

## 1. Content of the 'Topic Description' document

### 1.1. Topic area

Diagnostics, field detection, surveillance

### 1.2. Links to the Euphresco Strategic Research Agenda

The topic addresses the following objective(s) of the 2017-2022 Euphresco Strategic Research Agenda

- Objective 2017-R-1.1: to improve knowledge on the biology, epidemiology and ecology of priority invasive and (re)emerging pests
- Objective 2017-R-2.1: to improve knowledge on emerging pathways of entry and means of spread for pests
- Objective 2017-R-4.2: to explore the use of remote sensing technologies to support surveillance and detection activities
- Objective 2017-R-5.4: to test and validate the use NGS (e.g. whole genome sequencing, metagenomics, deep sequencing, typing by sequencing) for routine diagnostics
- Objective 2017-R-6.1: to test and validate methods for in situ detection and identification of pests
- Objective 2017-I-2.2: to contribute to databases for plant pests' identification and diagnostics
- Objective 2017-C-3.1: to favour knowledge exchange and support common initiatives with relevant players

### 1.3. Topic title

Preventing *Meloidogyne graminicola* spread in European rice paddies

### 1.4. Description of the problem the research should solve.

Rice (*Oryza sativa* L.) is the most important cereal crop worldwide since it provides food security for more than half of the world's human population. The total area growing rice within Europe is about 450,000 ha. According to the European Commission, the region produces around 70% of the total rice consumed domestically in Europe, with an average of 3.1 million tons/year. The European rice market can be sub-divided into two major rice varieties, Japonica and Indica. Japonica rice is the traditional European rice, representing around 75% of the European production, for which Europe is self-sufficient. On the other hand, Indica rice also known as traditional Asian rice, represents 25% of European production and the region depends on imports. The importance of the sector is recognized and materialized, however, there are still some weaknesses that need to be addressed, such as the reduced options to control pests/diseases (Global Agrimar, 2019).

Plant-parasitic nematodes (PPN) represent an important constrain to agricultural production, as they contribute to severe losses worldwide. Among the PPN, root-knot nematodes (RKN), *Meloidogyne* spp., and particularly *M. graminicola*, are serious pests of rice, being probably, the most economically important (Jones *et al.*, 2013). *M. graminicola* has a wide range of hosts that include weeds, grasses and cultivated crops, such wheat, oat, barley and rice, among others (McGowan and Langdon, 1989). *M. graminicola* is an obligate sedentary endoparasite adapted to flooded conditions. It is found in both upland (rainfed) and lowland (irrigated) rice, as well as in deep-water ecosystems and can complete several generations within a single growing rice season, leading to the rapid build-up of damaging population densities (Shrestha *et al.*, 2007; Mantelin *et al.*, 2017). The yield losses caused by *M. graminicola* infection can reach up to 70% and, although is considered a pest of tropical rice production, it was recently reported in Italy and included in the European and Mediterranean Plant Protection Organization (EPPO) Alert List (EPPO, 2016). Projections by the Intergovernmental Panel for Climate Change (IPCC) indicate that there will be an increase in mean annual temperature and rainfall. The elevated temperature and moisture may result in

an increasing rate of *M. graminicola*'s infection, development and reproduction, causing shifts in their abundance and geographic distribution. Such effects may have a detrimental impact on cereal production, mainly rice in temperate regions. Moreover, studies have shown that temperate rice cultivars are particularly susceptible to this pest, due to the lack of resistance, which poses a risk for European rice production (Wang *et al.*, 2019).

Since its detection in 2016, in the Piedmont region, *M. graminicola* has further spread to other Italian regions, such as Lombardy (EPPO, 2018). However, until now, it has not been reported in other European areas. Therefore, it is important to anticipate *M. graminicola* arrival and develop fast/reliable diagnostic methods, as well as to understand the molecular dialogue established between *M. graminicola* and plant hosts, not only for its identification, but also for field detection and development/selection of sustainable management strategies.

### 1.5. Description of the expected results

- Surveillance of rice and other main host crops fields (wheat, soy, corn and barley), other Poaceae and important weeds and cultivated host plants that may be present, to assess the occurrence/prevalence of *M. graminicola* and to create national distribution maps. In Lombardy (Italy), corn and soybean fields, next to rice fields, will be also monitored for the presence of *M. graminicola*.
- Validation of morphological, biochemical (esterase phenotype) and molecular methods (COXII-16S, SCAR markers and real-time PCR). As it has been reported that *M. graminicola* presents high variability, isolates from different geographical locations will be included for the development of this task, to better understand the origin and spread of this species.

It has been reported, by sequence analyses of both nuclear and mitochondrial genomes, the existence of two divergent types of nrDNA sequences and high diversity in the non-coding regions of the mitochondrial DNA in *M. graminicola*. Thus, the assessment of nuclear and mitochondrial haplotypes in Italian *M. graminicola* isolates will allow an accurate spatial reconstruction (GPS) of the spread of the species.

The existence of known/new haplotypes will also be used to clearly differentiate *M. graminicola* from closely related species, such as *M. oryzae*, *M. ottersoni* and *M. salasi*, associated with rice fields.

Sequencing, by high-throughput sequencing (HTS), of the genome of Italian and other *M. graminicola* isolates in collaboration with other groups involved in the project.

- Host suitability of selected rice, wheat and barley cultivars to *M. graminicola*, in local edaphoclimatic conditions, will be tested, in order to determine the ability of *M. graminicola* to parasitize the selected cultivars and the damage that it can cause.

The project will:

- Build a map of *M. graminicola* distribution in Europe;
- Develop knowledge to support risk analysis of spread with trade, especially in Mediterranean countries;
- Increase the availability of isolates for morphological, biochemical and molecular studies;
- Build a network of research and quarantine nematologists to harmonize and validate molecular protocols to support diagnosis of *M. graminicola*;
- Increase the availability of robust sequence data through Q-bank and Genbank;
- Improve the understanding of *M. graminicola* epidemiology through accurate characterisation;
- Include this species in the present rice breeding programs for the development of sustainable management strategies

### 1.6. Beneficiaries of this research product

The intended users/stakeholders of the research are: researchers, phytosanitary inspectors, technicians from quarantine laboratories, farmers, and companies from the plant-protection sector.



### 1.7. Research funders and research contribution/ distribution

Funding organisation	Research activity and researchers involved
<p>1. National Institute for Agricultural and Veterinarian Research, Portugal</p> <p>Leonor Cruz <a href="mailto:leonor.cruz@iniav.pt">leonor.cruz@iniav.pt</a></p>	<p>-Project coordination; -Survey in rice fields; -Morphological, biochemical and molecular identification; -Characterization of rDNA and mitochondrial haplotypes; -Identification of susceptible/resistant rice cultivars in Portuguese conditions; -Participation in the proficiency tests;</p> <p>Contact person: Maria Inácio E-mail address: <a href="mailto:lurdes.inacio@iniav.pt">lurdes.inacio@iniav.pt</a></p> <p>Contact person: leidy Rusinque E-mail address: <a href="mailto:leidy.rusinque@iniav.pt">leidy.rusinque@iniav.pt</a></p> <p>Contact person: Filomena Nóbrega E-mail address: <a href="mailto:filomena.nobrega@iniav.pt">filomena.nobrega@iniav.pt</a></p> <p>Contact person: Rita Varela E-mail address: <a href="mailto:rita.varela@iniav.pt">rita.varela@iniav.pt</a></p> <p>Contact person: Ana Sofia Almeida E-mail address: <a href="mailto:sofia.almeida@iniav.pt">sofia.almeida@iniav.pt</a></p>
<p>2. University of Coimbra, Portugal</p> <p>Carla Maleita <a href="mailto:carla.maleita@uc.pt">carla.maleita@uc.pt</a></p>	<p>-Project coordination; -Survey in rice fields; -Morphological, biochemical and molecular identification; -Characterization of rDNA and mitochondrial haplotypes; -Identification of susceptible/resistant rice cultivars in Portuguese conditions; -Participation in the proficiency tests;</p> <p>Contact person: Carla Maleita E-mail address: <a href="mailto:carla.maleita@uc.pt">carla.maleita@uc.pt</a></p> <p>Contact person: Isabel Abrantes E-mail address: <a href="mailto:isabel.abrantes@uc.pt">isabel.abrantes@uc.pt</a></p> <p>Contact person: Luci Conceição E-mail address: <a href="mailto:luci@zoo.uc.pt">luci@zoo.uc.pt</a></p>
<p>3. Austrian Agency for Health and Food Safety, Austria</p> <p>Sylvia Bluemel <a href="mailto:sbluemel@ages.at">sbluemel@ages.at</a></p>	<p>-Provision of knowledge and data (identification, field detection) on occurrence of <i>M. graminicola</i> on fields with host plants;</p> <p>Contact person: Ines Gabl E-mail address: <a href="mailto:ines.gabl@ages.at">ines.gabl@ages.at</a></p>



<p>4. Flanders Research Institute for Agriculture, Fisheries and Food Research, Belgium</p> <p>Kris de Jonghe <a href="mailto:Kris.DeJonghe@ilvo.vlaanderen.be">Kris.DeJonghe@ilvo.vlaanderen.be</a></p>	<p>-Testing of new molecular methods and new isolates of <i>Meloidogyne</i> spp;</p> <p>Contact person: Nicole Viaene E-mail address: <a href="mailto:nicole.viaene@ilvo.vlaanderen.be">nicole.viaene@ilvo.vlaanderen.be</a></p>
<p>5. Bulgarian Food Safety Agency, Bulgaria</p> <p>Ani Becheva <a href="mailto:a.besheva@bfsa.bg">a.besheva@bfsa.bg</a></p>	<p>-Survey in rice and wheat fields;</p> <p>Contact person: Ani Becheva E-mail address: <a href="mailto:a.besheva@bfsa.bg">a.besheva@bfsa.bg</a></p> <p>Contact person: Mirela Borisova E-mail address: <a href="mailto:m.borisova@bfsa.bg">m.borisova@bfsa.bg</a></p>
<p>6. Council for agronomic research and the bioeconomy, Italy</p> <p>luca Riccioni <a href="mailto:luca.riccioni@crea.gov.it">luca.riccioni@crea.gov.it</a></p>	<p>-Survey in rice, corn, soybean and fields along with weeds in Piedmont and Lombardy regions; -Morphological and molecular identification; -Characterization of nrDNA and mitochondrial haplotypes;</p> <p>Contact person: Giulia Torrini E-mail address: <a href="mailto:giulia.torrini@crea.gov.it">giulia.torrini@crea.gov.it</a></p> <p>Contact person: Agostino Strangi E-mail address: <a href="mailto:Agostino.strangi@crea.gov.it">Agostino.strangi@crea.gov.it</a></p>
<p>7. Netherlands Food and Consumer Products Safety Authority, the Netherlands</p> <p>Martijn Schenk <a href="mailto:M.Schenk1@nvwa.nl">M.Schenk1@nvwa.nl</a></p>	<p>-Survey in the open field on ornamental grasses and other host plants; -Providing and NGS sequencing of some non-European isolates of <i>M. graminicola</i>; -Provision of knowledge on (morphological) identification; -Characterization of nrDNA and mitochondrial haplotypes; -Participation in the proficiency tests;</p> <p>Contact person: Evelyn van Heese E-mail address: <a href="mailto:e.y.j.vanheese@nvwa.nl">e.y.j.vanheese@nvwa.nl</a></p> <p>Contact person: Gerrit Karssen E-mail address: <a href="mailto:g.karssen@nvwa.nl">g.karssen@nvwa.nl</a></p> <p>Contact person: Tim Warbroek Contact person: Daniel Apolito</p>
<p>8. Ministry of Agriculture Forestry and Food, Slovenia</p> <p>Erika Oresek <a href="mailto:erika.oresek@gov.si">erika.oresek@gov.si</a></p>	<p>-Survey in fields with host plants; -Morphological, biochemical and molecular identification; -Characterization of rDNA and mitochondrial haplotypes; -Participation in the proficiency tests;</p> <p>Contact person: Barbara Geric Stare E-mail address: <a href="mailto:barbara.geric@kis.si">barbara.geric@kis.si</a></p>
<p>9. Phytus Institute, Brazil</p>	<p>-Survey in fields with host plants; -Supply of <i>M. graminicola</i> isolates;</p>



<p>Cristiano Bellé  <a href="mailto:Cristiano.belle@iphytus.com">Cristiano.belle@iphytus.com</a></p>	<p>-Morphological, biochemical and molecular identification;</p> <p>Contact person: Cristiano Bellé          E-mail address: <a href="mailto:Cristiano.belle@iphytus.com">Cristiano.belle@iphytus.com</a></p>
<p>10. Emilia Romagna Plant Protection Service, Italy</p> <p>Giovanna Curto  <a href="mailto:Giovanna.Curto@regione.emilia-romagna.it">Giovanna.Curto@regione.emilia-romagna.it</a></p>	<p>-Survey in rice fields along with weeds in the region Emilia Romagna;</p> <p>Contact person: Giovanna Curto          E-mail address: <a href="mailto:Giovanna.Curto@regione.emilia-romagna.it">Giovanna.Curto@regione.emilia-romagna.it</a></p>
<p>11. National Research Council, Italy</p> <p>Francesca De Luca  <a href="mailto:francesca.deluca@ipsp.cnr.it">francesca.deluca@ipsp.cnr.it</a></p>	<p>-Survey in rice, corn, soybean and fields along with weeds in Piedmont and Lombardy regions;</p> <p>-Morphological, biochemical and molecular identification;</p> <p>-Characterization of nrDNA and mitochondrial haplotypes;</p> <p>Contact person: Francesca De Luca          E-mail address: <a href="mailto:francesca.deluca@ipsp.cnr.it">francesca.deluca@ipsp.cnr.it</a></p> <p>Contact person: Alberto Troccoli          E-mail address: <a href="mailto:alberto.troccoli@ipsp.cnr.it">alberto.troccoli@ipsp.cnr.it</a></p> <p>Contact person: Elena Fanelli          E-mail address: <a href="mailto:elena.fanelli@ipsp.cnr.it">elena.fanelli@ipsp.cnr.it</a></p>
<p>12. SFR Lombardia laboratory, Italy</p> <p>Stefano Sacchi  <a href="mailto:stefano_sacchi_cnt@regione.lombardia.it">stefano_sacchi_cnt@regione.lombardia.it</a></p>	<p>-Survey in rice, corn, soybean and fields along with weeds in Piedmont and Lombardy;</p> <p>Contact person: Stefano Sacchi          E-mail address: <a href="mailto:stefano_sacchi_cnt@regione.lombardia.it">stefano_sacchi_cnt@regione.lombardia.it</a></p>
<p>13. University of Naples Federico II, Italy</p> <p>Antonio Evidente  <a href="mailto:evidente@unina.it">evidente@unina.it</a></p>	<p>-Contribution to be detailed;</p> <p>Contact person: Antonio Evidente          E-mail address: <a href="mailto:evidente@unina.it">evidente@unina.it</a></p> <p>Contact person: Alessio Cimmino          E-mail address: <a href="mailto:alessio.cimmino@unina.it">alessio.cimmino@unina.it</a></p> <p>Contact person: Marco Masi          E-mail address: <a href="mailto:marco.masi@unina.it">marco.masi@unina.it</a></p>
<p>14. Clear Detections, the Netherlands</p> <p>Marta Santos  <a href="mailto:marta.santos@cleardetections.com">marta.santos@cleardetections.com</a></p>	<p>-Testing of new molecular methods and new isolates of <i>Meloidogyne</i> spp.;</p> <p>Contact person: Marta Santos          E-mail address: <a href="mailto:marta.santos@cleardetections.com">marta.santos@cleardetections.com</a></p> <p>Contact person: Marieke Beltman          E-mail address: <a href="mailto:marieke.beltman@cleardetections.com">marieke.beltman@cleardetections.com</a></p>



<p>15. University of Barcelona, Spain</p> <p>Salvador Noges  <a href="mailto:salvador.nogues@ub.edu">salvador.nogues@ub.edu</a></p>	<p>-Provision of knowledge about rice cultivation, stakeholders, etc.;</p> <p>Contact person: Salvador Noges  E-mail address: <a href="mailto:salvador.nogues@ub.edu">salvador.nogues@ub.edu</a>;</p> <p>Contact person: Xavier Serrat  E-mail address: <a href="mailto:xserrat@ub.edu">xserrat@ub.edu</a></p> <p>Contact person: Sandra Mace</p>
<p>16. Eskisehir Osmangazi University, Turkey</p> <p>Refik Bozbuga  <a href="mailto:refik.bozbuga@ogu.edu.tr">refik.bozbuga@ogu.edu.tr</a></p>	<p>-Survey in rice fields;  -Survey in the field on some other host plants, including maize;</p> <p>Contact person: Refik Bozbuga  E-mail address: <a href="mailto:refik.bozbuga@ogu.edu.tr">refik.bozbuga@ogu.edu.tr</a></p> <p>Contact person: Dilek Dinçer  E-mail address: <a href="mailto:dilek.dincer@tarimorman.gov.tr">dilek.dincer@tarimorman.gov.tr</a></p> <p>Contact person: Hulya Demirbas Pehlivan  E-mail address: <a href="mailto:hulya.demirbas@tarimorman.gov.tr">hulya.demirbas@tarimorman.gov.tr</a></p>

**1.8. Any other relevant information on content**

None.

## 2. Euphresco management aspects of the project

### 2.1 Indication of the topic budget

Funding organisation <sup>a</sup>	Mechanism <sup>b</sup>	Total Budget <sup>c</sup>
1. INIAV (PT)	NC	€
2. UoC (PT)	NC	€
3. AGES (AT)	NC	€
4. ILVO (BE)	NC	€
5. BFSA (BG)	NC	€
6. CREA (IT)	NC	€
7. NVWA (NL)	NC	€
8. MAFF (SI)	NC	€
9. Phytus (BR)	NC	€
10. ER-PPS (IT)	NC	€
11. CNR (IT)	NC	€
12. L-PPS (IT)	NC	€
13. UNINA (IT)	NC	€
14. Clear detections (NL)	NC	€
15. UB (ES)	NC	€
16. EOU (TR)	NC	€

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

36 months

### 2.3 Identification of project coordinator

Has the research project coordinator been identified?

- Yes  
 No

### 2.4 Any other relevant information on topic organisation and management

This project was designed to be coordinated by two Portuguese Institutions, the National Institute for Agriculture and Veterinary Research and the University of Coimbra. Victor Maurice Kommerell from the Consultative Group on International Agricultural Research (CGIAR) [V.Kommerell@cgiar.org](mailto:V.Kommerell@cgiar.org) asked to be informed about the progress of this topic mostly because during 2022 the funding opportunities may change in CGIAR.

<sup>a</sup> First member is project coordinator. A minimum of two partners are necessary for each proposal. Add lines as needed.

<sup>b</sup> Please indicate the preferred mechanism (e.g. real pot RP; virtual pot VP; non-competitive NC), or several mechanisms if there is flexibility.

<sup>c</sup> Optional, as this amount can still change in the next phase. In-kind contribution should also be indicated in this column.