SUNFLOWER GENOTYPES WITH HIGH OLEIC ACID CONTENT

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ABSTRACT

A program for the introduction of „high oleic acid content" trait into sunflower lines with superior agronomic traits was initiated at A.R.D.I. Fundulea in 1998. Simultaneously, these genotypes were also selected for resistance to the main sunflower pathogens such as *Plasmopara halstedii*, *Sclerotinia sclerotiorum*, and *Phomopsis helianthi* as well as to *Orobanche cumana* parasite. Seven cytoplasmic male sterile and 5 pollen fertility restorer lines with oleic acid content ranging between 80.3% and 88.0% were obtained. The hybrids resulted by their crossing achieved an oleic acid content of 78.7% - 87.2%.

Key words: bio-fuels, disease resistance, oleic acid, sunflower hybrid.

INTRODUCTION

The sunflower oil quality is determined by the saturated and unsaturated fatty acid ratio. The sunflower oil is a high qualitative one, due to very high percentage of poly-unsaturated fatty acids which can reach 90% from the total (Kinman and Earle, 1964; Vrânceanu, 1974, 2000; Skoric, 1989; Schuster, 1993).

Among unsaturated fatty acids, the linoleic one is dominant in classical sunflower. There is an important genetic variation regarding the fatty acid composition of the sunflower oil (Cummins et al., 1967; Simpson and George, 1985).

In classical sunflower, the fatty acid composition is the following: saturated acids 11% (stearic, palmitic), oleic acid 20% and linoleic acid 69%. The oil obtained from the classical sunflower has a large utilization in nourishment: in cooking or as margarine.

The new market requirements regarding the product safety lead to the necessity of resistant oils to high temperatures, less saturated, which resist longer to oxidation. Solving this issue is possible through releasing new sunflower oil type, with low linoleic acid and with a high oleic acid content.

During the last years, the interest for the non-food utilization of sunflower oil has increased all over the world.

The European Parliament has approved the direction COM 2003/30/EC (EC 2003) for the replacement of 2% from the total oil quantity used as fuel with bio-fuels, till 2005, and of 5.75% till 2010.

The vegetable oils could be turned into bio-fuels by methyl-esterification. For this utilization, the oil with high oleic acid content, obtained from the new sunflower type has an increased potential.

The first oil source with high oleic acid content was obtained by Soldatov (1976), by chemical mutagenesis. On the basis of the obtained material, Soldatov released the cultivar Pervenet with an oleic acid content of 85-90%. From this cultivar, the American researchers at USDA-Fargo, North Dakota, have selected some inbreds with high oleic acid content utilized all over the world as genetic sources for this trait.

Regarding the genetic control of „high oleic acid content" trait, the researchers have put forward the hypothesis of three complementary dominant genes (Ol_1, Ol_2, Ol_3) or a dominant one (*O1*) (Miller et al., 1987; Fernandez-Martinez et al., 1988). The results obtained by Demurin et al. (1996) have shown that the *Ol* gene penetration into heterozygote ranges between 0 and 100, on different genetic backgrounds.

The pressure exerted by infections with different pathogens has a strong influence on yield performances, in sunflower genotypes with high oleic acid content (Pacureanu-Joita et al., 2000; Nagyne-Kutui et al., 2004).

A conversion program of some inbreds with high agronomical value into lines with high oleic acid content at A.R.D.I. Fundulea started in 1998. The paper presents some results obtained till present.

MATERIAL AND METHODS

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In order to incorporate the „high oleic acid content" trait into pure pollen fertility restorer and sterility maintainer lines, backcrossing method and selection of individual seeds by oleic acid analysis on half seed were used.

Two lines originated from the University of North Dakota (USA) and University of Pisa (Italy) were used as sources for high oleic acid content. The seeds were analyzed by gas-chromatograph and F_1 progenies with high oleic acid content were obtained. These lines were used as recurrent parent for lines with low oleic acid content. Five-six backcross and 2-3 self-pollination generations were performed.

In order to test the resistance to the main pathogens, artificial inoculations using the most efficient methods for each pathogen, including *Orobanche cumana*, were performed.

RESULTS AND DISCUSSION

Sunflower lines with superior agronomic traits and improved oil quality, having with 80-88% oleic acid content have been obtained by utilization of „donor" sources for „O_l" gene after 4-5 backcross and 1-2 self-pollination generations.

Table 1 presents 7 male sterile lines and 5 pollen fertility restorers with high oleic acid values. For each genotype, the generation when the analogous line with the highest oleic acid content was selected, is specified.

Table 1. The oleic acid content of several „high oleic" sunflower lines

No.	Genotype	Generation of selection	Oleic acid content (%)
1.	HO-842-1	$F_1 (BC_5)^2$	84.1
2.	HO-842-2	$F_1 (BC_5)^3$	88.0
3.	HO-804-1	$F_1 (BC_5)^2$	80.1
4.	HO-804-2	$F_1 (BC_6)^2$	83.4
5.	HO-850	$F_1 (BC_5)^3$	81.2
6.	HO-822	$F_1 (BC_5)^2$	86.4
7.	HO-837	$F_1 (BC_5)^2$	84.1
8.	HO-884-RF	$F_1 (BC_5)^2$	80.3
9.	HO-920-RF	$F_1 (BC_4)^2$	86.4
10.	HO-875-RF	$F_1 (BC_5)^2$	85.3
11.	HO-942-RF	$F_1 (BC_4)^2$	87.4
12.	HO-918-RF	$F_1 (BC_5)^2$	85.1

Simultaneously with the selection for high oleic acid content, selection for resistance to different pathogen and *Orobanche cumana* parasite was performed. By repeated testing, under both natural infection and artificial inoculation conditions the most resistant variants were selected, the results being presented in figures 1, 2, 3 and 4.

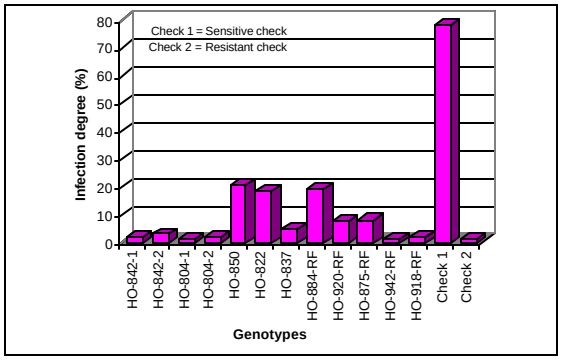

Figure 1. The resistance to the attack of *Phomopsis helianthi/Diaporthe helianthi*, under artificial inoculation conditions, for 12 „high oleic" sunflower genotypes

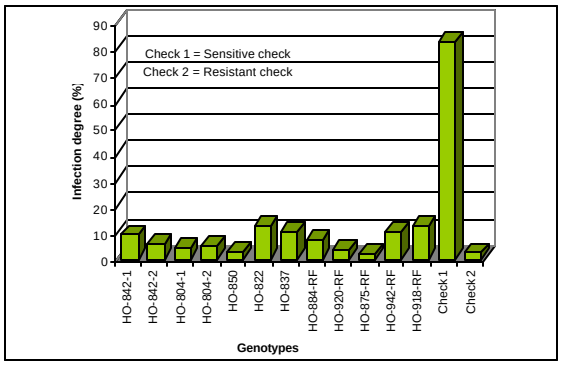

Figure 2. The resistance to the attack of *Sclerotinia sclerotiorum* under artificial inoculation conditions, for 12 „high oleic" sunflower genotypes

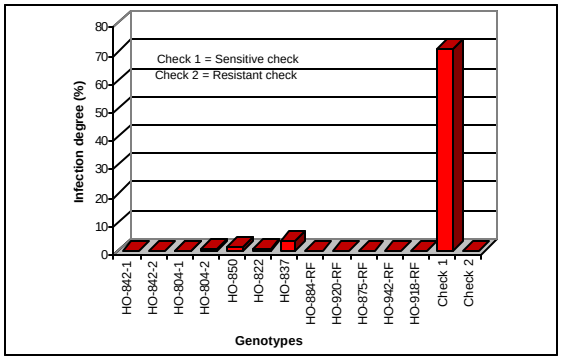

Figure 3. The resistance to the attack of *Plasmopara helianthi*, under artificial inoculation conditions, for 12 „high oleic" sunflower genotypes

Due to embryonic control of gametophyte and involved genes, for the „high oleic acid content" trait, the obtained hybrids have lower oleic acid content, because the F_1 seeds segregate into high, intermediary and low oleic acid levels. The average oleic acid content will be about 75-80%, or even lower.

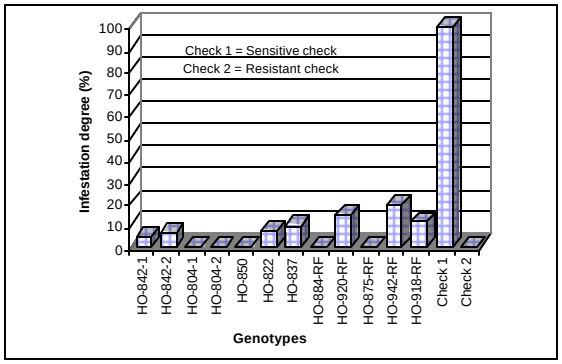

Figure 4. The resistance to the parasite *Orobanche cumana* under artificial inoculation conditions, for 12 „high oleic" sunflower genotypes

Table 2 presents the results regarding the seed yield, seed oil content and oleic acid content for the sunflower hybrids tested in competitive trials, some of them, being under official S.I.V.T.R. network testing for registration.

Table 2. Seed yield, oil and oleic acid content of new „high oleic" sunflower hybrids

No.	Hybrid	Seed yield (kg/ha)	Oil content (%)	Oleic acid content
1.	HO-842-1 x HO-875-RF	3254	51.7	80.4
2.	HO-842-1 x HO-942-RF	3742	52.9	81.7
3.	HO-842-1 x HO-918-RF	3420	53.7	84.2
4.	HO-842-1 x HO-920-RF	3455	50.2	83.8
5.	HO-842-2 x HO-875-RF	4015	50.2	83.7
6.	HO-842-2 x HO-942-RF	3944	52.1	79.7
7.	HO-842-2 x HO-918-RF	3422	49.4	83.0
8.	HO-842-2 x HO-920-RF	3920	51.7	84.1
9.	HO-804-1 x HO-875-RF	4145	51.3	80.2
10.	HO-804-1 x HO-942-RF	3394	52.9	81.4
11.	HO-804-1 x HO-918-RF	4020	53.8	83.3
12.	HO-804-1 x HO-920-RF	3740	50.4	80.0
13.	HO-804-2 x HO-875-RF	4132	51.0	87.4
14.	HO-804-2 x HO-942-RF	3220	52.8	85.3
15.	HO-804-2 x HO-918-RF	3752	49.0	84.7
16.	HO-804-2 x HO-920-RF	4125	51.9	87.2
17.	HO-850 x HO-875-RF	4015	52.3	80.9
18.	HO-850 x HO-942-RF	3744	50.2	78.7
19.	HO-850 x HO-918-RF	3390	54.3	80.1
20.	HO-850 x HO-920-RF	3455	54.7	81.2
LSD 5%		7.1	6.7	6.2

CONCLUSIONS

Several valuable cytoplasmic male sterile and pollen fertility restorer lines, with high oleic acid content were obtained at A.R.D.I. Fundulea.

Simultaneously with the increase in oleic acid content, the resistance to different pathogens and *Orobanche cumana* was improved.

The sunflower hybrids obtained from these lines presents high oleic acid content and a good resistance to diseases and could be successfully utilized as raw matter for bio-fuels.

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