BROOMRAPE (*OROBANCHE CUMANA* WALLR.), THE MOST IMPORTANT PARASITE IN SUNFLOWER CROP IN ROMANIA

Luxiţa RÎŞNOVEANU[1], Maria JOIŢA-PĂCUREANU[2], Florin Gabriel ANTON[2]

e-mail: luxita_risnoveanu@yahoo.co.uk

Abstract

Broomrape (*Orobanche cumana* Wallr.) is a parasitic angiosperm that has been causing a great deal of damage to sunflower production for more than a century. There has been a constant tug-of-war between sunflower breeders and *Orobanche cumana*, with frequent changes in which side has the upper hand. Almost as soon as the breeders find a source of resistance to the latest race of the parasite, broomrape responds by evolving another virulent race. Russian researchers identified the first two races of this parasite (A and B), after that, being identified other four races (C, D, E and F) as well as the sunflower differentials carrying the dominant genes for resistance, by the researchers in Romania and Spain. In the last years, some authors have communicated the appearance of the new, very virulent populations of broomrape, in different regions cultivated with sunflower, over the world.

Sunflower selection for broomrape resistance makes use of different methods for testing breeding materials (in the field or in greenhouse), looks for resistance sources and has so far produced significant results. Dominant genes for resistance to races A, B, C, D, E and F have been found and incorporated into cultivated sunflower genotypes. The resistant hybrids having resistance to the broomrape populations more virulent than race F have been produced by incorporating genes of resistance, coming specially from wild *Helianthus* species.

The aim of our investigation was to compare the virulence of broomrape samples collected in different areas cultivated with sunflower and infested with broomrape, from Romania. The same, we studied the dissemination of these populations in time and territory, in relation with different sunflower resistant genotypes. It was evaluated the influence of the parasite populations on the sunflower hybrids seed yield.

Ten populations of broomrape collected from different locations in Romania have been used in the artificial infestation conditions, for establishing the presence of different broomrape (*Orobanche cumana* Wallr.) races in these areas. The broomrape samples were stored in saved conditions and used for artificial infestation in the green house and phytotron. There have been tested sunflower differentials for the broomrape races until the sixth one and, different hybrids with different resistance to the newest virulent populations of the parasite.

Results of evaluation of sunflower differentials for different races or populations of the parasite *Orobanche cumana* have demonstrated that in Romania, the three more spread broomrape populations in the largest area cultivated with sunflower, are very different regarding the virulence and dissemination of the parasite.

The influence of the parasite on sunflower seed yield was very high, depending by the hybrid type of resistance.

Key words: sunflower, broomrape, races, resistant genotypes

Sunflower is one of the most important annual oilseed crops in the world. *Orobanche cumana* Wallr. (sunflower broomrape), a holoparasitic angiosperm plant that infects sunflower roots, is regarded as one of the main constraints on sunflower production in Southern Europe, Spain, Black Sea region, Ukraine, China and the Middle East (Molinero-Ruiz *et al*, 2015).

According to Morozov (1947), the first reports of broomrape in sunflower came from Saratov in Russia and date back to the 1890s expanding to Moldova and Romania by the beginning of 20th century (Iliescu, 1974). Morozov (1947) mentions that it was identified the first race of broomrape (race A) in the breeding station of Saratov area (communicated by Placek, 1918) and the second race (B), communicated by Zdanov (1926), in Rostov area.

Soon, after being discovered the two races of the parasite, it was developed a number of sunflower varieties resistant to them. Later on, a new race that could not be controlled by the genes for resistance to races A and B was identified in Moldova by Sharova (1968). Through genetic research, Vranceanu *et al* (1980) established that there were five broomrape races (A, B, C, D, E) in Romania and identified dominant genes controlling resistance to them. They also identified a set of

[1] „Dunarea de Jos" University, Galati
[2] Agricultural Research and Development Institute, Fundulea

differential lines that had cumulative resistance to the five successive races, conferred by the dominant genes *Or1*, *Or2*, *Or3*, *Or4* and *Or5*, respectively. Alonso et al. (1996) found a new, virulent race (race F) of the parasite, in Spain. The race F was found in Romania too, being identified and the dominant gene *Or6* in the inbred line LC 1093, which confers resistance to this race (Pacureanu-Joita, 1998). Changes of the broomrape race composition in Romania have been reviewed (Pacureanu-Joita *et al*, 2009). The findings of the study show that a new virulent population of the parasite has appeared in the country, started with 2006 year.

The aim of our investigation was to compare the virulence of broomrape samples collected in different areas cultivated with sunflower and infested with broomrape, from Romania. The same, we studied the dissemination of these populations in time and territory, in relation with different sunflower resistant genotypes.

MATERIAL AND METHOD

Ten broomrape populations collected from different fields cultivated with sunflower, in Romania have been studied in the artificial infestation conditions, in the greenhouse or in phytotron. The seeds collected in 2012, 2013, 2014 and 2015 years were stored in refrigerator at the temperature of four degree.

In the experiments for the broomrape virulence evaluation there have been used the differential lines for the races D (S-1358 line), E (P-1380 line) and F (LC 1093), as well as some hybrids resistant to the new populations of the parasite. It was used as check for sensitivity the inbred line AD-66. These hybrids have been tested before, in the natural infested fields in Romania, In Turkey or in Spain.

Some experiments have been done in field conditions, some others in the artificial infestation conditions.

Broomrape tests in the artificial infestation conditions were performed using two methods. For test in phytotron wooden cases 1.0x0.5x0.01 m in size, have been used, in which a soil-sand mixture (50:50) is laid, this being thoroughly mixed with 5 g broomrape seeds and 500 g sand. In this case 9 sunflower rows are sown, 10 cm apart. Starting with 26 days from emergence, plants can be removed, in order to note occurrence or absence of broomrape attack on sunflower plant roots. In the greenhouse, vegetation pots of 10 l in capacity have been used, and a homogenous mixture of earth, sand and broomrape seeds is poured inside, infestation being carried out with 0.5 g broomrape seeds, mixed with sand (1:9). The broomrape attack was noted after sunflower blossoming, when broomrape plants appear on soil surface. The attack degree was calculated using McKinney formula (quoted by Acimovic, 1979).

RESULTS AND DISCUSSIONS

The parasite *Orobanche cumana* has developped very fast, new virulent populations in sunflower crop in Romania. So, in the last 10 years, there have been identified two or three new races of the parasite (*figure 1*). We named these races G and H, taking into consideration their virulence but, there are not differential lines for these races, the inheritance of resistance to these races being more complicate, comparing with races A to F.

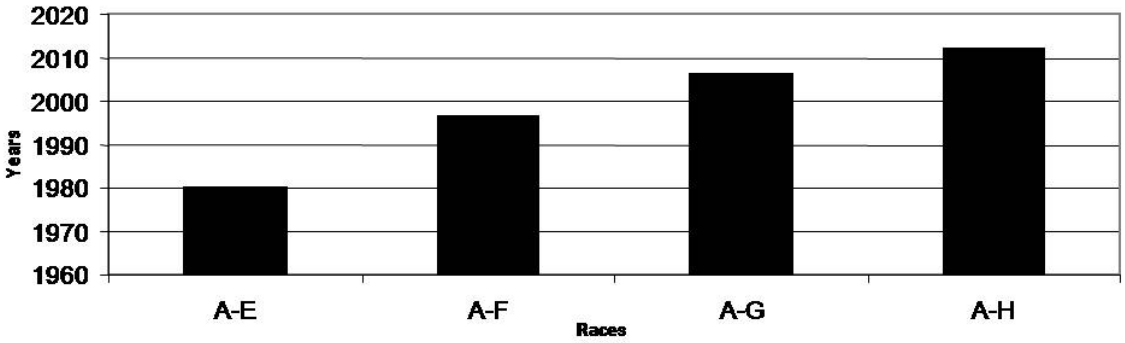

Figure 1 **The evolution of broomrape (*Orobanche cumana*) parasite races, in sunflower crop, in Romania**

Ten populations of broomrape (*Orobanche cumana* Wallr.), collected from different areas are presented in *table 1*. The seeds have been collected in different four years.

These populations have been used for testing in the artificial infestation condition, using differential lines for different broomrape races.

Table 1

The broomrape populations collected from different infested fields, in different years

Area	Location	Year
Braila 1	Valea Canepii	2013; 2015
Braila 2	Scarlatesti	2013;2015
Braila 3	Tufesti	2013;2015
Constanta 1	Cuza Voda	2012;2014
Constanta 2	Stupina	2013, 2015
Constanta 3	Pantelimon-Gradina	2012; 2015
Tulcea 1	Topolog	2013;2015
Tulcea 2	Traianu	2012;2015
Ialomita 1	Baraganu	2012;2014
Ialomita 2	Iazu	2013;2015

The results presented in the *figure 2* are showing that the differential line for the race E of the parasite (line P-1380) was attacked by all broomrape populations used in this experiment. The attack degree on this line was higher in case of source of broomrape Braila 3, as well as Tulcea 2 and Ialomita 2. The differential line for the race F (line LC 1093) was not attacked in Braila 3 and Ialomita 2, having a very low attack degree in Tulcea 2 and Ialomita 1 locations. The higher attack of the parasite on this line is in case of Braila 1 and Constanta 2 locations. This it means that the new virulent population of the parasite is still not present in two locations and it has low attack (below 10%) in three locations.

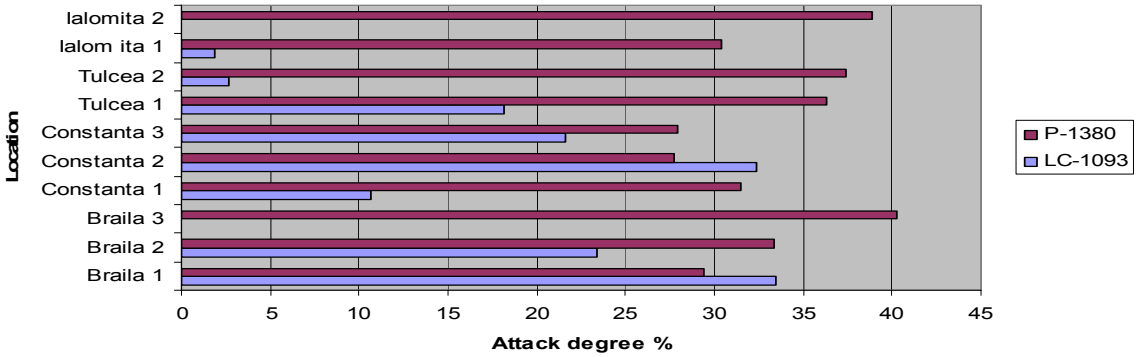

Figure 2 **Attack degree of ten populations of broomrape (*Orobanche cumana*) on the differential lines for the races E and F of the parasite**

Taking into consideration these results, it was made a study of these ten populations of broomrape, using the differential line for the race D of the parasite. The results presented in *figure 3* show that this line was attacked in all cases, the attack degree being not so high comparing with the check for sensitivity. The hybrid PR644LE19, which is known as resistant to the race E of the parasite, was attacked, the attack degree being lower in two locations, Braila 3 and Ialomita 2.

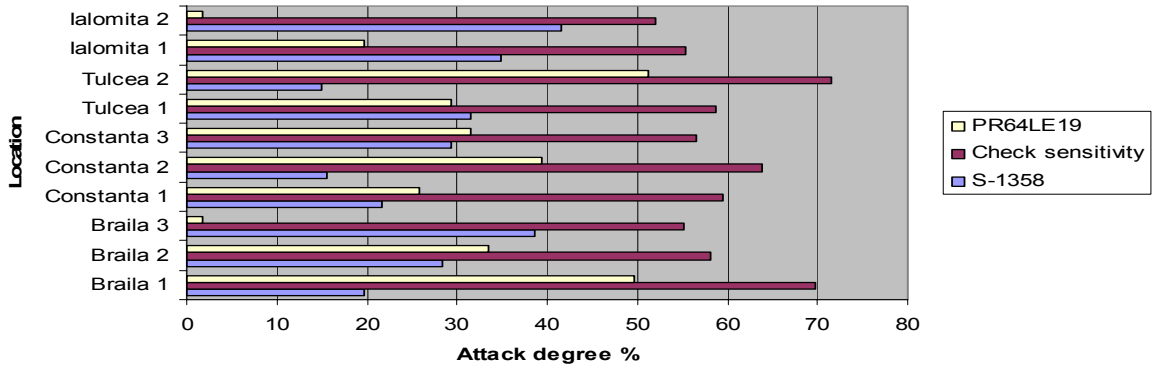

Figure 3 **Attack degree of ten populations of broomrape (*Orobanche cumana*) on the differential line for the race D of the parasite**

In *figure 4* are presented results regarding the behavior of the hybrids Favorit (resistant to race F) and PR64LE20 (resistant to race G) to the attack of the ten populations of broomrape parasite. The hybrid Favorite was not attacked in case of tow populations: Braila 3 and Ialomita 2. The attack degree on this hybrid is high, taking into consideration that some years ago this hybrid was full resistant in all areas infested with broomrape in Romania. The hybrid PR64LE20 is full resistant in three locations (Braila 3, Ialomita 1 and Ialomita 2), having a low attack degree (below 10%) in other 4 locations. The highest attack of broomrape on this hybrid was in Braila 3 location. This it means that the new race, overcoming the resistance to race G is present in all locations were this hybrid was attacked.

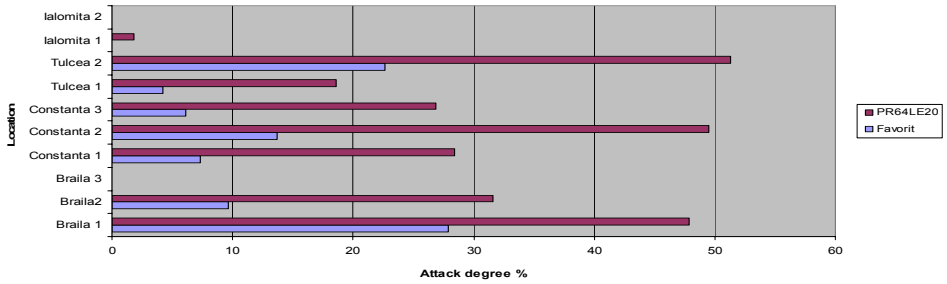

Figure 4 **Attack degree of ten populations of broomrape on the two hybrids resistant to the races F**

In *figure 5* are presented the results regarding the seed yield released by the hybrids Favorit and PR64LE20, in six locations from the four areas infested with broomrape, in year 2015. These are showing that in locations (Tufesti-Braila and Iazu-Ialomita) were the new races of the parasite are not still present, the two hybrids have released good seed yield. In locations as Valea Canepii-Braila and Stupina- Constanta, were the infestation degree with the new races is high there is a big difference between these two hybrids, regarding the seed yield. This it means that in these areas were the new races of the parasite have been spread in the last years must to be cultivated sunflower hybrids resistant to them.

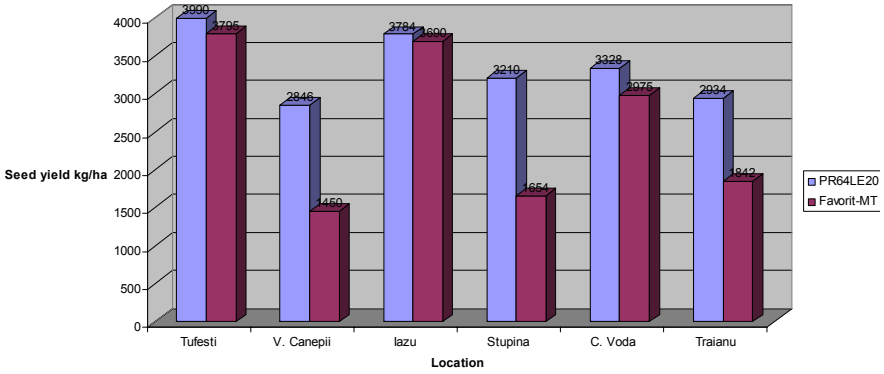

Figure 5 **Realized seed yield for the hybrids Favorit and PR64LE20, in six locations in Romania, in 2015 year**

CONCLUSIONS

Parasite broomrape (*Orobanche Cumana*) has developed in the last years, new virulence in sunflower crop in Romania. These new races have overcome the resistance of the hybrids which have been resistant to the race F of the parasite. The new virulent populations of the parasite are different in some areas like Braila, Tulcea or Constanta. In Ialomita area the new races are not still present. There is a high difference between the seed yield released by the hybrids having resistance to the race F, respectively to the race G, in the areas with high infestation of the parasite.

REFERENCES

Acimovic, M. 1979. *Evaluation procedures for the intensity of disease occurrence in sunflower*. Helia, 2, 55-57.

Alonso, L.C., Fernandez-Escobar, J., Lopez, G.Rodriguez-Ojeda, M. and Sallago, F. 1996. *New highly virulent sunflower broomrape (Orobanche cernua Loefl.) pathotype in Spain.* In: M. Moreno, J. Cubero, D. Berner, D. Joel, L. Musselman, and C. Parker (Eds), Advances in Parasitic Plant Research. Proc. 6th Int. Symp. Parasitic Weeds. Cordoba, Spain, 16-18 April 1996. pp. 639-644.

Iliescu H., 1974. *Boli*. In : Vrânceanu, A.V., 1974, *Floarea-soarelui*,Ed.Academiei Române,Bucureşti, pp. 265-285

Molinero-Ruiz L., Delavault P., Perez-Vich Păcureanu Joița M., Bulos M., Altieri E., Dominguez J. 2015. *Review: Joint evolution of the race structure of Orobanche Cumana and the breeding of sunflower for resistance to the parasitic weed.* Spanish Journal of Agricultural Research. Chp. Plant Protection (Vol. 13, No. 4, December).

Morozov,V.K. 1947. *Sunflower breeding in USSR*. Pishchepromizdat.p.p. 1-274. Moscow. (In Russian).

Păcureanu-Joița M. 1998. *The evaluation of the parasite-host interaction in the system Helianthus annuus L.- Orobanche cumana* Wallr. in Romania. Proc. Second Balkan Symp. On Field Crops, Novi Sad, Yugoslavia, 16-20 June, 1998, Vol. I: 153-155

Pacureanu-Joita, M., Raranciuc, S., Sava, E., Stancin, D. and Nastase, D. 2009. *Virulence and aggressiveness of sunflower broomrape (Orobanche cumana Wallr.) populations in Romania.* Helia. Vol. 32. No.51: 119-126.