

# PHYSIOLOGICAL RACES OF *Orobanche cumana* Wallr. ON SUNFLOWERS IN YUGOSLAVIA

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## INTRODUCTION

Before 1960, *Orobanche cumana* had offered serious problems to sunflower production in Yugoslavia. The largest problems were encountered in the northeastern part of the country, in Vojvodina, which grew sunflowers on 80% of the total hectarage under this crop. Intensive attacks by *Or. cumana* decreased drastically the yields of sunflower which in turn caused considerable reductions of the hectarage under sunflowers in Vojvodina.

After the import of Soviet varieties VNIIMK 8931 and Peredovic, resistant to A and B races of *Or. cumana*, the attacks by the parasite were low for 7-8 years. However, *Or. cumana* started frequenting these varieties in the last 10 Years of their growing, the intensity of attack ranging from low to high.

In the last three years, domestic sunflower hybrids were grown. *Or. cumana* attacked them more seldom than the previously grown varieties. Nevertheless, the parasite still occurs, varying in intensity and distribution.

We decided to examine the virulence of several populations of the pathogen collected from different sunflower prots around Vojvodina.

## MATERIALS AND METHOD

During the growing season of 1976, *Or. cumana* occurred in several localities in Vojvodina. Intensive attacks were observed in

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three distant localities, labelled A, B, and C. *Or. cumana* seeds were gathered in these three localities for the tests of virulence. The degree of virulence of these three populations of *Or. cumana* was examined on 24 sunflower genotypes at the experimental field of the Institute of Field and Vegetable Crops at Novi Sad.

*Or. cumana* seeds were mixed with soil in the ratio 1: 10. Sunflower genotypes were planted manually on April 14, 1977. Approximately equal quantities of the mixture of *Or. cumana* seeds and soil were added to each hill. All 24 sunflower genotypes, 12 plants per genotype, were planted in three blocks. Each block was inoculated with one *Or. cumana* population. With some genotypes, *Or. cumana* plants occurred immediately after the stage of budding. The emergence of *Or. cumana* plants was successive to the end of the growing season.

The number of *Or. cumana* plants was counted two times-10 days after the full flowering and at the end of sunflowers' growing season. The examined sunflower genotypes were classified into three groups according to their reaction to *Or. cumana*:

- I (immune)      no occurrence of *Or. cumana*.
- R (resistant)    less than 1 broomrape plant per sunflower plant. Broomrape plants remain stunted, flower seldom, and produce seed hardly ever.
- s (susceptible) more than 1 broomrape plant per sunflower plant. Broomrape plants develop normally, flower, and produce seed prolifically.

## RESULTS AND DISCUSSION

*Or. cumana* had offered serious problems to sunflower production in the U.S.S.R., Romania, Bulgaria, Hungary, Yugoslavia, and, more recently, Spain. The solution to the problem was approached from two sides: (1) development of sunflower varieties and hybrids resistant to this floriferous parasite and (2) chemical control of the parasite. Unfortunately, the latter attempt has not rendered satisfactory results (Vasiljev and Baranova, 1974; Aćimović, 1978).

The work on the development of resistant varieties was most intensive in the U.S.S.R. However, the developed varieties tended to gradually lose their resistance due to the occurrence of new and more virulent pathogenic races.

So far, three physiological races (groups) of *Or. cumana* have been

identified —A, B, and M. Race B is more virulent than race A, race M more virulent than either A or B. In the period 1910-1927, sunflower varieties Saratovski 169, Kruglik 631, and Kruglik A-4 were developed which were resistant to race A. A more virulent race B, which occurred subsequently, attacked all varieties resistant to race A. Varieties VNIIMK 8931, Peredovic, Smena, etc. were then developed which were resistant to races A and B (Pustavoit, 1966).

A new race of *Or. cumana*, Moldavian (M), occurred in early sixties, attacking all varieties resistant to races A and B (Sharova, 1968).

Buherovich (1966) studied three populations of *Or. cumana* collected from different sunflower-growing regions of the U.S.S.R. but on the same varietal assortment. He found differences in the intensity of attack depending primarily on the origin of seed of the parasite —the races of the parasitic populations from the regions of Kishenyev and Vejdelev were more virulent than the races of the population from the Region of Krasnodar.

The same author analysed for three years the racial composition of a Moldavian population on the same varietal assortment and found that the composition varied from year to year (Buherovich, 1967).

Analysing a population of Moldavian *Or. cumana*, Sharova (1968) concluded that its virulence differed considerably from those of other populations, specially that from the region of Krasnodar. She found the Moldavian population to have 17-22 very virulent physiological races.

We tested three populations of *Or. cumana* on different sunflower genotypes in order to determine the existence of physiological races of *Or. cumana* in the northeastern part of Yugoslavia. The results are given in Table 1.

The results in Table 1 show that the examined genotypes reacted differently towards the populations of *Or. cumana*. The reaction of sunflower genotypes differentiated clearly seven degrees of the parasite's virulence which, roughly speaking, represent seven physiological races of the parasite.

First race was differentiated by those genotypes which showed high susceptibility to all three parasitic populations (SSS = Or V1); second race was differentiated by the genotypes susceptible to populations A and B and resistant to population C (SSR = Or V2); third race was differentiated by the genotypes susceptible to populations A and C and immune to population B (SIS = Or V3); fourth race was differentiated by the genotypes resistant to populations A and C but susceptible to population B (RSR = Or V4); fifth race was differentiated by the genotypes resistant to population A, susceptible to popula-

tion B, and immune to population C (RSI = Or V5); sixth race was differentiated by the genotypes resistant to population A and immune to populations B and C (RII = Or V6); seventh race was differentiated by the genotypes immune to populations A and C but susceptible to population B (ISI = Or V7).

Tab. 1 - Virulence of *Or. cumana* populations

No.	sunflower genotype	Virulence			Race
		A	B	C	
1.	NS-S	S	S	R	Or V2
2.	NS-S-1	S	S	S	Or V1
3.	NS-S-2	S	S	S	Or V1
4.	NS-S-3	S	S	S	Or V1
5.	NS-S-4	R	S	R	Or V4
6.	NS-S-5	S	S	R	Or V2
7.	NS-S-6	S	S	S	Or V1
8.	NS-S-7	S	S	S	Or V1
9.	NS-S-8	S	S	R	Or V2
10.	NS-S-11	S	S	S	Or V1
11.	NS-S-12	S	S	S	Or V1
12.	NS-S-13	S	S	S	Or V1
13.	NS-S-15	S	S	S	Or V1
14.	NS-S-16	S	S	S	Or V1
15.	NS-S-17	S	S	S	Or V1
16.	NS-S-18	S	S	S	Or V1
17.	Ex-H-NS-H-25	S	S	R	Or V2
18.	Ex-H-NS-H-26	R	S	I	Or V5
19.	Ex-H-NS-H-62	R	S	I	Or V5
20.	Ex-H-NS-H-67	S	S	S	Or V1
21.	STR-384 x R-114	R	I	I	Or V6
22.	STR-388 x R-115	R	I	I	Or V6
23.	STR-390 x R-116	S	I	S	Or V3
24.	STR-393 x R-118	I	S	I	Or V7

The relationships among the identified races of *Or. cumana* are shown in Table 2.

Table 2 - Frequency of physiological races of *Or. cumana* on the examined sunflower genotypes

No.	Race	Frequency	Frequency in %
1	Or V1	13	54.20
2	Or V2	4	16.60
3	Or V3	1	4.20
4	Or V4	1	4.20
5	Or V5	2	8.30
6	Or V6	2	8.30
7	Or V7	1	4.20
Total:		24	100.00

The results given in Table 2 show that the most frequent race was Or V1. It occurred 13 times or 54.2%, Or V2 four times of 16.6%, and Or V5 and Or V6 two times or 8.3%. Or V3, Or V4, and Or V7 were the least frequent races; each of them occurred only once, or 4.2%.

Sum values of the virulence of *Or. cumana* populations on sunflower genotypes are given in Table 3.

Table 3 - Sum results of *Or. cumana* virulence

<i>Or. cumana</i> population	Virulence	No. of sunflower genotypes
A	S	18
	R	5
	I	1
B	S	21
	R	0
	I	3
C	S	14
	R	5
	I	5

The results in Table 3 show that the examined populations of *Or.*

*cumana* differed considerably in the degree of virulence; population B was most aggressive, population C the least aggressive.

The results obtained in this study confirm the conclusions of Buherovich (1966) and Sharova (1968) that there are differences in virulence among *Or. cumana* populations.

## CONCLUSION

On the basis of a study on the degree of virulence of three populations of *Or. cumana* Wallr. which were collected in 1977 in Vojvodina, the northeastern part of Yugoslavia, and tested on 24 sunflower genotypes, the following seven physiological races of *Or. cumana* were identified: Or V1, Or V2, Or V3, Or V4, Or V5, Or V6, and Or V7.

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