INTERACTION BETWEEN NON-HOMOLOGOUS PORTUGUESE ISOLATES OF *Albugo candida* AND *Brassica oleracea*

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INTRODUCTION

Albugo candida is the causal agent of white rust or blister in crucifers. The aerial parts of infected plants become recovered with white, chalky, blister-like pustules, and hypertrophy, distortion ("stagheads") and abnormal pigmentation of the affected tissues are also frequent. It causes major economic losses on commercial brassica crops. Like other aerial fungal diseases, white blister has, in recent years gained some importance, because modern F_1 hybrids are more susceptible to diseases, and consumers concern about pesticide residues have restricted the application of chemicals for disease control (Kalloo & Bergh, 1993).

Physiological specialization in *A. candida* has long been reported, and until now has been related ten biological races (Hill *et al*.,1988). Although isolates of *A. candida* cause most severe symptoms on the species from which they were originally isolated (homologous), they are usually capable of colonizing some genotypes of related species .(Pound & Williams, 1963; Liu & Rimmer, 1991; Petrie, 1988). There are almost no reports in literature about the interaction and variation of response of *Brassica oleracea* to non-homologous isolates of *A. candida.* The objective of this study was to find more about these interactions, using isolates collected in *B. rapa* and in *Raphanus sativus*.

Table 1 - List of five isolates of *A. candida* (Ac), collected in the field and used in the pathogenicity study.

Number[1]	Place of collection	Host
Ac 506	**Portimão**	***B. rapa var. rapa***
Ac 508	**Lourinhã**	***B. rapa var. pekinensis***
Ac 509	**Costa de Caparica**	***B. rapa var. rapa***
Ac 510	**Póvoa do Varzim**	***B. rapa var. pekinensis***
Ac 513	**Portimão**	***R. sativus***

[1] **Code number of the isolates in the crucifer isolates genebank of Instituto Superior de Agronomia.**

MATERIAL AND METHODS

Forty accessions of *B. oleracea* from different locations were screened for their susceptibility to non-homologous *A. candida* isolates, at cotyledon stage.

In Table 1 are listed the five portuguese *A. candida* isolates used in this study: Ac 506, Ac508, Ac509, Ac510, from *B. rapa* ; Ac513, from *R. sativus*. Accessions designations/common names and genebank sources are described by Jorge (1998), and partially listed in Table 2.

Zoospore suspension, inoculation of seven days age seedlings and incubation conditions, were made according to the method described by Williams (1985). The susceptible host-pathogen interaction phenotype (IP) was evaluated ten days after inoculation and scored according the classes of Leckie *et al*. (1996):S_1 = sparse sporulation on the upper face of cotyledon, no sporulation on the lower face; S_2 = sparse sporulation on both faces of cotyledon; S_3 = heavy sporulation, with large to coalescent pustules on the lower face of cotyledon, or both.

The experiment was arranged as completely randomized blocks. Were screened by accession a total of thirty seedlings, distributed by three replications.

The results of each accession were expressed as percentage of seedlings on each susceptibility IP class.

RESULTS AND DISCUSSION

In Table 2 are presented the interaction phenotypes of the most susceptible accessions, expressed in percentage. Some accessions presented susceptibility to the non-homologous isolates of *B. rapa*, mainly head cabbage 'Large Blood Red' and savoy cabbage 'Brusselse Winter'. These accessions exhibited mean levels of infection higher than 20 and 46.7% respectively, independently of the *B. rapa* isolate tested, but there was some variation for response to isolates. Brussels sprouts 'Gr. Sel.v. Prooiem' revealed susceptibility only to Ac 508, with a mean level of infection of 13.3%. The isolates Ac508 and Ac510 revealed higher pathogenicity in the forty *B. oleracea* accessions tested than isolates Ac506 and Ac509.

The isolate from *R. sativus* was the less pathogenic for the *B. oleracea* accessions tested. The kale 'Verza San Giovanni' was the accession that exhibits higher susceptibility to this isolate with 20.7% of infected plants.

This results showed that are differences amongst *B. oleracea* accessions, and between isolates, and that is important to know more about the interactions and the variability between them.

Table 2 – Examples of susceptibility phenotypes[1] in the non-homologous *B. oleracea* - *A. candida* interactions (%).

	ISOLATES[2]									
	Ac 506		Ac 508		Ac 509		Ac 510		Ac 513	
ACCESSIONS[3]	S_1	S_2+ S_3	S_1	S_2+ S_3	S_1	S_2+ S_3	S_1	S_2+ S_3	S_1	S_2+ S_3
2 – Kale"Chembere Dzagumhana" (HRI 4293)	3.4	0.0	0.0	**13.3**	3.3	0.0	0.0	3.3	0.0	0.0
3 - Kale "Verza San Giovanni" (HRI 4773)	0.0	0.0	0.0	3.3	0.0	**6.7**	0.0	3.3	**10.3**	**10.3**
7 - Kale (HRI 8207)	0.0	0.0	0.0	3.3	3.4	**10.3**	**10.7**	**14.3**	**7.1**	0.0
14 - "Aut. It. Pyr. Type" Cauliflower (HRI 4988)	0.0	0.0	0.0	**20.0**	0.0	0.0	0.0	0.0	0.0	**6.7**
20 - **"L. B. Sel. Smit" Cabbage** (CGN 11121)	**6.7**	**6.7**	**6.7**	0.0	**10.0**	**16.7**	3.3	3.3	0.0	3.3
22 - **"Large Blood Red" Cabbage** (HRI 7833)	**13.3**	**6.7**	**6.7**	**33.3**	**10.0**	**10.0**	3.3	**26.7**	0.0	**6.7**
35 - "Gr.sel. Prooiem"Brussel sprouts (CGN 14076)	0.0	0.0	0.0	**13.3**	0.0	0.0	0.0	0.0	0.0	0.0
39 - **Brusselse Winter Savoy cabbage**(CGN 7102)	**23.3**	**23.3**	**10.0**	**40.0**	**23.3**	**26.7**	**13.3**	**43.3**	0.0	3.3
40 - **Rapid cycling CrGC 3.4 (control)**	**3.3**	0.0	0.0	**13.3**	0.0	**11.1**	3.3	**16.7**	0.0	0.0

[1] **S1, S2 and S3** – Increasing susceptibility interaction phenotypes, according to Leckie *et al.* (1996);[2] Host of **Isolates**: Ac 506 and Ac509 from *B. rapa* var. *rapa*; Ac 508 and Ac510 from *B. rapa* var. *pekinensis*; Ac513 from *R. sativus*. [3]Botanical varieties of the 40 ***B. oleracea*** studied: 2 to 7 (var. *acephala*); 14 (var. *botrytis*); 20, 22 (var. *capitata*); 35 (var. *gemmifera*); 39 (var. *sabauda*); 40 = rapid cycling *Brassica*. CGN = Center for Genetic Resources, Wageningen, Netherland; CrGC = Crucifer Genetic Cooperative, Madison, Wisconsin, U.S.A.; HRI = Horticulture Research International, Wellesbourne, United Kingdom.

CONCLUSIONS

Non-homologous isolates of *B. rapa* and *R. sativus* were able to colonize some *B. oleracea* host accessions, which means that it is important to study the interaction and the variability between different brassica accessions and isolates, and to review the concept of "races" of *A. candida* to *formae speciales*.

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