# RESEARCH ON SUNFLOWER OIL QUALITY IN THE CASE OF *OROBANCHE CUMANA* ATTACK

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***Abstract.*** *In Romania the most infested fields with Orobanche cumana are situated in South-Eastern part of the country especially in Buzau, Tulcea and Constanta county. Our study assesses the influence of Orobanche attack on sunflower oil quality. We have used two sunflower hybrids MAS95 IR and MASS 83R from Maisadour provenance in a field experience through randomized blocks design. The location was on the Casimcei plateau, in vicinity of Sarighiol de Deal, Tulcea county. There were no mechanical or hand hoeing, not applied herbicides or any other insecticide and fungicide treatments in sunflower vegetation period. In September twenty five of sunflower heads were harvested from each hibrid, samples from parasitized sunflower plants and non- parasitized by broomrape respectively. The sunflower oils have been obtained by chemical extraction. The fatty acid profiles were analyzed by GC-MS. The results have revealed that the linoleic acid is the prevalent fatty acid in seeds. Sunflower plants parasitized with broomrape were not affected from point of view of palmitic and stearic acid contents, but in case of oleic and linolenic acids are noted increases of contents. The differences are variable depending on genotype profiles of plants.*

***Keywords:*** *sunflower oil yield, broomrape attack, linolenic acid, oleic acid*

## INTRODUCTION

Ever since the end of XX century it was known that *Orobanche cumana* is naturally distributed from central Asia to South-Eastern Europe, where it parasitizing wild *Asteraceae* species, mainly *Artemisia* spp. Even though it has been considered by some authors as an intraspecific taxon of *Orobanche cernua* L., nowadays is widely accepted as a separate species (PARKER, C., 2013). In Romania the most infested fields are situated in South-Eastern part of the country where *O. cumana* has been occurring on sunflower fields from the beginning of the 40s (PACUREANU-JOITA M, 2005).

The transformation of sunflower into one of the major world oil crops started in Russia in the second half of the nineteenth century and it had an effect on broomrape spread. Currently, *O. cumana* is present in the main sunflower-producing countries around the world, particularly in Central and Eastern Europe, Spain, Turkey, Israel, Russia, Ukraine, Iran, Kazakhstan, and China (PARKER, C., 2013). Moreover, the parasite has spread to new areas in recent years (AMRI, 2012; JOUFFRET, 2010), because seeds are extremely small, and are easily dispersed by sunflower seeds, water, wind, animals, humans, or machinery (CASTEJON, 1990, PEREZ –VICH, 2013). Besides individual plants can produce an impressive number of seeds that remain viable in the soil up for 20 years.

By point of view of sunflower resistance to broomrape attach different mechanisms are involved such as genetic, physiological, mechanical, and not at least biochemical. By far the most important is the genetic system used by breeders which is characterized by the existence of genes controlling resistance. Because their work to be effective, breeders must first determine the current races in the region and then test their selection line for broomrape resistance. Recently PACUREANU-JOITA ET AL. (2008) has applied a new breeding strategy for obtaining a sunflower resistant line that consists in combining of two independent resistance factors in order to interrupt the gene-for-gene development for broomrape, achieving in this way the line AO 548 totally resistant to all *Orobanche cumana* races including race F. This was based on the idea that the parasite cannot overcome two different resistances at the same time.

In the present study we assessed the influence of Orobanche attack on sunflower oil quality for two sunflower hybrids such as MAS95 IR and MAS 83R from Maisadour provenance in a field experience proper for year 2015.

**MATERIAL AND METHODS.**

The sunflower experience had as placement the South East of Casimcei Plateau, near Sarighiol de Deal, from Beidaud district.


Fig 1. The localization of sunflower experiment

The area is characterized by high amplitude of annual temperature, low level of rainfall (ca 400 mm/year), extended periods of drought, air relative humidity of the lowest in the country (below 56%), and a dominant wind regime from the North East direction. Soil type was a kastanozem- humus rich soil that were originally covered with early-maturing native grassland vegetation, which produces a characteristic brown surface layer.

The climate conditions were characteristic for Casimcea plateau in the sunflower vegetation period (april-sept) for 2015 year (Figure 2.). Regarding the thermal regime since spring, respectively in the second week of April, were recorded increases in temperature above the multi-annual, with a maximum average of $28^0$ C/week and a minimum average of 10 $^0$C/ week.

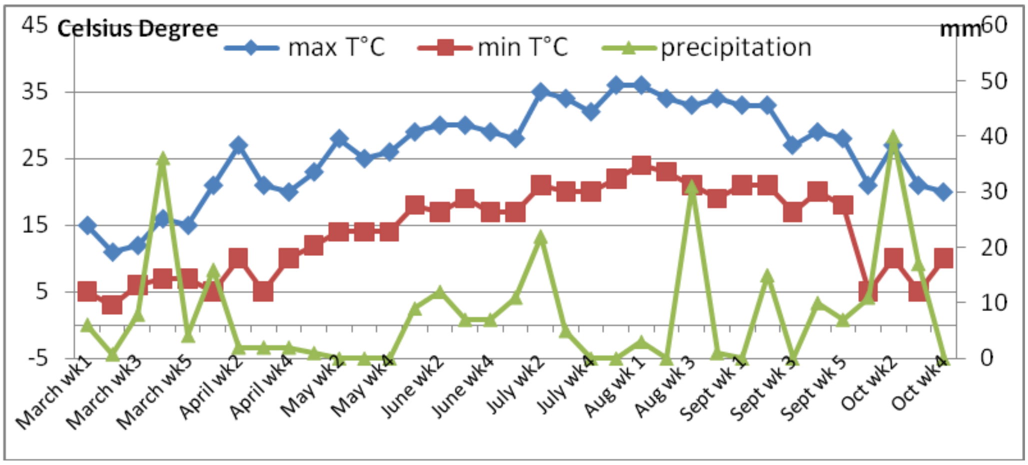


Fig 2. The weekly recording of maximal, minimal temperature and rainfall for period between March-Oct 2015.(source: http://www.accuweather.com/ro/ro/sarighiol-de-deal)

Additionally, from April to May a moisture deficit was recorded that lead to an uneven sprouting and sunflower staggered growth.

The rainfall that occurred in June failed to restore the plants water needs due to the little amounts. The moisture loss not only conducted to a delay in plant development but also a tardy attack of brooomrape was generated. Precipitations from July (only 7 mm on 2 th week) drove to plant development, seed germination broomrape and obviously parasitized of sunflower roots. From the second week of July to September the period recorded high temperatures levels (maximum temp over 30 degrees in day time and minimum over 20 degrees in night time) and sporadic precipitations.

Sunflower hybrids were sown on 25 April 2015, at 70 cm between rows and about 24 cm between plants on the row, depth of 6 cm, density of 6 plants / sqm in randomized blocks design. From the official presentation made by producer MAISADOUR we noted that MAS 83R and MASS 95IR are differently from the point of view of broomrape resistance. There were no mechanical or hand hoeing, was not applied herbicides on vegetation or any other insecticide and fungicide treatments. The harvest was at 3 september.

For oil quality evaluation - 25 sunflower heads were harvested from plots of sunflower hybrids from both samples of infested sunflower plants and non- infected by broomrape. The sunflower oils have been obtained by chemical extraction. The Soxhlet extraction used hexane at 70 ºC for 2 hours at a ratio of 1 to 10 followed by evaporation of the solvent at low pressure.

The fatty acid contained in sunflower oils were transmethylated into fatty acid methyl esters by treating 10 mg of oil samples with 3 ml of methanol/toluene/sulphuric acid (88/10/2 v/v/v) for 1 h at 80 ºC. The resulting methyl esters were then extracted twice with 1 ml of heptane and analysed by GC-MS in a Shimadzu 2010 Plus gas chromatography apparatus (Shimadzu, Kyoto, Japan). The column used was a capillary column DB 1 (30 m length; 0.25 mm i.d.; 0.25 µm film thickness) with helium as the carrier gas at 0.93 L $min^{-1}$. The injector temperature and MS source were maintained at a temperature of 250°C and 200°C, respectively.

**RESULTS AND DISCUSSIONS**

In our country the sunflower fields from Tulcea, Buzau and Constanta may be subject to high broomrape attack, but the potential is not limited just for this culture. Due to „hearth" infestation a fair estimation of intensity, frequency, and attack rate of broomrape may be difficult. Overall, regarding to our experience, the broomrape attack has determined decreases of oil yield in sunflower seeds in case of both hybrids. The lowest sunflower oil yield was recorded at the MAS 95IR plants parasitized by broomrape (Table 1). A decrease by 18.75% of the oil yield was recorded for hybrid MAS 83R. Furthermore, the effect of the broomrape attack on the seeds oil content was more evident in case of sunflower hybrid MAS 95, resulting a decrease of 25.4% of oil yield compared with non parasitized sunflower plants.

*Table 1.*

The yield performance of sunflower

| sources | Sunflower seeds MAS 83 R | | | Sunflower seeds MAS 95 IR | | |
|---|---|---|---|---|---|---|
| | total oil content (%), ($x \pm s_x$) | % | Difference | total oil content (%), ($x \pm s_x$) | % | Difference |
| broomrape non-parasitized plants | 48±0.2 | 100 | - | 51±0.3 | 100 | - |
| broomrape parasitized plants | 39±0.3 | 81.25 | -18.75 | 38±0.4 | 74.5 | -25.4 |

In literature there are very few data concerning the fatty acid profiles of seeds from broomrape infected plants. From this point of view our results bring a novelty in this issue.

It can be observed that the linoleic acid is the prevalent fatty acid because it was determined in the highest value (Figure 3.).

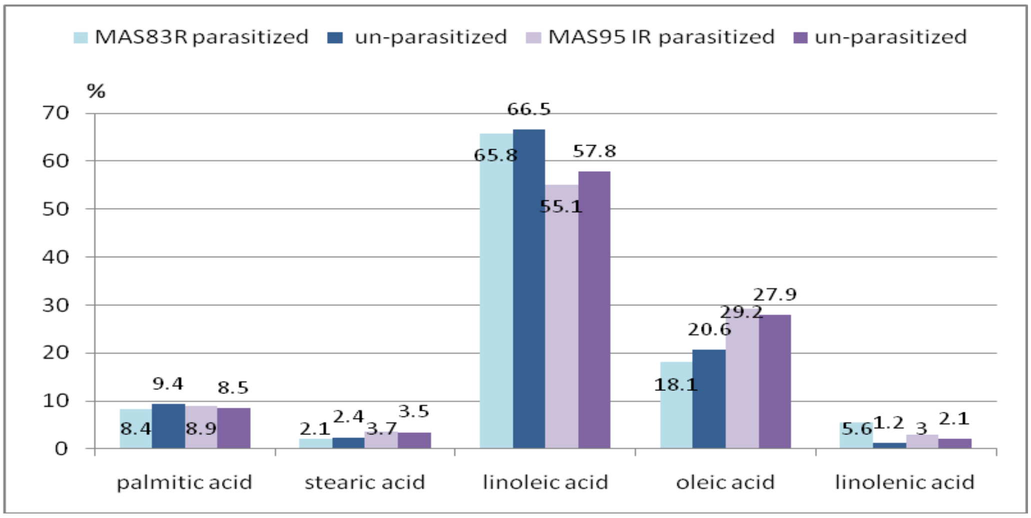


Figure 3. The compositional variation of saturated and unsaturated fatty acids in seeds from broomrape parasitized and un- parasitized sunflower plants

The highest values were registered for MAS 83 R in seeds from un-parasitized plants.

The mean values ranging between 65.8% and 66.5% classify the sunflower genotype in category of drought tolerant. Meanwhile MAS 95IR seeds with an average of linolenic acid below 60% content allow affirmation that its performance is for a Mediterranean area. (Bonjean, 1993). The sunflower plants parasitized with broomrape were not affected from point of view of palmitic and stearic acid contents, the differences being insignificant, but in case of oleic and linolenic acids are noted increases of contents in parasitized plants. The differences are variable depending on genotype profiles of plants. Thus, in hybrid seeds MAS 83R was noted an increase of linolenic acid content (5.6%) came from parasitized plants compared with no parasitized plants (1.2%) while for the hybrid MAS 95IR seeds the Increase of oleic acid content in parasitized plant (29.2%) compared to non-parasitized sunflower plant (27.9%).

## CONCLUSIONS

*Orobanche cumana* remains an important biological factor with direct action on sunflower productivity but also it seems that can affect and its quality. The compositional analysis of fatty acids from parasitized plants reveal a quantitative variability that is due to the genetic but also environmental factors. In the future together breeders, physiologists, and biochemists researchers have to be aggregated to minimize the damage and to induce a great tolerance for sunflower plants to Orobanche attack. The effort should be made to alter the anatomy of plant roots as well as using biochemical alternatives (germination inhibitors or phytoalexins).

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