



A New Approach to Measure Potato Susceptibility to *Phytophthora infestans*, a Causal Organism of the Late Blight

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Introduction

The common method of estimation of the late blight resistance of potato in the field is based on the scoring of the foliage destruction usually performed at any certain stage of the plant development. The late blight resistance is also scored under laboratory conditions using artificially inoculated detached potato leaves by the measurement of the size of necroses or the level of sporulation. Results of such estimation are expressed in accordance with the 9-score scale (Colon et al., 1995). We consider that the traditional late blight assessment methods can be improved; to do this, one should use the quantitative value of the LB-caused yield loss, calculated from the dynamics of dying-off of infected tops during the whole vegetation period, as the key evaluation factor.

1. FIELD TESTS FOR FOLIAR BLIGHT RESISTANCE

The field assessment of the partial resistance of tested potato cultivars to late blight is carried out on the natural or artificial background by the measuring of the level of a leaf infection each 10-12 days using a special scale.

Our program is based on the known van der Plank hypothesis (1968), which assumes a direct ratio between the AUDPC on the potato foliage and yield losses.

Basing on this assessment data one can determine the area under the disease progress curve (AUDPC), in the course of the vegetation season, the corresponding yield losses caused by the early destruction of leaves (%), and the late blight resistance level (in scores).

The calculated yield losses are then converted to the scores characterizing the level of the late blight resistance in accordance with the 9-score scale, where 9 scores represent the highest resistance level (Fig. 1). The program of calculation is placed at the website of the All-Russian Research Institute of Phytopathology http://vniif.ru/index.php?option=com_content&view=article&id=40&Itemid=30&lang=ru.

The quantitative manifestation of the partial LB resistance within the same potato cultivar depends on the infection load, the level of aggressiveness of *P. infestans* strains, and weather conditions. Therefore, an objective assessment can be performed by the arrangement of field trials in regions, which are usually favorable for the late blight development (such as the Sakhalin island and Central Mexico).

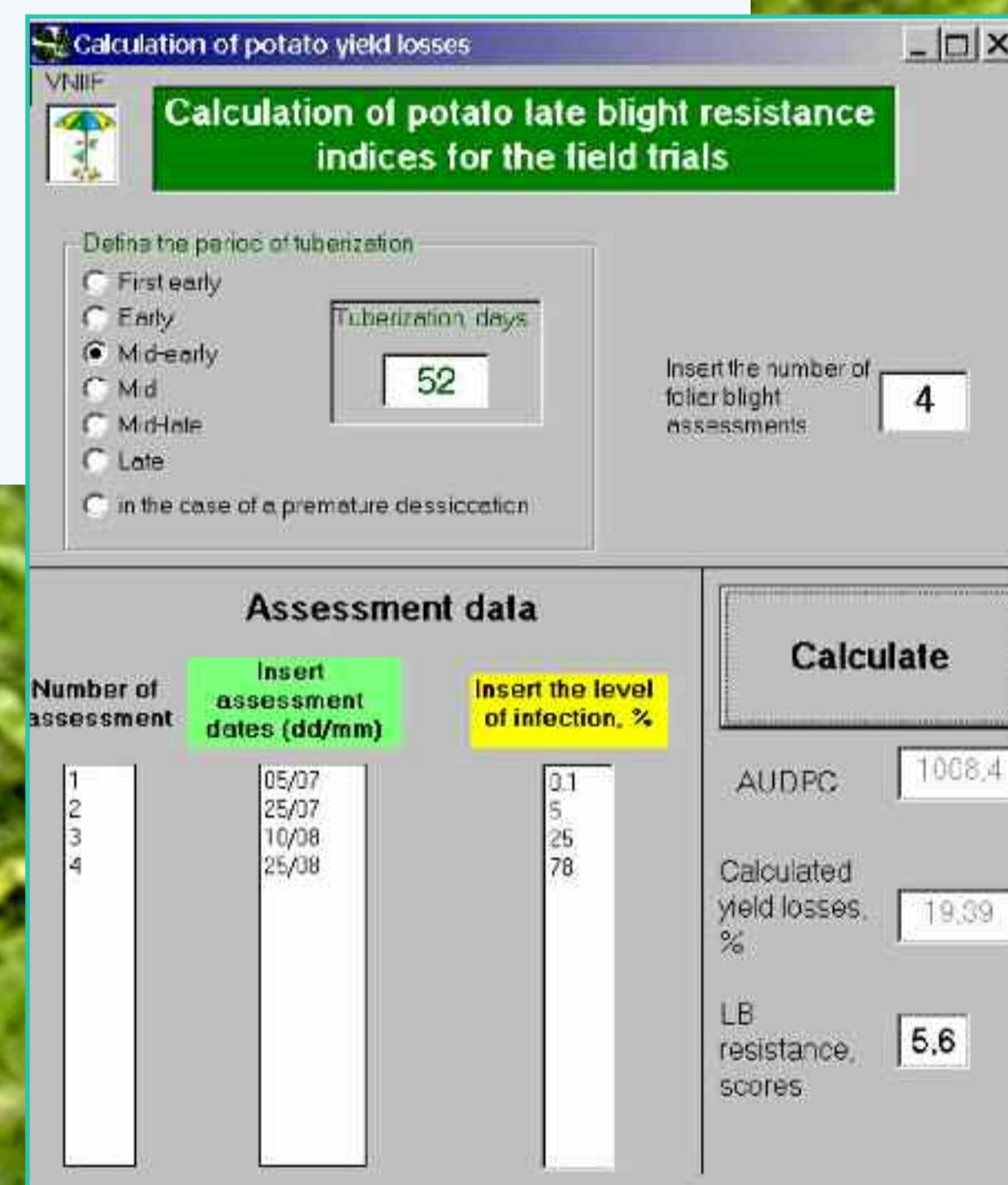


Fig. 1. Working window of the program for the calculation of potato yield losses, caused by the late blight and the resulting early destruction of leaves

2. DETACHED LEAF TESTS FOR FOLIAGE BLIGHT RESISTANCE

The laboratory assessment method, developed in our institute, is based on the joint use of the artificial inoculation of detached potato leaves and the mathematical model, simulating the late blight development under standard favorable meteorological conditions and at the given primary infection level. This model, based on the measurement of the inoculation efficiency, size of necroses, and sporulation productivity, reproduces the dynamics of the foliage destruction during a vegetation season and calculates the correspondence of this dynamics to the yield losses caused by the late blight of potato (Gurevich, Filippov, and Tverskoy, 1979). The method makes it possible to assess the cultivar resistance to the most aggressive *P. infestans* strains, including exotic ones under isolated laboratory conditions.

The tests are carried out on detached leaves, collected from the studied potato cultivars and inoculated with the studied *P. infestans* isolates, and, in parallel, on detached leaves of the standard potato cultivar, inoculated by the standard *P. infestans* strain.

In the proposed method we use the cv. Sante as a standard cultivar and the N161 *P. infestans* strain as a standard. The field yield loss of the above-mentioned cultivar, infected with the chosen strain, makes 30% under the weather conditions favorable for the disease development.

Using the tests, one can measure the basic parameters of the infection cycle on each tested cultivar as compared to the standard cultivar.

All after-measurement calculations are performed separately for potato cultivars of three maturing groups. The program developed on the basis of the above-mentioned measurements, calculates the AUDPC value, yield losses, and the level of the late blight resistance of the tested cultivar under fixed conditions favorable for the disease development (Fig. 2). The program can be found on the above-mentioned web site of our institute.

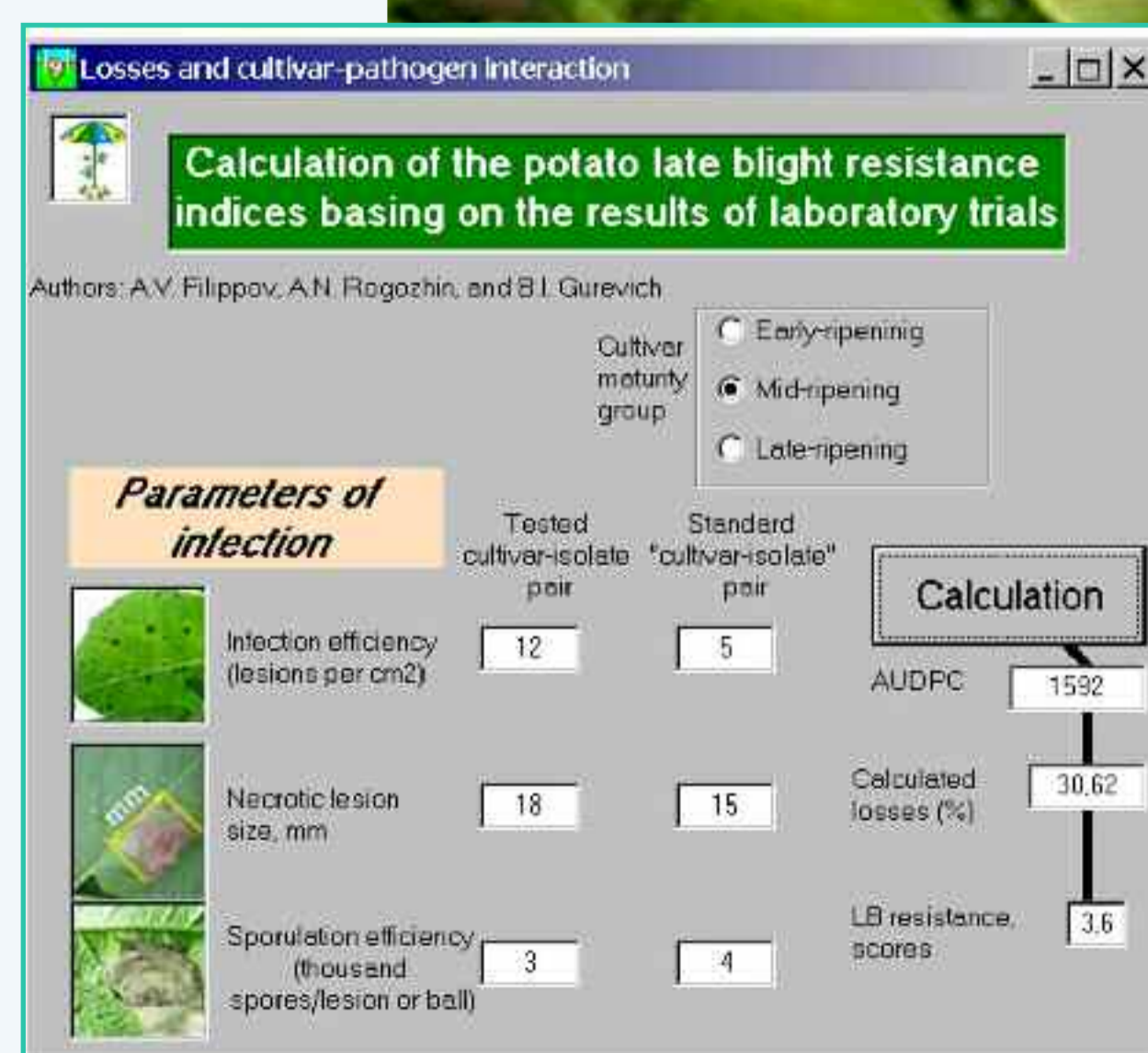


Fig. 2. Working window of the program calculating the level of the leaf blight resistance of potato cultivars under conditions, favorable for the disease development, on the basis of the measurement of the main parameters of the infection cycle on detached leaves

3. TUBER SLICE TESTS FOR TUBER BLIGHT RESISTANCE

To assess the late blight resistance of potato tubers under laboratory conditions, we propose to use a Lapwood method (Lapwood, 1965, 1967) with some modifications.

Potato tubers are sliced into pieces (7x5x40mm) in the twenty-fold repeatability. One end of each piece is submerged for 3-5 s into a zoospore suspension poured into Petri dishes (2-3-mm layer). After a 6-day incubation, the length of the infected zone is measured by a ruler (mm), and the mycelial covering intensity is determined using a 4-score scale (Fig. 3). Tuber slices of the cv. Sante, inoculated with the N161 strain, are used as a standard. According to the expert assessments, the level of the tuber resistance of the cv. Sante to the N161 strain is equal to 5.5 scores of the 9-score scale, where 9 scores correspond to the maximal resistance level.

The cv. Sante and the strain 161 can be replaced by any other "standard" cultivar-isolate pair with the known result of their interaction, expressed in scores. From the practical point of view, it is desirable that the tuber resistance level of the selected "standard" cultivar towards the selected *P. infestans* isolate would be within the range of 4-7 scores. The calculated indices are then converted into scores using a special chart (Fig. 4). The program can be found on the above-mentioned web site of our institute.

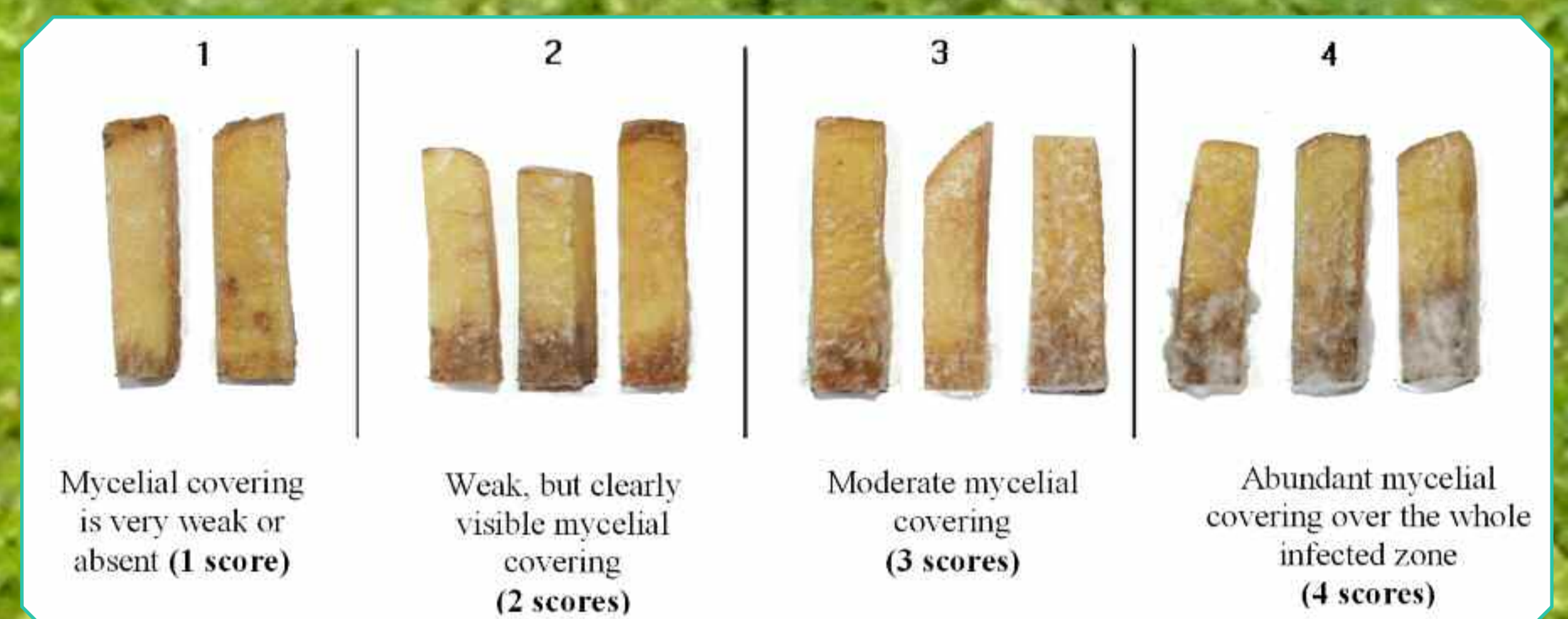


Fig. 3. Scale for the visual assessment of the mycelial covering intensity

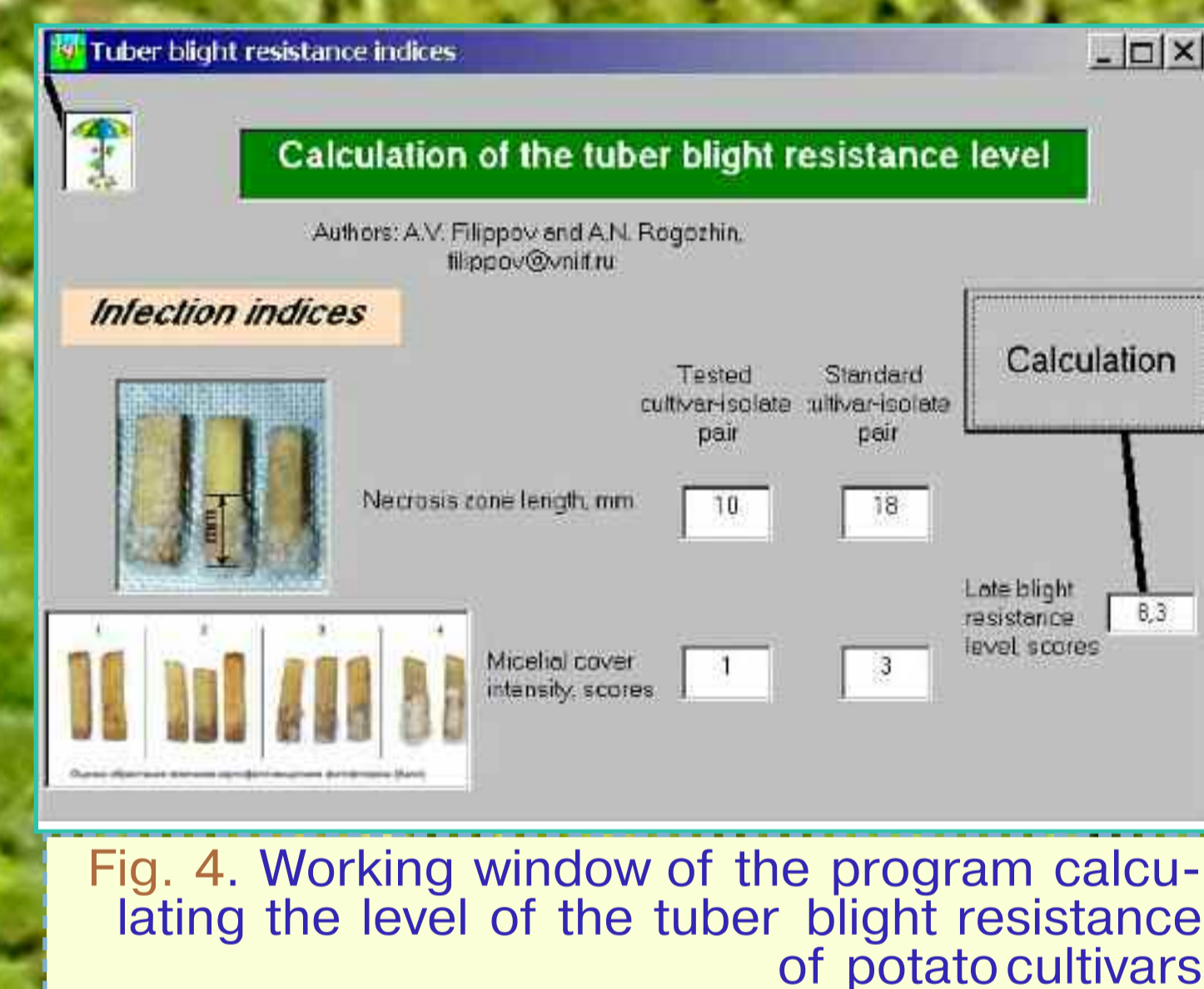


Fig. 4. Working window of the program calculating the level of the tuber blight resistance of potato cultivars

The methods presented in this paper are offered for the use as a procedure for the state registration of new potato cultivars in Russian Federation.

Conclusion

The proposed method makes it possible to evaluate the level of the foliage and tuber susceptibility of potato cultivars to *Phytophthora infestans* under field and laboratory conditions using a mathematical simulation approach.

ACKNOWLEDGMENTS

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