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# Resistance of the potato blight causal agent *Phytophthora infestans* (Mont.) de Bary population to metalaxyl in Lithuania

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The study was performed in 1990–1998 at Lithuanian Agricultural Institute Elmininkai reset station. The aim of the study was to prove the existence of isolates of *Phytophthora infestans* (Mont.) de Bary (hereinafter referred to as *Ph. infestans*) the metalaxyl-resistant pathogen of potato late blight in the local population, and the trends of changes of the resistance.

Two methods were used for evaluation of resistance: the leaf disk method and the lawn method.

Isolates of the metalaxyl-resistant fungus *Ph. infestans* were found within all the years under research in all regions of Lithuania in the populations singled out both from tubers and vine. With the aid of the leaf disk method we found that according to the average data for 9 years 76.0–18.5% of isolates isolated from tubers and 97.7–23.4% of isolates from vines showed resistance to metalaxyl. The metalaxyl-resistance frequency within the years of the study deviated from 48.6 to 6.4%.

**Key words:** potatoes, late blight, isolate, metalaxyl, resistance

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## INTRODUCTION

From the end of the 60 s the systematic fungicides of the phenylamide group with metalaxyl as an agent were widely used for protection against late blight. The first among these fungicides was 25% rudomil. In the beginning it was used pure, without any contact component, later – in a form of mixture with polycarbacyn, copper oxychloride, mankoceb. Within the first year of application ridomil showed a high biological and economical efficiency. The application of ridomil allowed to an extra yield 20% [1]. There were no potato tubers or a very low number of them infected with late blight. Within the later years, because of a too intensive use (the fungicides of the phenylamide group were used 2–3 times), their protective effect dropped down, and resistant isolates of the fungus appeared.

Metalaxyl-resistant isolates were found in Canada, Holland, Ireland, Israel (1979), England and Ireland (in 1980 there were 50% of them and in 1987 – already 86%) [2, 3]. According to the data of research carried out in between 1985–1987, metalaxyl-resistant *Ph. infestans* isolates were found in Israel, Poland, Germany [4, 5]. According to the data of research performed in Belarus in 1989, 36% and in

1989 already 86 of the examined samples were metalaxyl-resistant % [6]. In Russia, metalaxyl-resistant *Ph. infestans* isolates were found in tubers and vines of potato of practically all sorts [7]. In Lithuania, metalaxyl-resistant fungus isolates were found for the first time in 1986. According to the data of J. Vorobjova and V. Shemiakina, in farms of Vilnius district the share of resistant isolates in the pathogen population in 'Pimūnės' and 'Varsna' sorts of potatoes was almost 80% [8].

The appearance of pathogen-resistant isolates was caused by the following factors: in most farms rudomil was used free of contact components and often 3–4 times within a season; sometimes rudomil was mixed or alternated with sandophane as well as with one of the fungicides of the phenylamide group, exchange of seeds among various regions where phenylamide-resistant isolated were found.

## MATERIALS AND METHODS

The study was performed in 1990–1998 at Elmininkai Station the Lithuanian Agricultural Institute. Investigation of the metalaxyl-resistance of the population of *Ph. Infestans*, the pathogen of potato late blight, was performed using the leaf disk and lawn

methods [9]. The leaf disk is a qualitative method. It enables to fix the presence of metalaxyl-resistant fungus isolates in the population if their number exceeds 1%. This means that if at least one resistant isolate is present in a sample, the sample under study will show resistance. The lawn method is quantitative. It enables to find the concentration of resistant fungus isolates in the population.

Samples for the analysis were selected among crops infected with late blight and tubers from storehouses at various places of the country.

For the study, solutions of the following concentrations were used: 1.0 mg/ml; 10.0 mg/ml; 100.0 mg/ml; 1000.0 mg/ml.

Leaves and tubers of 'Dietskoselskij' sort of potatoes, sensitive to late blight, were used as working material. A two-week culture of *Ph. infestans* was used for analysis.

## RESULTS AND DISCUSSION

Metalaxyl-resistant isolates of the fungus *Ph. infestans* were found in populations extracted from both tubers and vines in all regions of Lithuania each year. In the literature it is mentioned that metalaxyl-resistant fungus isolates are very vital and pathogenic, so part of tubers is damaged by resistant isolates.

Application the leaf disk method showed that 76.0 to 18.57% of isolates extracted from tubers and 97.7 to 23.4% of isolates extracted from leaves were metalaxyl-resistant (Table).

Within the 9-year period, a reduction of the number of metalaxyl-resistant isolates took place. In 1990, metalaxyl-resistance was shown by 97.1% of isolates extracted from vines and 72.1% from tubers and, in 1995, by 46.8% of and 39.4%, respectively, *i.e.* 2.1 and 1.8 times less. Three years later, in 1998, the numbers were 23.4% and 18.5%, respectively, *i.e.* 4.1 and 13.9 times less.

In Table, data on the metalaxyl-resistance frequency (the average data for 1990–1998) are presented. They show that the resistance frequency nine years ago 48.6%. This was caused by an intensive

use of preparations that contained metalaxyl, because at that time only systemic preparations of the phenylamise group were available in the market. In the later years the resistance continuously fell down. The first sudden reduction of resistance frequency occurred in 1993. For the second time the resistance frequency fell down more than twice in 1996. Later on, changes of the resistance frequency were inconsiderable and varied from 7.6 to 6.4%. This was predetermined by the changed farming conditions as well as by a general reduction of the use of fungicides. The depression of potato late blight in 1992 and 1994 affected the results as well, because the disease was manifested very weakly and few protection preparations were used, if any. In addition, the chirch of fungicides broodened and in the market new systemic preparations containing new agents (such as acrobat, tatoo and so on) appeared.

Based on the resistance frequency observed within the last three years (7.6–6.4%), it is possible to state that preparations containing metalaxyl may be used without considerable restrictions, following the strategy of the anti-resistance program. The base of this resistance-regulating strategy is an alternation of fungicide mixtures, various active materials within a season, because these mixtures cause a synergetic effect against the resistive isolates of the pathogene. If other active agents are used, then not only isolates sensitive to metalaxyl, but also those resistant to it are exterminated. A provisional rejection of metalaxyl-containing preparations is one of the measures to reduce the resistance, because the number of resistant isolates falls down in the course of time.

At present, to protect potato against late blight nine systemic fungicides are offered to potato cultivators of Lithuania; six of them contain active agents of the phenylamide group. But it is necessary to mention that new preparations containing other agents appeared in the market, and they soon became popular among cultivators and now are widely used.

## CONCLUSIONS

Isolates resistant to the metalaxyl fungus *Ph. infestans* are found each year in all regions of Lithuania in populations extracted both from potato tubers and vines. Within the study years the number of metalaxyl-resistant isolates decreased. Using the leaf disk method it was found that, according to the average data of the nine-year period, 77.2–18.5% of isolates extracted from tubers and 97.7–23.4% isolates extracted from leaves, were metalaxyl-resistant. On increasing the of concentration of metalaxyl the number of isolates of potato late blight able to grow and produce spores decreased. According to the

Years	% of metalaxyl-resistant samples		Resistance frequency, %
	in vine	in tubers	
1990	97.1	72.1	48.6
1991	97.7	76.0	47.8
1993	86.1	62.1	18.4
1995	46.8	39.4	14.2
1996	29.0	26.7	7.6
1997	22.3	19.2	7.2
1998	23.4	18.5	6.4

average data, the metalaxyl-resistance frequency within the study years varied between 48.6–6.4%. As the resistance frequency within the last three years was <10%, the preparations containing metalaxyl may be used without considerable restrictions, following the anti-resistance strategy.

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#### **PHYTOPHTHORA INFESTANS (MONT.) DE BARY POPULIACIJOS ATSPARUMAS METALAKSILUI LIETUVOJE**

#### S a n t r a u k a

Tyrimai daryti 1990–1998 m. Lietuvos žemdirbystės instituto Elmininkų bandymų stotyje. Tyrimų tikslas – nustatyti atsparių metalaksilui bulvių maro sukėlėjo *Phytophthora infestans* kamienų buvimą vietinėje populiacijoje bei atsparumo kitimo tendencijas. Atsparumui įvertinti naudoti šie metodai: lapų diskų ir gazoninis.

Atsparūs metalaksilui grybo *Phytophthora infestans* kamienai rasti visais tyrimų metais visuose Lietuvos regionuose, tiek iš gumbų, tiek ir iš bulvienočių išskirtose populiacijose. Atlikę tyrimus lapų diskų metodu (vidutiniai 9 metų duomenys), nustatėme, kad 18,5–72,1% kamienų, išskirtų iš gumbų, ir 23,4–97,1% izoliatų, išskirtų iš bulvienočių, buvo atsparūs metalaksilui. Vidutiniais duomenimis, atsparumo metalaksilui lygis tyrimo metais svyravo nuo 48,6 iki 6,4%. Sumažėjus metalaksilą turinčių fungicidų panaudojimui, pastebima sukėlėjo populiacijos reversija.

**Raktažodžiai:** bulvės, bulvių maras, kamienai, atsparumas, metalaksilas