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Breeding for Resistance to the Potato Cyst Nematode in Ukraine

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Abstract: Ukrainian breeders from Institute of Potato Research and nematologists from Institute of Plant Protection have been breeding potato cultivars for resistance to potato cyst nematode *Globodera rostochiensis* Wollenweber, *pathotype Ro1* since 1994. Three new nematode resistant potato cultivars (Dnipryanka, Zahadka, Lileya) have been bred since then. These cultivars belong to different maturity groups and have many characters of economic importance (high yield potential, good taste quality, disease resistance).

Key words: potato; potato cyst nematode; cultivars; resistance; genotype.

Nematode resistant cultivars are widely practiced against the potato cyst nematode (PCN). The aim of such a control is, on the one hand, to limit or prevent the nematode from completing its life cycle. As a result, growing resistant cultivars for one or three seasons may decrease soil infestation by 80–99% (BRODIE 1984; SIGAREVA & PYLYPENKO 1998). This is especially important for PCN, which, unlike other species of nematodes, can be so persistent in the soil (PHILLIPS & TRUDGILL 1998). On the other hand, it allows predict significant loss of tuber yield and quality – in the nematode infested field resistant cultivars can yield 30–50% more than susceptible ones, depending on the PCN population densities. As nematode resistant potato cultivars are considered to be an effective and environmentally safe method of nematode control, major potato-producing countries with a cyst-nematode problem have plant-breeding programs with PCN resistance as a priority objective (DALE & SCURRAH 1998). The situation in Ukraine is the same because of presence of PCN in potato growing areas since the early 1960s.

The potato is an important crop for Ukrainian agriculture, comprising more than 1.5 Mha with annual production of 16.9 Mt. According to a survey, conducted by General State Inspection on Quarantine of Plant and Institute of Plant Protection for the purpose of monitoring the spread of infestation, it was noted that the distribution of PCN had been increasingly coincident with the increased monoculture, the reduced crop diversity and private seed production (PYLYPENKO 1998).

Although considerable research has been done in Ukraine with a PCN problem, there is still much to do. Currently efforts have been made in breeding PCN resistant potato cultivars with combined resistance to other pathogens (bacteria, viruses and fungus) and proceeding qualities (OSYPCHUK 2002).

MATERIALS AND METHODS

Several new nematode resistant interspecific hybrids and nematode resistant potato cultivars, with resistance genes from *Solanum andigenum*, *S. vernei* and *S. spegazzinii*, had been used in a breeding programme as initial material. This material was crossed with interspecific hybrids and susceptible cultivars, which had had a complex of desired agronomic characters. Additionally seeds were derived from self-pollination nematode resistant interspecific hybrids and nematode resistant cultivars.

Seeds were sowed in the greenhouse plots. 40–45-days-old seedlings and 3 tubers of each obtained genotype were planted in the fields, which had been fertilized as required; parent forms and standard cultivars were planted as well as a control with planting density 70 × 28 cm.

Harvest was carried out at full maturity; for each genotype tuber yield and its structure were determined separately. Taste quality was assessed and starch contents were measured by standard methods (KONONUCHENKO 2002).

Assessment of the plant resistance to PCN was conducted in three stages. The primary (1st year) assay was done to identify susceptible cultivars in the glasshouse plots. Then, only nematode-resistant and partially resistant genotypes were tested in the secondary (2nd year)

assay in the glasshouse plots as well as in the primary assay. Genotypes, which had been characterized resistant in both the primary and secondary assays, were tested in the main assay (3rd year) simultaneously in the glasshouse and field plots, in order to confirm their level of nematode resistance and to determine their effectiveness against PCN.

Resistance to *Synchytrium endobioticum, Phytophthora infestans, Streptomyces scabies, Corynebacterium sepedonicum, Pseudomonas xanthochlora, Ditylenchus destructor* and potato viruses were evaluated by standard diagnostics (KOVAL' 1987; KONONUCHENKO 2002).

RESULTS

Breeding for resistance to *G. rostochiensis, pathotype Ro1* has been successful through the use of resistance genes from *S. andigenum*, *S. vernei* and *S. spegazzinii*: three new nematode resistant cultivars (Dnipryanka, Zahadka, Lileya) have been bred recently. Cv. Dnipryanka derived resistance from nematode resistant cv. Sante (cross Sante × interspecific hybrid), as well as cv. Zahadka (cross interspecific hybrid × Sante); cv. Lileya – from nematode resistant cv. Leander (cross interspecific hybrid × Leander).

Cvs Dnipryanka and Zahadka belong to the early maturing group, Lileya – to the mid early maturing group. All of these cultivars are fully resistant to *G. rostochiensis* – no newly formed cysts were found on the plant roots in nematode infested soil. The cultivars showed a high effectiveness against *G. rostochiensis* – growing such cultivars decreased soil infestation by 81–96% in one season.

Average tuber yield of all new cultivars was significantly higher compared to the standard cultivars: Dnipryanka – 2.79 t/ha (+0.72 t/ha), Zahadka – 2.47 t/ha (+0.63 t/ha), Lileya – 2.40 t/ha (+0.61 t/ha). Large differences in starch contents between nematode resistant cultivars were observed, which varied from 13.3% (Zahadka) to 17% (Lileya). But as well as yield, this index was greater for new nematode resistant cultivars rather then for the standard cultivars. All new cultivars have good taste quality.

Cv. Dnipryanka has been determined to be fully resistant to *S. endobioticum*, partially resistant to *Ph. infestans*, *Str. scabies*, *C. sepedonicum*. Cv. Zahadka has been considered to be fully resistant to *S. endobioticum*, partially resistant to *D. destructor* and *C. sepedonicum*. Cv. Lileya has been described to be fully resistant to *S. endobioticum* and partially resistant to *Ph. infestans* and *Ps. xanthochlora*.

DISCUSSION

The results presented here indicate, that using directed selection can shorten the time taken for breeding programmes, which are targeted at resistance to PCN. The efficient use of resistance resources leads to useful levels of nematode resistance in the cultivated potato. Three new nematode resistant cultivars Dnipryanka, Zahadka and Lileya with good taste qualities and commercially desirable traits were bred within such potato breeding programmes. Cv. Dnipryanka was officially listed in Ukraine in 2002. Cvs Zahadka and Lileya have been put for the official trials since 2002. All of these nematode resistant cultivars may be used in integrated pest management of PCN in Ukraine.

It is important to conclude that further research investigations will emphasize on:

– using alternative sources of PCN resistance from a wide range of *Solanum* species to solve the problem of durability of resistance;
– screening breeding material against *G. rostochiensis* populations from different geographical origins of country as they may vary in virulence;
– assessing tolerance of nematode-resistant genotypes as they may differ in their reaction patterns to attack by PCN;
– combining both resistance and tolerance in breeding materials.

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