

GENETIC PROGRESS IN SUNFLOWER BREEDING IN ROMANIA

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SUMMARY

Uniform evaluation of data for different hybrid sets and for the long-time check variety Record permitted the estimation of the genetic contribution of heterosis to the increase of seed and oil yields, as well as of oil content and self-fertility degree, in the period of 1970-1987. Based on the annual rate trends, certain conclusions were drawn and needs for future breeding research outlined.

This study aimed also at assessing the genetic gains concerning the most important morphological and physiological plant traits, and especially resistance to disease attack. New Romanian competitive hybrids for the most agronomical traits were developed.

INTRODUCTION

Modern sunflower breeding is particularly associated with the exploration of heterosis in the production of sunflower hybrids. Extensive work on selecting inbred lines was initiated in Romania by the year 1958 (V r â n c e a n u, 1970) and the first hybrids were released for the large production in 1971 (V r â n c e a n u and S t o e n e s c u, 1975). After 1978, sunflower hybrids have covered the entire acreage planted with this crop in Romania due to their important advantages in comparison with open-pollinated varieties.

There is a continuing question of how much of the increased seed and oil yield is due to increased genetic gains and how much is due to the reduction in constraints to yield using progressively improved crop management, pest and weed control, mechanization, etc. If improvement in genetic potential has been a major component of yield augmentation, is genetic improvement being sustained?

Uniform evaluation of data for different hybrid sets and for a long-time check cultivar permitted the estimation of the genetic contribution to the increase of seed and oil yields, oil content and self-fertility degree, in the period of 1970-1987. Beside of this, the present paper attempts to assess the genetic progress recorded at the Research Institute for Cereals and Industrial Crops of Fundulea concerning the most important morphological and physiological plant traits, resistance to parasites and adverse environmental conditions. New Romanian competitive hybrids for the most agronomical traits are presented.

MATERIALS AND METHODS

The sources of data and observations reviewed included 9 experimental biennial cycles of trials, carried out in 10 locations, in the period of 1970-1987.

The number of tested hybrids in each trial was of 19. The experimental design was the latin rectangle with 5 replications. Seed and oil yield data, as well as oil content and self-fertility degree, were converted to percentages of the appropriate long-time check cultivar

(the Romanian open-pollinated variety Record), and graphs were constructed on that basis. An assumption was made that constraints were similar for all entries in each trial.

The reaction to the main parasite attacks was estimated under artificial and (or) natural infections. Their response to different adverse environments was appreciated only in the field.

R E S U L T S

The evaluation of genetic contribution to seed yield improvement is presented in Fig. 1a. The regression line of the highest yielding hybrids showed an upward trend, but at a relative slow rate (1.17 % per year). The positive and significant coefficient of correlation ($r=0.82$) indicated that the theoretical values were quite close to the recorded ones. Trial average values had the annual rate higher, of 1.42 %, proving that the group of high yielding hybrids enlarged each cycle. Lower yield levels in certain years (1972, 1977, 1981, 1987) were determined in a large measure by environmental constraints as: drastic droughts, very high temperature especially in blooming and seed formation periods, strong attack of Sclerotinia sclerotiorum, Phomopsis helianthi, etc. At the same time the check open-pollinated variety Record revealed a wide adaptability to different environmental conditions, and performed rather constantly throughout the testing period.

Oil content trends for the top entries, as well as for the trial averages are presented in Fig. 1 b. Trial average values were placed under the check levels in the first two cycles, but afterwards they increased almost constantly as a result of the sustained selection pressure on this direction.

Although the top hybrids presented averages with 4.2-13.1 % higher than the check, the regression line had the annual rate of only 0.47 %. This situation could be explained taking into consideration that oil content of the open-pollinated variety Record (as check) was already high, in many cases over 50 % in dry matter, and so significant advances have been much more difficult to obtain taking into consideration the nearing to the biological limits of this trait.

The upward trend in performance concerning oil yield per area unit is a clear evidence that the breeding work in this respect has been more successful, high seed yielding hybrids with very high oil content at the same time being obtained (Fig. 1 c). The calculated annual rates of improvement were of 1.79 % and 2.38 % for the highest yielding hybrids and for the trials averages, respectively.

Selection pressure on self-fertility, performed at Fundulea in the period of 1976-1987, resulted in creating highly self-fertile hybrids, with degrees of self-fertility seven-eight times greater than those encountered at the open-pollinated varieties (V r â n c e a n u et al., 1987). The regression line of the top hybrids had a considerable upward trend, with an annual rate of 21.14 % (Fig. 1 d).

The graphs presented in Figure 2 suggest the success of disease resistance breeding work. The genes used for obtaining Plasmopara helianthi resistant hybrids were Pl₁, Pl₂ and Pl₅ (V r â n c e a n u et al., 1981). Over 80 % of the hybrids tested in competitive trials in the last 5 years possessed at least an allele of these Pl genes. Only results recorded in years with significant field attack were taken into consideration for the reaction to Sclerotinia sclerotiorum, Phomopsis helianthi and Orohanche cumana.

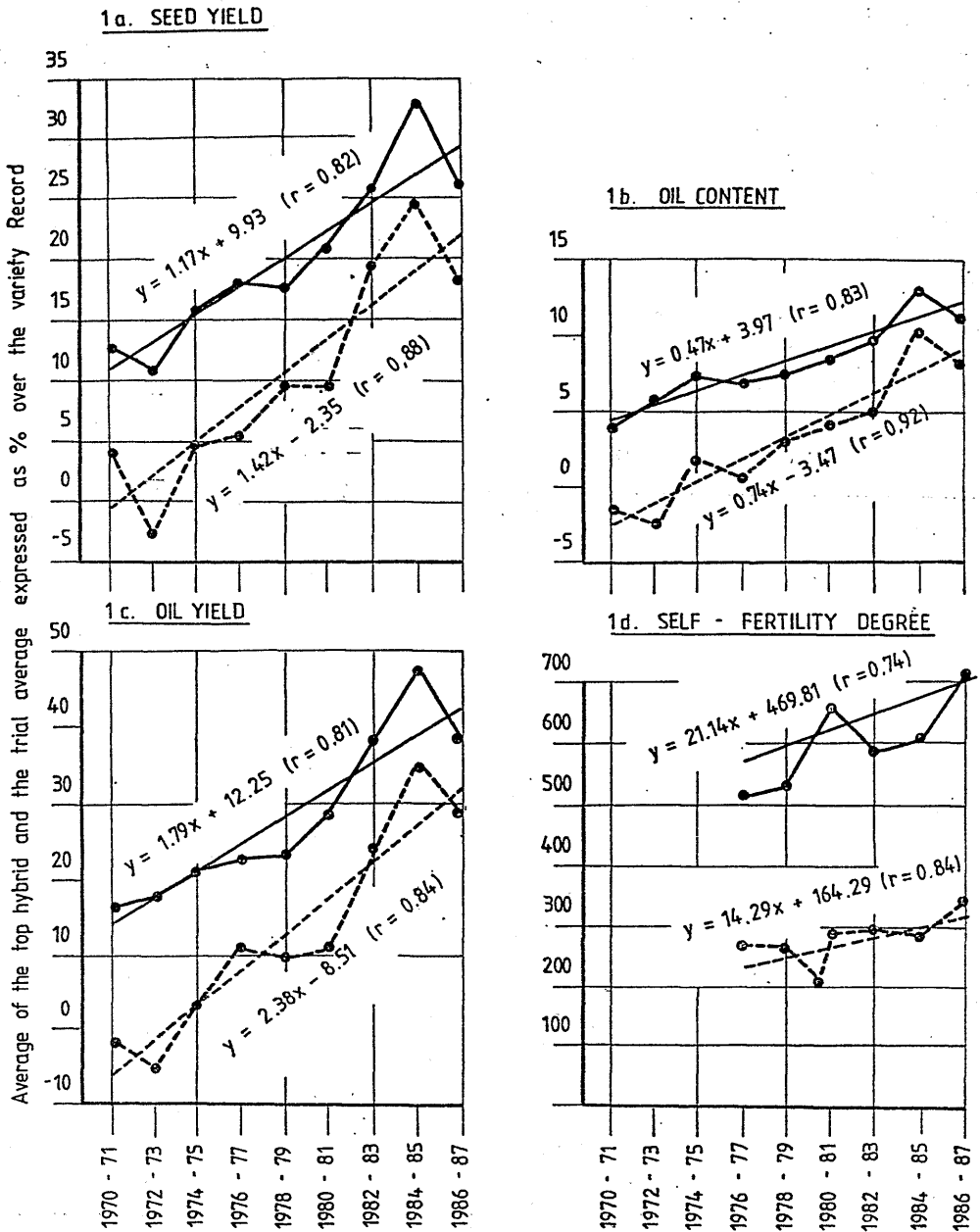


Fig. 1. Genetic contribution of sunflower hybrids to seed yield (a), oil content (b), oil yield (c) and self-fertility (d), expressed as percentage changes from the performances of the long-time check, evaluated in 9 biennial trials and 10 locations

Table 1

New Romanian competitive hybrids for the most important agronomical traits

Traits	Hybrids ^x
Seed yielding capacity (4800-5270 kg/ha)	Ro-157(SH), Ro-167 (TH), Ro-1213 (SH), Ro-1233(SH), Ro-1279 (SH), Ro-1293 (SH), Ro-1421 (SH), Festiv (TH)
Oil content in dry matter (54-56.3 %)	Ro-961 (SH), Ro-989 (SH), Ro-1212 (SH), Ro-1213 (SH), Ro-1219 (SH), Ro-1279(SH), Festiv (TH).
Vegetation period shorter than 100 days	Ro-886 (SH), Ro-1005 (SH), Ro-1216 (SH), Ro-1218 (SH), Ro-1271 (SH), Ro-1321(SH)
Stem height shorter than 100 cm	Ro-15 (SH), Ro-940 (SH), Ro-1155 (SH), Ro-1323 (SH), Ro-1414 (SH), Ro-1424 (SH)
Self-fertility degree higher than 70 %	Ro-55 (SH), Ro-70 (SH), Ro-931 (SH), Ro-1155 (SH), Ro-1197 (SH), Ro-1216 (SH), Ro-1279 (SH), Ro-1405 (SH), Ro-1422(SH), Ro-1423 (SH), Ro-1427 (SH)
Field resistance to Sclerotinia sclerotiorum	Ro-29 (TH), Ro-154 (TH), Ro-157 (TH), Ro-212 (SH), Ro-961 (SH), Ro-1004 (SH), Ro-1006 (SH), Festiv (TH).
Field resistance to Phomopsis helianthi	Ro-29 (TH), Ro-1256 (SH), Ro-1275 (SH), Ro-1293 (SH), Ro-1303 (SH), Ro-1425 (SH), Ro-1427 (SH), Ro-1429 (SH), Ro-1516(SH), Ro-1520 (SH), Ro-1528 (SH)
Field resistance to Sclerotium bataticola	Ro-131 (SH), Ro-940(SH), Ro-1197 (SH), Ro-1200 (SH), Ro-1213(SH), Ro-1228(SH), Ro-1405 (SH), Ro-1414(SH), Ro-1418(SH).
Field resistance to Puccinia helianthi	Ro-158 (SH), Ro-1227 (SH), Ro-1229 (SH), Ro-1429 (SH)
Resistance to the new races of Orobanche cumana	Ro-70 (SH), Ro-931(SH), Ro-1005 (SH), Ro-1218 (SH), Ro-1271 (SH), Ro-1279 (SH), Ro-1534 (SH), Ro-1547 (SH)

^xSH: single hybrid

TH: three-way hybrid

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Helia, No. 4, p. 23 - 28.

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