THE ATTACK OF THE *OROBANCHE CUMANA* WALLR. AND IT'S INFLUENCE ON A DIFFERENTIAL SUNFLOWER HOST ASSORTMENT UNDER DOBROGEA CONDITIONS

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Abstract: *Broomrape (Orobanche cumana Wallr.) is the most important parasite of the sunflower crops in the South-East of Romania and is especially spread over Constanta, Tulcea, Ialomita, Braila, Buzau and Calarasi counties where this parasite recorded the most severe attacks. In the last years the parasite became more aggressive for the sunflower crops, with a tendency of spreading toward the adiacent zones of this area and to the west of the country. The broomrape's virulence increased significantly in the last two decades due to a short crop rotation and the use of non-resistant sunflower hybrids, causing a loss of yield and oil production. Experiments for testing Orobanche cumana Wallr. infestation were carried out in 2011 in fields with sunflower monoculture at ARDS Valu lui Traian, Constanta county, and also in open fields of Orobanche at ARDS Valu lui Traian to determine seed and oil production in conditions without infestation. We identified races more aggressive than race E, as the hybrid Favorit (race F resistant) showed infestation. We also identified some populations more aggressive than the race G, but these new populations were present with a lower frequency; the attack degree of the hybrid PR64E71 had very low values, without a negative influence on the yield. The yield losses reported for the hybrid Performer (without resistance genes) were up to 19%. Hybrids with genetic resistance to race F (Favorit) and to races more aggressive than race F (PR64E714) can be successfully cultivated in Dobrogea.*

Key words: *orobanche cumana, sunflower, attack degree, dobrogea conditions*

INTRODUCTION

The parasite *Orobanche cumana* Wallr. lives attached on the sunflower's root system and it can cause severe damages that can reach up to 90% depending on the virulence of the populations and physiological races of the parasite in the area cultivated with sunflower and on the attack's intensity (number of broomrape plants formed on one sunflower plant) (VRÂNCEANU, 2000).

Broomrape was described for the first time in Russia at the end of the 19th century. From the southern regions of Russia and Ukraine, the broomrape extended in the same time with the sunflower crops in the other riverside countries, Romania, Bulgaria and Turkey (VRÂNCEANU, 2000).

In Romania, the parasite was seen for the first time in the sunflower crops in 1940-1941 by SĂVULESCU et al. (1928-1960), quoted by DUMITRAŞ and ŞESAN (1988). The highest frequency and intensity of the broomrapes attack is found in the central and southern area of Moldova, in Dobrogea and in the east of Câmpia Bărăganului.

VRÂNCEANU et al. (1980) identified five pathogenic races named A through E with a set of sunflower differentials carrying the dominant resistance genes Or_1 through Or_5, which provide cumulative resistance to the five successive races.

In 1998, PĂCUREANU-Joița et al (1998) reported the race F and also the corresponding resistance gene Or_6 present in the differential line LC-1093.

The research carried out by PĂCUREANU et al. (2009) identified the race G in some experiments in the South - East of the country, using a differential host assortment made up of

inbred lines and commercial hybrids available in Romania and presented by the authors as being resistant to *Orobanche* races more aggressive than race E.

The aim of the study was to identify the broomrape species populations (*Orobanche cumana* Wallr.) in Dobrogea area, the parasite population virulence and their influence on yield under conditions of moderate and high natural infestation. The results are intended to offer the farmers information regarding sunflower hybrids zoning in Dobrogea.

MATERIAL AND METHODS

The testing methodology consisted in using a differential host assortment to indentify broomrape species structure and their virulence, the assortment consisting of sunflower hybrids with known reaction against *Orobanche cumana* Wallr. parasite. The hybrids that were used are commercial ones and were described by the producers regarding the reaction to the parasite published in trade catalogs or existing data in literature. Research concerning broomrape species (*Orobanche cumana* Wallr.) was conducted in fields with natural infestation at ARDS Valu lui Traian, Constanta County. Research regarding the parasite influence on seed and oil production was conducted at ARDS Valu lui Traian in sunflower monoculture fields for testing the reaction to *Orobanche cumana* Wallr. and also in open field with broomrape at ARDS Valu lui Traian.

The differential host assortment consisted of 4 hybrids mentioned below:

Variant 1- Performer – without resistance genes (NARDI Fundulea);

Variant 2 – PR64A89 – resistant to race E (Pioneer Hi-Bred Seeds Agro Romania, 2008 seed catalog);

Variant 3 – Favorit – resistant to race F (NARDI Fundulea);

Variant 4 – PR64E71 – resistant to race F+ (Păcureanu et al., 2009; Pioneer Hi-Bred Seeds Agro Romania, 2009 seed catalog).

The variant without resistance to *Orobanche cumana* Wallr., the hybrid Performer, was additionally included as sensitivity control to verify the uniformity of infestation in the experimental field.

The trial design was randomized blocks and plant population was 48.500 pl./hectare.

The study regarding the parasite influence on seed and oil production was carried out in 2011 at ARDS Valu lui Traian in the following manner: 3 replications; 2 rows/plot; 5 m plot length; 17 plants/row; 2 harvested rows; 7 square meters sown area/plot; 6.58 square meters harvested area/plot. The harvested seed weight of the plot was calculated under conditions of infestation at Valu lui Traian and was compared to that obtained under conditions of free infestation at Valu lui Traian.

During the vegetation period, observations were made regarding the evolution of the parasite and the hybrids' reaction to its attack. The frequency, the intensity and the attack degree at the end of flowering and before harvest, was determined by counting the parasite on each plant. The number of sunflower plants per plot, the plant height, the head diameter, the percent of empty seeds, the thousand kernel weight, the hectolitrical weight, the number of plants attacked by broomrape, the average number of broomrape stalks per host plant, the production per plot at harvest and the kernel oil content were recorded.

RESULTS AND DISCUSSIONS

The precision of the research results regarding the parasite-host plant system studied in conditions of natural infestation depends on the uniformity of the experimental field infestation and on the studied genetic material. The experimental results were obtained in 2011 at ARDS Valu lui Traian Constanta County. All the tested hybrids presented different levels of infestation with broomrape. The race structure was evaluated depending on the hybrids'

reaction from a differential host assortment. The results regarding the parasites frequency, intensity, the attack degree and the average yield reduction are presented in table 1 and figures 1, 2 and 3.

Table 1

Results on the identification of *Orobanche cumana* Wallr. populations in 2011 at Valu lui Traian

Year	*Orobanche cumana* Wallr. race	Experimental variants – resistant genes	Frequency = [(no. of infested sunflower plants/total no. of plants) x 100]	Intensity = (no. of *Orobanche* plants/no of infested sunflower plants)	Attack degree = [(F x I) / 100] (%)	Average yield reduction (%)
2011	A, B, C, D, E, F, G	V_1 – Performer - without resistance genes	96%	2.3	2.3	16
2011	E, F	V_2 – PR64A89 - gene for race E	43%	0.7	0.6	3
2011	F, G	V_3 –Favorit - gene for race F	14%	0.2	0.03	0
2011	G, G+	V_4 – PR64E71 - gene for race F+	**6%**	**0.06**	**0.005**	**0**
2011	A, B, C, D, E, F, G	Ctrl– Performer - without resistance genes	100%	3.3	3.3	19

In the experimental year 2011, at Valu lui Traian Constanta County, all the tested hybrids presented different levels of infestation, depending on the resistance genes of the differential host assortment used for the identification of the broomrape races in the experimental field. The hybrid Performer, without resistance genes, presented the highest attack degree, of 2.3% and a yield reduction of 16%, being the most affected hybrid by the broomrape s attack. The same hybrid, Performer, which was used as a control in order to observe the infestation uniformity in the experimental field, had an attack degree of 3.3% and a yield reduction of 19%.

Table 2

Explanations on the identification of broomrape races in the experimental fields

Differential host	Possible situations	Race identification
Hybrid without resistance genes	heavily infested, does not reach blooming	Race above E
Hybrid resistant to race E	heavily infested, blooms but the sunflower plants remain small, affected	Race F
Hybrid resistant to race F	average infestation, the yield is only affected a little, not significant	Race G
Hybrid resistant to race G (Păcureanu et al., 2009)	weakly infested, without influence on yield	Population more virulent than race G

The hybrid PR64A89, resistant to race E, recorded lower values of frequency, intensity and attack degree than the control. The attack degree had values of 0.6% and a yield reduction of 3%.

The hybrid Favorit, having resistance gene for race F, had the attack degree 0.03% in 2011 at Valu lui Traian, without influence on yield. It was identified race G of broomrape.

Very low insignificant values were recorded in the hybrid PR64E71, for the frequency, the intensity and the attack degree, without influence on yield. At Valu lui Traian

the attack degre of 0.005% in 2011 (Table 1). The hybrid is resistant to race G (PĂCUREANU et al., 2009) and according to the commercial catalog of Pioneer Hi-Bred Agro SRL Romania 2009 Company is described as being resistant to *Orobanche* races that are more aggressive than the race E. The infestation at Valu lui Traian enables us to conclude that in Dobrogea a physiological race of broomrape that is more aggressive than race G exists (Table 2), but the cultivation of hybrids with the corresponding resistant gene can prevent the yield losses.

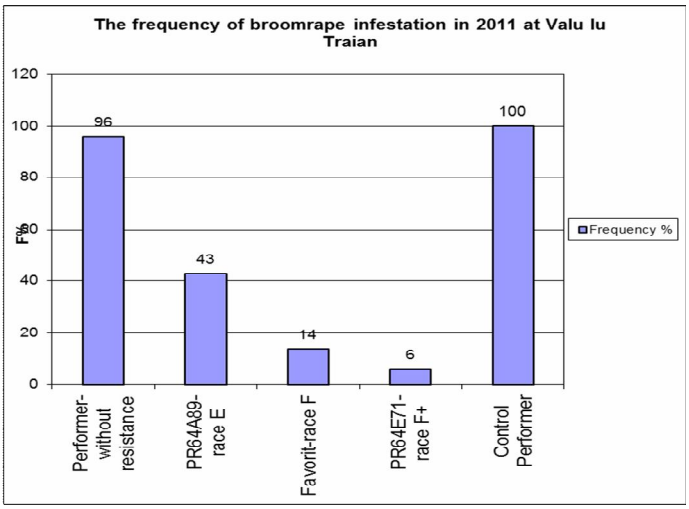

Figure 1. The frequency of broomrape infestation in 2011 at Valu lui Traian

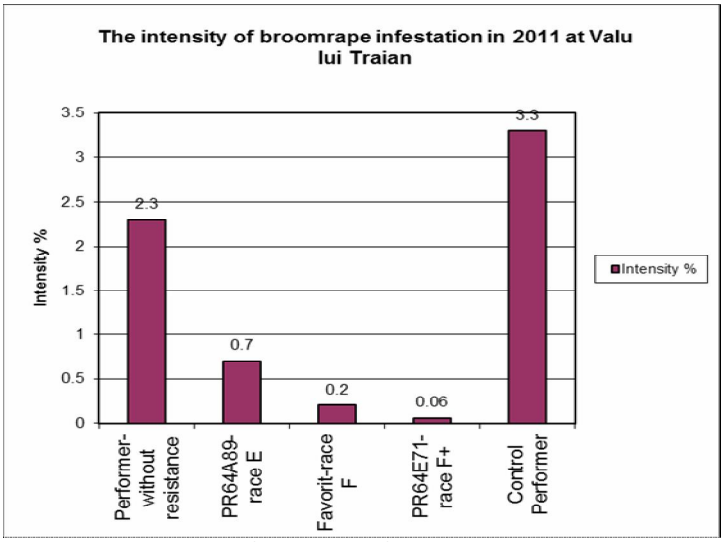

Figure 2. The intensity of broomrape infestation in 2011 at Valu lui Traian

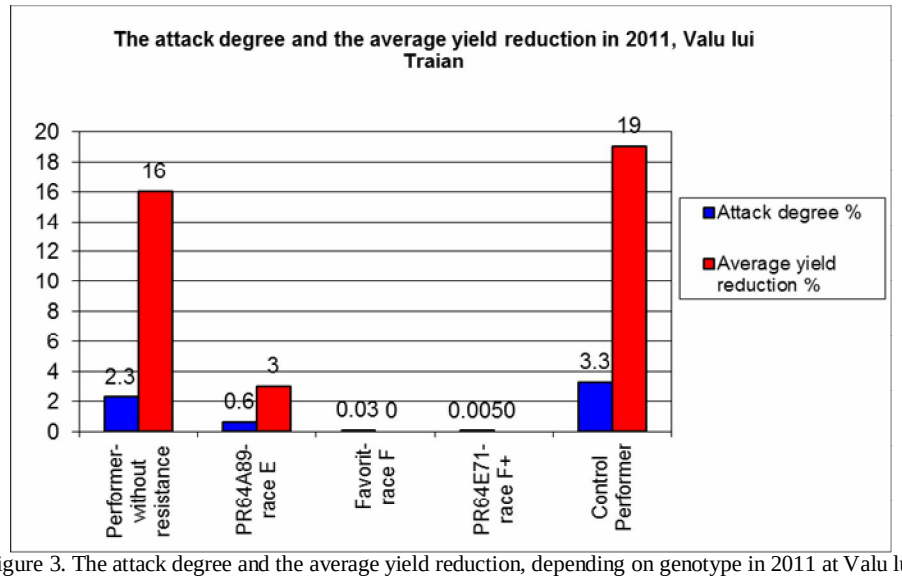

Figure 3. The attack degree and the average yield reduction, depending on genotype in 2011 at Valu lui Traian

The yields registered by the sunflower hybrids (figure 4, table 4) related to the frequency of the broomrape infestation show that the more the hybrids are infested, the smaller yields they recorded.

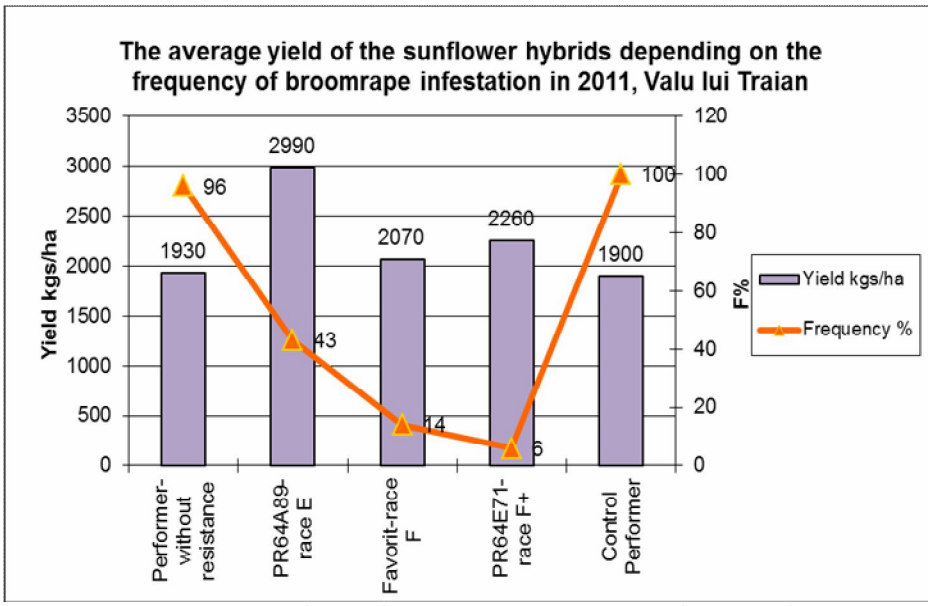

Figure 4. The average yield of the sunflower hybrids depending on the frequency of broomrape infestation in 2011 at Valu lui Traian

Table 3

The influence of the broomrapes attack on the yield and on some morfo-physiologycal characteristics of the sunflower hybrids

Experimental variants – resistant genes	*Orobanche cumana* Wallr. race	Yield (kgs/ha)	HW (kgs/hl)	TKW (g)	Plant height (cm)	Head diameter (cm)
V_1 – Performer - without resistance genes	A, B, C, D, E, F, G	1930	34	57,4	142	20
V_2 – PR64A89 - gene for race E	E, F	2990	37,1	50,3	138	20,3
V_3 –Favorit - gene for race F	F, G	2070	33,5	48,6	131	19,6
V_4 – PR64E71 - gene for race F+	G, G+	2260	33,8	41,9	143	21,3
Ctrl– Performer - without resistance genes	A, B, C, D, E, F, G	1970	32,7	52,5	141	19

CONCLUSIONS

The identification of physiological races of the *Orobanche cumana* Wallr. parasite was done by using a differential host assortment that consisted of sunflower hybrids: Performer, PR64A89, Favorit and PR64E71. These hybrids have different genes resistant to the parasite: without resistance genes, resistance to race E, resistant to race F and resistant to race G respectively. The assortment was established based on literature data and descriptions of seed trade catalogs.

The study proved that the parasite is present in the territory in „hearth" of infestation, the structure of *Orobanche cumana* Wallr. populations being more aggressive than race E, a race stable until the year 2000.

We identified races more aggressive than race E, as the hybrid Favorit (race F resistant) showed infestation. We also identified some populations more aggressive than the race G, but these new populations were present with a lower frequency; the attack degree of the hybrid PR64E71 had very low values, without a negative influence on the yield. The yield losses reported for the hybrid Performer (without resistance genes) were up to 19%. Hybrids with genetic resistance to race F (Favorit) and to races more aggressive than race F (PR64E714) can be successfully cultivated in Dobrogea. The experimental results can improve the zoning sunflower hybrids in Dobrogea area so the farmers should use sunflower hybrids with the corresponding resistance gene.

The results precision depends on the structure of the differential host assortment that is used to cover the whole spectrum of the parasite as completely as possible, and also on the homogeneity of infestation with *Orobanche cumana* Wallr. in the experimental field where the identification of physiological races is done.

ACKNOWLEDGEMENTS

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