AMAS Conference I, March 18-19, 2013, Rabat, Morocco

The First International American Moroccan Agricultural Sciences Conference

AMAS Conference I

March 18-19, 2013

La Tour Hassan Hotel

Rabat, Morocco

Promoting Cooperation in Scientific Research and Education Between USA and Morocco

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Khalid Meksem, Southern Illinois University, USA

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Silvia R. Cianzio, Professor Dept. of Agronomy; Agronomy Hall, Iowa State University; Ames, Iowa, USA

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David Lightfoot, Professor; Plant Genomics Core Facility, Department of Plant, Soil, and Agricultural Systems, Southern Illinois University, USA

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Alan Walter, Professor, Southern Illinois University, USA

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Badiaa Lyoussi, Physiology-Pahrmacology & Environmental Health Laboratory, University Sidi Mohamed Ben Abdallah, Fez, Morocco

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My Abdelmajid Kassem, Fayetteville State University, USA

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Sponsored By the Ministry of Foreign Affairs & Cooperation
Honorary Guest: Dr. Saad Eddine El-Othmani, Minister
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8:00-10:00 **Dinner, Awards, and Banquet**

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ORAL PRESENTATIONS ABSTRACTS
MONDAY MARCH 18, 2013

I. Plant Breeding and Biotech Session

Chair: Gunter Kahl, University of Frankfurt (GenXPro, Frankfurt), Germany

1.1. A Decade of Soybean Breeding for Disease and Pest Resistances.

Silvia R. Cianzio, Dept. of Agronomy, Agronomy Hall, Iowa State University, Ames, Iowa, USA. E-mail: scianzio@iastate.edu.

Abstract

Food security and sustainability is one of the most important concerns for society in the 21st Century. Climate change and continuous growth of the world human population require important efforts from the agricultural sector to provide food. Breeding of all crops conducted collectively, is one of the means to protect human population and their intellectual pursuits to improve survival chances of the race. Breeding programs in general have as the main objective the release of cultivars and germplasm lines for use by the agricultural sector. Genetic resistance to diseases and pests is one of the most durable forms of protecting crops and yield. It is also environmentally friendly, and an economical management tool for commercial production, that avoids expensive use of chemical inputs. The objective of the presentation is to review progress in soybean breeding for disease and pest resistances at Iowa State University during the last decade. The project uses classical breeding methods, molecular information, bioinformatics tools, off-season locations, and the invaluable resources of the USDA-ARS US National Soybean Genetic Collection to achieve cultivar and germplasm releases. A number of researchers from diverse disciplines (molecular geneticists, plant pathologists and nematologists, soybean breeders, bionformaticians, and statisticians) collaborate closely to identify new genes for resistance, determining its mode of action and inheritance. The project collates information, determines an appropriate breeding approach and delivers improved germplasm and cultivars to the public. This is only possible, thru effective and generous collaboration of researchers from diverse disciplines, which together have contributed to increase efficiency of breeding. The soybean breeding for disease and pest resistances has released cultivars and germplasm lines widely used by public and private soybean breeders, and in commercial operations by organic farmers, and farmers planting conventional non-GMO cultivars. The material released thru the Iowa Soybean University Research Foundation (ISURF) reaches farmers, private seed companies and breeding programs, benefitting stakeholder and the soybean commodity.

1.2. Pleiotropic Resistances in Soybean.

David Lightfoot, Plant Genomics Core Facility, Department of Plant, Soil, and Agricultural Systems, Southern Illinois University, 1207 Lincoln Drive SIUC, 1207 Lincoln Drive, Bldg 66, Carbondale, IL, 62901, USA. E-mail: ga4082@siu.edu.

Abstracts

Soybean (*Glycine max* (L. Merr.)) resistance to any population of *Heterodera glycines* (I.), or *Fusarium*

virguliforme (Akoi, O'Donnell, Homma & Lattanzi) required a functional allele at Rhg1/Rfs2. H. glycines, the soybean cyst nematode (SCN) was an ancient, endemic, pest of soybean whereas F. virguliforme causal agent of sudden death syndrome (SDS), was a recent, regional, pest. This study examined the role of a receptor like kinase (RLK) GmRLK18-1 (gene model Glyma_18_02680 at 1,071 kbp on chromosome 18 of the genome sequence) within the Rhg1/Rfs2 locus in causing resistance to SCN and SDS. A BAC (73p06) encompassing the Rhg1/Rfs2 locus was sequenced from a resistant cultivar and compared to the sequences of two susceptible cultvars from which 800 SNPs were found. Sequence alignments inferred that the resistance allele was an introgressed region of about 59 kbp at the center of which the GmRLK18-1 was the most polymorphic gene and encoded protein. Analyses of plants that were either heterozygous at or transgenic and so hemizygous with the resistance allele of GmRLK18-1 at a new location were made. Those plants infested with either H. glycines or F. virguliforme showed that the allele for resistance was dominant. In the absence of Rhg4 the RLK was sufficient to confer nearly complete resistance to both root and leaf symptoms of SDS caused by F.virguliforme and provided partial resistance to three different populations of nematodes (mature female cysts were reduced by 30-50%). In the presence of Rhg4 the plants with the transgene were nearly classed as fully resistant to SCN as well as SDS (females reduced to 11% of the susceptible control). A reduction in the rate of early seedling root development was also shown to be caused by the resistance allele of the GmRLK18-1. Field trials of transgenic plants showed an increase in foliar susceptibility to insect herbivory. These phenomena were associated with proteome alterations. Dimerization of the RLK and subsequent binding of CLE-like peptides was shown to underlie resistance. Peptide treatments could induce resistance in susceptible genotypes. The inference that soybean has adapted part of an existing pathogen recognition and defense cascade (H.glycines; SCN and insect herbivory) to a new pathogen (F. virguliforme; SDS) has broad implications for crop improvement. Stable resistance to many pathogens might be achieved by manipulation the genes encoding a small number of pathogen recognition proteins.

1.3. Effect of Explants Density and Size on the in vitro Proliferation of Globe Artichoke (*Cynara cardunculus* var. scolymus L.).

Rachida El Boullani, Aissam El Finti, Abdelkhaleq Elmoslih, Abdelhamid El Mousadik and Mohammed Amine Serghini.

Rachida El Boullani, Laboratory of Biotechnologies and Natural Resources Valorization, University of Ibn Zohr, Faculty of Sciences, Ibn Zohr University, B.P. 8106, Agadir, Morocco. E-mail: rachida3483@yahoo.fr

Abstract

Globe artichoke is normally propagated by vegetative way. This method often causes physiological, pathological and economically disadvantages. In vitro tissue culture of artichoke can be considered as a valid alternative to the usual systems of propagation; it is the key to rapid material propagation, health indexing and genetic uniformity. The contamination problem and the low multiplication rate are limiting factors for micropropagation in this species. This work aimed (1) to select the density of explants, and (2) to determine the explants size of shoot which are suitable to ameliorate the multiplication rate of globe artichoke (Cynara cardunculus var. scolymus L.) accession Art 21. Separated shoots of different sizes (< 1 cm, 1 to 1.5 cm, 1.5 to 2 cm and > 2 cm) were cultured on proliferation medium containing 1 mg.l-1 kinetin and 0.1 mg.l-1 NAA. Similarly, four explant densities (3, 4, 6 and 7 shoots per 132 cm2 area of culture media) were tested using the same proliferation medium. In general, results revealed that explants of 1-1.5 cm length exhibited high rate of survival shoots (100%) and the best number of new formed buds (7.33) among the explant sizes tested. Also, a density of 4 explants per area of culture

medium gives the important results how can ameliorate the budding and shoot regeneration and thereafter the multiplication rate.

II. Agricultural Practices and Soil Management Session

Chair: Alan Walter, Southern Illinois University, USA

2.1. Agro-physiological Characterization of Common Bean (Phaseolus vulgaris) Rhizobia Symbiosis Tolerance to Osmotic Stress.

Cherki Ghoulam, Faculty of sciences and Techniques, University Cadi Ayyad, Marrakech, Morocco. E-mail: ghoulam@fstg-marrakech.ac.ma.

Abstract

The symbiosis legume-rhizobia's ability is handicapped by many biotic and abiotic constraints as osmotic stress that is the more prevailing stress in the south of the Mediterranean basin. The aim of this work was to assess the performance of some symbiotic combinations of Phaseolus vulgaris varieties and rhizobia strains for symbiotic nitrogen fixation (SNF) under water deficit and to determine the effect of this constraint on some agrophysiological parameters in the inoculated plants. In Field trials, the seeds of three common bean varieties; Efequence (Fq), Flamingo (Fl), and Paulista (Pl) were inoculated with two Moroccan rhizobia strains using peat. The stressed plants were irrigated each two week while the controls were irrigated each week. While in greenhouse trials, the seeds were sterilized and germinated in sterilized sand and peat. The plantlets were inoculated with two rhizobia strains, RhM11, RhM12, and an international strain CIAT 899 used as reference, and then transplanted into a 5 L plastic pots containing sand and peat at 4/5 and 1/5 respectively. The control plants were irrigated each two days and the stressed ones were irrigated each 4 days. At the plant flowering stage, the trials were assessed using plant growth parameters, nodulation and some physiological parameters in all of the tested symbiosis combinations with some difference. The obtained results showed that osmotic stress negatively affected the plant and nodule biomass. This constraint reduced the plant water parameters as RWC, increased electrolyte leakage and reduced nitrate reductase activity (NRA) in plant leaves. For nodules, osmotic stress increased also electrolyte leakage of these organs and reduced NRA for the majority of symbiotic combinations except for Pl-RhM12 and Fq-CIAT899 that did not show any reduction. Also, osmotic constraint affected negatively metabolic activity as phosphoenolpyruvate carboxylase (PEPC), malate dehydrogenase (MDH), acid phosphatase (APase) and trehalose phosphatase (TPase) activites in all of the tested combinations with substantial variability between them. Particularly, the stimulation of antioxidative enzymes as peroxydase (PO), polyphenoloxydase (PPO), superoxyde dismutase (SOD) and catalase (CAT) were more pronounced in the nodules than in the leaves and was associated with low H_2O_2 concentrations indicating that nodules play a sink role for detoxification of stress induced reactive oxygen species. Inoculation with the local rhizobia strain RhM11, characterized by high nodulation and symbiotic efficiency, improved nodular enzyme activities and compensate the stress induced loss of the host plant growth.

2.2. Chickpea (Cicer arietinum L.) Responses to Irrigation Water Salinity.

Abdelaziz Hirich, Student, Agronomic and Veterinary Medicine Hassan II Institute, Complex of Horticulture, Agadir, Morocco. E-mail: hirich_aziz@yahoo.fr.

Abstract

Salinity is an ever-increasing problem in agriculture worldwide, especially in the Mediterranean region. Chickpea (Cicer arietinum L.) is the third most important food legume grown in the world. An experiment was conducted in the south of Morocco in order to evaluate the response of local variety of chickpea to irrigation water salinity. Differences in water uptake, seedling, growth, stomatal conductance, organic compounds, photosynthetic pigments, Na+ and K+ content were tested in order to put forward the relative mechanisms of chickpea to cope with salt induce damage. Obtained results showed a negative relationship between water salinity and most of measured plant growth parameters. Irrigation water salinity has affected negatively germination rate, growth and biomass accumulation and caused early senescence of plants. Increased water salinity lead to reduced germination, grain yield, water uptake and water use efficiency and decreasing in stomatal conductance and photosynthetic pigments. While proline, soluble sugars, Na+ and Na+:K+ ratio increased with increasing irrigation water salinity. The finding highlighted the role of proline and soluble sugars as osmolytes to cope with salinity stress.

2.3. Irrigation Management for Vegetables Grown in Dry and Semi-dry Climates.

Alan Walters, Southern Illinois University, 1205 Lincoln Dr, Room 176, Agriculture Bldg, MC 4415, Carbondale, IL 62901, USA. E-mail: awalters@siu.edu.

Abstract

In dry and semi-dry climates that receive little rainfall, irrigation is essential for vegetable crops. Since irrigation is required in these climates to support the high water demand for these crops, water is often the most important factor that limits vegetable production. Therefore, water use efficiency through irrigation selection and management, as well as crop-irrigation scheduling becomes increasingly important during the production season. Irrigation systems that are commonly used in these climates have unique advantages/disadvantages and each type will be related to the suitability for vegetable production in these environments.

III. Animal Sciences Session

Chair: Abdelhai Guerouali, Agronomic and Veterinary Institute Hassan II, Rabat, Morocco

3.1. Continuous Culture Fermenter System as a Model to Study Fermentation and Nutrients Metabolism in Ruminant Animals

Amer A. AbuGhazaleh, Department of Animal Science, Food and Nutrition. Southern Illinois University, Carbondale, IL, 62901, USA. E-mail:

Abstract

The digestive system of ruminant animals is characterized by the highly specialized foregut fermentation system. Ruminant animals depend on foregut microbial fermentation to extract most of their needed nutrients from the ingested plant materials. The study of foregut fermentation in animals is generally challenging because of: i) the difficulty in taking representative samples from the foregut, ii) the difficulty in measuring the production of gaseous, metabolites and nutrients that escape the foregut, iii) the cost to prepare and maintain surgically altered animals, and iv) the inherited variability between cannulated animals. Continuous culture fermenters are stimulation systems that mimic foregut fermentation and esti-

mate the amounts of fermentation products that leave the foregut as nutrients for the host animal. These systems have been extensively and successfully used as alternatives to animals in studying rumen fermentation. Our fermentation system is based on fermenter vessel with custom fabricated "T" fitting that serves as the overflow and stirring system that allow raft mat formation. This system provides researchers with the ability to: i) control foregut environment such as pH, dilution rate, retention time, temperature, and rate of mixing, ii) collect products of fermentation (VFA, ammonia, gasses, microbial community,.etc), and iii) estimate nutrients digestibility and flow of fermentation products from the foregut. Our system settings and operation plus research data from recent study that evaluated the effects of substituting corn with glycerol as a feed alternative will be presented. The research study used four fermenters in a 4 x 4 Latin square design with four 10 days consecutive periods. Treatment diets (60:40 forage to concentrate) were fed at 45 g/d dry matter (DM) in three equal portions. Glycerol was used to replace corn in a grain mix at proportions of 0% (T0; control), 15% (T15), 30% (T30) and 45% (T45). Effluents were collected from each fermenter during the last 3 days of each period and analyzed for nutrients composition. On day 10 of each period, additional samples were collected from each fermenter at 3 h after the morning feeding and analyzed for volatile fatty acids (VFA), ammonia-nitrogen (NH3-N), and microbial DNA concentration. The effects of treatment diets on fermentation, nutrients digestibility and ruminal bacteria will be presented.

3.2. Effect of Pigments with Different Origins on Pigmentation and Performance of Broilers

Mohammed T. Tunio, Y. Shuming, G. Chen, A. Chen, J. Qiu, and Z. Mohsina

Key Laboratory of Agri-food Safety and Quality, Ministry of Agriculture, Institute of Quality Standards & Testing Technology for Agro-products, Chinese Academy of Agricultural Sciences, Beijing 100081, P.R. China. Email: Tarique_tunio@hotmail.com

Abstract

A study was conducted using 600 1-d-old AA standard broilers from 1 to 49 days to investigate the response of pigments on pigmentation and performance of broiler with different origins with different levels of canthaxanthin, natural lutein and orange II based on standard diet. An additional objective was to determine the histology study of connective tissue of broiler muscles contained pigments. Broilers chicks were randomly assigned into 10 groups according to three dietary treatments with 3 replication, male and female chickens were separated respectively. Experimental diet of 1-d-day old broiler groups consisted on basal diet plus Natural Lutein at 25 mg/kg, 50 mg/kg and 100 mg/kg, basal diet plus canthaxanthin at 25 mg/kg, 50 mg/kg and 100 mg/kg, and basal diet plus orange II at 25 mg/kg, 50 mg/kg and 100 mg/kg received respectively and the other group received the diet without the addition of pigments (Control diet).The results showed that there were no significant ($p > 0.05$) treatment effects on broiler performance. Assessments of visual color observation of chickens was done in a specific area of breast, shanks and vent skin by using a Kemin color fan (KCF), were taken on 3rd, 4th, 5th 6th and 7th week. Birds fed the canthaxanthin 25mg/kg, 50mg/kg and 100mg/kg had highest pigmentation than those fed equivalent quantities of natural lutein and orange-II. These data suggested that pigmentation score reached a satisfactory level, although carotenoids synthetic pigments might have been absorbed better in the small intestine then natural and azo ones while synthetic carotenoids pigments were more efficient in increasing skin and shanks color. The histological studies also revealed that pigments belong to Azo dyes group have negative (<0.0001) effect on the meat quality and connective fibers as compare to canthaxanthin and natural lutein pigments. These finding supports the hypothesis use of pigments have much interest due to their potential use as tool of best color and quality of meat by feed industry to meet the consumer demand.

3.3. The Effect of Feed Additives Rich in Lipids on Methane Production Mitigation in Dairy Cattle

Guerouali Abdelhai, Department of Animal physiology, Hassan II Agronomic and veterinary Institute, Rabat, Morocco. E-mail: a.guerouali@iav.ac.ma.

Abstract

One of the causes of global warming is the increase in atmospheric methane and ruminants are responsible for a portion of the emission of methane. Development of simple and inexpensive means of decreasing methane emission by ruminants would contribute to efforts to slow and stop global warming. Such an intervention is one that would not necessitate lifestyle changes of developed countries, and would also be accompanied by an increased production efficiency of the ruminant animal. New feeding strategies were explored to reduce methane emissions in the ruminant animal by the incorporation of lipids in the diet. For this, an experiment was conducted to test the effect of feed additives, rich on medium-chain fatty acids, on methane production in dairy cattle and four Holstein dairy cows were selected from a herd and used for this study. The cows were fed for maintenance requirements a ration composed of 40% of concentrate and 60% of forage. After 2 weeks of adaptation, Methane production was measured in cows without feed additive then the feed additive was added to the same ration (50 g / day / animal) during another 2 weeks of adaptation and a second measurement of methane was performed. Methane production showed an increase 2 hours after the meal with a peak in the third hour, and then began to decline to stable value. A second increase in methane production was observed after a second meal. Without meals, methane production was stable and showed its minimal values. The feed additive rich in lipids was behind a reduction by 32% in methane production in the cows and methane emission was decreased from 5.46 to 3.74 liter/hour, from 14.10 to 9.54 liter / kg DMI) and from 16.20 to 10.33 liter / liter of milk). It is recommended that small amount of feed additive rich in lipids incorporated in the dairy cattle diet would contribute to efforts of slowing down the global warming.

IV. Plant Microbe Interactions

Chair: Khalid Meksem, Southern Illinois University, USA

4.1. Plant Parasitic Nematodes Communities Associated with Olive in Morocco

Nadine Ali[1], Elodie Chapuis[1], Johannes Tavoillot[1], Mohamed Aït Hamza[2], Abdelhamid El Mousadik[2], Aïcha El Oulkadi[3], Guillaume Besnard[4], Ahmed El Bakkali[5], Abdelmajid Moukhli[3], Bouchaib Khadari[6], Cherkaoui El Modafar[7], Mohammed Ater[8], Zahra Ferji9 Thierry Mateille[1]

[1] IRD, UMR CBGP, Montferrier sur Lez, France; [2] UIZ-FST, Agadir, Morocco; [3] INRA, Marrakech, Morocco; [4] CNRS, UMR EDB, Toulouse, France; [5] INRA, Meknes, Morocco; [6] INRA, UMR AGAP, Montpellier, France; [7] UCAM-FSTG, Marrakech, Morocco; [8] UAE-FST, Tetouan, Morocco; [9] IVA-CA, Agadir, Morocco. E-mail: nadine.ali@supagro.inra.fr

Abstract

Plant-parasitic nematodes (PPN) are major crop pests. In olive (*Olea europaea*) orchards and nurseries, the damages they induce are poorly documented all over the world. However, these parasites significantly contribute to economic losses in the ten-top olive producing countries in the world, especially in the Mediterranean basin (Spain, Italy, Greece, Tunisia, and Morocco). Moreover, their damages increase with cropping intensification. PPN are everywhere found in communities (i.e. species population mixtures).

As for all life organisms, diversity and structures of PPN communities respond to evolutionary, environmental and anthropogenic forces. Instead of controlling the main pathogenic nematode species as usual, one of the innovative strategies to control PPN would be to manage diversity in communities in order to lead them to be less pathogenic. The present study is conducted under the PESTOLIVE project (Contribution of olive history for the management of soil-borne pests in the Mediterranean basin) funded by ARIMNET (www.arimnet.fr) and supported by the 7th EU-FP7. It aims at understanding the contribution of olive domestication and human impacts on the PPN communities by analyzing the diversity of PPN in cultivated olive compared to wild olive in Morocco. Thus, 220 samples were collected in 2012 in several sites with cultivated and feral olive trees (i.e. wild olive resulting from cultivated olive) in the olive production areas located all along the Atlas foothills, as well as on wild olive (i.e. O. europaea subsp. europaea in the Rif and O. europaea subsp. maroccana in the Western High Atlas). Morphobiometric observations revealed a significant diversity of PPN, belonging to 12 families and 28 genera. First results showed high abundances of the genera Helicotylenchus, Rotylenchus, Pratylenchus and Meloidogyne that are known for their damages on Mediterranean olive. The incidence of geo-climatic characteristics, of ferality, and of crop management on biodiversity indices and on PPN community patterns is discussed.

4.2. Arbuscular Mycorrhizal Symbiosis Provides Key Ecological Services to Strengthen Plant Performance and Improve Agricultural Production

Essahibi A, MO Fouad, L Benhiba, and **A Qaddoury**, Faculty of Sciences and Technology, University Cadi Ayyad, Marrakesh 40000, Morocco. E-mail: qadahmed@gmail.com.

Abstract

Nowadays, it is well known that the management of soil microorganisms as ecosystem engineers, biocontrol agents biofertilizers or bioenhancers, is at the forefront of generating and promoting agricultural production technologies. These organisms, can participate in improving plant growth and nutrition, strengthening plant performance, restoring ecosystems and combating pests and pollution. The most important providers of these ecological services are arbuscular mycorrhizal (AM) fungi which can form a symbiotic association with roots of most land plants. Several studies have clearly highlighted the fundamental role that mycorrhizal fungi play at the interface between the soil and plant roots enhancing thereby the multitrophic and protective interactions that affect productivity, competitiveness and survival of the majority of plant species both in natural ecosystems and in managed field. Nevertheless, in spite of the undeniable evidence of the positive effects of these symbionts, the majority of horticulturalists, farmers, foresters and environmentalists, still have only a limited understanding of the importance of mycorrhizas. To date, plants production cycles and cultural practices have been designed and implemented ignoring completely the existence of mycorrhizae and their multitude beneficial effects. Mycorrhizal fungi are, however, ubiquitous and play fundamental roles in all aspects of plant life. This major knowledge gap must be bridged before mycorrhizal fungi can fully express their potential to enhance sustainable plant production. Understanding the biology and functioning of mycorrhizas allows knowing how to benefit from using mycorrhizal fungi in diverse aspect of plant production, while respecting the delicate balance of nature. Examples taken from the latest development of our research activities will be used in this presentation. In particular, the aspects production and application of AM fungi will be discussed. Potential and advantages of AM fungi for answering tomorrowâ€™s challenges of a more convincing and efficient use of these bioenhancers will also be given through these examples.

4.3. Use of Natural Plant Extracts as a Biopesticide Against Olive Psyllid (Euphyllura olivina Costa) in Morocco

Ghizlane Echchgadda and Abderahim Maammar, National School of Agriculture, Meknes, Morocco. E-mail: gechchgadda@yahoo.fr.

Abstract

In order to find alternative methods to control diseases and pests of the olive tree, we tested the effectiveness of botanical biopesticides on the olive psyllid (Euphyllura olivina Costa) in vivo. Olive psyllid, Euphyllura olivina, is an insect that causes severe damage to young shoots and flowering organs of the olive trees, thereby affecting their production. In the present study, we tested the effect of biopesticides on different extracts from several aromatic and medicinal plants, namely, Capsicum frutescens, Allium sativum, Zingiber officinale and Thymus satureioidaes. Untreated trees or trees sprayed with a chemical product were used as controls. Psyllid populations were estimated before and 3, 7, 15, 20 days after treatment. We found, that the natural products tested significantly affected the level of psyllid populations. In fact, these products further reduced the density of pests compared to the untreated controls. Moreover, these biopesticides had different levels of efficiencies that varied depending on the type and duration of treatment. Indeed, the potency of the four products examined increased gradually in function of time post application. For the chemical product, natural extracts of garlic, chilli, ginger and thyme, the effect of treatment, changed from 68.29%, 28.46%, 16.26% and 15.45%, recorded at day 3 to 100%, 87.5%, 84.62 % and 83.65% recorded at day 20, respectively. Also, the different biopesticides showed selectivity towards the auxiliary. Therefore, we conclude that these biopesticides can be used in integrated pest management program as a means to control the olive psyllid, and especially to overcome any potential risk of pests resistance to synthetic insecticides.

4.4 The *Arabidopsis thaliana* PSS1 Gene Confers Nonhost Resistance Against two Soybean Pathogens, *Phytophthora sojae* and *Fusarium virguliforme*.

Madan K. Bhattacharyya, Rishi Sumit, Binod B. Sahu, Min Xu and Devinder Sandhu; Agronomy Department, Iowa State University, Ames, Iowa, USA. E-mail: mbhattac@iastate.edu.

Abstract

The mechanisms that confer wide-spectrum protection in a plant species against all isolates of a pathogen are termed as nonhost resistance. Arabidopsis confers nonhost resistance against most soybean pathogens including the Asian soybean rust fungus and hemi-biotrophic pathogen *Phytophthora sojae* that causes root and stem rot disease. Three Arabidopsis genes, PEN1, 2 and 3 were recently shown to be involved in the expression of Arabidopsis pre-haustorial nonhost resistance against a powdery mildew pathogen. Arabidopsis pen1-1 mutant is penetrated by P. sojae. Over 3,000 M2 families were created by treating pen1-1 with EMS and screened for mutants that showed loss of resistance against *P. sojae* and identified a *Phytophthora sojae* susceptible mutant, pss1. Genetic data suggest that PEN1 is not epistatic to PSS1. PSS1 was mapped to a region very close to the southern telomere of chromosome 3. We challenged six P. sojae susceptible and six resistant families, generated from a cross segregating for the alleles at the PSS1 locus with the fungal pathogen, Fusarium virguliforme that causes sudden death syndrome in soybean. We observed that PSS1 is required for Arabidopsis nonhost resistance against *F. virguliforme*. Thus, PSS1 governs a novel nonhost defense mechanism against two highly destructive soybean pathogens. It encodes a novel protein with unknown function. The possible role of PSS1 in enhancing disease resistance in soybean will be discussed.

V. Education & Scientific Cooperation

Chair: My Abdelmajid Kassem, Professor and Chair, Department of Biological Sciences, Fayetteville State University, USA

5.1 Minister's Remarks
Lahcen Daoudi, Minister, Ministry of Higher Education and Scientific Research, Morocco. No Abstract.

5.2 Moroccan American Commission for Education and Cultural Exchange (MACECE)

James Miller, MACECE Executive Director, Rabat, Morocco

5.3. Challenges and Rewards as a Developing Professional in the United States: Reflections from a Moroccan Post-Doctoral Fellow in a US University.

Saadia Bihmidine, Division of Biological Sciences, University of Missouri-Columbia, USA. E-mail: saadia.bihmidine8@gmail.com.

Abstract

I will be discussing my experience as a Moroccan graduate student and then post-doctoral researcher in the United States. I will share my background to illustrate the path that lead to my pursuit of a Ph.D. in the US, and then discuss the many challenges, rewards, and research, teaching, and service opportunities I had while studying at the University of Nebraska-Lincoln and while working as a post-doc at the University of Missouri-Columbia. In addition, I will discuss topics related to women in science, technology, engineering, and mathematics (STEM) and present some useful information targeted to Moroccan students interested in pursuing a graduate degree. Finally, I will highlight my ongoing efforts and future aspirations in representing and contributing to Morocco and Moroccan women in pursuit of higher education and career development.

ORAL PRESENTATIONS ABSTRACTS
TUESDAY MARCH 19, 2013

VI. Plant Genome Sciences

Chair: Klaus Theres, Max Planck Institute for Plant Breeding Research, Germany

6.1. Quantitative Trait Loci (QTL) for Seed Isoflavones Contents Mapped in the PI438489B by 'Hamilton' Recombinant Inbred Line (RIL) Population of Soybean [Glycine max (L.) Merr.].

Masum Akond[1], Richard Bazzelle[1], Bobby Ragin[1], Stella Kantartzi[2], Khalid Meksem[2], and **My Abdelmajid Kassem[1*]**.

[1] Plant Genomics and Biotechnology Lab, Department of Biological Sciences, Fayetteville State University, 1200 Murchison Rd, Fayetteville, NC 28301, USA. E-mail: mkassem@uncfsu.edu; [2] Department of Plant, Soil, and Agricultural Systems, Southern Illinois University, Carbondale, IL 62901, USA.

Abstract

Understanding the genetic control of seed isofalvones contents is of great importance to develop cultivars that produce high amounts of these isoflavones. The objective of this study was to map quantitative trait loci (QTL) for seed isoflavones contents in the PI 438489B by 'Hamilton' recombinant inbred line (RIL) population of soybean across two environments over two years. A total of six QTL for seed isoflavones content were identified 5 different linkage groups (LGs) of the soybean geneome. The QTL LOD scores ranged from 2.6 to 5.3. Two QTL were identified for daidzein: qDAID001 and qDAID002 on chromosome 2 (LG M) and chromosome 17a (LG D2), respectively. Similarly, two QTL were identified for glycitein: qGLY001 and qGLY002 on chromosome 2 (LG D1b) and chromosome 8 (LG A2), respectively. Three QTL were identified for genistein: qGEN001 on chromosome 8 (LG A2), and both qGEN002 and qGEN003 on chromosome 12 (LG H). One QTL (qGLY002/qGEN001) controls both glycitein and genistein contents. The QTL identified here can be introduced in breeding programs aimed at producing cultivars with high seed isoflavones contents. The QTL identified here can be introduced in soybean breeding programs to develop cultivars with high isoflavones contents beneficial to human consumption.

6.2. Shoot Architecture and Leaf Dissection in Tomato Are Regulated by Homologous Gene Modules.

Klaus Theres, Bernhard L. Busch, Ali A. Naz, Smita Raman, Susanne Rossmann, Jia Ding, Florence Piron, Abdelhafid Bendahmane, Ciera Martinez, Neelima Sinha, Gregor Schmitz.

Max Planck Institute for Plant Breeding Research, Carl-von-Linne-Weg 10, Cologne, D-50829, Germany. E-mail: theres@mpipz.mpg.de.

Abstract

Aerial plant architecture is predominantly determined by the pattern of shoot branching and leaf morphology, which are governed by underlying developmental processes, axillary meristem formation and leaf dissection, that appear fundamentally unrelated. In tomato these processes share essential functions

in boundary establishment. We identified Potato leaf (C), a key regulator of leaf dissection, to be the closest paralog of the shoot branching regulator Blind (Bl). Comparative genomics revealed that both R2R3 MYB genes are orthologs of the Arabidopsis branching regulator RAX1. Expression studies and complementation analyses indicate that these genes have undergone sub- or neofunctionalisation due to promoter differentiation. Bl is expressed in the axils of leaves whereas C transcripts accumulate in the boundary zones of leaflets. Furthermore, the known leaf complexity regulator Goblet (Gob) is crucial for axillary meristem initiation and leaf dissection acting in parallel to C and Bl. RNA in-situ hybridization revealed that the branching regulator Lateral suppressor (Ls) is also expressed in leaves. All four boundary genes, C, Bl, Gob and Ls, may act by suppressing growth, as indicated by gain of function plants. Finally, we have identified a new regulator, Trifoliate (Tf), which plays a critical role in both processes. Tf encodes a MYB transcription factor that maintains morphogenetic competence during compound tomato leaf development. In addition, these gene activities condition a cellular environment that enables the formation of new meristems. Thus, leaf architecture and shoot architecture rely on a conserved mechanism of boundary formation preceding the initiation of leaflets and axillary meristems.

6.3. A Soybean Cyst Nematode Resistance Gene Points to a New Mechanism of Plant Resistance to Pathogens.

Shiming Liu[1], Pramod K. Kandoth[2], Samantha D. Warren[3], Greg Yeckel[2], Robert Heinz[2], John Alden[2], Chunling Yang[4], Aziz Jamai[1], Tarik El-Mellouki[1], Parijat S. Juvale[4], John Hill[4], Thomas J. Baum[4], Silvia Cianzio[5], Steven A. Whitham[4], Dmitry Korkin[3], Melissa G. Mitchum[2*], **Khalid Meksem**[1*]

Khalid Meksem, Professor, Department of Plant Soil and Ag Sciences, 1205 Lincoln Drive, Room 176, Southern Illinois University, Carbondale, IL 62901-4415, USA. E-mail: meksemk@siu.edu.

Abstract

Soybean cyst nematode (SCN), Heterodera glycines Ichinohe, causes more than a billion dollar in yield losses annually in the United States, it is indeed the most economically important pathogen on soybean. Moreover, virulent populations are overcoming most known resistance sources, therefore, the urgent need to identify, isolate and deploy new genes for resistance to SCN. Genes for resistance to SCN has been identified and mapped to several regions of the soybean genome by both, classical and molecular genetics using a variety of soybean germplasm. The Rhg1 locus on chromosomes 18 and the Rhg4 locus on chromosome 8 were identified by several research teams as two major resistances QTL to SCN. An integrated approach, combining positional cloning with newly developed functional genomics tools in soybean (VIGS, RNAi, Hairy root complementation and TILLING), allowed the isolation and confirmation of a metabolic gene at the Rhg4 locus in resistance to SCN. The discovery is a major breakthrough in the field of plant disease resistance that will impact greatly our understanding of soybean's resistance against SCN and will allow the development of soybean lines with durable resistance to soybean cyst nematode.

Plenary Session 1. Quo Vadis, Genetics? (An Attempt to Portray its Future)

Gunter Kahl, University of Frankfurt (GenXPro, Frankfurt), Germany. E-mail: kahl@em.uni-frankfurt.de.

Abstract

It is often heard that Biology, in particular Genetics, superseded Physics as the Science of this century. Clearly this is an overstatement, since the new disciplines of physics as e.g. astrophysics are effectively dominating the news. However, the relatively young discipline of Genetics also hits the headlines. Shak-

ing off the fatigue of a once specialized field for relatively few specialists working with flies, fish or flax aside the mainstream, Genetics developed into a technology-driven modern field of Biology, that generates breathtaking successes, but also raises fears. It is time to portray modern Genetics and quest its benefits and risks. Today the limited time forces to restrict on few topics, which virtually represent the fuel of molecular genetics today: whole genome sequencing, genome profiling and human history, microbiome sequencing, discovery of disease genes and development of personalized medicine. Though examples for each discipline will be discussed, the presentation will remain a superficial glimpse on only some, yet prominent aspects of modern Genetics.

Plenary Session 2. Expanding Horizons in Agriculture

Karen Stoelzle Midden, Professor and Landscape Architect, Department of Plant, Soil and Agricultural Systems, Southern Illinois University, Carbondale, IL 62901-4415, USA. E-mail: kmidden@siu.edu.

Abstract

With the increasing demands of available fresh and local produce in urban environments, alternative farming practices are proving to be successful on green roofs. The infrastructure of a green roof creates a defined space with challenges and opportunities unique to urban agriculture while also serving environmental, social and aesthetic benefits. These challenges include engineered medium often lacking adequate nutrient and soil structure, limited root depth and more extreme weather occurrences being on a roof. However, Keith Agoada, Chair of Rooftop Agriculture Committee, emphasizes that roof top gardening extends the growing season, provides freedom from ground level pests and vandalism, creates new jobs, reduces the cost and waste of energy to transport rural grown produce and offers educational opportunities for young urban children (Green Roofs for Healthy Cities, 2010, Introduction to Rooftop Urban Agriculture, Participants Manual). There are successful green roof farms as Brooklyn Grange in Queens, New York, United States (US) and smaller scale gardens for homeowners, schools and restaurants yet best practices to produce the healthiest yield is just evolving. The College of Agricultural Sciences at Southern Illinois University Carbondale (SIUC), US, installed an extensive green roof in September 2010. This roof is used as a demonstration area and for research focusing on native plants and vegetable production. Based on research conducted on the green roof at SIUC, successful yields of Solanum lycopersicum (tomato) and Lactuca (lettuce) species were achieved with managed fertility and water practices. This presentation will present a brief review of green roof farming and best practices determined in a two-year study.

Plenary Session 3. The National Institute for Agricultural Research (INRA) of Morocco: Infrastructure and Mission

Mohamed Badraoui, Professor and Director, Institut National de la Recherche Agronomique, Direction Generale, Rabat, Morocco. Email: mohamedbadraoui@gmail.com.

VII. Food, Nutrition, Dietetics, and Neutraceuticals

Chair: Abdelmalek El Meskaoui, National Institute of Medicinal and Aromatic Plants, SMBA University, Fez, Morocco. E-mail: abdelmalek.elmeskaoui@usmba.ac.ma, elmeskaoui@gmail.com.

7.1. Medicinal Value of Food and Dietary Supplements in Cardiovascular Diseases.

Badiaa Lyoussi, Laboratory of Physiology-Pharmacology and Environmental Health Laboratory, University Sidi Mohamed Ben Abdallah, Fez, Morocco. E-mail: lyoussi@gmail.com or lyoussi@rocketmail.com.

Abstract

The dividing line between food and medicine is often blurred. In earlier civilizations and many cultures today the medicinal value of food plants has been accepted but now it is enjoying renaissance at a global level. There is now sufficient evidence that the food plants contain chemicals with disease preventing and curing properties and that fruits, vegetables, legumes and spice are a rich in their antioxidant contents along with some other medicinally active chemicals; hence act against a wide variety of diseases, including cardiovascular diseases. Garlic and onion have been shown to be protective in cardiovascular disorders. Similarly, Fish oil rich in omega-3 fatty acids, olive oil, vitamin C and L-arginine have been shown to be useful in cardiovascular disorders. We found in our lab that the medicinal plants are relatively rich in their calcium channel blocking (CCB) activity and that CCBs usually co-exist in novel synergistic and side effects neutralizing combinations. For example plants such as Olives, Ginger, pomegranate, figs, grapes, cherries, Carum copticum and Nigella sative mediate their blood pressure lowering effect through combination of muscarinic receptor stimulation and calcium channel blockade and interestingly enough the ingredients of this combination have inhibitory effect in the cardiovascular system but opposing effect in other systems such as gut and renal, which may be the reason for relative safety of food plants. Thus foods are rich in medicinal value and their proper use has enormous health benefits.

7.2. Glimpses of Plant Cell Tissue and Organ Culture Biotechnology For the Production of Medicinal and Aromatic Plants and their Secondary products

Abdelmalek El Meskaoui, Plant Biotechnology Unit, National Institute of Medicinal and Aromatic Plants, University of Sidi Mohamed Ben Abdellah, Fez, Morocco. E-mail: abdelmalek.elmeskaoui@usmba.ac.ma, elmeskaoui@gmail.com

Abstract

Without claiming to deal with all aspects of this topic, this conference aims to provide a brief overview of the status quo contribution of plant cell tissue and organ biotechnology in the field of the valorization and conservation of medicinal and aromatic plants (MAPs) and their secondary metabolites. Several textbooks and review articles have been described this topic more comprehensively than is possible in this conference. MAPs are increasing worldwide and continue to attract growing interest for various industries because they represents a natural biological resources that have a great potential to synthesize a huge variety of important secondary compounds far more than animal and even microorganisms. Recently, MAPs are finding a new, expanding market as herbal components of health foods and preventative medicines, especially under the terms functional foods, nutraceuticals and health products. The supply of the source plants however, is often limited due to disease, changes in climate, and changes in the development in the growing regions. Nowadays, most of MAPs are still harvested from the wild in a no sustainable way. Such practice can lead to over-exploitation of endangered and vulnerable species as well as

to biotope destruction. In order to overcome some of these various problems, the agrobiotechnological approach by utilizing plant cell tissue and organ culture (PCTOC) technology has been expected to be an efficient and useful tool for the breeding (selection) of high-quality MAPs and for the preservation of endangered species as well while providing an alternative source production of phytochemical products.

VIII. Agriculture and Regional Stability

Chair: Mohammed Benhammou, Centre Marocain des Études Stratégiques (CMES), Rabat, Morocco.

8.1. Agriculture and Regional Stability in Africa

Mohammed Benhammou, Centre Marocain des Études Stratégiques (CMES), Rabat, Morocco.
E-mail: etudestrategique@yahoo.fr

8.2. Agriculture Development Strategies for Insecure Areas: Lessons from Afghanistan

John Groninger, Southern Illinois University Carbondale, IL, USA.
E-mail: groninge@siu.edu

Abstract

Wars and insurgencies are often accompanied by degradation and outright destruction of agricultural systems and the soil, water and genetic resources needed to ensure productivity, food security, and to permit marketability. Supply chains and market access may also become disrupted. Furthermore, human capacity is diminished as farmers are absent from their trade, either as combatants or refugees. Lasting damage results when continued fighting interrupts agricultural knowledge from one generation to the next. Under traditional development scenarios, improvements in the agricultural systems require a cessation of hostility and freedom of movement for development workers. These conditions do not exist in many parts of Afghanistan and, increasingly, in other parts of the world. Based on our experience in Afghanistan, we will present the physical and social context of rural Afghanistan and discuss various limitations associated with conflict zone development and present opportunities to address these. Areas of focus include techniques for providing basic agriculture knowledge to military personnel, enlisting and training local agents, embedding agriculture experts with military units, use of rapidly deployed demonstrations, and making accessible training materials for field personnel through the proliferation of field-compatible communications technologies. Continuing challenges associated with proliferating these challenges within existing and emerging Afghan institutions will also be discussed. Possible opportunities for collaboration among Moroccan and American colleagues will be introduced.

IX. Private and Public US–Morocco Collaboration Network and Open Discussion

Khalid Meksem, Professor, Department of Plant Soil and Ag Sciences, 1205 Lincoln Drive, Room 176, Southern Illinois University, Carbondale, IL 62901-4415, USA. E-mail: meksemk@siu.edu

9.1. Morocco-France-USA Collaboration

Abdelhafid Bendahmane, INRA, URGV, France

Abstract - Not provided

9.2. Small Fruit Berry Crops: promising new crops for Morocco

Mark Gaskell, University of California Cooperative Extension; San Luis Obispo, CA 93401
Fulbright Senior Scholar to Morocco (2012-2014). E-Mail: mlgaskell@ucanr.edu

Abstract

Morocco's mild winter climate combined with its proximity to European markets has enabled Moroccan growers to produce off-season fresh fruits and vegetables for export to Europe (EU). Strawberries have been profitably produced and exported from coastal areas of Morocco for more than 20 years and now efforts are underway to include raspberries (Rubus ideaus L.), blueberries (Vaccinium spp.), and blackberries (Rubus spp.) among the small fruit crops exported from Morocco. Demand is increasing for these berry crops in Europe as in North America and much of the rest of the world while demand for strawberries is leveling off. These other small fruit crops share many production, post-harvest, and marketing traits with strawberries but overall are some of the most challenging fruit crops to grow and require intensive use of manual labor. This provides additional opportunities for Moroccan agriculture help stimulate the economies and to help reduce high unemployment in rural areas of Morocco. Off-season supplies of raspberries, blueberries, and blackberries for the EU currently are shipped from Chile, Argentina, South Africa, and Mexico, so Morocco's geographic advantages with respect to the EU, contribute to considerable cost savings and improved fruit quality and shelf life. Early efforts to produce raspberries in Morocco in the 1990s met with little success because it involved the digging and artificial chilling of floricane fruiting cultivars with considerable additional cost and complexity. More recently, newer primocane fruiting raspberry cultivars have been introduced and are becoming established on Moroccan farms and they have been followed closely by low-chill Southern Highbush blueberries. Blackberries are in experimental trials and also appear to be promising additional alternatives. The cultural practices of each of these crops is reviewed in the Moroccan setting with emphasis on critical management needs. Acreage of these berry crops is expanding in Morocco and current complementary efforts are now underway to develop Moroccan research programs and technical support to support this new berry industry.

9.3. Promoting Research, Education, and Outreach Between the INRA of Morocco and the US

Mohamed Badraoui, Professor and Director, Institut National de la Recherche Agronomique, Direction Generale, Rabat, Morocco. Email: mohamedbadraoui@gmail.com

Abstract - Not provided

POSTER PRESENTATIONS ABSTRACTS

1. Morphological Characterization of *Opuntia* spp. in Southern Morocco

El Finti A, R El Boullani*, I Yamani*, F Msanda*, and A El Mousadik

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Abstract

Opuntia spp. belongs to the Cactaceae family. The most economically important species is O. ficus indica, cultivated both for fruits and cladodes. The genus includes other important edible species (from diploid to octoploid) that occur worldwide as either wild or cultivated species in many arid or semiarid areas (e.g., the Mediterranean region). Several accessions are cultivated in different growing regions, but little is known about their ancestries and levels of genetic diversity. This study investigates through a choice of pilot sites the characterization in-situ of Opuntia ecotypes with two selection criteria: fruit and oil content in seeds. For this purpose, and with the support of local population, the identification of ecotypes, prospection and collection of fruits were realized in various sites representing four principal provinces of Opuntia ficus indica area (Marrakech, Agadir Ida-Outanane, Chtouka Ait-Baha and Tiznit). Within each provenance, measurements related to 450 fruits and the morphometric data were subjected to the analysis of the variance.(fruit weight (g), fruit diameter (mm), fruit length (mm), width of pulp (mm), peel weight, areole density in the fruit, and total soluble solids (TSS; Brix)). Results obtained increases our knowledge of the variability among some of the most diffused Opuntia cultivated accessions. Also points to the inconsistencies of previous taxonomical genotype assignments that were based solely on morphological characteristics.

2. Forage Legumes As An Alternative to Climate Change and Farming Practices on the Management of Soil Fertility in the Sous-Massa

Mimouni Abdelaziz[1], F. Msanda[2], R. Mrabet[3], and M.Ghazi[1]

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Abstract

The intensive and extensive agricultural practices in the Souss-Massa, have contributed to a net degradation of soil fertility. This degradation of soil fertility is accentuated by climate change has suffered the region over the last thirty years. The experimental set up for three years in Tizi-N-Test and Experimental Station of INRA on the use of barley and mixed forage legumes, vetch/barley and pea/barley in rotation with corn has shown positive effects on soil fertility. Both mixtures were Fixed a high amount of biological Nitrogen respectively on average 93 and 126 kg N/ha respectively for the pea/barley and vetch/barley. Compared to the rotation barley/corn, they enrich the soil mineral nitrogen along the crop cycle from 45 to 85% while barley to the poorer with a loss of more than 10%. These mixtures of forage legumes have also improved the rate of organic matter from 15 to 22% and total nitrogen in

soils from 20 to 26%. They also improved the yield and the nitrogen content of leaves of corn in rotation respectively from 27 to 56% and 26 to 32% compared to the rotation barley/corn.

3. Effects of Fluorescent Pseudomonads and Bacillus spp. on the Development of Penicillium italicum, the Causal Agent of Citrus Blue Mold

Latifa Askarne, Hassan Boubaker*, El Hassane Boudyach, Mohamed Amine Serghini, Abdellah Ait Ben Aoumar

Laboratoire de Biotechnologies et Valorisation des Ressources Naturelles, Université Ibn Zohr, Faculté des Sciences, B.P 8106, Agadir, Morocco. * Corresponding author - hassanboubaker@yahoo.fr. E-mail: as.latifa@gmail.com.

Abstract

Blue mold of citrus caused by *Penicillium italicum* is an important and devastating storage disease of citrus fruits. Currently, measures employed to manage this disease involve the application of synthetic fungicides, which have adverse effects on the environment and health. To overcome these problems, taking into consideration the increased concern of consumers towards pesticide use, alternative methods for decay control are needed. Of various biological approaches, the use of antagonistic microorganisms is becoming popular throughout the world. A total of 466 bacteria isolated from the surface of citrus fruits, leaves and rhizospheric soil were screened in vitro for their antifungal activity against *P. italicum*. Results showed that among 110 active isolates, 69 were fluorescent pseudomonads and 41 belong to the *Bacillus* genus. Isolates which presented the widest inhibition zone (25 mm<Ø< 45 mm) in the in vitro study, were in vivo screened against blue mold on citrus fruit " cv. Valencia- late" harvested in the Souss-Massa-Draa valley, Agadir, Morocco. The results showed that treatment of fruit by antagonistic bacteria, 2 h before inoculation with the pathogen, induced significant protection. Indeed, more than 46% of tested isolates reduced the incidence of blue mold by 0 and 16% after 5 days of incubation at 20°C.

4. Antifungal Effects of the Essential Oil of three Moroccan Wild Growing Species of Thyme on Grapevine Fungal Pathogens

Saadia Belmalha[1], Ghizlane Echchgadda[2], and M. El Idrissi[1]

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Abstract

Resistance to conventional fungicides causes the poor disease control of agriculture. Natural products from plants have great potential as novel fungicide sources for controlling pathogenic fungi. In these study in vitro and in vivo antifungal effects of the essential oil of threes Moroccan wild growing species of thyme: *Thymus zygis* L. subsp. gracilis (Boiss.) *R. Morales, Thymus satureioides* Cosson, and *Thymus riatarum* Humbert & Maire on grapevine fungal pathogens were tested. The essential oils were isolated from leaf and flowers by hydro distillation and analyzed by gas chromatography coupled with mass spectrometry (GS/MS). The major compound was thymol (38.04%) for the essential oils of *T. zygis* and borneol (28.38%, 31.13) for the essential oils of T. satureioides and T. riatarum, respectively. The essential oils of *Thymus zygis* and *Thymus satureioides* were tested in vitro as antipathogenic agent against

two plant fungi *Eutypa lata* and *Botryosphaeria obtusa*. The essential oils tested have an inhibitory effect on the colonies growth of *E. lata* and *B. obtusa*. The antipathogenic effect varies with thymus species and essential oils concentrations. The MIC was 0.2% for *T. satureioides* and 0.1% for *T. zygis* on *Eutypa lata* and 0.1% for both species of thyme on *Botryosphaeria obtusa*. The essential oils of *Thymus zygis*, *Thymus satureioides*, and *Thymus riatarum* were tested on the field of grapevine infested by eutypa dieback which is one of the most important and devastating diseases of grapevine. The results showed significant reduction of the incidence of fungal infection in vineyard treated with the essential oil of different species of thyme comparing to the untreated control.

5. Effect of Argane Oil Consumption on Hypertension in Postmenopausal Women in Morocco

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Abstract

Background: WHO estimates that 7.5 million deaths worldwide are due to hypertension, approximately 12.8% of all deaths. This is an important risk factor for cardiovascular disease. Argane oil is an integral part of Moroccan diet. Several studies showed that a diet supplemented with argane oil decreased systolic and diastolic blood pressure measurements in animals and suggested that consumption of argane oil may have a beneficial effect in preventing cardiovascular disease. Object of study: To study the effect of a regular consumption of argane oil on hypertension in healthy postmenopausal women. Methods: 77 postmenopausal women (55,49 Â± 6,17 years) were assigned to consume 25 ml of argane oil during 8 weeks of nutritional intervention. Anthropometric (weight, height and BMI) and clinical profile (blood pressure) have been determined at 0 and 8 weeks. Results showed that systolic blood pressure was significantly reduced (125,1 Â± 13,4 to 119,6 Â± 15,1 mmHg) after 8 weeks (p=0,0212). Diastolic blood pressure underwent a slight decrease (81,5 Â± 8,6 to 79,8 Â± 8,8 mmHg) but not significantly (p=0,2307). Conclusion and perspective: These results suggest that consumption of argane oil can be relevant to prevent cardiovascular disease into postmenopausal women and help to decrease cardiovascular risk. The positive impact on blood pressure recorded by a significant decrease in SBP and hypertension is a significant result, however, the mechanisms involved in obtaining this result need to be defined more accurately, focusing mainly on the effects of certain constituents of argane oil as gamma-tocopherol on the mechanisms regulating blood pressure.

6. Electrochemical Degradation of Cypermethrin Pesticide on a SnO_2 Anode

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Abstract

This paper presents the study of the electrochemical oxidation of the pesticide cypermethrine at a SnO_2. In this work, the effect of using different supporting electrolytes (NaCl, NaOH, Na_2CO_3, H_2SO_4 and Na_2SO_4) during the galvanostatic electrolysis of cypermethrine was investigated. It was observed that the removal of cypermethrine and chemical oxygen demand (COD) was only achieved at appreciable rates when NaCl was used as the supporting electrolyte, due to the oxidising species formed in this elec-

trolyte. Variation of the NaCl concentration demonstrated that, although only low concentrations of NaCl are necessary to result in the complete removal of cypermethrine in solution. The achieved reductions of % COD were 75% for 2% NaCl. Examination of the applied current density indicates that the efficiency of COD removal reaches a maximum at 80 $mA.cm^2$. in this work presents, the effect of temperature and pesticide concentration of cypermethrine are investigated. The high efficiency of this technology can be explained in terms of the direct electro-oxidation at the SnO_2 surface and the oxidation carried out by hydroxyl radicals (OH) and other electro-generated oxidants (ClO^-).

7. Effect of Medium Strength and Different Levels of Naphtoxy Acetic Acid and Kinetin to Improve in vitro Shoot Proliferation and Regeneration in Date Palm (*Phoenix dactylifera* L.).

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Abstract

Somatic embryogenesis is the most commonly used technique for date palm (*Phoenix dactylifera* L.) micropropagation; however, the genetic instability of regenerated plants through this method and the need to produce true-to-type plantlets of superior cultivars in Morocco, lead to the use of other techniques of rapid multiplication; Therefore, we developed a novel large-scale micropropagation pathway based on direct organogenesis. Organogenic stems obtained from the shoot tip explants of the Moroccan cultivar Najda were used to evaluate the effect of Beauchesne Medium (BM) and Murashige and Skoog Medium (MS) full strength, half-strength and one-third-strength, with various concentrations (0, 0.25, 0.5 and 1 mg/L) of naphthoxy acetic acid (NOAA) and kinetin on in vitro shoot proliferation. MS/2 supplemented with 0.5 mg/L NOAA and 0.5 mg/L kinetin proved to be the most effective during the multiplication phase, resulting in high number (23.5) and morphologically superior shoots with low vitrification level. To achieve elongation, shoots were isolated and transferred to the same proliferation medium, or to MS or to MS/2 media lacking growth regulators. In media supplemented with hormones, shoots elongated rapidly and showed a high rate of root formation. For instance, on MS/2 medium containing 1 mg/L NOAA and 1 mg/L kinetin, the average shoot length was 15.1 cm, the average number of roots per shoot was 6.2 and their average length was 3.4 cm. On hormone-free media, shoots were shorter with fewer roots, but with wider and greener leaves. Two months after transferring shoots to the greenhouse, their survival rate was depending on the elongation media. Shoots cultured on hormone-free media showed high survival rates, exceeding 90% in most cases, while there was a poor survival rate of shoots that had been cultured on media containing hormones during the elongation phase.

8. Nematicidal Effect of Castor and Argan Cake on Meloidogyne javanica and *Helicotylenchus multicinctuc* Associated with Banana

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Abstract

A pot experiment was carried out in order to evaluate the efficiency of some organic amendments. Grounded castor leaves at 50 and 100g, grounded castor seeds at 50 and 100g, argan cake at 150g

and the control were the treatments that has been tested. The efficiency of the treatments was evaluated by means of the effect on Meloidogyne and Helicotylenchus multicinctus population as well as the damage they cause on banana roots. A decrease in nematode population has been obtained when these treatments were used compared to the untreated plants. Argan cake allowed the highest nematode reduction (up to 100%). Also, only few small galls were formed on argan cake treated plants (IG=0,42) compared to the control (IG=4,42). An improvement of plant growth has been noticed on treated plants. The best weight (127,72g), aerial plant parts weight (225,31g), the height (64,8cm) and the circumference (10,87cm) were obtained on argan treated banana plants.

9. Shoot Elongation, Rooting and Acclimatization of Date Palm (*Phoenix dactylifera* L.) cv. Najda: Impacts of Liquid Media, Plant Growth Regulators and in vitro Pre-Acclimatization

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Abstract

In vitro organogenesis is a very interesting method for large-scale multiplication with genetic fidelity in date palm. This technique was adopted in Morocco to reconstitute groves destroyed by the bayoud disease, caused by the fungus Fusarium oxysporum f. sp. Albedinis. However, the success of organogenesis is highly genotypic dependent. For Najda cv., adventitious shoots obtained through in vitro organogenesis showed some difficulties during the elongation-rooting phase. Indeed, shoots continue proliferation or show a very slow growth. To solve this problem, the effects of stationary liquid media to improve shoots elongation of Najda cv. and an in vitro pre-acclimatization stage to increase the survival percentage of plantlets in the greenhouse were investigated. Two basal liquid media were tested: full strength and half strength Murashige and Skoog medium (MS). Media were either devoid of plant growth regulators (PGRs), supplemented with 0.5 mg/L 6-benzylaminopurine (BAP) or 0.5 mg/L indole-3-butyric acid (IBA) and 0.5 mg/L BAP. After three months of culture, all liquid media were efficient and allowed to overcome slow growth problem. The maximum shoot elongation was 11.3 cm, obtained in MS medium supplemented with 0.5 mg/L BAP and 0.5 mg/L IBA. The shoots were isolated and transferred either to the greenhouse or to one month in vitro pre-acclimatization stage in a PGR-free solid medium (MS or MS/2) then to the greenhouse. A higher surviving rate (ranging from 70 to 86 %) was obtained after one month pre-acclimatization compared with the direct transfer to the greenhouse (12-28 %).

10. Antibacterial Evaluation of the Essential Oils of three Satureja spieces: *Satureja briquetti*, *Satureja atlantica*, and *Satureja alpina*

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Abstract

In order to elucidate the importance of medicinal plants growing wild in the middle Atlas Mountains of Morocco, hydro-distilled volatile oils from the aerial parts of Satureja briquetti, Satureja atlantica and Satureja alpina have been studied. Authenticated voucher specimens were deposited in the Herbarium

of the National Institute of Medicinal and Aromatic Plants, Sidi Mohamed Ben Abdellah University, Fez, Morocco (INP 233, 269 and 268). The essential oils yield were 1,30% for S. briquetti, 1,35% for S. atlantica and 1,76% for S. alpina. A paper disc diffusion method was used for the screening of anti-bacterial activity of essential oil samples against twelve pathogen bacteria isolated from the University Hospital of fez. The results showed all tested microorganisms were inhibited by essential oil samples with 1/8 as minimum inhibitory concentration for Satureja alpina against Vibrio alginolytieus.

11. Organic Carbon Storage in the Oak Evergreen Forest Ecosystems of the Middle and High Moroccan Atlas Areas

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Abstract

This study was conducted in the evergreen oak forest (*Quercus ilex* L.) of the Middle and high Moroccan Atlas area, with the aim of determining the stock of organic carbon in the different components (soil, litter and biomass) of the ecosystems studied. The best correlations were obtained with allometric regressions of the type: Y (carbomass) = aXb (X is the circumference at 1.30 m (C1,30)) for the various components of aboveground biomass of Quercus ilex of Middle and High Atlas. The total carbomass of the aboveground part stands range from 17 tC.ha^{-1} (Aït Aamar) 40 tC.ha^{-1} (Ifghane) in the High Atlas and 55 tC.ha^{-1} (Dayat. Hachlaf) to 91 tC.ha^{-1} (Ksiba) in the Middle Atlas. Thus, It appears from this study that the soil organic carbon stock (SCOS) varies from 24.6 tC.ha^{-1} for Aït Aamar to 141.4 tC.ha^{-1} for Ajdir. Over 80% of SCOS is stored in the first 30 centimeters. The correlative approach shows that SCOS are heavily dependent on the depth for the different study plots. The SCOS decrease with depth following an exponential curve with a negative exponent for all plots (Middle and High Atlas). The stock of organic carbon in the soil litter (SCL) varies from 1.4 to tC.ha^{-1} for Asloul to 14.3 tC.ha^{-1} for Ajdir. For the various components studied, the Middle ecosystems of Atlas area sequester more carbon. The SCOS and FBCS represents more than 50% of SCOT. The SCOS, SCL and SCB vary considerably with the basal area. The total stock of organic carbon in the ecosystems studied varies between 53 tC.ha^{-1} for Aït Aamar to 343 tC.ha^{-1} for Ajdir. The forest ecosystems of Middle Atlas (648.103 ha) and High Atlas (409.103 ha) of Morocco stored 235 t ha^{-1} and 78 t ha^{-1} respectively of the total organic carbon, and for that there were a sequestration in these forest ecosystems of 560 and 117 MtCO_2. Therefore, the Moroccan oak forests store more or less 800 MtCO_2. With a mean tree age of 80 years, the Moroccan oak forests store 10 MtCO_2 year^{-1}. The estimation of nette emissions of GES in Morocco in the 2010 are in the order of 75,4 MtE-CO_2. This shows that the Moroccan oak forests stored aproximately 1/8 of GES issued by all Moroccan country. The analysis of net emissions per inhabitant confirms the very low contribution of Moroccan to emissions of GES (2,97 tE-CO_2 in the 2020), despite there is an increase of 60% respect to the 1994 (1,84 tE-CO_2).

12. SNP Markers as a Tool to Assess Quinoa (*Chenopodium quinoa* Willd.) Genetic Diversity

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Abstract

Quinoa (*Chenopodium quinoa* Willd.) is an important pseudo-cereal originated from the Andes. It has excellent nutritional value and has the capacity for growth under several abiotic stresses such as drought and heat. Improving quinoa productivity is very important to assure food security in both old world and new world. For that reason, it has been the objective of many breeding programs. In this study, our goal was to characterize and assess the genetic diversity among a series of 94 accessions, originated from Bolivian and Peruvian germplasm and selected for their adaptation to Moroccan conditions using the single nucleotide polymorphism (SNP) technique. Ninety-six biallelic SNP markers were utilized in KASPar™ assays on a 96.96 Fluidigm EP1 platform. The 94 quinoa accessions were evaluated also on the basis of IBPGRI morphological traits. Those primers were selected on quinoa for their repartition across the genome and their high allelic frequency among 400 SNPs developed by genome reduction. This technique does not require a priori genome sequence information reducing the cost of SNPs development. Cluster analysis and PCA divided all quinoa accessions into four discrete clusters. The highest average of expected heterozygosity (He) of 0.42 was between individual within the cluster III and the lowest was 0.16 within the cluster II. The fixation index (Fst) is comprised between 0.15 and 0.76 showing a very important diversification within the four principal populations.
This molecular analysis technique provides the quinoa breeders community with a new set of easy to use and highly informative genetic markers and allowed us to establish a diversified quinoa germplasm to enhance breeding program of this crop.

13. Soybean Cyst Nematode Disease Resistance: Understanding a Novel Mechanism of Resistance in Plants to Cyst Nematodes

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Abstract

Soybean (*Glycine max*) is the world's most widely used legume crop, providing 68% of world protein meal as well as food oil and renewable fuels, and farm gate value of over $35 billion in the U.S alone. Soybean cyst nematode (SCN; Heterodera glycines) is the most economically damaging pathogen of soybean, causing over $1 billion dollars in annual losses. SCN has infested most major soybean producing areas worldwide, and there are no practical means of eradication. Although planting of resistant cultivars forms the core management strategy for this pathogen, nothing is known about the nature of resistance. Our group identified recently the first soybean gene resistance in soybean against nematodes, A Serine Hydroxymethyltransferase Gene Confers Resistance to Soybean Cyst Nematode called GmSHMT at the rhg4 locus (for resistance to Heterodera glycines) based on important features such as mutation analysis, gene silencing and transgenic complementation approaches. Other group identified

also by gene silencing that another genes at the rhg1 locus that contribute to SCN resistance. Our initial in vitro analysis shows some interactions between those genes. In this work, we present a detailed characterization of those genes and other candidate genes involved in SCN resistance to better understand SCN resistance pathways in Soybean. Several techniques and tools have been implemented to fulfill this goal such as the generation of multiple mutants, detailed phenotypic analysis, Yeast Two Hybrid, fishing method using Western Bloot followed by MS to identify interactors. In vivo methods have been also used expressing the proteins candidates by Agroinfiltration in Nicotiana Bentamiana and Arabidopsis thaliana leaves followed by Immunoprecipitation. All data generated were complemented and supported by in silico and Bioinformatics analysis.

14. Effect of Salt Stress and Na^+ and K^+ Ions on Seed Germination and Growth in Alfalfa (*Medicago sativa* L).

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Abstract

Tolerance of legumes grown in soil rich in salts as if at the same time irrigated for intensive cultivation of forages region and traditional agricultural systems in the pre-Saharan oasis would deserve of scientific investigation in order to propose an alternative technique to traditional irrigation methods high water users responsible for salinization. It is in this context that our research has been conducted to compare the tolerance of two genotypes of Medicago sativa (Europe and Tafilallet) from two different soil and climate to salt stress of varying degrees. If the application of salt has caused a drop in the germination capacity of two varieties, the effect of addition of NaCl in the medium has been more pronounced among Europe than in the variety Tafilalet. They lose 78% and 22% of their capacity for germination at 100 mM NaCl compared with the control. Among the two varieties, no seed germination was recorded when NaCl concentration in the medium reached 200 mM. The results showed that seed of Europe (EU) and Tafilalet (TA) have different degrees of sensitivity to salinity in the medium. Unlike the variety Europe, it was shown that salinity causes a drop in biomass in TA. In two varieties, an increasing the content of leaves and roots sodium after 14 days of treatment with 200 mM NaCl. This led to the decrease in K^+ / Na^+ ratio.

15. Quinoa Yield Potential in the Semi Arid Region of Rhamna

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Abstract

Quinoa (*Chenopodium quinoa*) is a highly nutritious grain crop growing in the Andean region since more than 5000 years; it presents a large adaptation to various environmental conditions. It has been experimented in Morocco for more than 10 years in two agro climatic regions. At the present, adapted varieties made available to be used by small farmers in arid and semi-arid zones. The present research was carried out to evaluate quinoa yield potential under Rhamna climate. Rhamna area minimal temperatures ranged from 4.3 to 5.1°C, and maximal temperatures from 37.5 to 39.3°C. Its average annual rainfall

is 250mm/year. Three trials at Bouchane community farms were conducted to estimate the quinoa's yield potential. Fives quinoa accessions developed at the IAV Hassan II, Rabat breeding program were used. Experimental units (4.5 m^2) were organized in a completely randomized design with three repetitions. The soil low in terms of organic matter and mineral fertilizers has not been supplied as the local growers do. The three experimental plots differed in terms of the soil type and the irrigation system. Yield was evaluated at the maturity stage through its components, plant density per meter square, total biomass and total grain biomass per plant and per square meter. The data analysis highlighted significant yield variation among the tested accessions and trials. The best accession L142 presented the highest yield at the three locations; it has reached 1520 kg/ha under gravity-fed irrigation and 930 kg/ha under rainfed cropping. L142 recorded also the highest harvest index (0.43). Both L119 and L143 accessions were intermediate in both their yields and their harvest indexes. L123 accession was the least in terms of yield and harvest index who was as low as 0.16. Highest yield of all accessions confounded (130 kg/ha) was obtained with drip irrigation which improves yield potential. L142 is the best accession for our breeding program.

16. Effects of Compost and *T. harzianum* on Tomato Growth

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Abstract

The incorporation of municipal solid waste compost in substrate has improved health and growth parameters of tomato plants to 58.83% as well as early formation of fruit. Spraying and fertigation plants with compost extracts induced stimulation responses that vary depending on the concentration and extraction time between 12.21% and 25.17%. A rate of 20% of compost extracts was selected for biocontrol essays. This effect of compost and its extracts is, at least in part, due to the presence of a *T. harzianum* population in compost that has a strong potential to stimulate plant growth. Indeed, inoculation of tomato plants with a strain of *T. harzianum* isolated from compost has significantly improved plant growth of 45.92%. These stimulation responses are strongly related to root colonization and competitiveness of this strain in plant rhizosphere against soil microflora.

17. In vitro Rooting of Globe Artichoke (*Cynara cardanculus* var. scolymus L.)

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Abstract

Globe artichoke (*Cynara cardanculus* var. scolymus L., 2n = 34), a plant belonging to the family of Asteraceae, is native of the Mediterranean region and usually propagated vegetatively. The development and extension of this culture are hampered by phytosanitary problems and low multiplication rate. By in vitro propagation, free-disease and genetically uniform plants can be produced. However, problems of rooting and acclimatization of plantlets limited partially the application of this technique to globe artichoke. In our work, we aimed to develop a protocol for in vitro rooting of the globe artichoke and

successful acclimatization. The culture of shoots on rooting medium MS supplemented with NAA, with a previous passage in an elongation medium, gave a rooting rate of 58.33%. Meanwhile, the test of Tavazza et al. (2004) medium, with or without activated carbon showed that the addition of this compound increased the rooting percentage of the higher generation shoots.

18. Valorization of Some Traditional Moroccan Recipes

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Abstract

In this work, we have confirmed an important anti-inflammatory activity of two recipes of plants which are used in traditional medicine. The first recipe contains five plants from Southeast Morocco (Rissani region-ER-Rachidia) and the second contains Agave americana L. which is used in different regions of Morocco. These two inventions (Patents N° 34 033 and 34 032, OMPIC) have for the main objective to improve traditional phytomedicine based on a Moroccan herbs, which are selected from ethnopharmacological investigations developed by our laboratory team and for Agave americana L. which is described largely in the book of BELLAKHDAR, 1997. It is important to know that in most cases, the treatment of inflammation involves anti-inflammatory drugs (glucocorticoïds) and NSAIDs like aspirin which causes many side effects such gastrointestinal complications, risk of infection, neuropsychiatric manifestations, etc. In this study, we develop two kinds of anti-inflammatory from Moroccan traditional phytomedicine, for external and internal applications, syrup and cream. They are non-steroidal, natural at 100 %, more powerful than indomethacine (anti-inflammatory reference medicine) without preservatives and other chemicals reagents that could be harmful to health.

19. Production of Soybean Mutant Lines for Biodiesel Production

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Abstract

Soybean [*Glycine max* (L.) Merr.] biodiesel can become a fuel alternative produced by soybean oil. A key concern in biodiesel production is the amount of energy available in individual blends. On average, biodiesel contains between 127,000 and 118,170 British Thermal Units/gallon (btu/gallon) compared to 137,000 and 128,000 btu/gallon for diesel. In order for biodiesel to become more widely accepted, the power output must be increased. The power can be calculated by looking at the bond energies present in the different acid compositions that are used in biodiesel. In soybean, mutation breeding can create unique fatty acid compositions suitable for biodiesel production that would not be achievable though traditional methods. A 0.45% concentration of ethyl-methanesulfonate (EMS) was applied to seeds of 'Forrest' cultivar in order to create mutant lines (M0). Putative M0 mutants were advanced to M1 generation and were grown in field conditions. Seeds collected from individual plants were analyzed for oil content and oil composition. Fifty-two lines had significantly higher and lower stearic acid and linolenic acid content than original line. Nine of them showed extremely high and low values of stearic and linole-

nic acid. These lines may be the best avenues for increased energy production in biodiesel. Introduction of mutant lines with acid profiles which favor high energy production in breeding projects can lead to the development of elite cultivars with higher energy yield.

20. Antifungal Activity of Some Essential Oils Applied as Fumigants Against two Stored Grains Fungi

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Abstract

The antifungal activity of five essential oils as vapors was evaluated against two species of stored grains pathogenic fungi, Aspergillus flavus and Fusarium moniliforme. Six doses 1, 2.5, 5, 10, 25 and 50 µl/plate were used for each oil. The antifungal activity of the essential oils was evaluated by calculating the percentage of mycelial inhibition. Regarding the Aspergillus flavus, cinnamon, clove and thyme oils showed the most remarkable vapor inhibitory effects. As the oil dose increases the inhibitory effect increases and achieved the completely growth inhibition begging from 5 µl dose. The fungus Fusarium moniliforme was very sensitive to the lower doses of cinnamon oil. Whereas, 100% growth inhibition was achieved even by its least dose (1 µl). Moreover, thyme oil showed a highly performance to inhibit the fungus achieving 100% growth inhibition with 5 µl. While, clove oil recorded 100% inhibition begging at 10 µl. On other hand, marjoram and neem oils had very weak vapor activity against both fungi. Whereas, neem and marjoram oils at their highest dose (50 µl/plate) recorded 27% and 18% growth inhibition against A. flavus and 25% and 50% growth inhibition against F. moniliforme, respectively. Finally, cinnamon, clove and thyme oils approved to be appropriate to alternate fungicides for controlling stored grains pathogenic fungi, Aspergillus flavus and Fusarium moniliforme as fumigants (vapor phase). These encouraging results indicate that we should be able to develop and maintain the antifungal activity of these oils to be used with a recent formulation.

21. Biological Control of Phytophthora capsici Root Rot of Pepper Using Trichoderma harzianum, Streptomyces rochei and Burkholderia cepacia in Combination

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Abstract

Two bacterial and one strain of *Trichoderma harzianum* were tested alone and in combination for ef-

ficacy in control of root rot disease caused by *Phytophthora capsici* in pepper plants under greenhouse conditions. These bacteria are (Streptomyces rochei Ezziyyani and Bourkholderia cepacia). Streptomyces rochei was the bacterial partner, isolated by M. Ezziyyani, from the rhizosphere of a healthy plant of pepper grown in Murcia, Spain and selected from 467 isolates of bacteria associated with roots of pepper and tested for both in vitro antagonistic activity towards *P. capsici* and synergism with *T. harzianum*, *B. cepacia* and *S. rochei* Ezziyyani. This particular isolate was named *S. rochei* Ezziyyani. A combination of three compatible micro-organisms, *T. harzianum*, *S. rochei* Ezziyyani and *B. cepacia* both antagonistic to the pathogen *P. capsici*, was used to control root rot in pepper. The population of the pathogen in soil was reduced by 83% as a result. In in vitro assays, *B. cepacia* was antagonistic against *P. capsici* and produced high levels of pyrrolnitrin. Vegetative growth of the mycelium of *P. capsici* was inhibited in vitro on the second day after *P. capsici* and *T. harzianum* were placed on the opposite sides of the same Petri plate. *T. harzianum* was capable of not only arresting the spread of the pathogen from a distance, but also after invading the whole surface of the pathogen colony, sporulating over it. Streptomyces rochei Ezziyyani produced a zone of inhibition, from which was obtained a compound with antioomycete property secreted by the bacteria. When purified by high-pressure liquid chromatography, this compound was identified as 1-propanone, 1-(4-chlorophenyl), which seems to be one of the principal compounds involved in the antagonism. A formulation was prepared that maintained the compound's capacity to inhibit growth of the pathogen for up to 2 years when stored at room temperature in the laboratory on a mixture of plantation soil and vermiculite. The two antagonists, added as a compound formulation, were effective at pH from 3.5 to 5.6 at 23 30°C. Scanning electron microscopy showed the hyphae of *P. capsici* surrounded by those of antagonists micro-organisms, their subsequent disintegration, and the eventual suppression of the pathogen's growth. This is the first report of a compound biocontrol formulation of these three antagonists with a potential to control root rot caused by *P. capsici*.

22. Induction of Defense Responses in Pepper Plants (*Capsicum annuum* L.) by the Biocontrol Agent's Antagonists Rhizospheric Microorganisms in Combination

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Abstract

Several recent studies have established the role of selected strains of nonpathogenic plant growth-promoting rhizobacteria (PGPR) and fungi (PGPF) in enhancing plant resistance. Induced systemic resistance, mediated by such nonpathogenic rhizospheric microorganisms, has been demonstrated in several plant species and shown to be effective against bacterial, viral, and fungal disease. This study presents conclusive evidence for the induction of a systemic response against angular leaf spot of pepper (*Phytophthora* capsici) following compatible application of *Trichoderma harzianum*, *Burkholderia cepacia*, and *Streptomyces rochei* Ezziyyani in combination to the root system. The potential of the biocontrol agent´s *T. harzianum*, *B. cepacia*, and *S. rochei* Ezziyyani to trigger plant defense responses was investigated by

inoculating roots of pepper seedlings with *Trichoderma*, *B. cepacia*, and *S. rochei* Ezziyyani in combination in an aseptic, hydroponic system. *Trichoderma*, *B. cepacia*, and *S. rochei* Ezziyyani-treated plants were more developed than non treated plants throughout the experiment. Electron microscopy of ultrathin sections from *Trichoderma*, *B. cepacia*, and *S. rochei* Ezziyyani-treated roots revealed penetration of microorganisms into the roots, restricted mainly to the epidermis and outer cortex. Strengthening of the epidermal and cortical cell walls was observed, as was the deposition of newly formed barriers. These typical host reactions were found beyond the sites of potential fungal penetration. Wall appositions contained large amounts of callose and infiltrations of cellulose. The wall-bound chitin in Trichoderma hyphae was preserved, even when the hyphae had undergone substantial disorganization. The total chitinase activity assay was based on the colorimetric determination of p-nitrophenyl cleaved from a chitin-analogues substrate, p-nitrophenyl-Beta-D-N,N´-diacetylchitobiose (PNP). Peroxidase activity was assayed spectrophotometrically at 610 nm with phenol red as a substrate. Biochemical analyses revealed that inoculation with the combination initiated increased peroxidase and chitinase activities within 48, 72 and 96 h, respectively. These results were observed for both the roots and the leaves of treated seedlings, providing evidence that the combination from *T. harzianum*, *B. cepacia*, and *S. rochei* Ezziyyani may induce systemic resistance mechanisms in pepper plants.

23. Screening and Application of Phosphate Solubilizing Bacteria (PSB) for Rice Production in Calcareous Soil in Northwest Morocco

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Abstract

Phosphate predominantly present as inorganic compounds, which are either calcium or iron and aluminum salts. The release of insoluble and fixed forms of phosphorus is an important aspect of increasing soil phosphorus availability. Plant root-associated phosphate solubilizing bacteria (PSB) have been considered as one of the possible alternatives for inorganic phosphate fertilizers for promoting plant growth and yield The objective of our work is the isolation and selection of rhizobacteria belonging to the genera Pseudomonas with beneficial activities in vitro, to be used as inoculum for the rice. Seven bacteria (PP7, PE76, PP17, PE77, PG1, PG70 and PP22), belonging to the genus Pseudomonas, were isolated from the rhizosphere of three rice varieties (Puntal, Elio and Guadiamar), and selected for their tricalcium phosphate-solubilizing ability. These strains were analyzed for production of siderophores, of indole acetic acid (IAA), of ACC deaminase and the capacity to fixe the nitrogen. To assess the effect of these rhizobacteria on rice growth, Puntals seeds were inoculated and grown under glasshouse conditions for a month. Three growth measurements were recorded: shoot length, dry weight of shoot, and dry weight of root. The results show that all strains are able to produce siderophores and also the IAA, but only two strains were capable of degrading the ACC. While all isolates were negatives for fixing atmospheric nitrogen. For the effect of inoculation, only PG1, PG70 and PP22 showed an increase in the measured parameters of the orders of 50% and 10% respectively for the negative and the positive control. While the other bacteria (PP7, PE76, PP17 and PE77), a decrease was obtained when compared to negative control. Our findings indicate that PG1, PG70 and PP22 have a potential capacity to promote rice growth through direct physiological mechanisms such as the production of phytohormones and siderophores, and solubilization of phosphates. These bacteria offer a basis for a new biofertilzer in order to make rice cultivation sustainable and less dependent on P chemical fertilizer.

24. Initiation to Micropropagation of Selected Saffron Cultivars (*Corcus sativus*) of Taliouine

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Abstract

The valorization of saffron (Croactus sativus) through in vitro propagation techniques for rapid production of healthy selected saffron cultivars. In this in vitro culture of saffron work, we have developed an efficient protocol for disinfection of bulbs. Initiation and propagation via direct and indirect organogenesis of saffron explants have been met using the MS medium (Murashig and Skoog) and different hormonal combination. The use of 0.25 mg/l 2,4-D and 1 mg/l BAP, during indirect organogenesis, gave masses of cal over which we have assisted to the formation of shoots by changing the hormonal concentrations : 2.75 mg/l BAP and 0.5 mg/l NAA. In the experience of direct organogenesis, we stimulated the formation of adventitious shoots from apical and lateral buds by increasing the concentration of BAP (6 mg/l). The average rate of multiplication after decapitation was 9 shoots/explant. These results provide a first database on the in vitro culture of Moroccan saffron cultivars.

25. Identification of Rhizosphere Soil Bacteria and their Potential in Antifungal Biocontrol

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Abstract

Phytopathogenic fungi affecting crop and post-harvested vegetables are a major threat to food production and food storage. Worldwide, this has led to important economic losses, particularly over the past few decades as agricultural production has intensified. Control of postharvest pathogens still relies mainly on the use of synthetic fungicides, but the development of fungicide-resistant pathogens and the public demand to reduce pesticide use have increased the need for alternative control strategies. Bacillus species are well known for their ability to control plant diseases through various mechanisms, including the production of secondary metabolites. Nine strains of Bacillus spp. screened from more than three hundred bacteria strains, isolated from roots and soil rhizosphere of strawberry plants, showed antagonistic activities in vitro towards the Botrytis cinerea pathogen, a causal agent of grey mould disease. The strain of Botrytis cinerea used in this study was isolated from a strawberry fruit. The antagonistic bacteria were conserved and two isolates, identified as Bacillus amyloliquefaciens in CECT (the Spanish Type Culture Collection) were effectives when tested in vivo against this pathogen. Bacillus amyloliquefaciens coded as Bc7 produced a diffusible metabolite that inhibited the mycelial growth and conidial germination of Botrytis cinerea. A liquid culture media and solide culture media, both of them were used in this experiment for extraction of antifungal substances. The extractions were performed with methanol and ethyl acetate solvent. The crude extract of culture bacteria in fermentation was compared with the crude extract of inhibition after separation and fractionation. The analysis was performed using thin layer chro-

matography (TLC) column chromatography (CC) and nuclear magnetic resonance spectroscopy (NMR). Macrolactins and other antifungal compounds were detected. The fractionation of the methanolic extract showed two substances with antifungal activity. On the other hand, the macrolactins were detected in the ethyl acetate extract.

26. Genetic Diversity of Wild and Cultivated Grapevines from Morocco

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Abstract

In order to define a strategy for the conservation and improvement of Moroccan grapevine heritage, we used nuclear and chloroplast microsatellite loci to genotype Moroccan grapevine accessions (*Vitis vinifera* L.) stocked in germplasm collections, as well as plants cultivated in farm fields or found under wild conditions. Genetic diversity parameters of the global Moroccan sample are equivalent to what had been described for cultivated grapevines from other regions around the Mediterranean basin. Predominant chlorotypes among the analyzed samples were A and C. Comparison of Moroccan genotypes with published genotypes for other grapevine cultivars show the existence of multiple synonyms between cultivars growed in Morocco and Spain. Interestingly, the analysis of genetic relationships among Moroccan cultivars distinguished groups of cultivated and wild samples and among the last ones separated accessions with chlorotype C that could represent ancient cultivars generated by spontaneous hybridizations. Additionally, A total of 243 SNPs and 4 chloroplast SSR loci allowed for identifying synonyms, trios (mother father offspring) and duos (parent offspring) relationships. This study sheds light on the genetic relationships among cultivars from Spain and Portugal related to the important cultivar Djinani from Morocco. Finally, we also demonstrate that SNP are a powerful tool for parentage inference in grapevine.

27. Genetic Diversity of Natural Populations of *Atriplex halimus* L. in Morocco as Revealed by RAPD Analysis

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Abstract

Atriplex halamus L. (*Chenopodiaceae*) is a monoecious C_4 perennial shrub native to the Mediterranean Basin, used as fodder shrub for livestock and useful for rehabilitation of degraded rangelands. To assess the levels and patterns of genetic diversity of this species, 99 samples of 11 populations collected throughout the natural range in Morocco plus 9 samples obtained from one population originating from USA, were analyzed using RAPD. 157 reproducible amplified bands were obtained with 17 primers. Out

of 157 bands amplified, 146 (93%) were polymorphic, and only 11 (7%) monomorphic. Global AMOVA (Analysis of Molecular Variance) showed that the most genetic variation was within populations (66.57), with the reminder occurring between populations (33.43%). Hierarchical AMOVA analysis revealed that variation among regions (Morocco versus USA) accounted only for 5.87% of the total genetic variation, suggesting that there is not a significant genetic differentiation of populations located at the opposite sides of the Atlantic Ocean. The present genetic structure could have arisen by moderate level of gene flow (0.50). A neighbour- joining dendrogram based on Dice's coefficient resolved six major groups of populations correlated in part with geographic origin. The data obtained in this study should have important implications for the conservation and management strategies of genetic variation of Atriplex halimus in Morocco.

28. Evaluation of Actinobacteria Isolates for their Potential to Bioprotect Soft Rot of Potato Caused by *Pectobacterium carotovorum* and *Pectobacterium atrosepticum*

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Abstract

The aim of this study was the isolation, characterization, and selection of actinobacteria strains with antagonistic activity against potato soft rot disease caused by *Pectobacterium carotovorum* and *Pectobacterium atrosepticum* during storage. We evaluated over than 250 actinobacteria isolated from Moroccan soil and testing there in vitro and in vivo antimicrobial activity on potato slices and on harvested tubers Desirée cultivar. We studied also the effect of the selected potential control agent (*Streptomyces* sp. strain OE7) to induce defense responses on tobacco cell suspension. The obtained results showed that 2% exhibit an activity against *P. carotovorum* and *P. atrosepticum*. In vivo, potato slices were susceptible to the control agents particularly to the OE7 strain that showed a high inhibition percentage toward *P. carotovorum* (65-93%) and *P. atrosepticum* (66-94%). We demonstrate also that Streptomyces OE7 has increased the activities of CAT, POD and PPO in potato tissue. We further evaluated on tobacco BY2 cells the ability of the Streptomyces filtrate to induce cytosolic calcium variations, production of reactive oxygen species (ROS) and programmed cell death (PCD). When applied to aequorin-expressing BY2 cells, OE7 metabolite mixture induced an increase in $[Ca^{2+}]$cyt. This variation has been maintained throughout the experiment without returning to resting values. After 30 min of the application of OE7 filtrate, we recorded an increase in luminol-mediated chemiluminescence caused by H2O2 release into the culture medium. Oxidative bursts reached their maximum around 3h, then, H2O2 levels decreased to control levels after 5 hours. H_2O_2 production was blocked by the NADPH oxidase inhibitor DPI and Ca^{2+} chelator BAPTA, suggesting that plasma membrane NADPH oxidase was involved in H_2O_2 production and that Ca^{2+} influx was an upstream event to the oxidative bursts induced by OE7 metabolite mixture. After 24 h of pretreatment, OE7 filtrate further induces PCD which could be considered as a defense response. This PCD, reduced by BAPTA and Tiron is thus dependant on Ca^{2+} influx and oxidative bursts. To our best knowledge, this is the first report of biocontrol agent for potato soft rot in storage by actinobacteria.

29. Estimates of Methane Emission from the Camel Compared to Dairy Cattle

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Abstract

Kill a camel to stop pollution? That is precisely what Australia is considering. The suggestion came in a paper from the Australian Department of Climate Change and Energy Efficiency (Writers, S. 2009). The Department noted that a camel produces methane equivalent to one ton of carbon dioxide a year, making the animal one of the country's biggest greenhouse gas emitters. In the proposed plan, a commercial company would shoot the camels from a helicopter or round them up and send them to a slaughterhouse. As scientists working on camel physiology and human beings dealing with animal welfare and protection, we developed a trial to measure methane emissions in the camel and compared them to dairy cattle receiving the same amount of feed. Seven Holstein cows (average weight 350 kg) and seven she-camels (average weight 330 kg) were used in this study. All animals were not pregnant and in the latest stage of lactation with very limited milk production. Animals were housed in boxes and fed individually the same ration composed of 3kg of barley and 2 kg of Lucerne hay daily at 9 a. m. After eating, methane emissions measurements were made for 2 to 3 hr by using a face mask open circuit system, extrapolated to 24 hr and expressed in liters per day, liters per kg of dry matter intake. Methane production was recorded continuously to examine the methane emission cycles. In the camel, there was an average of 18 emission cycles per hour corresponding to eructation number and most of the methane was emitted by eructation (90%) while the rest was eliminated through the expiration. In cattle, the number of emission cycles (corresponding to the eructation number) averaged 54 eructations per hour. As with the camel, most of the methane was emitted by eructation but less than in camel (85%) while the rest was eliminated through respiration. Methane emission from the camel was estimated to average 66.64 liters per day corresponding to 15.2 liters per kg of dry matter intake while dairy cattle methane emissions was estimated to average 193.76 liters per day corresponding to 42.20 liters per kg of dry matter intake. The present study showed clearly that dairy cattle produced three times more methane than camel when the two species received the same diet. Some digestive and metabolic particularities of each species may explain the difference. Other solutions to reduce the green house gasses should be proposed than the eradication of the camel population of Australia.

30. Evaluation of the Antifungal Activity of Organic and Inorganic Salts Against *Botrytis cinerea*: The Causel Agent of Tomato Grey Mold

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Abstract

The aim of this work was to find an alternative to synthetic fungicides used in the control of the devastating fungus *Botrytis cinerea*, the causal agent of grey mould disease of tomato. In vitro trials were conducted to evaluate the effect of several inorganic and organic salt compounds on mycelial growth, spore germination and germ tube elongation of *B. cinerea*. Among 36 tested compounds, copper sulfate,

EDTA and sodium metabisulfite completely inhibited mycelial growth of *B. cinerea* at only 0.02 M. Other compounds such sodium bicarbonate, sodium carbonate, sodium phosphate dibasic, sodium nitrite, sodium salicylate and potassium carbonate completely inhibited the mycelial growth of the pathogen at 0.2 M. The Minimum Inhibitory Concentration (MIC) and the Minimum Fungicidal Concentration (MFC) were determined for the most active salt compounds. The effect on spore germination and germ tube elongation were determined for the salts having inhibited mycelial growth by more than 50%. Results from this study provide an important basis for further in vivo study into the use of salt compounds for the control of grey mold of tomato.

31. Implication of the Endogenous Nitrogen to Water Stress Tolerance of the Lucerne: Methodology of Use of the Stable Isotopic Tracer ^{15}N

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Abstract

The predicted worldwide increase of arid areas and water stress episodes will strongly affect crop production. Alfalfa (*Medicago sativa* L.) is an extremely adaptable plant that can be grown under a wide range of climate conditions from the equator to almost arctic polar circle regions, demonstrating that this perennial forage species has developed specific morphological, physiological and biochemical mechanisms as a means to increase their tolerance to drought. Because it was well established that N reserves are closely related to shoot growth and perennity of alfalfa, the aim of our study was to determine the effect of progressive drought and subsequent water recovery on N reserves management in four alfalfa genotypes differing in drought sensitivity: three cultivars adapted to a Mediterranean climate, Tafilalet (TA), Tierra de Campos (TC) and Moapa (MO), and another representative of an oceanic climate, Europe (EU). The atoms of carbon (C), nitrogen (N), oxygen (O) and sulfur present stable isotopic forms in which the difference in atomic mass is due to the difference in the number of neutrons in the nucleus. They are called “not radioactive” or stable isotopes and they have the same properties but different reaction rates and states balances. The study of the relationships of the concentrations of the various isotopes gives access to information onto the functioning of plants and their responses to environmental constraints. Thus, the effect of water stress on the distribution of the endogenous nitrogen between the different organs of the plant was studied in alfalfa (*Medicago sativa* L.) by using the stable isotope ^{15}N as a tracer. The labeling period, realized from the sowing until the application of treatments allowed to obtain a uniform distribution inside the various organs of the plant and the various pools of nitrogen. Any remobilization of 15N is proportional to the remobilization of the element N (^{15}N and ^{14}N). This allowed to determine the flows of remobilized nitrogen by distinguishing organs called “sources” characterized by the disappearance of a quantity of tracer during time of treatment and organs called “wells” defined by an increase of their contents ^{15}N during a time of treatment.

32. Some Agrophysiological Characteristics to Screen Durum Wheat Genotypes for Drought Tolerance in Semi-Arid Zones of Morocco

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Abstract

In Morocco, durum wheat is classified among the three important cereal cultures after bread wheat and barley. This crop is cultivated mainly under rainfall conditions which account for 83% of the total cultivated area. Under these conditions, climatic fluctuations induce more negative effects on grain yield. For these reasons, selection of drought tolerant genotypes could help in increasing yield and productivity in those regions where durum wheat is commonly cultivated. Such selection has been focused in many studies using physiological, morphological and agronomical approaches which revealed very useful in screening genotypes for drought tolerance. The present study was carried out on 24 durum wheat genotypes provided by INRA (Institut National de la Recherche Agronomique, Morocco) under field conditions during 2009 growing-season. Stomatal resistance and density, chlorophyll content, leaf posture and rolling, heading time, grain yield and yield components were recorded. The results obtained showed an important increase in stomatal resistance during heading as compared to tillering. The correlation between stomatal density and stomatal resistance was more important during heading ($r = 0.4$) than in tillering ($r = 0.134$). The combination of these two parameters (resistance and density) revealed that genotypes Haurani and Kofa showed the highest values. Chlorophyll content was positively correlated to harvest index and total grain yield and could be used for prediction of yield formation. Similarly, Leaf posture and rolling were positively associated to grain yield under semi-arid conditions. Regression analysis revealed that total grain yield was negatively correlated to heading time but had positive and significant correlations with harvest index and number of spikes/m^2 while it was not significantly associated to mean grain weight.

33. Amelioration of Potato (Cultivar "Nicola") Vegetation By Slaughter Houses Waste Treated Biologically

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Abstract

Improving the processing and slaughterhouse waste of red meat in Morocco is possible by the discovery of biotechnology techniques. These biological techniques have the advantage of being easy and competitive with other methods used in the field of waste treatment. Thus, as we were able to isolate and characterize two strains of lactic acid bacteria (HBL5, HBL10) and yeast strains (HL2, HL15) with a significant fermentative power. Product stability is obtained from the twelfth day of fermentation. Moreover, the bacterial strains have a strong bactericidal effect vis-a-vis pathogens, allowing a significant improvement of the hygienic quality and taste of the finished product, and the pH profile shows a remarkable evolution during fermentation to reach a stable value of 3,93. The acidity increased from

0,22% to 1,25% between the beginning and end of fermentation. The fertilizer trials conducted by the bio-fertilizer, showed a significant improvement culture of potato "Nicola" with a maximum value of 17,8 T/ha, obtained in the case of test II (15T/ha) relative to the chemical treatment and control.

34. Introduction of Quinoa as a New Crops in Crop Rotation Using Unconventional Water for Irrigation Under Semi-Arid Conditions in Morocco

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Abstract

This work was conducted at the experimental station of the IAV Hassan II-CHA-Agadir in southwest Morocco between 2010 and 2012. It aimed to assess the effects of the use of treated wastewater on soil properties and agronomic parameters by adopting crop rotation introducing quinoa (*Chenopodium quinoa* Willd.) as a new crop under semi-arid climate. Biomass production, yield, soil electrical conductivity, organic matter and nitrate were the monitored parameters during the three growing seasons. Results show that quinoa proved a promising behavior when it is preceded by the culture fabae bean in term of water use efficiency and also recording to the lowest level of salt accumulation in the soil in comparison with the combinations bean> quinoa and fallow> quinoa. For growth and yield, it was found that after growing quinoa chickpea was more advantageous in terms of biomass productivity and yield.

35. Growth Promotion, Yield Enhancement, and Arbuscular Mycorrhization of Peanut (*Arachis Hypogaea* L.) By Application of Plant Growth Promoting Rhizobacteria

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Abstract

The permanent search for improving productivity of peanut in the northwest region of Morocco, by the exaggerated use of pesticides and chemical fertilizers on highly permeable sandy soils, has a very negative impact on quality of the environment. From this situation, inoculation of peanut plants by some PGPR which could have positive effects on arbuscular mycorrhization, offers a promising alternative to the traditional chemical fertilization. The effect of some bacterial strains: GP70, GT1, PT29,L22 and GT70 on the development of AM fungi was assessed by measuring the parameters of mycorrhization, nodule number, root and aerial dry biomass (RDB and ADB) after 6 weeks growth in two soils collected from subsistence farmers fields of Laaouamra and Moulay Bouselham. Both AMF colonization and dry biomass differed by an order of magnitude among the two soils. The frequency of mycorrhization ranged from 50, 17 to 91, 58% according to the PGPR inoculant, with a significant increase in the arbuscular intensity for plants inoculated with GP70, and L22 which is accompanied by a significant increase in ADB. Likewise, the inoculation of peanut plants by GP70 and L22 has exerted considerable improvement

in number of root nodules. Results of the pot experiment indicate that GP70 and L22 were identified as PGPR by expression of one or more of the traits like suppression of phytopathogens, solubilization of phosphate, production of siderophore, nodulation promotion and AMF colonization might have contributed to the enhancement of growth, yield and nutrient uptake of peanut.

36. Effect of Arbuscular Mycorrhizal Fungi (AMF) on Growth, Water Status and Oxidative Metabolism in Olive Plantlets Under Water Deficit

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Abstract

An experiment was conducted to evaluate the effect of the arbuscular mycorrhizal fungi strain *Glomus mosseae* on growth, physiology and metabolism of olive plantlets under water stress. Plantlets issues from rooted cuttings of olive (Moroccan Picholine) were inoculated or not with *Glomus mosseae* and subjected to two watering regimes, 75% of field capacity well water) and 25% of field capacity (water stress). Results obtained after ten weeks of water stress treatment showed that water deficit strongly decreased growth parameters (shoot height, root length and leaf number and leaf area) and biomass production in non-mycorrhizal olive plantlets; while growth parameters and biomass production decreased slightly in plantlets inoculated with *Glomus mosseae*. Water deficit caused oxidative damage in non-mycorrhizal plantlets which is characterized by an increased accumulation of H2O2 and MDA and decreased antioxidant enzyme activities (SOD, POD, CAT, APX). However plantlets colonized with Glomus mosseae escaped to the oxidative stress by increasing antioxidant enzymes activities and by reducing accumulation of H_2O_2 and MDA. Furthermore, inoculation of olive plantlets with *Glomus mosseae* strengthened their tolerance to water deficit by maintaining their relative water content and their stomatal conductance at a higher value. Association with *Glomus mosseae* significantly increased water potential and osmotic adjustment by increasing accumulation of sugar, proline and potassium in drought stressed olive plantlets.

37. Diversity Analysis of Durum Wheat Landraces from Southern Regions of Morocco.

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Abstract

Durum Wheat is one of the oldest cultivated cereals species. Nowadays it is of major importance in the cereals production areas from the Mediterranean basin. Undoubtedly a comprehensive characterization of crop evolution events is critical to optimize improvement of the quality and productivity of crop. Thus, approaches based on parentage analysis, or molecular polymorphism studies to estimate genetic relationships, genetic diversity analysis have been carried out. As a consequence of green revolution, local landraces have been discarded whereas the use of modern cultivars, shorter, spring type represented a smaller genetic basis spreaded. As they are adapted to environmental conditions and agronomical practices, these landraces are valuable sources of genes for adaptation and their evaluation is important. The topic of this thesis is to evaluate genetic relationships between landraces from different regions focusing southern area of Morocco. Recently, genetic diversity in durum wheat has been described using

neutral markers and gene polymorphism (Thuillet 2002, Maccaferry, 2005, Haudry, 2008). The resulting knowledge allows us to provide i) a general view of the genetic diversity available inside the different genetic pools (ie wild, primitive and elite forms) and ii) how evolutionary history (in particular domestication and recent selection events) had affected the level of genetic diversity in different genome regions.

38. Abuscular Mycorrhizal Fungi Enhance Plant Growth and Antioxidant Metabolism in Date Palm Seedling Under Water Stress

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Abstract

Water stress is a major obstacle for plant development particularly in arid and semi-arid regions of Morocco where water deficit is a structural handicap. It is actually well known that mycorrhizal symbiosis constitute a new tool that strengthens plant potential to overcome environmental constraints and soil pathogens. Several studies have clearly highlighted the fundamental role that arbuscular mycorrhizal fungi (AMF) play at the interface between the soil and plant roots enhancing thereby the host plant growth and improving their resistance to different environmental stresses. The present study aimed to evaluate the effect of arbuscular mycorrhizal fungi (AMF) on growth and physiology of date palm seedlings under water stress. Date palm seedlings were inoculated or not with one of the three AMF strains (*Glomus manihotis*, *G. fasciculatum* and *G. agregatum*) or a local strain (Complex of Aoufous) and subjected to two water treatments 100 % of field capacity (well watered) or 50% of field capacity (water stress). Obtained results showed that mycorrhizal colonization improves growth parameters (fresh weight, plant height and root length) as well as biomass production (shoots and roots dry weight) in date palm seedlings regardless water stress regime. Furthermore, under water deficit, relative water content, stomatal conductance and water potential were also higher in inoculated plants compared to non-inoculated ones. Along with these results, mycorrhization of date palm caused a significant increase in antioxidant enzymes (APX, PPO, CAT) activities and in soluble sugars, proline and proteins contents. The overall results of this study showed that the effectiveness of mycorrhizal fungi in improving tolerance to date palm drought varies according to fungal species, thus *Glomus manihotis* was generally the most efficient under water stress.

39. Antifungal Activity of Different Extracts of Astericus imbricatum Against *Botrytis cinerea*

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Abstract

Medicinal and aromatics plants play a significant role in the economy of Morocco. As part of a contribution to the development of natural Moroccan heritage, many researches are currently testing the efficacy of medicinal plant extracts against diseases of fruits and vegetables. The aim of this study was to evaluate the antifungal activity of different extracts of Astericus imbricatus, an endemic medicinal plant of southeast of Morocco, against the phytopathogenic fungus Botrytis cinerea. Aqueous and solvent

extracts of the plant were screened in vitro for their antifungal activity against Botrytis cinerea mycelial growth. The antifungal activity was determined by the agar-dilution assay. The results showed that solvent extracts of the plant were more effective than the aqueous extract. The percentage of the inhibition was 100% for the four solvent extracts at the concentration of 500 ppm. Ether and chloroform extracts at 250 ppm showed 70% of the inhibition of the mycelial growth. While, ethyl acetate and methanol extracts exhibited moderate activity since the inhibition percentages were 60 % and 50%, respectively.

40. A Rapid Method Based on the One Step Reverse Transcriptase-Polymerase Chain Reaction (RT-PCR) Technique for Detection of Citrus Tristeza Virus in Morocco

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Abstract

A rapid and sensitive assay based on the one-step reverse transcriptase-polymerase chain reaction (RT-PCR) technique was developed for the detection of *Citrus tristeza* virus (CTV; genus *Closterovirus*) in citrus plants. This method combines reverse transcription (RT) and polymerase chain reaction (PCR) in one tube using an optimized buffer condition and efficient enzyme mix. RNA extracted from young leaves by guanidine-isothiocyanate lysis with the speed and purity of silica membrane purification using silica-membrane technology (RNeasy plant mini Kit, QIAGEN) is submitted to reverse transcription and amplification by using the One- Step RT-PCR kit (QIAGEN). 11 field samples were collected on April 2012, from 15-20 year-old trees of sweet orange and clementine grafted on sour orange. Surveyed plots were located in a CTV-contamined area of Morocco (Tadla, Central region of Morocco). Of All samples tested, faint-non specific amplification products were observed in a few samples. The adaptation of the RT-PCR One-step to the routine diagnosis in a laboratory of virology is possible and will allow its evaluation on a greater number samples.

41. Improvement of Genetic Resources and Valuation of Atlas Cedar (*Cedrus atlantica* Manetti): Application of Somatic Embryogenesis.

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Abstract

Application of somatic embryogenesis (SE) procedure and other biotechnological tools in *Cedrus atlantica* Manetti, is hampered by difficulties in obtaining mature somatic capable of germination at an acceptable level. In this work, we evaluate the effect of different compounds affecting culture medium specially growth regulators hormones supplemented with 1% sucrose, 0.9% difco-bacto agar. Embryogenic cultures derived from mature Cedrus zygotic embryos. The genotype is considered to be the most important factor affecting SE. Sharma and Rajan (1995a,b) found that genotype, explant and genotype-explant interactions had significant effects on both organogenesis and SE, with genotype exerting maximum effect on both processes. The choice of explant is considered to be an important factor in the induction of SE. Embryogenic tissue formed directly on the mature zygotic embryos (ZE) explant obtained after 10 days of culture medium, Half Litvay Modified-1 (HLM-1), containing a combination hormone Auxin

/ Cytokinin (2,4-dichlorophenoxyacetic acid (2,4-D)/ benzylaminopurine (BAP)). Embryogenic best productions are obtained with the combination of 10 µM (2,4-D) and 5 µM (BAP) , (9,05 µM 2,4-D ; 0 µM BAP), (18,1 µM 2,4-D ; 0 µM BAP), (18,1 µM 2,4-D ; 4,4 µM BAP) for somatic embryogenesis induction from cedrus zygotic embryos. Maintenance of established embryogenic cultures was carried out on the same culture conditions used for initiation with 1% difco-bacto agar. Subcultures were carried out with successive transfers to fresh medium of the same composition at 1-2 week intervals.

42. Improving Water Use Efficiency of Almond, Peach, and Plum Trees Using the Regulated Deficit Irrigation Technique

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Abstract

Reduction of water resources and constant increase of water requirements in agriculture, due to the competition with the other sectors, such as industry and drinking water, have lead to the concern of water savings. Therefore, it is necessary to develop techniques for improving plant-water use efficiency, especially for more water requiring species, like the majority of rosaceous trees, especially in regions where drought events are frequent, such as the case of Morocco. This can be achieved through the effective management of irrigation, which consumes in Morocco 80 at 90% of available water resources. Water restrictions management for fruit rosaceous during slowdown periods of fruit growth can increase water use efficiency and improve fruit quality without reducing significantly their yield. In this context, two water restriction levels were tested during four consecutive seasons (2007-2011) in peach, plum and almond trees during slowdown periods of fruit growth corresponding to stage II for peach and plum and to stages II and III for almond. Water was applied by drip irrigation to produce different fractions of maximal requirements corresponding to crop evapotranspiration (ETc): 50% ETc (treatment T50) and 75% ETc (treatment T75) of non-stressed trees irrigated at 100% ETc (treatment T100). The response of trees is presented only for the last season of the experiment (2010-2011) where the effect of the applied water stress is more pronounced. Results show that the effect of water restrictions varied depending on the species. Yield and fruit size were reduced significantly for peach only under treatment T50. Fruit quality was improved for this species with an increase of brix refractometric index and a decrease of acidity. These parameters were evolved in the same manner for plum but the observed differences were not significant. For almond, kernel quality remained unaffected by water restriction at T75. However, the epidermal wrinkles of kernels were more embossed, in response to treatment T50, which affected their appearance. Except leaf area, the evolution of shoots growth, chlorophyll content and leaf temperature showed that the physiology of all species was affected by water stress created by the application of the two irrigation treatments but without profound influence, particularly in plum. In conclusion, irrigation-water may be economized during slowdown periods of fruit growth without major negative effect up to 25% ETc for peach and almond and up to 50% ETc for plum.

43. Effect of Seaweed concentrates on the growth and biochemical constituents of *Phaseolus vulgaris* L. variety Paulista.

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Abstract

Seaweed extracts contains major and minor nutrients, amino acids, vitamins, cytokinins, auxin and abscisic acid like growth promoting substances and have been reported to stimulate the growth and yield of plants, develop tolerance to water stress. Unlike, chemical fertilizers, extracts derived from seaweeds are biodegradable, non-toxic, non-polluting and non-hazardous to humans, animals and birds. A field experiment was conducted during the summer season in Morocco in 2012 to study the effects of foliar applications of different concentrations of seaweed extract (prepared from two species of Moroccan marine algae *Ulva rigida* and *Fucus spiralis*) on development of *Phaseolus vulgaris* L. variety Paulista grown under water deficit condition. The results indicate that seaweed liquid extract applied by foliar spary conduct a reduction of the chlorophyll content, a high accumulation of proline and Malondialdehyde (MDA) in the leaves of plants. The severity of water stress was attenuated in the presence of algal extracts of 25% Fucus and 50% Ulva with a decrease in the rate of reduction of chlorophylls a and b to less than 60%. Treating plants with algal extracts also allowed reducing the rate of accumulation proline. Bean plants subjected to moderate stress conditions and treated with extracts of 25% Fucus and 50% Ulva accumulated less proline (1.7 and 1.3 respectively µmol/100mg MF) compared to untreated plants (3 µmol/100mg MF). IT is the same for the accumulation of MDA, reduced by 22.34% and 40% respectively in treated plants by 25% Fucus extracts and 50% Ulva. In conclusion, the *Ulva rigida* and *Fucus spiralis* derived seaweed extract is effective in increasing the growth parameters and enhancing tolerance to water deficit.

44. Seaweed Liquid Extracts Effect on Growth and Biochemical Constituents of *Phaseolus vulgaris* L. variety Paulista.

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Abstract

Seaweed Liquid extracts (SLE) of two species of Moroccan marine alga: *Fucus spiralis* and *Ulva rigida* increased the rate of growth and physiology of bean. However, at lower concentration (25 and 50%), the SLE significantly increased growth parameters, shoot length, root length, fresh weight, dry weight, leaf area and moisture content. Moreover, biochemical parameters such as photosynthetic pigments, and nitrate reductase activity were also enhanced when compared to untreated seedlings. There was also noticeable reduction of water stress effect on plant treated compared to control. Thus, the results indicate

that severity of water stress was attenuated in the presence of algal extracts of 25% Fucus and 50% Ulva with a decrease in the rate of reduction of chlorophylls a and b to less than 60%. Treating plants with algal extracts also allowed reducing the rate of accumulation proline. Bean plants subjected to moderate stress conditions and treated with extracts of 25% Fucus and 50% Ulva accumulated less proline (1.7 and 1.3 respectively ¼mol/100 mg f.w) compared to untreated plants (3 ¼mol/100 mg f.w). IT is the same for the accumulation of MDA, reduced by 22.34% and 40% respectively in treated plants by 25% Fucus extracts and 50% Ulva. In conclusion, the *Ulva rigida* and *Fucus spiralis* derived seaweed extract showed a remarkable increase in the growth parameters and an enhance tolerance to water deficit.

45. Design of Process Controller for Variable Rate Spraying Application of Chemical in Small Scale Farms.

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Abstract

The use of pesticides and fertilizers in agriculture faces to problems of applying precisely the necessary doses on vegetable crops. There is a lack in small scale farms of using adequate technology to accurately control rate application and variably metering it proportionally to speed variation due to irregular working conditions in agricultural field. Chemical misapplication results in economic loss, water and soil pollutions and risk of exposing human to contamination by pesticides. With remarkable development of electronic and process control technologies, it becomes feasible and affordable to develop process control unit for improving precision application of agricultural sprayers and limit its application error within 5%. The conventional sprayers mainly used by small farmers cannot be of such efficiency due to its disability to adjust applied chemical for variable operating speed. The research project consists on developing an electronic controller for applying liquid solutions of pesticides and fertilizers using direct injection metering technology. Evaluation of the controller mounted for direct injection test bench of five meters spraying boom, shows that its performance satisfy the system response time of 2 s for processing concentration change and maintaining application rate error within the range of 5%.

46. Opuntia Ficus indica Cladodes, Functional Components and Applications Insights

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Abstract

The Chemical Bio-engineering Society is seeking to employ all available tools to meet the challenges of increasing food supplies for nutritional and health safety. One such tool can be the rich opportunities that exist for food, beverages, drugs and genes from relatively unexploited plant sources such as cacti. Many indigenous underemployed crops available in many regions in the world hide precious hunted biomolecules that might be used as a less expensive option for producing added value industrial drugs and food additives. Among sustainable resources currently being sought for this purpose, Opuntia spp. merits particular consideration due to its agronomic advantages, namely its ability to grow in water scarce regions and degraded lands, as well as the low input energy needed for its commercial exploitation. The current study was designed to assess the nutritional potential of cladodes from *Opuntia ficus* indica by evaluating

the physic-chemical properties and technological parameters. A first part was dedicated to identify the variety and the growth stage of the cladodes that provide the highest level of nutritional components. The results showed that cladodes are rich in fiber, protein and ash. In addition, we have developed a method for a water extraction of cactus pads mucilage. The mucilage yield expressed with respect to cladodes dry matter was 20.8 % for the great spineless variety. The mucilage is a heteropolysaccharide known for its high capacity to imbibe water allowing the plant to resist during long periods of drought. In order to study the composition of the mucilage,A hydrolysis optimization of mucilage was first required; the purpose was to select the least destructive hydrolysis technique which provides the best sugars yield. Thus, the influence of the hydrolysis parameters like: acid type, concentration, temperature and time on the release kinetics of monosaccharides were evaluated. In the second part of this work, we investigate the effect of the cladode powder adding on the rheological properties of dough and bread making. An addition of nopal powder in the dough led to a decrease of water absorption, to a lesser extent and to an increase of dough tenacity. In addition to that, nopal powder affected negatively the technological quality of bread and adds an herbaceous, bitter and unpleasant taste feature of this powder. An alternative to avoid these disadvantages, or at least take the edge off the effects of the raw powder, was the incorporation of the mucilage in a wheat flour. The aim is to mimic the viscous-elastic properties of gluten and to improve structure, sensory attributes and shelf-life of the baked end-product.

47. Moroccan Alfalfa Rhizobia Symbiosis Under Water Deficit Conditions: Effect on Nodule Carbon Assimilating Enzymes

Mohamed Farissi[1,2], Abdelaziz Bouizgaren[2] and Cherki Ghoulam[1]

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Abstract

The effect of water deficit on nodule biomass and some enzymes of carbon metabolism was studied in ten symbiotic associations involving two Moroccan alfalfa populations (Tata and Dem) and five rhizobial strains, isolated from different Moroccan areas. The experiment was conducted in a greenhouse at 32/22 °C d/n, 50-80% of relative humidity and a photoperiod of 16 h (18000 Lux). Seed of two alfalfa populations were allowed to germinate in pots containing sterile sand and peat at 9/10 and 1/10 ratio respectively. After emergence of the first true leaves, the plants were inoculated with five rhizobial strains (RhL2, RhL29, RhL48, RhL68 and RhL80). Six days after inoculation, the culture was submitted to two water regime: 75% of Field capacity, FC (optimal irrigation) and 25% FC (water deficit). After 45 days of stress, the nodule biomass and some nodule carbon assimilating enzymes as phosphoenolpyruvate carboxylase (PEPC) and malate dehydrogenase (MDH), were analyzed. The results indicated that the water deficit caused a significant reduction in nodule biomass with the significant differences between the tested symbiotic combinations. Indeed, the plants inoculated with RhL2 and RhL80 showed lowest reductions. Under this constraint, the PEPC and MDH activities were found decreased with significant variation among the studied symbiotic combinations. The high nodule biomass of some combinations was associated with a maintain of an adequate level in terms of nodular carbon assimilating enzymes suggesting that enhancing of the activity of these enzymes could play a critical role in water deficit tolerance.

48. Salinity Effect on Yield and Forage Quality of Moroccan Alfalfa Populations Under Field Conditions

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Abstract

The effect of salinity constraint on yield and some traits related to forage quality was studied in Moroccan alfalfa (*Medicago sativa* L.) populations. The experiment was conducted under field conditions in the experimental station of National Institute for Agronomic Research - Marrakech. Four Moroccan alfalfa populations (P1, P2, P3, P4) originated from Oasis and High Atlas of Morocco and Moapa variety, originated from USA, were used. The trial was conducted under two irrigation treatments. The first treatment was normal irrigation, providing an amount of water corresponding to the potential evapotranspiration of the crop, and the second treatment was salt stress (7g/L NaCl). For each treatment, the experimental design was based on four randomized blocks. The plants were harvest at flowering stage and the same cutting regimes were applied for all cultivars tested. At each cut (Three cuts), the fresh and dry yields were measured. The forage quality was evaluated by leaf/stem ratio, chlorophyll content and nitrogen and potassium contents. The obtained results indicated that the salinity constraint has significantly reduced the fresh and dry yields of all cultivars. The forage quality was also negatively affected, NaCl reduced the leaf/stem ratio and the chlorophyll content. The nitrogen and potassium contents were found decreased under salinity. The behavior of tested populations was significantly different. The populations from Oasis (P1 and P2) were most adapted to saline conditions and Moapa variety was least adapted while population from High Atlas (P3 and P4) displayed moderate salinity adaptation.

49. The In Vitro Responses of Nodal Explants to Benzylaminopurine and Indole Butyric Acid Combinations During Carob Tree (*Ceratonia siliqua*) Micropropagation

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Abstract

The carob tree (*Ceratonia siliqua*), is a typical Mediterranean tree with high hardiness and adaptability to the climatic conditions of marginal and sub-marginal areas. These characteristics, together with it ability to preserve and enrich soil fertility and the economic value of its products (used in food, chemicals, cosmetics, processing etc.) make this species not only a biological tool to counteract processes of erosion and desertification, but also a challenge for development of these areas. However the large-scale cultivation of the carob tree is limited by the traditional methods of propagation that fail to meet the growing demand for carob plants with valuable agro-economical characteristics. This study aimed to develop a more performing protocol for carob tree micropropagation using nodal explants taken from juvenile (young germination) or (female adult tree) plant material. Effectiveness of combination of differ-

ent concentrations of benzylaminopurine (BAP 0, 0.2, 0.5, 1 and 3 mg/L) and indole butyric acid (IBA 0, 0.2, 0.5, 1 and 3 mg/L) in stimulating the reactivity and proliferation of plant tissue have been assessed. Obtained data have shown that Augmentin and tetracycline were the more effective antibiotics in obtaining in vitro healthy plant material. However, plant tissue proliferation was negatively affected by these antibiotics (decrease of elongation, and number of leaves and internodes). Strong bud initiation was obtained with the juvenile material on all tested hormonal combinations, whereas adult material shows a low bud initiation with a maximum of budding for 1 mg/L and 3 mg/L BAP concentrations. In addition, shoot growth assessed following buds extension and leaves number showed that auxin concentration is the most discriminating factor. The best shoot growth was obtained with 0.5 mg/L of IBA combined to 0.2 mg/L of BAP. Higher IBA concentrations caused a decrease in shoot growth while change of BAP concentration did not significant affect shoot growth.

50. Antioxidant and Antifungal Activities of *Origanum Compactum* Extracts

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Abstract

The objective of this study was to evaluate antifungal and antioxidant activities of *Origanum compactum* extracts against the growth of the phytopathogenic fungus *Penicillium digitatum*. The aerial parts of *Origanum compactum*, an endemic medicinal plant of the Moroccan North, were extracted with the soxhlet apparatus using the following solvents: petroleum ether, hexane, chloroform and methanol. The methanol 80 % and the aqueous extracts were distilled by cold maceration. All The extracts were used to study the antifungal activity against the mycelial growth of *Penicillium digitatum*. For the antioxidant activity only methanol 80 % and aqueous extracts were used. The results showed that aqueous and methanol 80 % extracts were very effective to control the growth of the fungus with 100% of the inhibition percentage at the concentration of 25g/l. Moreover, the percentage of the inhibition of the mycelial growth was more than 97% at 1,125 g/l for the aqueous extract. From the soxhlet extracts, petroleum ether extract presented an important antifungal activity (83%) followed by methanol extract (45,9%). While hexane and chloroform extracts were less effective. The methanol 80% and the aqueous extracts showed an antioxidant activity with 58,50% and 18,54%, respectively.

51. Moroccan Alfalfa-Rhizobia Symbiosis Under Water Deficit Conditions: Effect on Nodule Carbon Assimilating Enzymes

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Abstract

The effect of water deficit on nodule biomass and some enzymes of carbon metabolism was studied in ten symbiotic associations involving two Moroccan alfalfa populations (Tata and Dem) and five rhizobial strains, isolated from different Moroccan areas. The experiment was conducted in a greenhouse at 32/22°C d/n, 50-80% of relative humidity and a photoperiod of 16 h (18000 Lux). Seed of two alfalfa populations were allowed to germinate in pots containing sterile sand and peat at 9/10 and 1/10 ratio

respectively. After emergence of the first true leaves, the plants were inoculated with five rhizobial strains (RhL2, RhL29, RhL48, RhL68 and RhL80). Six days after inoculation, the culture was submitted to two water regime: 75% of Field capacity, FC (optimal irrigation) and 25% FC (water deficit). After 45 days of stress, the nodule biomass and some nodule carbon assimilating enzymes as phosphoenolpyruvate carboxylase (PEPC) and malate dehydrogenase (MDH), were analyzed. The results indicated that the water deficit caused a significant reduction in nodule biomass with the significant differences between the tested symbiotic combinations. Indeed, the plants inoculated with RhL2 and RhL80 showed lowest reductions. Under this constraint, the PEPC and MDH activities were found decreased with significant variation among the studied symbiotic combinations. The high nodule biomass of some combinations was associated with a maintain of an adequate level in terms of nodular carbon assimilating enzymes suggesting that enhancing of the activity of these enzymes could play a critical role in water deficit tolerance.

52. Carbohydrate Metabolism of *Argania spinosa* Leaves in Response to Drought Stress

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Abstract

The enzymes involved in carbohydrate metabolism are often affected in response to drought stress. These enzymes have highly significant and positive direct effects on foliar glucose concentration during water stress. In order to determine whether part of the changes in carbohydrate content, under water stress conditions, could be due to an increase in enzymes mobilizing sucrose or hexose in Argania spinosa, we determined the activities of Glucose-6-phsphate dehydrogenase (G6PDH), aldose 6-phosphate reductase (A6PR), Sorbitol dehydrogenase (SDH), acid invertase and soluble carbohydrates concentration: glucose (as glucose + sucrose) and fructose (as fructose + sucrose). Four ecotypes of *Argania spinosa* L. Skell (2 coastal ecotypes (Adm and Rab) and 2 paralittorale ecotypes (Alz and Lks)) were subjected to moderate and severe water stress and analysed every fortnight during 2 months to test the drought effects on carbohydrate metabolism. Water stress significantly increased the activity of these four enzymes compared with control values ($P < 0.001$). The activities of these enzymes in the leaves of plants stressed were increased signiïcantly in a time-dependent manner ($P < 0.001$). The ecotype effect was significant for these parameters ($P < 0.001$). Significant increase of both hexoses was observed in all four ecotypes under water stress conditions, particularly under severe water stress ($P < 0.001$). The effects of the interactions between the factors fixed (Watering regime, ecotype and time) were tested by the two-way ANOVA. Moreover, significant positive correlations between these four enzymes and the concentrations of the both hexoses were recorded. The four ecotypes studied were separated by two discriminant functions obtained by canonical discriminant analysis.

53. Technical Options for an Efficient Management of the Association Olive Tree Annual Crops.

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Abstract

The agroforestry or the associations of perennial and annual crops on the same land is widely practiced in the Moroccan conditions. This fact constitutes due to its diversity (various systems of productions, various agro ecological conditions and different agricultural practices) a natural laboratory the follow-up of which will allow the constitution of a rich and useful database. Indeed, the processing and the exploitation of the results of the feasibility study of the Project Fruit cultivation (PAF), indicate that the practice of the association of olive tree annual crops concerns 75 % of farms concerned by the project. This reality constitutes a very interesting opportunity to be able to accompany the efforts of reconversion of the cultivation of cereals in olive growing. This work of analysis and synthesis of orientations for an efficient management of the association olive tree annual crops is based on: the feasibility study of the project, the follow-up of the practices of the farmers and the exploitation of the first results of the trials conducted in experimental stations and at farms in various regions of Morocco. It is about the presentation of options of efficient management of the association olive tree annual crops. This by trying to bring answers to the various questions asked namely: In which pedo climatic conditions this practice is possible?. Witch spatial arrangement between olive tree and annual crops to adopt? And what are the technical practices to follow for an efficient management of the whole association?

54. In Vitro Selection and Micropropagation of Argan tree for Salt Tolerance

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Abstract

Argan (*Argania spinosa* L.; *Sapotaceae*) is ranked third in the forest flora of Morocco. It covers an area of 828 000 ha in the southwest of Morocco. It plays a major ecological and socio-economical role in this area. Due to heavy, animal and human pressure on the argan forests, millions of trees have been destroyed and not replaced. The present study was undertaken in order to improve its propagation via in vitro culture and use somaclonal variation in order to obtain highly tolerant plants of Argania spinosa to salt stress as well. This was achieved by adjusting the protocols of micro-propagation and callogenesis

from the explants of meristems, then by applying a selection and screening procedure to the calli obtained using Sodium Chloride (NaCl) as a selective agent. Finally, the tolerance of the selected calli was characterized through biochemical analysis.

55. Inhibitory Effects of Non Pathogenic Bacteria Against the Growth of Potato Wilt *Ralstonia solanacearum* Strain

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Abstract

Study on the non pathogenic bacteria species effect against the growth of bacterial *Ralstonia solanacearum* isolates. Using in vitro sensitivity test of some isolates of fluorescent pseudomonades against *R. solanacearum* showed that, isolate *Pseudomonas fluorescens* F1 had high antagonistic inhibitory effect. *Bacillus coagulans* occupied the second significant active organism ranking after Pseudomonas fluorescens isolates, followed by *Streptomyces griseus* which gave the least significant effect against *R. solanacearum*. In the present research, the best media promoted the fluorescent pseudomonades growth and consequently suppressed *R. solanacearum* growth was nutrient agar, followed by King B agar medium. Ability of crud antibiotic compound filtrate of *P. fluorescens* (F and F1), *B. coagulans* (B), and remain-medium extracted with ethyl acetate inhibited the growth of *R. solanacearum*. It was found that crud antibiotic (B) and (F1) exhibited the most potent antibacterial activity against R. solanacearum isolates. Also, it was found a remarkable inhibition of remain-media against *R. solanacearum*. The best time for good production of active substances from antagonistic isolates, was 120 h.

56. Effect of Arbuscular Mycorrhizal Fungi (AMF) On Growth and Physiology of Carob Seedling Under Nursery Conditions

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Abstract

In Mediterranean ecosystems, the effect of climatic constraints combined to low soil fertility and poor soil quality lead to the degradation of vegetation cover especially in marginal and sub-marginal areas. Due to its interesting agroecological features, such as resistance to drought and salinity, adaptation to poor soils, and minimal cultural requirements, Carob tree is suitable for the revegetation of marginal and sub-marginal dry areas of the Mediterranean basin (Batlle and Tous, 1997). Carob tree (*Ceratonia siliqua*), is a typical Mediterranean tree with high potentiel to adapt to the detrimental conditions of the marginal and sub-marginal areas. These characteristics, combined to its high ability to increase soil fertility and to preserve and improve soil quality as well as the economic value of its products (used in food, chemicals, cosmetics, processing etc.) make this species as a suitable bio-tool not only to prevent ecosystems

degradation but also a challenge for the promotion of sustainable development of these areas. Carob is among vascular plants that can establish symbiotic association with arbuscular mycorrhizal fungi (AMF). Nowadays, it well known that AMF symbiosis is at the root of the plant ability to adapt to poor soil and the severity of the environment. The aim of this work was to evaluate the effect of arbuscular mycorrhizal fungi (AMF) on the growth and physiology of young carob seedlings under nursery conditions. Plantlets issues from germination of carob seeds were grown on inert substrate inoculated or not with one of the four Glomus strains: *Glomus intraradices*, *G. manihotis*, *G. fasciculatum*, and *G. aggregatum*. After 13 weeks, obtained results showed that the ability to colonize roots and the subsequent effect on the growth and physiology of carob seedlings varied among AMF strains. The highest mycorrhizal potential (frequency mycorrhization and intensity of colonization, 100% and 75% respectively) was recorded in seedlings inoculated with G. intraradices. Farther more, AMF inoculation have significantly improved plant growth, biomass production, mineral nutrient (P, K, Na) accumulation and phosphorus use efficiency, compared to non-mycorrhized plants. These positives effects were clearly higher in seedlings inoculated with *Glomus Inrtaradices* and *G. fasciculatum*.

57. Assessment of the Quality of Surface Waters of the City of Wadi Taza Used in Vegetable Agriculture (Morocco)

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Abstract

Currently, the watershed Inaouen in Morocco is threatened by pollution intensive, given the huge volume of discharges, without pretreatment, the city of Taza. Total pollution released by the city of Taza reach 30,354 m^3 / d in 2015 (RADEETA, 2004). Agricultural use of wastewater Inaouen tributaries of the river is more intense and is mainly vegetable crops. This use is associated with health risk assessment requires knowledge of the physical-chemical and microbiological waters. The results obtained in this study indicate that the physico-chemical and microbiological water used for irrigation of crops do not always meet the criteria for the use of wastewater in agriculture. However, stations located respectively upstream of the town of Taza slightly likely to meet the criteria set by WHO. By cons, irrigation water stations downstream releases from the town of Taza are polluted on the chemical and bacteriological. They are characterized by low levels of dissolved oxygen, high levels of TSS, BOD5, COD, Nitrate, Orthophosphate and high rates exceed the limited value for the irrigation of heavy metals such as iron and manganese as well as a significant presence of coliforms and faecal streptococci that exceed the limits set by WHO. The protection of waters against contamination variety is necessary and imperative that these waters are still used in agriculture.

58. Technological Evaluation of Raw Milk from Gharb (Western) Region

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Abstract

Milk is very important element in the Moroccan diet. To determine the hygiene quality of the milk consumed in the Gharb region, randomized bovine crude milk samples were collected and bacteriological analyses were performed. Our results show the presence of some bacteria: total and fecal coliforms, fecal streptococcus, total aerobic mesophilic flora, which were evaluated to 49.106, 37.105, and 71.106 cfu/ml, respectively. These values were significantly higher when compared to normal value of 105cfu/ml (directive 92/46/CEE). Yeasts and molds were also observed and estimated to 16.102 and 9.102 cfu/ml respectively. However, pathogen-bacteria including Listeria, Salmonella and Clostridium, were not detected in the analyzed bovine crude milk samples; while staphylococcus aureus was detected in 75% of the milk samples. Because of the importance of the hygiene in dairy product, traceability method was applied to determine the critical control points along the milk chain collect. Our data show clearly that there is a lack of respect of fundamental hygiene practices in the farms and the different collection centers in the Gharb region.

59. Evaluation of the Argan Goat Milk Health Importance Via Its Biotechnological Characterization

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Abstract

Goat milk is under-exploited in Morocco, especially argan goat milk. It is known that Moroccan argan trees are endemic and play a good social role in Morocco. This particular milk is produced in small quantities and consumed locally. Among the vegetation profile in southwest of Morocco, some contain high phytochemical compounds which are very important in human nutrition field. Because all argan tree parties (roots, leaves, nuts) are known to contain beneficial substances such as antioxidants (polyphenols), but also unsaturated fatty acids and unsaponifiable matters. The present research is carried out to verify if argan goat milk can have the same compounds. Moreover, characterization of lactic acid bacterium of argan goat milk is one of the objectives of our laboratory team. In another hand, our experimental design targets an elaboration of dairy product nutritent to value the milk from goat in southwest of Morocco by revealing its phytochemicals contents and their beneficial effects in nutrition and health benefits against certain Moroccan known diseases such as obesity, diabetes, etc.

60. Optimization of Cultivation Techniques (Sowing Date, Genotype, and Supplemental Irrigation) for Cereal Production in Morocco

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Abstract

According to the Green Morocco plan, cereal area have to be reduced by 1 million hectares; from 5.3 million hectares to 4.2 million currently cultivated.. However, it aims to increase production from 53 million to 76 million quintals year. It is in this perspective that the cereal should be concentrated in areas most favorable for good production. Meanwhile, efforts to conduct optimal technique must be developed to improve food production in these areas. Several techniques can increase the production and water use efficiency especially with climate change and reduced rainfall, including planting date, supplemental irrigation and the use of the most efficient genotypes. In this context a study was led at the experimental

station of Douyet (INRA) combining three factors (date of sowing (D1 : 1 November and D2 : 17 November), the genotype (G) (G1: Achtar, G2 : Arrehane and G3 : Mahdia) and water regime (I) (I0 = rainfall, I1 = irrigated at tillering and I2 = irrigated at heading (60 mm), I3 = irrigated at seedlings (20 mm) + irrigated at tillering (40 mm) and I4 = irrigated at seedlings (20 mm) + irrigation at heading (40 mm)).Statistical analysis revealed a significant effect of the three factors studied on grain yield and its components. Early sowing in rainfall regime (D1: 1 November) gave a grain yield of 20.13 qx/ha while the seeding season (D2: mid-November) has allowed to obtain a performance that grain of 18.33 qx/ha. Water regimes I3 and I4 gave a grain yield of 25.77 qx/ha, followed by I2 and I1 systems with a yield of 23.66 qx/ha, while the rainfall recorded a yield not exceeding 18.61 qx/ha.
In the other hand, the variety Arrehane gave an average grain yield of 26.8 qx/ha higher grain yield recorded by the variety Mehdia which was 22.54 qx/ha. While the variety Achtar recorded the low yield with an average of 20.17 qx/ha.

61. Micropropagation of *Thymus satureioides* Coss. an Endangered Medicinal Plant of Morocco

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Abstract

The objective of this study was to develop a rapid system for regeneration of an important endemic medicinal plant of Morocco, *Thymus satureioides* Coss. (*Labiatae*). Initially in vitro grown seedling were exposed to full strength Murashige and Skoog (MS) medium or reduced to ½MS or ¼MS hormone-free. Then, for axillary shoots proliferation, 6-benzylaminopurine (BAP), Kinetin (KIN), Î±-naphthaleneacetic acid (NAA) and indole-3-acetic acid (IAA) were tested for their ability to multiply *T. satureioides*. Shoots obtained on proliferation medium were exposed to elongation medium containing gibberellic acid (GA3) (0.5, 1.0, 2.5, or 5.0 µM). The effect of the auxins IAA, indole-3-butyric acid (IBA) and NAA, on the in vitro rooting of the shoots was studied. Maximum number of shoots (5.25±0.52) was observed on the Â½MS medium containing 2.22 µM of BAP. Incorporation of 1.0 µM of GA3 in ½MS medium significantly improved the shoot elongation within 3 weeks of culture. For rooting, rhizogenezis was promoted on half strength MS medium hormone-free. Regenerated plants were transferred to dimpled plates filled by peat and vermiculite (2/3:1/3 v/v) mixture. Micropropagated Thymus satureioides plants had a 95% survival rate, and showed vigorous and uniform growth.

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