1. Content of the 'Topic Description' document

1.1. Topic area

Diagnostics, field detection, surveillance.

1.2. Topic title

Global warming and distribution of root-knot nematode species of the tropical group.

1.3. Description of the problem the research should solve

Root-knot nematodes (RKN) (*Meloidogyne* spp.) are considered to be the most harmful plant parasitic nematodes. Among plant parasites, only RKNs lead to crop losses of around 15% in the sub-tropical countries. Moreover, yield losses of 50-80% caused by these nematodes in vegetable crops are common. Several RKN species belong to the 'tropical' RKN group (*M. incognita, M. arenaria*, *M. javanica, M. enterolobii, M. ethiopica, M. hispanica, M. paranaensis* etc.) which may cause substantial economic losses in agriculture particularly in vegetable production. The species within this group reproduce by mitotic parthenogenesis and have a wide host range including monocotyledons, dicotyledons, herbaceous and woody plants. The damage and yield losses caused by this group is greater in tropical than in temperate regions due to more favourable environmental conditions for pest colonization, development, reproduction and dispersal. However, climate change is likely to influence the future distribution of the pests and it is expected that *Meloidogyne* species previously found in tropical and subtropical regions will become important pests in temperate regions as well. Tropical RKN species can move northwards and both temperate and tropical root-knot nematodes can have more generations per year (Wesemael *et al*., 2011).

In addition, an intensive global trade, trends in environment friendly plant production and lack of adequate management strategies pose a serious risk of these pests for the agricultural production in Europe. Two species, *M. incognita* and *M. javanica*, from the tropical RKN group were recognised as globally the most rapidly spreading plant pests, as measured by country saturation rate of 424 plant pests and diseases (Bebber *et al*., 2014). Several species of the tropical group are able to survive open field winter conditions particularly in the Mediterranean countries. Open field occurrence represents additional risk of these pests for several agricultural crops especially because of predicted climate change effects and the fact that infestations at larger acreages are much more difficult to manage.

To cope with such threats, detection and identification methods/schemes for tropical RKN species are needed. Due to the hybrid origin of parthenogenetic RKNs as suggested by Lunt *et al*. (2014), the usage of nuclear markers such as rDNA as well as methods that focus on a single molecular marker are inappropriate for species identification and barcoding the species within this group. The most promising results were obtained by analysing multiple marker genes of the mtDNA (Janssen *et al*., 2016) but the diagnostic methods for a certain species are not developed yet. Currently, one of the most reliable and available method for the group diagnostics is the isozyme phenotyping which has some disadvantages and difficulties, particularly with the performance of the method using different equipment and final calculations of the isozymes migration rates.

1.4. Description of the expected results

a) Occurrence and distribution map of the tropical RKN species (the surveillance will be performed at the open field and protected areas). Interest to contribute to this activity: Slovenia, France, Portugal.

Record data for the tropical RKN species occurrence will be collected separately for the open field and protected areas vegetable and potato production. Additionally, a survey will be carried out in Slovenia and France, sampling and analysing samples (Slovenia committed for 150 samples using bio-tests with tomato seedlings). The available data of these pests in import consignments of different agricultural products including ornamental plants will also be included and high risk countries will be identified.

b) Validation of biochemical and/ or molecular diagnostic methods for the tropical RKN species occurring in Europe. Interest to contribute to this topic: Slovenia, France, Portugal.
A ring test of Isozyme phenotyping will be organized in order to obtain validation data for the Isozyme electrophoresis esterase (Est, EC 3.1.1.1) and malate dehydrogenase (Mdh, EC 1.1.1.37) using the tropical RKN culture collections at partnering institutions. Isozyme migration rates will be calculated and compared between the laboratories.
Available molecular diagnostic methods will be evaluated for the tropical RKN species and reliable tests will be implemented. Biological material and experiences will be exchanged between laboratories.

c) Survival ability of *M. incognita* and *M. arenaria* at the open field conditions in the continental climate and Mediterranean/ Atlantic conditions. Interest to contribute to this topic: Slovenia, Portugal.
Tropical RKNs have not been detected in open field in continental climate conditions in Slovenia yet. However, a tropical species of *M. luci* (previously identified as *M. ethiopica*) was shown to be able to survive these conditions. The ability of survival will be tested for *M. incognita* and *M. arenaria* which occurs in Slovenia in a micro-plot 3-year experiment.

d) Assessment of the effect of climate change scenarios on the tropical RKN species potential spreading in the open field agricultural production areas in Europe. Interest to contribute to this topic: Slovenia, France, Portugal.
The data from occurrence and distribution study will allow identifying the coldest locations that certain tropical RKN species manage to overwinter successfully. This climate data will be used to analyse agricultural production areas in Europe to identify the same or milder winter conditions. Geographical maps of possible open field spreading for each tropical RKN species occurring in Europe will be generated. The data will be used for simulations of different climate change scenarios and predictive studies will be conducted using Climex simulation software.

1.5. Beneficiaries of this research product

The intended users/stakeholders of the research results by category are: decision bodies, phytosanitary inspectors, scientists as well as companies from breeding sector and plant protection companies.

1.6. Research funders and research contribution/ distribution

Funding organisation	Research activity and researchers involved
1. Kmetijski inštitut Slovenije, Slovenia Saša Širca sasa.sirca@kis.si	The team will contribute to points: a, b, c and d (see section 1.4). Contact person: Saša Širca

	sasa.sirca@kis.si Contact person: Polona Strajnar polona.strajnar@kis.si Contact person: Barbara Gerič Stare barbara.geric@kis.si Contact person: Gregor Urek gregor.urek@kis.si Contact person: Matej Knapič matej.knapic@kis.si Contact person: Uroš Žibrat uros.zibrat@kis.si
2. Agence nationale de sécurité sanitaire de l'alimentation, de l'environnement et du travail, France Geraldine Anthoine geraldine.anthoine@anses.fr	The team will contribute to points: a, b and d (see section 1.4). Contact person: Laurent Folcher laurent.folcher@anses.fr Contact person: Alain Buisson alain.buisson@anses.fr Contact person: Fabrice Ollivier fabrice.ollivier@anses.fr Contact person: Anne-Marie Chappé anne-marie.chappe@anses.fr
3. Netherlands Food and Consumer Product Safety Authority, the Netherlands Martijn Schenk M.Schenk1@nvwa.nl	-Contribution to be detailed Contact person: Gerrit Karssen g.karssen@nvwa.nl
4. National Institute for Agricultural and Veterinarian Research, Portugal Leonor Cruz leonor.cruz@iniav.pt	-The team will contribute to points a, b, c and d (see section 1.4). Contact person: Maria Lurdes Inácio lurdes.inacio@iniav.pt Contact person: Filomena Nóbrega filomena.nobrega@iniav.pt
5. Agricultural Extension Service, Serbia Jasmina Bacic jasmina.bacic@jasminabacic.rs	-Contribution to be detailed Contact person: Jasmina Bacic jasmina.bacic@jasminabacic.rs

1.7. Research project partnership outside Euphresco

Euphresco funding ensures a certain level of transnational collaboration among Euphresco member countries. It is possible, if the funding consortium is interested, to contact funding

organisations or research groups outside the geographical area covered by Euphresco members. The Euphresco coordinator could advertise the research topic in order to have an enlarged collaboration. If funders are interested in this possibility, please check the case below:

☐ The funding consortium of the topic mentioned in section 1.2 requires to advertise the topic outside the Euphresco network

Information to sharpen the profile of sought partners could be useful (but not mandatory): country/region (if there are preferences), skills/expertise required, etc.

1.8. Any other relevant information on content

References:

- Bebber, D. P., Holmes T., Gurret S. J. (2014). The global spread of crop pests and pathogens. *Global Ecol Biogeogr*, 23:1398-1407.
- Janssen, T., Karssen, G., Verhaeven, M., Coyne, D., Bert, W. (2016). Mitochondrial coding genome analysis of tropical root-knot nematodes (*Meloidogyne*) supports haplotype based diagnostics and reveals evidence of recent reticulate evolution. *Sci. Rep*. 6, 22591; doi: 10.1038/srep22591.
- Lunt, D. H., Kumar, S., Koutsovoulos, G., Blaxter, M. L. (2014).The complex hybrid origins of the root knot nematodes revealed through comparative genomics. *Peerj* 2, doi: 10.7717/peerj.356.
- Wesemael, W.M.L., Viaene, N., Moens, M. (2011). Root-knot nematodes (*Meloidogyne* spp.) in Europe. *Nematology*, 13, 3–16.

2. Euphresco management aspects of the project

2.1. Indication of the topic budget

Funding organisation[a]	Mechanism [b]	Total Budget [c]
1. KIS (SI)	NC	€ 25 000
2. Anses (FR)	NC	€ 15 000
3. NVWA (NL)	NC	€ 24 000
4. INIAV (PT)	NC	€ 15 500
5. AES (RS)	NC	€ 3 000
total		€ 82 500

2.2. Expected duration of the project (only for non-competitive topics)

36 months.

2.3. Any other relevant information on topic organisation and management

[a] First member is project coordinator. A minimum of two partners are necessary for each proposal. Add lines as needed.
[b] Please indicate the preferred mechanism (e.g. real pot RP; virtual pot VP; non-competitive NC), or several mechanisms if there is flexibility.
[c] Optional, as this amount can still change in the next phase. In-kind contribution should also be indicated in this column.