

Independent Inheritance of Avirulence and Dodine Resistance in *Nectria haematococca* var. *cucurbitae*

A. Kappas and S. G. Georgopoulos

Nuclear Research Center "Democritus", Athens, Greece.

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ABSTRACT

Of six dodine-resistant mutants of *Nectria haematococca* var. *cucurbitae* obtained in the laboratory, four were found less pathogenic to squash seedlings than the original wild-type strains. However, no definite effect of dodine resistance genes on pathogenicity could be concluded. In one case, ap-

propriate genetic analysis showed the presence of a gene for reduced virulence which segregated independently of the gene for resistance to dodine present in the mutant strain. *Phytopathology* 61:1093-1094.

Additional key words: pathogenicity, squash root rot.

In recent years, there have been a number of reports of fungicide-resistant strains which are pathogenic under field conditions, and in some cases have created problems of practical significance (3). In some of the laboratory-induced fungicide-resistant mutants, on the other hand, virulence is often found reduced or entirely absent (1). Such an observation, however, does not prove that the resistant gene present affects virulence unless constant association of the mutant gene with the avirulent phenotype is found in all of the independently isolated mutants at the same locus, and in all the resistant recombinants from appropriate crosses. In this communication, data is given showing that the avirulence of a dodine (*n*-dodecyl-guanidine acetate)-resistant mutant of *Nectria haematococca* var. *cucurbitae* Dingley (syn. *Hypomyces solani* f. *cucurbitae* Snyder & Hans.) is not due to the dodine resistance mutation.

Following ultraviolet or gamma irradiation treatments, 12 dodine-resistant mutants of *N. haematococca* were obtained and grouped in four classes, *dod-1*, *dod-2*, *dod-3*, and *dod-4*, according to the mutated locus (5, 6). Six of these mutants were compared to the original wild-type strains with respect to pathogenicity on 5-day-old squash (*Cucurbita pepo* L.) seedlings using previously described techniques (1). The two wild-type strains, 10 and 14, were highly patho-

genic, causing death of ca. 90% of the seedlings within 15 days following inoculation (Table 1). Such high virulence was found in only two of the six dodine-resistant mutants tested. Although only one representative of each of the classes *dod-2*, *dod-3*, and *dod-4* was used in these pathogenicity tests, the results obtained with the three *dod-1* mutants suggest that the fungicide-resistant gene has no definite effect on virulence for the host plant, for the pathogenicity has not been affected in strain RD₄ but has been greatly reduced in RD₁₀ and RD₂₇.

To further investigate this point, the dodine-resistant, almost avirulent strain RD₂₇ was crossed to the wild-type, highly pathogenic strain 10, and samples of 23 random ascospore progeny isolates were analyzed for both dodine resistance and pathogenicity. The techniques for making crosses and for random ascospore analysis have been described (2). About half of the 11 progeny isolates that were resistant to the fungicide were highly virulent, like their dodine-sensitive parent, in spite of the presence of the mutant gene *dod-1* (Table 2). The fungicide-sensitive progeny from the same cross showed a similar 1:1 segregation for viru-

TABLE 1. The pathogenicity to squash seedlings of dodine sensitive and dodine-resistant strains of *Nectria haematococca* var. *cucurbitae*

Strain		Mutated locus	Number of seedlings	
Wild type	Mutant		Inoculated	Killed within 15 days after inoculation
10		None	44	40
	RD ₄	<i>dod-1</i>	44	40
	RD ₁₀	<i>dod-1</i>	46	4
14		None	46	40
	RD ₉	<i>dod-2</i>	46	40
	RD ₁₄	<i>dod-4</i>	46	0
	RD ₁₅	<i>dod-3</i>	44	6
	RD ₂₇	<i>dod-1</i>	46	2

TABLE 2. Independent inheritance of dodine resistance and reduced virulence to squash seedlings in strain RD₂₇ of *Nectria haematococca* var. *cucurbitae*

Strain used to inoculate 40 seedlings	Seedlings killed within 15 days after inoculation	
Dodine-resistant progeny from cross RD ₂₇ × 10	No.	%
	1	97.5
	2	2.5
	3	87.5
	4	90.0
	5	20.0
	6	90.0
	7	5.0
	8	92.5
	9	0.0
	10	7.5
	11	95.0
Parents		
	10	90.0
RD ₂₇		7.5

lence:avirulence and, therefore, in the cross RD₂₇ × 10, a pair of allelomorphs affecting pathogenicity segregates independently of the *dod-1* gene controlling resistance to dodine. This independent mutation might have been induced by the radiation treatment or taken place in culture after the isolation of the resistant strain.

In the case of apple scab (*Venturia inaequalis*), the high virulence of dodine-resistant strains has become known through the serious damage that they cause under field conditions (7). It is not yet known whether a multigenic system for resistance to dodine exists in *V. inaequalis*, as has been found to be the case with resistance to other fungitoxicants (4, 8). The present study shows that in a multigenic system, even if one of the resistance mutations affects virulence this does not have to be the case with all of them. Comparison of *dod-2* and *dod-3* in Table 1 is sufficient to demonstrate this point. Furthermore, in a laboratory-induced resistant strain that may be found avirulent, this avirulence may be due not to a pleiotropic effect of the fungicide-resistant gene but to an independent mutation at another locus, as is the case with strain RD₂₇ of *N. haematococca* var. *cucurbitae* (Table 2).

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