

International Symposium on Broomrape (*Orobanche spp.*) in Sunflower

By

Republic of Türkiye

Ministry of Agriculture and Rural Affairs

**The General Directorate of Agricultural
Research**

**Trakya Agricultural Research Institute
Edirne, Türkiye**

Collaboration with

Turkish Plant Breeders Association

International Sunflower Association

FAO (Food and Agriculture Organization)

November 30 – December 3, 2008

Fame Residence Hotel, Antalya, Turkey

This symposium jointly organized by

Republic of Turkey

Ministry of Agriculture and Rural Affairs

The General Directorate of Agricultural Research

Trakya Agricultural Research Institute – Edirne

Turkish Plant Breeders Association

International Sunflower Association

FAO (Food and Agriculture Organization)

This symposium jointly sponsored by

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WELCOME NOTES

Dear Participants,

As the Chair for the **International Symposium of Broomrape (*Orobanche spp.*) in Sunflower** in Antalya, Turkey, I'd like to welcome you and to give some information on this event. Our symposium brings together a variety of sunflower researchers from government, commercial, and academic organizations worldwide to foster cooperation on sunflower and broomrape and to promote information sharing among researchers largely. The aim of our international symposium is present the newest research results and research goals, analyze present conditions and perspectives in Broomrape biology, plant host relationships and resistance breeding, chemical and other control methods in sunflower. As always, we also extend a warm welcome to all our colleagues in the sunflower research and industry who share our interest in improving information to increase the income of sunflower producers.

As organizers, we also would like to discuss in new project ideas on EU Research Framework and also on other international organizations. If you or your organization are interested in joining these discussions and taking part in preparing new projects, this will be great opportunity for further developments for sunflower research and these efforts will contribute to increase collaborations at international level among us. In addition to the excellent program, the symposium provides an excellent environment to meet your peers in sunflower research, build relationships, and exchange lessons learned.

As one of beautiful cities in the world, first time visitors to Antalya are usually overwhelmed by the sheer beauty of the city and surroundings. Antalya is a city that manages to surprise and enthuse in equal measure, with reminders of Antalya's rich landscape and historical sites. Antalya which is Turkey's principal holiday resort is an attractive city with palm lined street and it is full of history with a beautiful coastline of beach has and rocky coves where the towering Toros mountains. There is sunshine for 300 days of the year in Antalya and it is perfect place for sunbathing and swimming or for sporting activities such as windsurfing water-skiing, sailing and also climbing, trekking, hunting and skiing on mountains, etc... We are sure that these symposium days and half day sightseeing tour will be enough to notice the beauty of Antalya province but not enough to discover it.

We wish you nice stay in Antalya for truly rewarding days.

Dr Yalçın KAYA
Chair
On the behalf of Organizing Committee

Symposium Program:

<u>Day</u>	<u>Event</u>
Sunday, November 30, 2008	
16⁰⁰ - 19⁰⁰	Registration
Monday, December 1, 2008	
8³⁰ - 9⁰⁰	Registration
9⁰⁰ - 9³⁰	Opening Talks: Dr. Yalcin KAYA, Chair, Organizing Committee Dr. Necmi BESER, Director of Trakya Agricultural Research Institute Dr. Vehbi ESER, President of Turkish Plant Breeders Association Prof Dr. Dragan SKORIC, On the behalf of Scientific Committee Assoc. Prof Dr. Masum BURAK, Director General, The General Directorate of Agricultural Research
9³⁰ - 10⁰⁰	Invited speakers: A. Höniges, K. Wegmann, A. Ardelean Orobanche Resistance in Sunflower
10⁰⁰ - 10³⁰	Invited speaker: D. M. Joel, D. Plakhine Seed Conditioning of <i>Orobanche</i> in Agricultural Fields: Ecophysiological Aspects
10³⁰ - 10⁴⁵	Coffee break
10⁴⁵ - 12⁰⁰	1st Session: <u>BROOMRAPE BIOLOGY, PLANT HOST RELATIONSHIPS</u> Session Chair : Prof. Dr. Jose Maria Melero Vera
10⁴⁵ - 11⁰⁵	Broomrape (<i>Orobanche</i> spp.) Problem in The Eastern Mediterranean Region of Turkey F. Bülbül, E.Aksoy, S.Uygur, N.Uygur
11⁰⁵ - 11²⁵	Current status of broomrape (<i>Orobanche cumana</i> Wallr) in Serbia B. Dedić, N. Lačok, S. Tančić, S. Jocić
11²⁵ - 11⁴⁵	Sunflower broomrape (<i>Orobanche cumana</i> Wallr.) in Castilla-León, a traditionally non broomrape infected area in Northern Spain. J. Fernández-Escobar, M.I. Rodríguez-Ojeda, L.C. Alonso
11⁴⁵ - 12⁰⁰	Questions and Answers
12⁰⁰ - 13⁰⁰	Lunch
13⁰⁰ - 14¹⁵	2nd Section: <u>RESISTANCE BREEDING</u> Section Chair : Prof. Dr. Stevan Masirevic
13⁰⁰ - 13²⁰	Virulence and aggressiveness of sunflower broomrape (<i>Orobanche cumana</i> Wallr.) populations, in Europe M. Pacureanu Joita, S. Raranciuc, E. Sava, E. Petcu, N. Babeanu, O. Popa
13²⁰ - 13⁴⁰	The Wild Species <i>Helianthus</i> - Source of Resistance to the Parasite <i>Orobanche cumana</i> M. Christov, R. Batchvarova, M. Hristova-Cherbadzhi
13⁴⁰ - 14⁰⁰	Behavior of some sunflower cultivar at the broomrape attack in Romania V. Jinga, H. Iliescu, S. Stefan, D. Manole
14⁰⁰ - 14¹⁵	Questions and Answers
14¹⁵ - 14³⁰	Coffee break
14³⁰ - 17⁰⁰	3rd Section: <u>RESISTANCE BREEDING</u> Section Chair : Prof. Dr. Jose Maria Fernandez
14³⁰ - 14⁵⁰	Sunflower breeding for resistance to the new broomrape race in the Krasnodar region of Russia S.V. Gontcharov
14⁵⁰ - 15¹⁰	The Use of new Rf Inbred Lines Originating from Interspecific Population

	with <i>H. deserticola</i> for the Production of Sunflower Hybrids Resistant to Broomrape N. Hladni, S. Jocić, V. Miklič, D. Saftić-Panković, D. Škorić
15¹⁰ - 15³⁰	The performance of sunflower hybrids resistant to race F of <i>Orobanche cumana</i> Wall. in naturally infested fields. J. M. Melero-Vara, R. García Ruiz, J. Domínguez, M. L. Molinero-Ruiz
15³⁰ - 15⁵⁰	The Evaluation of Broomrape Resistance in Sunflower hybrids Y. Kaya, G. Evcı, V. Pekcan, T. Gucer, M. I. Yilmaz
15⁵⁰ - 16¹⁰	The Virulence of Broomrape (<i>Orobanche cumana</i> Wallr.) Populations on Sunflower in some Regions of Northern Caucasus T.S. Antonova, N.M. Araslanova, S.Z. Guchetl, T.A. Tchelustnikova, S.A. Ramazanova, E.N. Trembak
16¹⁰ - 16³⁰	Determination Superior Hybrid Combinations in Sunflower and Testing Hybrid Performance in Broomrape (<i>Orobanche Cumana</i> Wallr.) Infested Areas O. Gunduz, A. T. Goksoy
16³⁰ - 16⁵⁰	Ongoing Research Strategies for Sunflower Broomrape Control in Spain J. M. Fernández-Martínez, J. Domínguez, B. Pérez-Vich and L. Velasco
16⁵⁰ - 17¹⁰	Status of broomrape in Serbia S. Masirevic
17¹⁰ - 17³⁰	Questions and Answers
17³⁰ - 18³⁰	Discussion Session: Recent developments on the distribution of new race of Broomrape by participating countries Session Chair: Prof. Dr. Ferenc Vranýl
19⁰⁰ - 20⁰⁰	Dinner
Tuesday, December 2, 2008	
9⁰⁰ - 11⁰⁰	4th Session: Broomrape Chemical and Other Control Methods in sunflower Session Chair : Prof. Dr. Horia Iliescu
9⁰⁰ - 9²⁰	Improving sunflower for resistance to Orobanche and Sulfonylureas herbicides - Sunflower hybrid PF100 G. Dicu, N. Dumitrescu, M. Radu, O. Diaconescu
9²⁰ - 9⁴⁰	Control of Broomrape in Iran A. Esmaailifar, A. Nezamabadi, A. Mirabadi
9⁴⁰ - 10⁰⁰	Status of <i>Orobanche cernua</i> Loefl. and Weeds in Sunflower Production in Turkey M. Demirci, Y. Kaya
10⁰⁰ - 10¹⁵	Questions and Answers
10¹⁵ - 10³⁰	Coffee break
10³⁰ - 11³⁰	Discussion: COST and other joint EU Project proposals Session Chair : Prof. Dr. Dragan Skoric
11⁴⁰	Closing the symposium
12⁰⁰ - 12³⁰	Lunch
12³⁰ - 20⁰⁰	Sightseeing Tour (Antalya city and around)
20³⁰ - 21³⁰	Dinner
Wednesday, December 3, 2008, Leaving from the hotel	

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Dr Yalcin KAYA (Head of Committee)
Dr Goksel EVCI
Veli PEKCAN
Prof Dr Dragan SKORIC

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The hotel and sightseeing tour arrangements are organized by SSC Tour Travel Agency.

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Orobanche Resistance in Sunflower

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Abstract

This report will present the current knowledge of *Orobanche*-resistance in sunflower from the breeder's view and from the biochemists' view. A major difficulty for the breeder is the fast development of new pathotypes of *Orobanche cumana*, which overcomes the resistance of newly developed sunflower lines. The basis of increasing aggressiveness of *Orobanche cumana* pathotypes is discussed. Nevertheless, there is still great potential for resistance breeding in the genus *Helianthus*, since very different resistance factors are already known or shall be elucidated.

A survey is presented on known resistance factors, like low stimulant, mechanical barriers and how they develop, phytoalexins, *Orobanche* seed germination inhibitors, inhibition of the exoenzymes of the *Orobanche* radicae, in particular of polygalacturonase. In this context an interesting new approach may be found in the polygalacturonase-inhibitory proteins occurring in cell walls, which inhibit the invasion of pathogenic fungi. The need for molecular biological studies will be stressed. Interdisciplinary collaboration of the breeders with biochemists and molecular biologists may lead to more advanced breeding strategies.

Key words: *Orobanche cumana* resistance in sunflower, resistance factors, phytoalexins, polygalacturonase inhibitors.

Seed Conditioning of *Orobanche* in Agricultural Fields: Ecophysiological Aspects

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It is widely known that *Orobanche* seeds need a conditioning phase of several days under suitable temperatures and wet conditions before being able to germinate in response to germination stimulants. However, this knowledge of seed behavior is solely based on in vitro experiments, while the conditions in the field may significantly differ from the conditions in Petri dishes. In a series of experiments we have shown that *O. cumana* seeds respond to the germination stimulant GR24 even without prior conditioning. The germination of non-conditioned seeds was not observed before, because the experiments did not last long enough to observe germination, since the non-conditioned seeds need a longer lag time before germinating after stimulant reception. These results are consistent with our hypothesis that, under certain field circumstances, non-conditioned *Orobanche* seeds may also germinate when a host root comes close to them, which may be significant in the understanding of *Orobanche* behavior in sunflower fields.

Broomrape (*Orobancha* spp.) Problem in The Eastern Mediterranean Region of Turkey

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ABSTRACT

Broomrapes (*Orobancha* spp) which belong to the family *Orobanchaceae* are obligate parasitic flowering plants. The main center of distribution is the Mediterranean basin where large areas are heavily infested. Yield losses due to *Orobancha* attack range from 5 to 100 % depending on the region and the crop. Some broomrape species were determined in some crops in the Eastern Mediterranean Region of Turkey. As results of survey studies conducted in the region; *Orobancha aegyptiaca* / *ramosa* were present in 27.72 % of the tomato greenhouses and 80 % of the tomato fields, *Orobancha crenata* and *O. aegyptiaca* / *ramosa* were present in 57.89 % of the fababean fields and 75.51 % of the lentil fields.

Among the crops cultivated in the Eastern Mediterranean Region, sunflower cultivation has been gradually increasing from 2005. In 2005, sunflower sown area and production in the region were increased more than three times compare to 2004.

There is not any record on broomrapes in sunflower fields in the East Mediterranean Region, yet. But broomrapes are considered a possible threat for sunflower fields in this area. *Orobancha cernua* Loef. cause considerable damage all sunflower fields in Thrace region of Turkey and it may spread from the region to East Mediterranean region, easily. In addition, sunflower is also a host plant of *O. ramosa* L. and *O. aegyptiaca* Pers. Unfortunately, these species were found in some crops in the East Mediterranean Region and growers are not careful about dispersal of broomrape. Because of their small seeds are dispersal easy and their control is very difficult, all quarantine measures must be taken in Turkey immediately.

Since the magnitude of the Broomrape problem is increasing every year in Turkey, a “National Broomrape Project” has been conducting collaboration of some governmental institutes and universities since 2006. After the studies of the Project, producers are going to be educated on preventive measures for dispersal of broomrape seeds.

Key words: Sunflower, broomrape, *orobanche*

The performance of sunflower hybrids resistant to race F of *Orobanche cumana* Wall. in naturally infested fields.

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ABSTRACT

Sunflower hybrids resistant to race F of *O. cumana* seldom show complete lack of broomrape attachment and emergence. The effects on yield of 4 resistant hybrids with that of two susceptible highly productive hybrids were compared. Incidence of plants with emerged broomrapes (BI), final degree of attack (FDA), seed and oil yields, and oil content were determined in naturally infested fields of two locations of southern Spain (2004-2006). Although resistance is generally expressed by low FDA, higher BI was observed in 2006, showing much dependency on the environment. Vertical resistance of hybrid PR64A71 contrasted with horizontal resistance in Arango, Centurión and Olimpia, which showed higher FDA values in one heavily-infested field. Although year and location influenced yield variables, oil content mainly depended on hybrid. Cropping resistant hybrids in moderately-infested fields provided up to 11% seed yield increases. The high field potential of resistant hybrids is highlighted in heavily-infested fields since, despite the higher disease levels in the latter three hybrids, yield increases averaged 124 and 199% depending on water availability.

Key Words: sunflower broomrape, *Helianthus annuus*, field resistance.

Ongoing Research Strategies for Sunflower Broomrape Control in Spain

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ABSTRACT

Sunflower broomrape (*Orobanche cumana* Wallr) continues to be one of the most important constraints in sunflower production in Spain. In the last ten years, genetic resistance has been the predominant strategy of control against *O. cumana*. However, the introduction of new resistance is frequently followed by the appearance of new virulent races overcoming that resistance. In this report, a combined strategy to control *O. cumana* is discussed, including: a) The use of IMI sunflower cultivars to control winter and early spring weeds and sunflower broomrape; b) The combination of vertical and horizontal resistance mechanisms in the same genotype in order to develop a more durable resistance, together with molecular studies to identify QTLs associated with broomrape resistance genes to facilitate the pyramiding of different resistance genes and the combination of different resistance mechanisms; c) The study of the variability and racial composition of Spanish sunflower broomrape populations using classical and molecular methods.

Key words: Broomrape control, *Helianthus annuus*, resistance mechanisms, IMI sunflower, QTL mapping.

Current status of broomrape (*Orobanche cumana* Wallr) in Serbia

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ABSTRACT

Broomrape is the parasitic plant that presents the major problem in sunflower production in Serbia. Since its first appearance in our country the species *Orobanche cumana* Wallr had been responsible for considerable yield loss in some sunflower growing areas. In Serbia broomrape is mostly present in Vojvodina province, where distribution and virulence groups of parasite are constantly monitored. Only two distinct broomrape populations currently exist in this part of country. According to previous research race B is dominant in south of the Vojvodina province and race E in the north. During 2008 set of 8 commercial hybrids with different broomrape resistance genes were sown in regions of Vojvodina and Central Serbia with sunflower production, on 34 different locations. Presence of broomrape was confirmed on 6 sites but occurrence of parasitic plants was not detected on hybrids resistant to race E. The survey of sunflower fields in regions where broomrape was not previously detected was also done. Survey revealed occurrence of broomrape in the new region. Infested areas are placed in Bor County near state border with Romania and Bulgaria.

Key words: broomrape, sunflower, distribution, race

Behavior of some sunflower cultivar at the broomrape attack in Romania

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ABSTRACT

One of the most dangerous parasites on the plants there is Broomrape (*Orobanche spp*) in Romania. On sunflower fields were identified the population of weedy broomrapes of *Orobanche cumana* Wallr. It was shown a significant dissemination, especially in the south and south-eastern area of the country. The behavior of some sunflower cultivars against *O. cumana* were studied under artificial inoculation and natural contamination conditions. In the artificial inoculation conditions, experiments performed at the Research Development Institute for Plant Protection Bucharest, hybrids HS 1900, Turbo, Justin and Favorit have showed an absolute resistance. In natural contamination at SC Sport Agra srl ,Amzacea- Dobrogea, best result have showed: Rigasol, Flores, Albani Florena, Sunay, Favorit, Festiv and Turbo. The influence of specific herbicides on phanerogamous *O. cumana* was studied.

Key words: broomrape, sunflower, hybrids, behaviors.

Sunflower breeding for resistance to the new broomrape race in the Krasnodar region of Russia

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ABSTRACT

Broomrape (*Orobanche cumana* Wallr.) is a parasitic plant, feeding on sunflower roots. During the last years some new, more aggressive races have been found in the different parts of the world (Spain, Turkey, Romania, etc.). A little bit later they appeared in Russia and we started a special breeding program. Previously one resistant line (VK 623) to the race F was found among the lines of the VNIIMK breeding. In a short time some new prospective sunflower inbred lines with resistance to both broomrape races – E and F were developed. Now they are on the way of being converted to the CMS-lines. However recessive character of this resistance create some difficulties in commercial sunflower hybrid breeding, so to obtain new donors of resistance in the future, the cultivated sunflower was crossed with *H. tuberosus* (used as a pollinator).

Key words: breeding, broomrape, hybrid, resistance, sunflower.

Sunflower broomrape (*Orobanche cumana* Wallr.) in Castilla-León, a traditionally non broomrape infested area in Northern Spain.

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ABSTRACT

Spanish sunflower acreage is basically divided in 3 main and isolated areas, the Guadalquivir valley, Southern Spain, represents the 37 % of the total acreage, the Cuenca area located in Spain's Central plateau, with 28% and the Castilla-León area, Northern Spain, with 29 %. Sunflower broomrape (*Orobanche cumana*, Wallr.) has been present in Spain since the 1960's. From that time on, different waves of dissemination and dispersion of the parasite have been found. The latest correspond to broomrape race E dispersion in the early 1990's and race F in the first years of 2000. These broomrape dissemination waves have been circumscribed only to the Guadalquivir and Cuenca areas. In the Castilla-León area, the presence of broomrape had not been noticed until now.

In 2008, a highly virulent broomrape infection focal point (about 300 m²) has been detected in one sunflower plot near Medina del Campo (Valladolid), south of the centre of the Castilla-León area. Racial determination has proved that this broomrape inoculum belongs to race F.

Key word: *Orobanche cumana*, broomrape, sunflower, dissemination, F race

The Wild Species *Helianthus* - Source of Resistance to the Parasite

Orobanche cumana

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ABSTRACT

Eleven perennial species *Helianthus*, with different ploid level, and several hybrid forms of sunflower, with origin from crosses of wild species with cultivated *Helianthus annuus* L., were included in this research. The obtained hybrid forms and the new lines, created from them, showed resistance to different races of *Orobanche cumana*. Full resistance to the most virulent broomrape race, widely distributed in Bulgaria, showed the materials, obtained from crosses of the tetraploid *H. decapetalus* and crosses of the diploid *H. divaricatus*. The difference in the profile of resistant and non-resistant lines was proved by the RAPD method. Part of the new resistant lines participate in the creation of new hybrid sorts.

The Evaluation of Broomrape Resistance in Sunflower Hybrids

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ABSTRACT

Broomrape (*Orobanche cumana* L.) is the biggest problem both in Turkey and in some Eastern European countries and also in Spain. The research covering broomrape tests of sunflower hybrids in the trials based on National Sunflower Research Project was conducted in Trakya region, which has 75% of sunflower production in Turkey in 2006, 2007 and 2008 years. Based on this project, in natural infested conditions 306 in 2006, 443 in 2007 and 533 genetic materials (commercial and candidate hybrids, inbred lines, etc..) tested in 2008 and from these tested materials, 12 of them in 2006, 56 in 2007 and 140 in 2008 were observed as resistant in the research. In winter time, broomrape tests continued in growth chamber and in the pots as artificially infested conditions. Broomrape seeds were collected from naturally infested area of Trakya region , then used in to determine of the reactions of developed hybrids and lines against these races. At this part of study, 1752 in 2006, 816 in 2007 and 1389 in 2008 sunflower genotypes were tested. Based on these tests, 332 materials in 2006, 94 in 2007 and 404 materials were found as resistant to new races of broomrape in the study.

Key Words: Sunflower, Hybrid, Broomrape, Resistance.

The Use of New Rf Inbred Lines Originating From Interspecific Population with *H. deserticola* for the Production of Sunflower Hybrids Resistant to Broomrape

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ABSTRACT

One of the directions in sunflower breeding is selection for the resistance to broomrape. The population of broomrape has been stable in Serbia for a longer period of time, but the racial composition has changed in recent years, with race E being predominant in the regions of north Backa and Banat. Cultivated sunflower is genetically narrow and deficient in many desirable genes. Its genetic variability can be increased by the use of wild sunflower species and interspecific hybridization.

The resistance of 15 new experimental hybrids to broomrape was tested on locations in Serbia (Pačir) during three years (2006, 2007, 2008) and in Romania (Baraganu, Bralia) during 2008. These hybrids were produced by crossing female inbred lines (Ha-26PR-A, PH-BC₂-92-A and Ha-98-A) susceptible to broomrape and new Rf inbred lines (RHA-D-2, RHA-D-5, RHA-D-6, RHA-D-7, RHA-D-8), developed from interspecies population originating from *H. deserticola*, and resistant to broomrape race E. All examined hybrids were resistant to broomrape on both locations. Since broomrape race F is present on location in Romania, it is expected that the new Rf inbred lines-male components of examined hybrids, have the resistance gene for race F also.

Key words: sunflower, interspecific hybridization, resistance, broomrape

The Virulence of Broomrape (*Orobanche cumana* Wallr.) Populations on Sunflower in Some Regions of Northern Caucasus

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ABSTRACT

At virulence comparison of broomrape seeds collected on sunflower in Northern Caucasus in different years the populations Svetlogradskaya (Stavropol region, 2005) and Morozovskaya (Rostov region, 2006) were found as a high virulent for two resistant inbred lines of VNIIMK. The population Privolnenskaya (Krasnodar region, 2003) has shown the weakest virulence.

Eight hybrids (different resistance against races A - E) were tested in field conditions against artificial infectious backgrounds of seeds from Svetlogradskaya and Privolnenskaya populations. The quantity of parasite stems appeared on the soil surface was counted.

The sunflower variety Peresvet (VNIIMK) and a hybrid P 96 (resistant against race F in Spain) were tested at separate artificial inoculation by broomrape: race F (from Spain), the mixture of races F, G, H (from Turkey), also Svetlogradskaya and Privolnenskaya populations. The quantity of healthy tubercles was counted on sunflower roots after 30 days of growing.

The all results confrontation let to make the conclusion: Svetlogradskaya and Privolnenskaya populations are represented by mixture of non virulent and virulent races for tested sunflower genotypes. But Svetlogradskaya contains a high percentage seeds of race F and insignificant admixture of the more virulent biotype. Privolnenskaya contains a high percentage seeds of race E and insignificant admixture of the more virulent biotype. The numerous tracks of died individuals of non virulent races were seen on roots of all experimental plants.

Key words: broomrape, virulence, races, sunflower,

Improving sunflower for resistance to *Orobanche* and Sulfonylureas herbicides - Sunflower hybrid PF100

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ABSTRACT

Procera Agrochemicals Romania is a company that has developed a program for sunflower breeding, since 2004. One of the main goals of this improvement program is to obtain sunflower hybrids resistant to broomrape, as a consequence of the well-known fact that Romania has a constantly increasing incidence of soil-areas infested with this parasite.

Sunflower hybrid PF100 is a semi-late hybrid that has genetic resistance to broomrape and is also genetically improved with resistance-genes to Sulfonyl Urea herbicides SURES-1 and SURES-2, for both male and female lines. PF100 has been tested in the Romanian official network of the State Institute for Variety Testing and Registration for the last two years (2006-2008). The results recorded showed that the seed production varied from 2348 kg/ha (Timiș county, 2005) to 4604 (Vaslui county, 2006) and the oil content in seeds was between 47-51%. In 2008, the highest seed yield of this hybrid (3700 kg/ha) was obtained in the tests trials from the demo-plots established at Viziru, Brăila county (one of the most infested county with broomrape).

Control of Broomrape in Iran

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ABSTRACT

Broomrape is one of the most dangerous parasitic plants for many crops. The communities of weed broomrapes were investigated from sunflower fields in Iran. In the sunflower fields the populations of weed broomrapes consists of plants of *Orobanche aegyptica*, *O.ramosa*, *O.cumana* and *O.crenata*. There are present in Iran but sporadically, other species of *Orobanche*. Method of control and management for each parasite were included: crop rotation, clean seeds, sowing dates, biological control, genetic resistance and herbicides. The behaviour of some Iranian sunflower cultivars (RT21, AS508, Hysun 33, Hysun 25, Euroflore, Record,...) to *O. aegyptica* attack was tested in the artificial inoculation and natural contamination. It could be noted that all hybrid cultivars and from OP, Record exhibited an absolute resistance. To eradicate this dangerous plant was and still is the aim of specialists worldwide. In order to diminish the negative effect of broomrape on sunflower yield, there were tested the next methods: herbicides: crop - rotation, deep ploughing, deep seeding or watering, biological control by trap - plants, insects(*Phthomyza orobanche*), fungi(*Fusarium oxysporum* f.sp. *orthoceras*), herbicides. The chemical method was proved to be a necessity for a modern agriculture. It was tested the efficacy of 5 variants of herbicides (Treflan 48 EC + Glyforom RV, Stomp 330 EC + Glyphogan 480 SL, Treflan 48 EC + Basta EC, Stomp 330 EC + Assert 250 EC, Stomp 350 + Basta EC) in 2 experimental field. The best results was with Treflan 48 EC (trifluralin 480 g/l) preemergent 2 l/ha + Glyforom RV (glyphosate 360 g/l) post emergent 0,2 l/ha + 0,3 l/ha applied at 40 and 60 days from planting with efficacy 82,7% and Stomp 330 EC (pendimethalin 330 g/l) preemergent 4 l/ha + Glyphogan 480 SL (glyphosate sal 360 g/l) postemergent 0,2 + 0,3 l/ha, efficacy 80,7%, in the broomrape control.

Keywords: Broomrape, Control, Herbicide, Insect,Fungi

Determination Superior Hybrid Combinations in Sunflower and Testing Hybrid Performance in Broomrape (*Orobanche Cumana Wallr.*) Infested Areas

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ABSTRACT

This research was conducted during 2004 - 2007 to estimate the parents and crosses showing superior general and specific combining abilities, F₁'s hybrid vigor and genetic structure of a hybrid sunflower population in terms of phenological characters, agronomical traits, yield and quality characters and to identify suitable parents and promising hybrid combinations of resistance to Broomrape. Twenty five experimental hybrids were created using 5 cytoplasmic male sterile (CMS) and 5 pollen tester (restorer) lines having different levels of resistance to Broomrape in sunflower. Field trials of the research were made at three different locations (Center, Ferhadanlı and Banarlı districts) in Tekirdag province. The experiments were designed in a randomized complete block with three replications.

According to the results, the general and specific combining ability (sca) variances were highly significant for all traits investigated except days to 50% flowering. According to the general combining ability effects obtained from the all locations, A₃ (TTAE 4156A) for oil content, seed yield and oil yield were determined as the most suitable parents. The significant SCA effect and high mean values of hybrids combinations showed that A₄ x B₇, A₃ x B₇, A₄ x B₈, A₅ x B₆, A₃ x B₉ and A₃ x B₈ for seed and oil yields were promising hybrid combinations. It was found that A₃ x B₆, A₃ x B₇, A₃ x B₁₀ and A₄ x B₇ hybrids produced 20-25 % more oil yield compared with the average of control cultivars in some location. The results of Broomrape test indicated that, based on the commercial checks results, all trial areas were infested with the new races. In Ferhadanlı, except Sanbro, all of the hybrids have showed lower attack degree. B₁₀ male line was resistant to broomrape population in all locations. A₃ x B₆ and A₃ x B₇ experimental hybrids were found highly tolerant to the new broomrape races in all locations, instead of their parents' susceptibility. Also, none of the B₁₀ male line hybrids were not showing any resistance to broomrape even at tolerant level.

As a results, genotypes A₃ (TTAE 4156A), A₄ (TTAE BAH8 A), B₆ (RHA14) and B₇ (RHA 20) were the parents involved in the best-yielding crosses. Among these parents, A₃ and B₇, which possesses a considerable positive GCA effect, might be utilized as a good parent in hybrid sunflower breeding programs. On the other hand, A₃ x B₆, and A₃ x B₇ might be considered as promising hybrid combinations for higher yield based on their heterosis and heterobeltiosis values, SCA effects and resistance to Broomrape.

Key Words: Sunflower, *Helianthus annuus* L., combining ability, heterosis, line x tester, broomrape, *Orobanche cumana* W., yield and quality.

Virulence and aggressiveness of sunflower broomrape (*Orobanche cumana* Wallr.) populations, in Europe.

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ABSTRACT

The pathogenic composition of the broomrape populations has changed over the years, slowly at first, then rapidly in Eastern Europe, Turkey and Spain. In the last years, in Europe, new and aggressive populations of the parasite, have attacked sunflower crop, specially in Turkey, Spain, Romania, Russia, Ukraine and Bulgaria. In Romania there are three important areas infested with broomrape (*Orobanche cumana* Wallr.), different as infestation degree and presence of different virulent groups. A new highly virulent population of broomrape has attacked sunflower in Romania in 2006 year. Many commercial hybrids belonging to different companies lost their resistance to this parasite. Sunflower genotypes, existing in Fundulea germplasm collection, used as differentials for the broomrape races, were tested with the parasite seeds collected from Romania, Spain, Turkey, Bulgaria and Ukraine. The spectrum of the broomrape races in these areas are different. Many genotypes, for some of them being known the reaction to the races in Spain or Turkey, were tested in Romania in 2008 year. The results have indicated a new and different virulent population of the parasite.

Key words: sunflower, broomrape, virulence, resistant ,sensitive.

Status of *Orobanche Cernua* Loefl. and Weeds in Sunflower Production in Turkey

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ABSTRACT

Broomrape (*O. cernua*) is one of the most serious hindrances in sunflower production throughout the Turkey and Eastern Europe. Previous and late studies have shown that imidazolinone (IMI) herbicides applied onto IMI resistant sunflower effectively controls *O. cernua* by rapid absorption, translocation and accumulation in the root attached parasite. However, susceptibility level of susceptible sunflower varieties to the herbicides has been an obstacle in application of these herbicides. Preliminary studies were conducted with susceptible sunflower varieties. But the best results obtained from single foliar treatment of Imazamox (35 g/l)+imazapyr (15 g/l), 43,75+18,75 g/ha was applied on IMI resistant sunflower plants 8-10 true leaf stage. The treatment caused serious damage to susceptible sunflower plants but no damage observed IMI resistant varieties and completely controlled *O. cernua*, resulting in a three-fold increase in sunflower seed yield over the non-treated control. In addition same treatment controlled key weeds that seriously harm sunflower production. Further studies are in progress to determine affectivity of other members of IMI herbicides application rates and timing. Broomrape (*O.cernua*) and weeds have infested and reduced yield in the sunflower production area with high economic level. But using IMI resistant and broomrape tolerant inbred varieties have suppressing and decreasing weed population and epidemics effectively in last three years.

Key Words: *Orobanche cernua*, weed control, imidazolinone herbicides, sunflower

Status of broomrape in Serbia

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ABSTRACT:

Epiphytic spread of broomrape in Serbia started in the beginning of nineties and continues up to date. It is considered that new race was introduced by confectionery sunflower seed. Sunflower is endangered on the north of Bačka region. The main foci of hazard are areas under sunflower on the Subotica - Bačka Topola route, with a tendency of spreading toward Senta and Čantavir, while the second direction is toward Čonoplja and Aleksa Šantić, and then to the south. Less intensive attack is also noticed in Banat around Padej, Itebej i Vršac. It is significant to underline that broomrape has appeared in new localities Svetozar Miletić, Mol, Novi Bečej and Zmajevó at which it had not been registered previously. The analysis of population showed that broomrape in Serbia belonged to race E of the parasite. Constant monitoring of broomrape population is very important due to changes in race composition and evolution of new more virulent races. The most reliable method for control of the parasite is cultivation of resistant sunflower hybrids including IMI resistant hybrids.

Key words: broomrape, Serbia, physiological races, methods of control, sunflower

This symposium jointly organized by

Republic of Turkish

Ministry of Agriculture and Rural Affairs

The General Directorate of Agricultural Research

Trakya Agricultural Research Institute – Edirne

Turkish Plant Breeders Association

International Sunflower Association

FAO (Food and Agriculture Organization)

This symposium jointly sponsored by

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