THE EFFICIENCY OF SOME FUNGICIDES APPLIED TO CONTROL THE *PHYTOPHTHORA INFESTANS (MONT) DE BARY* FUNGUS ON POTATO

Daniela POPA*

**Potato Research and Development Station, Targu-Secuiesc, Romania*
daniela_ralpopa@yahoo.com

Abstract. The research was carried on at Targu - Secuiesc within 2002-2004 and its objective was to determine the most efficient fungicides to control the late potato blight caused by the fungus *Phytophthora infestans*. All the applied products were efficient in controlling the disease in comparison to the untreated control variant.

The results of the research show that during the observed period the products Curzate and Acrobat proved to be highly efficient in a constant manner at the three varieties: *Ostara, Sante* and *Desiree*. The lowest frequency of infected tubers was registered at the varieties treated with Altima, Acrobat, Tatoo C.

Keywords: *Phytophthora infestans,* fungistats, control, potato.

INTRODUCTION

Year by year the late blight of potato is the most harmful disease of the potato. The crop loss is different from region to region, i.e. it depends on the climatic conditions, the period when the attack takes place (the vegetation phase), the variety and the applied control measures [5].

Research on new fungicides with higher efficiency in controlling the late blight of potato caused by the *Phytophthora infestans* fungus is carried on continuously [1, 2]. In spite of that, no fungicide available at the moment provides absolute control of the late blight of potato [4]. There can be cited papers which present the efficiency of certain fungicides during different research projects[3, 6].

This paper presents the efficiency of certain fungicides in controlling the late blight of potato caused by the *Phytophthora infestans* fungus under the conditions specific to the Targu - Secuiesc region.

MATERIALS AND METHODS

The tests were carried out at the Potato Research and Development Station, Targu - Secuiesc, between 2002 - 2004 on the varieties *Ostara, Sante* and *Desiree*. The experiments were located in randomized blocks in four repetitions; the size of an experimental plot was 22.5 mp. There were applied all the technological stages of the cultivation. It was noted the intensity of the attack on the leaf system according to the CIP (International Potato Center) scale, using classes from 1 (no attack) to 9 (destroyed leaf system).

The fungicides examined between 2002 – 2004 were: Melody duo, Champion 50 WP, Acrobat, Antracol 70 WP, Curzate manox, Altima 50 SC, Folpan 50 WP, Tattoo C, Equation Pro.

In May, after the plants had sprouted, the Agroexpert system was put into function, the first treatment being done at warning. If this system does not exist, in the Targu - Secuiesc region the warning to the first treatment can be made based upon the following elements:

- Localization of the source of infection;
- Average temperatures of 16-21°C;
- Rainfall ≥ 20 mm;
- Duration of the presence of water drops (dew) ≥ 5 hours / day;
- Relative air humidity ≥ 75 %.

In general treatments were applied every 7 – 8 days in the case of the contact fungicides, but also at smaller or larger intervals depending on the weather conditions. In the case of the varieties treated with systemic fungicides the treatments were applied at intervals of 10 – 12 days.

Treatments were applied with a portable pump AS 16, using a quantity of 300 litters of solution per hectare. Vines were destroyed with cu Reglone 4 l/ha. The harvest was made manually, the total crop was weighed and the sick, blighted tuber was counted.

The crop registered according to varieties and repetitions was analysed statistically, and the results were interpreted based on limit differences.

RESULTS AND DISCUSSIONS

From the analysis of the climatic data (**Tables 1, 2, 3**) it was stated that the experimental years 2002 – 2004 were rich in precipitations, in July and August it was registered an excess of precipitation in comparison to the multiannual average for that period. Thermal conditions were also higher, exceeding the multiannual average, having values of 0.8 – 2.6°C.

In the year 2002 (**Table 1**) the attack of the *Phytophthora infestans* fungus emerged on the *Ostara* susceptible variety in the second decade of June, when the temperatures of 17.9°C, the precipitations of 47.1 mm and the number of 79.4 hours created favourable conditions for this pathogens.

In the year 2003 (**Table 2**) the climatic conditions registered in June, characterized by low precipitations (21.9 mm), average temperatures of 18.8°C, as well as a low number of hours with dew (48.1; 27.4; 30.5) contributed to the delay of the late blight attack's emergence until July 2.

Table 1. The climatic conditions of year 2002

Year	May		June		July		August	
2002	**tºC**	**dew (hours)**	**tºC**	**dew (hours)**	**tºC**	**dew (hours)**	**tºC**	**dew (hours)**
Decade I	13,8		13,9	65,8	20,4	74,8	18,7	121,4
Decade II	14,3		17,9 ***18.06**	79,4	21,7	80,6	16,6	59,6
Decade III	15,8	13,7	19,3	91,1	18,2	100,1	16,2	9,7
Monthly total		**13,7**		**236,3**		**255,5**		**190,7**
Monthly average	14,6		17,0		20,1		17,2	
Multiannual average	13,0		16,2		17,9		17,4	
Deviance	**+1,6**		**+0,8**		**+2,2**		**-0,2**	
	precipitation / no. days		**precipitation / no. days**		**precipitation / no. days**		**precipitation / no. days**	
Decade I	0,6	1	24,2	7	24,7	6	31,2	6
Decade II	11,7	3	47,1	5	17,8	5	33,3	7
Decade III	49,4	5	4,1	3	98,1	9	1,0	1
monthly total	61,7	9	75,4	15	140,6	20	65,5	14
Monthly average	70,8		84,0		78,7		62,7	
Multiannual average	**- 9,1**		**- 8,6**		**+ 61,9**		**+ 2,8**	
Deviance								

* - start date of the late blight attack on the *Ostara* variety

Table 2. The climatic conditions of year 2003

Year	May		June		July		August	
2003	**tºC**	**dew (hours)**	**tºC**	**dew (hours)**	**tºC**	**dew (hours)**	**tºC**	**dew (hours)**
Decade I	18,5	8,75	19,5	48,1	18,0 *2.07	90,45	18,3	105,3
Decade II	17,3	39,5	19,3	27,4	16,4	111,96	18,2	106,75
Decade III	17,0	107,75	17,6	30,5	18,7	134,5	19,4	86,6
Monthly total		**156,0**		**106**		**336,91**		**298,65**
Monthly average	17,6		18,8		17,7		18,6	
Multiannual average	13,0		16,2		17,9		17,4	
Deviance	**+4,6**		**+2,6**		**-0,2**		**+1,2**	
	precipitation / no. days		**precipitation / no. days**		**precipitation / no. days**		**precipitation / no. days**	
Decade I	3,1	3	18,6	3	41,2	8	18,3	6
Decade II	0,6	2	1,9	2	30,8	5	18,2	4
Decade III	23,8	8	1,4	2	25,3	5	19,4	1
Monthly total	27,5	13	21,9	7	97,3	18	50,6	11
Monthly average	70,8		84,0		78,7		62,7	
Multiannual average	**-43,3**		**-62,1**		**+18,6**		**+12,1**	
Deviance								

* - start date of the late blight attack on the *Ostara* variety

The climatic conditions of the year 2004 (**Table 3**) in the period when the late blight attack emerged were relatively similar to those in 2003. The attack of the *Phytophthora infestans* fungus on the *Ostara* susceptible variety emerged in the second decade of July.

These very favourable climatic conditions provided a proper microclimate for the emergence and development of the *Phytophthora infestans* fungus, the attack on the leaf system was extremely intense.

Thus, in the case of the *Ostara* variety (**Fig. 1**) the lowest average intensities of attack were registered at the varieties treated with the products Curzate and Acrobat, while the untreated control variant was attacked in a high percentage, 65%. In the case of the contact fungicides the registered attack was relatively severe; the active substances of these products not being absorbed by the plant tissues did not protect the new growths.

Of all the examined varieties the lowest average attack intensities were registered at the *Desiree* variety (**Fig. 2**). It can be stated that the lowest average attack intensities were registered at the varieties which were treated with the Curzate and Acrobat fungicides, respectively 15 %, these were the lowest values in the whole experiment. The varieties treated with Equation Pro and Tattoo behaved quite similarly, the late blight attack was situated between 24 - 28%. The untreated control variant displayed a continuous ascendant evolution, reaching 50%.

Table 3. The climatic conditions of year 2004

Year	May		June		July		August	
2004	**tºC**	**dew (hours)**	**tºC**	**dew (hours)**	**tºC**	**dew (hours)**	**tºC**	**dew (hours)**
Decade I	13,6	18,95	13,9	37,45	17,1 * 5.07.	102,5	16,9	65,15
Decade II	10,6	40,9	16,9	36,5	16,7	98,0	17,3	73,5
Decade III	12,4	93,5	17,7	22,6	18,6	133,5	17,5	100,5
monthly total		**153,35**		**96,55**		**334,0**		**239,15**
Monthly average	12,2		16,2		17,5		17,2	
Multiannual average	13,0		16,2		17,9		17,4	
Deviance	**-0,8**		**0,0**		**-0,4**		**-0,2**	
	precipitation / no. days		**precipitation / no. days**		**precipitation / no. days**		**precipitation / no. days**	
Decade I	0,8	2	6,6	5	21,3	4	39,0	6
Decade II	32,4	6	8,1	7	44,7	7	10,6	5
Decade III	12,6	3	4,3	3	37,5	7	25,7	3
monthly total	45,8	11	19,0	15	103,5	18	75,3	14
Monthly average	70,8		84,0		78,7		62,7	
Multiannual average	**-25**		**-65,0**		**+24,8**		**+12,6**	
Deviance								

* - start date of the late blight attack on the *Ostara* variety

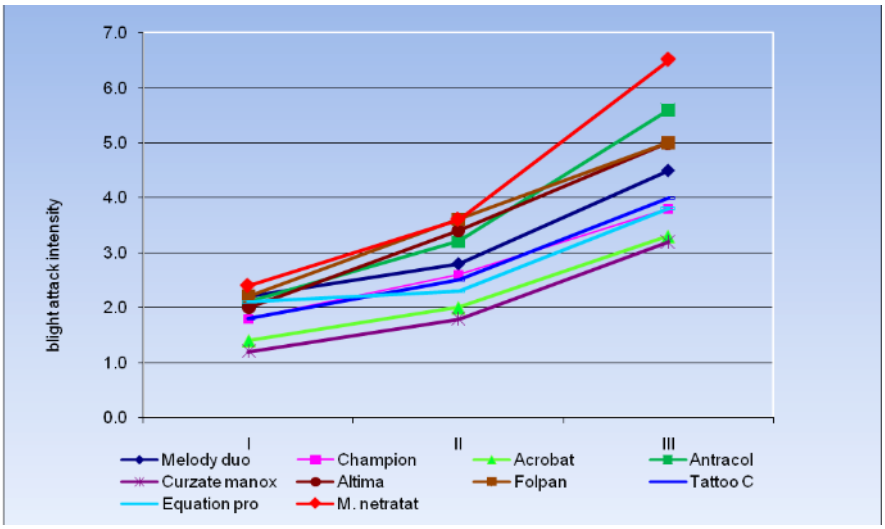

Figure 1. Blight attack on foliage to *Ostara* variety

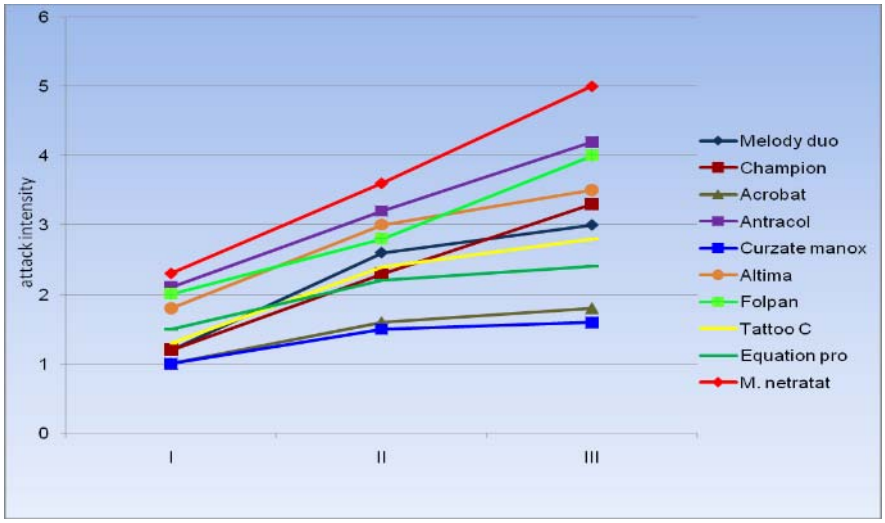

Figure 2. Blight attack on foliage to *Desiree* variety

In the case of the *Sante* variety (**Fig. 3**) the lowest average attack intensity, i. e. 20% was registered at the variety treated with the product Curzate. The fungicides which behaved well and very well were Acrobat, Tattoo and Equation Pro.

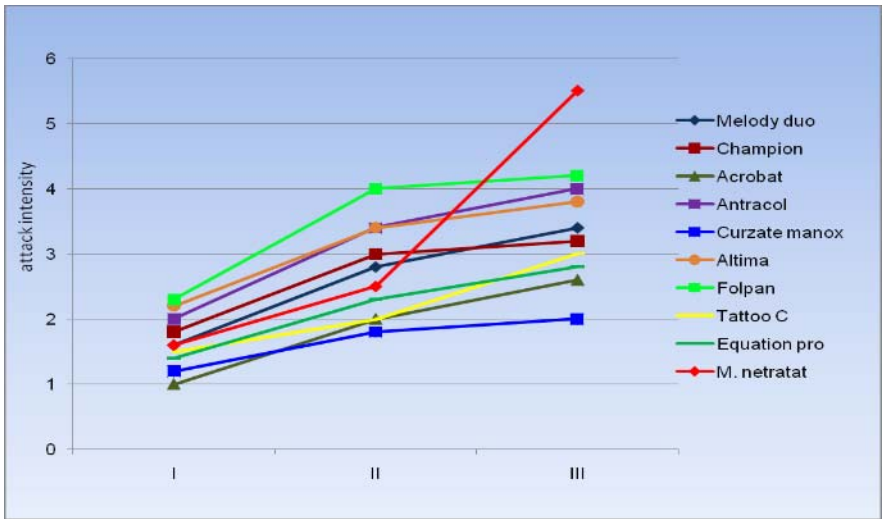

Figure 3. Blight attack on foliage to *Sante* variety

Table 4. The efficiency of certain fungicides in controlling the *Phytophthora infestans* fungus on the potato: 2002 - 2004

Fungicide	Dose Kg/ha	Ostara		Desiree		Sante		Media	
		t/ha	Duncan Test	t/ha	Duncan Test	t/ha	Duncan Test	t/ha	Duncan Test
Melody duo	3,0	**t/ha**	**Duncan Test**	**t/ha**	**Duncan Test**	**t/ha**	**Duncan Test**	**t/ha**	**Duncan Test**
Champion 50 WP	3,0	23,4	C	35,2	B	34,6	B	31,1	BC
Acrobat	0,4	23,7	C	31,8	B	28,8	C	28,1	C
Antracol 70 WP	2,0	30,4	A	35,3	B	35,6	A	33,8	AB
Curzate manox	2,5	23,5	C	31,0	C	30,9	B	28,5	C
Altima 50 SC	0,4	29,5	A	37,3	A	36,9	A	34,6	A
Folpan 50 WP	2,0	24,7	C	32,4	C	31,8	B	29,6	C
Tattoo C	2,5	22,6	C	32,0	C	28,5	C	27,7	D
Equation Pro	2,0	29,5	A	35,2	B	34,6	B	33,1	B
Control variant	3,0	27,4	B	37,0	A	36,3	A	33,6	AB

Dl 5% (fungicide) = 1,1 t/ha
Dl 5% (variety x fungicide) = 1,8 t/ha

According to **table 4** it can be stated that all the applied products were efficient in controlling the disease in comparison to the untreated control variant. The largest crops were obtained in the case of the variants treated with the products Curzate 34.6 t/ha; Acrobat 33.8 t/ha; Equatino Pro 33.6 t/ha and Tattoo 33.1 t/ha. The most reduced efficiency was obtained in the case of the variants treated with Folpan.

It was noted the frequency of the blighted tubers in the case of the variants treated with fungicides (**Fig. 4**).

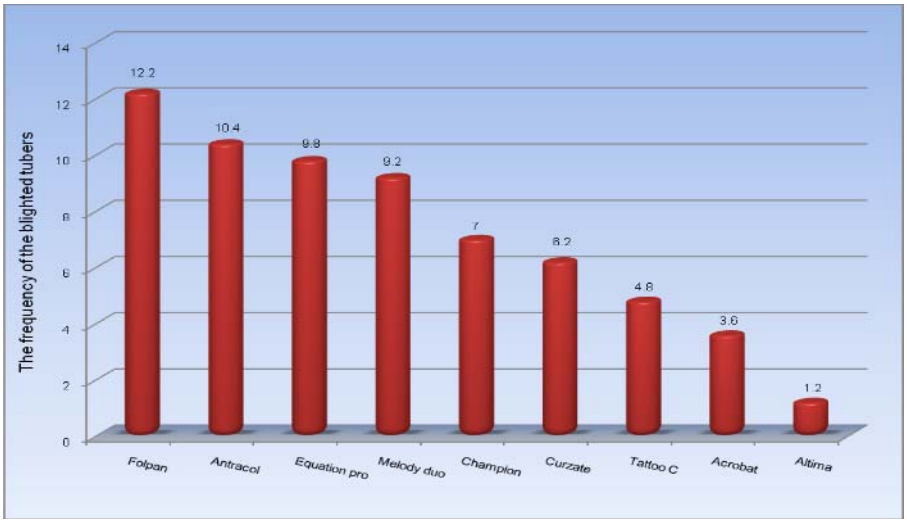

Figure 4. The frequency of the blighted tubers in the case of the variants treated with fungicides

These data show that the lowest frequency of blighted tubers was registered at the varieties Altima, Acrobat, Tattoo C, and the most blighted tubers were found at the varieties treated with Folpan, Antracol. It can be stated that the fungicides which protect tubers best against late potato blight are the ones that contain active substances based on fluazinam, dimetomorf, propamocarb and copper. The ones that have no effect are cymoxanil, mancozeb and chlorotalonil.

CONCLUSIONS

- The lowest average attack intensities were registered in the case of the *Desiree* variety, at the variants treated with the products Curzate and Acrobat
- From the point of view of the efficiency and production the following products proved to be outstanding: Curzate manox, Acrobat, Tattoo and Equation Pro.
- The lowest frequency of blighted tubers was registered at the variants treated with active substances based on on fluazinam, dimetomorf, propamocarb and copper. The ones that have no effect are cymoxanil, mancozeb and chlorotalonil.

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