



FIRST REPORT OF *FUSARIUM GLOBOSUM* IN EUROPE. V. Balmas^{1,2}, A. Marcello^{1,2}, F. Masia² and Q. Migheli^{1,2}. ¹Dipartimento di Protezione delle Piante, Unità di ricerca Istituto Nazionale Biostrutture e Biosistemi, Università degli Studi, Via E. De Nicola 9, 07100 Sassari, Italy. ²Centro per la Conservazione e la Valorizzazione della Biodiversità Vegetale, Università degli Studi di Sassari, Loc. Surigbeddu, Alghero, SS, Italy. E-mail: balmas@uniss.it

In April, 2007, samples of tomato plants grown in a greenhouse near Alghero (Sardinia, Italy) and showing dark necroses on the stem were analysed. Isolation on potato dextrose agar (PDA) and water agar indicated that plants were largely affected by the common soilborne pathogen *Phytophthora infestans*. In addition, several *Fusarium* colonies were isolated and morphological characteristics of monosporic cultures grown on PDA and on carnation leaf agar either in the darkness or under alternating 12-h darkness/light condition allowed their unambiguous identification as *F. globosum* Rheeder, Marasas & P.E. Nelson. The morphology of this species is unique, and includes three types of microconidia: mostly clavate to ellipsoid, with evident truncate base, forming in chains; rare pyriform to napiform; globose, with or without a distinct papilla and 0-1 septate. The conidiophores are mono- and polyphialides. The macroconidia may be produced from monophialides or in sporodochia, present thin walls and are slightly curved, with apical cell curved to a point, and basal cell pedicellate or foot-shaped. Upon inoculation with a spore suspension (10^6 spores ml⁻¹), the tested isolates did not establish on mechanically wounded tomato seedlings, suggesting that this plant species does not represent a susceptible host. *F. globosum* was first described in 1996 by Rheeder *et al.* (*Mycologia* 88: 509-513, 1996) following isolation from corn kernels. A second report came from in Japan (Aoki and Nirenberg, *Mycoscience* 40: 1-9, 1999), indicating this species as a frequent coloniser of healthy wheat culm. *F. globosum* may produce fumonisins, low levels of beauvericin, and in some cases also fusaproliferin. However, the reports of *F. globosum* are too limited to allow a precise definition of its ecological and pathogenic relationships.

MOLECULAR ECOLOGY OF SARDINIAN *FUSARIA*. V. Balmas¹, Q. Migheli¹, P. Garau¹, S. Kang², D.M. Geiser² and K. O'Donnell³. ¹Dipartimento di Protezione delle Piante, Università degli Studi, Via E. De Nicola 9, 07100 Sassari, Italy. ²Department of Plant Pathology, The Pennsylvania State University, University Park, PA, USA. ³NCAUR-ARS-USDA, Peoria, IL, USA. E-mail: balmas@uniss.it

Mediterranean islands such as Sardinia are well known for their diversity of vascular plants and high floristic endemism. We hypothesized that saprobic soil fusaria might exhibit distinct genetic structures based on environmental contexts of their origins. To test this hypothesis, we measured the species and haplotype diversity of 313 fusaria cultured from soil obtained from ten diverse field sites across Sardinia. Information collected from these sites included global positioning system (GPS) coordinates, soil type, average yearly precipitation and land-use-type. Genetic diversity was assessed using sequences of partial translation elongation factor (*EF-1 α*) and the second largest RNA polymerase subunit (*RPB2*) gene. In addition, 2-locus haplotypes (*EF-1 α* + IGS rDNA) were assigned to members of the *Fusarium oxysporum* species complex (FOSC). Similarly, 3-locus haplotypes (*EF-1 α* + *RPB2* + ITS-LSU rDNA) were assigned to members of the *F. solani* species complex. Spatial distribution of individual genotypes and association between genotypes and geospatial and envi-

ronmental contexts of sampling sites were investigated. All data from this study will be available for visualization via the geovisualization function within the next web-accessible version of *Fusarium-ID*.

COMPARATIVE STUDY OF *FUSARIUM* COMMUNITIES FROM SOIL AND RHIZOPLANE OF MELON PLANTS FROM TROPICAL FARMING SOILS. M. de Cara¹, D. Palmero², M. Santos¹ and J.C. Tello¹. ¹Departamento de Producción Vegetal, Universidad de Almería, Carretera Sacramento s/n, 04120 Almería, Spain. ²Universidad Politécnica de Madrid, EUIT Agrícola, Ciudad Universitaria s/n, 28040 Madrid, Spain. E-mail: mdecara@ual.es

Fifty-nine rhizospheric soil samples from twenty different melon farms of Guatemala and Honduras were analysed to study the *Fusarium* species present in the soil and those developing on roots surfaces. At the moment of the survey, all farms had been cropping melons for more than five years. Air-dried soil samples were firstly analysed by Warcup's technique using Komada medium. Rhizoplane of thirty-six melon plants (45 days-old) per sample were analysed by plating three root pieces per plant on the analogue selective medium. *F. oxysporum*, *F. solani*, *F. dimerum*, *F. moniliforme* (*sensu* Snyder & Hansen), and *F. roseum* (*sensu* Snyder & Hansen) were detected from both soil and rhizoplane, as well as the percentages of samples with each species. For soil: 57.6, 83.1, 13.6, 20.3 and 83.1% respectively; and for rhizoplanes: 37.3, 89.8, 3.4, 62.7 and 76.3% respectively. *F. roseum* was represented by *F. equiseti*, *F. acuminatum*, *F. semitectum*, *F. longipes*, *F. scirpi* (only in Honduras) and *F. sambucinum* (only in Guatemala). *F. moniliforme* was represented by *F. anthophilum*, *F. proliferatum* and *F. verticillioides* (*sensu* Gerlach & Nirenberg). Two species were isolated exclusively from soils: *F. chlamydosporum* (22% of total samples) and *F. lateritium* (only in one sample from Honduras). Positive correlation between presence in soil and presence on rhizoplane for the same sample was 34.2% for *F. oxysporum*, 75.9 for *F. solani*, 0% for *F. dimerum*, 20% for *F. moniliforme* and 73.6% for *F. roseum*.

CURRENT DISTRIBUTION OF *FUSARIUM* FUNGI ON SMALL GRAIN CEREALS IN RUSSIA. T.Y. Gagkaeva and O.P. Gavrilova. Laboratory of Mycology and Phytopathology, All-Russian Institute of Plant Protection (VIZR), 196608 St. Petersburg-Pushkin, Russia. E-mail: gagkaeva02@yahoo.com

A mycogeographic survey of *Fusarium* species associated with grain of cereals has been done over the agricultural areas of Russia. *Fusarium* fungi were isolated from surface sterilized grains. Representatives of the genus have been found in all areas where cereals are cultivated (near 40 million ha). Collated records of occurrence have indicated two general types of distribution pattern among *Fusarium* species: widespread and geographically restricted. According to abundance of these species, *Fusarium* spp. may be divided in groups with dominant or infrequent positions in the complex of pathogens. The widespread and dominant fungi, *F. poae*, *F. sporotrichioides*, *F. avenaceum*; the widespread and infrequent fungi, *F. tricinctum*, *F. equiseti*, *F. semitectum*. Most likely the second group has less pathogenicity and biological activity than the first one. The distribution of these ubiquitous fungi is not associated with climate. *F. graminearum* belongs to geographically restricted fungi. This is a typical pathogen in the South-European area and in the Far East. During the few last years, this pathogen was detected in Central and North-western regions. The infrequent fungi are obviously linked to the environmental



conditions: *F. acuminatum* (Central, Siberia, Far East), *F. culmorum* (North-western, Central, Ural), *F. cerealis* (South, Far East), *F. sambucinum* and *G. fujikuroi* complex (South, Far East, Central), *F. solani* and *F. oxysporum* (Far East, Central). *F. solani sensu lato* and *F. oxysporum* complex may be isolated from any soil, but these fungi quite rarely detected as pathogens of grain. *F. culmorum* and *F. sambucinum* occurred with less frequency in comparison with the previous observations. Current investigations have detected *F. langsethiae* in north-western and central European regions of Russia.

FUSARIUM SPECIES ASSOCIATED WITH GRASS ROOT DEBRIS FROM ALPINE MEADOW SOILS IN GANSU PROVINCE, CHINA. J. Li¹, L.W. Burgess² and Z. Chai¹. ¹College of Grassland Sciences, Gansu Agricultural University, Lanzhou, China. ²Faculty of Agriculture, Food and Natural Resources, The University of Sydney, NSW 2006, Australia. E-mail: l.burgess@usyd.edu.au

The grasslands of north-western China occupy large areas of three regions, Gansu Province, the Qinghai-Tibetan Plateau and the Inner Mongolian Autonomous Region. These grasslands are grazed in summer by yak and sheep. The survey reported here was designed to determine the spectrum and abundance of *Fusarium* species associated with grass root debris from alpine meadow grasslands across Gansu Province. Composite soil samples were collected from each of four sites in each of six sampling areas at altitudes of 2500-3000m. The sampling areas had never been cultivated. Each composite soil sample consisted of 10 cores each taken under a grass plant. Samples were stored in paper bags and air-dried. Root debris was extracted from a composite sample by a flotation and sieving process. It was then washed in sterile water and air-dried on sterile paper tissues. Two hundred pieces of root debris were plated on Peptone PCNB agar. Colonies of *Fusarium* that developed from the root pieces were sub-cultured onto CLA and incubated under lights. The resulting cultures were purified and grown on CLA and PDA under lights for morphological identification. Five morphological species of *Fusarium* and an undetermined population were recovered. *F. acuminatum*, *F. equiseti* and the undetermined population were the predominant populations recovered from the debris. Three other species were isolated infrequently, namely *F. oxysporum*, *F. solani* and *F. tricinctum*. The undetermined population resembles *F. torulosum* and is the subject of continuing study. It is noteworthy that no isolates of recognised *Fusarium* cereal root rot pathogens were recovered.

FUSARIUM PATHOGENS OF CULTIVATED CROPS FROM NATURAL ECOSYSTEMS IN AUSTRALIA. E.C.Y. Liew¹, A.R. Bentley², H.T. Phan², T. Petrovic, J.L. Walsh², B.A. Summerell¹ and L.W. Burgess². ¹Royal Botanic Gardens Sydney, Botanic Gardens Trust, Mrs Macquaries Road, Sydney, NSW 2000, Australia. ²Faculty of Agriculture, Food and Natural Resources, The University of Sydney, Sydney, NSW 2006, Australia. E-mail: edward.liew@rbgsyd.nsw.gov.au

In Australia the majority of our agricultural crops are species and cultivars introduced into the continent. Until recently *Fusarium* species associated with various diseases of these cultivated crops were generally thought to have been introduced, concurrent with or subsequent to the host introduction. The cotton wilt pathogen, *Fusarium oxysporum* f. sp. *vasinfectum*, however, has been shown to be genetically more closely affiliated with native populations of this fungus and is believed to have a local origin.

We have been investigating *Fusarium* endophytes in non-cultivated hosts, in both natural ecosystems and agricultural environments. The focus of our research has been on grasses (native and introduced) in natural ecosystems geographically isolated from the agricultural environment. A wide range of plant pathogenic species have been commonly isolated from these grasses. Some of these, e.g. *F. thapsinum* and *F. pseudograminearum*, were shown to have low genetic differentiation from strains obtained from their respective cultivated hosts, sorghum and wheat. Furthermore, some were shown to be pathogenic on the cultivated host in the greenhouse. Implications of these findings and future research directions are discussed.

FUSARIUM VERTICILLIOIDES, F. GRAMINEARUM AND F. PROLIFERATUM COLONIZATION AND MYCOTOXIN CONTENT OF ORGANIC AND CONVENTIONAL MAIZE: A THREE-YEAR SURVEY. S. Nutz, U. Hettwer and P. Karlovsky. Georg-August-University Goettingen, Molecular Phytopathology and Mycotoxin Research Unit, Grisebachstrasse 6, 37077 Göttingen, Germany. E-mail: pkarlov@gwdg.de

The infection of maize with *Fusarium* spp. causes a disease called *Fusarium* ear rot. Apart from yield reduction, diseased plants can accumulate high concentrations of mycotoxins. The contamination of maize products with mycotoxins poses a health hazard to humans and farm animals. The infection of maize and cereals with *Fusarium* spp. is modulated by a number of environmental factors. It is not known, however, to which extent the form of cultivation (organic versus conventional) affects the contamination of grains with mycotoxins. In order to clarify this question, we grew 20 maize genotypes under conventional and organic conditions at two or three locations for three consecutive years. Symptoms of *Fusarium* infection were visually rated and the content of deoxynivalenol, zearalenone and fumonisin B1, which are the most important mycotoxins in maize, was determined by HPLC-MS. Real-time PCR was used for species-specific quantification of the biomass of *Fusarium graminearum*, *F. verticillioides* and *F. proliferatum*.

FUSARIUM SPECIES ISOLATED FROM WATER FROM FLUVIAL CHANNELS AND SEA BEDS OF THE SOUTH-EASTERN COAST OF SPAIN. D. Palmero¹, M. de Cara², C. Iglesias¹ and J.C. Tello². ¹Universidad Politécnica de Madrid, EUIT Agrícola, Ciudad Universitaria s/n. 28040 Madrid, Spain. ²Universidad de Almería, Departamento de Producción Vegetal. Cañada de San Urbano s/n.; 04120 Almería, Spain. E-mail: daniel.palmero@upm.es

This study reports analytical results for the presence of the *Fusarium* genus in coastal water samples of the Mediterranean Sea and in waters from the Andarax River in the provinces of Granada and Almería (southeastern Spain). A total of 18 water samples were analyzed from the Andarax River, from which ten species of *Fusarium* were isolated: *F. anthropilum*, *F. acuminatum*, *F. chlamydosporum*, *F. culmorum*, *F. equiseti*, *F. verticillioides*, *F. oxysporum*, *F. proliferatum*, *F. solani* and *F. sambucinum*. Five species were isolated from 23 water samples from the Mediterranean Sea: *F. equiseti*, *F. verticillioides*, *F. oxysporum*, *F. proliferatum* and *F. solani*. Of the total samples analyzed, 27.45% of the river water samples and 29.41% of the marine water samples presented a minimum of one *Fusarium* species over a period of almost 12 months of sampling. Considering the samples according to their origins, 77.77% of river water samples and 45.45% of marine water samples presented some *Fusarium* species. The

greater presence of *Fusarium* in river water could be due to soil particles and organic matter content from run-off of the river banks after rainfall events. The presence of species found in the sea could be the consequence of river water flowing into the sea. Nevertheless, other explanations cannot be excluded.

GROWTH OF *FUSARIUM* SPECIES AS AFFECTED BY TEMPERATURE AND OSMOTIC POTENTIAL (NaCl AND KCl) INTERACTIONS. D. Palmero¹, M. de Cara², C. Iglesias¹ and J.C. Tello². ¹Universidad Politécnica de Madrid, EUIT Agrícola, Ciudad Universitaria s/n. 28040 Madrid, Spain. ²Universidad de Almería, Departamento de Producción Vegetal. Cañada de San Urbano s/n.; 04120 Almería, Spain. E-mail: daniel.palmero@upm.es

Mycelial growth of 90 *Fusarium* strains of *F. acuminatum*, *F. chlamydsporum*, *F. culmorum*, *F. equiseti*, *F. verticillioides*, *F. oxysporum*, *F. proliferatum*, *F. solani* and *F. sambucinum* isolated from fluvial channels and sea beds of the south-eastern coast of Spain was tested on potato-dextrose-agar adjusted to different matric potentials with either KCl or NaCl (from -1.50 to -144.54 bars). Fungal growth was determined by measuring colony diameter in four days time, with a temperature of incubation from 15 to 35°C. Mycelial growth was maximal at 25°C. Quantity and frequency pattern of mycelial growth of *Fusarium* species were sensitively different at 15 and 25°C, with the maximum growth at the lower water potential tested (-1.50 bars); and the 35°C pattern, with a maximum of mycelial growth at -13.79 bars. Results show how the effect of osmotic potential was independent of the salt type. The general pattern emerging was that isolates showed declining growth at potentials below -41.79 bars. Significant statistical differences were found in mycelial response to water potential and temperature separately and to their interactions. Growing frequencies were progressive minor as the water potential dropped, but growth was registered at -99.56 bars. The response to the salinity of the media has a markedly specific behaviour. *F. solani*, *F. oxysporum*, *F. proliferatum*, *F. equiseti* and *F. verticillioides* growing pattern changes with the temperature. It was observed how fungal growth of seabed isolates at 35°C was favoured with salt addition in the first or second osmotic pressure tested. These results could indicate that some *Fusaria* have the capacity of metabolic adaptation to low water potential environments. Differences founded between frequency and growth quantity could indicate that biological factors that determine the growing capacity and those that determine the final growth after 4 days of incubation are affected in different ways by water potential.

DIVERSITY OF FUMONISIN-PRODUCING *FUSARIUM* STRAINS ISOLATED FROM FRENCH CORN. L. Pinson-Gadais, G. Marchegay, C. Ducos, F. Turtaut, C. Barreau and F. Richard-Forget. UR 1264 Mycologie et Sécurité des Aliments, Institut National de la Recherche Agronomique, 33883 Villenave d'Ornon, France. E-mail: lpinson@bordeaux.inra.fr

In Europe, the occurrence of fumonisins B (FB) on maize is mainly ascribed to *Fusarium verticillioides* and *F. proliferatum*. Although the risk is correlated with some *Fusarium* species, it also depends on the ability of strains to produce toxins. Controlling the mycotoxin risk requires to assess the diversity of fumonisins producers. Eighty-five strains of the *Liseola* section were isolated from French corn harvests in 2004 and 2006: *F. verticillioides* (63), *F. proliferatum* (12), *F. subglutinans* (10). The strains were grown on autoclaved corn (25°C, 1 a_w, 21 days) and their

ability to produce fumonisins was assessed. This characterisation indicated that *F. verticillioides* and *F. proliferatum* strains were able to produce fumonisins, mainly FB1. A high diversity in the levels of toxins was observed (19 to 4500 ppm). Our data suggest that *F. proliferatum* strains produce less fumonisins than *F. verticillioides* strains. Among the 10 *F. subglutinans* strains studied, six were shown to produce low levels of FB1. It was investigated if this variability in levels of produced toxins could be linked with differences inside the sequences of the *FUM* gene cluster. For *F. verticillioides* and *F. proliferatum* strains, whatever the considered gene or intergenic sequences studied, no differences were observed between high and low FB1 producers. None of the *FUM* genes and intergenic regions studied was amplified for the 10 *F. subglutinans* strains, although some were characterised as toxigenic. This result suggests that the *FUM* genes of *F. subglutinans* strains are largely different from that of *F. verticillioides* and *F. proliferatum*.

***FUSARIUM* spp. ASSOCIATED WITH LEAF LITTER FROM MABIRA TROPICAL FOREST, UGANDA.** S. Serani and H.K. Taligoola. Makerere University, Department of Botany, Faculty of Science, P.O. Box 7062 Kampala, Uganda. E-mail: serasn@yahoo.com

Fungi may live as saprobes, which bring about decay of organic materials or as parasites, which attack living organisms thus causing disease of plants and animals. Fungi perform essential roles in every terrestrial ecosystem, as decomposers of dead organic matter; releasing nutrients and supporting plant life. Leaf litter at different stages of decomposition was collected from the forest floor under a canopy of known tree species in Mabira Tropical Forest in Central Uganda. A number of *Fusarium* species were isolated from leaf litter of four different tree species, i.e. *F. lateritium*, *F. semitectum*, *F. solani*, *F. graminearum*, *Nectria* sp. The tree species were *Ficus valis*, *Celtis* sp., *Cola gigantica* and *Chrysophyllum* sp. Most of the species were isolated in the second and third stage of decomposition and there was no significant difference in isolation frequency for the tree species.

GENETIC VARIABILITY OF A *FUSARIUM SEMITECTUM* POPULATION ISOLATED FROM *MEDICAGO SATIVA* L. CULTIVATED IN AN UNIQUE FIELD IN NORTHERN ITALY. M. Zaccardelli¹, M. Carelli² and V. Balmas³. ¹CRA, Centro di Ricerca per l'Orticultura, Gruppo di Ricerca di Battipaglia, SS 18 204, 84091 Battipaglia (SA), Italy. ²CRA, Centro di Ricerca per le Produzioni Foraggere e Lattiero-Casearie, Viale Piacenza 29, 26900 Lodi, Italy. ³Dipartimento di Protezione delle Piante, Università degli Studi, Via E. De Nicola 9, 07100 Sassari, Italy. E-mail: massimo.zaccardelli@entecra.it

Fusarium semitectum Berk. & Ravenel is often isolated from soil and plant tissues, where it can be associated to complex diseases. It has been reported as pathogenic when inoculated on different hosts, however it is not considered as an important plant pathogen. During summer and autumn 1998, several isolates of *F. semitectum* were obtained from diseased alfalfa (*Medicago sativa* L.) cultivated in different fields in the Po Valley (Northern Italy). The plants showed chlorosis and wilting symptoms. A population of *F. semitectum*, providing from an unique alfalfa field in Po Valley (Lodi district), were analysed for DNA polymorphism to study genetic variability of the fungus from an unique host in a very restricted cultivation area. Isolations were performed on potato dextrose agar (PDA) and on Komada's substrate from basal portions of alfalfa stem. Monosporic cul-

tures were transferred on carnation leaf agar (CLA) for identification. Twenty-six isolates were used for molecular characterization, performed by minisatellite and microsatellite primed-PCR. By minisatellite analysis (M13 primer: 5'-GAGGGTGGCG-GTTCT-3') the isolates of *F. semitectum* were grouped in four genotypes, whereas four and five genotypes were observed by microsatellite analyses using (GACA)₄ and (GTG)₅ primers, re-

spectively. Pathogenicity tests performed on a subset of isolates showed that some of them were non-pathogenic on alfalfa plantlets, whereas other isolates were pathogenic but differed in virulence. All the non-pathogenic isolates belonged to the same M13 genotype. The coexistence, in the same field, of non-pathogenic and virulent isolates of *F. semitectum* suggests further considerations and studies.