OIL CROPS: SESAME AND SUNFLOWER SUBNETWORKS

PROCEEDINGS OF THE JOINT SECOND
WORKSHOP HELD IN CAIRO, EGYPT,
9–12 SEPTEMBER 1989
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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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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 Nached,
Senior Program Officer,
IDRC, Cairo
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My participation in the 12th International Sunflower Conference at Navi Sad, Yugoslavia during July 25-29, 1988, was fully funded by IDRC as Chairman of the International Sunflower Sub-Network to get acquainted with: (i) the latest research informations available in the world on sunflower, (ii) germplasm status and its utility for Asian and African countries, and (iii) identification of potential institutions and resource personnel for training and consultancies in various disciplines for the development of sunflower in Asia and Africa. This mandate was vested in pursuance of the recommendations of the International Oilcrops Research Network meeting held at Kenya during January 25-29, 1988.

Participation, Deliberations and Observations

Over 500 delegates participated in the conference. The five days deliberations were directed to wide ranging topics varying from collection, conservation and evaluation of germplasm to the understanding of genetic basis of resistance to various biotic and abiotic stresses, quality and other economic considerations leading to the development of improved varieties and hybrids with in-built resistance to various diseases and pests and higher oil content in the seed. Most of the topics were addressed for hybrid development with limited efforts for the development of populations which were confined to USSR, India and certain other Asian and African countries.

Genetics and breeding

Forty five papers were presented in the genetics and breeding section. These papers may be grouped into four categories.

The first category was the use of wild sunflower as a source of genetic variability. The Conference began with the plenary paper discussing the contribution of wild species to research today, providing us with a wide range of cytoplasmic and male sterility, disease and insect resistance, oil and seed quality, and useful agronomic traits. It was felt that exploration must continue for adding new accessions to the collection. Subsequent papers described cytological studies on interspecific crosses, techniques to facilitate these crosses such as embryo culture and chromosome doubling, and the report on new restorer genes for sources of cytoplasmic male sterility.

The second category was in the field of biotechnology. This appeared as a relatively new research area for sunflower and a very interesting addition to the conference reports. Papers discussed anther culture, the application of tissue and protoplast culture, somatic embryogenesis, and the use of biotechnology for improvement of sunflower in the area of industrial and edible oils. Regeneration of whole plants from cell culture appeared positive, with transfer of genes through recombinant DNA technology, showing feasibility to add diversity in resistance to insects, diseases, and also for herbicide tolerance.

The third category described the variability of oil quality in sunflower and the use of breeding to develop high linoleic, high palmitic and high oleic sunflower hybrids and cultivars. These useful variations appeared to have potential to create alternative markets for sunflower world wide.
The fourth category covered genetic analyses and breeding methodologies. Genetic studies gave new information on the inheritance of earliness, branching pattern and morphological traits such as short petioles and head position. Also, studies on the combining ability for yield components, genetic architecture of traits of economic significance, genetic distances, and recurrent selection provided adequate ground for contemplating further improvement of the crop.

Three papers described the genetic progress and improvement of sunflower over the past few decades in Argentina, Romania and the United States. These papers were encouraging in that they documented their efforts in research, leading to increases in production through genetics, breeding, and new cultural applications.

**Crop management and Production**

In this section physiology, environmental effects on yield and quality, nutrition, agronomy and mechanization was deliberated. The main objective was to understand plant functioning, by itself, and also in various environments in conjunction with varying cultural practices. Greater emphasis was accorded to bio-synthesis, setting and filling of grains and other fundamental approaches all aiming at greater plant efficiency and better harvest. A critical analysis of adaptation in varying climate, soil, and water conditions and cultural practices viz. plant population, fertilization etc., was presented indicating tremendous scope for enhanced productivity and production. In crop physiology, growth analysis, leaf area development and light interception were presented and it was felt that leaf area index of about 2.5 is sufficient for light interception. The enzymatic aspects of photosynthesis were more clearly understood showing net progress in the field than ever before but a similar progress in the area of assimilates partitioning probably both dependent on enzymes and hormones was not visible. The mechanism of stress resistance was another area where little research work was observed. The water stress effects, drought tolerance, temperature tolerance and various other important fields were probably not well covered.

In the field of agronomy, the most important way appeared to adopt location specific technologies to meet yield expectations depending on the prevailing price structure. In view of the prevailing priorities and price structure, it was felt that both high physiological performances of sunflower and its robustness allow a large scale of expected yields. It was explained that although quality is important the main character will continue to be the yield. It was observed that shorter stem prevents lodging and directs more assimilates to the head and further permits greater plant population per unit area reflecting higher net monetary returns. Among C₃ crop plants, sunflower has the highest physiological performance but probably they are not skillfully exploited. One of the weaknesses appears to be the partitioning of the assimilates for the best advantages.

**Crop protection**

There were 73 papers in total and 3 newly reported pathogens on sunflower: Coniellia in Nigeria, Stemphyllium and Verticillium lateritium in Yugoslavia. Eleven articles described the distribution of diseases already known on sunflower in new growing areas and special mention was made of Sclerotinia and Alternaria in China, Phomopsis in Iran, downy mildew in India and Alternaria alternata in Greece.

**Sclerotinia**: There is continued
world wide interest in this pathogen, with increasing attacks in many countries, including Argentina and China. After studies in recent years in France and Yugoslavia, there were some reports of epidemiological studies in Hungary and Argentina. The reports described the modified techniques for producing inoculum and testing plants for resistance. It can now be concluded that most of the problems regarding inoculation and testing procedures have been resolved and selection for resistance is on but with relatively slow pace concerning head rot due to the problems of negative correlation with oil content. Search for improved and more rapid screening methods has led French and American teams to work on phenol contents induced by Sclerotinia infection. Phenols could provide both resistance markers and a better understanding of the physiology of resistance. It appears that phenolic fingerprints are quite characteristic of each genotype. Another new development in resistance studies is the use of tissue culture. Differences were demonstrated in the reaction of calli to Sclerotinia culture filtrates related to field reaction. This method was applied for Phoma macdonaldii. There were several reports, mainly by French workers, of studies on improved chemical control, particularly techniques of spraying. The recent discovery of true systemic, Fenpropinor, opens new possibilities of chemical control of head rot.

Phomopsis: This disease, which was first discovered in Yugoslavia in 1980, was reported to be one of the most serious diseases in all countries of Europe and has been observed in the United States, Iran and Pakistan. This disease is likely to spread to other countries. Much research has been done in Yugoslavia and France on the biology, histopathology and control of the pathogen.

One of the problems complicating the work with Phomopsis has been the inability to produce perithecia of the Diaporthe stage, away from sunflower tissue. Workers in France and a combined Yugoslav-American team have produced mature perithecia on several types of media. This achievement will facilitate screening germplasm for resistance because only ascospores can infect sunflower.

From an exhaustive study of 60 different Phomopsis isolates of different hosts, it appears that Diaporthe helianthii is a distinct species. No definitive study has assessed whether the European isolates and those from North America are the same species.

Inoculation procedures to infect plants through the leaf petiole and stem have been developed. Each method has its advantages and correct identification of resistant plants may require use of more than one method. Screening of calli cultures with a culture filtrate was successful in distinguishing resistant and susceptible germplasm. This method will save much time and labour.

In the absence of complete genetic resistance, pathologists have identified several fungicides which control the pathogen. To be highly effective, chemicals have to be applied either before disease appearance or when symptoms are confined to leaves. Thus the use of genetically resistant hybrids/populations appears to be the most feasible preposition for which research efforts need to be intensified.

Plasmopara: There is renewed interest in downy mildew, particularly with the need to control new races and to identify and control the disease in new areas where it appears (India in particular). With further studies of biology, conservation of inoculum and testing methods are no longer a problem.
However, at present, all the resistance known is reported to be race-specific. Perhaps in the future, researches should be made for some horizontal form of resistance.

Rust: So far, five rust resistance genes have been identified although only four are still existant. Resistance to race 4 has been found to be governed by two dominant genes. In an effort to standardize procedure and facilitate communication between pathologists and breeders in different countries, it would be desirable to standardize the nomenclature system and the use of the same differential varieties and preferably the same inoculation and evaluation procedures to make definite dent on this vital front.

Alternaria: This appears to cause some symptoms outside its usual area in China and France. Efficient resistance tests developed by Australian and French workers can effectively be used by breeders in different countries for evolving resistant/tolerant varieties and hybrids.

Diverse fungal diseases: Epidemiological and resistance breeding studies on *Macrophomina phaseolina* and biological studies of *Septoria* and *Rhizopus* spp were reported. It was surprising to note that there was no paper on *Botrytis*, inspite of its importance in Northern and Western Europe.

Insect pests: Five articles described the insect pests present in China, Iran, Yugoslavia and Hungary. Detailed studies carried out on aphids in Yugoslavia and France were presented. There was a chinese report on the importance of the sunflower moth in their country. In fact, problems enlisted and efforts undertaken/contemplated on entomological aspects appeared limited.

Processing, utilization and marketing

The 11 presentations covered the high technology of processing as well as the use of sunflower for diverse human food. Indication in one of the papers was there to elucidate that sunflower oil apart from edible purposes could be processed for use as fuel. Nevertheless, need for studying the economic aspects of this project was emphasized. Various kinds of packing for long- and short-term storage and depending on need was emphasized.

Germplasm in the field

Yugoslavia is the center for the maintenance of FAO germplasm of sunflower. The germplasm are maintained by the Department of Sunflower of the Yugoslavian Field and Vegetable Crops Research Institute located at Novi Sad. Apart from the participation in the deliberations of the conference, with the kind gesture of Dr. Skoric, Head of the Sunflower Department and Secretary General of the Conference, a field visit was undertaken for on-the-spot assessment of the germplasm in the field.

Ten thousand germplasm lines were grown in the field showing wide diversity with respect to plant type, head type and its position, plant stature, maturity duration, resistance to diseases, drought and various other traits of economic significance. Out of about 2,000 restorer lines grown, the majority was of multi-headed type. Some of which were reported to possess as much as 64% oil in the seed. These lines may be of great interest for enhancing oil content in hybrids and may also be of use in population improvement programs. Although multi-headed trait is undesirable but, interestingly, it is controlled by recessive gene which provides an opportunity to exploit these lines in
hybrid development programs. Fifty one wild species were maintained showing wide diversity in various traits and a few of them were easily crossable and the progenies were grown in the field. Some of these populations may be of considerable significance particularly for developing populations for drought resistance as well as for incorporating resistance to diseases and pests. A few stable short-statured lines with upright growing leaves were observed which may be of considerable interest for architecturing plant types for increasing plant populations per unit area under mono culture. These lines may be of great significance where the sunflower is grown or likely to be grown as mixed crop/ intercrop.

World Sunflower Hybrids on Display

The opportunity was availed to visit the demonstration plots where almost all the promising hybrids from all over the world developed in both public and private sectors numbering 198 (Annexure) were grown. This provided a unique opportunity to have a look and assess the relative performance/traits of all the hybrids. Depending on the plant type, maturity duration, resistance to diseases, likely yield potential, reported oil content, etc., 28 hybrids (Annexure*) were identified as probable potential materials. Instead of fragmented approaches of testing x- or y- hybrid at a time, it may be of interest to evaluate all the 28 hybrids at a time which may provide a base for further negotiations depending on the potential of the hybrids under varying agro-climatic conditions.

Resource Personnel and Training Facilities

It was felt that training of scientists in plant breeding and oil quality in the first instance would be much more rewarding and on this endeavour the Oilcrops Department of the Institute of Field and Vegetable crops, Novi Sad, would be an appropriate institution. The matter was discussed at length with Dr. Dragan Skoric and he agreed for imparting the training of about one month duration to the senior breeders/biochemists and four to five months training to junior researchers/technicians of Asian and African countries. It was felt that the expertise, experience, well equipped laboratories and-over everything - availability of the world germplasm at the Institute would provide a unique opportunity for the trainees for their development. It was further felt that expertise for different diseases and facilities for such training viz.: rust in Canada, downy mildew in UK and France, Alternaria in Yugoslavia and Sclerotinia in France may be availed as and when required. For consultancies in plant breeding and seed production, Dr. Skoric of Yugoslavia and Dr. Alex viorel Vranceanu of Romania may be resource personnels. In the field of Plant Pathology, services of Dr. Sackston E. Waldemar of Canada may be had.

General

1. It was decided to organize the 13th International Sunflower Conference at Pisa, Italy, in 1992. It was further decided that the 14th and 15th International Sunflower Conferences in 1996 and 2000 would be held in China and Mexico, respectively.

2. A perusal of the over all scenario indicated that area under sunflower will increase considerably in African and Asian countries in the years to come where, unlike Western
countries, populations would continue to play a dominant role under rainfed situations. However, under well managed irrigated conditions, hybrids would make much dent if seed supply is assured.

3. Looking to the intense and multifarious research requirements of the crop, fragmented approaches are not likely to pay much dividends.

It would, therefore, be necessary to have one or two centers of excellence preferably one national center in India where integrated approaches involving biotechnology, genetics, breeding, plant protection, biochemistry, processing and other related disciplines well supported with modern laboratory facilities can deliver the goods for this potential upcoming crop in the country.

ANNEXURE

LIST OF COMMERCIAL HYBRIDS AVAILABLE

1. NS-H-45 39. NS-H-7 77. OROSOL*
2. NS-H-43 40. NS-H-10 78. SC 062
4. NS-H-15 42. NS-H-12 80. HYSUN 354
5. NS-H-17 43. CONTIFLOR 3* 81. SUNBIRD
6. NS-H-26-RM 44. CONTIFLOR 7 82. DO 704 X L
7. NS-H-27-RM 45. CONTIFLOR 8* 83. DO 855
8. NS-H-33-RM 46. CONTIFLOR 9 84. DO 728
9. NS-H-47 47. CONTINENTAL P-86 85. DO 705
10. NS-H-HELIOS 48. BARBARA 86. DO 705
11. NS-H-52* 49. HNK-81 87. IS 7111
12. NS-H-53 50. HNK-173* 88. IS 33076
13. NS-H-54 51. IBH-166 89. ISOMAX
14. NS-H-55 52. SUN M 20 90. IS 320025
15. NS-H-57 53. S 1283 91. HYSUN 32
16. NS-H-58 54. SF-100* 92. HYSUN 33
17. NS-H-60 55. SF-102 93. T-548
18. NS-H-64* 56. ADVANCE 94. T-557 Dw*
19. NS-H-65 57. CANNON 95. T-560 A
20. NS-H-66 58. DYNAMITE 96. T-565
22. NS-H-70 60. SUPER 405 98. DOBRICH
23. NS-H-79 61. SUPER 430 99. ALBENA
24. NS-H-84 62. SUPER 530 100. SUPER START
25. NS-H-85 63. SH-222 101. OS-H-393
26. NS-H-86 64. NS-26 102. OS-H-325*
27. NS-H-87 65. ALHAMA EXTRA 103. OS-H-125
29. NS-H-89 67. SH-3322 105. OD 128*
30. NS-H-90 68. SH-3822 106. OD 123
31. NS-H-91 69. SH-3622 107. OD 122
32. NS-H-92 70. FRANKASOL 108. OD 106*
33. NS-H-1 71. ALPHASOL 109. OD 105
34. NS-H-2 72. MIRASOL 110. CMS 821/1264-1*
35. NS-H-3 73. CARIGISOL 111. S-335
36. NS-H-4 74. PARADISOL 112. ST-349
37. NS-H-5 75. FLORASOL 113. ST-330
38. NS-H-6 76. RIOSOL 114. ST-314
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* May be of merit to Network countries.