

DOI: 10.37317/pbss-2019-0001

Anna Przetakiewicz

Plant Breeding and Acclimatization Institute – National Research Institute,
Radzikow, 05-870 Błonie; e-mail: a.przetakiewicz@ihar.edu.pl

DISTRIBUTION OF PCN PATHOTYPES IN POLAND

ABSTRACT

Both *Globodera rostochiensis* (Wollenweber, 1923) Behrens, 1975 and *Globodera pallida* (Stone, 1973) are considered the most economically important nematode pest. Annual regional survey conduct in Poland have revealed high infestation of pathotype Ro1 to the northwest of the country and presence of new pathotype Ro5 of *G. rostochiensis*. In 2009-2013 fifty eight soil samples were tested. parasitic root organisms cause significant losses in quantity and quality of potato crops. In many European countries PCN have become a major problem in potato production mainly in starch potato cultivars. The pathotype Ro1 was detected mostly in central and northern Poland and pathotype Ro5 in four separated provinces: malopolskie, lubuskie, lubelskie and pomorskie. The abundance of cysts in location where the new pathotype was detected suggests that is a thread of further spread of pathotype Ro5 of *G. rostochiensis* in the country. Consequently, producers and farmers need to grow resistant potato cultivars to keep nematode population below damaging level. These results indicate the urgent need to prevent the spread of PCN to non-infested areas. This report focused on identification of nematode pathotypes in soil samples from infested polish fields and presentation of *G. rostochiensis* distribution on territory of Poland.

Keywords: *Globodera rostochiensis*, potato cyst nematodes (PCN), pathotypes, distribution

INTRODUCTION

Yellow potato cyst nematode (*Globodera rostochiensis* (Wollenweber, 1923) Behrens, 1975) belongs to quarantine pest attacking potatoes causing decrease of tubers yield up to 80%. It is the subject of strict regulations and quarantines in many countries, even where they do not already occur. Now, in Poland the most known is pathotype Ro1 of *G. rostochiensis*, however recently the outbreaks of pathotype Ro5 were reported (Przetakiewicz, 2013). Due to easier movement of potato tubers across frontiers and the freeing of markets, there is a possibility of emergence other

Communicated by Grzegorz Żurek

Globodera pathotypes on polish potato fields. Because of fast distribution on new territory and long-term survival of cysts in soil nematodes pose a real threat for potato production. Polish breeding company are not prepared on presence of new pathotype of nematode. Eradication of cysts is troublesome and ineffective. So far the only way to limited of pest population on fields is planting of resistant potato varieties. Reliable information about pathotype present in a particular fields gives an opportunity of using resistant variety to limited pest population. Data of PCN distribution in this investigation indicate that *Globodera rostochiensis* was presented for many years in Polish potato fields but results wasn't published. In order to find out the distribution of PCN and to prevent further spread or increase of nematode populations on territory of the country, surveys in potato fields areas were undertaken from 2009 to 2017.

MATERIALS AND METHODS

Collection of soil samples

Soil sampling was conducted by inspectors of State Plant Health and Seed Inspection Service according procedure recommended by Seinhorst (Seinhorst, 1962a) with a cylindrical sampling tool, from no deeper than 10 cm in the soil. Soil samples consisting of 60 cores of soil were taken in a grid pattern throughout the plot. Every last quarter of the year soil sampling was collect from the fields after harvest of potato crop. Samples of approximately 10 kg were processed completely in the laboratory. In 2009-2017 seventy nine soil samples were collected and analyzed.

Processing of soil samples

Samples were dried for extracting of nematodes. 10-kg of each sample was mixed thoroughly on set of 6 sieves:ø2000, 1000, 900, 850, 500 and 250 µm at room temperature. Soil from three last sieves were separated using flotation method (Seinhorst, 1962a) with an automatic cyst extractor (Mekku GmbH). The process of extraction was repeated until the whole soil sample was processed, which was of great importance in detecting low populations of potato cyst nematodes.

Species and pathotype identification

Samples consisted of an insufficient number of cysts for pathotyping were multiplied on susceptible potato cultivars Desiree or Zebra twice or three times. Tests for each sample were performed in three replications. All soil samples were identified directly after cysts isolation using PCR (species identification) and bio-tests (pathotype identification). Multiplex PCR analysis was perform as a first step to discriminate *G. rostochiensis* from *G. pallida* (Fullaondo *et al.*, 1999). Bioassays on set of differential genotypes of potato were carried out to identify the pathotype of *G. rostochiensis*. Tests was carry out according international PCN pathotype scheme proposed by Kort (Kort *et al.*, 1977). The set of seven differentiating genotypes of potato were inoculated separately with 79 populations of *G. rostochiensis*

cysts. Tests were conducted in controlled glasshouse conditions with temperature 16 - 26°C, average humidity of 65 % and photoperiod 16/8 h day/night within 2,5-3 month. Each sample was performed in three replications.

RESULTS

Pathotype Ro1 of *G. rostochiensis* was detected on potato field for the first time in Poland in 1946 (Jasińska, 1955). Thereafter annual national surveys conducted in every province of the country confirmed the presence of golden potato nematode pathotype Ro1 in almost all new outbreaks of the disease (State Plant Health and Seed Inspection Service data). Nowadays, *G. rostochiensis* is widely distributed in the whole Europe. Multiplex PCR analysis identified cysts in all tested soil samples as belonging to *G. rostochiensis*. Further bio-tests showed the presence of pathotype Ro1 in 62 soil samples and pathotype Ro5 in 8 samples, existed separately. The results of pathotype identification are presented on Fig. 1 and Table 1. The highest infestation by the pathotype Ro1 was observed in northern and east Poland and in two provinces of southern part of the country. As it was previously reported (Przetakiewicz, 2013), a new pathotype Ro5 appeared in three separated provinces: małopolskie, lubuskie and lubelskie. In 2017 this pathotype was detected also in pomorskie province.

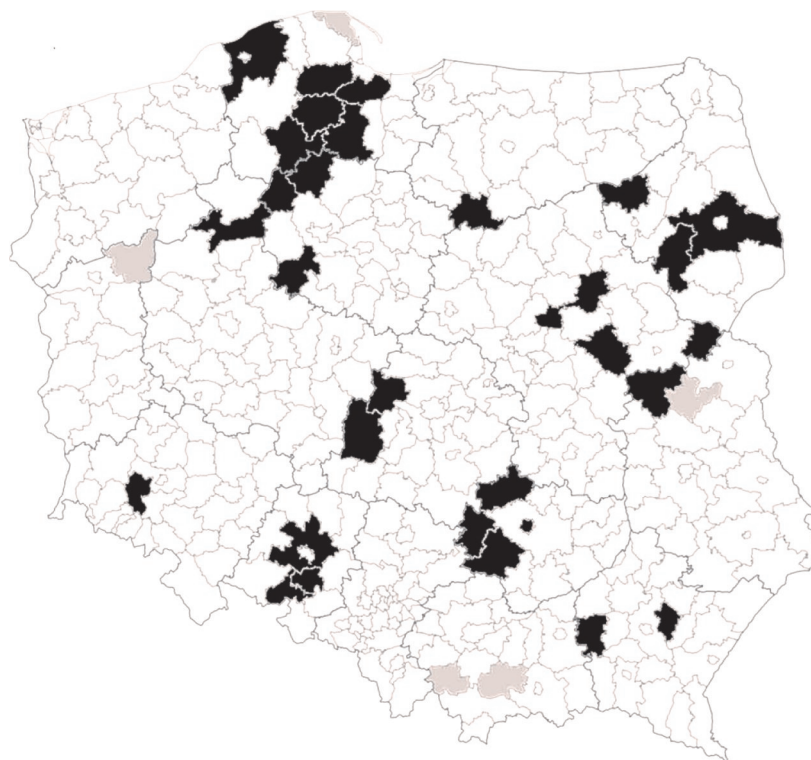


Fig. 1. Distribution of *Globodera rostochiensis* pathotypes in Poland

Table 1

Identification of PCN pathotype on infested Polish fields

Province	Year	No of sample	Detected pathotype	Mean no of cysts/100g of soil
dolnośląskie	2017	1	Ro1	2,2
	2009	1	Ro1	1,3
kujawsko-pomorskie	2011	3	Ro1	0,9
	2012	2	Ro1	1,5
	2014	1	Ro1	0,7
	2009	2	Ro1	2,8
lubelskie	2010	1	Ro1	1,2
	2010	1	Ro5	3,4
	2011	6	Ro1	1,4
	2012	2	Ro1	1,8
	2012	2	Ro5	3,1
	2014	1	Ro5	2,3
	2016	1	Ro1	1,1
	2010	1	Ro5	5,7
lubuskie	2012	1	Ro1	2,0
	2012	1	Ro1	0,8
łódzkie	2013	1	Ro1	1,6
	2016	1	Ro1	2,6
	2017	1	Ro1	0,9
	2010	1	Ro5	3,5
małopolskie	2012	2	Ro5	2,1
	2009	1	Ro1	1,9
mazowieckie	2011	5	Ro1	0,7
	2013	3	Ro1	1,1
	2010	1	Ro1	1,0
opolskie	2012	1	Ro1	1,8
	2012	2	Ro1	2,2
podkarpackie	2015	1	Ro1	1,2
	2010	1	Ro1	2,6
podlaskie	2014	2	Ro1	1,2
	2009	2	Ro1	1,8
pomorskie	2010	1	Ro1	0,8
	2011	2	Ro1	2,7
	2012	1	Ro1	2,1
	2013	2	Ro1	1,4
	2016	2	Ro1	2,8
	2016	1	Ro5	1,1
	2009	1	Ro1	1,2
	2010	1	Ro1	1,7
świętokrzyskie	2011	1	Ro1	1,2
	2012	1	Ro1	1,0

Identification of PCN pathotype on infested Polish fields (continued)

Table 1

Province	Year	No of sample	Detected pathotype	Mean no of cysts/100g of soil
warmińsko-mazurskie	2009	1	Ro1	2,6
	2010	3	Ro1	1,3
	2011	2	Ro1	1,0
	2012	1	Ro1	1,0
	2013	1	Ro1	0,8
wielkopolskie	2010	1	Ro1	1,1
	2011	1	Ro1	0,8
	2013	2	Ro1	2,0
	2014	1	Ro1	1,2
	2015	1	Ro1	2,3

DISCUSSION

Easy transfer of potato tubers across European Union countries creates opportunities of emergence new pathotypes of *Globodera* spp. in Poland. For example, in two batches of potato imported from Cyprus in 2010 cysts of *G. pallida* were identified (Karnkowski *et al.*, 2012a). Although *G. pallida* was not observed in our research, it had been identified in province opolskie by Karnkowski *et al.* (2012b). Current status of *G. pallida* in Poland is: “absent” (EPPO Global Database) but there is a big threat of re-emergence in subsequent years. The outbreaks of *G. pallida* were reported in Czech Republic (Zouhar *et al.*, 2003), Croatia (EPPO, 2004), Ukraine (Pylypenko *et al.*, 2005), Serbia (Radivojević *et al.*, 2006), Finland (EPPO, 2012), Slovenia (Širca *et al.*, 2012), Denmark (EPPO, 2013) and Bosnia and Herzegovina (Nježić *et al.*, 2014). So far white cyst nematode was not found in Lithuania, Latvia, Estonia, Belarus and the European part of Russia (Limantseva *et al.*, 2014). In other European countries, both species were reported. *G. rostochiensis* is still the dominant species in Europe (besides England and Wales, where *G. pallida* is prevailing (Minnis *et al.*, 2002). However there is the lack of precise information on the spread of each pathotype of *Globodera* spp.

Before 2013 Ro1 was the dominant pathotype of *Globodera* in Poland. Results obtained in the last 9 years and presented in this report show distribution of this pathotype mainly in northern and west part of Poland with some infested fields in the central provinces of the country and in the mountain regions. Zachodnio-pomorskie is the only province in which there was no new outbreaks of *Globodera* in recent years. New pathotype of yellow potato cyst nematode emerged in 2013 (Przetakiewicz, 2013) in three separated parts of Poland and has been observed again in 2017 in pomorskie province. Presence of Ro5 pathotype with a large number of cysts in tested soil sample suggest possibility of further spread and easiness to acclimation to different field condition, both in mountain and marine provinces. The only practical way to keep density of nematode population below damaging level is growing of resistant potato varieties

with multiple resistance to Ro1 and Ro5 pathotype of *Globodera rostochiensis* (Przetakiewicz *et al.*, 2017).

REFERENCES

- EPPO Reporting Service, 2004. Situation of several quarantine pests in Croatia in 2003.
- EPPO Reporting Service, 2012. Situation of *Globodera pallida* in Finland in 2011.
- EPPO Reporting Service, 2013. First report of *Globodera pallida* in Denmark.
- Fullaondo, A., Barrena, E., Viribay, M., Barrena, I., Salazar, A., Ritter, E., 1999. Identification of potato cyst nematode species *Globodera rostochiensis* and *G. pallida* by PCR using specific primer combinations. *Nematology* (1), 157–163.
- Jasińska, A., 1955. Mątwik ziemniaczany. *Przegląd Ogrodniczy* (32), 15–16.
- Karnkowski, W., Dobosz, R., Kaczmarek, A., Obrepalska-Stęplowska, A., Kierzek, D., 2012a. Occurrence of the white potato nematode *Globodera pallida* (Stone, 1973) Behrens, 1975 (Nematoda: Heteroderae) in two consignments of table potatoes moved to Poland from Cyprus. *Progress in Plant Protection* (51), 1545–1549.
- Karnkowski, W., Kaczmarek, A., Dobosz, R., Wiczorek, P., Obrepalska-Stęplowska, A., 2012b. Occurrence of the white potato nematode *Globodera pallida* (Stone, 1973) Behrens, 1975 (Nematoda: Heteroderae) on the territory of Poland. *Progress in Plant Protection* (52), 1087–1092.
- Kort, J., Ross, H., Rumpfenhorst, H.J., Stone, A.R., 1977. An international scheme for identifying and classifying pathotypes of potato cyst-nematodes *Globodera rostochiensis* and *G. pallida*. *Nematologica* (23), 333–339.
- Limantseva, L., Mironenko, N., Shuvalov, O., Antonova, O., Khiutti, A., Novikova, L., Afanasenko, O., Spooner, D., Gavrilenko, T., 2014. Characterization of resistance to *Globodera rostochiensis* pathotype Ro1 in cultivated and wild potato species accessions from the Vavilov Institute of Plant Industry. *Plant Breed* (133), 660–665.
- Minnis, S.T., Haydock, P.P.J., Ibrahim, S.K., Grove, I.G., Evans, K., Russell, M.D., 2002. Potato cyst nematodes in England and Wales - occurrence and distribution. *Annals App Biol* (140), 187–195.
- Nježić, B., Stare, B.G., Širca, S., Grujić, N., 2014. First Report of the Pale Potato Cyst Nematode *Globodera pallida* from Bosnia and Herzegovina. *Plant Disease* (98), 575–575.
- Przetakiewicz, A., 2013. The First Report of *Globodera rostochiensis* pathotypes Ro5 occurrence in Poland. *Plant Disease* (97), 1125–1125.
- Przetakiewicz, A., Milczarek, D., Zimnoch-Guzowska E., Flis, B., 2017. The improvement level of nematode resistance in potato facing changes in population of *Globodera* spp. *The J Anim Plant Sci* (27) 6, 1958 – 1962.
- Pylypenko, L.A., Uehara, T., Phillips, M.S., Sigareva, D.D., Blok, V.C., 2005. Identification of *Globodera rostochiensis* and *G. pallida* in the Ukraine by PCR. *European J Plant Pathol* (111), 39–46.
- Radivojević, M., Krnjaić, D., Grujić, N., Oro, V., Gladović, S., Madani, M., 2006. The first report of potato cyst nematode *Globodera pallida* (Stone, 1973) from Serbia. In: *International Symposium on Crop protection* (58th). Gent, Belgium, 23rd May, Book of Abstracts (1), 73 p.
- Seinhorst, J. W., 1962a. Modifications of the elutriation method for extracting nematodes from soil. *Nematologica* (8), 117–128.
- Širca, S., Stare, B.G., Strajnar, P., Urek, G., Lautar, I.M., 2012. First report of the pale potato cyst nematode *Globodera pallida* from Slovenia. *Plant Disease* (96): 773–773.
- Zouhar, M., Rysanek, P., Gaar, V., 2003. First report of the potato cyst nematode (*Globodera pallida*) in the Czech Republic. *Plant Disease* (87), 98–98.