

Final Outcome of ARIMNet2 Call 2015

Final list (Alphabetic Order)

Proposal	Title	Participating countries (in bold, country of the coordinator)
AVIAMED	AVIAn viral disease prevention and control with plant vaccines for the MEDiterranean area	IT EG MA
BacPlant	Towards a sustainable agriculture by increasing plant tolerance to biotic stress under climatic change	FR TN MA
BEST	Exploring genotypic diversity to optimize barley grain and straw quality under marginal/stressful growth conditions	TN FR EG SI MA
BrucMednet	Improvement of epidemiological and serological tools for diagnosis and control of Brucellosis in the Mediterranean region	IT GR EG PT TN
EMERAMB	Emergent viruses and virus vectors in Mediterranean Basin crops	ES GR SI TR EG MA IL FR IT
MASCC	Mediterranean Agricultural Soils Conservation under global Change	FR IT MA PT ES TN
MedOOmics	Mediterranean Extra Virgin Olive Oil Omics: profiling and fingerprinting	PT FR TN TR
ORPRAMed	Risk assessment of introduction of Xanthomonas citri subsp citri through commercial trade of ornamental rutaceous plants in the Mediterranean basin	IT ES FR TR
SALTFREE	Salinization in irrigated areas: risk evaluation and prevention	PT EG TN IT
STomP	Sustainable Tomato Production: plant defense enhancement, development of new biopesticides and optimization of environmental, water and chemical inputs	IT TN FR MA GR



AVIAMED

AVIAn viral disease prevention and control with plant vaccines for the MEDiterranean area
IT EG MA

Emergence and re-emergence of infectious viral poultry diseases remain an important challenge to both productivity and public health especially in the Mediterranean basin. Vaccines are regarded as the most beneficial interventions to prevent this kind of infections. Although most of the vaccines are still based on whole pathogens, many novel vaccine candidates, based only on those pathogen components (antigens) that are critical to initiate protective immune responses, are currently under development. The challenge for these new formulations is to mimic infection by stimulating a complete immune response (innate and adaptive, humoral- and cell-mediated) with minimal morbidity and low production costs. Infectious Bursal disease virus (IBDV) and Newcastle disease virus (NDV) are the cause of economically important diseases of poultry in Morocco, Egypt and also Southern Europe Mediterranean countries. The aim of the present project is to use plants as “biofactories” for the transient and stable expression of IBDV and NDV antigens both in their native forms or as fusion to: i) the fragment crystallizable region of chicken IgY immunoglobulins or to ii) the coat protein of the plant virus Potato virus X. The transiently and the stably expressed antigens will be used to: i) evaluate the type of immune response they activate by performing immunization trials through subcutaneous/intramuscular, and mucosal/oral routes; ii) evaluate the efficacy of the selected prototype vaccines in terms of clinical protection and virus shedding following experimental challenge; iii) set up novel diagnostic assays. The plant “biofactory” approach has the potential to result in: i) ease and rapidity of production scale up at low costs due to the use of plants as expression systems; ii) simplification of the purification procedures; iii) improvement of the immunogenic properties of the antigens obtained by self-assembly in multimeric subviral particles/virus-like particles or by the proposed innovative fusion strategies; iv) development of low-cost and ready to use diagnostic tools able to differentiate infected from vaccinated animals (DIVA) in surveillance programs and international trade of poultry and poultry products. AVIAMED will gather together 3 different countries: Italy, as coordinator, Morocco and Egypt. Five research teams will be involved with complementary competences on molecular farming (transient expression of antigens in *Nicotiana benthamiana*, ENEA-Italy; maize stable transformation, INRA-Morocco and AGERI-Egypt), testing of veterinary vaccine prototypes efficacy (NDV, IZSVE-Italy; IBDV, IAV-Morocco) and development of novel diagnostic tools (ENEA- and IZSVE-Italy). The AVIAMED proposal brings together high-level expertise in diverse scientific domains establishing a strong interconnection and know-how transfer between EU and non EU participants in the Mediterranean region.





BacPlant

Towards a sustainable agriculture by increasing plant tolerance to biotic stress under climatic change
FR TN MA

Nowadays, agriculture must overcome unprecedented challenges. In addition to improving food supply to the one billion people currently malnourished, agriculture must meet new demand from growing population and competition for agricultural products from bioenergy production. Meantime there is high confidence that climate change (CC) will have great impacts on crop production in many parts of the world. For the Mediterranean Basin, one of the potentially more vulnerable areas, we predict a rise of annual mean temperatures and a decline in the annual mean precipitation. In addition, drought period duration will be from 3 to 8 times more frequent than at present. Elevated temperatures and water deficit resulting from CC may considerably influence plant growth and development as their susceptibility to pathogens. In this situation, Mediterranean agriculture will need to adapt to CC. Furthermore, there is an increasing demand for "safe" agricultural products, with a reduced use of chemicals (fertilizers and pesticides). Since, plants are surrounded by dense populations of Microbial biocontrol agents, which potentially allow them to better cope with biotic and abiotic stresses, there is a need to valorize them. There are currently an increasing number of results from both field and laboratory studies, which confirmed that inoculation with microbial biocontrol agents can have positive effects on plant health and growth. These beneficial microbes can also enhance plant resistance to several environmental stresses, e.g., drought, salinity, and nutrient deficiency. By moderating stress, these beneficial microorganisms opens novel avenues/possibilities for advanced technology through their use to inoculate plants or to deliver seeds coated with MBAs that are able to cope with stress and thereby increasing sustainability of production systems. Our project will adopt environmentally sustainable strategy to face drought and heat effects while preserving or even improving crop yield, health and quality. Furthermore, the use of microbial biocontrol agents will improve soil quality by using low inputs, and mitigate carbon emissions in future climates.





BEST

Exploring genotypic diversity to optimize barley grain and straw quality under marginal/stressful growth conditions

TN FR EG SI MA

Mediterranean climate and soils impose drastic constraints to agriculture. Barley (*Hordeum vulgare*) is one of the best adapted species to Mediterranean conditions. Climate change and growing Mediterranean population will further increase environmental and anthropic constraints on barley culture in a near future. An urgent objective is therefore to obtain barley varieties with high yield under stress conditions, while maintaining high nutritional quality of edible parts, associating high protein, mineral and fiber content with low contamination. In this context, the use of biostimulants of plant growth may help improving stress tolerance as well as nutritional quality, while limiting the use of classical chemical fertilizers that contribute to soil pollution. Our proposal is based on exploring the genetic diversity of a collection of Mediterranean barley accessions subjected to combined environmental constraints: heavy metals (HM), salinity, drought and pathogens. A collection of representative *H. vulgare* cultivars from Morocco, Algeria, Tunisia and Egypt as well as wild barley accessions (*H. spontaneum*) will be screened in the frame of this project. The project will therefore make use of local biodiversity to identify ideotypes maintaining high nutritional quality and low contaminant content even when grown under combinations of biotic and abiotic stresses. Nutritional quality and mineral content of grain and straw of these accessions will be analyzed under combinations of different abiotic (drought, salinity, Cd) and biotic (the fungal pathogen *Rhynchosporium commune*) stresses. Physiological and molecular characterization of genotypes with contrasting phenotypes will shed light on the mechanisms underlying their adaptation to multiple stresses. Biostimulants provided by the private partner Roullier will be tested to evaluate their ability to increase stress tolerance and nutritional quality. This project will bring together the expertise of 9 partners from 5 European and North African Mediterranean countries. It is expected to provide key information on the resilience and quality traits of Mediterranean barley germplasm under stress conditions, which can be used by breeders and farmers to choose their variety depending on a particular agricultural environment. We will identify potential ideotypes for entering breeding programs to reach resilience objectives while preserving nutritional quality. An important scientific output of this project will be a better understanding of the molecular and physiological mechanisms involved in barley nutritional quality and tolerance to combined stresses that will be of great relevance for agronomical and scientific communities.





BrucMednet

Improvement of epidemiological and serological tools for diagnosis and control of Brucellosis in the
Mediterranean region
IT GR EG PT TN

Despite Brucellosis eradicated from most of the developed Countries, it still causes a Public Health impact and economic losses in animal husbandry in the Mediterranean area. In the last years brucellosis is reemerging as a new challenge with new foci of both human and animal disease. The design of adequate strategies for preventing animal brucellosis and consequently human brucellosis requires a detailed understanding of disease epidemiology. Molecular epidemiology greatly enhances traditional epidemiology contributing to the development of more rational approaches for disease prevention with the improving of public health. On the other hand current indirect diagnostic tests still suffer of specificity problems and are not suitable for differentiating infected from vaccinated animals (DIVA) when vaccination policies based on the use of Brucella smooth live attenuated vaccines (*B. melitensis*Rev.1) are adopted. To date few multicenter Mediterranean projects have been conducted on brucellosis and this kind of approach is paramount to tackle this dangerous disease. Thus, the main objectives of the project are to implement molecular epidemiology based on VNTRs within the Mediterranean region and to improve the indirect diagnosis by developing diagnostic test suitable for a DIVA strategy. We expect to develop a web based server for VNTRs data useful for epidemiological investigations and for tracing back the sources of brucellosis of domestic ruminants (sheep, goats, cattle, water buffaloes and camels) living in Mediterranean countries. The system will be freely accessible and hosted by the IZSAM partner server where users (mostly supposed to be stakeholders or researchers worldwide), will compare the profile of their Brucella isolates with reference and field strains previously isolated and characterized in order to correctly assign species, lineages, and genotypes. This epidemiological tool will serve as free access bank for Brucella VNTRs data and using a self-feeding approach all the stakeholders worldwide will contribute to define a detailed picture of Brucella epidemiology. As a second task we want to carry out a detailed characterization of *B. melitensis* proteome and immunoproteome that will further extend current knowledge on Brucella biology, host-pathogen interaction and immunogenic antigens. All the results achieved will be applied to improve indirect diagnosis by developing a novel serological test suitable for a DIVA strategy. In addition results obtained will serve scientific bases for development of promising recombinant vaccines. Prevention of human brucellosis depends on control of the disease in animals, as well as proper handling and treatment of animal products. According to this view, BrucMednet project wants to impact on Brucella control strategies in the Mediterranean region and over focusing on improvement of animal health for disease prevention in humans. This will be achieved by through a multicountry approach and in the framework of sustainable research cooperation dynamics.





EMERAMB

Emergent viruses and virus vectors in Mediterranean Basin crops

ES GR SI TR EG MA IL FR IT

Emerging plant viral diseases represent a significant burden to plant health, and their highest impact in Mediterranean agriculture is on vegetables grown under intensive horticultural practices. Intensive horticulture is very competitive and one of the most dynamic sectors in Mediterranean agriculture. The emergence of a new viral disease results from a complex interaction among several factors, including ecological changes of host and vector populations, and genetic changes due to the introduction of new crop varieties and the evolution of the viruses and/or vectors. A transnational consortium incorporating 12 research groups from 5 EU and 4 non-EU Mediterranean countries has been gathered to analyse different aspects of the ecology and biology of specific plant viruses, providing measures for the management and control of specific emergent viral diseases in Mediterranean horticulture and, importantly, a better understanding of the phenomenon of emergence itself. We will focus on a few undisputedly important case studies for Mediterranean horticulture, such as whitefly-transmitted gemini viruses in tomato and cucurbits, aphid-transmitted viruses in cucurbits and Pepino mosaic virus in tomato. Specific objectives of the project include (i) identification of host reservoirs for emergent viruses, (ii) development of advanced diagnostic tools, (iii) analysis of host-range determination and host-range modification, (iv) analysis of short- and long-range virus dispersion, including vector transmission and population genetics, (v) analysis of virus evolution, (vi) risks evaluation of virus emergence in a changing environment and (vii) development of sustainable strategies for the control of emerging plant viral diseases.





MASCC

Mediterranean Agricultural Soils Conservation under global Change

FR IT MA PT ES TN

MASCC aims to address mitigation and adaptation strategies to global change by assessing current and future evolution of Mediterranean agricultural soil vulnerability to erosion in relation to projected land use, agricultural practices and climate change. It targets to i) assess the similarities/dissimilarities in dominant factors affecting the current Mediterranean agricultural soil vulnerability by exploring a wide range of Mediterranean contexts; ii) improve the ability to evaluate the impact of extreme events on both the current and projected agricultural soil vulnerability and the sediment delivery at catchment outlet; iii) provide benchmarks regarding the vulnerability of agricultural production to a combination of potential changes in a wide range of Mediterranean contexts, iv) and provide guidelines on sustainable agricultural conservation strategies adapted to each specific agro-ecosystem taking into consideration both on- and off-site erosion effects and socio-economics issues. To reach these objectives, the MASCC project will gather researchers from 6 Mediterranean countries (France, Morocco, Tunisia, Italy, Spain, and Portugal) that monitor mid- to long-term environmental catchment and that get mutual knowledge due to previous projects and network. The major advantages for the project are: i) the availability of an unrivalled database on soil erosion, (innovative) agriculture practices covering a wide range of Mediterranean contexts, ii) the capacity to better evaluate the impact of extreme events on soil erosion, iii) the availability of the LANDSOIL , a catchment-scale integrated approach of the soil-landscape system that enables to simulate both the sediment fluxes at the catchment outlet and the soil evolution properties, iv) the multi-disciplinarity of the involved researchers with an international reputation in the fields of soil science, modelling changes in soil properties, erosion and sediment transport, agronomy and socio-economy. The MASCC project will be conducted through a coordination and dissemination workpackage and three scientific work-packages : WP1 will consist in elaborating plausible scenario (climatic, land use and adaptative innovative agricultural practices) for the future (20 to 50 years); WP2 will simulate soil vulnerability for current conditions and scenarios from WP1; and WP3 will focus on the comparative evaluation of present and future on-site and off-site effects of soil erosion on agriculture sustainability.





MedOOmics

Mediterranean Extra Virgin Olive Oil Omics: profiling and fingerprinting
PT FR TN TR

Olive oil is one of the oldest vegetable oils, and is the major constituent of the Mediterranean diet. Its consumption has also spread remarkably outside the Mediterranean Basin. It is considered as a commodity and nutraceutical product that has a huge economic impact in the Mediterranean countries. Nowadays, consumers awareness concerning quality, safety and traceability of food products, in general, and olive oil in particular, is increasing. More information is required in terms of labeling, and also legislation frameworks are in constant updating, aiming to maintain and improve the overall quality of this product. In this regard issues related to olive oil authenticity and traceability are considering crucial. MedOOmics (Mediterranean Extra Virgin Olive Oil Omics: profiling and fingerprinting) aims to profile and fingerprint monovarietal extra virgin olive oils made of the most typical varieties from different regions of four countries, addressing issues related to varietal and geographical traceability and authentication. The objectives can be summarized as 1) the establishment of chemical markers of geographical and varietal traceability and 2) establish a pattern comprising the “markers of authenticity” to be used in the identification of olive oil adulterations. The novelty of MedOOmics is based on an integrated approach, comprising a deep knowledge of some of the least studied olive oil varieties in the Mediterranean Basin. Olive oils profiling will be achieved by the determination of several class of compounds in a multicomponent analysis: trace elements by ICP-MS; stable isotope ratio analysis by EA-IRMS and/or GC/C-IRMS; volatile and phenolic compounds, tocopherols, pigments, sterols, fatty acids and triacylglycerols by chromatographic techniques- GC-FID, GC/MS or HPLC-DAD, LC/MS. Olive oils fingerprinting, focus on recognition of patterns, will comprise NMR techniques, including multidimensional NMR, Infrared Spectroscopy (mean infrared (MIR) and near infrared (NIR)) and Raman Spectroscopy. Appropriated statistical analysis will be performed, namely chemometric tools using multivariate descriptive and predictive methods. MedOOmics activities will span 8 working packages, gathering four countries, Portugal as coordinator, France, Turkey and Tunisia. Seven research teams will be involved with different skills and complementary competences enabling to establish an international network related with Olive Oil Omics thematic. Altogether, this proposal will contribute to the implementation of a “MedOOmics database” comprising the chemical markers of varietal and geographical origin for the most relevant EVOOs from the Mediterranean countries encompassed in this work, which constitute a valuable tool in the field of “Food Authentication”.





ORPRAMed

Risk assessment of introduction of *Xanthomonas citri* subsp. *citri* through commercial trade of ornamental rutaceous plants in the Mediterranean basin

IT ES FR TR

Citrus crops in the Mediterranean region are currently threatened by several plant pathogens. The most important risk factor for the introduction of new pathogens is the importation of infected yet symptomless plant material and plant pathogen vectors. The European “Plant Health Directive” (2000/29CE) and following amendments lists the requirements for the introduction into the EU of citrus plants, including fruits, which could be a pathway for the entry of citrus pests. Among those pests listed as quarantine organisms *Xanthomonas citri* subsp. *citri* (Xcc) or *X. fuscans* subsp. *aurantifolii* (Xfa), not known to occur in the European community and entire Mediterranean region, are causal agents of Citrus Bacterial Canker (CBC) a devastating disease that severely affect citrus plants and fruits being noncommercial or dropped prematurely. In case of introduction, CBC control would be problematic since some treatments used for CBC control are not allowed in most of the Mediterranean Countries and those usually used, such copper compounds, are going to be reduced in the EU in the next future. Two of the seven CBC causing bacteria entry pathways highlighted by EFSA are ornamental rutaceous plants through both the commercial trade and passenger pathways, respectively. Rutaceous ornamental species are extensively grown in Mediterranean countries, in nurseries, orchards but also private gardens or public avenues or squares. The rutaceous relatives plants, particularly those not covered by the 2000/29EC directive, represent a threat of the introduction of this pathogen in the Mediterranean basin both by the introduction of infected plants and planting material through official routes and via passenger traffic and/or illegal traffic. ORPRAMed (Ornamental rutaceous plants risk assessment in Mediterranean) aims to risk evaluation of the introduction of Xcc in the Mediterranean region by means of ornamental rutaceous species, by generating and improve our understanding of the interactions between Xc and ornamentals. Such data would help facing an introduction of the pathogen in the Mediterranean region. ORPRAMed is divided in four scientific work-packages; WP1- Economics and trade of ornamental rutaceous plants in the Mediterranean region; WP2- Evaluation of rutaceous ornamental plants for difference in susceptibility and to Xcc; WP3-Mechanisms of epiphytic and endophytic colonization of Xcc in ornamental plants and survival of the bacterial populations after long distance shipment; WP4- Genomic and transcriptomic analysis of the resistant/susceptible phenotypes.

ORPRAMed aims at increasing the current knowledge on the proposed topic providing new data on the susceptibility of many ornamental rutaceous species to CBC, acquiring new about ornamental rutaceous relatives genomes not yet available. The added-value of the project consists also to promote collaboration between local Plant protection services and nurseries with research institutions and to blend join different European research teams in order to provide a multidisciplinary approach.





SALTFREE

Salinization in irrigated areas: risk evaluation and prevention PT EG TN IT

The aim of this project is to develop a framework to evaluate the salinization risk in irrigated production systems in the Mediterranean basin and to propose management practices to prevent or correct salinization mechanisms. We want to be able to advise managers of production systems about practices can reduce the vulnerability to salinization and conserve soil and water. Salinization has been identified as a major cause for soil degradation in countries around the Mediterranean. Soil salinization limits agricultural productivity and can ultimately cause desertification and abandonment of the land. Salinization can also affect the quality of both ground and surface water resources, degrade infrastructures, and decrease biodiversity. Such effects represent major negative social, economic, and environmental impacts. The ecological conditions of the Mediterranean region favor salt accumulation in soils. Furthermore, agricultural practices such as irrigation and fertilization may further promote salt accumulation and accelerate land degradation in Mediterranean environments. At the same time, irrigation is of primal importance to increase agricultural production. The irrigated area in Mediterranean basin is expected to expand, as a mean to increase production, and as result of climate change, with the annual precipitation being likely to decrease in most of the Mediterranean basin. The salinization risk in irrigated production systems depends on natural factors such as the soil type and the local climate, but also on the quality of the irrigation water, irrigation and fertilization management practices. We want to understand how these factors interact and make a production system more or less vulnerable to salinization. The work plan includes defining case-study production systems with varying parameters: soil type, irrigation and fertilization management; measurement of the pedosphere with geophysical methods (electromagnetic induction) during at least two periods of the irrigation cycle and during two consecutive years, in order to analyse the temporal variability of the salinity; and numerical modelling of the production systems and simulation under scenarios such as climate change and variability in the quality of the irrigation water. The result of our work is a powerful framework that can be used to achieve sustainable agricultural intensification. SALTFREE gathers scientists from around the Mediterranean in order to enhance knowledge about soil and water conservation in irrigation areas, namely prevention of soil salinization. We propose to do this by using innovative technological approaches, by harmonizing processes, and by gathering competencies in different areas. The project plans collaborative research and cross-training of young scientists, and continuous dissemination and publication of the results.





STomP

Sustainable Tomato Production: plant defense enhancement, development of new biopesticides and optimization of environmental, water and chemical inputs

IT TN FR MA GR

Tomato has a very high social and economical relevance in Europe and the whole Mediterranean area. The manifestation of new tomato diseases and invasive pest is promoted by climate change and globalized trade. Consequently, several key insect pests (e.g. *Tuta absoluta*, and the whiteflies) and fungal diseases (e.g. *Fusarium* spp., *Phytophthora infestans*, *Alternaria* spp., *Oidiumlycopersici*) affect the tomato industry in the Mediterranean. Both arthropod pest and disease control often relies on agrochemicals which can disrupt the existing integrated pest management programs (IPM). In addition, recurring use of insecticides can be counterproductive due to resistance phenomena on targeted pests, production cost increases and to significant risks for farmers, consumers and other non-target organisms. This project aims at developing and implementing environmental friendly methods for the management of tomato key pests and pathogens, limiting the use of chemicals and improving integrated control techniques. Specific topics of interest will include: (i) characterization of insecticide resistance of two invasive tomato pests (*T. absoluta* and *B. tabaci*) in populations coming from various Mediterranean countries; this will deal with current, potential and cross-resistance to insecticides currently used in the tomato crop. (ii) Potential for including vegetal extracts, known for their medical properties and widely diffused in the Mediterranean basin, in tomato IPM schemes, and development of new carriers and formulations for increased pest control efficacy and minimized phytotoxicity and non-target toxicity. (iii) Application of beneficial fungi and microbial consortia to enhance the defense barriers of tomato plants against biotic (pests and pathogens) and abiotic (reduced water) stress agents. (iv) Effects of different irrigation and fertilization levels on plant physiology, either in terms of nutritional value or chemical defenses, and their consequences on the two trophic levels of herbivorous and insect natural enemies. (v) Evaluation of a newly designed insect-proof ventilated greenhouse model in terms of tomato yields, pest and natural enemies' population dynamics. The research consortium aims at translating the obtained scientific results in new sustainable tomato cropping strategies. A significant increase of the cropping system suitability is expected through the reduction of chemical and water inputs, and the intensification of the role of natural resources, such as arthropod natural enemies, microbes and vegetal extracts. The visibility of the project will rely on a specific communication and dissemination plan, which will be implemented for the whole project duration. Special attention will be paid to the dissemination of the scientific and technological achievement of the project through web site, publications in technical and high impact journals, and meetings with stakeholders.

