CO-OPERATIVE RESEARCH PROGRAMME FELLOWSHIPS AWARDED FOR 2020

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Proposed Studies	Research Fellow's Nationality	Home Institution	Destination Country	Host Laboratory	Duration of Fellowship (weeks)
Theme 1 : Managing Natural Capital for the Future					
Death of spruce in Central Europe: disaster or opportunity? This project will use molecular biodiversity assessment to produce reliable data on the effect of two different management approaches on biodiversity. Intensive outbreak mitigation and natural stand disintegration will be tested to see if these approaches result in significantly different insect biodiversity, endangered species and bark beetle natural enemies. Spruce is studied because it is the main European timber commodity, but it is dying out across Central Europe because of an outbreak of the spruce bark beetle triggered by climatic changes and fuelled by the plantation-like structure of the forests. Law makers in countries are struggling to balance pressure from the forestry sector, which insists on traditional management, with pressure from academia and non-profits, which argue for systemic adaptation of forest management to increasing temperatures, drought and pest pressure. Empirical evidence of the outcomes of the different management styles is missing from this debate, and the researchers involved hope to be able to provide some of that empirical evidence. Forestry industries in OECD Member countries are important to the global economy, contributing billions of euros annually. Forests are also exceptional among commodities in the massive non-monetary functions they provide, including water management, carbon storage, non-timber commodities, biodiversity conservation and wellness for large parts of the population. These benefits are being threatened in Central Europe where vast expanses of spruce forests are undergoing the largest epidemic of the spruce beetle in recorded history. The evidence gathered during this fellowship will help guide the adaptation of forests to future climates to support their future sustainability.	United States	University of Florida	Czech Republic	Czech University of Life Sciences	20

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Proposed Studies	Research Fellow's Nationality	Home Institution	Destination Country	Host Laboratory	Duration of Fellowship (weeks)
Development of a web-based framework for integrated water management in agriculture based on data assimilation and machine learning techniques. The aim of this research project is to provide a web-based framework for implementing data assimilation and machine learning techniques into hydrological models for agricultural water management. A web-based framework will help to predict the soil hydric status for irrigation and water management purposes. Implementing hydroinformatics into agricultural water management results has the potential to substantially increase profits, reduce negative environmental impacts and improve the social infrastructure of agricultural production. The framework will, in fact, use data from different disciplines, including meteorology, hydrology, agronomy, biogeochemistry and economics to produce a simple to use application. This integrated water management web-based platform will provide producers with a powerful tool to help use soil and water sustainably and responsibly. The platform will also help water shed planning and decision makers in testing scenarios within the model provided by the platform.	Brazil	Université Laval, Canada	Italy	University of Padova	20
Development of advanced *in vitro* protocols for plant biodiversity conservation The objective of this research project is to develop advanced in vitro protocols for a range of threatened plant species. In the face of climate change, it is vital that feasible plant propagation methods are available to ensure the conservation and sustainability of biodiversity, and particularly threatened plant species. The importance of biodiversity conservation and management for long term natural and human needs and processes, such as food production is increasingly recognised. Although many plant species can relatively easily propagated by traditional methods, there is an important number of species with propagation problems, notably endangered species. Actions to protect, recover or conserve biodiversity include in situ and ex situ approaches. Seed banking is an ex situ option for plant conservation, but some species are not suited to this and are difficult to propagate. In vitro propagation techniques have great potential and are highly important for the long term ex situ conservation of such species, making plant material readily available for direct propagation. In vitro techniques also have the advantage of being independent of the weather or time of year to be successful, require relatively little space to produce large quantities of plants which are free from microorganisms and pathogens, and are secure compared to *ex situ* conservation methods using field plants exposed to the environment. The development of innovative protocols allowing the propagation of recalcitrant materials, including specific methods for *in vitro* culture, will be of high importance for some endangered species across the globe.	Chile	Universidad Católica del Maule	Australia	Centre for Australian National Biodiversity Research - CSIRO	13

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Proposed Studies	Research Fellow's Nationality	Home Institution	Destination Country	Host Laboratory	Duration of Fellowship (weeks)
Integrative approach for improving forest tree productivity, climatic adaptation and stress tolerance The aim of this research project is to integrate complex genomic data of forest tree responses to different abiotic conditions, to advance a new paradigm for genetically improving environmentally adaptability in trees. The effects of global warming is threatening the health of native forests and the productivity of forest plantations. Both climate change and increases in the number and intensity of abiotic stress events (e.g. drought, frost occurrences) present challenges. At the same time, there is increasing competition for land. Advancing new approaches to increase forest productivity in different environments that are sub-optimal for agriculture and do not displace native forests or critical habitats can inform future policy decisions that ensure sustainability of natural resources, human communities and forest and agriculture production. Some fast-growing hardwoods show substantial natural variation in growth responses to various environmental conditions. These growth responses are controlled by complex gene regulatory networks that are poorly understood. Elucidating these mechanisms will identify specific genes and gene regulatory modules that can be genetically selected or manipulated to maximise growth in difference environments.	United States	Virginia Tech	Chile	Universidad de Concepción	8
Landscape approach to maintaining Chile's natural capital through sustainable viticulture This fellowship aims to develop concrete advice to vineyards about ecosystem-based natural capital management at a landscape scale, using local ecological and agricultural knowledge, earth observation data and ecosystem modelling. It will build on a pilot projected initiated by partners in one of Chile's important agricultural and viticultural regions. The project will demonstrate approaches to using open source software and data, and the huge potential for designing web services that enable non-technical users to interrogate spatial data in order to inform land planning. It is also hoped to provide data on an ongoing basis, enabling models to be re-run. Providing guidance on how data can be collected to feed into environmental modelling will be a large part of the research project. The potential of the outputs from this project to inform Conservation Right Legislation in Chile have already been noted. Conservation Rights can be established with respect to large ecosystems, and to attributes or functions of specific environmental components such as air, water, soil and ecosystem services. Conserving, or better still improving, these attributes and functions will contribute to the concept of "terroir" associated with high quality wine.	United Kingdom	Joint Nature Conservation Committee	Chile	Instituto de Ecologia y Biodiversidad (IEB)	10

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Proposed Studies	Research Fellow's Nationality	Home Institution	Destination Country	Host Laboratory	Duration of Fellowship (weeks)
Nematode trait-based indicators of climate change in semi-arid agricultural systems This fellowship will explore the effects of climate change on soil organisms in arid and semi-arid agricultural systems by using nematode trait-based indicators (body mass, sex and age ratios, anhydrobiotic abilities and metabolic footprints) to assess the effects of drought and warming in soil food webs. Soil nematodes are a diverse group of soil animals which play a key role in delivering ecosystem services and which are widely used as ecological indicators of soil management, pollution, soil degradation and desertification. The use of trait-based indicators, however, offers new possibilities to significantly improve understanding of the effects of climate change on soils. The results of this fellowship will be a step forward in the development of climate change sensors in arid and semi-arid agricultural systems and to contribute undeniable data to support the necessity of actively protecting agricultural soils worldwide.	Spain	National Institute for Agricultural and Food Research and Technology	United States	Colorado State University	13
Spatial modelling of Nature-based Solutions (NBS) in agricultural landscapes to enhance socio-ecological outcomes The aim of this fellowship is to develop a spatial modelling framework within a number of NBS scenarios can be evaluated, in terms of both beneficial and perverse outcomes, for agricultural landscapes. The management of agricultural lands globally has become a focus of scientific and public interest, because these highly-modified ecosystems are critical to the rehabilitation of precious, lost natural capital and the mitigation of ongoing and accelerating changes, and thus the survival and well-being of humans. The aim is to find science-based solutions to managing agroecosystems for multiple outcomes that inherently recognise that people and their livelihoods are at the centre of any path forward. The idea of actively promoting best-practice farm decision making to produce resilient, adaptable, and profitable agroecosystems is encapsulated within the framework of NBS. NBS are predicated on the idea of using and enhancing ecosystem functions at a location to address pressing societal challenges such as climate change adaptation, hazard mitigation, human well-being and biodiversity restoration. The fellowship will develop geographic information system-based approaches for modelling the impacts of typical farm-scale NBS activities on possible landscape-scale socio-economic and ecological outcomes, and evaluate and compare the results to understand to what extent NBS approaches can be generalised in different agricultural contexts.	New Zealand	Auckland University of Technology, School of Science	Canada	Carleton University	8

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Proposed Studies	Research Fellow's Nationality	Home Institution	Destination Country	Host Laboratory	Duration of Fellowship (weeks)
Use of IA methods for the assessment of wildfire occurrence and potential spread *(Confidential)* Forest fires are the main abiotic disturbance affecting landscapes on different biomes across the world, and a source of risk to the sustainable yield of forest products and other associated ecosystem services. Develop and implement fire-smart forestry strategies should be the initial step to mitigate the negative impact of fires, and a requirement to define efficiently other shorter-term strategies such as specific fuel treatments and suppression efforts. Current tools to assess fire spread potential either lack the capacity to evolve overtime as the landscape change (with an operational objective), or are based on gross oversimplifications (forest dynamics simulators). There is a need to develop tools to support tactical decision making under uncertainty, aiming to define medium to long term management strategies (where, when and what to do). This work will help to include fire risk into forest management plans, generating resistant landscapes that evolve overtime. **Manuscript:** Gonzalez-Olabarria J. R. et al. (2023), "A fire spread simulator to support tactical management decisions for Mediterranean landscapes", *Frontiers in forests and global change*, Vol. 6; doi.org/10.3389/ffgc.2023.1071484	Spain	Forest Science and Technology Centre of Catalonia (CTFC)	Chile	Complex Engineering Systems Institute, ISCI Uchile	18
Theme 2: Managing Risks in a Connected World					
Associative effects of fruit by-products and natural prebiotic supplementation on animal performance, rumen microbiota changes, and enteric methane emissions in meat goats Methane (CH_4) production in ruminants has attracted a great deal of attention in relation to its contribution to the greenhouse gas (GHG) effect and global warming. Systematic intervention in the rumen microbial populations with feeding control towards reduction of forage proportion is one of the most reasonable strategies. Although wheat is yet uncommon feed for cattle production, the team considered it worthwhile detail evaluating how wheat grain feeding works in respect to change in rumen fermentation kinetics. Another research interest is to deserve any forage source (as a prebiotic) suitable for preparing mixed ration with wheat. The collaborating group have already found one candidate for good forage (*Sunn hemp* [SH]; *Crotalaria juncea*). It would be warranted discovery of potential benefits of feeding preferable ration comprised of novel concentrate (wheat) and novel forage (SH) for practical (economic and sustainable) feed application. This project aims to elucidate microbial structures and the kinetics of bacteria and methanogens in digestive tracts of beef steers fed processed wheat and SH feed additive by applying two independent "-omics" approaches.	Japan	Shinshu University	USA	Tuskegee University	8

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Proposed Studies	Research Fellow's Nationality	Home Institution	Destination Country	Host Laboratory	Duration of Fellowship (weeks)
Characterisation of environmental calcium content as predictor of disease severity by the emergent plant pathogen *Xylella fastidiosa* This fellowship focuses on understanding the role of the mineral element calcium as a predictor of the geographic distribution, potential for establishment, and severity of diseases caused by *Xylella fastidiosa* (Xf). Xf is an emergent plant pathogen historically restricted to the Americas, but which has spread to Europe and has caused important economic losses in Europe in the last six years. It is already known that calcium increases the virulence traits of XF and that higher concentrates of calcium increase the severity of the disease. The fellow and host will model the relationship between soil calcium content in Europe and the US and XF disease occurrence and severity. By combining this information with climatic sustainability maps already available, the researchers will be able to develop risk maps to predict the potential hotspots and severity of XF outbreaks. This will contribute towards helping the early detection and assessment of a disease with a high impact on agricultural production, as well as providing information that can be used in the future for designing precise nutrition management options. **Manuscripts**: 1. "Two *Xylella fastidiosa* subsp. *multiplex* strains isolated from almond in Spain differ in plasmid content and virulence traits", *Phytopathology,* Vol. 113, N°6, doi.org/10.1094/PHYTO-06-22-0234-R; 2. "Complete circularised genome resources of seven strains of *Xylella fastidiosa* subsp. *fastidiosa* using hybrid assembly reveals unknown plasmids", *Phytopathology*, Vol. 113, N°6, doi.org/10.1094/PHYTO-10-22-0396-A	United States	Auburn University	Spain	Spanish National Research Council	19
Development of novel technologies in integrated biting fly management via understanding physiological mechanisms of spatial and contact repellency (Confidential) Stable flies are the most important blood-sucking that attack livestock animals. With climate change, fast changes in urbanisation and agronomic practices all over the world, they become even more problematic as pests and disease vectors not only to animals and pets, and further attack on humans. Stable flies are also involved in the transmission of several serious livestock diseases, including African Swine Fever. The fellow worked with the New Zealand Institute for Plant and Food Research to investigate the sensory physiological mechanisms involved in their host orientation and avoidance, including attractancy and repellence via single cell recording of stable fly olfactory sensillum responding to both attractant and repellent compounds. This mechanism understanding will further help us to develop more effective tools for this pest fly control using the environmental-friendly Push-Pull strategies globally.	United States	USDA-ARS	New Zealand	The New Zealand Institute for Plant & Food Research	14

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Proposed Studies	Research Fellow's Nationality	Home Institution	Destination Country	Host Laboratory	Duration of Fellowship (weeks)
Decision support for healthy ecosystem services Ecosystem services, such as pollination, are vital to human health and wellbeing and particularly to sustainable and efficient agriculture. In complex and strongly interconnected systems, decision support is vital form evidence –based decision-making. Estimating the abundance of pollinating insect populations is a challenging statistical problem, and estimates obtained are inevitably subject to uncertainty. In addition, pollination is affected by agricultural and other human practices, such as crop protection, energy production, housing and carbon sequestration measures. In a strongly interconnected world, decision-making in the landscape relies on many models for different parts of the system. The aim of this research is to provide decision support for policymakers concerned with protecting ecosystem services, by coupling the models within a Bayesian framework. We will focus on the example of pollination ecosystem services to support food production. We will explore the efficacy of this novel integrating decision-support system for pollinator abundance decisions under a range of policy scenarios.	United Kingdom	University of Warwick	Australia	University of Melbourne	8
Quantifying the risk of subclinical infections in ornamental fish to introduce new disease threats for fisheries and aquaculture The objective of this fellowship is to create new knowledge about the transmission risk posed by ornamental fish with a subclinical infection of a virus known as infectious spleen and kidney necrosis virus (ISKNV). This virus is one of a group of viruses considered to be significant biosecurity risks to global marine and freshwater aquaculture industries as they are known to infect over 50 species of fish. ISKNV causes severe mortality events in food fish and wild fish populations as well as in ornamental fish. Subclinical infection with no apparent sign of disease is common, particularly in ornamental fish; the infection can therefore go unnoticed, creating a high risk for the transboundary of the virus. However, there is currently poor understanding of the transmission risk posed by fish infected subclinically with ISKNV. The results obtained from this fellowship will all the potential risks of these fish being able to infect others or develop disease and potentially cause devastating impacts on economically and ecologically important fish populations to be quantified. This new knowledge will provide critical data to inform potential risk pathways for the transboundary spread of ISKNV and support the advancement of evidence-based biosecurity policies.	Australia	The University of Sydney	United States	University of Florida	13

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Proposed Studies	Research Fellow's Nationality	Home Institution	Destination Country	Host Laboratory	Duration of Fellowship (weeks)
Researchers know it, but do regulators? Lesser known aspects of fruit fly invasions Fruit flies are major impediments to global food security and are among the most invasive of all agricultural plant pests. Whilst many aspects of fruit fly invasion biology (e.g. pathways, post-entry spread and economic impact) are well known and help inform biosecurity and practice, two aspects of fruit fly invasions still appear to be largely ignored or unknown to policy makers. These are the biological mechanisms which allow flies to establish and spread beyond the geography ranges predicted by climate-matching models, and the intra-specific competition which follows when one fruit fly species invades an area where other fruit fly species already exists. This fellowship will review both these areas, within a biosecurity framework, to better inform policy decisions and raise their profile with regulatory and policy agencies. **Manuscripts:** 1. Clarke A. et al (2022), "The fallacy of year-round breeding in polyphagous tropical fruit flies (*Diptera: Tephritidae*): evidence for a seasonal reproductive arrestment in bactrocera species", *Insects*, 13(10), 882; doi.org/10.3390/insects13100882 2. Clarke A. and P. M. Measham (2022), "Competition: a missing component of fruit fly (*Diptera: Tephritidae*) risk assessment and planning", *Insects*, 13, 1065; doi: 10.3390/insects13111065	Australia	Queensland University of Technology	Austria	BOKU, University of Natural Resources and Life Sciences, Vienna	14

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Theme 3: Transformational Technologies and Innovation					
Epigenetic markers of fish domestication for selective breeding The aim of this project is to identify epigenetic markers related to domestication that can be used for selective breeding purposes in aquaculture. The incorporation of epigenetic markers for breeding plans has the potential to accelerate the adaptation of stocks to the farm environment, and should allow fish lines to be selected that are better adapted to live in captivity through the epigenetic mechanisms that are associated with domestication. It should be possible to use these mechanisms to establish an environmental memory during development. Whilst domestication of animals has played a unique role in human history and fish have been important in the human diet for millennia, massive expansion of aquaculture did not happen until the 1960s. The domestication of fish, therefore, is very recent and this constitutes one of the biggest obstacles for achieving long-term sustainability in aquaculture. Optimising the domestication of local stocks would be a sustainable approach, but this is hampered by a considerable lack of understanding of the fish domestication process, in part by a lack of consider of how the different genetic potentials are expressed under local conditions (epigenetics). The research from this fellowship is hoping to see how epigenetics can be exploited to the benefit of aquaculture.	Spain	Swansea University, United Kingdom	Spain	Instituto Nacional de Investigación y Tecnología Agraria y Alimentaria	13
Evaluation of the functional significance of Interleukin-8 haplotype for anti-viral immunity This project has the objective of enhancing understanding the molecular process that regulates immune response in bovine respiratory diseases to contribute to breeding cattle that are more resistant to diseases. To help towards breeding better disease resistance in cattle, both a more comprehensive understanding of the bovine immune response and the identification of genes underlying variation in immune responsiveness and disease resistance is required. Bovine respiratory disease is a common multifactorial disease that involves interactions between different bacterial and viral pathogens and causes major economic losses to livestock industries worldwide. A key feature of disease pathogenesis is the ability of the multiple causal organisms to subvert the immune response from the host. The *Interleukin-8* gene regulates neutrophil mobilisation and activation in response to infection. The	Italy	CREA-Council for Agricultural Research and Economics	Ireland	University College Dublin	10

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Proposed Studies	Research Fellow's Nationality	Home Institution	Destination Country	Host Laboratory	Duration of Fellowship (weeks)
researchers will look at two genetic haplotypes (genetic determinants in a single chromosome) in the *Interleukin-8* gene which are suspected of being beneficial for bacterial infection and viral infection and analyse the effect of these genetic haplotypes on the ability of neutrophils to tackle viruses and ensure that a favourable genetic haplotype for bacterial infection does not exacerbate viral infection. The end result will be the ability to select cattle with superior immunity, thereby underpinning the sustainability of the livestock sector and reduce losses and welfare issues – such as antimicrobial resistance – associated with cattle disease.					
Investigating next-generation sequencing technology as a standard diagnostic tool for grapevine trunk disease fungal pathogens This project aims to develop the first next-generation sequencing (NGS) pipeline for detecting grapevine trunk diseases fungi, which will expand the number of grape pathogens that can be detected in one single test. It will provide solutions to current gaps in molecular diagnostics and provide science-based evidence to support international efforts to validate and standardise NGS as a diagnostic tool for use in import-export programmes. GTD are caused by over 130 fungal pathogens and are emerging diseases currently considered the main biotic factor limiting both production and vineyards' lifespan worldwide. GTD fungi occur in planting material and thus they can be routinely moved within and between countries. Because grapes are clonally propagated and distributed worldwide, with millions of plants moving each year between countries and continents, the movement of contaminated grape material represents a serious risk not only to growers but also to countries' agriculture economies. Contrary to other grape pathogens, there are currently no methods in place to detect GTD fungi in grape stock and import-export biosecurity programmes. Consequently, grape stock may be imported or exported as "clean" because they can be demonstrated to be free of viruses and bacteria, but no biosecurity programme can say that the stock is GTD free. NGS technology has recently been identified as an alternative to current DNA-based diagnostic tools as having some success in the area of grapevine viruses detection. This research project will build on that success to introduce NGS technology to detect GTD fungi.	Spain	Agriculture and Agri-Food Canada	Spain	Instituto de Ciencias de la Vid y el Vino (ICVV)	18

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Proposed Studies	Research Fellow's Nationality	Home Institution	Destination Country	Host Laboratory	Duration of Fellowship (weeks)
Mining orchard yeast diversity for novel horticultural biocontrol agents This project will seek to characterise yeast strains collected from pest insects and from fruit and nuts from orchards around the host institute, with the ultimate goal of identifying particularly promising isolates for biocontrol applications. Invertebrate pests inflict substantial economic losses on the horticultural sector annually, and climate change, restrictions in synthetic pesticide use and emerging pesticide resistance are likely to exacerbate the problem and necessitate the development of alternative pest management strategies. This research project will look at insect-associated yeasts which could be a promising tool for "attract and kill" pest management strategies. An additional benefit for using this approach is that yeasts secrete volatile organic compounds (VOCs) and some yeast-derived VOCs have been shown to inhibit the growth of filamentous fungi, including many fungal species responsible for post-harvest spoilage of fruit. The researchers will sequence the yeast genomic barcodes to help identify the isolates which will be best for biocontrol applications. The data produced in the course of the project will be valuable to the international research community by laying the foundations of a sequence-based framework for understanding global yeast inter- and intra-species diversity with respect to biocontrol properties.	Sweden	Swedish University of Agricultural Sciences	Australia	Agriculture Victoria	12
Resilient pest management programs in horticultural crops based on increased plant defensive responses The aim of this fellowship is to investigate the mechanism of induced defences in horticultural crops by several species of zoophytophagous predators commonly used in biological pest control. These induced defences provide an added value to biological control. The researchers will focus on tomato and sweet pepper, as these are two highly important horticultural crops in the EU on which zoophytophagous predators are used widely used for biological pest management. A considerable decrease of pests and diseases has been observed in these crops, and the hypothesis is that it is the predators which are activating defence mechanisms in the crops due to their phytophagy. These induced defences could offer an opportunity to increase crop resilience if properly managed. By investigating the origin of this resilience, the researchers hope to provide a scientific basis for developing novel and sustainable crop protection practices to respond to the global challenge of food security.	Italy	University of Bologna	Spain	IVIA (Instituto Valenciano de Investigaciones Agrarias)	13

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Proposed Studies	Research Fellow's Nationality	Home Institution	Destination Country	Host Laboratory	Duration of Fellowship (weeks)
Manuscripts: 1. Depalo L. et al. (2022), "Eliciting sweet pepper plant resistance to *Aulacorthum solani* and attractiveness on *Aphelinus abdominalis* by exposure to (Z)-3-hexenyl propanoate", *Entomologia Generalis;* https://doi.org/10.1127/entomologia/2022/1595 2. Depalo L. et al. (2024), "Advancing tomato crop protection: Green leaf volatile-mediated defense mechanisms against *Nesidiocoris tenuis* plant damage", *Biological Control*, Ed. Elsevier, Vol. 192, 105517; doi.org/10.1016/j.biocontrol.2024.105517					
Understanding the mechanisms involved in epigenetic variability and inheritance in plants The objective of this proposal is to initiate a study on epigenetic variability and its inheritance in plants. Epigenetic refers heritable information that is not coded in the DNA sequence but that alters gene expression. Epigenetic regulation plays a key role in plant response to the environment, in establishing reproductive barriers and gene inheritance, and this fellowship will look at how studying and characterising the epigenetic variation and its link with phenotypic variability can provide relevant scientific information on the contribution of epigenetic changes to crop adaptations and stability. This will have important implications in advanced plant breeding and will help on the selection of natural traits from wild species to successfully address the new challenges in agriculture and food production, increasing resources use and lowering inputs. The two crops used in the study will be *Arabidopsis* (closely related to cabbage and mustard and the first plant to have its entire genome sequenced and in which changes are easily observed, making it a very useful model) and the fruit tree crop apple. Over recent decades, agrodiversity of cultivated fruit trees has been considerably reduced and most cultivated varieties are highly susceptible to diseases and pests. Wild relative species represent a reservoir to broaden the genetic basis of traits and maintain biodiversity. Understanding the epigenetic mechanisms will help overcome the inter-specific barriers that limit the use of wild species in breeding programmes.	Spain	Institut de Recerca en Tecnologia Agroalimentàries	United States	Whitehead Institute	18