the total area under oil crops as well as the production per unit area. Sunflower is considered promising in this respect. It is the second most important source of vegetable oil in the world, second only to soybeans. It can be grown in the new reclaimed lands as well as in the low maize-yielding soils without drastic changes in the crop rotation in Egypt. The crop responds well to new techniques of irrigation. Such conditions are prevailing in Suez Canal region.

The local varieties of sunflower have only about 30% oil while the new cultivars in the developed countries have more than 50%. Therefore, high yielding, short season with high oil content varieties should be introduced or bred to grow the crop successfully.

The research project entitled "Some aspects towards overcoming vegetable oils insufficiency in Egypt" was initiated in 1985 and continued in 1986 and 1987 seasons. The period of the project was two years. The main objectives of the project were to:

1. select the most suitable cultivars to be grown in Suez Canal region on different types of soil as well as under different irrigation systems.
2. have synthetic variety of higher seed and oil yields.
3. adapt the agricultural practices for the selected varieties such as sowing date, seeding rate and plant density, fertilization and weed control.
4. recommend areas to be cultivated with sunflower about 50,000 faddans (1 faddan = 4200 $m^2$) in Suez Canal region and adjacent reclaimed lands.

In this paper some of the agronomic studies conducted in the new reclaimed lands as well as in areas where maize is usually grown will be demonstrated.

## SEASON I (1985)

### I. Evaluation of Some Sunflower Varieties at Different Levels on New Reclaimed Lands

#### Materials and methods

Four field experiments were conducted, two at Ismailia under surface irrigation and two at Salhia project under sprinkler irrigation (Pivot irrigation). Meanwhile, at each situation, one experiment was performed as early summer sowing and the other as late summer one. In each experiment, 10 cultivars were evaluated at two levels of fertilization and three planting distances.

The cultivars were: 2 open varieties "Giza-1" and "Maiak" (Russian variety introduced to Egypt in 1970); 4 American hybrids "H. 7000", "H. 7111", H. 7116 " and H. 7780" and 4 French hybrids - "Elia", "Topflor", "Cerflor" and "Bolero". The American hybrids are produced by Interstate Seed and Grain Company,

North Dakota, USA, while the French ones were imported for Salhia project. The local cv. "Giza-1" was not included in the late summer experiment at Salhia.

The two levels of fertilization were 40 kg N + 15 kg $P_2O_5$ + 25 kg $K_2O$ per faddan and 80 kg N + 30 kg $P_2O_5$ + 50 kg $K_2O$ per faddan. The three planting distances were 36, 30 and 24 cm between one-plant hills within the row 70 cm in width. The split-split plot design was used where the two fertilization levels were allocated in the main plots, the three planting distances in the sub-plots and the 10 varieties in the sub-sub plots. The experimental plot consisted of 4 rows 360 cm long and 70 cm wide in the two summer experiments as well as in the late summer at Salhia while in the late summer at Ismailia the plot was three ridges only.

Sowing was carried out on 28th April and 1st May in early summer and 19th July and 29th July in late summer at Ismailia & Salhia, respectively. Hand hoeing as well as irrigation were carried out as proper.

At 75 days from sowing, data were recorded for plant height, number of leaves/plant, fresh and dry weights/plant, fresh and dry weights of stem/plant, fresh and dry weights of head/plant, and number of days to flowering as well as to harvesting. At harvesting, the following data were obtained: plant height, head diameter, seed index, seed yield and seed oil content. The data were subjected to the proper statistical analysis of variance at the Central Lab., Computer Unit, Faculty of Agric., Alexandria University.

## Results

A. Effect of fertilization: (Tables 1,2)
   a. The high level of fertilization caused almost insignificant increases in the seed yield and its components such as head diameter and seed index, while the reverse was true in seed oil content.
   b. The high level of fertilization is not recommended for sunflower in sandy soils under Ismailia Governorate conditions regardless of the irrigation methods.

B. Effect of planting distances: (Tables 3, 4).
   a. In general, head diameter as well as seed index decreased consistently as planting distance was decreased from 36 to 24 cm and the differences were highly

Table 1. Effect of fertilization levels on yield and its components.

| Fertilization Levels | No. of days to harvest | Plant height (cm) | Head diameter (cm) | 100-seed weight (g) | Seed yield (kg/fad.) | Seed oil content (%) |
|---|---|---|---|---|---|---|
| **Ismailia Summer Experiment** | | | | | | |
| 40 N + 15 $P_2O_5$ + 25 $K_2O$ | 104.70 | 163.19 | 15.90 | 4.74 | 1000 | 45.15 |
| 80 N + 15 $P_2O_5$ + 50 $K_2O$ | 104.20 | 161.58 | 15.70 | 5.03 | 1007 | 43.57 |
| L.S.D. 5% | N.S | N.S | N.S | 0.09 | N.S | N.S |
| 1% | N.S | N.S | N.S | 0.17 | N.S | N.S |
| **Salhia Summer Experiment** | | | | | | |
| 40N + 15 $P_2O_5$ + 25 $K_2O$ | 115.0 | 117.0 | 16.30 | 5.27 | 850 | 41.02 |
| 80 N + 15 $P_2O_5$ + 50 $K_2O$ | 115.60 | 121.32 | 16.90 | 5.29 | 930 | 39.37 |
| L.S.D. 5% | N.S | N.S | 0.60 | N.S | N.S | 0.47 |
| 1% | N.S | N.S | N.S | N.S | N.S | 0.69 |

Table 2. Effect of fertilization level on yield and its components.

| Fertilization Levels | No. of days to harvest | Plant height (cm) | Head diameter (cm) | 100-seed weight (g) | Seed yield (kg/fd.) | Seed oil content (%) |
|---|---|---|---|---|---|---|
| | | Ismailia late summer experiment | | | | |
| 40 N + 15 $P_2O_5$ + 25 $K_2O$ | - | 85.30 | 8.41 | 4.315 | 568 | 42.44 |
| 80 N + 15 $P_2O_5$ + 50 $K_2O$ | - | 87.80 | 8.59 | 5.657 | 667 | 41.92 |
| L.S.D. 5% | - | 0.52 | N.S | N.S | 78 | - |
| 1% | - | Salhia late summer experiment | | | N.S | |
| 40 N + 15 $P_2O_5$ + 25 $K_2O$ | - | 65.89 | 10.91 | 3.77 | 380.0 | 44.33 |
| 80 N + 15 $P_2O_5$ + 50 $K_2O$ | - | 70.15 | 13.00 | 3.77 | 378.0 | 45.10 |
| L.S.D. 5% | - | N.S | 3.34 | N.S | N.S | N.S |
| 1% | - | N.S | 9.78 | N.S | N.S | N.S |

significant in all experiments, except in late summer under sprinkler irrigation at Salhia. However, comparisons between the three planting distances, within each experiment, showed that the highest seed yield was obtained with 30 cm under surface irrigation and with 24 cm under sprinkler irrigation. However, the differences were statistically significant in the late summer at Salhia only.

b. It could be recommended to grow sunflower at planting distance of 30 cm under surface irrigation and 24 cm under sprinkler irrigation.

C. Effect of varieties: (Tables 5,6,7 and 8)

a. According to the data of earliness (number of days to flowering and/or number of days to harvesting). The results showed the differences among the open varieties, the American and French hybrids.

The delay in flowering and maturing in Salhia experiments under sprinkler irrigation as compared to Ismailia ones under surface irrigation within each planting (summer or late summer) might be attributed also to the difference in the soil type. The soil at Ismailia was pure sandy, while at Salhia it was sandy loam.

b. In the Summer experiment at Ismailia under surface irrigation, the highest seed yields were obtained for the French hybrids followed by the open varieties without significant differences among them. That was more evident with planting distance of 24 cm and under the high or level of fertilization. In Salhia Summer experiment, the highest seed yields were obtained for Giza-1 followed by H. 7116 followed by H. 7780 and Elia. In the late Summer experiments, the French hybrids, Elia and Bolero gave the highest seed yields.

c. The highest seed oil contents were obtained from the hybrids Topflor, Maiak, H. 7780, Bolero and Elia in Ismailia Summer experiment under surface irrigation. The introduced hybrids gave higher seed oil content with planting distance of 30 cm. In Salhia Summer experiment, the hybrids Topflor and

Table 3. Effect of plant distances on yield and its components.

| Planting distances | No. of days to harvest | Plant height (cm) | Head diameter (cm) | 100-seed weight (g) | Seed yield (kg/fad.) | Seed oil content (%) |
|---|---|---|---|---|---|---|
| | | | Ismailia summer experiment | | | |
| 36 cm | 105.30 | 167.33 | 16.60 | 5.35 | 969 | 44.04 |
| 30 cm | 104.40 | 162.73 | 16.10 | 4.94 | 1065 | 45.22 |
| 24 cm | 103.70 | 157.09 | 14.80 | 4.35 | 975 | 43.93 |
| L.S.D. 5% | 1.17 | N.S | 0.73 | 0.16 | N.S | |
| 1% | N.S | N.S | 1.03 | 0.22 | N.S | |
| | | | Salhia summer experiment | | | |
| 36 cm | 116.4 | 133.90 | 18.20 | 5.54 | 870 | 40.64 |
| 30 cm | 114.50 | 117.84 | 16.50 | 5.29 | 870 | 39.96 |
| 24 cm | 115.10 | 116.04 | 15.40 | 5.02 | 930 | 40.75 |
| L.S.D. 5% | N.S | 6.07 | 0.90 | 0.12 | N.S | 0.47 |
| 1% | N.S | N.S | 1.30 | 0.17 | N.S | 0.69 |

Table 4. Effect of plant distances on yield and its components.

| Planting distances | No. of days to harvest | Plant height (cm) | Head diameter (cm) | 100-seed weight (gm) | Seed yield (kg/fad.) | Seed oil content (%) |
|---|---|---|---|---|---|---|
| | | | Ismailia summer experiment | | | |
| 36 cm | - | 90.90 | 8.63 | 5.400 | 623 | 42.05 |
| 30 cm | - | 82.90 | 8.92 | 4.928 | 651 | 42.12 |
| 24 cm | - | 85.90 | 7.93 | 4.929 | 578 | 42.37 |
| L.S.D 5% | - | 0.59 | 0.35 | N.S | N.S | |
| 1% | - | 0.86 | 0.42 | N.S | N.S | |
| | | | Salhia late summer | | | |
| 36 cm | - | 71.52 | 12.80 | 3.95 | 354 | 43.37 |
| 30 cm | - | 67.52 | 12.07 | 3.63 | 381 | 46.0 |
| 24 cm | - | 65.06 | 10.99 | 3.72 | 402 | 44.79 |
| L.S.D. 5% | - | N.S | 3.34 | 0.07 | - | - |
| 1% | - | N.S | 9.78 | 0.11 | - | - |

Table 5. Effect of varieties on yield and its components in Ismailia summer experiment.

| Varieties | Plant height (cm) | Head diameter (cm) | 100-seed weight (g) | Seed yield (kg/fad.) | Seed oil content (%) | No. of days to harvesting |
|---|---|---|---|---|---|---|
| Maiak | 214.48 | 17.50 | 5.71 | 1005 | 46.68 | 112.00 |
| Giza 1 | 266.57 | 18.10 | 5.84 | 1053 | 33.25 | 113.25 |
| Hybrid 7000 | 136.51 | 14.80 | 5.67 | 820 | 42.82 | 100.60 |
| " 7111 | 135.93 | 14.60 | 4.52 | 856 | 43.80 | 100.30 |
| " 7116 | 140.65 | 14.60 | 3.78 | 975 | 44.87 | 100.55 |
| " 7780 | 139.96 | 14.20 | 3.90 | 962 | 46.64 | 103.15 |
| Elia | 165.37 | 14.60 | 4.85 | 1169 | 46.40 | 104.30 |
| Topflor | 138.69 | 15.10 | 4.90 | 1028 | 48.03 | 106.55 |
| Cerflor | 145.48 | 14.80 | 4.60 | 1121 | 43.65 | 99.90 |
| Bolero | 138.58 | 15.50 | 5.02 | 1044 | 46.48 | 104.30 |
| L.S.D. 5% | 6.80 | 0.89 | 0.24 | 256 | 2.27 | 3.21 |
| 1% | 8.91 | 1.17 | 0.31 | 336 | 3.01 | 4.22 |

Table 6. Effect of varieties on yield and its components in Salhia summer experiment.

| Varieties | Plant height (cm) | Head diameter (cm) | 100-seed weight (g) | Seed yield (kg/fad.) | Seed oil content (%) | No. of days to harvesting |
|---|---|---|---|---|---|---|
| Maiak | 164.52 | 19.3 | 6.70 | 1150 | 40.33 | 132.6 |
| Giza 1 | 193.08 | 20.8 | 6.77 | 1280 | 28.21 | 130.9 |
| Hybrid 7000 | 97.92 | 14.8 | 5.85 | 640 | 40.70 | 108.6 |
| " 7111 | 97.32 | 15.1 | 4.95 | 780 | 42.55 | 108.0 |
| " 7116 | 101.64 | 16.1 | 4.61 | 960 | 43.64 | 110.6 |
| " 7780 | 108.24 | 16.1 | 4.36 | 870 | 42.54 | 112.1 |
| Elia | 111.0 | 16.0 | 4.98 | 870 | 41.65 | 115.1 |
| Topflor | 100.20 | 15.7 | 4.35 | 710 | 44.73 | 114.7 |
| Cerflor | 110.16 | 16.0 | 5.27 | 840 | 40.61 | 108.1 |
| Bolero | 107.64 | 16.2 | 4.97 | 810 | 39.52 | 113.2 |
| L.S.D. 5% | 4.87 | 0.9 | 0.27 | 84 | 1.76 | 2.1 |
| 1% | 6.38 | 1.2 | 0.35 | 114 | 2.34 | 2.7 |

Table 7. Effect of varieties on yield and its components in Ismailia late summer experiment.

| Varieties | Plant height (cm) | Head diameter (cm) | 100-seed weight (g) | Seed yield (kg/fad.) | Seed oil content (%) |
|---|---|---|---|---|---|
| Maiak | 126.7 | 11.15 | 5.858 | 570 | 41.31 |
| Giza 1 | 118.7 | 9.17 | 5.336 | 651 | 30.56 |
| " 7000 | 82.2 | 8.77 | 5.578 | 554 | 41.00 |
| " 7111 | 73.4 | 6.93 | 4.847 | 523 | 43.34 |
| " 7116 | 78.7 | 8.18 | 4.293 | 572 | 43.99 |
| " 7780 | 79.5 | 9.20 | 4.616 | 595 | 45.36 |
| Elia | 85.9 | 8.93 | 4.650 | 720 | 43.93 |
| Topfor | 78.5 | 8.19 | 4.859 | 653 | 48.18 |
| Cerflor | 75.2 | 6.83 | 4.239 | 663 | 41.34 |
| Bolero | 66.7 | 7.68 | 5.578 | 672 | 42.76 |
| L.S.D. 5% | 1.06 | 0.37 | 0.846 | 36 | 2.52 |
| 1% | 1.41 | 0.50 | 1.130 | 48 | 3.34 |

Table 8. Effect of varieties on yield and its components in Salhia late summer experiment.

| Varieties | Plant height (cm) | Head diameter (cm) | 100-seed weight (g) | Seed yield (kg/fd.) | Seed oil content (%) |
|---|---|---|---|---|---|
| Maiak | 97.38 | 14.82 | 3.80 | 465 | 39.21 |
| Hybrid 7000 | 62.20 | 10.68 | 4.13 | 237 | 45.25 |
| " 7111 | 60.57 | 11.52 | 3.54 | 361 | 44.19 |
| " 7116 | 61.08 | 12.07 | 3.68 | 395 | 43.47 |
| " 7780 | 62.68 | 11.93 | 3.28 | 329 | 42.35 |
| Elia | 72.43 | 12.64 | 4.16 | 474 | 44.95 |
| Topflor | 65.59 | 11.70 | 3.67 | 391 | 47.84 |
| Cerflor | 68.02 | 10.79 | 3.67 | 317 | 46.31 |
| Bolero | 62.28 | 11.42 | 3.87 | 442 | 48.29 |
| L.S.D 5% | 5.63 | 1.55 | 0.13 | 46.80 | 1.29 |
| 1% | 7.48 | 2.07 | 0.17 | 61.95 | 2.65 |

H.7116 had the highest seed oil content and that was more evident with planting distance of 24 cm. In the late Summer experiment at Ismailia, hybrid Topflor followed by H. 7780 had the highest seed oil content with planting distance of 24 cm. H. 7780 responded negatively to the higher level of fertilization in this respect. However, under sprinkler irrigation at Salhia in the late Summer sowing, hybrids Bolero and Topflor had the highest seed oil content and that was more evident under the higher level of fertilization as well as with planting distance of 30 cm.

d. On the basis of earliness, seed yield per faddan and seed oil content, it is recommended for sunflower producers to cultivate the French hybrids as well as the American hybrids 7116 and 7780 for the Summer sowing in Sandy soil under surface irrigation, while under sprinkler irrigation at Salhia project where the soil is sandy loam, H. 7116 followed by 7780 and Elia are recommended for the same sowing. Although the seed yield decreased markedly in the late summer sowing, generally the same afore mentioned cultivars were also the superiors.

e. The open variety Maiak gave high seed yield and almost did not differ significantly from the high yielding hybrids in yield as well as in seed oil content. That was particularly true for the summer sowings. But this variety was relatively late-maturing (by about 2 weeks at Ismailia and 3 weeks at Salhia). Therefore, a breeding program of mass selection is recommended for its purification and earliness.

D. Effect of planting dates

The Summer planting in May resulted in high yields under surface as well as sprinkler irrigations, while in the late summer sowing (Nily), the yields remarkably decreased. Moreover, at Ismailia region, the yield was severly subjected to the attack of birds. Therefore, it is recommended to cultivate sunflower in both locations as a summer crop. However, sowing dates should be studied further.

## SEASON II (1986)

In Summer 1986 season, a series of experiments were conducted in Ismailia province in areas where maize is usually cultivated. The following exp. were carried out:

### II. Evaluation of Some Sunflower Varieties at Different Planting Distances and Fertilization Levels

#### Materials and Methods

The same experiment (I) which was conducted on the new reclaimed lands at Ismailia as well as at Salhia project in 1985, was also performed in 1986 season at Abo-Sultan district in a special farm, the soil of which is sandy loam.

The phosphorus fertilizer in the form of superphosphate 15.5% as well as the potassium fertilizer in the form of potassium sulphate 48% were added during soil preparation, while nitrogenous fertilizer was applied twice, one half before the second irrigation and the other half before the third irrigation. The following data were recorded: number of days to harvest, plant height at harvest, head diameter, 100-seed weight, seed yield.

Table 9. Effect of fertilization levels on sunflower characters in Abo-Sultan experiment during 1986.

| Fertilization Levels | No. of days to harvest | Plant height (cm) | Head diameter (cm) | 100-seed weight (g) | Seed yield (kg/fad.) |
|---|---|---|---|---|---|
| 40 N + 15 $P_2O_5$ + 25 $K_2O$ | 104.0 | 151.1 | 17.8 | 7.28 | 974 |
| 80 N + 30 $P_2O_5$ + 50 $K_2O$ | 104.1 | 153.1 | 18.0 | 7.94 | 1042 |
| L.S.D 5% | N.S | N.S | N.S | N.S | N.S |
| 1% | N.S | N.S | N.S | N.S | N.S |

## Results

a. Effect of fertilization: (Table 9)

The studied characteristics were found to be affected slightly but insignificantly by increasing fertilization level. The increases in 100-seed weight and seed yield amounted to 9.06% and 6.89%, respectively.

b. Effect of planting distances: (Table 10)

Table 10. Effect of planting distances on sunflower characters in Abo-Sultan experiment during 1986 season.

| Planting distances | No. of days to harvest | Plant height (cm) | Head diameter (cm) | 100-seed weight (g) | Seed yield (kg/fd.) |
|---|---|---|---|---|---|
| 36 cm | 104.1 | 151.1 | 18.2 | 8.02 | 867 |
| 30 cm | 103.7 | 153.3 | 18.0 | 7.66 | 1024 |
| 24 cm | 104.1 | 152.0 | 17.5 | 7.16 | 1133 |
| L.S.D. 5% | N.S. | N.S. | N.S. | 0.396 | 32.91 |
| 1% | N.S. | N.S. | N.S. | 0.557 | 47.80 |

Decreasing planting distance from 36 cm to 24 cm did not affect significantly, number of days to harvesting, plant height at harvesting and head diameter. On the other hand, 100-seed weight was found to decrease consistently and significantly as planting distance was decreased. Meanwhile, seed yield increased consistently and highly significantly as planting distance was decreased. There were increases in seed yield of 18.11 and 30.68% by decreasing planting distance from 36 cm to 30 and 24 cm, respectively.

c. Varietal differences: (Table 11)

Number of days to harvest: Significant differences were found among varieties The American hybrids as well as the French ones matured significantly earlier than the local varieties Maiak and Giza- 1 (by about 10 days). Meanwhile, the tallest plants were recorded for Maiak followed by Giza-1 and both differed highly significantly from the introduced varieties which did not differ significantly from each other in this respect.

Head diameter: the differences among the varieties were highly significant. Giza-1 followed by Maiak had the largest heads and both surpassed significantly the introduced hybrids. Hybrid 7116 had larger heads compared with the other introduced hybrids and deviated significantly from all of them except Elia.

100-seed weight: The differences among the varieties were highly significant. The heaviest seeds were

Table 11. Effect of varieties on sunflower characters n Abo-Sultan experiment during 1986 season.

| Varieties | No. of days to harvest | Plant height (cm) | Head diameter (cm) | 100-seed weight (g) | Seed yield (kg/fd.) |
|---|---|---|---|---|---|
| Maiak | 111.5 | 221.8 | 20.0 | 8.64 | 1603 |
| Giza 1 | 111.6 | 191.4 | 21.4 | 8.93 | 1470 |
| Hybrid 7000 | 102.1 | 136.9 | 16.3 | 8.28 | 691 |
| " 7111 | 102.1 | 137.0 | 16.7 | 8.18 | 788 |
| " 7116 | 101.7 | 138.2 | 18.6 | 6.90 | 1023 |
| " 7780 | 102.5 | 135.7 | 16.7 | 6.45 | 911 |
| Elia | 102.5 | 152.5 | 17.8 | 7.57 | 977 |
| Topflor | 102.4 | 138.9 | 17.4 | 7.52 | 901 |
| Cerflor | 101.7 | 141.9 | 17.5 | 7.00 | 940 |
| Bolero | 102.3 | 127.2 | 16.8 | 7.13 | 775 |
| L.S.D. 5% | 1.339 | 26.74 | 0.966 | 0.803 | 240.20 |
| 1% | 1.772 | 35.39 | 1.280 | 1.063 | 317.92 |

those of Giza-1 while the lightest ones were those of hybrid 7780.

Seed yield: Over the two fertilization levels and the three planting distances, the highest seed yield was obtained from Maiak followed by Giza-1. Both local cultivars, highly significantly, out yielded the introduced hybrids. H.7116 had the highest seed yield when compared with the other introduced hybrids but it deviated significantly from H. 7000 only.

The interactions among the three factors did not affect significantly, all the studied characteristics.

## III. The Response of Certain Sunflower Cultivars to Planting Distances at Different Planting Dates

### Materials and Methods

Three field experiments were conducted on low maize yielding soil at Abo-Swier district in 1986 season at three dates of sowing (22 May, 12 July and 5 August). In each experiment, three cultivars namely, Maiak and the American Hybrids 7116 and 7780 were tested at four planting distances: 12, 18, 24 and 30 cm. The experimental design was split-plot with four replications. The planting distances were allocated in the main plots and the cultivars in the sub-plot. The plot consisted of four rows of 60 cm width and 360 cm length. Fertilizer was applied at 60 kg N + 15 kg $P_2O_5$. The phosphorus fertilizer was added before sowing in the form of calcium superphosphate, while nitrogen fertilizer was added twice before the 2nd and the 3rd irrigations in the form of Ammonium nitrate. Thinning was carried out after about 7 weeks from sowing. Data were recorded in two stages:

i. At 75 days from sowing: The following data were estimated on a sample of 3 plants taken randomly from the inner rows of each plot: plant height, fresh-weight per plant, dry weight per plant, and leaf area index (LAI).

ii. At harvesting: Plant height as an average of 10 plants, head diameter as an average of 10 plants, 100 seed weight, and seed yield.

The data were statistically analyzed and Duncan's multiple range test was used for comparison among averages.

### Results

Table 12 indicates the mean averages of all characters at the three planting dates for the three

varieties at the four studied planting distances.

1. Plant height (cm)

Plant height decreased consistently as planting distance was increased, but at 75 days from sowing, the differences were significant in the third sowing only, while at harvesting these differences were significant in the three sowings. Meanwhile, the differences between 24 and 30 cm were not significant. Maiak, as it was expected, had the tallest plants and differed significantly from the American hybrids 7116 and 7780 which almost did not differ from each other in this respect. However, plant height was decreased evidently by delaying sowing from 22 May to 12 July as well as to 5 August.

2. Fresh- and dry-weight per plant (g)

Both characters increased consistently as planting distance was increased. The planting distance of 12 cm deviated almost significantly, from the other distances, while the differences between 24 and 30 cm were not significant. Maiak had the heaviest plants as compared to H. 7116 and H. 7780. The plants of hybrid 7780 were heavier, but the differences were significant in July and August sowings concerning fresh weight and August sowing concerning dry weight. Plants became lighter by delaying sowing from May to July or August. The plants of May sowing were, on the average, heavier by 65.4% and 77.6% in fresh-weight and by 71.3% and 68% in dry-weight compared to those of July and August sowings.

3. Leaf area index at 75 days of sowing (LAI)

LAI decreased consistently as planting distance was increased. In May sowing, the differences between 12 and 18 cm as well as between 24 and 30 cm, were not significant, while in the July/August sowings the differences among the four distances were significant. Maiak had the highest LAI and deviated, significantly, from the other two hybrids. H.7780 plants had significantly larger LAI than H.7116 in July/August sowings.

4. Head diameter (cm)

Although head diameter increased consistently as planting distance was increased, the differences among the four planting distances were significant in July/August sowings only. Maiak gave larger heads than both hybrids, which did not differ significantly from each other. That was true in the three dates of sowing.

5. 100-seed weight (g)

This trait was not affected significantly by the plating distances when sowing in May as well as in August, while the weight increased consistently and significantly as planting distance was increased. H.7780 gave the heaviest seeds in the three sowings and differed significantly with Maiak and H.7116. In May sowing, H. 7716 resulted in seeds significantly heavier than those of Maiak, while the differences between them were not significant in July/August sowings. Generally, the seeds of May sowing were heavier than the seeds of the other sowing dates.

6. Seed yield (kg/fad)

In the May sowing, the highest seed yield was obtained by sowing sunflower at planting distance of 12 cm compared to the other distances, which did not differ significantly from each other in this respect. In the July/August sowing, the yield decreased consistently and significantly as planting distance

was increased. There were no significant differences among the three cultivars in May sowing as wellas in July sowing, while in August H.7116 gave seed yield less than H.7780 and Maiak, which did not differ significantly from each other in this respect. There was significant interaction between distances and cultivars concerning the effect on seed yield. All over the factors studied May sowing outyielded July and August sowings by about 37%.

Table 12. Response of some sunflower cultivars to planting distances at different sowing.

| Cultivars | 22/5/1986 Sowing — Planting distances (cm) | | | | | 12/7/1986 Sowing — Planting distances (cm) | | | | | 5/8/1986 Sowing — Planting distances (cm) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 12cm | 18cm | 24cm | 30cm | Avg. | 12cm | 18cm | 24cm | 30cm | Avg. | 12cm | 18cm | 24cm | 30cm | Avg. |
| Effect on plant height (cm) after 75 days: | | | | | | | | | | | | | | | |
| H.7116 | 179a* | 185a | 184a | 160a | 177B | 123a | 134a | 132a | 116a | 126B | 126de | 126de | 123e | 118f | 123B |
| H.7780 | 176a | 166a | 168a | 157a | 167C | 128a | 131a | 127a | 110a | 124B | 129de | 130d | 124def | 106g | 122B |
| MAIAK | 213a | 206a | 194a | 203a | 204A | 201a | 197a | 205a | 178a | 195A | 212a | 197b | 194bc | 187c | 198A |
| AVG. | 189A | 186A | 181A | 174A | 182 | 150A | 154A | 155A | 135A | 148 | 156A | 151B | 147C | 137D | 148 |
| Effect on plant height (cm) at harvesting: | | | | | | | | | | | | | | | |
| H.7116 | 178d | 178d | 171de | 166de | 173B | 140 | 136 | 128 | 120 | 131B | 135e | 132ed | 126df | 116g | 127B |
| H.7780 | 173d | 168de | 162de | 154e | 164B | 137 | 132 | 124 | 116 | 127C | 134e | 137e | 125f | 112g | 127B |
| MAIAK | 284a | 256b | 232c | 238c | 252A | 266 | 242 | 223 | 216 | 236A | 245a | 232b | 226c | 219d | 230A |
| AVG. | 212A | 201AB | 188B | 186B | 197 | 181A | 170B | 158C | 151D | 165 | 171A | 167B | 159C | 155C | 162 |
| Effect on fresh weight per plant (g) after 75 days: | | | | | | | | | | | | | | | |
| H.7116 | 722a | 734a | 950a | 1097a | 876B | 360a | 454a | 556a | 555a | 481C | 380a | 435a | 502a | 528a | 461C |
| H.7780 | 552a | 942a | 917a | 998a | 852B | 476a | 529a | 596a | 577a | 544C | 410a | 454a | 519a | 540a | 481B |
| MAIAK | 939a | 1283a | 1107a | 1325a | 1164A | 596a | 676a | 769a | 851a | 723A | 491a | 515a | 572a | 593a | 543A |
| AVG. | 738B | 986A | 992A | 1140A | 964 | 478B | 553AB | 640A | 661a | 583 | 427D | 468C | 531B | 554A | 495 |
| Effect on dry weight per plant (g) after 75 days: | | | | | | | | | | | | | | | |
| H.7116 | 117a | 118a | 139a | 161a | 134B | 58a | 77a | 80a | 82a | 74B | 70a | 82a | 92a | 94a | 85C |
| H.7780 | 93a | 143a | 139a | 164a | 135B | 67a | 84a | 79a | 81a | 78B | 78a | 87a | 96a | 95a | 89B |
| MAIAK | 156a | 194a | 175a | 198a | 181A | 95a | 104a | 124a | 118a | 110A8 | 86a | 87a | 104a | 98a | 94A |
| AVE. | 122A | 152A | 151A | 174A | 150 | 73A | 86A | 94A | 94A | 87 | 78C | 85B | 97A | 96A | 89 |
| Effect on leaf area index after 75 days: | | | | | | | | | | | | | | | |
| H.7116 | 1.21 | 0.76 | 0.82 | 0.55 | 0.83B | 0.72 | 0.62 | 0.56 | 0.43 | 0.58 | 0.75c | 0.62de | 0.59e | 0.49fg | 0.61C |
| H.7780 | 0.92 | 0.91 | 0.67 | 0.50 | 0.75B | 0.91 | 0.63 | 0.56 | 0.49 | 0.65 | 0.95b | 0.80c | 0.59e | 0.44g | 0.70B |
| MAIAK | 1.64 | 1.46 | 0.96 | 0.94 | 1.25A | 1.21 | 1.01 | 0.98 | 0.78 | 1.00 | 1.09a | 0.81c | 0.68d | 0.55ef | 0.78A |
| AVE | 1.25A | 1.04A | 0.82B | 0.64B | 0.94 | 0.95 | 0.75 | 0.70 | 0.57 | 0.74 | 0.93A | 0.74B | 0.62C | 0.49D | 0.70 |
| Effect on head diameter (cm) at harvest: | | | | | | | | | | | | | | | |
| H.7116 | 16.7a | 17.3a | 17.7a | 18.7a | 17.6B | 12.3a | 14.3a | 14.3a | 14.7a | 13.9B | 7.7g | 8.7g | 10.7f | 13.3de | 10.1B |
| H.7780 | 15.7a | 16.0a | 18.0a | 18.0a | 16.9B | 10.7a | 12.6a | 14.3a | 15.0a | 13.2B | 7.7g | 9.0g | 12.7cd | 14.7cd | 11.0B |
| MAIAK | 19.0a | 21.0a | 22.7a | 25.0a | 21.9A | 14.3a | 16.7a | 18.7a | 22.0a | 17.9A | 14.0cde | 15.0c | 17.3b | 18.3a1 | 16.2A |
| AVG. | 17.1A | 18.1A | 19.4A | 20.6A | 18.8 | 12.4D | 14.6C | 15.8B | 17.2A | 15.0 | 9.8D | 10.9C | 13.6B | 15.4A | 12.4 |
| Effect on 100 seed weight (g): | | | | | | | | | | | | | | | |
| H.7116 | 6.57a | 5.26a | 6.42a | 6.21a | 6.11B | 4.43a | 4.78a | 5.39a | 5.29a | 4.97B | 5.07a | 5.64a | 5.26a | 5.54a | 5.38B |
| H.7780 | 7.41a | 6.15a | 7.21a | 7.24a | 6.94A | 5.50a | 5.64a | 6.27a | 6.28a | 5.92A | 5.68a | 5.96a | 6.41a | 6.35a | 6.10A |
| MAIAK | 5.10a | 5.37a | 5.64a | 5.88a | 5.50C | 4.70a | 4.82a | 5.08a | 5.86a | 5.12B | 4.96a | 5.07a | 5.32a | 6.20a | 5.39B |
| AVG. | 6.36A | 5.59A | 6.42A | 6.44A | 6.20 | 4.90C | 5.08BC | 5.58AB | 5.81A | 5.34 | 5.24A | 5.56A | 5.67A | 6.03A | 5.62 |
| Effect of seed yield per faddan (kg): | | | | | | | | | | | | | | | |
| H.7116 | 1800a | 1526a | 1495a | 1589 | 1602A | 1410a | 1288a | 1159a | 1040a | 1224A | 1330a | 1189a | 1047a | 905a | 1118B |
| H.7780 | 1916a | 1508a | 1472a | 1483a | 1594A | 1297a | 1175a | 1133a | 1063a | 1167A | 1437a | 1334a | 1066a | 949a | 1194A |
| MAIAK2 | 2144a | 1555a | 1533a | 1636a | 1717A | 1412a | 1198a | 1095a | 1049a | 1188A | 1450a | 1294a | 1093a | 943a | 1195A |
| AVG. | 1953A | 1530B | 1500B | 1569B | 1638 | 1373A | 1220B | 1129BD | 1050D | 1193 | 1406A | 1272B | 1065C | 932D | 1169 |

Values followed by the same letter for each character are not significantly different.