

Praca doktorska pt.:

**Ocena stabilności plonu i właściwości kulinarnych
bulw ziemniaka odpornego na *Phytophthora infestans*.**

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Promotor: dr hab. Bogdan Flis prof. nadzw. IHAR-PIB, Oddział w Młochowie
Zakład Genetyki i Materiałów Wyjściowych Ziemniaka

**”Stability of yield and culinary characteristics of potatoes
resistant to *Phytophthora infestans*”**

Abstract

The choice of the potato cultivar for cultivation depends on the height of obtained yield and on the presence of specific quality and resistance traits. The most important factor is the ability of cultivar to maintain high and stable level of these traits in changing conditions of environment. The stability analysis is performed mainly for yield, while for other traits is done rarely.

Modifying influence of environmental factors allow to expect improvements of tubers culinary traits by cultivation potato cultivars in the ecological system. However, the yield of tubers grown under ecological cultivation systems is significantly lower in comparison to conventional cultivation, what often discourages the owners of ecological farms from undertaking the production of potatoes. The largest yield losses in ecological plantations are caused by *Phytophthora infestans*, the causal agent of late blight. Despite many efforts of breeders, the satisfactory progress in improving the level of resistance to late blight has not been achieved. This progress may be obtained by introducing the resistance genes from wild potato species as well as by using new breeding techniques, e.g. a selection assisted by molecular markers.

The aims of this thesis were:

- (a) the evaluation of stability of tuber yield and selected culinary traits (cooking type, taste, darkening flesh of tubers) of potato clones resistant to *P. infestans*;
- (b) the assessment of relationship between high resistance to late blight (LB) and level and stability of traits examined in environments differing in cultivation systems (traditional and ecological);
- (c) the selection of potato clones resistant to late blight, which show stable level of examined traits and suitability for growing in different cultivation systems.

The plant material consisted of 119 clones originating from 3 unselected progenies, 7 standard varieties and parental forms. Parental forms of tested progenies were two clones with resistance to *P. infestans* originating from species *Solanum phureja*, conferred by *Rpi-phu1* gene and from cv. Sárpo Mira, which resistance is determined by a locus *Smiral*. Cultivar Lord was a susceptible parent, which was a donor of genetic factors determining a short period of vegetation, high yield and good culinary quality.

The resistance to LB was estimated by applying molecular markers linked with gene or locus of resistance as well as by the inoculation of detached leaflets of tested progeny clones and standards with *P. infestans* isolates. On the basis of the received data, tested

individuals were divided into two groups: resistant and susceptible. The group of resistant forms consisted of genotypes with *Rpi-phu1* gene or *locus* coming from cv. Sárpo Mira or with both these *loci* of resistance.

The yield of tested genotypes was evaluated for three years: 2012-2014, in the field trials (3 repetitions) in 5 locations, in which two systems of cultivation were applied (the traditional system in 3 locations and the ecological in 2 locations). It was found that the tuber yield was influenced by genotype, years and systems of cultivation. In ecological system of cultivation, the tuber yield was lower by 33,6 % as compared to the conventional system. However, the yield of late blight resistant genotypes was the same as the yield of susceptible forms.

The evaluation of yield stability in the examined forms was based on the analysis of genotype \times environment interaction ($G \times E$) and was performed by statistical program SERGEN, in which Schéffe – Caliński's mixed analysis of variance model and the joint regression Caliński – Kaczmarek' model are implemented. It was found that the frequency of stable forms was not related with the resistance to late blight. The genotypes showing stable expression of tuber yield were observed with similar frequency in the groups of resistant and susceptible clones.

In the resistance breeding, some disadvantageous traits are introduced together with the resistance genes from wild species and these disadvantages are not always eliminated by back crossings. The analysis of variation of culinary traits of tubers, performed with nonparametric Kruskal – Wallis' test, showed the lack of relationship between resistance to late blight and tuber taste or the darkening of the flesh of cooked tubers. The average ratings for these traits were the same for resistant and susceptible clones.

The analysis of biological (or static) stability of the culinary traits was done after the collating data obtained from each tested clone or cultivar in each of the environments. The highest frequency of stable forms was observed for 'after cooking darkening of flesh' (in 10 minutes), then for cooking type and tuber taste. The least frequent stable individuals were found for 'after cooking darkening in 24 hours'. The comparison of the frequency of individuals stably expressing culinary traits in groups of clones resistant and susceptible to *P. infestans*, did not reveal any significant differences.

In spite of many years of breeding work, potato cultivars highly resistant to *P. infestans* and with short vegetation period have not been obtained so far. The chance on developing such a cultivar is in introduction new sources of resistance, in which the resistance is not connected with a long vegetation period. Within the frame of presented work, the evaluations of length of vegetation period of the tested clones were performed. It was found that the resistance governed by the gene *Rpi-phu 1* and by the *locus* of resistance in Sárpo Mira are not linked to a late maturity. In the progenies of parental forms with such determination of resistance, the resistant genotypes with shorter vegetation period were selected.

On the basis of the performed studies, the set of resistant clones with high and stable levels of tuber yield and culinary traits in various environments was selected.

Piotr Kamiński