THE BEHAVIOUR OF CERTAIN POTATO VARIETIES AND LINES TOWARDS THE ATTACK OF THE *PHYTOPHTHORA INFESTANS (MONT) DE BARY FUNGUS*

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Abstract. This paper presents the behaviour of some potato varieties and lines towards the attack of the *Phytophthora infestans* (Mont) de Bary fungus under the field conditions of the Potato Research and Development Station, Targu-Secuiesc. During the observed period (2001-2003) the appearance of new forms of attack was registered, for example the attack on the stem, on the leaf petioles, as well as a greater number of infected tubers. The greatest number of blighted stems belonged to the varieties *Sante* and *Ostara*, and the smallest one was registered in the case of the variety *Lady Roseta*, followed by *Desiree* and *Nemere*. The results prove that there is a direct relationship between the frequency of the attack on the stems and that of the blighted tubers in the case of every variety, except for the varieties Lady *Roseta* and *Nemere* at which the smallest number of infected tubers was registered.

Keywords: *Phytophthora infestans,* varieties, attack on the stems, the frequency of blighted tubers

INTRODUCTION

The *Phytophthora infestans* fungus, which produces the blight of the potato and the tomato, is one of the most virulent parasites of the cultivated plants. It attacks all the organs of the potato plant, except for the roots. In the last few years there was remarked a dangerous form of attack in Romania, i. e. the attack on the stems [4]. The research carried on by KAPSA and PERZ-WOJCIECHOWSKA showed that the isolates on the stems are much more aggressive than those on the leaves [2]. This form of attack is dangerous because in this case the fungus survives under drought conditions, which causes sporulation and the disease starts again when conditions become favourable. BAIN et al. remarked that in the case of the attack on stems sporulation is realized on the whole attacked zone, not only on the edge of the lesion, as in the case of the attack on leaves [1].

In Poland 81,5 %, respectively 67,3 % of the examined potato plants were affected by stem attack in the years 1997 and 1998, the disease emerged 71 – 80 days after plantation [3]. All these facts show that the virulence of the *Phytophthora infestans* has increased. The analysis of the diversification of the attack forms proved the existence of a population with certain genetic differences in comparison to the former populations, i. e. the existence of a new population [5].

The objective of the research carried on was to know the behaviour of certain potato varieties and lines towards the attack of the *Phytophthora infestans* fungus on the leaf system, stems and tubers under the field conditions of the Potato Research and Development Station – Targu Secuiesc

MATHERIALS AND METHODS

For the study of the behaviour of certain potato varieties and lines towards the attack of the *Phytophthora infestans* fungus there was located an experiment with 10 potato varieties (*Ostara, Sante, Desiree. Cristian, Roclas*, *Kondor, Romano, Fresco, Escort, Rubin*) and 6 potato lines (Ts 91-867-50, Ts 92-923-1473, Ts 92-1078-64, Ts 92-1038-54, Ts 93-1089-42, Ts 93-1106-71) in the form of randomized blocks in four repetitions belonging to different maturity groups. During the vegetation period ratings were made according to the CIP (International Potato Center) scale, using classes from 1 to 9 (1 – there is no sign of the disease or only a few, no more than 1 – 2 spots / plant; 9 – all leaves dead, stems dead or almost dead). The observations were made on an untreated ground, depending on the climatic conditions of the region. While the attack on the leaf system was noted, blighted tubers were counted, as well. The harvest was done manually, the total crop was weighed and the blighted tubers were counted.

RESULTS AND DISCUSSIONS

It was stated that the behaviour of the potato varieties and lines towards the attack of the *Phytophthora infestans* fungus in the Targu-Secuiesc region (**Figures 1, 2, 3, 4, 5**), under conditions of natural infection, is different in the case of the same variety, depending on the climatic conditions of the given region.

According to certain authors (Groza, H., 1975) it seems that the variation of the field notes from one year to another in the case of the same variety is caused by the variation of the density and the racial composition of the inocul in the atmosphere. The varieties which were most intensely attacked by late blight during the three years examined were: *Cristian, Ostara, Fresco* (the latter except for the year 2003) and the least attacked were *Escort* and *Rubin*. In the case of the lines, the least attacked by late blight were Ts 91-867-50, Ts 93-1106-71, Ts 93-1078-64, in both years the average intensity of the attack was much reduced.

Analyzing data in **table 1** it can be observed that according to the estimates made on the field the varieties' behaviour was moderately sensitive in the case of the varieties *Ostara, Sante, Cristian, Romano, Fresco*; relatively resistant in the case of the varieties *Desiree, Roclas, Kondor, Escort;* and resistant in the case of the variety *Rubin*. The majority of the varieties behaved similarly to the characterization received at their homologation with respect to the leaf system's tolerance, but there were some exceptions, as well.

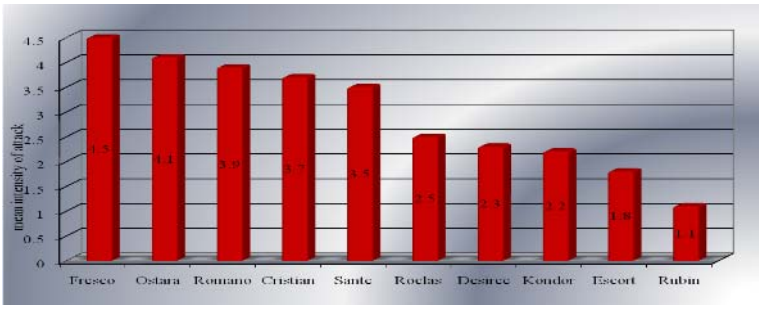

Figure 1. The behaviour of certain potato varieties to the pathogenic action of the *Phytophthora infestans* fungus – 2001

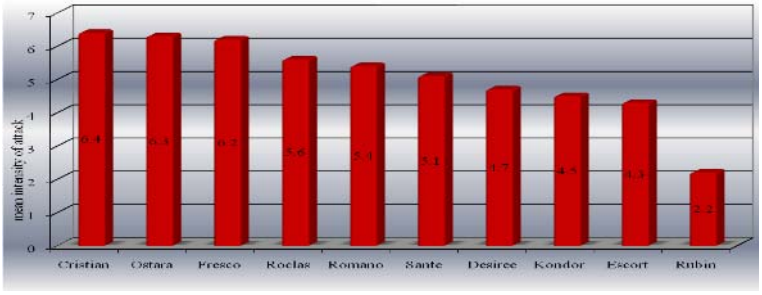

Figure 2. The behaviour of certain potato varieties to the pathogenic action of the *Phytophthora infestans* fungus – 2002

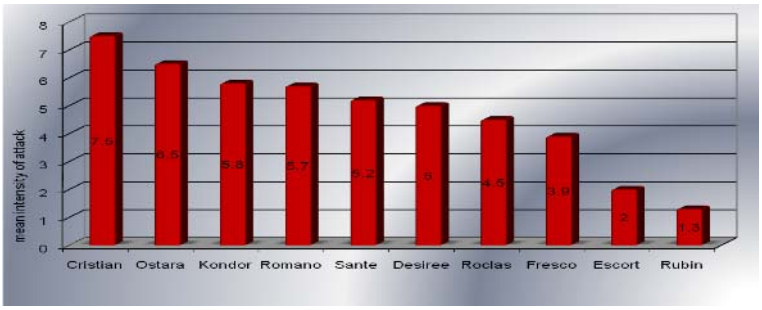

Figure 3. The behaviour of certain potato varieties to the pathogenic action of the *Phytophthora infestans* fungus – 2003

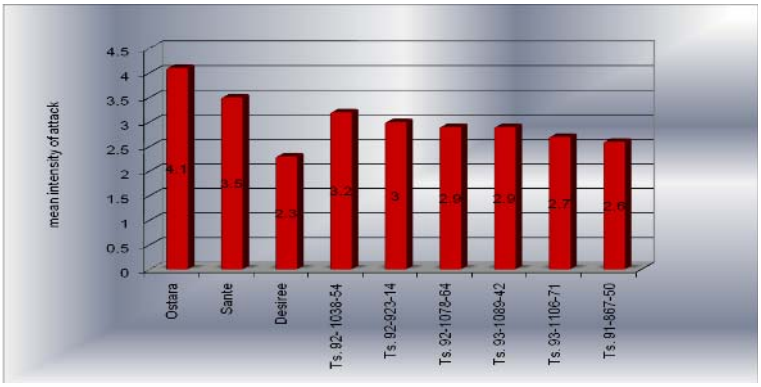

Figure 4. The behaviour of certain potato lines to the pathogenic action of the *Phytophthora infestans fungus* – 2001

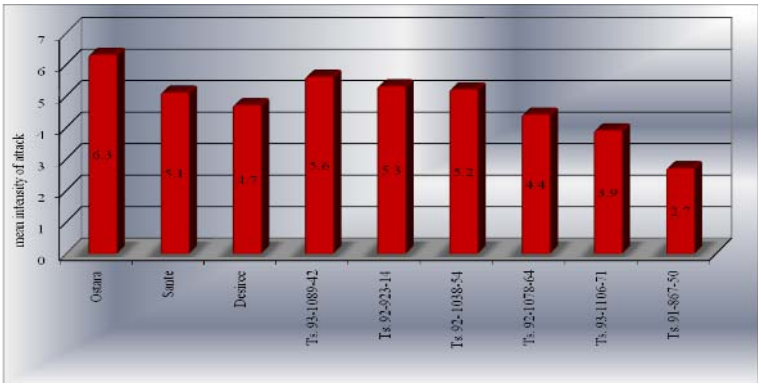

Figure 5. The behaviour of certain potato lines to the pathogenic action of the Phytophthora *infestans* fungus – 2002

Thus, the *Sante* variety behaved under natural conditions as moderately sensitive, while in the catalogue of potato varieties was listed as being relatively resistant. The *Roclas* variety is mentioned in the catalogue as a resistant one, but it behaved as a relatively resistant variety. In the culture the *Escort* variety oscillated between relatively resistant and resistant, in the catalogue being classified as a variety which is resistant to blight attack on the leaf system. These behaviour oscillations on the field of the varieties may be explained by the fact that the attack under natural conditions does not only depend on the climatic conditions but also on the pathogenic agent's spectrum of races.

Table 1. The behaviour of the potato varieties to the pathogenic action of the *Phytophthora infestans* fungus (2001-2003)

Variety	2001		2002		2003		2001 – 2003		Resistance in the catalogue of varieties	
	Average of blight attack	Noted resistance class	Average of blight attack	Noted resistance class	Average of blight attack	Noted resistance class	Average of blight attack	Noted resistance class		
Ostara	4,1	Rr	6,3	Ms	6,4	Ms	5,6	Ms	**5***	**Ms**
Sante	3,5	Rr	5,1	Ms	5,2	Ms	4,6	Ms	**6**	**Rr**
Desiree	2,5	Rr	4,4	Rr	5,0	***Ms***	4,0	Rr	**6**	**Rr**
Cristian	3,7	Rr	6,4	Ms	7,5	***S***	5,9	Ms	**5**	**Ms**
Roclas	2,4	R	5,6	Ms	4,4	Rr	4,2	Rr	**8**	**R**
Kondor	2,2	R	4,5	Ms	5,8	Ms	4,2	Rr	**6**	**Rr**
Romano	3,9	Rr	5,4	Ms	5,7	Ms	5,0	Ms	**5**	**Ms**
Fresco	4,5	Ms	6,2	Ms	3,9	Rr	4,9	Ms	**5**	**Ms**
Escort	1,8	R	4,3	Rr	2,0	R	2,7	**RR**	**8**	**R**
Rubin	1,1	Fr	2,2	R	1,3	Fr	1,5	R	**8**	**R**

* Classes in the catalogue of varieties (9 = very resistant, 1 = very sensitive)

All of the examined potato lines (**Table 2**) behaved as relatively resistant, just like the *Desiree* control variety.

Our observations concerning the attack on stems proved the importance of this form of attack on the frequency of the blighted tubers (**Fig. 6**). There was established a direct relationship between the attack on the stems and the sick tubers, except for the *Lady Roseta* and *Nemere* varieties, in case of which the number of blighted tubers was the most reduced. Our research shows (**Table 3**) that largest number of blighted stems belonged to the varieties *Sante* and *Ostara*, followed by *Redsec, Luiza, Coval, Milenium*, and the smallest number of blighted tubers was registered in the case of *Lady Roseta*, followed by *Desiree, Nemere* and *Productiv*.

Table 2. The behavior of the potato lines to the pathogenic action of the *Phytophthora infestans* fungus (2001-2002)

Line	2001		2002		2001-2002	
	Average of blight attack	**Noted resistance class**	**Average of blight attack**	**Noted resistance class**	**Average of blight attack**	**Noted resistance class**
Ostara (Mt)	**4,1**	Rr	**6,3**	**Ms**	**5,6**	**Ms**
Sante (Mt)	**3,5**	**Rr**	**5,1**	Ms	**4,6**	Ms
Desiree (Mt)	**2,5**	**Rr**	**4,4**	**Rr**	**4,0**	**Rr**
Ts. 91-867-50	2,8	Rr	2,7	Rr	2,8	Rr
Ts. 92-923-1473	3,0	Rr	5,3	Ms	4,2	Rr
Ts. 92-1078-64	2,9	Rr	4,4	Rr	3,7	Rr
Ts. 92-1038-54	3,0	Rr	5,2	Ms	4,1	Rr
Ts. 93-1089-42	2,9	Rr	5,6	Ms	4,3	Rr
Ts. 93-1106-71	2,9	Rr	3,8	Rr	3,4	Rr

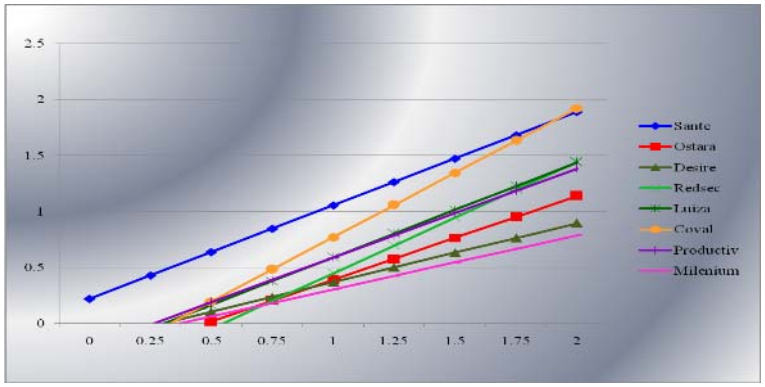

Figure 6. The relationship between the attacked stems and the sick tubers (*Phytophthora infestans*, Targu-Secuiesc, 2001-2003)

The analysis of correlations between the average number of blighted stems and the average number of blighted tubers (Table 4) shows that these correlations are very significant at: *Ostara, Redsec, Luiza* and *Coval*. In the case of these varieties the number of sick tubers grows in a larger proportion than at other varieties.

Table 3. The number of blighted stems and the number of blighted tubers at certain potato varieties, Targu-Secuiesc, 2001-2003

No.	Variety	Yield		Nr. of blighted stems		Nr. of blighted tubers		Rate between the nr of blighted stems / nr of blighted tubers	
		t/ha	Duncan test	nr. / m^2	Duncan test	nr. / m^2	Duncan test	Rate	Duncan test
1.	Sante	35,8	A	1,36	A	1,36	A	1,01	A
2.	Ostara	22,7	B	1,11	AB	0,47	BC	0,38	BC
3.	Desiree	35,0	A	0,61	BC	0,16	C	0,22	BC
4.	Redsec	38,6	A	0,75	ABC	0,19	BC	0,22	BC
5.	Luiza	38,9	A	0,86	ABC	0,47	BC	0,49	BC
6.	Lady Roseta	30,4	AB	**0,36**	C	**0,13**	C	0,50	BC
7.	Nemere	36,1	A	0,50	BC	0,13	C	0,44	BC
8.	Coval	36,3	A	0,88	ABC	0,63	B	0,58	B
9.	Productiv	36,4	A	0,58	BC	0,25	BC	0,38	BC
10.	Milenium	32,6	A	0,77	ABC	0,19	BC	0,16	C
	Average	**34,2**	-	**0,78**	-	**0,40**	-	**0,44**	-
	Coefficient of variation	**17,17**	-	**48,08**	-		-	**51,07**	-

Table 4. Correlation between the average number of blighted stems and the average number of blighted tubers at certain varieties, Targu-Secuiesc, 2001 - 2003

No.	Variety	Average number		Coefficient of variation	Equation terms Y=a+bx		Probability
		Blighted stems	Blighted tubers		a	b	
1.	Sante	1,36	1,36	0.95^{*}	0.22	0.83	0.020
2.	Ostara	1,11	0,47	0.99^{***}	-0.36	0.75	0.001
3.	Desiree	0,61	0,17	0.97^{**}	-0.16	0.52	0.008
4.	Redsec	0,75	0,19	0.98^{***}	-0.55	0.99	0.000
5.	Luiza	0,83	0,47	0.99^{***}	-0.26	0.85	0.000
6.	Lady Roseta	0,36	0,14	0.86	-0.05	0.519	0.091
7.	Nemere	0,50	0,14	0.80	-0.02	0.327	0.148
8.	Coval	0,89	0,64	0.98^{***}	-0.38	1.151	0.003
9.	Productiv	0,58	0,25	0.93^{*}	-0.21	0.797	0.035
10.	Milenium	0,78	0,20	0.96^{**}	-0.18	0.484	0.015

Bain et al. (1997) stated that the frequency of the sick tubers in a much closer relationship with the size of lesions on the stems than with the intensity of the attack on the leaf system. Considering the fact that attack on the stems is less relieved than the attack on the leaf system, the fact that the *Phytophthora infestans* fungus sporulates more abundantly on the stems than on the leaves may explain the high frequency of the blighted tubers in certain years, when the late blight attack was moderate or it was not evident on the leaf system [1].

CONCLUSIONS

In the Targu-Secuiesc region the range of potato varieties and lines reacted to the attack of the *Phytophthora infestans* pathogens in the following way:

- Moderately sensitive: *Ostara, Sante, Cristian, Romano, Fresco*;
- Relatively resistant: *Desiree, Roclas, Kondor, Escort*;
- Resistant: *Rubin*.

There existed oscillations of behaviour within the same variation from a year to another (the *Sante* variety behaved as moderately sensitive, being catalogued as a relatively resistant variety; *Roclas*, catalogued as resistant under field conditions behaved as relatively resistant etc.). The examined potato lines behaved as relatively resistant, as well as the *Desiree* control variety.

Especially important is the form of attack of the *Phytophthora infestans* fungus on the stems, which contributes to the maintenance of a high level of infection potential in the potato cultures. Our research concluded that the highest number of blighted stems belonged to the *Sante* and *Ostara* varieties, followed by *Redsec, Luiza, Coval, Milenium*, and the smallest number of blighted tubers was registered at *Lady Roseta*, followed by *Desiree, Nemere* and *Productiv*.

In the case of the cultivated varieties it was stated a direct relationship between the pathogen's attack on the stems and the number of sick tubers, which explains

the high frequency of blighted tubers in years when the attack on the leaf system was moderate.

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