

Host-pathogen interaction between *Alternaria* species and *S. tuberosum* under different conditions

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SUMMARY

Under favorable for the early blight development conditions, the *Alternaria* fungus species (*A.alternata* and *A.solani*) differed in their pathogenicity towards potato leaves and tubers. *A.alternata* isolates are characterized by the higher aggressiveness especially towards the leaves, whereas isolates of *A. solani* are more aggressive towards tissue of potato tubers. On the basis of a leaf reaction for *A.alternata* and *A.solani* infection, tested cultivars were divided into 3 groups: resistant, medium sensitive and sensitive. Only a part of them showed clear-cut reaction for both of the *Alternaria* species. A few cultivars revealed quite a dissimilar reaction for *A.alternata* and *A.solani* species.

KEYWORDS

potato, early blight, *Alternaria alternata*, *Alternaria solani*, cultivar resistance.

INTRODUCTION

Recent years showed an increase in the importance of a fungal disease called early blight. Early blight, that is caused by two species of genus *Alternaria* (*A.solani* and *A.alternata*), occurs worldwide on potato crops, particularly in the regions with high temperature and alternating periods of dry weather and high humidity and/or irrigated potato soils, light-textured, sandy, low in organic matter (Gudmestad and Pasche 2007). *A.solani* and *A.alternata* – causal agents of the early blight are more and more risk-important pathogens on potato crops. The early blight occurs in all potato production areas, but there is a significant impact on the tuber yield and the quality only in warm, wet conditions in the early season, which favours a rapid disease development. Quantity share of both species varies and is dependent on the climate / on the weather conditions (Hausladen and Leiminger 2007, Kapsa 2007).

In Polish climatic conditions high regional losses caused by early blight – up to 45%, were recorded. However, most of these high losses were associated with cultivars with recognized susceptibility to this disease (Kapsa and Osowski 2004).

The causal agents of the early blight are typical examples of a necrotrophic organism, when a pathogen infects weaker and older plants (Rotem 1966). Potato plants infected with some viruses are more susceptible to the early blight infection (Hooker 1990).

Genetic resistance of cultivars to pathogens is one of the major factors taken into consideration at the assessment of usefulness of a cultivar for cultivation at severe infection pressure of pathogen or for determining the number of chemical treatments.

The aim of the studies carried out in Bonin in the years 2003-2005 was to estimate the level of susceptibility of different potato cultivars to two species of *Alternaria* fungus and the correlation between the leaf and tuber resistance of the tested cultivars.

MATERIALS AND METHODS

Studies on the leaf and tuber resistance of selected potato cultivars to 2 pathogens: *Alternaria alternata* and *Alternaria solani* were carried out under laboratory conditions. Thirty six selected potato cultivars, which differed in the earliness (from very early to late), were examined during summer (on the leaf resistance) and after the harvest (on the tuber resistance). The aggressiveness of the pathogens was assessed using a method with artificially inoculated detached leaves and sliced tubers („sandwich method”).

From each examined cultivar, 10 leaves from the same stem segment and 10 tubers were collected for the tests. Plant material was placed in a cuvette on moistened filter paper and infected with inoculum of *A.alternata* and *A.solani* at the concentration 100 spores / 1 mm³. One droplet of inoculum was placed with a pipette on 10 detached leaves and between 10 pairs of tuber slices.

The inoculated plant material was incubated for 7-9 days (leaves) and 15-20 days (tubers) at the temperature of 18°C, RH 100%, under 16-hour artificial light (2000 luxes). Criteria for evaluation were as follows:

- percentage of successful infections and size of lesions,
- percentage of changed leaf surface (yellowing tissue, chlorosis, necrosis),
- percentage of upper tuber slice surface covered with mycelium.

Collected results were analyzed statistically with the use of the analysis of variance and the index of correlation.

RESULTS AND DISCUSSION

The experimental results and analysis of variance revealed significant differences in the susceptibility of leaves and stems of examined potato cultivars to *Alternaria* infection, depending on the fungus species which was used for inoculation. *Alternaria alternata* was more aggressive towards potato leaves, developing 2-3 times greater changes on the leaf tissue (tab.1). The same reaction was observed among all tested cultivars in all maturity groups. The mean level of leaf infection caused by *A. alternata* was assessed for 12,7%, whereas caused by *A.solani* was 5,3%

Table 1. Average level of infection caused by *Alternaria* spp. on leaves (%)

Pathogen	Maturity		
	First early+early (13)	Medium early (10)	Medium late+late (11)
<i>A. alternata</i>	13,6	12,3	12,2
<i>A. solani</i>	5,7	4,1	6,2

Opposite reaction was observed after the tuber inoculation (tab.2). *A.solani* species seemed to be very aggressive towards the flesh of the tested potato tubers, causing really greater changes in the tuber tissue. An average level of infection caused by *A.alternata* was assessed for 4,2% whereas caused by *A.solani* was 32,7%.

Table 2. Average level of infection (%) caused by *Alternaria* spp. on tubers

Pathogen	Maturity		
	First early+early (13)	Medium early (10)	Medium late+late (11)
<i>A. alternata</i>	2,1	4,3	6,1
<i>A. solani</i>	35,5	32,5	30,1

Very early and early cultivars.

Among fourteen of the very early and early cultivars, a few of them - Rosalind, Inovator, Lady Claire, Korona and Felka showed the most sensitive reaction of the leaves for *A. alternata* infection (tab.1, fig. 1). Symptoms of a changed leaf surface caused by *A. solani* were much weaker, when compared to the *A. alternata* infection; the most sensitive reaction was observed on cultivars Lady Claire, Korona and Lord.

A different tuber reaction was also observed after *A. alternata* and *A. solani* inoculation. Tuber tissue of cultivars Gracja, Lady Claire, Bard and Rosalind was the most sensitive for *A. solani* infection. The reaction of the all cultivars' tubers was very weak after inoculation with *A. alternata* (tab.2, fig. 1). Only tubers of Dorota and Molli reacted more clearly for *A. alternata* pathogen.

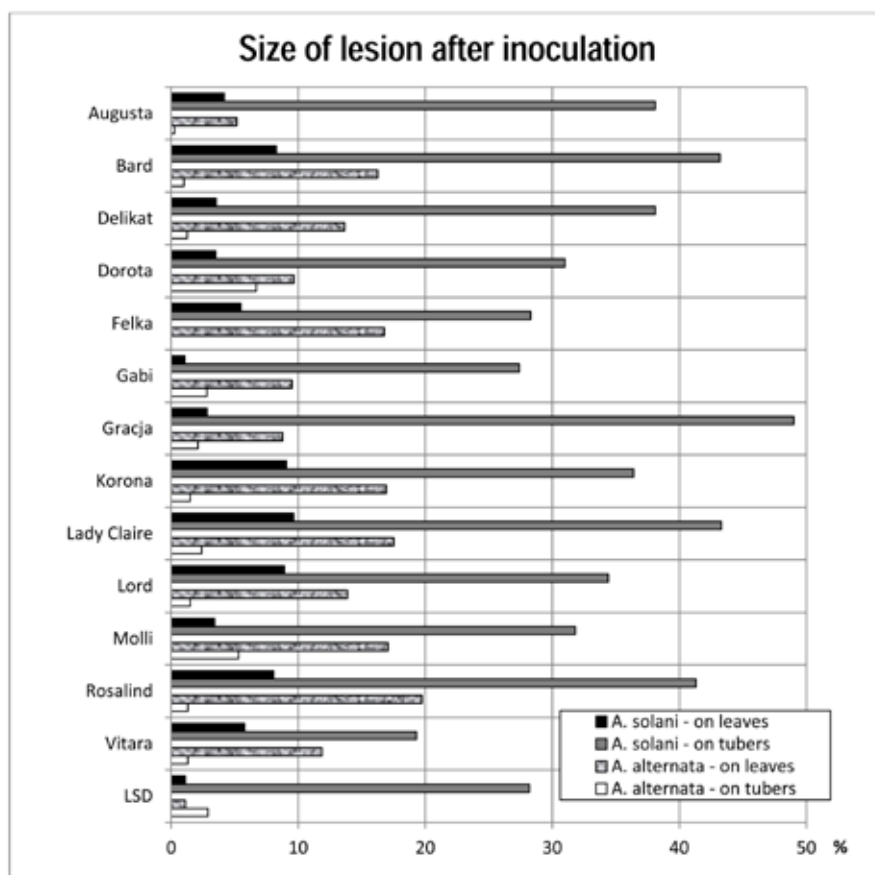


Figure 1. Comparison of leaf and tuber reactions of very early and early potato cultivars to *Alternaria* infection

Medium early cultivars.

Similar reaction for *Alternaria* species infection was observed in the group of medium early cultivars (tab. 2). Generally, stronger reaction of the leaves was observed after inoculation of *A.alternata* compared with *A.solani*. On the other hand, tubers of the all tested cultivars were more sensitive to *A. solani* infection.

Leaves of cultivars Asterix, Andromeda, Romula and Cycloon reacted very strongly on *A.alternata* infection whereas cultivars Asterix and Victoria were the most sensitive to *A.solani* infection. Tubers of Asterix, Andromeda and Pirol were very susceptible to *A.solani* infection. Andromeda, Zebra and Pirol were more sensitive to *A.alternata* than the rest of the tested cultivars.

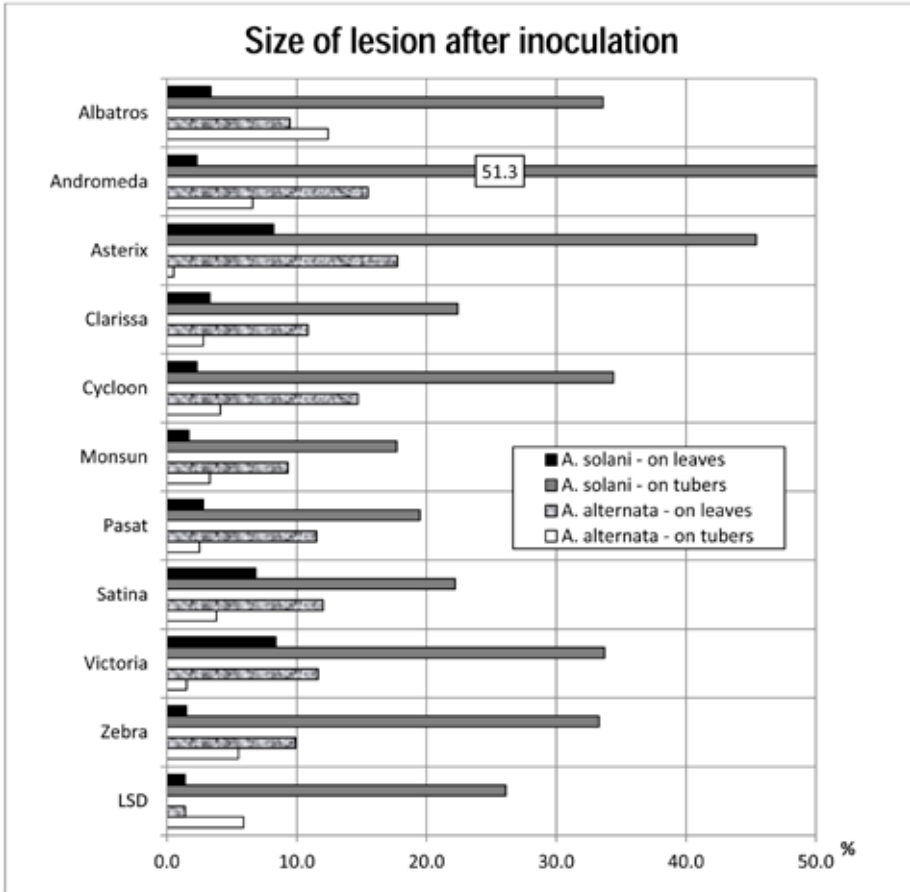


Figure 2. Comparison of leaf and tuber reactions of medium early potato cultivars to *Alternaria* infection

Medium late and late cultivars.

The biggest differentiation of leaf reactions to *A.alternata* was observed among eleven of the tested potato cultivars in this group of maturity. Cultivars Danusia, Fianna and Skawa were significantly more susceptible than the others. Differences of leaf reaction of tested cultivars in the group for *A.solani* infection was not so clear. Nevertheless, significant differences of tuber susceptibility to both of the pathogens were observed (fig.3).

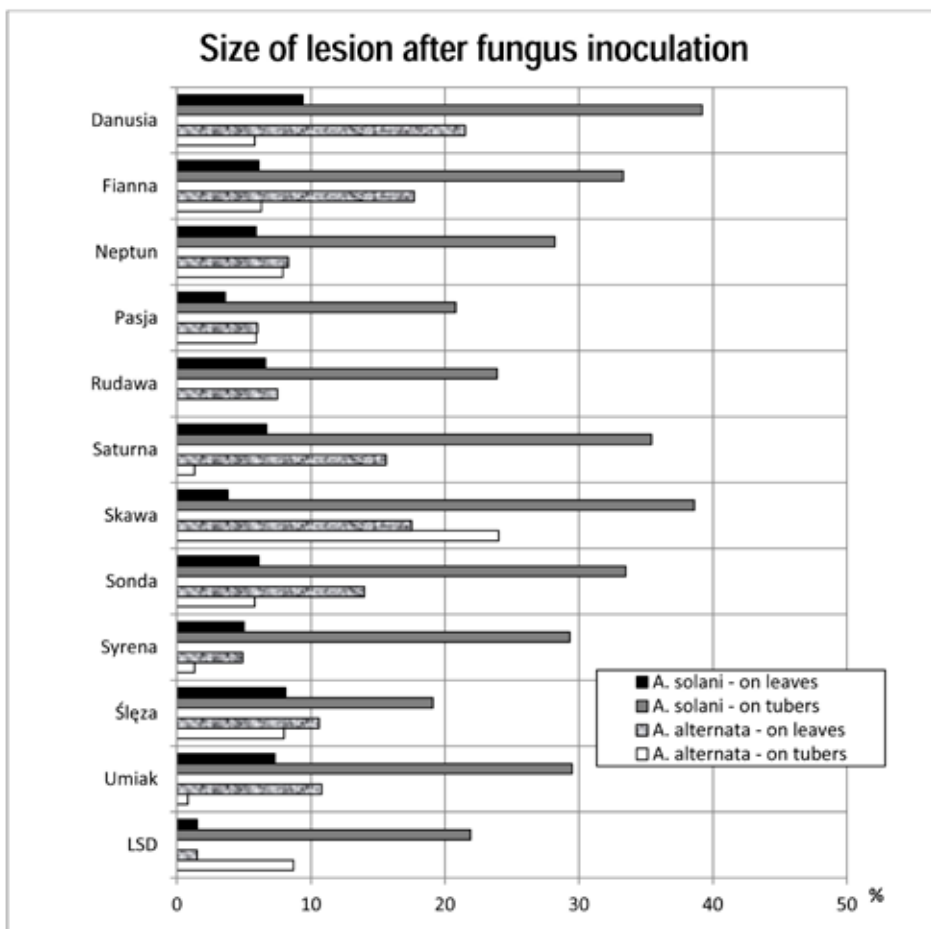


Figure 3. Comparison of leaf and tuber reactions of medium late and late potato cultivars to *Alternaria* infection

Laboratory tests carried out on 36 potato cultivars showed different reactions of the leaves and tubers to fungus *Alternaria*, depending on the pathogen species used for inoculation. Only some of the tested cultivars showed a similar leaf reaction to *A.alternata* and *A.solani* (tab.3). Resistant to both species were the cultivars Augusta, Dorota, Gabi, Gracja, Albatros, Clarissa, Monsun, Zebra, Pasja and Syrena. Medium sensitive cultivars were Lord, Vitara, Satina, Victoria, Sonda, Ślęza and Umiak. A few tested cultivars (Innovator, Molli, Andromeda and Skawa) showed quite different leaf reactions – susceptibility to the *A.alternata* infection and the resistance to *A.solani*.

Table 3. Level of susceptibility of different potato cultivars to *A.alternata* and *A.solani* (on the basis of leaf reaction)

Very early + early			Medium early			Medium late + late		
Cultivar	<i>Alternaria</i>		Cultivar	<i>Alternaria</i>		Cultivar	<i>Alternaria</i>	
	<i>alternata</i>	<i>solani</i>		<i>alternata</i>	<i>solani</i>		<i>alternata</i>	<i>solani</i>
Augusta	+++	+++	Albatros	+++	+++	Danusia	+	++
Bard	+	++	Andromeda	+	+++	Fianna	+	++
Delikat	++	+++	Asterix	+	++	Neptun	+++	++
Dorota	+++	+++	Clarissa	+++	+++	Pasja	+++	+++
Felka	+	++	Cycloon	++	+++	Rudawa	+++	++
Gabi	+++	+++	Monsoon	+++	+++	Saturna	+	++
Gracja	+++	+++	Pasat	++	+++	Skawa	+	+++
Innowator	+	+++	Romula	+	++	Sonda	++	++
Korona	+	++	Satina	++	++	Syrena	+++	+++
L.Claire	+	++	Victoria	++	++	Śleza	++	++
Lord	++	++	Zebra	+++	+++	Umiak	++	++
Moli	+	+++						
Rosalind	+	+++						
Vitara	++	++						

ratings:	+++	resistant
	++	medium sensitive
	+	sensitive

The process of profiling the susceptibility of the chosen potato cultivars to *Alternaria* showed different leaf and tuber reactions. The variations in the reactions depended on the fungus species that was used in the inoculation of the plant material. The further research in this area demands answering a basic question – if characteristics of the resistance of new potato clones should be based on the inoculation of leaves and tubers with a single species of the fungus or with a mixture of both species?

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