THE POTENTIAL OF POSTHARVEST PATHOLOGY TO REDUCE LOSSES OF FRESH PRODUCE

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According to FAO one third of the food produced in the world for human consumption every year (approximately 1.3 billion tons) is lost or wasted. Fruits and vegetables have the highest wastage rates of any food. 'Food loss and waste refers to the edible parts of plants and animals produced or harvested for human consumption but not ultimately consumed by the people' (WSI, 2013). The European Union to make citizens aware of this issue, declared 2014 'year against waste'. This presentation will focus on postharvest (PH) losses of fresh fruit and vegetables (FFV) caused by diseases, physiological disorders, injuries, and their control. In developed countries diseases and disorders account for 60 to 90% of total PH losses in perishable FFV. The cold chain together with modified atmosphere are the basic techniques for their control. However, more advanced physical treatments such as plasma, electron beam, micro waves are being applied in fruit working lines. Although biological control and natural substances are gaining importance in PH control strategies, nevertheless they are used on few products. Control methods are less and less relying on synthesized chemicals due to the reduced number of registered a.i. and to the extremely low dissipation rate, at low temperature, within the cold chain. Very often they are replaced by PH washings with disinfectants to reduce human and plant pathogens. Ongoing research on FFV-pathogen interactions will help managing varietal resistance more efficiently and will improve methods to reduce losses in the PH chain. Pre-storage detection of latent field infections by the electronic nose, library trays or induced symptoms expression are useful tools to store FFV with the lowest infection rate and to treat only when necessary. Research and the EU education program should work together to successfully reduce PH losses.

WHY ARE LEAFHOPPERS, PLANTHOPPERS AND PSYLLIDS PHYTOPLASMA VECTORS

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Phytoplasmas are transmitted by insects of a few families of Homoptera. Transmission specificity defines the fact that only selected species can act as vectors of a pathogen. Phloem-feeding behaviour is a pre-requisite for transmission of phloem-restricted pathogens like phytoplasmas. Although we know that many heteropterans and most homopterans are phloem feeders, yet only few are vectors. Insect–phytoplasma recognition and adherence, notably at the midgut and salivary gland levels, is another pre-requisite for phytoplasma entrance and colonisation of the vector. Attachment of phytoplasma cells to insect organ extracts is apparently not very specific in *in vitro* assays, while a specific interaction between the major phytoplasma antigenic membrane protein (Amp) and the insect microfilament complex (actin and myosin) has been observed. Similarly, ATP synthase of selected vector species specifically interacts with phytoplasma Amp. Once the phytoplasmas have colonised the midgut epithelium they must cross the basal lamina to spread in the haemolymph and multiply. To elucidate insect permissivity, both phytoplasma multiplication and gene expression in the vectors have been studied. The resistance of the salivary glands to phytoplasma infection may also explain the fact that some species acquire phytoplasmas but are not vectors. Finally, physical barriers, such as the grid-like structure of the basal lamina of Heteroptera and the size of the food and salivary canals of the aphid and whitefly mouthparts may also explain why these phloem-feeders are not phytoplasma vectors. Experimental works relevant to the understanding of the transmission specificity will be presented and discussed.

RESEARCH ASSESSMENT IN ITALY: SCIENCE OR SORCERY?

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The Italian National Agency for Research Evaluation (ANVUR) has just completed a national research assessment exercise (VQR 2004-2010). The exercise was carried out by 14 area panels using peer-review in the Human and Social Sciences and a hybrid bibliometric/peer-review methodology in the hard sciences. The VQR was controversial under three aspects: communication of results, scientific methodology and ideological background. Concerning communication, ANVUR released a number of rankings ranging from whole universities to departments and research groups. An established evaluation agency as the English HEFCE refrains from producing rankings because they lack scientific background and play no role in resource allocation. To accomodate the comparison of institutes having disparate sizes ANVUR introduced size segments (small, medium, large). The rankings turned out to be "double face" as ANVUR changed size segments used in the official report in order to produce university rankings eventually released to the press. Also department rankings were "double face", one version being published by area panels and another being released to the press by ANVUR. Controversy about the scientific methodology regarded the automatic assessment of individual papers through citation data and impact factors, a practice ruled out by the scientometric literature and also by the English evaluation agency. In the Italian VQR, hard sciences papers were judged on the basis of thresholds on cites and impact factor. This scheme, invented in a few weeks without scientific validation, compromised the comparability of scores between the scientific areas and even between scientific disciplines within the same area. For instance, a better score of a department relative to another one does not necessarily reflects better quality of scientific production but may depend on a greater ratio of researchers working in a field where scores are biased upward. At the beginning of the research assessment, ANVUR declared that the VQR was aimed at downgrading or closing poorly performing universities. The adoption of unscientific methods find its motivation in the belief that "a bad evaluation is better than no evaluation", especially if the university system is lagging behind relative to foreign competitors. As a matter of fact, international bibliometric data reported in the VQR report contradict this belief as they show that, in terms of expenditure and number of researchers, productivity of Italian public research is comparable or even better than the German or French one. These international comparisons were almost completely ignored by the media and ANVUR itself.

PRIMING OF DEFENCE: THE ADAPTIVE COMPONENT OF PLANT IMMUNITY

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Plants have evolved diverse strategies to resist pests and diseases. Apart from their innate immune system that controls pre-programmed defence reactions, plants can also enhance the responsiveness of their immune system after sensing specific signals in their environment, a phenomenon commonly referred to as "defence priming". We have identified a novel regulatory gene of defence priming, which encodes a putative receptor protein of the chemical plant resistance activator beta-aminobutyric acid (BABA). When investigating the durability of defence priming in Arabidopsis, we discovered that disease-exposed Arabidopsis can transmit defence priming epigenetically to their progeny, thereby providing transgenerational adaptation to disease pressure. In a parallel research project on the role of secondary metabolites in maize innate immunity, we found an unexpected signalling role for apoplastic benzoxazinoids in the regulation of callose deposition during the early stages of attack by aphids and pathogenic fungi. Belowground, exudation of benzoxazinoids was found to recruit plant-beneficial *Pseudomonas putida* bacteria that can prime the leaves for wound-inducible defences. We conclude that the plant immune system encompasses a highly adaptive regulatory system that governs responses at different levels and time scales, ranging from transiently expressed defence reactions at the sites of attack to long-lasting epigenetic modifications of defence genes and recruitment of disease-suppressing soil microbes.

THE ITALIAN RESEARCH IN PLANT PATHOLOGY AND ENTOMOLOGY

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For the first time the Italian research has been subjected to an evaluation. The Agenzia Nazionale di Valutazione del Sistema Universitario e della Ricerca (ANVUR) has just concluded an assessment of institution performance, taking into account bibliometric data and peer review of research products. The results of this assessment will be used by the Ministero dell'Università e della Ricerca (MiUR) to distribute funds to academia. Moreover, ANVUR has also defined the eligibility criteria for associate and full professorship. To apply for any position at the national level, candidates must meet these criteria. The application of this new system is expected to promote research quality both at the individual and institutional level. Our scientific community has to face this new system by setting the stage for appropriate strategic changes, aiming at improving the current performance of institutions and at enhancing in the long-term the quality of the research. Here we discuss the results of the last evaluation exercise concerning the SSDs AGR/11 and AGR/12 (entomology and plant pathology), trying to point out the main strength and weakness points of our communities. Then, we will suggest which cultural objectives are to pursue and how to put in place new measures to improve research quality, trying also to define which role the two SSDs should play in this delicate process.

DECISION SUPPORT SYSTEMS FOR CROP PROTECTION: A KEY ELEMENT IN THE EU DIRECTIVE FOR THE SUSTAINABLE USE OF PESTICIDES

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The EC Directive 128/2009 on the Sustainable Use of Pesticides establishes a strategy for the use of plant protection products in the European Community so as to reduce risks for human health and the environment. Integrated Pest Management (IPM) is a key component of this strategy, which will become mandatory as of 2014. Eight general principles of IPM are listed in Annex III of the Directive, some of them dealing with tactical decisions concerning whether and when plant protection actions are required, and how to select the best option for disease control. The so called "informed decision-making process" is the basis for the practical implementation of these IPM principles; based on the Directive, the necessary information comes from: continuous filed monitoring; scientifically sound warning, forecasting, and early diagnosis systems; and the advice of qualified advisors. Modern Decision Support Systems (DSS) are useful tools for supporting informed decision-making in plant protection. They are characterised by: (i) a holistic vision of crop management problems with the focus on all the different individual operation issues (pests, diseases, fertilisation, irrigation, etc.) and on their interactions; (ii) incorporation of mathematical models to predict plant growth and development, disease development, etc., (iii) provision of information on the focus of the decision in the form of easy-to-understand decision supports; (iv) easy and fast access through the Internet; and (v) two-way communication between users and providers, which make it possible to consider context-specific information, such as crop and varieties, soil characteristics, etc., in addition to weather data.

MOLECULAR DISSECTION OF THE INITIAL INFECTION PROCESSES BY *FUSARIUM GRAMINEARUM* ON WHEAT

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The mycotoxin-producing fungal pathogen *Fusarium graminearum* is the causal agent of Fusarium head blight (FHB) of small grain cereals worldwide. *F. graminearum* infects the wheat flower at the time of anthesis. After infecting the flower the pathogen progresses through the rachis and colonizes the entire spike. It hinders kernel development and contaminates the harvest with mycotoxins like deoxynivalenol, an inhibitor of protein biosynthesis. We will demonstrate the formation of different types of infection structures penetrating the flower leaves. After epiphytic runner hyphae colonized the surface of the flower leaf, infection structures develop with increasing complexity. The mycotoxin deoxynivalenol is exclusively synthesized in compound appressoria but is not a prerequisite of successful penetration. Several mutants will be presented which allow the molecular and physiological dissection of the infection process.

ENDOPHYTIC FUNGI ARE INVOLVED IN MULTIPLE BALANCED ANTAGONISM

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In order to infect, grow and survive within their plant hosts, fungal endophytes must deal not only with the plant's physical barriers and defense responses, but also with bacterial and fungal competitors. Secondary metabolites of both host and endophyte are involved in these interactions. Whereas endophytic colonization of the host often activates host defense reactions, endophytic fungi may secrete metabolites toxic to the host. In fact, endophytes produce a higher proportion of herbicidal metabolites than even phytopathogens do. But endophytes also secrete metabolites active against competitors. Co-culture of fungal endophytes with bacterial or fungal competitors resulted in altered secondary metabolite profiles, with each of the partners secreting metabolites toxic to the other. This is the case when the root endophytes *Pseudomonas aeruginosa* and *Fusarium* sp. are grown in co-culture, with the fungus secreting metabolites that inhibit *P. aeruginosa* that are not synthesized in monoculture. In another example, in co-culture, endophytes of *Fraxinus excelsior* secreted metabolites that inhibited growth of *Hymenoscyphus pseudoalbidus*, the causal agent of ash dieback. However, *H. pseudoalbidus* secreted metabolites that inhibited growth of the endophytes. This co-culture also resulted in reduced synthesis by *H. pseudoalbidus* of its phytotoxic metabolite, viridiol. In conclusion, we hypothesize that in order to grow asymptomatically within their hosts, endophytic fungi secrete metabolites toxic to the host to counter plant defense reactions, as well as those that inhibit growth of competitors. In addition, environmental conditions influence the outcomes of the interactions. Thus, in order to grow asymptomatically, fungal endophytes are involved in multiple balanced antagonisms, responding with phenotypic plasticity to the respective situation. Pathogens are specialists; endophytes are masters of adaption.