

ENVIRONMENTAL ISSUES FOR ROMANIA REGARDING THE CONTROL OF POTATO CYST NEMATODES

ANTOFIE Maria Mihaela

Abstract. Since the nineteenth century potato became one of the main crop species for Romania. The imported potato brought also specific pests and diseases, as exotic species for Europe. Potato cyst nematode attacks were registered in Romania for the first time in 1984 and since 2007 our country is under phytosanitary quarantine for these nematodes. The analysis of institutional capacity on the controlling measures implemented at national level in the European Union (EU) context shows that the movement and transhumance of sheep and goats in the counties that are important for producing seed potatoes are not integrated into the potato monitoring program. Moreover, management plans for protected areas covering counties such as Brașov, Covasna, Harghita and Suceava do not include controlling measures on these issues, nor on the control of potato cultivation within and in the borders of the natural habitat of feral herbivores that could contribute to the spread of potato cyst nematodes.

Keywords: capacity building, phytosanitary quarantine, agricultural practices, sheep and goats movement and transhumance, boars.

Rezumat. Aspecte de mediu pentru România privind controlul nematozilor cu chiști ai cartofului. Începând cu secolul XIX cartoful devine una dintre principalele plante de cultură pentru România. Cartoful odată introdus a adus cu sine și bolile și dăunătorii specifici acestuia, specii exotice pentru Europa. Atacul nematozilor cu chiști a fost înregistrat în România pentru prima dată în 1984, iar din 2007 țara noastră este sub carantină fitosanitară pentru nematozii cu chiști ai cartofului. Analiza capacității instituționale cu privire la măsurile implementate la nivel național în contextul Uniunii Europene (UE) relevă faptul că pendularea și transhumanța oilor și caprelor în județele importante pentru producerea de cartof de sămânță nu sunt integrate programului de monitorizare al cartofului. Mai mult, nici un plan de management din nici o arie protejată din județele Brașov, Covasna, Harghita și Suceava nu include măsuri de control cu privire la aceste aspecte și nici cu privire la controlul culturilor de cartof din interiorul sau din limitele habitatului natural al ierbivorelor sălbatice care ar putea contribui la răspândirea nematozilor cu chiști.

Cuvinte cheie: capacitate instituțională, carantină fitosanitară, practici agricole, pendularea și transhumanța oilor și caprelor, mistreț.

INTRODUCTION

Environmental protection became more important on political agenda in the European Union (EU) after 2010 when the target to stop the loss of biodiversity was not reached (BUTCHART et al., 2010; PEREIRA et al., 2013). Coupling political issues such as the quality of live and environmental protection will further support the future policy for sustainable development in the EU for 2020 (ANGRICK et al., 2013) and further with high implications in crops production for 2050 (BREGAGLIO et al., 2013). Moreover, integrating phytosanitary measures for improving the quality of life should be a real challenge for the economic future at global level (COHEN et al., 2014). Climate change is challenging further the maintenance of a healthy environment from phytosanitary point of view (SPORLEDER et al., 2013; HILL et al., 2016).

Thus, agro-biodiversity becomes a central player for the world economy where an imported place will be devoted to the implementation of phytosanitary measures (DALMAZZONE & GIACCARIA, 2014). *Globodera pallida* and *G. rostochiensis* have been listed in the top ten of the most damaging parasites over the world (JONES et al., 2013). In 2006, it was estimated that the loss in potato production increased up to 9% all over the world (TURNER & ROWE, 2006).

Today, it is considered that only practical issues for the implementation of clear measures will be supported at the political level and also adapting measures to new risks regarding the prevention of spreading and evolution of these pests associated to agro-biodiversity, economic loss and citizen welfare (HULME et al., 2008). Currently, at the EU level, it is implemented the Directive 2007/33/EC and needs in terms of capacity building have been considered during this time for the national level (PICKUP, 2014) or European level (HOCKLAND et al., 2012).

The scope of this article is to present the current institutional capacity for implementing the requirements of articles 4 and 5 of the Directive 2007/33/EC on the control of potato cyst nematodes (PCNs), in direct connection with the new risks related to the environment regulatory framework and country peculiarities such as sheep and goats movement and boar habitat. Thus, this study investigates their possible role in the spreading of PCNs for supporting new risks to be taken into account for the full implementation of all necessary measures according to the Directive 2007/33/EC. Moreover, some observations will be made in direct connection with land cover for protected areas present in the regions with long history in seed potato production for the country before 2004.

MATERIAL AND METHODS

This paper is developed based on an integrative approach regarding the SWOT (strengths, weaknesses, opportunities, and threats) analysis of the current institutional capacity developed at the national level for the control of the implementation of the Directive 2007/33/EC on the control of potato cyst nematodes and repealing Directive 69/465/EEC (SEEHOFER, 2007). In this regard, there have been used different data bases belonging to the Ministry of Environment and to the Ministry of Agriculture and Rural Development.

RESULTS AND DISCUSSIONS

Capacity building for PCNs phytosanitary control system. Romania faced the presence of *G. rostochiensis* for the first time in 1984 and starting with 1985 approved the implementation of phytosanitary measures to control the spreading of the PCNs (ROJANCOVSCHI & DEHELEANU, 1986; DONESCU & ENOJ, 1987). Once Romania joined the European Union in 2007, it also needs to implement controlling measures for stopping the spreading of these PCNs in line with the Directive 2007/33/EC that establishes clear measures to be taken into account by all Member States against both species: *G. pallida* and *G. rostochiensis*.

Thus, it is compulsory to map their distribution, to impose measures preventing their spread and more to control their population growth and spreading. In this regard, the Directive imposes to all Member States, based on peculiarities of the country, to tackle all these three subjects in terms of institutional capacity for all involved authorities from the national level to the local level. In the context of the EU, potato is a valuable genetic resource especially in monetary terms when considering potato for commercialization. It is the case for wade and seed potato or potato for import – export.

The Directive addresses in its preamble three important points regarding PCNs infestation among the EU countries such as the following: [1] to evaluate all spreading means (Preamble Para. 7) [2] to apply suitable agricultural practices such as crop rotation combined with resistant potato varieties (Preamble Para 8) and [3] to stop any potato movement for infested areas. All these elements can be visualized in their connectivity into Fig. 1.

Once PCNs are detected into the field of a certain Member State there have to be in place official investigations working under their own national authorities at the EU level. The planning also includes other plant species listed in the Annex I that also can host the PCNs (e.g. *Capsicum* spp., *Lycopersicon lycopersicum* (L.) Karsten ex Farw., *Solanum melongena* L. *Allium porrum* L., *A. ascalonicum* L., *A. cepa* L., *Beta vulgaris* L., *Brassica* spp., *Fragaria* ssp. L., *Asparagus officinalis* L. *Dahlia* spp., *Gladiolus* Tourn. Ex L., *Hyacinthus* spp., *Iris* spp., *Lilium* spp., *Narcissus* L. and *Tulipa* L.). According to the provisions of Art. 4 of the Directive these phytosanitary controlling measures will cover the entire food chain from planting, seed potatoes up to storing, trade and retailers. Romania adopted the 12th Official Potato Monitoring Programme (PMP) during 2015 and accordingly complies with the provisions of this Directive (DG SANCO, 2010).

Romania as a Member State is under phytosanitary quarantine starting with 2007 (i.e. the year of accessing the EU) it needs to comply with the following compulsory measures: [1] have to monitor production potato all over the Romanian territory; [2] ensures and accepts the free circulation of healthy potato within the EU (seed potato and wade potato) and [3] applies measures for any Import of potato from third countries (i.e. the trade outside the European Union). Each year, Romania needs to report to the European Union about the results of this PMP.

The entire institutional capacity working under this Directive for Romania is presented in Fig. 2. As it can be seen, Romania also established a communication system for disseminating the information falling under the scope of this Directive, which works only under the Ministry of Agriculture (Fig. 3). Still this system should include authorities from the Ministry of Environment especially due to the integration of arable land into natural or semi-natural landscape areas of the country including in this context also protected areas.

This is important due to the promotion of traditional agricultural practices inside protected areas that may become contradictory with current phytosanitary measures in place. Moreover, in the research area, the Ministry of Education should be included for fully ensuring that all plant material dedicated for research is monitored from phytosanitary point of view (MACK et al., 2000).

Potato seeds need to be tested for their resistance to PCNs and agricultural practices needs to be re-evaluated for their effectiveness on one hand for supporting biodiversity conservation and on the other hand for supporting the coherent implementation of the official PMP. The calendar for sampling PCNs inside the food chain is harmonized to the EU level and it is different form that published in 1991 (COJOCARU, 1991).

The phytosanitary quarantine in case of PCNs is very complex and highly costly for ensuring the full and consistent implementation of the provisions of Art. 4 (Fig. 4) and Art. 5 (Figs. 5-6). Thus, the quarantine will be lifted up after 12 years of constant reporting the free zones for PCNs based on officially approved testing methods upon a clear calendar (Fig. 5).

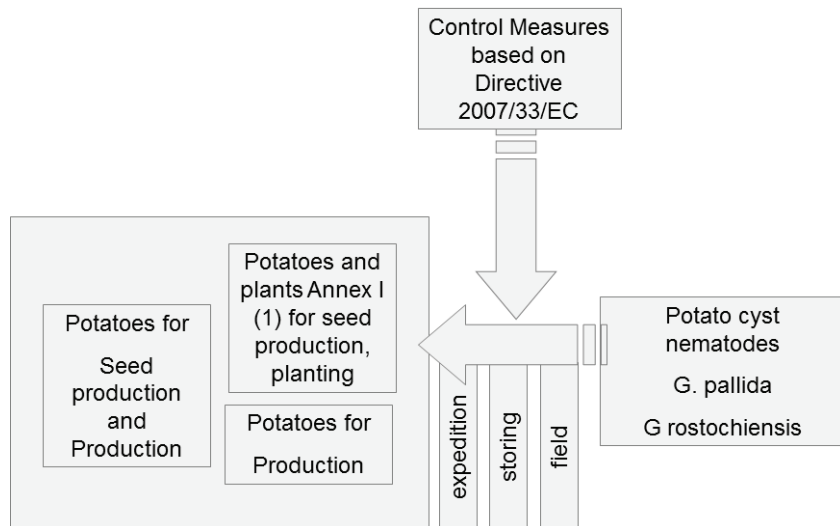


Figure 1. The European Union philosophy in developing control measures for PCNs once recorded into the field according to the Directive 2007/33/EC.

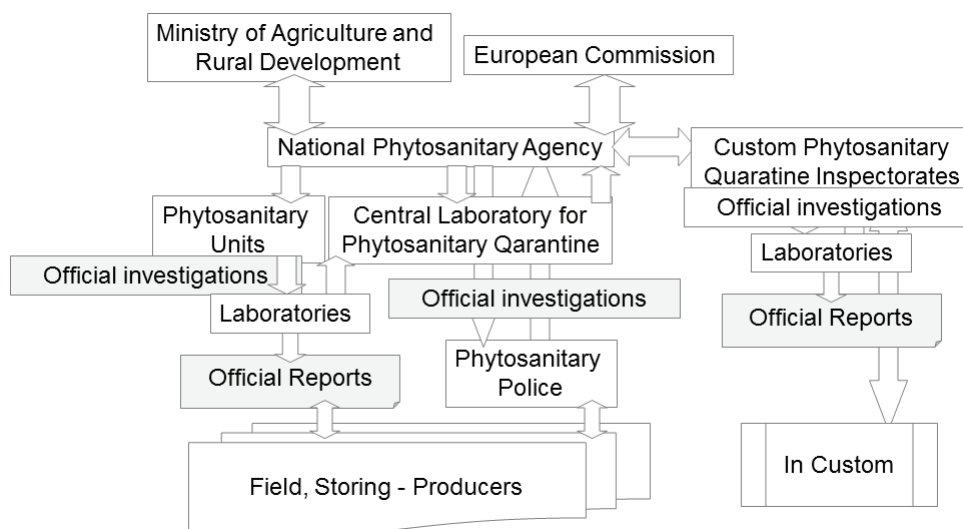


Figure 2. Official network supporting the implementation of the Potato Monitoring Programme in Romania.

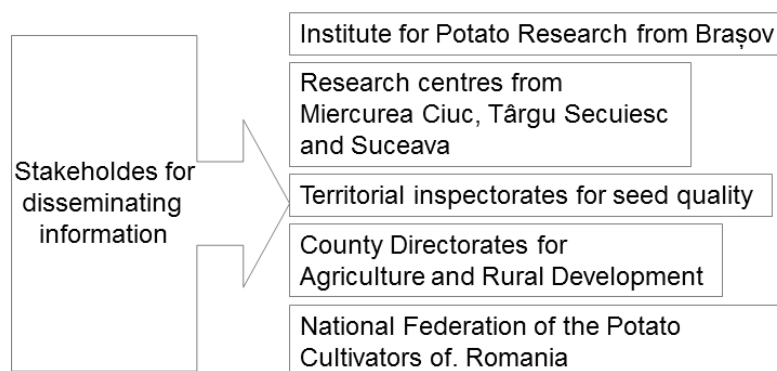


Figure 3. Communication system in supporting the implementation of the Potato Monitoring Programme in Romania.

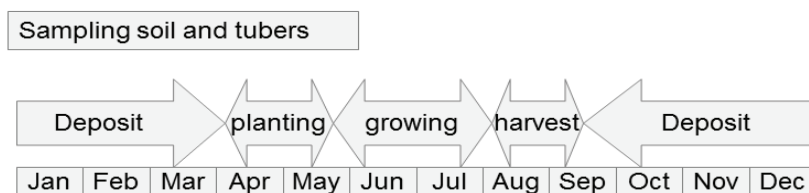


Figure 4. Approved calendar for official investigations in Romania after 2007.

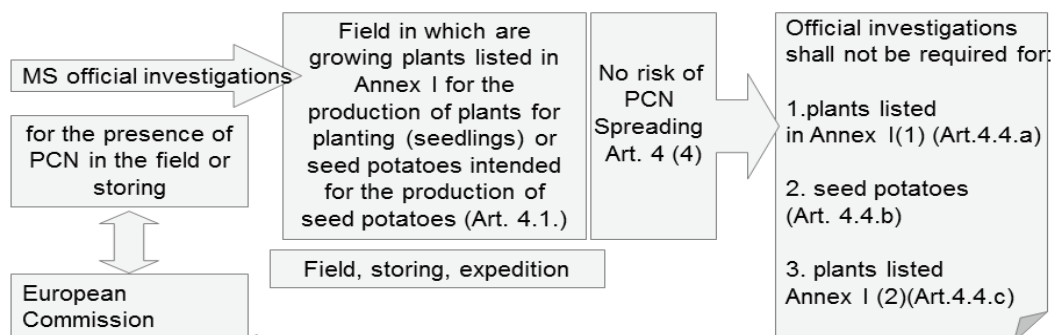


Figure 5. A simplified scheme regarding the implementation of Art. 4 of the Directive including Art. 4.4. setting measures when no PCNs may be detected.

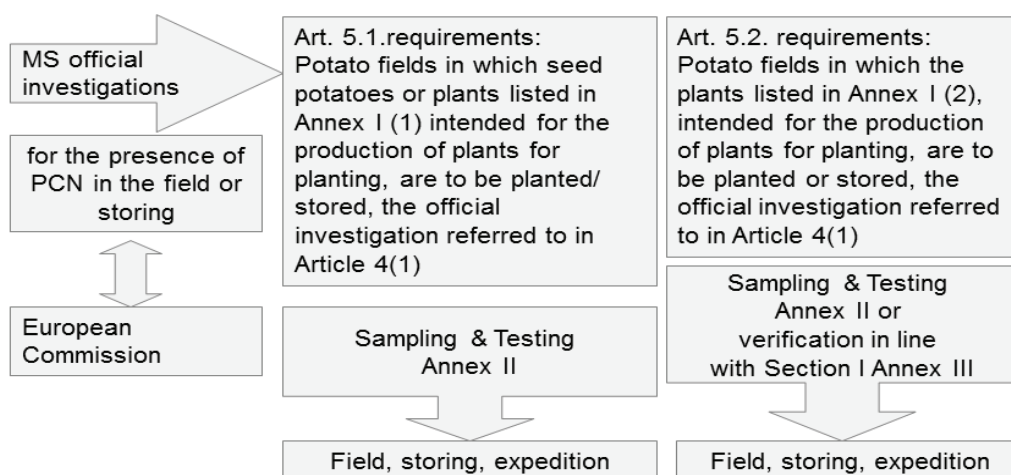


Figure 6. A simplified scheme regarding the implementation of Art. 5.1 and 5.2 of the Directive 2007/33/EC.

In the case of Romania, due to the peculiarities of the country it was already reported that PCNs may resist up to 28 years for the climatic conditions of 1990 (BOȚOMAN, 1991). However, the viability of the cysts may be prolonged based on the peculiarities of the pedological-climatic conditions of the country. As Romania is a country where potato is produced on huge surfaces of arable land it become obviously that the country may not recover very soon from the phytosanitary quarantine without the support of environmental authorities.

Capacity building needs. Seed potatoes have been produced in our country starting with 1957 in four counties such as the following: Brașov, Covasna, Harghita and Suceava that after 2007 are under full phytosanitary quarantine (BOȚOMAN, 1991). In this regard, it should be mentioned that traditional practices present in these four counties (i.e. sheep and goats movements and transhumance over arable land designated to potato cultivation) needs to be addressed also under the environmental regulatory framework for capacity building.

According to the last report of the Ministry of Agriculture and Rural Development at least 9.28% of the total sheep and goats of Romania for 2015 (i.e. 15,025,796.00) are located in these four counties (i.e. Brașov with 463,683.00; Covasna with 357,082.00; Harghita with 288,761.00 and Suceava with 285,287.00) (2016). On the other hand, according to the information provided by the portal of the Ministry of Environment, Brașov County has interests in 25 protected areas (i.e. covering almost 51% of County surface) (STANCIU & FLORESCU, 2009), Covasna in 24 protected areas (i.e. covering almost 21% of County surface) (APMCV, 2010), Harghita County in 23 protected areas (i.e. covering almost 34% of County surface) and Suceava County in 22 protected areas (i.e. covering almost 40% of County surface).

Consulting all officially adopted management plans for protected areas inhabited with rural population, there are no phytosanitary measures or guidelines for developing management plans for controlling sheep and goats movements as traditional practices mentioned in the current management plans (Ministry of Environment, 2016). In terms of wild animal biodiversity in these four counties there have been recorded only for 2015, 11.21% of the total individuals of 33,262.00 boars population (i.e. Brașov with 805.00; Covasna with 1,035.00; Harghita with 1,266.00 and Suceava with 623.00) (MMAP, 2016).

Under such circumstances continuing traditional agricultural practices (i.e. sheep and goats movements and transhumance) in the near habitats of boars or other feral herbivores, without any evaluation against the current requirements falling under phytosanitary and veterinary commitments taken as a Member State under the Directive 2007/33/EC, it may further contribute to the prolonging in the future the phytosanitary quarantine of our country with tremendous economic loss. Therefore, it should be reanalysed integrated controlling measures (STANCĂ-MOISE, 2007) designated to sheep and goats movements as well as to large feral herbivores that should be addressed by EUROPHYT system and the Rapid Alert System for Food and Feed (RASFF) (TÖKES, 2001). Also, some proposed new agricultural practices for potato cultivation may be of support in fully implementing a functional potato management programme (SAND et al., 2013).

CONCLUSIONS

The survey of the national regulatory framework on environment and agriculture does not mention any phytosanitary measure supporting the control of traditional practices such as sheep and goats movements in protected areas or regarding practices on potato or other host species cultivation inside or in the borders of boar habitats, for all four counties with long history in seed potato production. Therefore, based on the results of this analysis, it is recommended to be included into the current potato monitoring programme clear measures for controlling PCNs spreading with the support of sheep and goats as well as feral herbivore. Clear measures should be adopted for potato cultivation practices as well as for all host species in these sensitive areas.

REFERENCES

- ANGRICK M., BURGER A., LEHMANN H. 2013. *Factor X: Policy, Strategies and Instruments for a Sustainable Resource Use*. Springer Science & Business Media. London. 229 pp.
- BOȚOMAN G. 1991. Ce sunt nematozii? *Cartoful în România. Publicație de informare tehnică pentru cartof*. Edit. Universitaria. Brașov. **1**(3): 16-17.
- BREGAGLIO S., DONATELLI M., CONFALONIERI T. 2013. Fungal infections of rice, wheat, and grape in Europe in 2030–2050. *Agronomy for sustainable development*. Elsevier. London. **33**(4): 767-776.
- BUTCHART S. H., WALPOLE M., COLLEN B., VAN STRIEN A., SCHARLEMANN J. P., ALMOND R. E., CARPENTER K. E. 2010. Global biodiversity: indicators of recent declines. *Science*. Academic Press. London. **328**(5982): 1164-1168.
- COHEN J. E., CLARKE-HARRIS D. O., KHAN A., ISAAC W. A. P. 2014. Sustainable Management of Invasive Species for Small Island Developing States under Changing Climates. *Impacts of Climate Change on Food Security in Small Island Developing States*. New York: 312-316. www.unep.org/pdf/Emerging_issues_for_small_island_developing_states.pdf (Accessed on 3 March, 2016).
- COJOCARU N. 1991. Din istoria cartofului, *Cartoful în România. Publicație de informare tehnică pentru cartof*. Edit. Universitaria. Brașov. **1**(2): 10-22.
- DALMAZZONE S. & GIACCARIA S. 2014. Economic drivers of biological invasions: A worldwide, bio-geographic analysis. *Ecological Economics*. Elsevier. New York. **105**: 154-165.
- DONESCU D. & ENOHI M. 1987. *Nematozi și insecte. Protecția cartofului: boli, dăunători, buruieni*. Edit. Ceres. București. 164 pp.
- HILL M. P., BERTELSMEIER C., CLUSELLA-TRULLAS S., GARNAS J., ROBERTSON M. P., TERBLANCHE J. S. 2016. Predicted decrease in global climate suitability masks regional complexity of invasive fruit fly species response to climate change. *Biological Invasions*. Elsevier. New York: 1-15.
- HOCKLAND S., NIERE B., GRENIER E., BLOK V., PHILLIPS M., DEN NIJS L., VIAENE N. 2012. An evaluation of the implications of virulence in non-European populations of *Globodera pallida* and *G. rostochiensis* for potato cultivation in Europe. *Nematology*. Springer. Stuttgart. **14**(1): 1-13.
- HULME P. E., BACHER S., KENIS M., KLOTZ S., KÜHN I., MINCHIN D., NENTWIG W., OLENIN S., PANOV V., PERGL J., PYSEK P., ROQUES A., SOL A., SOLARZ W., VILÀ M. 2008. Grasping at the routes of biological invasions: a framework for integrating pathways into policy. *Journal Applied of Ecology*. Elsevier. London. **45**: 403-414.
- JONES J. T., HAEGEMAN A., DANCHIN E. G. J., GAUR H. S., HELDER J., JONES M. G. K., KIKUCHI T. 2013. Top 10 plant-parasitic nematodes in molecular plant pathology. *Molecular Plant Pathology*. Elsevier. New York. **14**(9): 946-961.

- MACK R. N., SIMBERLOFF D., MARK LONSDALE W., EVANS H., CLOUT M., BAZZAZ F. A. 2000. Biotic invasions: causes, epidemiology, global consequences and control. *Ecological applications*. Springer. Berlin. **10**(3): 689-710.
- PEREIRA H. M., FERRIER S., WALTERS M., GELLER G. N., JONGMAN R. H. G., SCHOLLES R. J., BRUFORD M. W., BRUMMITT N., BUTCHART S. H. M., CARDOSO A. C., COOPS N. C., DULLOO E., FAITH D. P., FREYHOF J., GREGORY R. D., HEIP C., HÖFT R., HURTT G., JETZ W., KARP D., MCGEOCH M. A., OBURA D., ONODA Y., PETTORELLI N., REYERS B., SAYRE R., SCHARLEMANN J. P. W., STUART S. N., TURAK E., WALPOLE M., WEGMANN M. 2013. Essential biodiversity variables. *Science*. Elsevier. London. **339**(6117): 277-278.
- PICKUP J. 2014. The status of potato cyst nematodes in Scotland. In *The Dundee Conference. Crop Protection in Northern Britain 2014, Dundee, UK, 25-26 February 2014*. The Association for Crop Protection in Northern Britain: 259-264.
- ROJANCOVSCHI E. & DEHELEANU A. 1986. Nematodul cu chist al cartofului, *Globodera rostochiensis* (Woll) Mulvey & Stone, un nou dăunător detectat în țara noastră. *Buletinul de Protecția Plantelor*. Edit. Ceres. București. **2**: 43-50.
- SAND C.S., ANTOFIE M. M., BARBU C. H., POP M. R. 2013. Medicinal plant introduction into potato culture for pests control. *International Multidisciplinary Scientific GeoConference: SGEM: Surveying Geology & mining Ecology Management*. Elsevier. Paris. **1**: 671-676.
- SEEHOFER H. 2007. Council Directive 2007/33/EC on the control of potato cyst nematodes and repealing Directive 69/465/EEC. *Official Journal of the European Union*. Springer. Bruxelles. **156**: 12-22.
- SPORLEDER M., TONNANG H.E., CARHUAPOMA P., GONZALES J. C., JUAREZ H., KROSCHER J. 2013. 23 Insect Life Cycle Modelling (ILCYM) Software—A New Tool for Regional and Global Insect Pest Risk Assessments under Current and Future Climate Change Scenarios. *Potential Invasive Pests of Agricultural Crops*. Elsevier. New York. **3**: 412-415.
- STANCA MOISE CRISTINA. 2007. Integrated management of pests for biodiversity maintaining and ecosystems health. *Bulletin USAMV-CN*. Edit. Universitaria. Cluj-Napoca. **63**: 329-334.
- STANCIU E. & FLORESCU F. 2009. *Ariile protejate din România. Noțiuni introductive*. Edit. Green Steps. Brașov. 87 pp.
- TÖKES G. 2001. A decade of information—a summary of the activity of the Panel on Plant Quarantine Information. *EPPO Bulletin*. Plant Science. London. **31**(3): 397-403.
- TURNER S. J. & ROWE J. A. 2006. Cyst nematodes. In: *Plant Nematology*. Perry R. N. and Moens M. (Eds.). CAB International. Wallingford, Oxfordshire: 90–122.
- ***. APMCV2010. <http://apmcv-old.anpm.ro/files/APM%20Covasna/Anuare/2010/anuar2010capV.pdf> (Accessed on 3 March, 2016).
- ***. DG SANCO. 2010. 2010-8603 - Final report of a specific audit carried out in Romania from 03 to 11 may 2010 in order to evaluate phytosanitary controls in the potato sector and the general system of surveillance for harmful organisms in the context of a general audit. file:///C:/Users/User/Downloads/2010-8603_FINAL.pdf (Accessed on 3 March, 2016).
- ***. GREEN HARGHITA. <http://www.greenharghita.ro/index.php/ro/prezentare/> (Accessed on 3 March, 2016).
- ***. MINISTRY OF AGRICULTURE AND RURAL DEVELOPMENT. 2016. *Report on sheep and goats for 2015* <http://www.madr.ro/en/component/k2/2313-sheep-and-goats.html> (Accessed on 3 March, 2016).
- ***. MMAP. 2016. *Cote de recoltă*: <http://www.mmediu.ro/articol/cote-de-recolta/43> (Accessed on 3 March, 2016).

Antofie Maria-Mihaela

Lucian Blaga University of Sibiu,
Faculty for Agricultural Sciences, Food Industry and Environmental Protection
5-7 Dr. Ioan Ratiu Str, Sibiu, Romania.
E-mail: mihaela.antofie@ulbsibiu.ro

Received: March 12, 2016
Accepted: June 3, 2016