CURRENT POLITICAL FRAMEWORK REGARDING CONTROL MEASURES ON POTATO CYST NEMATODES IN ROMANIA

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Abstract The scope of this article is to reveal major gaps in the research needs for the support of implementing the phytosanitary quarantine monitoring plan for *Globodera rostochiensis* and *G. pallida* known as potato cysts nematodes (PCN) in line with the new Directive 2007/33/EC. Romania is currently cultivating potato on 1.8 % of the arable land and according to this plan it needs to analyse over 2,500.00 soil samples at least. The financial needs in implementing this Directive are high, only the costs associated with soil sampling being estimated to be at least 2.4 mil Euros for a period of 12 years (i.e. between 2007 and 2019). The budget may rise up to 5.6 mil Euros in case of failing the implementation of the current monitoring plan by 2019. Additionally controlling measures have been investigated and this study support the idea that Romania needs to further develop research for the 19 counties currently cultivating potatoes for weed control, feral and livestock movements in order to ensure the successful implementation of the current monitoring plan. The biological control of PCNs in direct connection with potential host plants or animal species that may influence their dissemination are research subjects of outmost importance.

Keywords: *Globodera rostochiensis*, *G. pallida*, potato, phytosanitary quarantine, control measure, Romania.

INTRODUCTION

Potato becomes part of the Romanian diet starting with the XVIII century, being introduced as a gardening crop and in less than two centuries it becomes one of the most important field crops not only for our country [40] but all over the world [21]. Currently potato, as a major crop in ensuring food security at the global level, is facing a broadening of pest's infestations [30]. Only in the UK the estimations for potato production loss due to potato cyst nematodes (PCNs) *Globodera rostochiensis* and *G. pallida*, is about 70 million $/year or 9% of the country production [10]. Globally are estimated today to existing more than 4100 species of plant-parasitic nematodes [11] that may be the cause of a global economic loss of at least $US 80 billion/year [30]. As a consequence, food security is on the edge [16, 18, 42] when such pests may be further supported by favourable climate change that may exacerbate their attacks [29, 30, 32].

The European Union (EU) concerns regarding the healthy status of potatoes for commercialization starts early in 1969 with the adoption of the Directive 69/465/EEC on control of Potato Cyst Eelworm [26]. This Directive sets phytosanitary controlling measures against *Heterodera rostochiensis* Woll. the former name of *G. rostochiensis*, because potato occupied an important place for the European agriculture [22]. The former Directive was not addressing yet issues related to *G. pallida* due to the lack of filed infestation in the Economic European Community (EEC) for that moment. After 38 years of enforcing the implementation of the Directive 69/465/EEC, in 2007 entered into force the Directive 2007/33/EC on the control of potato cyst nematodes and repealing Directive 69/465/EEC, imposing the implementation of new measurers for the larger European Community: the EU. The new Directive is addressing phytosanitary measures for the control of both species: *G. pallida* and *G. rostochiensis* as well as new measures for enforcing the implementation of this Directive in terms of preventing the spread of PCNs [22]. Among these measures it is worth to mention the compulsory needs for each country to make public the list with potato varieties showing proved resistance against PCNs and banning any commercial activity implying potatoes in case of phytosanitary quarantine [19]. Moreover, a list of host plant species is also attached to the Directive and the controlling measures are more drastic compared to the former Directive. In 1969, the EEC comprises only nine countries and the evolution of PCNs continued to become more and more problematic [15]. The new Directive's goal is "no PCNs are to be found in the fields" (i.e. Para. 4, Provisions of the Directive) [41].

The scope of this article is to envisage capacity needs in research for the implementation of a comprehensive monitoring plan for controlling PCNs. Romania lost the market place for seed potato as well as for the commercialization of free of PCNs potatoes staring with 2007, the year of entering the EU mostly due to the recognition of potato field infestation with PCNs [48].

MATERIAL AND METHODS

This article is a SWOT analysis (Strengths, Weaknesses, Opportunities, and Threats analysis) based on the DG Sanco Reports [47, 48] regarding the monitoring plan of potato for phytosanitary quarantine, the Directive 2007/33/EC as well as related documentation for revealing gaps and needs for research in the phytosanitary domain [12, 49, 50]. An interview with the representatives of the Phytosanitary Unit Sibiu was conducted for the first economic estimation of sampling and analysis costs.

RESULTS

Harmonized measures for PCNs detection are described in the context of art. 4. According to these provisions Romania needs to financially support official investigations for revealing the presence or absence of PCNs in the fields for plants species listed in the Annex I of the Directive such as "host plants with roots" (i.e. *Capsicum* spp., *Lycopersicon lycopersicum* L., *Solanum melongena* L.) or "other plants species with roots" (i.e. *Allium porrum* L., *Beta vulgaris* L., *Brassica* spp., *Fragaria* L., *Asparagus officinalis* L.). Also, the Directive is listing species with bulbs, tubers and rhizomes as organs adapted for hosting the life cycle of PCNs (i.e. *Allium ascalonicum* L., *Allium cepa* L., *Dahlia* spp., *Gladiolus* Tourn. Ex L., *Hyacinthus* spp., *Iris* spp., *Lilium* spp., *Narcissus* L., and *Tulipa* L.) proving the complexity of this issue [24, 37]. According to the Report of the Ministry of Agriculture and the Official Catalogue of Crops Cultivars and Hybrids, Romania is currently cultivating all species listed in the Annex I of the Directive, as potential species for PCNs spreading. Additionally on the arable land reside weeds as wild crops relatives belonging to all ten families of these crops species listed in Annex I (i.e. Alliaceae, Asparagaceae, Asteraceae, Brassicaceae, Chenopodiaceae, Hyacinthaceae, Iridaceae, Liliaceae, Rosaceae, Solanaceae). Studies regarding the adaptability of PCNs to these plant species as well as their adaptability to different weeds species have not been published for our country. Moreover the impact of these wild crops relatives in controlling PCNs are well documented [1, 39] but in our country this was not a subject of research.

The lifting procedure of phytosanitary quarantine is presented in the provisions of art. 7 when the Member State will ensure that no PCNs have been officially recorded and this should be for 12 years as mentioned in the provisions of Annex III, Section I, Verification. In the same section it is accepted the case when no cropping history in which no potatoes or other hosts plant species listed in point 1 of Annex I have been grown in the field in the past 12 years. In case of Romania it was already published a study that states the PCNs may be viable in soil up to 28 years [5]. In this specific case the perspectives of prolonging phytosanitary quarantine may become a reality.

The continuation of phytosanitary quarantine is provided by the provisions of art. 8 the responsible official body (i.e. the Phytosanitary Direction of the Ministry of Agriculture in Romania) will ensure that such information is officially recorded and transferred to the European Commission in order to inform all Member States. Such a measure is also included in the Official Phytosanitary Program for Potato in Romania for 2012-2013 up to 2015-2016. This Official Programme adopts provisions regarding: (a) national monitoring plan, (b) monitoring plan for community free circulation of potato including: import – export, (b) medium action plan and (c) reporting. The calendar for sampling from the field is according to the climatic conditions of the country and published in 1991 [7].

According to the current monitoring plan the major targets in sampling in Romania are as following: (1) all seed potatoes fields; (2) 0.5% of the total surface of each county for production potato fields and (c) all crops listed in Annex I (i.e. before planting). According to the Ministry of Agriculture report published in 2015 the arable land surface of our country is of 13.3 mil ha and 1.8% is cultivated with potatoes [50]. This means that around 240,000.00 ha need to be tested by phytosanitary authorities. As the distribution per counties is different according to the Ministry of Agriculture and Rural development (MARD), 2500 samples should be taken from the field on an annually basis respecting the standard European and Mediterranean Plant Protection Organization (EPPO) [26]. The Directive is clear stating in the text of art. 5 that 0.5% from the potato fields should be sampled. Screening the standard EPPO PM3/75 [49] it is clearly stated that at least 10 ml soil (e.g. brushed potatoes or potatoes from sandy soil) per 1 tone of potato production should be taken [14]. Thus, according to the MARD statistics for 2012 it has been produced about 2465.2 thousands tones of potatoes which are in line with the already announced 2,500.00 samples to be collected from potato production. In 2015 with 3,519.3 thousands tones Romania will need to increase sampling to 3,520.00 with at least 1,000.00 more soil samples compared to 2012 [50]. The major issue for the Romanian agriculture is that it has a large arable land area covering 19 counties only for potato production. There is a soil of high quality and it may become a burden when applying phytosanitary measures for complying with accepted standards. A minimum sampling of 10 ml of soil would costs around 80 Euros for Romania according to the Phytosanitary Office Sibiu, that includes transport, storage, processing, microscopy and PCR identification which may lead to around 200,000.00 Euros for 2,465.00 tones (i.e. 2500 samples). In case of 3,519.30 tones (i.e. 3520 samples) it may rise up to 281,600.00 Euros. Based on a minimum of 12 years of implementing the PCNs monitoring programme, without PCNs in the field, a raff costs for 2,000.00 thousands potato tones should be around 2.4 mil Euros. This amount may become a reward only in case that Romania will no longer be part of the phytosanitary quarantine and re-joining the potato market by 2019. But, as in Romania the PCNs it was proved to survive up to 28 years the monitoring programme costs may rise up to 5,6 mil. Euros at least for a longer period of time. All these costs are not including other costs related to the surveillance of crop species listed in Annex I of the Directive. Additional costs should be added for any extra control measure implying the control of fields, equipment [23, 43], machineries [3, 17], sheep and goat movement, feral animal movement [31], including

weed control and crops wild relatives for all species listed in Annex I [9, 10].

According to official reports Romania is under phytosanitary quarantine for all four traditional producing seed potatoes counties: Braşov, Covasna, Harghita and Suceava and it is extended to also other counties that may become important for seed production such as: Hunedoara, Iaşi, Neamţ and Sibiu (i.e. almost 700 ha) (Fig.1a). These areas may be monitored due to three laboratories acting as the official network of Regional Laboratories for Nematology (i.e. Bucharest for 20 counties; Braşov for 10 counties and Suceava for 10 counties) and the Central Phytosanitary Laboratory from Bucharest where molecular analysis (i.e. polymerase chain reaction diagnostic) may be performed according to EPPO standards. 12 counties are recognized for producing wade potatoes (Timiş, Alba, Sălaj, Bihor, Satu Mare, Baia Mare, Cluj, Bistriţa, Botoşani, Iaşi, Buzău and Vrancea) that have to be monitored for *Globodera* species.

PCNs survey as a procedure is put in place for each of the Member States through the provisions of art. 6 and implementing Annex III of the Directive [45]. The major requirements imposed for our country as well for the others are as following: (1) the official surveys referred to in art. 6(1), shall be conducted on at least 0.5 % of the acreage used in the relevant year for the production of potatoes, other than that intended for the production of seed potatoes and (2) the results of the survey shall be notified to the Commission by 1 April for the previous 12 month period. In terms of capacity building [13] it can be seen the involvement of the national competent authority interconnecting the European Commission and the entire national phytosanitary system for issuing the annual report for surveying fields, storing and expeditions implying PCNs (Fig. 2). In terms of laboratory analysis the official surveys shall involve sampling and testing for the presence of PCNs in accordance with Annex II para 2 and shall be carried out in accordance with Section II of Annex III [4]. In case of infestation than will applies the provisions of art. 8 (3) [34, 44].

In case of phytosanitary quarantine the provisions of art. 8 shall apply (fig. 3). Under such circumstances only for seed potatoes fields from the four counties Romania investigated about 554.12 ha since 2007 that increase up to almost 700 ha in 2015. Sampling applies for each 0.5 ha and this means that more than 1,000.00 soil samples are originating from seed potatoes fields.

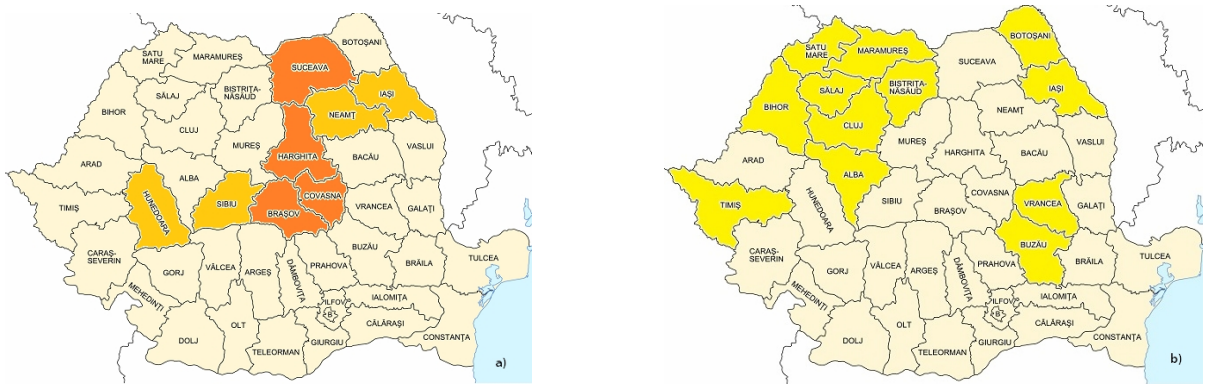

Figure 1. 19 counties in Romania are part of the complete monitoring plan for PCNs such as following: four counties for seed production and other four that may be involved into the future (a) and 12 counties recognized for wade potato production (b).

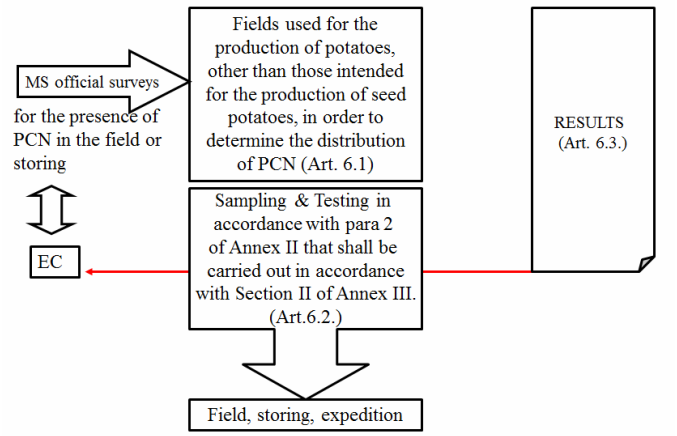

Figure 2. Overview regarding the requirements for the implementation of art. 6 of the Directive 2007/33/EC

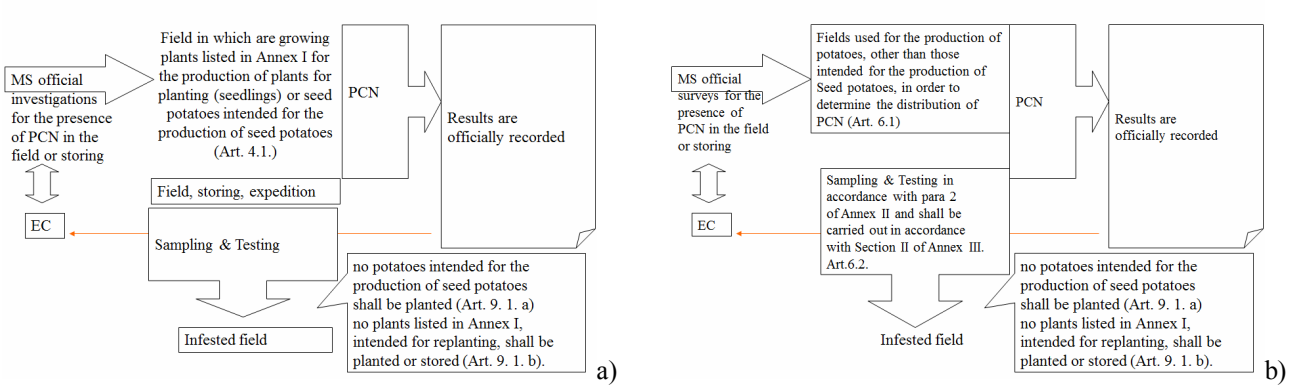

Figure 3. The implementation of art. 8.1. (a) and 8.2. (b) reveals the compulsory testing in the filed for the presence of PCNs

Control measures are further put in place through the provisions of articles 9-14. The provisions of art. 9, is addressing the compulsory need in case of positive infestation of the fields to become subject to the official control up to the suppression of PCNs in the support of taking effect the provisions of art. 8 [35]. The provisions of art. 10 are directly connected with art. 8 (3) putting in place specific controlling measures [36]. Based on the provisions of art. 12 all Member States needs to use resistance cultivars to PCNs and therefore they need to supply the list of recommendations in this regard [27]. However, in Romania the implementation of this article needs to be correlated to the public research systems and the current strategy for research.

DISCUSSIONS

In Romania, the first official recognition of the infestation with *G. rostochiensis* was in 1984 [40] but this PCN has to be present longer before as more than 100 years as it was already reported by other European countries [12, 28]. Since 2007 Romania is under phytosanitary quarantine for both species *G. rostochiensis* and *G. pallida* and no longer may take place on the market for seed potatoes [47] based on the Directive 2007/33/EC. The major principles for diagnostic according to the Directive are very clear and the member states need to ensure the entire community that the species was observed or not, the accurate name of the species is mentioned and that the cysts are or not viable once identified reason for which the costs are really high in implementing the phytosanitary measures. Such analysis has to be performed in the three phytosanitary laboratory network [38]. Thus, starting with 2007 Romania as a Member State country, is implementing the Directive 2007/33/EC in order to ensure that no PCNs are found *in fields in which seed potatoes intended for the production of seed potatoes*, and *certain plants intended for the production of plants for planting, are planted or stored* according to the para (4) of the Preamble of the Directive.

Appling the provisions of art. 4 for all species listed in Annex I, will become extremely expensive for a country having one of the high quality soils in Europe regarding the organic carbon up to 1 m depth of the soil profile [2]. As well as the 942 types of soil profiles [6] proving a huge diversity that may generate also biodiversity [8, 25]. What is not harmonized yet in the European context is the soil restoration that needs to improve the soil quality in the EU member states to a set of standards [20]. A high quality soil will have better chances to become infested with plant pathogens such as PCNs compared to a low quality soil and measures for eradicating PCNs will become more problematic and may take longer than 12 years as it is stated into the European Directive. In addition, in Romania resides wild plant species belonging to all 10 families listed in the Annex I. Moreover, it was already proved that some weedy species of Solanaceae family may have positive effects in removing PCNs and a weed control was proposed as an additional control measure to be implemented [46]. Wild flora from Romania is distinct compared to that of other European countries and new threats for the coherent implementation of this monitoring programme may not be identified if new research projects will not be implemented on this theme. No economic costs have been published related to the full implementation of the provisions of art. 4. Also, to implement the provisions of art. 6 for surveying the 19 counties producing potatoes will be highly costly and never have been part of an economic study. Only for implementing the provisions of art. 8 Romania needs to spend at least 2.4 mil. Euros in case of positive results up to 2019 for lifting the phytosanitary quarantine. On the other hand making agriculture in a soil profile of more than 2 m compared to countries in the region [33], should not be comparable to other European countries (i.e. the soil profile may be less than 1 m in France or Spain). There are no costs estimations related to the implementation of articles 9-14 and it can be considered that the economic burden for Romania may easily reach 5.6 mil Euros if in 2019 the phytosanitary quarantine against PCNs is not lifted.

Currently the EU do not set any financial mechanism for rewording soil biodiversity and Romania need to prove through economic studies that biodiversity rich soils have to be recognized for their value. Upon this a balanced financial mechanism should be implemented for supporting both the richness

of soil biodiversity and removing of pests pathogens from agricultural land only for the case of phytosanitary quarantine.

As concluding remarks the monitoring plan in Romania is strictly following the minimal requirements of the Directive 2007/33/EC and a raff analysis of the economic impact reveals that it may cost at least 2.4 mil Euros up to 2019 only for sampling and diagnostic if for 12 years no PCNs will be detected. The monitoring plan may be amended with strict measures for controlling livestock and feral herbivores movements. Also new studies need to be realized regarding the possible weeds control on the PCNs. Romania needs to develop a research strategy for maintaining and improving soil quality and furthermore correlating all negative and positive economic implications including the costs of phytosanitary quarantine.

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