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This series includes meeting documents, internal reports, and preliminary technical documents that may later form the basis of a formal publication. A Manuscript Report is given a small distribution to a highly specialized audience.

La présente série est réservée aux documents issus de colloques, aux rapports internes et aux documents techniques susceptibles d’être publiés plus tard dans une série de publications plus soignées. D’un tirage restreint, le rapport manuscrit est destiné à un public très spécialisé.

Esta serie incluye ponencias de reuniones, informes internos y documentos técnicos que pueden posteriormente conformar la base de una publicación formal. El informe recibe distribución limitada entre una audiencia altamente especializada.
OIL CROPS:
SESAME AND SUNFLOWER SUBNETWORKS

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

Edited by
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Organized by
Agricultural Research Centre, MOA, Giza, Egypt
and
International Development Research Centre, Canada

Sponsors
Food and Agriculture Organization, Industrial Crops and European Office, Rome
International Bureau of Plant Genetic Resources, Rome
International Development Research Centre, Canada

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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

<table>
<thead>
<tr>
<th>Forward</th>
<th>iii</th>
</tr>
</thead>
<tbody>
<tr>
<td>List of Participants</td>
<td>vi</td>
</tr>
<tr>
<td>Introduction</td>
<td>ix</td>
</tr>
</tbody>
</table>

## Part 1. SESAME SUBNETWORK - II

Sesame Genetic Resources: Collection, Evaluation and conservation.

AMRAM ASHRI ........................................ 2

Sesame Research in the Sudan.

MOHAMED EL-HASSAN AHMED .................... 10

Progress in Sesame Research in Ethiopia.

HIRUY BELAYNEH, BULCHA WEYESSA AND ELIAS URAGE ....... 13

A Brief Outline of Sesame (Sesamum Indicum L.) Research in Tanzania.

J.Y CHAMBI AND E.M. KAFIRITI .................. 17

Scope of Sesame (Sesamum Indicum) in Pakistan.

MUHAMMAD ASLAM, MASOOD A. RANA AND M. SIDDIQUE MIRZA .. 21

Status of Sesame as Oilseed in Bangladesh.

M.A. KHALEQUE AND HASINA BEGUM .............. 24

Problems and Progress of Sesame Production In India.

S. THANGAVELU, G. KANDASAMY, M. SIVANADAM AND R.K. MURALI BASKARAN ........................................ 27

Pests of Sesame and their Control.

S. THANGAVELU ...................................... 31

Review and Prospects on Sesame Production in China.

TU LICHUAN ........................................... 41

Sesame Irrigation in Egypt.

AHMED MOHAMED EL-WAKIL ........................ 44

Agronomic Studies on Growth, Yield and Yield Components of Sesame.

SAMIR TAHA AND MOHAMED EL-SROGY ................ 48

Sesame Research and Progress in Egypt.

NESSIM R. GUIRGUIS ................................. 52

Root-Rot and Wilt Diseases of Sesame in Egypt.

A.A EL-DEEB ......................................... 55

Highlights on Improving Production of Sesame in Egypt.

A.F. IBRAHIM ........................................ 59

Evaluation of Some Cultivars and Promising Strains of Sesame (Sesamum indicum L.).

A.A. EL-SHIMY AND M.Z. EL-HIFNY ................. 61

## Part 2. SUNFLOWER SUBNETWORK - II

Use of Wild Species in Sunflower Breeding.

DRAGON SKORIC ................................... 70

Sunflower Breeding: General Objectives and Recent Advances.

JOSE FERNANDEZ MARTINEZ ....................... 95

Progress in Sunflower Research in Ethiopia.

HIRUY BELAYNEH .................................. 102

Sunflower Adaptation in Morocco.

S. QUATTAR, T.E. AMEZIANE AND A. BAIDADA .......... 106
Effect of Maturity Stages and Desiccant Application on Yield, Oil Content and Oil Quality of Sunflower.
MASOOD A. RANA, CHAUDHRY A. OZAIR, M. AYUB KHAN AND SHAFIULLAH ......................................................... 114

Trends and Strategy of Sunflower Production in Pakistan.
MASOOD A. RANA ....................................................... 125

Sunflower Production in India - Problems and Prospects.
M. RAI AND P.S. BHATRANGAR ........................................ 128

MANGALA RAI .......................................................... 135

Status of Sunflower as Oilseed in Bangladesh.
M.A. KHALEQUE, AND S.H. MIRZA .................................... 142

Some Aspects Towards Overcoming Vegetable Oils insufficiency in Egypt: Production of Sunflower and its Improvement in Suez Canal Region.
ABDEL-FATTAH MOHAMED ABDEL-WAHAB ........................................ 144

SALWA I. EL-MOHANDES ............................................. 155

Sunflower Research and Production in Egypt.
BADR A. EL-AHMAR .................................................... 158

Performance of a New Synthetic Sunflower Stock Developed From Local and Introduced Germplasm and Further Improvement Via Population Improvement Method.
R. SHABANA .......................................................... 163

Response of Sunflower and Associated Weeds to Some single and Tank Mixed Herbicides.
A.F. IBRAHIM, Z.R. YAHIA, H.R. EL-WEKIL AND E.D. ABUSTEIT ......................................................... 167

Report on Sunflower Production In Dakalia Governorate, Egypt.
S.E. EL-KALLA ......................................................... 168

Studies of Diallel Cross in Sunflower (Helianthus annuus L).
KHALED HAMMAD ...................................................... 171

Effect of Some Intercropping Patterns of Sunflower/Soybean on Yield, Yield Components and Land Usage in Egypt.
M.A. MADKOUR .......................................................... 175

Sunflower Diseases in Egypt.
ARAF A. HILAL .......................................................... 180

Part 3. GENERAL

The Vegetable Oil/Protein System Program: The Kenyan Experience.
CARLOS ZULBERTI ..................................................... 184

Microbial Control of Lepidopterous Pests of Oilseed Crops.
H.S. SALAMA .......................................................... 203

Sunflower and Sesame Research in the Philippines.
NENITA M. TEPORA ..................................................... 206

Part 4. DISCUSSIONS AND RECOMMENDATIONS

Discussions and Recommendations ...................................... 213

I. Sesame ............................................................. 213
II. Sunflower .......................................................... 218
III. General ............................................................ 223
The gap between production and consumption of edible oils in Egypt, as well as in many African countries, is increasing from year to year. The failure in ceasing the gap increments has many reasons, among which the population and consumption are the two main ones.

The population has increased from about 10 million at the beginning of the 20th century to 28 million in 1960. Nowadays, it became over 55 million and is expanding at a rate of about 3% every year. Surprisingly, not only the population that increased at a higher rate, but also the consumption of edible oil per person which increased in the last decade from 9 to 12 kg. Besides, the area under cotton, which was and still is the main oil crop in Egypt, decreased from 1.9 million feddan (1 feddan = 4200 m²) with 888,000 MT of seed in 1960 to 1.05 million with 552,000 MT in 1986. As a result, self-sufficiency decreased from 95.4% of 1960 to 34% in 1980. At present, domestic production accounts for approximately one fifth of our consumption. Thus, more attention and investments are given to oil crops including sunflower.

International experience from sunflower growing countries revealed that crossing among a limited number of chosen selfed lines to develop synthetic cultivars would be a better way for sunflower improvement in most countries. Moreover, synthetic varieties of open pollinated crops are more acceptable in many third world countries due to the price policy and the prevailing market conditions. Hybrid seed of sunflower can only be produced in Egypt under some sort of governmental support through the distribution of subsidized seeds to the farmers.

Choice of parents

For the best choice of parents, an approach was made to define the model cultivar needed in Egypt (4) by testing 120 accessions which represent local and introduced germplasm in several evaluation experiments that covered the environmental conditions prevailing in Egypt. The work continued in cooperation between the Agronomy Departments of Cairo and Suez-Canal Universities. Through this university's linkage programs, we made a collection from farmers in Middle and Upper Egypt who used to grow their own seed for many years. Although these land races had mixed seed colors (mainly white and striped seeds) which would affect their acceptance and lower their price, they were known to have a good yielding ability (2.4-3.6 tons/ha), under conditions of small holders. They showed also vigorous growth and adaptation. However, they had some disadvantages such as tallness, late maturity and low oil content (30% or less). We aimed to combine high oil content, earliness and shortness from exotic materials with high yield potential and adaptability of our land races. Thus, we tested all the available accessions at Giza and Ismailia. The evaluated accessions included a varietal cross which I made in the previous season between the two distributed cultivars in Egypt (Giza - 1 and Maiak) and some selections from previous works (5). At Giza, I used the polycross method to test the combining ability of the accessions that showed superiority in their characteristics to fit our need. Based on the evaluation experiments and the combining ability
results, three land races were selected to be used as female parents together the two distributed cultivars. As male parents, we selected VN-03, VN-04, and VN-05, as gene sources for earliness and short stems; Citosol, Drysol, and ISEA were also selected as a source for high oil content. Characteristics of male and female parents against the F1 of the varietal cross Giza-1 x Maiak are presented in Table 1.

<table>
<thead>
<tr>
<th>Parents</th>
<th>Days to flowering</th>
<th>Plant height (cm)</th>
<th>Head diameter (cm)</th>
<th>1000 seed weight (g)</th>
<th>Seed yield (t/ha)</th>
<th>Seed oil content (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Giza-1</td>
<td>85.5</td>
<td>363.2</td>
<td>20.9</td>
<td>96.45</td>
<td>3.06</td>
<td>29.59</td>
</tr>
<tr>
<td>Maiak</td>
<td>75.5</td>
<td>362.3</td>
<td>15.5</td>
<td>87.50</td>
<td>1.51</td>
<td>38.20</td>
</tr>
<tr>
<td>Varietal cross</td>
<td>83.0</td>
<td>432.5</td>
<td>13.0</td>
<td>85.55</td>
<td>2.36</td>
<td>33.50</td>
</tr>
<tr>
<td>ISEA</td>
<td>75.0</td>
<td>304.5</td>
<td>19.5</td>
<td>85.00</td>
<td>2.61</td>
<td>42.60</td>
</tr>
<tr>
<td>VN-03</td>
<td>58.0</td>
<td>188.5</td>
<td>18.4</td>
<td>82.10</td>
<td>1.13</td>
<td>41.23</td>
</tr>
<tr>
<td>VN-04</td>
<td>60.0</td>
<td>193.0</td>
<td>18.0</td>
<td>77.5</td>
<td>2.07</td>
<td>42.24</td>
</tr>
<tr>
<td>VN-05</td>
<td>49.5</td>
<td>92.0</td>
<td>7.0</td>
<td>56.60</td>
<td>0.52</td>
<td>33.11</td>
</tr>
<tr>
<td>Citosol</td>
<td>68.5</td>
<td>216.0</td>
<td>17.5</td>
<td>85.00</td>
<td>1.91</td>
<td>42.18</td>
</tr>
<tr>
<td>Land race</td>
<td>82.5</td>
<td>453.2</td>
<td>21.9</td>
<td>91.80</td>
<td>4.33</td>
<td>23.54</td>
</tr>
<tr>
<td>Land race</td>
<td>81.0</td>
<td>453.8</td>
<td>23.0</td>
<td>91.25</td>
<td>3.48</td>
<td>22.73</td>
</tr>
<tr>
<td>Land race</td>
<td>83.0</td>
<td>410.0</td>
<td>23.5</td>
<td>98.75</td>
<td>3.90</td>
<td>25.05</td>
</tr>
</tbody>
</table>

**Formation of base synthetic population**

More than 100 healthy plants per parent were selected for selfing by inducing the plants to form two branches (6). Selfing was continued for two seasons fall and summer. Visual selection was manipulated in the field. After harvest, heads with higher seed yield and oil content in each parent were kept. S2 of female parents were sown 15 days earlier than male parents and were treated by GA3 as a gametocide when heads were one cm. in diameter. Crosses between males and females were done by hand. Half the seed of each cross was evaluated in two diverse locations (Giza and Ismalia) in the summer of 1986. Crosses that showed less plant height, larger heads, absence of natural disease symptoms, bird resistance and morphological characteristics such as: drooping heads, lightness of seeds, more concave heads and bracts that extend over the head, were selected in the field. Based on the harmony in flowering date, crosses with high seed yield or oil content were grouped:

- **Group (I):** included the earlier crosses with high oil yield.
- **Group (II):** included medium maturing crosses with high oil yield.

Equal quantities of seed from crosses selected in each group (Synthetic 0) were mixed, irrespective of their seed color, to form Synthetic-1. Syn-1 from group I was assigned to the Agronomy Department, Suez Canal Univ. while, that from group II was my responsibility for further improvements. I will restrict myself in the rest of my presentation to improvements made with respect to group II.

Data in Table 2 show the ranges among the crosses from which we selected the ones that composed Syn-1. It is obvious that taller plants dominated the crosses. Thus, one of the objectives is to increase gene frequencies for shortness. However, it seems a difficult task from the experience with my synthetic...
population so far. Table 2 shows also transgressive segregations for achene yield per plant and oil percentage.

Table 2. Range among the crosses, mode and percentages of frequencies among the sunflower crosses, below or above the mode class.

<table>
<thead>
<tr>
<th>Character</th>
<th>Range</th>
<th>Mode</th>
<th>Percentage of frequencies below modal class</th>
<th>Percentage of frequencies above modal class</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of leaves/plant*</td>
<td>19-59</td>
<td>34.39</td>
<td>50.79</td>
<td>37.30</td>
</tr>
<tr>
<td>Plant height (cm.)</td>
<td>127-375</td>
<td>257.21</td>
<td>32.59</td>
<td>35.56</td>
</tr>
<tr>
<td>Head diameter (cm.)</td>
<td>12-27</td>
<td>19.46</td>
<td>42.31</td>
<td>41.02</td>
</tr>
<tr>
<td>Achene yield (g/plant)</td>
<td>77-307</td>
<td>143.36</td>
<td>51.13</td>
<td>34.47</td>
</tr>
<tr>
<td>Oil content (%)</td>
<td>13.3-48.5</td>
<td>30.00</td>
<td>27.47</td>
<td>56.04</td>
</tr>
</tbody>
</table>

* Ranges for number of leaves among male and female parents were 7-39 and 17-46, respectively.

To increase gene frequencies for the desired characters, I began a recurrent selection program. In Zambia, a recurrent selection program was manipulated using a composite and it was possible to increase the potential yield from 1.5 to 2.5 mt/ha and the oil content from 28-32% to 35-44% on a country wide basis (3). The experiment revealed the advantages of local breeding programs.

In my recurrent selection program, I tested the general combining ability using a weak tester for the characters in question (p < 0.5). Thus, to screen the population for high achene yield, I used var. Maik as a tester. By contrast, to screen for oil content in the population, I used var. Giza-1 (oil content about 30% only) as a tester. Selection pressure of performance in the field and achene yield was 10% but about 1% was retained after oil analysis.

After one cycle of recurrent selection, the synthetic population was divided into six sub-populations based on achene yield, oil content or oil yield and seed color (black, white or striped). Performance of the six sub-populations (mean of five replications) is presented in Table 3.

I hope to continue in developing these populations via population improvement. With this procedure, populations of plants are dynamic gene pools, to which new sources of germplasm are added when feasible, in which the frequencies of desired alleles are progressively increased through recurrent selection, in which genetic recombination is enhanced by massive hybridization among selected genotypes, and from which cultivars, inbred or parental lines can be extracted at any stage (2). Indeed, it had been also suggested (1) that a breeder who wants to start a population breeding program should spend 3.5 years evaluating and selecting plant materials from locally adapted and exotic sources for inclusion in the population. These suggestions are consistent with the present breeding work.
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