# EXPERIMENTATION OF SUNFLOWER HYBRIDS IN INTERNATIONAL TRIALS (1976 AND 1977)

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## INTRODUCTION

The $F_1$ hybrids represent a new step in sunflower crop development due to their multiple advantages, the most important of them being the exploration of heterosis effect in terms of seed and oil yield. Their uniformity, both regarding stem height and maturity and a better resistance to lodging, facilitate the mechanical harvesting with minimum seed losses. Breeding for resistance to diseases and pests has been more successfully performed working with inbred lines. Thus, the first downy mildew resistant hybrids became available as soon as a gene conferring resistance to *Plasmopara helianthi* was identified in 1969, although the preoccupation for making resistant open pollinated varieties dates from long ago. By crossing two inbreds, it is possible to associate in a hybrid the complementary characters of the parents, if they are dominant traits. In this way, cultivars with a larger spectrum of disease and pest resistance could be created. As regards the oil content in the seed, crosses betwenn inbred lines allow to reach very high levels in a more accelerated rhythm than it has been possible by means of conventional breeding methods.

Nevertheless, single hybrids have a more limited ecological plasticity than open pollinated varieties due to their narrower genetic background, so that it is much more difficult to have a single hybrid extended on such a large area as some of the best sunflower varieties, Peredovik for instance.

The more reduced plasticity of single sunflower hybrids, which results in an important variation of heterosis intensity, not only in accordance with the geographical area but also with the climatic annual variation within the same area, requires first of all the necessity of carring out breeding works in certain soil-climatic conditions, typical for the respective sunflower growing zone with the purpose of achieving a better adaptability. Secondly, it is necessary to develop sunflower hybrids with a broader genetic basis, ar for instance the three-way or double-way crosses, which in addition offer the advantage of an increased economic efficiency of hybrid seed production. At last, a great number of hybrids have to be tested in more than one year in several locations, in order to find out the most valuable and constant hybrids, both concerning seed and oil yield.

The experimentation of sunflower hybrids in international trials, answers the third above discussed desideratum and corresponds to an urgent need for the present time, when hybrid sunflower breeding is at its beginning.

The testing of a varied range of hybrids belonging to different classes of plant maturity and height will allow to determine the optimum biological parameters of the crop for each country and zone, especially for those countries where sunflower culture is of a recent date or it is less known.

The international co-operation for testing sunflower hybrids has a cyclical character, permitting the renewal of the entries every two years, by including in trials the most recent achievements of breeders from all over the world.

This paper presents the results obtained in the first two-year cycle.

## MATERIALS AND METHODS

A number of 25 sunflwer hybrids and varieties, representing the most recent creations of the Bulgarian, French, Polish, Romanian, Spanish and Yugoslav breeders were tested in 20 locations from 16 countries, in 1976 and 1977.

Sunflower cultivars were divided into two groups, according to their supposed maturity and height, as follows :

**Trial No. 1,** with medium-late cultivars including 14 hybrids, one open pollinated variety and one local cultivar (Annex 1).

*Annex 1*

**TRIAL NO. 1**

**with medium-late sunflower cultivars (1976—1977) (SH = single hybrid, TH = three way hybrid, OPV = open pollinated variety)**

| Entry No. | Cultivar | Genetic type | Origin |
|---|---|---|---|
| 1 | Peredovik | OPV | U.S.S.R. (1976) Bulgaria (1977) |
| 2 | Local cultivar | | |
| 3 | Helios 322 | SH | Bulgaria |
| 4 | Yu NS-65 | SH | Yugoslavia |
| 5 | H-223 [1] | SH | Spain |
| 6 | H-465 [2] | SH | Spain |
| 7 | H-489 [3] | SH | Spain |
| 8 | Airelle | SH | France |
| 9 | Relax | SH | France |
| 10 | Remil | SH | France |
| 11 | Romsun 52 | SH | Romania |
| 12 | Romsun 53 | SH | Romania |
| 13 | Romsun 59 | SH | Romania |
| 14 | Sorem 80 | SH | Romania |
| 15 | Sorem 82 | SH | Romania |
| 16 | Sorem HT-64 | TH | Romania |

[1] Replaced in 1977 by Yu NS-28
[2] Replaced in 1977 by Sorem HT-58
[3] Replaced in 1977 by HB 14/219

The Spanish hybrids were replaced in 1977 because of lack of hybrid seeds by Yu NS-28 (Yugoslavia), Sorem HT-58 (Romania) and one Bulgarian hybrid (Helios 14—219) which was studied in the first year in trial No. 2 with early cultivars ;

**Trial No. 2,** with early and medium-early cultivars, comprising 7 hybrids and 2 open pollinated varieties (Annex 2). Helios 14—219 (Bulgaria) and Fransol (France) were replaced in 1977 by H 5-C 3 and Flambeau (France), respectively.

Because some of the participating institutes have expressed their concern about the possibility of introducing the more virulent North-American downy mildew race in Europe along

*Annex 2*

**TRIAL NO. 2**

**with early and medium-early sunflower cultivars (1976—1977) (SH = single hybrid, OPV = open pollinated variety)**

| Entry No. | Cultivar | Genetic type | Origin |
|---|---|---|---|
| 1 | Issanka | OPV | France |
| 2 | Wielkopolski | OPV | Poland |
| 3 | Helios 14 [1] | HS | Bulgaria |
| 4 | Yu NS-1 | HS | Yugoslavia |
| 5 | H-23 | HS | Spain |
| 6 | Fransol [2] | HS | France |
| 7 | Romsun 18 | HS | Romania |
| 8 | Romsun 20 | HS | Romania |
| 9 | Romsun 301 | HS | Romania |

[1] Replaced in 1977 by HS-C 3
[2] Replaced in 1977 by Flambeau

with sunflower seeds sent for testing, only hybrids and varieties produced in Europe were studied in this first testing cycle. The accepted sunflower entries were either registered cultivars or under registration in official varietal lists and which have been supposed to be availabe for seed production and trade at the end of the experimental cycle.

The comparison was done with the best open pollinated varieties : for Trial No. 1, the medium-late variety Peredovik, as the most spread variety in production in Europe, and for Trial No. 2, the early variety Issanka, grown in France. The locations and the names of participants in Trial No. 1 and Trial No. 2 are mentioned in Annex 3.

The experimental design was unique, but the cultural practices were adapted to the local conditions. Trial No. 1 was sown in $4 \times 4$ triple lattice and Triol No. 2 in $3 \times 3$ triple lattice, with or without reiteration of the basic scheme so that the number of replications was either 6 or 3, depending on the local technical and working facilities.

The replications being independent experimental units, they could be arranged in various positions. Each plot comprised as a rule a minimum of 80 harvesting plants after discarding the borders (1 or 2 marginal rows and 2 frontal plants per each row). The following phenological observations, in number of days, were noted :

— emergence (when cotyledons are visible to 90% of the seedlings) ;

— formation of the first pair of true leaves (to 90% of the seedlings) ;

— head formation (when 90% of the plants have the head receptacle as a little star of 15—20 cm diameter) ;

*Annex 3*

**List of participants in F.A.O. co-operative trials (1976—1977)**

| Country | Name and address | Trials conducted |
|---|---|---|
| 1. Austria | Ing. D. Wolffhardt, Bundesanstalt f. Pflanzenbau und Samenprüfung, Alliertenstr. 1, Viena II | Trials No. 2 |
| 2. Bulgaria | Dr. Yordanka Stoyanova, Institute for Wheat and Sunflower, General Toshevo, Tolbuhin | Trials No. 1 and 2 |
| 3. France | Ing. M. Rollier, CETIOM, 174 Av. Victor Hugo, 75 116 Paris | Idem |
| 4. France | Dr. P. Leclercq, Station d'amélioration des plantes INRA, Route du Pont-du-Chateau, 63100 Clermont-Ferrand | Idem |
| 5. France | Dr. G. Piquemal, Station d'amélioration des plantes INRA, Place Vialla, 34000 Montpellier | Trial No. 2 |
| 6. Hungary | Dr. József Frank, Cereal Research Institute, P. O. Box 6726, H-6701 Szeged | Trials No. 1 and 2 |
| 7. Hungary | Dr. E. Kurnik, Research Institute for Fodder Crops, 7095 Iregszemcse | Idem |
| 8. Iran | Dr. H. A. Sheybani, Seed and Plant Improvement Institute, Karaj-Tehran | Idem (1977) |
| 9. Iraq | Mr. Kahtan Khalaf Ali, Cotton and Oilseed Crop Development Project, Abu-Ghraib, Baghdad | Idem (1977) |
| 10. Israel | Dr. Yalon Shchori, Institute of Field and Garden Crops, A.R.O., Division of Industrial Crops, P. O. Box 6, Bet Dagan | Trial No. 2 |
| 11. Italy | Dr. Elio Alba, Istituto di Miglioramento Genetico delle Piante Agrarie, Via Amendola 165, 70126 Bari | Trials No. 1 and 2 |
| 12. Italy | Dr. Gianni Vicentini (1976 ; deceased 1977), | |
| | Dr. G. P. Vannozzi (1977), Istituto di Agronomia Generale e Coltivazioni Erbacee, Via S. Michele degli Scalzi 4, Pisa | Idem |
| 13. Poland | Dr. Z. Kloczowski, Plant Breeding and Acclimatization Institute, Dept. Oil Crops, Sieroca 1 a, 61-771 Poznań | Trial No. 2 |
| 14. Portugal | Ing. Francisco Pinheiro Alves, Plant Breeding Station, Elvas | Trials No. 1 and 2 |
| 15. Romania | Dr. A. V. Vrânceanu, Dr. Fl. M. Stoenescu, Research Institute for Cereals and Industrial Crops, Fundulea, Ilfov | Idem |
| 16. Spain | Dr. Juan Dominguez-Giménez, Departamento Nacional de Plantas Oleaginosas, Apartado Correos 240, Córdoba | Idem |
| 17. Sweden | Prof. Dr. Rune Larson, Agricultural College of Sweden, Department of Plant Husbandry, S-750 07 Uppsala | Trial No. 2 |
| 18. Turkey | Mr. K. Haksel, Agricultural Research Institute, P. O. Box 1, Yeşilköy-Istanbul | Trials No. 1 and 2 |
| 19. U.S.A. | Dr. D. E. Zimmer, Dr. G. N. Fick, U.S.D.A. Agricultural Research Service, State University Station, Waldron Hall, Fargo, North Dakota 58102 | Idem |
| 20. Yugoslavia | Dr. D. Skorić, Faculty of Agriculture, Institute of Field and Vegetable Crops, Maxim Gorki 30, Novi Sad | Idem |

— the onset of flowering (when the ray-flowers unfold to 10% of the plants) ;

— the maximum flowering (when the ray-flowers unfold to 90% of the plants) ;

— the end of flowering (when the ray-flowers unfold to the last 2—3 plants) ;

— physiological maturity (when 75% of the heads are yellow and the rest yellow-brown coloured).

The biometrical determinations performed were :

— plant height, measured after flowering from the soil level to the insertion point of the head, 20 plants per replication ;

— head diameter, 20 plants per replication.

The percentage of male sterile and anthocyanic plants was also noted for evaluating the purity of the experimented cultivars, as well as their pollen fertility restauration degree, the majority of them being hybrids produced on the basis of nuclear or cytoplasmic male sterility.

Yielding capacity and seed characteristics :

— seed yield per plot (kg), for each replication ;

— number of harvested plants per plot ;

— seed moisture (%) ;

— volumetric weight (kg/hl) for each replication ;

— husk percentage ;

— oil percentage in dry seeds for each replication.

Screening for disease resistance :

— severe artificial infections for testing downy mildew resistance *(Plasmopara helianthi)* were done at : Clermont-Ferrand (France), Fundulea (Romania) and Novi Sad (Yugoslavia) ;

— artificial infections with *Sclerotinia sclerotiorum* and *Sclerotium bataticola* were performed at Novi Sad ;

— field resistance to natural infections with other pathogens was also noted, where conditions for the attack were favourable.

## RESULTS AND DISCUSSION

The common experimental procedures have been respected in most cases. Trial No. 1 was conducted adequately in 7 locations and Trial No. 2 in 9 locations, permitting a good mean yield evaluation in both years. In some cases, less reliable data were obtained due to subjectives causes, as for instance :

— three participating countries — Spain, Turkey and Israel received the seed samples with delay and planted them very late, under unfavourable climatic conditions, getting very low yields, heavily affected by bird attack ;

— the institutions of Montpellier (France), Córdoba (Spain) and Szeged (Hungary) did not receive seed samples from all entries and replaced them with other available cultivars ;

— some institutions did not follow the common methodology or did not send complete results, making difficult the statistical interpretation of the experimental data (Bari-Italy, Szeged-Hungary).

**Trial No. 1.** The seed yields obtained in the two years (Table 1) presented high values in most cases, ranging from 12.4 q/ha at Aude-France to 40.9 q/ha at Iregszemcse-Hungary with highly significant differences. Oil yields (Table 2) varied also significantly from 5.0 q/ha at Pisa, Italy to 21.2 q/ha at Novi Sad, Yugoslavia. The Romanian hybrids Sorem 82, Romsun 52 and Sorem HT-64 displayed the highest mean seed and oil yields.

The analysis of variance (Table 3) clearly shows that environmental influences, especially locations, contributed much more then cultivars to the variability of both seed and oil yields. Small, but significant interactions of hybrids with years and locations were obtained, indicating that the reaction of hybrids was different, especially from year to year. The high significant location × year interactions reveal that the year influence was quite different from one location to the other.

The distribution of cultivars from Trial No. 1 in terms of yield capacity and coefficient of variation is presented in Figure 1. The highest and more constant seed and oil yields have expressed the hybrids : Sorem 82, Romsun 52, Sorem HT-64 and Romsun 59. Hybrids Romsun 53, Sorem 80 and Yu NS-65 outyielded the check variety only in certain favourable environments.

The most valuable hybrids at Clermont-Ferrand were in 1976 : Airelle, Helios 322, H-489 ; at Montpellier : Sorem HT-64, Romsun 53 and Sorem 80 ; at Szeged : Helios 322, Yu NS-65, Sorem 80 and Sorem 82 (Table 4).

Seed and oil yields obtained in 1977 in 5 locations are recorded in Table 5. Hybrids with the best performances were : Sorem HT-64, Sorem 82, Helios 322, Sorem 80 and Romsun 53.

Data presented in Table 6 characterize sunflower hybrids for the main morpho-physiological traits. Most of them have the vegetation

*Table 1*

**TRIAL No. 1 with sunflower medium-late hybrids. Two-year seed yield test (q/ha, 0% moisture)**

| Exp. no. | Cultivar | Romania Fundulea | | Bulgaria Toshevo | | Hungary Iregszemcse | | Yugoslavia Novi Sad | | Italy Pisa | | France Aude (CETIOM) | | France Montpellier | | Mean 1976—1977 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1976 | 1977 | 1976 | 1977 | 1976 | 1977 | 1976 | 1977 | 1976 | 1977 | 1976 | 1977 | 1976 | 1977 | |
| 1 | Peredovik | 27.1 | 33.7 | 27.7 | 30.2 | 24.6 | 30.5 | 34.5 | 25.5 | 32.4 | 18.9 | 28.8 | 18.0 | 37.3 | 30.9 | 28.6 |
| 3 | Helios 322 | 27.6 | 33.0 | 25.0 | 31.5 | 24.3 | 28.5 | 28.4 | 19.4 | 28.9 | 24.0 | 25.4 | 14.8 | 35.3 | 40.2 | 27.6 |
| 4 | Yu NS-65 | 27.7 | 35.5 | 22.5 | 31.8 | 16.9 | 27.6 | 39.8 | 34.9 | 32.5 | 22.5 | 26.8 | 25.4 | 34.4 | 37.8 | 29.8 |
| 8 | Airelle | 27.6 | 29.4 | 30.4 | 27.2 | 19.8 | 25.5 | 28.5 | 12.7 | 22.5 | 17.5 | 29.1 | 12.4 | 35.0 | 38.8 | 25.5 |
| 9 | Relax | 27.9 | 32.3 | 28.5 | 29.6 | 18.2 | 24.4 | 40.5 | 30.7 | 29.3 | 21.3 | 28.2 | 25.6 | 38.3 | 35.8 | 29.3 |
| 10 | Remil | 24.4 | 30.9 | 24.1 | 31.5 | 20.3 | 26.7 | 36.6 | 30.5 | 25.2 | 17.0 | 26.0 | 28.8 | 35.0 | 37.5 | 28.2 |
| 11 | Romsun 52 | 31.1 | 35.0 | 32.9 | 31.8 | 24.6 | 29.7 | 39.8 | 27.9 | 32.4 | 19.9 | 32.2 | 34.1 | 39.3 | 37.2 | 32.0 |
| 12 | Romsun 53 | 29.6 | 35.4 | 26.9 | 32.6 | 20.3 | 24.1 | 35.5 | 28.0 | 33.1 | 20.5 | 25.8 | 34.8 | 39.3 | 40.9 | 30.5 |
| 13 | Romsun 59 | 32.2 | 39.8 | 30.0 | 30.3 | 20.9 | 30.8 | 33.1 | 22.7 | 31.7 | 26.0 | 27.7 | 25.2 | 38.4 | 35.7 | 30.4 |
| 14 | Sorem 80 | 29.5 | 37.7 | 21.9 | 30.2 | 17.7 | 31.2 | 37.8 | 32.8 | 27.4 | 20.6 | 27.0 | 34.1 | 38.6 | 38.8 | 30.4 |
| 15 | Sorem 82 | 30.6 | 38.1 | 24.4 | 29.2 | 24.4 | 40.9 | 32.6 | 33.1 | 29.1 | 24.8 | 30.1 | 33.5 | 39.0 | 40.8 | 32.2 |
| 16 | Sorem HT-64 | 29.5 | 35.0 | 25.0 | 30.0 | 22.1 | 23.3 | 39.3 | 32.1 | 33.3 | 25.9 | 31.1 | 32.5 | 39.1 | 39.1 | 31.2 |
| | L.S.D. 0.05 | 1.6 | 2.1 | 1.1 | 2.7 | 2.8 | 3.1 | 5.6 | 4.1 | 6.3 | 10.4 | 3.8 | 5.6 | 3.5 | | 3.0 |

*Table 2*

**TRIAL No. 1 with sunflower medium-late hybrids. Two-year oil yield test (q/ha)**

| Exp. no. | Cultivar | România Fundulea | | Bulgaria Toshevo | | Hungary Iregszemcse | | Yugoslavia Novi-Sad | | Italy Pisa | | France Aude (CETIOM) | | Mean 1976—1977 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1976 | 1977 | 1976 | 1977 | 1976 | 1977 | 1976 | 1977 | 1976 | 1977 | 1976 | 1977 | |
| 1 | Peredovik | 14.6 | 16.6 | 14.0 | 13.9 | 12.2 | 14.3 | 18.8 | 12.2 | 14.3 | 6.5 | 15.3 | 9.2 | 13.5 |
| 3 | Helios 322 | 15.5 | 16.4 | 13.2 | 14.7 | 12.4 | 13.7 | 15.9 | 10.1 | 14.6 | 5.7 | 14.1 | 7.5 | 12.9 |
| 4 | Yu NS-65 | 13.2 | 16.6 | 10.8 | 13.9 | 7.8 | 12.5 | 20.2 | 16.4 | 14.2 | 6.2 | 13.9 | 13.1 | 13.3 |
| 8 | Airelle | 13.4 | 13.7 | 15.0 | 11.6 | 8.9 | 10.9 | 19.5 | 6.0 | 9.5 | 5.1 | 15.3 | 6.1 | 11.3 |
| 9 | Relax | 12.8 | 14.1 | 12.8 | 12.3 | 7.6 | 9.7 | 19.5 | 13.1 | 11.3 | 5.0 | 14.8 | 12.5 | 12.1 |
| 10 | Remil | 11.4 | 13.7 | 11.1 | 13.9 | 9.2 | 11.1 | 18.2 | 13.9 | 9.0 | 6.0 | 13.9 | 14.6 | 12.2 |
| 11 | Romsun 52 | 17.5 | 17.4 | 16.3 | 13.9 | 11.3 | 13.5 | 21.0 | 12.9 | 13.1 | 6.2 | 17.4 | 17.9 | 14.9 |
| 12 | Romsun 53 | 15.8 | 17.7 | 14.0 | 14.1 | 9.3 | 10.5 | 19.3 | 13.5 | 14.5 | 5.8 | 13.8 | 18.6 | 13.9 |
| 13 | Romsun 59 | 17.3 | 19.9 | 15.7 | 14.4 | 10.2 | 13.8 | 18.0 | 10.7 | 13.8 | 7.6 | 14.7 | 13.0 | 14.1 |
| 14 | Sorem 80 | 14.8 | 18.3 | 11.7 | 13.6 | 7.8 | 13.8 | 20.1 | 16.0 | 12.7 | 7.2 | 14.0 | 17.3 | 14.0 |
| 15 | Sorem 82 | 16.0 | 18.7 | 13.0 | 13.1 | 11.0 | 18.4 | 14.2 | 16.3 | 13.1 | 5.8 | 15.7 | 17.4 | 14.4 |
| 16 | Sorem HT-64 | 15.2 | 17.2 | 14.6 | 13.1 | 10.0 | 10.5 | 21.2 | 15.2 | 14.8 | 7.2 | 16.7 | 16.7 | 14.4 |
| | L.S.D. 0.05 | 1.2 | 1.6 | 1.0 | 1.5 | 1.6 | 1.9 | 2.8 | 2.3 | 3.2 | 4.9 | 2.2 | 2.8 | 1.8 |

*Table 3*

**TRIAL No. 1 — Analysis of variance for seed and oil yields in medium-late hybrid tests, evaluated in 6—7 locations and 2 years**

| Source | Seed yield | | | Oil yield | | |
|---|---|---|---|---|---|---|
| | df | mean square | F | df | mean square | F |
| Cultivars (C) | 11 | 52.66 | 7.45** | 11 | 15.72 | 6.16** |
| Locations (L) | 6 | 462.67 | 65.43** | 5 | 153.99 | 60.32** |
| Years (Y) | 1 | 0.7 | <1.0 | 1 | 71.68 | 28.08** |
| C × L | 66 | 16.20 | 2.29** | 55 | 3.95 | 1.55* |
| C × Y | 11 | 24.98 | 3.53** | 11 | 8.68 | 3.40** |
| L × Y | 6 | 239.67 | 33.89** | 5 | 96.76 | 37.91** |
| Pooled error | 66 | 7.07 | | 55 | 2.55 | |

*, ** Significant at the 0.05 and 0.01 probability, respectively.

period shorter than Peredovik with 2—5 days, the earliest being Sorem 80 and Sorem HT-58.

Plant height varied from 97 cm to 214 cm. A mean plant height less than 150 cm have the following hybrids : Airelle, Relax, H-489, H-465, H-223 and Remil.

The oil content in dry seeds varied from 31.3% to 55.9%, depending on the hereditary characteristics and the environmental conditions. Mean values over 48% have the following hybrids : Helios 322, Sorem 82, Romsun 53, Sorem 80 and Helios 14-219. Peredovik proved to have better constancy of the oil content than most of hybrids and for this reason its mean value was one of the highest. Its lower oil yield per hectare is due to the inferior seed yields.

A good volumetric weight characterizes the hybrids Yu NS-26, Sorem 82, H-223, H-465, H-469 and Sorem HT-58.

The weight of 1000 seeds is the highest at Peredovik, Romsun 53 and Sorem 80.

*Table 4*

**TRIAL No. 1 with sunflower medium-late hybrids. One-year (1976) seed and oil yields tests (q/ha), in three locations**

| Exp. no. | Cultivar | France Cl. Ferrand | | France Montpellier | Hungary Szeged | |
|---|---|---|---|---|---|---|
| | | seed yield | oil yield | oil yield | seed yield | oil yield |
| 1 | Peredovik | 24.9 | 13.5 | 18.3 | — | — |
| 2 | Local cultivar | 27.1 | 13.5 | 18.4 | 39.8 | 20.3 |
| 3 | Helios 322 | 32.5 | 17.9 | 18.6 | 49.6 | 25.6 |
| 4 | Yu NS-65 | 27.5 | 13.1 | 16.3 | 49.8 | 23.4 |
| 5 | H-223 | 34.7 | 17.4 | 19.1 | 39.0 | 17.6 |
| 6 | H-465 | 31.7 | 16.0 | 19.1 | 41.8 | 19.1 |
| 7 | H-489 | 34.8 | 17.2 | 19.4 | 40.4 | 20.8 |
| 8 | Airelle | 44.5 | 22.0 | — | 39.1 | 18.5 |
| 9 | Relax | 32.0 | 15.0 | 17.7 | 44.7 | 20.3 |
| 10 | Remil | 30.4 | 14.7 | — | 42.4 | 20.3 |
| 11 | Romsun 52 | 26.9 | 12.8 | 19.4 | 35.8 | 16.8 |
| 12 | Romsun 53 | 24.8 | 12.8 | 19.9 | 42.3 | 21.0 |
| 13 | Romsun 59 | 30.8 | 16.0 | 19.4 | 39.6 | 20.3 |
| 14 | Sorem 80 | 24.5 | 12.7 | 19.5 | 46.0 | 22.0 |
| 15 | Sorem 82 | 31.0 | 14.6 | 19.0 | 44.8 | 22.2 |
| 16 | Sorem HT-64 | 23.4 | 12.3 | 20.0 | 44.6 | 21.4 |
| | L.S.D. 0.05 | 1.3 | 1.1 | | | |

The results of screening for resistance to the most important diseases are presented in Table 7. A clear cut resistance to downy mildew *(Plasmopara helianthi)* is evident to the following hybrids : Yu NS-65, Remil, Romsun 52, Romsun 53, Sorem 80, Sorem 82, H-223, H-465, H-489, Yu NS-26 and Sorem HT-58.

A better resistance or tolerance to white rot *(Sclerotinia sclerotiorum)* was encountered at : Remil, Relax, H-223, H-489, Sorem 82, Yu NS-65 şi Sorem HT-58. A certain field resistance to gray rot *(Botrytis cineria)* manifested : Remil, Sorem 82, Relax, Sorem HT-64, H-223.

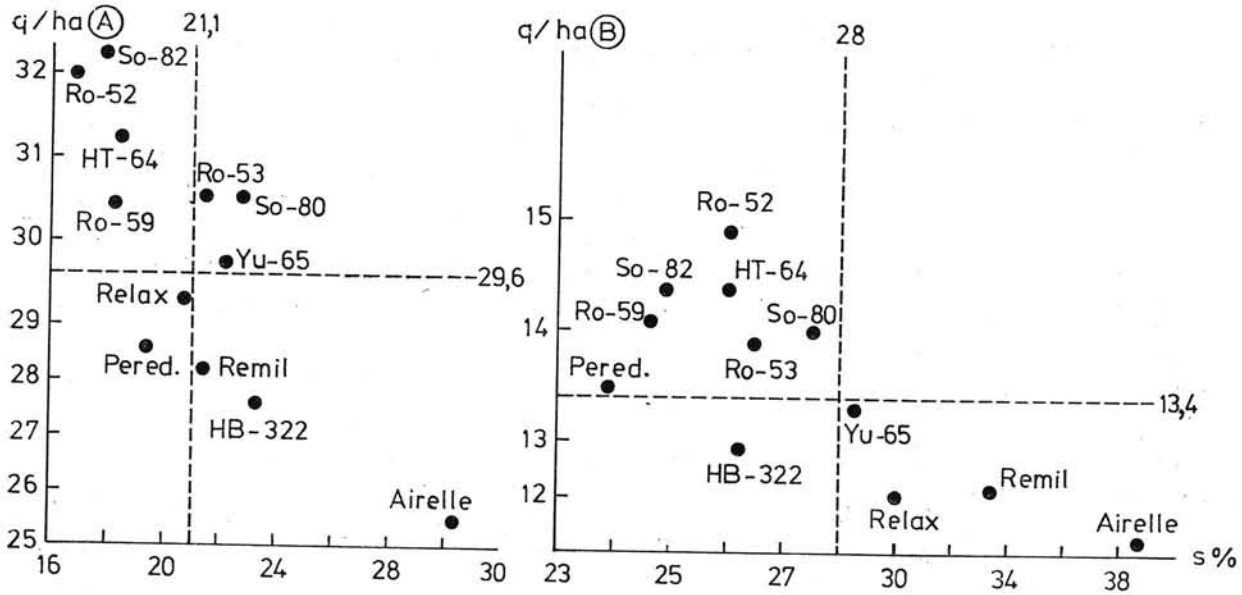


*Fig. 1* — Distribution of medium-late sunflower cultivars in terms of yielding capacity and coefficient of variation ($A$ = seed yield, $B$ = oil yield).

*Table 5*

**TRIAL No. 1 with sunflower medium-late hybrids. One-year (1977) seed and oil yield tests (q/ha), in 5 locations**

| Exp. no. | Cultivar | Iran, Karaj | | Turkey, Yeşilköy | | Hungary, Szeged | | Portugal, Elvas | | France, Montpellier |
|---|---|---|---|---|---|---|---|---|---|---|
| | | seed yield | oil yield | seed yield | oil yield | seed yield | oil yield | seed yield | oil yield | oil yield |
| 1 | Peredovik | 23.7 | 10.5 | 31.5 | 15.6 | 40.3 | 19.6 | 24.9 | 13.0 | 16.7 |
| 2 | Local cultivar | 26.7 | 12.5 | 31.7 | 15.3 | 40.3 | 19.6 | 25.0 | 13.4 | 16.7 |
| 3 | Helios 322 | 29.8 | 13.9 | 33.4 | 16.9 | — | — | 25.7 | 11.8 | 23.0 |
| 4 | Yu NS-65 | 23.4 | 9.3 | 28.8 | 13.2 | 36.1 | 17.9 | 26.4 | 9.0 | 18.8 |
| 5 | Yu NS-26 | 29.8 | 12.6 | 34.6 | 16.4 | 33.4 | 16.4 | 28.3 | 12.6 | 19.9 |
| 6 | Sorem HT-58 | 30.2 | 12.6 | 33.9 | 15.8 | 35.3 | 17.9 | 27.6 | 13.5 | 14.9 |
| 7 | Helios 14-219 | 22.0 | 9.8 | 27.3 | 13.7 | — | — | 26.3 | 13.4 | 19.2 |
| 8 | Airelle | 28.9 | 12.2 | 27.7 | 12.7 | — | — | 28.7 | 10.4 | 20.1 |
| 9 | Relax | 25.7 | 9.9 | 28.9 | 12.7 | — | — | 29.1 | 10.8 | 17.5 |
| 10 | Remil | 23.9 | 10.2 | 28.2 | 10.8 | — | — | 34.7 | 14.6 | 18.2 |
| 11 | Romsun 52 | 25.7 | 10.5 | 32.9 | 15.3 | 34.2 | 17.0 | 34.3 | 16.7 | 19.7 |
| 12 | Romsun 53 | 27.8 | 11.7 | 32.0 | 15.4 | 37.8 | 19.6 | 31.9 | 14.0 | 22.9 |
| 13 | Romsun 59 | 28.2 | 12.2 | 33.0 | 15.2 | — | — | 32.1 | 15.2 | 18.8 |
| 14 | Sorem 80 | 27.6 | 12.7 | 33.3 | 16.6 | 39.8 | 19.3 | 32.3 | 14.0 | 21.1 |
| 15 | Sorem 82 | 26.7 | 12.0 | 40.8 | 20.2 | 37.8 | 19.9 | 34.3 | 14.9 | 21.7 |
| 16 | Sorem HT-64 | 32.0 | 14.2 | 34.4 | 17.1 | 42.5 | 21.9 | 32.2 | 12.9 | 21.2 |
| | L.S.D. 0.05 | 5.2 | 2.4 | 1.4 | 0.9 | 4.2 | | 6.3 | 2.0 | 3.2 |

The Romanian hybrids Romsun 53 and Sorem 80 proved to have complete resistance to the new, more virulent races of broomrape *(Orobanche cumana)* which have occured in the Eastern regions of Romania. All the other entries showed a clear susceptibility to this parasite in artificial infections carried out at Fundulea.

A medium resistance to charcoal rot *(Sclerotium bataticola)* was noted at : Sorem 80, Romsun 59 and Sorem HT-64. Romsun 59 manifested also a better resistance to *Phoma* sp.

**Trial No. 2.** Yields given by early hybrids and varieties were inferior to those obtained with medium-late cultivars. Seed yields, presented in Table 8, ranged from 8.4 q/ha to 42.2 q/ha, and oil yields from 4.0 q/ha to 20.9 q/ha (Table 9), displaying highly significant differences. The highest mean seed and oil yields were recorded at the hybrids : Romsun 20, Yu NS-1 and H-23.

Analysis of variance (Table 10) indicates that location effects on the variability of both seed and oil yields had the greatest magnitude. In comparison with Trial No. 1, the differences among cultivars appear to be more consistent.

*Table 6*

**Two-year sunflower test with medium-late hybrids, in 12 locations. Morpho-physiological characteristics**

| Cultivar | Vegetation period (days) | | Plant height (cm) | | % oil in dry matter | | Volumetric weight (kg/hl) | | 1 000 seed weight (g) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | limits | mean | limits | mean | limits | mean | limits | mean | limits | mean |
| Peredovik | 120—138 | 131 | 140—214 | 171 | 42.3—54.0 | 48.9 | 32—40 | 38 | 61—102 | 74 |
| Helios 322 | 119—135 | 129 | 141—200 | 173 | 43.1—55.8 | 50.1 | 33—41 | 39 | 53—86 | 69 |
| Yu NS-65 | 116—135 | 128 | 131—205 | 168 | 34.4—52.1 | 46.3 | 37—43 | 38 | 52—72 | 65 |
| Airelle | 117—133 | 127 | 97—179 | 131 | 31.3—52.8 | 45.3 | 28—41 | 36 | 56—75 | 61 |
| Relax | 110—131 | 127 | 111—181 | 142 | 34.3—52.2 | 42.1 | 36—44 | 38 | 56—84 | 66 |
| Remil | 121—131 | 129 | 127—199 | 148 | 35.8—52.9 | 43.8 | 37—43 | 39 | 62—87 | 69 |
| Romsun 52 | 119—131 | 128 | 97—190 | 152 | 38.4—52.4 | 47.0 | 29—40 | 37 | 55—86 | 68 |
| Romsun 53 | 110—131 | 127 | 120—184 | 156 | 35.3—55.9 | 48.3 | 31—39 | 36 | 59—89 | 71 |
| Romsun 59 | 120—132 | 129 | 120—207 | 158 | 36.4—53.4 | 47.9 | 36—41 | 38 | 57—90 | 70 |
| Sorem 80 | 110—132 | 126 | 148—201 | 170 | 41.1—54.3 | 48.2 | 33—40 | 38 | 53—87 | 71 |
| Sorem 82 | 110—333 | 129 | 107—204 | 168 | 38.1—53.3 | 48.9 | 35—42 | 40 | 51—77 | 66 |
| Sorem HT-64 | 110—130 | 128 | 125—193 | 164 | 36.3—54.1 | 47.9 | 34—41 | 37 | 54—95 | 68 |
| H-223 | 117—134 | 129 | 105—185 | 147 | 34.0—53.8 | 46.6 | 36—41 | 40 | 55—78 | 63 |
| H-465 | 119—134 | 128 | 107—187 | 145 | 37.2—54.0 | 46.0 | 35—42 | 40 | 53—76 | 57 |
| H-489 | 116—135 | 129 | 113—201 | 143 | 37.9—53.3 | 47.1 | 36—43 | 40 | 49—72 | 56 |
| Yu NS-26 | 121—133 | 131 | 130—176 | 156 | 37.1—52.7 | 46.4 | 37—47 | 41 | 43—71 | 52 |
| Sorem HT-58 | 118—130 | 126 | 130—185 | 154 | 31.6—51.4 | 45.3 | 37—46 | 40 | 46—78 | 57 |
| Helios 14—219 | 122—132 | 129 | 138—191 | 162 | 35.6—52.1 | 48.1 | 30—42 | 38 | 59—88 | 70 |

*Table 7*

**Two-year sunflower test with medium-late hybrids. Percentage of diseased plants**

| Cultivar | *Plasmopara helianthi* | | | | | | | | | *Sclerotinia sclerotiorum* | | | | | | | | *Botrytis cinerea* | | | | *Orobanche cumana* | *Sclerot. bataticola* | | *Phoma* * | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Fundulea | | | | Novi Sad | Cl. Ferrand | | Tosh. | Szeged | Novi Sad | | | | | Cl. Ferrand | | Iregsz. | Cl. Ferrand | | Novi Sad | Szeged | Fundulea | Novi Sad | | Novi Sad | |
| | 1976 | | 1977 | | 1976 | 1976 | 1977 | 1977 | 1977 | 1976 | | | 1977 | | 1976 | 1977 | 1976 | 1976 | 1977 | 1976 | 1977 | 1977 | 1976 | 1977 | 1976 | 1977 |
| | art. | nat. | art. | nat. | art. | art. | nat. | nat. | nat. | art. | nat. root | nat. head | nat. root | nat. head | nat. | nat. | nat. on stem | nat. | nat. | nat. | nat. | art. | art. | art. | nat. | nat. |
| Peredovik | 100 | 62 | 100 | 59 | 98 | 100 | 57 | 1 | 46 | 39 | 2 | 3 | 50 | 58 | 2 | 26 | 4 | 19 | 26 | 14 | 42 | 93 | 20 | 30 | 2 | 2 |
| Helios 322 | 100 | 85 | 100 | 68 | | 94 | 27 | 1 | 46 | | 18 | 18 | 69 | 43 | 15 | 37 | 5 | 17 | 17 | 38 | 21 | 94 | | 30 | 2 | 4 |
| Yu NS-65 | 23 | 9 | 18 | 6 | 4 | 68 | 13 | 0 | 12 | 53 | 3 | 5 | 45 | 7 | 16 | 14 | 10 | 8 | 17 | 8 | 35 | 100 | 8 | 22 | 1 | 3 |
| Airelle | 100 | 76 | 99 | 72 | 55 | 100 | 81 | 5 | | 33 | 16 | 1 | 38 | 49 | 2 | 65 | 3 | 16 | 34 | 6 | | 97 | 70 | 28 | 1 | 5 |
| Relax | 100 | 62 | 100 | 59 | 100 | 100 | 28 | 7 | | 35 | 0 | 1 | 30 | 12 | 0 | 37 | 1 | 15 | 19 | 5 | | 95 | 60 | 22 | 2 | 4 |
| Remil | 0 | 3 | 0 | 0 | 5 | 3 | 2 | 0 | | 17 | 0 | 1 | 34 | 5 | 13 | 20 | 1 | 5 | 11 | 7 | | 100 | 17 | 21 | 2 | 1 |
| Romsun 52 | 2 | 0 | 1 | 0 | 0 | 18 | 2 | 1 | 1 | 38 | 9 | 4 | 49 | 29 | 15 | 43 | 5 | 53 | 39 | 12 | 16 | 94 | 27 | 24 | 2 | 3 |
| Romsun 53 | 5 | 7 | 3 | 1 | 0 | 5 | 2 | 0 | 7 | 48 | 10 | 9 | 70 | 18 | 17 | 54 | 3 | 62 | 23 | 17 | 21 | 0 | 33 | 26 | 2 | 4 |
| Romsun 59 | 95 | 85 | 100 | 74 | 76 | 98 | 46 | 4 | 71 | 39 | 17 | 4 | 74 | 35 | 4 | 28 | 3 | 36 | 33 | 17 | 13 | 91 | 0 | 22 | 1 | 1 |
| Sorem 80 | 2 | 0 | 1 | 0 | 9 | 51 | 0 | 0 | 1 | 40 | 7 | 5 | 66 | 14 | 13 | 37 | 4 | 37 | 24 | 8 | 30 | 2 | 0 | 21 | 1 | 3 |
| Sorem 82 | 6 | 4 | 0 | 0 | 5 | 5 | 1 | 0 | 0 | 55 | 3 | 0 | 48 | 10 | 3 | 38 | 3 | 3 | 24 | 12 | 27 | 92 | 9 | 21 | 4 | 5 |
| Sorem HT-64 | 52 | 56 | 58 | 42 | 64 | 70 | 4 | 0 | 4 | 59 | 14 | 10 | 64 | 14 | 6 | 48 | 2 | 34 | 39 | 12 | 5 | 73 | 0 | 25 | 2 | 2 |
| H-223 | 8 | 8 | — | — | 3 | 17 | | | | 25 | 0 | 0 | | 6 | 9 | | | 7 | | 6 | | 100 | 9 | | 2 | |
| H-465 | 17 | 7 | — | — | 3 | 9 | | | | 26 | 2 | 0 | | | 11 | | | 7 | | 7 | | 98 | 0 | | 2 | |
| H-489 | 14 | 7 | — | — | 15 | 13 | | 0 | | 29 | 0 | 0 | | | 5 | | | 11 | | 7 | | 100 | | | 2 | |
| Yu NS-26 | — | — | 14 | 2 | | | 2 | 0 | 26 | | | | 35 | 6 | | 25 | | | 33 | | 12 | 99 | | 25 | | 3 |
| Sorem HT-58 | — | — | 13 | 4 | | | 1 | 0 | 3 | | | | 47 | 3 | | 44 | 0 | | 25 | | 24 | 98 | | 26 | | 6 |
| Helios 14-219 | 98 | 68 | — | — | | | 33 | 1 | 46 | | | | 50 | 44 | | 33 | 0 | | 28 | | 42 | 93 | | 20 | | 3 |

* scale 0—10

*Table 8*

**TRIAL No. 2 with sunflower early hybrids and varieties. Two-year seed yield test (q/ha, 0% moisture)**

| Exp. no. | Cultivar | Romania Fundulea | | Bulgaria Toshevo | | Hungary Iregszemcse | | Yugoslavia Novi Sad | | Italy Pisa | | Austria Vienna | | Poland Poznan | | France Aude (CETIOM) | | France Montpellier | | Mean 1976—1977 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1976 | 1977 | 1976 | 1977 | 1976 | 1977 | 1976 | 1977 | 1976 | 1977 | 1976 | 1977 | 1976 | 1977 | 1976 | 1977 | 1976 | 1977 | |
| 1 | Issanka | 21.3 | 23.7 | 18.6 | 18.4 | 17.0 | 20.8 | 22.9 | 13.6 | 15.3 | 16.0 | 21.2 | 20.9 | 12.2 | 11.8 | 8.4 | 8.3 | 28.7 | 25.2 | 18.0 |
| 2 | Wielkopolski | 24.5 | 29.9 | 23.1 | 28.6 | 19.6 | 24.9 | 31.9 | 21.5 | 28.6 | 23.8 | 31.6 | 27.3 | 24.5 | 21.4 | 9.2 | 21.6 | 30.6 | 26.8 | 25.0 |
| 4 | Yu NS-1 | 26.9 | 35.1 | 25.3 | 31.0 | 22.7 | 28.3 | 42.2 | 29.3 | 22.1 | 15.4 | 35.6 | 25.5 | 29.7 | 22.0 | 10.6 | 34.7 | 36.0 | 37.8 | 28.3 |
| 5 | H-23 | 24.5 | 32.1 | 25.6 | 30.9 | 19.5 | 24.1 | 36.9 | 30.0 | 23.0 | 21.8 | 32.3 | 25.7 | 26.6 | 23.1 | 10.4 | 34.4 | 35.6 | 31.8 | 27.1 |
| 7 | Romsun 18 | 27.1 | 36.8 | 27.2 | 33.3 | 23.1 | 26.0 | 37.6 | 31.5 | 25.9 | 18.1 | 20.6 | 28.8 | 21.5 | 19.8 | 9.5 | 24.6 | 36.3 | 33.3 | 26.7 |
| 8 | Romsun 20 | 30.0 | 37.1 | 25.2 | 29.8 | 21.1 | 26.2 | 37.7 | 30.0 | 26.1 | 23.8 | 36.3 | 28.7 | 23.5 | 26.0 | 11.2 | 24.9 | 36.6 | 33.8 | 28.2 |
| 9 | Romsun 301 | 26.7 | 37.3 | 20.3 | 32.6 | 18.6 | 27.9 | 37.3 | 23.0 | 23.5 | 17.4 | 31.3 | 27.9 | 20.3 | 20.4 | 11.6 | 20.4 | 36.9 | 35.5 | 26.0 |
| | L.S.D. 0.05 | 1.8 | 2.6 | 1.0 | 1.4 | 2.7 | 2.4 | 4.0 | 4.7 | 3.2 | 5.3 | 7.6 | 2.2 | 5.8 | 4.4 | 1.2 | 5.5 | 5.3 | | 3.1 |

*Table 9*

**TRIAL No. 2 with sunflover early hybrids and varieties. Two-year oil yield test (q/ha)**

| Exp. no. | Cultivar | Romania Fundulea | | Bulgaria Toshevo | | Hungary Iregszemcse | | Yugoslavia Novi Sad | | Italy Pisa | | Austria Vienna | | Poland Poznan | | France Aude (CETIOM) | | Mean 1976—1977 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1976 | 1977 | 1976 | 1977 | 1976 | 1977 | 1976 | 1977 | 1976 | 1977 | 1976 | 1977 | 1976 | 1977 | 1976 | 1977 | |
| 1 | Issanka | 9.9 | 11.1 | 8.3 | 8.0 | 7.6 | 8.5 | 10.7 | 8.5 | 6.9 | 5.3 | 10.1 | 9.8 | 6.4 | 5.4 | 4.3 | 4.0 | 8.0 |
| 2 | Wielkopolski | 12.1 | 14.1 | 11.1 | 12.2 | 8.9 | 11.0 | 15.6 | 11.0 | 12.7 | 7.6 | 15.6 | 12.8 | 13.4 | 10.1 | 4.8 | 10.8 | 11.5 |
| 4 | Yu NS-1 | 12.7 | 17.0 | 12.4 | 14.1 | 10.4 | 13.1 | 20.7 | 13.1 | 9.4 | 5.5 | 16.9 | 12.4 | 15.6 | 11.1 | 5.4 | 17.3 | 12.9 |
| 5 | H-23 | 11.9 | 14.7 | 12.1 | 13.2 | 9.3 | 10.7 | 18.1 | 10.7 | 10.2 | 6.1 | 16.2 | 12.3 | 14.8 | 10.9 | 5.8 | 17.2 | 12.2 |
| 7 | Romsun 18 | 12.8 | 17.5 | 13.6 | 14.6 | 10.3 | 11.5 | 19.9 | 11.5 | 11.8 | 5.0 | 10.1 | 13.2 | 11.5 | 8.7 | 4.5 | 11.8 | 11.8 |
| 8 | Romsun 20 | 15.5 | 18.0 | 12.9 | 13.3 | 10.2 | 11.7 | 20.9 | 11.7 | 12.4 | 7.1 | 18.3 | 13.6 | 13.2 | 12.5 | 6.0 | 12.1 | 13.1 |
| 9 | Romsun 301 | 13.3 | 18.1 | 10.4 | 14.7 | 8.3 | 13.0 | 19.0 | 13.0 | 10.6 | 6.0 | 14.6 | 13.0 | 10.6 | 9.8 | 6.1 | 10.2 | 11.9 |
| | L.S.D. 0.05 | 1.1 | 1.8 | 0.8 | 1.1 | 1.6 | 1.8 | 1.9 | 1.8 | 1.1 | 2.6 | 4.1 | 1.5 | 3.1 | 2.4 | 0.7 | 2.6 | 1.7 |

*Table 10*

**TRIAL No. 2 Analysis of variance for seed and oil yield in early hybrid and variety tests, evaluated in 8—9 locations and 2 years.**

| Source | Seed yield df | Seed yield mean square | Seed yield F | Oil yield df | Oil yield mean square | Oil yield F |
|---|---|---|---|---|---|---|
| Cultivars (C) | 6 | 228.28 | 23.62** | 6 | 50.37 | 17.73** |
| Locations (L) | 8 | 375.82 | 38.88** | 7 | 82.83 | 29.15** |
| Years (Y) | 1 | 44.52 | 4.61* | 1 | 2.26 | <1.0 |
| C×L | 48 | 11.52 | 1.19 | 42 | 2.70 | <1.0 |
| C×Y | 6 | 6.1 | <1.0 | 6 | 1.23 | <1.0 |
| L×Y | 8 | 186.64 | 19.31** | 7 | 66.09 | 23.26** |
| Pooled error | 48 | 9.67 | | 42 | 2.84 | |

*, ** Significant at the 0.05 and 0.01 probability, respectively.

The high significant locations × year interactions put in evidence that year influence was quite different in each location.

Sunflower hybrids Romsun 20 and H-23 have the most constant and the highest seed and oil yields (Figure 2). Yu NS-1, Romsun 18 and Romsun 301 require certain favourable conditions for showing good performances.

Table 11 presents seed and oil yields obtained in 1976, in 3 locations. The most valuable hybrids are : Romsun 20, Yu NS-1 and Helios 14-219.

The experiments carried out in 1977, in 4 locations (Table 12), put in evidence again the hybrids Yu NS-1 and Romsun 20, followed by H-23 and Romsun 301.

The main morpho-physiological characteristics of the cultivars under this study are shown in Table 13. The earliest entries are : the variety Issanka and the hybrids Romsun 20 and Romsun 18, which need in most cases less than 120 days to reach physiological maturity. The hybrids Yu NS-1 and Helios 14-219 proved to

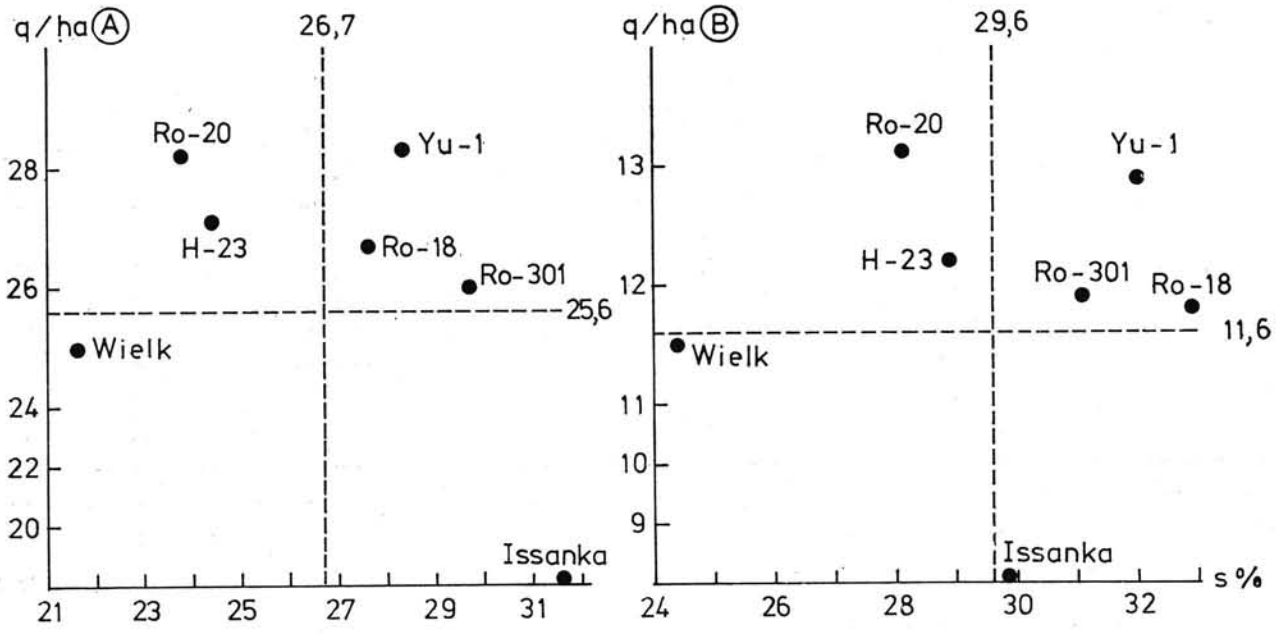


*Fig. 2* — Distribution of early and half-early sunflower cultivars in terms of yielding capacity and coefficient of variation ($A$ = seed yield, $B$ = oil yield)

*Table 11*

**TRIAL No. 2 with sunflower early hybrids and varieties. One-year (1976) seed and oil yield tests (q/ha), in three locations**

| Exp. no. | Cultivar | Sweden | | France | | |
|---|---|---|---|---|---|---|
| | | Uppsala | | Cl. Ferrand | | Montpellier |
| | | seed yield | oil yield | seed yield | oil yield | oil yield |
| 1 | Issanka | 12.1 | 5.5 | 17.5 | 8.1 | 13.9 |
| 2 | Wielkopolski | 11.7 | 5.2 | 26.3 | 13.0 | 15.2 |
| 3 | Helios 14-219 | 12.2 | 5.4 | 32.3 | 16.0 | 19.2 |
| 4 | Yu NS-1 | 15.4 | 6.6 | 29.4 | 14.1 | 18.1 |
| 5 | H-23 | 11.1 | 4.9 | 33.2 | 16.3 | 17.8 |
| 6 | Fransol | 12.8 | 5.8 | 26.7 | 12.6 | 15.5 |
| 7 | Romsun 18 | 12.8 | 5.9 | 24.0 | 10.9 | 17.0 |
| 8 | Romsun 20 | 12.6 | 6.4 | 25.8 | 13.5 | 19.2 |
| 9 | Romsun 301 | 11.7 | 5.0 | 27.5 | 13.7 | 18.6 |
| | L.S.D. 0.05 | 2.1 | 1.3 | 2.2 | 1.7 | 2.6 |

have a vegetation period similar to the medium-late hybrids being too late for the Central and Northern European countries.

Most hybrids have a mean plant height less than 140 cm, excepting the hybrids Yu NS-1, Helios 14-219 and Romsun 301 which proved to be too tall for the early hybrid type.

The oil content in dry seed ranged from 32.3% to 55.2% and the mean values from 42.3% to 49.5%. The hybrids Helios 14—219 and Romsun 20 possess the highest seed oil content, reaching the level of 55.2%.

Increased values of volumetric weight presented the hybrids : Yu NS-1, Romsun 20 and H 5—C 3.

*Table 12*

**TRIAL No. 2 with sunflower early hybrids and varieties. One-year (1977) seed and oil yield tests (q/ha), in four locations**

| Exp. no. | Cultivar | Iran | | Turkey | | Portugal | | France |
|---|---|---|---|---|---|---|---|---|
| | | Karaj | | Yeşilköy | | Elvas | | Montpellier |
| | | seed yield | oil yield | seed yield | oil yield | seed yield | oil yield | oil yield |
| 1 | Issanka | 13.3 | 5.5 | 15.1 | 6.2 | 16.9 | 7.0 | 10.5 |
| 2 | Wielkopolski | 15.2 | 6.2 | 23.3 | 10.5 | 19.2 | 8.0 | 12.5 |
| 3 | H5-C3 | 13.9 | 5.8 | 17.2 | 7.1 | 18.2 | 6.7 | 14.7 |
| 4 | Yu NS-1 | 22.2 | 9.7 | 28.6 | 14.2 | 19.6 | 9.3 | 19.2 |
| 5 | H-23 | 18.7 | 7.6 | 30.6 | 13.9 | 17.5 | 7.4 | 15.6 |
| 6 | Flambeau | 17.6 | 7.4 | 22.6 | 9.9 | 17.0 | 7.4 | 14.4 |
| 7 | Romsun 18 | 16.3 | 7.0 | 27.0 | 12.1 | 18.4 | 7.9 | 15.9 |
| 8 | Romsun 20 | 18.8 | 7.7 | 26.8 | 12.8 | 18.8 | 8.0 | 18.0 |
| 9 | Romsun 301 | 16.3 | 7.1 | 30.2 | 13.6 | 19.8 | 9.2 | 17.4 |
| | L.S.D. 0.05 | 3.1 | 1.7 | 1.9 | 1.2 | 4.9 | 1.2 | 3.2 |

The highest weight of 1000 seeds displayed Romsun 301, Issanka and H 5—C 3.

Table 14 contains the results of screening for resistance to the most important deseases of sunflower crop in Europe. An obvious resistance to downy mildew *(Plasmopara helianthi)* showed the following hybrids : Yu NS-1, Romsun 18, Romsun 20, H-23 and H 5—C 3.

A reduced susceptibility to white rot *(Sclerotinia sclerotiorum)* manifested : H-23, Yu

*Table 13*

**Two-year sunflower test with early hybrids and varieties, in 14 locations. Morpho-physiological characteristics**

| Cultivar | Vegetation period (days) | | Plant height (cm) | | % oil in dry matter | | Volumetric weight (kg/hl) | | 1 000 seed weight (g) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | limits | mean | limits | mean | limits | mean | limits | mean | limits | mean |
| Issanka | 91—129 | 114 | 78—132 | 102 | 37.3—51.1 | 45.1 | 26—39 | 35 | 50—88 | 64 |
| Wielkopolski | 97—135 | 123 | 70—139 | 106 | 38.1—51.9 | 46.2 | 34—44 | 38 | 52—78 | 62 |
| Yu NS-1 | 100—141 | 131 | 110—213 | 168 | 41.7—51.2 | 47.5 | 37—47 | 41 | 42—74 | 61 |
| H-23 | 97—137 | 124 | 99—169 | 135 | 32.3—51.9 | 45.9 | 38—42 | 40 | 39—59 | 53 |
| Romsun 18 | 95—131 | 120 | 80—156 | 116 | 32.4—52.0 | 46.2 | 34—43 | 38 | 46—76 | 58 |
| Romsun 20 | 94—136 | 119 | 81—167 | 121 | 34.0—55.2 | 48.4 | 37—44 | 41 | 37—81 | 60 |
| Romsun 301 | 98—139 | 126 | 104—181 | 140 | 40.8—53.1 | 46.9 | 32—41 | 36 | 49—88 | 65 |
| Helios 14—219 | 118—140 | 128 | 120—178 | 146 | 43.3—54.2 | 49.5 | 35—40 | 37 | 53—82 | 60 |
| Fransol | 114—133 | 124 | 78—154 | 132 | 39.7—50.8 | 44.2 | 36—41 | 39 | 43—58 | 52 |
| H5—C3 | 96—131 | 121 | 99—170 | 133 | 35.4—49.1 | 42.3 | 38—46 | 41 | 52—82 | 63 |
| Flambeau | 98—133 | 122 | 105—168 | 136 | 35.3—49.3 | 43.4 | 37—45 | 39 | 41—65 | 58 |

*Table 14*

**Two-year sunflower test with early hybrids and varieties Percentage of diseased plants**

| Cultivar | *Plasmopara helianthi* | | | | | | | | *Sclerotinia sclerotiorum* | | | | | | | | | | *Botrytis cinerea* | | | | | *Orob. cumana* | *Scl. batatic.* | | *Phoma* sp. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Fundulea | | | | Novi Sad | Cl. Ferrand | | Tos-hevo | Novi Sad | | | | | Cl. Ferrand | | Iregs-zemcse | | | Cl. Ferrand | | Novi Sad | Poz-nan | Iregsz. | Fun-dulea | Novi Sad | | Novi Sad | |
| | 1976 | | 1977 | | 1976 | 1976 | 1977 | 1977 | 1976 | | | 1977 | | 1976 | 1977 | 1976 | 1977 | | 1976 | 1977 | 1976 | 1976 | 1976 | 1977 | 1976 | 1977 | 1976 | 1977 |
| | art. | nat. | art. | nat. | art. | nat. | art. | nat. | art. | nat. root | nat. head | nat. root | nat. head | nat. | nat. | nat. | nat. stem | nat. | nat. | nat. | nat. | art. | art. | art. | art. | art. | art. | art. | art. | nat. | nat. |
| Issanka | 88 | 70 | 90 | 69 | 95 | 97 | 43 | 6 | 53 | 3 | 18 | 49 | 64 | 5 | 48 | 0 | 0 | 2 | 40 | 16 | 67 | 3 | 100 | 22 | 23 | 2 | 6 | | | | |
| Wielko-polski | 92 | 52 | 89 | 48 | | 100 | 20 | 8 | 16 | 3 | 1 | 39 | 15 | 8 | 26 | 0 | 0 | 2 | 13 | 13 | 37 | 8 | 91 | | 22 | 2 | 6 | | | | |
| Yu NS-1 | 2 | 0 | 1 | 0 | 0 | 0 | 2 | 0 | 58 | 0 | 0 | 58 | 45 | 6 | 23 | 3 | 4 | 4 | 23 | 4 | 70 | 9 | 100 | 11 | 20 | 3 | 4 | | | | |
| H-23 | 8 | 12 | 14 | 3 | 19 | 25 | 6 | 1 | 29 | 3 | | 38 | 2 | 12 | 22 | 3 | 0 | 3 | 13 | 6 | 41 | 10 | 100 | 9 | 21 | 2 | 6 | | | | |
| Romsun 18 | 13 | 0 | 11 | 1 | 11 | 15 | 0 | 0 | 34 | 3 | 4 | 31 | 38 | 2 | 35 | 0 | 2 | 16 | 31 | 13 | 72 | 10 | 98 | 0 | 28 | 2 | 6 | | | | |
| Romsun 20 | 14 | 4 | 16 | 3 | 12 | 28 | 0 | 0 | 53 | 0 | 5 | 31 | 45 | 2 | 19 | 2 | 2 | 8 | 11 | 7 | 83 | 5 | 97 | 22 | 33 | 2 | 6 | | | | |
| Romsun 301 | 100 | 61 | 95 | 48 | 8 | 14 | 39 | 5 | 38 | 39 | 5 | 29 | 24 | 13 | 36 | 2 | 4 | 17 | 28 | 10 | 71 | 21 | 99 | | 23 | 1 | 3 | | | | |
| Helios 14—219 | 98 | 68 | — | — | 100 | 100 | | | 39 | 25 | 1 | | | 6 | | 5 | | 31 | | 16 | 79 | 10 | 95 | 8 | | 1 | | | | | |
| Fransol | 100 | 39 | — | — | 100 | 92 | | | 70 | 2 | 2 | | | 18 | | 1 | | 2 | | 8 | 46 | 10 | 91 | 25 | | 2 | | | | | |
| H5—C3 | — | — | — | — | | | 0 | 0 | | | | 33 | 8 | | 8 | | 8 | | 9 | | | | 93 | | 25 | | 6 | | | | |
| Flambeau | — | — | 88 | 39 | | | 40 | 4 | | | | 34 | 35 | | 35 | | 1 | | 24 | | | | 98 | | 22 | | 6 | | | | |

* scale 0—10

NS-1, Romsun 20, Wielkopolski and Romsun 18. A medium field resistance to gray rot *(Botrytis cinerea)* presented : Fransol, Romsun 20, Issanka, Wielkopolski and H-23.

The response of all entries to the attack of *Sclerotium bataticola* and *Phoma* sp. was almost the same.

## SUMMARY AND CONCLUSIONS

The first biennial cycle of experimentation of sunflower hybrids and varieties (1976—1977) included two competitive trials with half-late and early cultivars, conducted in a large network of locations representing the most varied soil and climatic conditions. Most hy-

brids under study displayed high productivity, good uniformity, superior plant and seed characteristics and resistance to the most important diseases, expecially *Plasmopara helianthi.*

The half-late hybrids Sorem 82, Romsun 52 and Sorem HT-64, have given the highest seed and oil yields in the countries from South and South-Eastern Europe, having a higher oil content in dry seeds. High levels of productivity have been obtained in France and Portugal too.

The early and half-early hybrids are recommended in the Central and Northern European countries with short and cool summers. Thus in Austria the early hybrid Romsun 20 has given a maximum seed yield of 36.3 q/ha, with a seed oil content of 50.4% and in Poland the half-early hybrid Yu NS-1 yielded 29.7 q/ha seed with 47.4% oil. In Sweden, the experimental yields were lower, due to the short summer and autumn, the best results being obtained with the hybrids Yu NS-1 and Romsun 20.

## EXPERIMENTATION INTERNATIONALE DES HYBRIDES DE TOURNESOL

*Résumé*

Le premier cycle biennal d'expérimentation des hybrides de tournesol (1976—1977) a inclu deux essais de concours avec des cultivars démi-tardifs et précoces réalisés dans un réseau large de localitiés représentant les conditions les plus variées de sol et de climat. La plupart des hybrides étudiés ont montré une haute productivité, une bonne uniformité, une évidente supériorité en ce qui concerne les caractéristiques de la plante et des graines et une bonne résistance aux maladies, en particulier à *Plasmopara helianthi.*

Les hybrides demi-tardifs Sorem 82, Romsun 52 et Sorem HT-64 ont donné les plus élevés rendements en graines et en huile dans les pays du Sud et Sud-Est de l'Europe, ayant une teneur en huile plus élevée dans les akènes. Un haut niveau de productivité a été aussi réalisé en France et Portugal.

Les hybrides précoces et demi-précoces sont recommendés pour les pays du centre et du nord de l'Europe, avec des étés courts et froids. Ainsi, en Autriche l'hybride Romsun 20 a donné un rendement maximal en graines de 36,3 q/ha avec une teneur en huile de 50,4% et en Pologne l'hybride demi-précoce Yu NS-1 a produit 29,7 q/ha graines avec 47,4% huile. En Suède les rendements expérimentales ont été plus bas, à cause de l'été et l'automne courts, les meilleurs résultats étant obtenus avec les hybrides Yu NS-1 et Romsun 20.

## EXPERIMENTACIÓN INTERNACIONAL DE LOS HÍBRIDOS DE GIRASOL

*Resúmen*

El primer ciclo de dos anõs (1976—1977) de experimentación de las variedades y de los híbridos de girasol compredió cultivos comparativos con cultivares semitardías y precoces, efectuadas en una amplia red de localidades, representando las más variadas condiciones de suelo y clima. La mayoría de los híbridos estudiados se remarcaron por una productividad elevada, una buena uniformidad, características superiores de las plantas y de las semillas y resistencia a las más importantes enfermedades, especialmente a la *Plasmopara helianthi.*

Los híbridos semi-tardíos Sorem 82, Romsun 52, Sorem HT-64 dieron las mejores producciones de semilla y aceite en los países del sur y sur-oeste de Europa, teniendo un contenido superior de aceite en las semillas. Un nivel elevado de productividad se realisó también en Francia y Portugal.

Los híbridos precoces y semi-precoces se recomiendan en los países del centro y del norte de Europa, con veranos cortos y frescos. Así, en Austria el híbrido Romsun 20 dio una producción máxima de semillas de 36,3 q/ha con un contenido de aceite en las semillas de 50,4%, mientras en Polonia el híbrido Yu NS-1 produjo 29,7 q/ha semillas con 47,4% aceite. En Suecia, las producciones experimentales fueron más reducidas, a causa del verano y del otoño corto, los mejores resultados siendo obtenidos con los híbridos Yu NS-1 y Romsun 20.