

PM 3/68 (2) Testing of potato varieties to assess resistance to *Globodera rostochiensis* and *Globodera pallida*

Specific scope: This Standard describes the testing of potato varieties to assess resistance to the potato cyst nematodes *Globodera rostochiensis* and *Globodera pallida*. It should be used to fulfil requirements mentioned in PM 9/26 *National regulatory control system for Globodera rostochiensis and Globodera pallida*.

Specific approval and amendment: First approved in 1990–09¹.

Revised and edited as an EPPO Standard in 2006–09.

First revision of the EPPO Standard approved in 2021–09.²

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1 | INTRODUCTION

The test described here is intended to be used in official schemes for testing new potato varieties for resistance to potato cyst nematodes (PCNs). By including a standard or reference population of PCN and by comparing the nematode multiplication rate on a new variety with that on a reference variety, it is possible to relate the new variety to internationally recognized levels of resistance. It is also envisaged that the test could be used to provide a comparative measure of the virulence of populations of PCN. For further background information refer to Mugniéry et al. (1989). The test procedure proposed in this EPPO Standard should be reviewed regularly. In particular, the virulence characteristics of PCN populations in Europe should be closely monitored. The standard nematode populations used in the tests should be representative of the virulence groups found during this monitoring.

2 | DEFINITION OF RESISTANCE

A potato variety should be regarded as resistant (to PCN) when it significantly inhibits the development

¹Approved as a Council recommendation (EPPO, 1992).

²When available, results of the Euphresco Project *Survey of pathotypes of Globodera pallida occurring in Europe* (2020-a-035) will be considered to assess the relevance of further revising this Standard.

TABLE 1 Standard scoring notation^a

Relative susceptibility (RS) in %	Score
RS ≤ 1	9
1 < RS ≤ 3	8
3 < RS ≤ 5	7
5 < RS ≤ 10	6
10 < RS ≤ 15	5
15 < RS ≤ 25	4
25 < RS ≤ 50	3
50 < RS ≤ 100	2
>100	1

^aCalculation of the standard scoring notation is provided in point 16 of the test procedure. The level of resistance to be achieved in suppression strategies is given in PM 9/26 *National regulatory control system for Globodera rostochiensis and Globodera pallida*.

of the selected population. The degree of this resistance should be quantified, and all the varieties ranked according to a standard scoring notation (see Table 1) which indicates their potential use for control measures under local conditions.

A score of 9 indicates the maximum level of resistance.

3 | TEST PROCEDURE

1. The resistance test should be performed in a quarantine facility outside, in glasshouses or climate chambers.
2. The test should be performed in pots each containing at least 1 L of soil (or suitable substrate).
3. The soil temperature in the test containers throughout the duration of the test should not exceed 25°C and the test containers should be adequately watered.
4. When planting the test or control variety one potato eye plug of each test or control variety should be used. Removal of all stems except one is recommended.
5. The variety ‘Désirée’ should be used as a standard susceptible control in every test. Additional fully susceptible control varieties of local relevance may be added as internal checks. The standard susceptible control variety may be changed if research indicates that other varieties are either more suitable or more accessible.
6. The following standard populations of PCNs should be used in resistance tests against *G. rostochiensis*

pathotypes Ro1, Ro5 and *G. pallida* pathotypes Pal and Pa3:

Ro1 Ecosse (may be obtained from E. Grenier, INRAE, France)

Ro5 Harmerz (may be obtained from S. Kiewnick, JKI, Germany)

Pa1 Scottish (may be obtained from J. Pickup, SASA, United Kingdom)

Pa3 Chavornay (may be obtained from E. Grenier, INRAE, France).

Other populations of local relevance may be added. For these populations, records of how their pathotype was determined should be available. Note: When assessing the resistance to nematode populations in north-western Europe, those conducting the test are encouraged to use new virulent populations. Currently, the only defined new virulent population is the Oberlangen population (Mwangi et al., 2019), which can be used in addition to the Pa3 Chavornay population. However, the Oberlangen population is not yet stable and the pathotype not yet established (Grenier et al., 2020). Samples of the Oberlangen population may be obtained from S. Kiewnick, JKI, Germany.

As new potato varieties with different sources of resistance are developed, the standard nematode populations will be reviewed regularly to determine their virulence against these varieties. Similarly, if as a result of monitoring it is found that the virulence characteristics of PCN populations in Europe have changed, the standard nematode populations described here should be reviewed.

7. The identity of the standard population should be checked using appropriate methods. It is recommended that at least two resistant varieties or two differential standard varieties of known resistance capacity are used in the test experiments.
8. The PCN inoculum (Pi) should consist of five infective eggs and juveniles per millilitre of soil. It is recommended that the number of nematodes to be inoculated per millilitre of soil is determined in hatching experiments. The nematodes may be inoculated as cysts, or as eggs and juveniles in a suspension.
9. The viability of the cyst content used as inoculum source should be at least 70%. It is recommended that the cysts are 6–24 months old and are kept for at least 4 months at 4°C immediately prior to use.
10. There should be at least four replicates (pots) per combination of PCN population and potato variety tested. It is recommended that at least 10 replicates are used for the standard susceptible control variety.
11. The duration of the resistance test should be at least 3 months and the maturity of developing females should be checked before completing the experiment.

12. Cysts from the four replicates should be extracted and counted separately for each pot.
13. The final population (Pf) on the standard susceptible control variety should be determined by counting all cysts from all replicates and the eggs and juveniles from at least four replicates.
14. A multiplication rate of at least 20× (Pf/Pi) should be achieved on the standard susceptible control variety.
15. The coefficient of variation (CV) on the standard susceptible control should not exceed 35%. Other statistical tests may be applied at a later stage if there is evidence that those tests will increase the precision of the test results.
16. The relative susceptibility of the tested potato variety to the standard susceptible control variety should be determined and expressed as a percentage according to the formula: $Pf_{\text{test variety}} / Pf_{\text{standard susceptible control variety}} \times 100$.
17. If a tested potato variety has a relative susceptibility of more than 3%, cyst counts will suffice. In cases where the relative susceptibility is less than or equal to 3%, eggs and juveniles should be counted in addition to cyst counts.
18. Where the results of tests in the first year indicate that a variety is fully susceptible to a pathotype (when the score is, for example, ≤3), there is no requirement to repeat these tests in a second year.
19. If the tested variety is not fully susceptible, the results of the tests should be confirmed by at least one other trial performed in another year. The arithmetic mean of the relative susceptibility in the 2 years is used to derive the score according to the standard scoring notation (see Table 1).

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