

DURABLE RESISTANCE TO BROOMRAPE (*Orobanche cumana* Wallr. / *Orobanche cernua* Loeff.) IN SUNFLOWER

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Received: November 26, 1999

Accepted: July 17, 2000

SUMMARY

Six cultivars and one hybrid were evaluated for resistance to broomrape in the period 1988-1999. It was found that the resistance varied in the range from 0 to 100%. The evaluation was carried out under greenhouse conditions. Infestations were induced by mixed broomrape populations collected from different regions in Bulgaria. Different lines obtained from three cultivars, Progress, Oktjabr (Russia) and Vega (Bulgaria), and the hybrid Sorem 80 (Romania) showed stable resistance (80-100%) after ten years of evaluation, in spite of the occurrence and distribution of new races (D+E) of the parasite in Bulgaria.

Key words: resistance, evaluation, *Orobanche cumana*

INTRODUCTION

Since 1945, the parasite broomrape (*Orobanche cumana* Wallr./*Orobanche cernua* Loeff.) causes serious damage on sunflowers in Bulgaria (Buchvarova, 1978; Petrov, 1970). This is why the selection of cultivars and hybrids resistant to the parasite (B and R lines, respectively) has been of great importance for the sunflower production. To ensure success of the process of selection, it is absolutely necessary to find, evaluate and maintain resistant initial materials and the forms developed from these materials (Tzetkova and Shindrova, 1987). The expression and duration of resistance differs in the various sources of resistance to *Orobanche*. Interspecific hybrids, populations, varieties and mutants from countries around the Mediterranean and the Black Sea, where the parasite is widely dispersed, remain valuable sources of resistance (Alonso, 1998; Christov, 1996; Cubero, 1989; Encheva and Shindrova, 1993; Nikolova *et al.*, 1998; Sukno *et al.*, 1998).

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To be truly effective, resistance must be long lasting. Some sources possess a gene or genes that are easily overcome by the parasite, other sources are more durable. Durability depends to a large extent on the type of resistance source - cultivars and interspecific hybrids have been proven to be most reliable and long lasting. Evaluation of resistance to *Orobanche* should be a permanent process in order to ascertain how reliable the resistance of the various forms is.

The results presented in this paper are part of a study on the breeding and genetic aspects of resistance to *Orobanche*.

MATERIALS AND METHODS

Six Russian cultivars - Progress, Oktjabr, VNIIMK 1646, Jubileinii 60, Armavirskii 3497, one Bulgarian variety, Vega, and one Romanian hybrid, Sorem 80, were tested for reaction to broomrape in the period 1988-1990 at IWS, Bulgaria.

Different inbred lines, developed from three varieties, Progress, Oktjabr and Vega, and the hybrid Sorem 80 were evaluated for resistance durability from 1990 to 1999, using the method of Panchenko (1975). Thirty seeds were evaluated per each source and inbred tested, and at least fifty seeds of the F₁ crosses with the susceptible line 2607 were tested in greenhouse. The ratio unattacked/attacked plants was used as the criterion for resistance rating.

The inbred lines (I₁-I₇) were made by conventional breeding methods. To check the inheritance of resistance, F₁ crosses between the susceptible line 2607 and resistant lines were produced and evaluated.

RESULTS AND DISCUSSION

The results of the evaluation of the resistance sources are shown in Table 1. The varieties Progress, Oktjabr and Vega and the hybrid Sorem 80 were 100% resistant, whereas the varieties VNIIMK 1646, Jubileinii 60 and Armavirskii 3497 exhibited 80 to 90% resistance.

Table 1: Reaction of different sources to *Orobanche cumana* 1988-1990

Source	Type	Country of origin	% of resistance	Seed oil content %
Vega	cultivar	Bulgaria	100	46.2
Progress	cultivar	Russia	100	44.5
Oktjabr	cultivar	Russia	100	45.9
VNIIMK 1646	cultivar	Russia	90	46.9
Jubileinii 60	cultivar	Russia	80	45.1
Armavirskii 3497	cultivar	Russia	80	45.0
Sorem 80	hybrid	Romania	100	45.1

The Russian varieties had been developed before 1970, when only A and B races had been present in Bulgaria. The Bulgarian variety Vega was developed in

the period 1975-1990, as well as the hybrid Sorem 80. The Russian varieties were not expected to express such a high level of resistance, because of the dispersal of the races D+ E in Bulgaria (Encheva and Shindrova, 1993).

Inbred lines started to be developed in 1989 (Table 2). In the early stages of inbreeding, the resistance varied from 80 to 100%. The lowest variation in resistance was observed in the progenies of Progress and Vega, the highest in those of Oktjabr. After I₅, the resistance was stabilized in all progenies. In fact, the generations I₂ to I₄ were in the most critical situation (1990-1993), when the new races D and E expanded very rapidly.

Table 2: Reaction of sunflower inbred lines (I₁-I₇) to *Orobanche cumana* 1989-1998

Line	Origin	Resistance %						
		I ₁	I ₂	I ₃	I ₄	I ₅	I ₆	I ₇
L Pr 1 to 7 ^R	Progress	90-100	94-100	95-100	90-100	100	100	100
L Ok 1 to 9 ^R	Oktjabr	89-100	90-100	80-100	89-100	100	100	100
L V 1 to 21 ^B	Vega	98-100	95-100	95-100	95-100	100	100	100
L Sor 1 to 5 ^R	Sorem 80	80-95	90-100	80-100	87-100	100	100	100

^R - restorers of fertility

^B - normal cytoplasm

The lines listed in Table 2 expressed high resistance, with some fluctuations in the course of their development. After I₄, the resistance was stabilized. F₁ crosses between the susceptible line 2607 and some resistant lines were made in I₆ and I₇. The aim was to check the inheritance of resistance to *Orobanche* (Table 3). The resistance was inherited dominantly in all the crosses. The resistance seems to be controlled by a single dominant gene. This will be clarified after self-pollination in the F₂ generation.

Table 3: Reaction to *Orobanche cumana* in F₁ crosses between susceptible and resistant lines (I₆-I₇)

Cross	Generation	Resistance %	
		1997	1998
2607	check	0	0
L V-6	I ₆	100	100
2607 x L V-6	F ₁	-	100
L V-11	I ₆	100	100
2607 x L V-11	F ₁	100	100
L V-13	I ₆	100	100
2607 x L V-13	F ₁	100	100
L Sor-1	I ₇	100	100
2607 x L Sor-1	F ₁	100	-
L Pr-5	I ₇	100	100
2607 x L Pr-5	F ₁	100	-
L Ok-1	I ₇	100	100
2607 x L Ok-1	F ₁	100	-

CONCLUSIONS

The Russian varieties Progress and Oktjabr and the Bulgarian variety Vega are still reliable sources of genes for resistance to *Orobanche*. The inbred lines obtained from these sources possess stable resistance, which is inherited dominantly. As this resistance comes from the sources developed 20-30 years ago, it may be concluded that it proved its durability.

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RESISTENCIA CONSTANTE A LA OROBANCA (*Orobancha cumana* Wallr./*Orobancha cernua* Loebl.) EN EL GIRASOL

RESUMEN

Seis variedades y un híbrido eran apreciados por la resistencia a la orobanca en el periodo 1988-1999. Fue constatado que la resistencia variaba de 0 a 100%. La apreciación fue realizada en las condiciones de invernáculo. La infección era hecha por las poblaciones mixtas de parásitos, colectadas en diversas partes de Bulgaria. Las líneas obtenidas de tres variedades - Progres y Oktjabr (Rusia) y Vege (Bulgaria), así como el híbrido Sorem 80 (Rumania) mostraron la resistencia estable (80-100%) después de diez años de investigación, sin consideración de la aparición y extensión de nuevas razas de parásitos (D+E) en Bulgaria.

RÉSISTANCE DURABLE À L'OROBANCHE (*Orobancha cumana* Wallr./*Orobancha cernua* Loebl.) CHEZ LE TOURNESOL

RÉSUMÉ

Entre 1988 et 1999, six sortes et un hybride ont été évalués pour leur résistance à l'orobanche. Il a été établi que la résistance variait sur une échelle de 0 à 100 %. L'évaluation a été faite dans des conditions de serre. La contamination a été faite par des populations mixtes de parasites recueillies dans différentes régions de Bulgarie. Les lignes obtenues de trois sortes - Progres et Oktjabra (Russie) et Vege (Bulgarie) ainsi que l'hybride Sorem 80 (Roumanie) ont montré une résistance stable de 80 - 100% après dix ans d'examen, malgré l'apparition et la propagation de nouvelles races de parasites (D+E) en Bulgarie.

