Abstracts Book for Oral and Poster Presentations

at:

The 1st World Congress on the use of Biostimulants in Agriculture

26-29 November 2012

Strasbourg Congress Centre, France

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Scientific Committee

Prof Pierdomenico Perata, Chairman, Scuola Superiore Sant'Anna, Italy,
p.perata@sssup.it

Prof Patrick Brown, Co-Chair, UC Davis, USA,
phbrown@ucdavis.edu

Dr Michel Ponchet, Co-Chair, INRA,France,
Michel.Ponchet@sophia.inra.fr

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PROVISIONAL CONFERENCE PROGRAMME AS PER OCT 30th

Monday 26 November

14:00-18:00 – Registration, Poster set-up and Exhibition set-up
18:00-20:00 - Opening Cocktail Reception, Hosted by Regional Council of Alsace. Welcome address by Mr Francois Loos Vice President of the Regional Council and former French Minister of Industry.

Tuesday 27 November

08:45-09:30 - Welcome/opening Speeches
Jean Pierre Leymonie, Managing Director, New Ag International SARL, France

Antoine Herth, Member of the French Parliament & Vice President of the Regional Council of Alsace

Aaron Powers, Vice President of EBIC and Director of Strategic Development at Agrinos, Norway.

Prof Antonio Monteiro, President of the International Society of Horticultural Sciences (ISHS), Portugal

Dr Olivier Le Gall, Head of the Plant Health and Environment Department**,** Institut National de la Recherche Agronomique (INRA), France

Dr Willem Ravensberg, President, International Biocontrol Manufacturers Association (IBMA), Switzerland

Dr Prem Warrior, Senior Programme Officer, The Bill & Melinda Gates Foundation, USA

Prof Pierdomenico Perata, Chairman of the Congress Scientific Committee, Italy

SESSION 1: Plant derived biostimulants. Chair: Prof Patrick Brown, UC Davis, (USA)

9.30-10.10 Keynote lecture: Hormones as Biostimulants: What are the molecular impacts on Nitrogen nutrition?Dr Gabriel Krouk, Dpt of Biochemistry and Plant Molecular Physiology, CNRS-IBIP, Montpellier (France)

10.10-10.30 **-** Humic substances as tool to optimize crop production, by Geert Haesaert, Department of Plant Production, Faculty of Applied Bioscience Engineering, University College Ghent (Belgium)(**A108)**

10.30-11.00 coffee/tea break

11.00-11.20 - Characterization of a new phyto-stimulating preparation: mode of action and evaluation of agronomic performance, by Bernard Dumas, Laboratoire de Recherche en Sciences Végétales, UMR 5546 CNRS Université Paul Sabatier (France)(**A064)**

11.20-11.40 **-** Long term research activity on the biostimulant properties of natural origin compounds, by Andrea Ertani, University of Padova, Department of Agronomy, Food, Natural Resources, Animal and Environment, Agripolis (Italy) (**A097)**

11.40-12.00 - Biological activity of different botanical extracts as evaluated by an array of in vitro and in vivo bioassays, by Dr Vanina Ziosi, Director of Research, Biolchim S.p.A (Italy)(**A021)**

12.00-12.20 **-** Physiological responses to Megafol treatment in tomato plants under drought stress: a phenomic approach, by Gianluca Di Tommaso, Head of Agronomic Research, Business Innovation Department, Valagro S.p.A. (Italy) **(A086)**

12.20-12.40 - In vitro and in vivo bio-stimulatory properties of a *Lupinus albus* L. seed suspension and identification of active substances, by Elmarie van de Watt, Department of Soil, Crop and Climate Science, University of the Free State, (South Africa) (**A035)**

12:40-14:50 - Lunch in Exhibition area and Poster Session

SESSION 2: Biostimulants and abiotic stresses. Chair Prof P. Perata, Scuola Superiore Sant' Anna, Pisa (Italy)

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15.30-15.50 Nitrophenolate (Atonik) mode of action – from whole plant to genome level, by Helena Gawronska, Laboratory of Basic Research in Horticulture, Faculty of Horticulture and Landscape Architecture Warsaw University of Life Sciences (Poland) **(A006)**

15.50-16.10 - Enhanced plant tolerance to temperate stress with amino acids: an approach to its mode of action, by Anna Botta, R&D Department, Plant Physiology Division, BIOIBERICA, S.A. (Spain) (**A012)**

16.10-16.30 - Effects of CPPA on plant growth under abiotic stress conditions, by Terry Hanson, Vice President of Research and Development for FBSciences (USA)(**A038)**

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17.00-17.20 - Genomic approaches to unveil the physiological pathways activated in Arabidopsis treated with plant-derived raw extracts, by Antonietta Santaniello, PlantLab, Scuola Superiore Sant'Anna (Italy)(**A090)**

17.20-17.40 - COMPO Frost Protect – A new biostimulant to protect plants from frost damages, by Dr Georg Ebert, Research Director, COMPO GmbH & Co. KG (Germany) (**A093)**

17.40-19.00 Poster Session

Wednesday 28 November

SESSION 3: Biostimulants and plant defense mechanisms. Chair Dr Michel Ponchet, INRA Sophia Antipolis (France)

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09.40-10.00 - **"**BioMolChem", a tool to assess the defense status of grapevines after stimulation, or not, of cultivar or resistant genotypes: from genes to the field, by Marie-France Corio-Costet, INRA, UMR Santé et Agroécologie du vignoble, Villenave d'Ornon, (France). **A019**

10.00-10.20 - Oligosaccharide-triggered plant immunity and plant protection, by Alain Pugin, UMR Agroécologie INRA/Université de Bourgogne/AgroSup Dijon, (France) **A029**

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11.30-11.50 - Transcript profiling of chitosan-treated Arabidopsis seedlings, by Dr. Giovanni Povero, Research Assistant for the Business Innovation Department at Valagro S.p.A. (Italy) **A087**

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SESSION 4: Seaweed extracts as biostimulants. Chair Dr B.Prithiviraj, Associate Professor, Dalhousie University Truro, Nova Scotia (Canada).

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17.25-17.50 Keynote lecture: The legislative and regulatory approach to biostimulants in the USA D.G.Beaudreau, Vice President of Environmental Policy, DC Legislative and Regulatory Services, Washington DC (USA)

17.50-18.15 - Science and regulation of Biostimulants : Outcomes of a scientific review at the request of the European Commission, by Professor Patrick du Jardin, Head of Plant Biology Unit of Gembloux Agro-Bio Tech - University of Liège, (Belgium) and member of experts panels of the European Food Safety Authority. **A098**

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Thursday 29 November

SESSION 6: Microbes as living biostimulants. Chair Prof José Lopez-Bucio, Universidad Michoacana de San Nicolas de Hidalgo, (Mexico)

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SESSION 6 (Continued) Chair Prof Dr Karl Heinz Kogel, Justus Liebig University, Giessen (Germany)

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11.30-11.50 - Plant-growth-promoting rhizobacteria emit volatiles compounds with biostimulation activity in dicot and monocot plant species, by Professor Patrick du Jardin,Head of Plant Biology Unit of Gembloux Agro-Bio Tech - University of Liège, (Belgium) **A094**

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Closing remarks by Prof Patrick Brown, Co-Chairman of the Scientific Committee

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Moumène S. (*1),Barkat K. (1),Djafer A. (1)), Houmani Z. (1) & Bouznad Z.(2)
1- Laboratoire de recherche sur les plantes médicinales et aromatiques, faculté agrovétérinaire, université Saad Dahlab, BP.270, Douirète , 09100, Blida, Algérie.
2- Laboratoire de recherche en phytopathologie, Ecole Nationale Supérieure d'Agronomie , avenue hacene Badi, El Harrach, Algérie.
*E-mail : moumene_saida@yahoo.fr
abstract

As part of the biocontrol agent of *Phytophthora infestans* late blight of potato by the use of medicinal herbs and some Algerian's *Trichoderma* sp isolates . It was considered essential to know their impact on potato's crop. Thus, our research is based on the cultivation of four varieties of potato: Kondor, Spunta, Olympia and Mozart in pots and under glass to test the efficacy of plant-based concoctions of nettle *(Urtica dioica)* , horsetail *(Equisetum arvense),* and sage *(Salvia officinalis)* for watering plants and the contribution of their powders ground plants and *Trichoderma* sp. isolates of each pot before planting. The present study aims to test the effect of plant preparations and antagonistic isolates in their strategy as biostimulants of germination, growth and yield of potato crop. Indeed, the various herbal treatments have shown their stimulatory effects on the germination of tested varieties of potato. On the other hand, germination rates recorded were variable among treatments and varieties. Thus, the nettle powder or slurry and sage in the form of manure were the best germination stimulants.
Meanwhile, the best stimulation of germination was on the varieties Spunta and Olympia. In addition, powders and teas of the three plants tested showed their stimulating effect on stem length and the weight and size of tubers produced on the four varieties. As they have stimulated the dry weight of the aerial part of the plant variety only Mozart. Thus, powders of horsetail and nettle teas and the nettle and sage stimulated the dry weight of the aerial part of Olympia and Spunta varieties and number of leaves of the variety Mozart. Indeed, based on the number of tubers produced, sage and horsetail in the form of powder or liquid manure and the nettle powder were the best stimulants.
Parallely, the impact of *Trichoderma* sp. isolates on four varieties of potato has high lighted their stimulating effect on the germination, vegetative growth including the number and length of rods, and on the number of leaves and flowers. A slight stimulation has been found also on the dry weight of the aerial part under the effect of the two Trichoderma isolates Pa and Tco. On the other hand, the Tuberization was delayed for the whole of salaries and varieties. Similarly, the number, the weight as well as the caliber of the tubers produced by plant are still low compared with witnesses. Thus, the extension of the growth phase has misled a better force of the aerial parts of plants, which has prevented their senescence to activate a tuberization. However, use of algerian's *Trichoderma* sp isolates . on crops to air growth is a promising approach that helps reduce the use of fungicides, and fertilizers for aerial growth crops.
In this sense, our results are of interest for applications of these plants as biostimulants growth through organic farming. It then recommends further testing with the combination of these herbs for better rendements of potato's crop.

Key words : *Trichoderma* sp. , herbal preparation, *Solanum tuberosum*, *Phytophtora infestans*, biostimulant

A004 (P086) Effect of biostimulants: AlgaminoPlant and Biochikol 020 PC on acclimatization of microplantlets of Begonia x rex Putz. 'Fairy' to ex vitro conditions.

Ilczuk Agnieszka, Jacygrad Ewelina*, Jagiello-Kubiec Katarzyna, Świtlaga Paulina

Warsaw University of Life Sciences, Department of Ornamental Plants Nowoursynowska 166, 02-776 Warsaw, Poland

Tel./Fax. +48 22 593 22 68

Corresponding autor:

e-mail: ewelina_jacygrad@sggw.pl

Abstract

Adaptation of tissue-cultured plantlets to ex vitro conditions is a complex and long-lasting process. Plantlets that have grown in vitro have been continuosly exposed to an unique microenvironment that has been selected to provide minimal stress therefore they cannot survive in the environmental conditions when directly placed in a greenhouse or field. The purpose of this study was to determine the acclimatization process of Begonia x rex Putz. 'Fairy' with using biostimulants: AlgaminoPlant and Biochikol 020 PC to alleviate abiotic stress. The attempt was also made to detect a relationship between several different biochemical parameters of plantlets, as influenced by treatments, and their acclimatization to greenhouse conditions. The plants that was watering with AlgaminoPlant or spraying with Biochikol 020 PC were easily acclimated in a glasshouse (100%). There was no observed the influence of biopreparations on plant height, root development and content of dry matter. Regardless of application system, both biopreparations, increased the content of sucrose and free amino acids while watering with AlgaminoPlant, likewise decreased the level of anthocyanins, carotenoids and chlorophyll a+b. Biostimulants treatment during ex vitro process possitively affected by plant development in a greenhouse conditions.

A005 (P050) Effect of nitrophenolate biostimulant on field grown oil seed rape plants

A. Przybysz[1], M. Małecka-Przybysz[1], A. Słowiński[2], H. Gawrońska[1]

[1]Laboratory of Basic Research in Horticulture, Faculty of Horticulture and Landscape Architecture, Warsaw University of Life Sciences – SGGW, Nowoursynowska 159, 02-776 Warsaw, POLAND arkadiusz_przybysz@sggw.pl – helena_gawrońska@sggw.pl

phone: +48 22 593 20 97

[2]Arysta LifeScience sp. z o.o., Przasnyska 6b, 01-756 Warsaw, POLAND

Oil seed rape (Brassica napus L. var. oleifera) is important agricultural crop, acreage of which is increasing yearly. Nitrophenolate biostimulant, produced in Japan, is often used in many crops in order to improve/repair plants status. In this study an attempt was made to evaluate effect of biostimulant on: (i) plants growth and development, (ii) efficiency of photosynthetic apparatus, (iii) transpiration rate, (iv) biomass accumulation and (v) yield.

Oil seed rape was grown in the 2006/07 and 2007/08 seasons. Routine agricultural practices, recommended for this species, were employed. Nitrophenolate biostimulant was applied as single or double spray, in concentration of 0.2% v/v, in 300l ha^{-1}. Plants gas exchange, total chlorophyll content and chlorophyll a fluorescence were measured weekly and at harvest fresh weight and dry matter of above ground parts and yield were recorded.Oil seed rape plants treated with nitrophenolate biostimulant were more advanced in generative development and characterized with increased: (i) photosynthesis intensity (up to even 7 weeks), (ii) chlorophyll content, (iii) values of chlorophyll a fluorescence parameters, (iv) biomass accumulation and (v) seeds yield. Plants treated with biostimulant had higher transpiration rate what corresponded with usually lower stomatal resistance. Positive impact of nitrophenolate preparation was especially clear when plants experienced late spring frost (2006/07) and less noticeable when were grown under near optimal conditions. Carried measurements proved that examined biostimulant acts both as stimulant and as protection agent against spring frost stress.

A006 Nitrophenolate biostimulant mode of action - from whole plant to genome level

H. Gawrońska[1], A. Przybysz[1], E. Szalacha[1], M. Małecka-Przybysz[1], A. Słowiński[2]

1Laboratory of Basic Research in Horticulture, Faculty of Horticulture and Landscape Architecture, Warsaw University of Life Sciences – SGGW, Nowoursynowska 159, 02-776 Warsaw, POLAND (helena_gawrońska@sggw.pl arkadiusz_przybysz@sggw.pl phone: +48 22 593 20 85

[2]Arysta LifeScience sp. z o.o., Przasnyska 6b, 01 –756 Warsaw, POLAND

Biostimulants affect plant's vital processes on every level of biological organization. Positive effects are especially seen, but not solely, when plants are under stressful conditions what has been proved in studies as well as in practice. Nitrophenolate biostimulant, produced in Japan, is world-wide used in many crops in order to increase yield and ability to cope with stresses and repair damages caused by them.In this work we studied stimulatory and protective, against stressors, mode of action of nitrophenolate biostimulant on Arabidopsis thaliana L. Plants were grown under optimal or drought, heavy metals and platinum stress conditions. During study we focused on changes, after biostimulant application by measurements of selected morphological and physiological processes. We also monitored profile gene expression using cDNA A. thaliana Genome Oligo Set. Under optimal conditions examined preparation stimulates plant growth and development, especially generative, improved efficiency of photosynthetic apparatus via increased leaf area, intensity of photosynthesis, chlorophyll content and values of chlorophyll a fluorescence parameters. It also positively effected plant water status due to better roots development and increased water uptake. Out of over 26000 transcriptomes 13% of genes changed level of expression with 93-97% being up regulated. This together with their functions well corresponded with morphological observation, biometric measurements and changes in values of physiological processes. Under stresses nitrophenolate biostimulant show evident protective role on studied plant's vital processes. It can be concluded that studied biostimulant plays both stimulatory, under optimal conditions, and protective role against studied stressors.

A007 (P081) Exploitation of endophytic Bacillus subtilis with antimicrobial peptide genes and other metabolites for the management of dry and soft rot of noni fruits (Morinda citrifolia)

S.Nakkeeran[1]., P.Chandrasekar[2]., T.Ganapathy[3]., Chandrasekar,G[4]., Jonathan,E.I[5] and Fernando, W.G.D.[6]

1- Associate Professor (Plant Pathology), Department of Plant Pathology, Tamil Nadu Agricultural University, Coimbatore – 641 003, Tamil Nadu, India. Email: nakkeeransingai@yahoo.com2- Junior Research Fellow, Department of Plant Pathology, Tamil Nadu Agricultural University, Coimbatore – 641 003, Tamil Nadu, India.3, 4, - Professor (Plant Pathology), Department of Plant Pathology, Tamil Nadu Agricultural University, Coimbatore – 641 003, Tamil Nadu, India.5 - Professor (Nematology), Department of Plant Nematology, Tamil Nadu Agricultural University, Coimbatore – 641 003, Tamil Nadu, India. Email: dcpps@tnau.ac.in6 – Professor, Department of Plant Science, University of Manitoba, Winnipeg, MB, R3T 2N2, Canada. D_Fernando@UManitoba.ca

Survey of noni orchards at Tamil Nadu and Kerala of India, revealed the presence of dry and soft rot of noni fruits. The pathogen associated with dry fruit rot was due to Colletotrichum gloeosporioides and Alternaria alternata. The pathogen associated with soft rot was Pantoea agglomerans and was confirmed through fatty acid methyl ester analysis, 16s rDNA analysis and through biochemical characterization. The primary spread of dry fruit rot caused by C. gloeosporioides was due to the presence of dormant mycelium in the stems and barks and due to the fruiting body, acervuli. The primary spread by A. alternata was through infected crop leaf residues. The secondary spread of both the pathogen was through air borne conidia. Eighteen bacterial endophytes of Bacillus subtilis was screened for the management of noni fruit rot under field conditions. Studies indicated that, the B. subtilis isolates BS2 and BS8 having fengycin, surfactin, bacillomycin and iturin biosynthetic genes were effective against noni fruit rot both under in vitro and in vivo. Studies on the extracellular metabolites of the isolates BS1, BS2 and BS8 through GSMS analysis confirmed the presence of as L-glutamic acid dimethy ester, Dodecanoic acid, Petadecanoic acid, 14 methyl ester and 1,2 benzenedicarboxylic acid, disooctyl ester, 10-methyl ester, Hexadecanoic acid, Diglycerol, Tetradecanoic acid-12 methylester, Teradecanoic acid, 12-methyl-, methyl ester and 2-hexadeconal with antimicrobial properties. Field studies on the management of fruit rot revealed that foliar spray with Bacillus isolate BS2@1 % concentration recorded lesser incidence of dry and soft fruit rot under field conditions

A008 (P072) Elicitation – The act of plant excitement

Dr A G Spiers

Omnia, PO Box 217078, Botany Junction, Auckland, New Zealand (adrian.spiers@omnia.net.nz).

Elicitors are substances which stimulate defence responses in plants. Most are polysaccharides, proteins, nutrients, surfactants, some fungicides and fragments from plant, fungal and bacterial cell walls. In New Zealand and Australia Omnia have been using elicitors to enhance the response of plants to internal stem diseases viz., Silver leaf disease of fruit trees (*Chondrostereum purpureum*) and Dead arm disease of Grapevines (*Eutypa lata*) ; foliar pathogens such as Poplar leaf rust, Black Spot of apple, powdery mildews, *Botrytis* and fruit rots. Elicitors have been used to increase fruit firmness with/without mediation of calcium, also to increase the size and number of palisade cells in apples and potatoes. We have applied elicitors to pasture to increase nutrient profiles and palatability. Co-formulation of elicitors and fungicides has enhanced disease control and should delay the development of fungal resistance as reliance on a single enzyme pathway is avoided. Helping the plant to help itself is the key strategy of elicitor technology. Elicitors must be readily formulated, not phytotoxic or yield/growth adverse, robust, effective and inexpensive. In future as this concept is developed the distinction between elicitors, nutrients and certain fungicides will become obscured. Specific examples are given during this presentation.

A010 (P116) STERILISATION OF IN VITRO CULTURE MEDIUM BY PLANT ESSENTIAL OILS WITHOUT AUTOCLAVING

CHOCKPISIT THEPSITHAR, AREE THONGPUKDEE, APICHAYA DAORAT

Department of Biology, Faculty of Science, Silpakorn University,

Sanamchandra Palace, Muang, Nakhon Pathom 73000, Thailand

Abstract

Plant tissue culture is an important in vitro technology applied for agriculture and industrial production. A sterile condition of culture medium is one of the main aspects. The alternative technique for medium sterilization to replace autoclaving was carried out. For sterilization of plant tissue culture medium without autoclaving, some commercial pure essential oils, cassia oil, betel oil, bergamot oil, turmeric oil, lavender oil and clove oil, were tested alone or in combinations with some antiseptics. Each essential oil was added to 25-ml Murashige and Skoog (MS) medium before medium was solidified in a 120-ml container, kept for 2 weeks before evaluating sterile condition. Treated media, supplemented with essential oils, were compared to control medium, autoclaved at 121 degree Celsius for 15 min. In vitro sterile conditions were found 40 – 100% from these essential oils compared to 100% sterile condition from autoclaved medium. Furthermore, growth of chrysanthemum shoot explants on essential oil-treated media were also reported and discussed in the comparison of those on autoclaved medium.

A011 (P087) A Seaweed Fertilizer Based High Efficient Fertilization Technology on Open Field Crops – Wheat and Garlic in China

Bill DUAN, Leili Agrochemistry Co.,Ltd., No.22, West 3rd Ring Road North, Haidian Dist.,Beijing, 100044, China (me@leili.com)

Tang Jie, Leili Agrochemistry Co.,Ltd., No.22, West 3rd Ring Road North, Haidian Dist.,Beijing, 100044, China (tj@leili.com)

Wan Xuebing, Leili Agrochemistry Co.,Ltd., No.22, West 3rd Ring Road North, Haidian Dist.,Beijing, 100044, China (overseas@leili.com)

This technology has been adopted since 2009 to carry out high-yielding low carbon emission seaweed fertilizer based fertilization technology in Shandong Province. Thanks to the properties of seaweed fertilization, a recommended integrated technical system and dosage application based on soil tests and the planning of a fertilization procedure, the traditional fertilization costumes could be changed.

1).Impact on yield

Thanks to the adoption of the high-yielding low-carbon seaweed fertilization technology the yield per Ha increased by 10.96%~23.62% in the case of wheat and by 10.02%~18.23% in the case of garlic.

2). Ecological impact

In the case of garlic cultivation, the applied amount of pure nitrogen, pure potassium and pure phosphorus could be respectively reduced by 135-180kg/ha, 157.5-202.5kg/ha and 22.5-67.5kg/ha. In other words, the application ratio of nitrogen, phosphorus and potassium fertilizers decreased by 28%~34%, 40%~50% and 6%-17% respectively. In the case of wheat cultivation, the applied amount of pure nitrogen and pure phosphorus could be respectively reduced by 169.5-238.5kg/ha and 56.25kg/ha, i.e. the applied ratio decreased by 53% and 50% respectively.

3) Financial benefit

The income from wheat cultivation increased by 2325~2880CNY/ha, while the income from garlic cultivation increased by 18585~20700CNY/ha in comparison with the conventional chemical fertilization. The high-yielding low-carbon seaweed fertilizer based fertilization technology adopted for the cultivation of winter wheat and garlic can completely replace single-nutrient chemical fertilizers. While achieving the target of a high yield, it is also a key-factor in reducing the application of chemical fertilizers and pesticides as well as CO2 emissions.

A012 Enhancing plant tolerance to temperature stress with amino Acids: an approach to its mode of action.

Anna Botta
R&D Department, Plant Physiology Division, BIOIBERICA, S.A.
Pol. Ind. "Mas Puigvert", Ctra. N-II Km. 680.6, 08389 Palafolls (Barcelona), SPAIN (abotta@bioiberica.com)

Several environmental factors adversely affect plant growth, its development and the final crop yield, being temperature stress (cold, freeze or heat stress) one of the most limiting variables. Plant thermal acclimation mechanisms include accumulation of compatible N-rich solutes, such as amino acids, that confer stress tolerance because they act as osmolytes, regulate ion transport and stomatal opening, have enzyme protecting effect and influence gene expression and redox homeostasis. This increase of free amino acids is naturally originated from hydrolysis process of functional proteins or by inhibition of new protein synthesis. However, external applications of amino acids have the advantage of avoiding protein breakdown and saving energy resources. With the aim to assess the effect of exogenous amino acids treatments, several experiments with plants subjected to different stressing temperatures were conducted applying an amino acid product obtained by Enzymatic Hydrolysis (Terra-Sorb®). In a study under controlled environment on lettuce plants subjected to three different types of cold stress, treated plants show greater fresh and dry weight than control plants, exhibiting a higher stomatal conductance which implies productive improvements. Besides, heat stress tolerance was evaluated on ryegrass plants under several temperatures regimes where lawn physiological and quality parameters were measured. In this case, at high temperature (36ºC), ryegrass treated with Terra-Sorb® shows a superior photosynthetic efficiency (Fv/Fm) and maintains higher levels of chlorophylls and carotenoids. These findings suggest that Terra-Sorb® has a similar effect than natural plant amino acids and promotes a better and prompter crop recovery from temperature stress.

A013 Seaweed extract used as plant nutrition and yield booster

Anne Guiboileau[1], Jean-Marie Joubert[2]

[1]Laboratoires GOËMAR, Parc Technopolitain Atalante, Saint-Malo Cedex, 35419, France (anne.guiboileau@goemar.com)

[2]Laboratoires GOËMAR, Parc Technopolitain Atalante, Saint-Malo Cedex, 35419, France (jean-marie.joubert@goemar.com)

The challenge of modern agriculture is to adapt itself to the increase of world population by upgrading yield while preserving the environment. A method for achieving this goal is to improve plant nutrition with the use of biostimulants such as seaweed extracts. In fact, plant nutrition is a key process with a large impact on yield.

Nitrogen is a very important element for plants to produce proteins, nucleic acids and chlorophyll. Nitrate is absorbed from the soil and represents the major source of nitrogen for the plant. The nitrate uptake is performed by nitrate transporters belonging to the NRT family. Then, nitrate is converted to nitrite by the nitrate reductase. It has been shown that plants treated with seaweed extracts present a higher activity of this enzyme. Phosphorus is also an important macro-nutrient. Tomato plants treated with seaweed extracts present a higher phosphatases activity. Iron is participating to the chlorophyll synthesis and represents an important micro-element. Seaweed extract applications on plants increase the ferric chelate reductase activity.

Moreover, plants treated with seaweed extracts present a well-developed and more robust root system. The presence of more roots increases the exchange surface between the soil and the plant, and probably increases the nutrients uptake. Treatments with seaweed extracts allow a doubling of the foliar biomass in lab conditions, macroscopic effect which is easily visible. By these observations, we can conclude that seaweed extracts have a positive effect on plant nutrition and then on yield.

A014 (P088) BM Start eases the thinning in order to improve the quality of fruitsetting

Aude Bernardon-Méry[1], Jean-Marie Joubert[2]

(1) Laboratoires Goëmar S.A., Parc Technopolitain Atalante, CS 41908, Saint Jouan des Guerets 35419 Saint-Malo cedex – France (amery@goemar.com)
(2) Laboratoires Goëmar S.A., Parc Technopolitain Atalante, CS 41908, Saint Jouan des Guerets 35419 Saint-Malo cedex – France (jmjoubert@goemar.com)

The role of polyamines in flowering, fertilization and fruit setting and development of the young fruit is well known since the end of 1980's. "BM Start", an *Ascophyllum nodosum* filtrate, is powerful activator of flowering hormones of apple trees. "BM Start" is applied at 2L/Ha three times at the following stages: pink-bud stage, early full bloom, and at the end of flowering. The "BM Start" applications allow to increase the rate of polyamines during flowering. The incidence of "BM Start" on the polyamines manifests in an improvement of the quality of the fruitsetting and fruit development. Indeed at the end of the physiological drop, "BM Start" increases by 50% the number of king fruits left on their own (cluster), after lateral fruit fall. "BM Start" involves a more important lateral fruit fall, illustrated by the measurement of the fruition (fructification) rate. This differentiation of the king fruits allows a tangible manual cutback. Early intermediate measurements of the dominant fruit's caliber, underline important differences, right after the chemical thinning program. This early suppression of young fruits has an impact on the feeding and the size of the remaining fruits, and so the final calibers. "BM Start" increases the yield by ten points (percent) in classes of calibers superior to 70 mm and also allows a better homogeneity around 70-75 mm.

A015 (P066) Optical criteria for assessment of efficiency and adaptogenic characteristics of biologically active preparations

E.V. Kanash[1], G.G. Panova[2], S.Yu. Blokhina[3]

[1-3]Agrophysical Institute, Russian Academy of Agricultural Sciences, Grazhdansky prosp. 14, St. Petersburg, 195220, Russian Federation

[1]ykanash@yandex.ru, [2]gaiane@inbox.ru, [3]sblokhina@agrophys.ru

Qualitative and quantitative changes in biochemical composition of leaves and their inner structure that take place in adverse environmental conditions and in the process of plant adaptation provoke changes in their optical characteristics. The recording of optical characteristics is a non-destructive method that does not require preparation of plant samples. The aim of this work was to choose optical criteria for the assessment of biologically active preparations efficiency in enhancing plant nonspecific tolerance for abiotic stressors. Spectra of leaf reflectance were registered in situ using a fiber-optical spectrometer HR2000 combined with reflection sensor R200-7-UV-VIS (Ocean Optics, USA). The biologically active preparation used in the study was siliceous chelate micro fertilizer (SCM) developed in the Agrophysical Institute (St. Petersburg). The initiation of oxidation stress leading to the decrease of photochemical processes activity and, as a consequence, to growth inhibition can be detected before the occurrence of external symptoms of plant growth suppression from the change of some reflection indices (chlorophyll, carotenoids, anthocyanins, flavonoids) and other optical indicators characterizing the “down regulation” activity of photosystem II. It was shown that foliar SCM treatment prevents metabolic disorder and growth inhibition in conditions of soil drought, nitrogen deficiency and UV-B irradiation. Foliar SCM treatment preceding stressor action starts the process of plant adaptation. Investigation results revealed that the mechanism of SCM protective action includes the synthesis of secondary metabolites (anthocyanins, flavonoids etc.) which participate in spectral structure regulation of solar radiation getting into a leaf and start the process of plant active adaptation to changing environmental conditions.

A016 (P051) SYNTHETIC BIOSTIMULANT METHYURE IMPROVES PLANT SALT TOLERANCE

Taniana Palladina, Zhanna Bilyk, Olga Konturska

M. G. Kholodny Institute of Botany, National Academy of Science of Ukraine, 2 Tereschinkivska St., Kyiv 01601, Ukraine

tatiana_palladina@ukr.net

Methyure is a cheap and practically nontoxic preparation (for mouse LD_{50} >4000 mg/kg) synthesized in Ukraine. Seed soaking in Methyure weak solution stimulates plant growth and normalizes root system formation under soil salinity, whereas the positive effect continues during whole vegetation. The effect can be amplified by additional plant sprinkling, which increases seed crop.

Methyure effects on biochemical processes have been studied on *Zea mays* seedlings exposed at 100 mM NaCl during 1 or 10 days. It was found Methyure application supports osmotic and ion homeostasis and prevents oxidative stress. Methyure seed treatment can intensify Na^+/H^+ -antiporters activity in maize seedling roots. Thus, it was shown predominantly activation Na^+/H^+-antiporter in vacuolar membrane at 1-day NaCl exposition, whereas at 10-day the antiporter was more activated in plasma membrane. Secondary active Na^+/H^+ -antiporters energetically depended on primary active H^+-pumps functioned in these membranes. At NaCl exposition Methyure application activated H^+-pumps in both membranes especially in vacuolar.

Besides Methyure effects on antioxidant system in leaves tissues has been investigated. Methyure seeds treatment resulted in increase superoxide dismutase activity at 1-day NaCl exposition whereas ascorbate peroxidase activity was raised at both terms. At same condition, glutathione reductase activity did not alter.

A017 (P089) Effect of seaweed extract application on yield and quality of apples.

D. Wrona[1], K. Tomala[2]

[1]Department of Pomology, Warsaw University of Life Sciences, Nowoursynowska 159, Warsaw 02 776, POLAND dariusz_wrona@sggw.pl

[2]Department of Pomology, Warsaw University of Life Sciences, Nowoursynowska 159, Warsaw 02 776, POLAND kazimierz _tomala@sggw.pl

The investigations aimed at assessing the influence of *Ascophyllum nodosum* extract on the yield and fruit quality under climatic conditions of Central Poland depending on the number and dates of treatment. The studies comprised two field experiments. The first one was carried out in the years 2003-2004 and 2007 in a commercial orchard in the Grójec region and the second in the years 2004-2005 at the Warsaw-Wilanów Experimental Station. Both experiments were performed on 'Šampion' apple trees on M.9 and additionally on 'Gala' on M.9 in the commercial orchard. In the experiment I two combinations were compared: control and three sprays – at the green bud stage, at the pink bud stage and at full bloom. Experiment II included four treatments: control; a single spray – at the pink bud stage; two sprays – at the pink bud stage and at full bloom; three sprays – at the pink bud stage, at full bloom and after bloom. A dose of 3 l of seaweed extract per ha was applied at each date.

The highest fruit set and yield per tree was obtained in the treatment of triple spray (a complete spray programme). This programme also resulted in obtaining the largest fruit size, the biggest share of large fruits (over 80 mm in diameter) as compared with the control and the smallest share of small fruits (60 mm in diameter). The effects of a single and double sprays were less pronounced than those of three sprays, nevertheless all the performed treatments resulted in the fruit yield increase as well as in the improvement of fruit quality as compared with the untreated control.

A018 Efficacy of a new oligosaccharide active against scab on apple

Wendy Van Hemelrijck[1], Kjell Hauke[1], Piet Creemers[1]

[1]Proefcentrum Fruitteelt vzw, Fruittuinweg 1, 3800 Sint-Truiden, Belgium (wendy.vanhemelrijck@pcfruit.be)

Scab on apple, caused by the ascomycete *Venturia inaequalis* is one of the most important diseases in fruit growing. Seventy five % of the pesticide use in apple production is related with control of fungal diseases, in which apple scab has a share of 70 %. With the new regulation replacing Directive 91/414 and the Framework Directive on the sustainable use of Pesticides (2009/128/EC), products will disappear from the European market which will give a new challenge in IPM strategies to control pests and diseases. Besides there is the pressure of environmental and consumer groups on supermarkets to reduce residues on fruits. As such, the use of pesticides is at the moment under debate. To this end, research concerning alternative control measurements experiences a boost. The active compound tested here is an oligosaccharide extracted from seaweed. It is an elicitor which induces plant resistance mechanisms to bacterial and fungal diseases. Used alone to fight the scab pathogen, it can reduce the disease pressure. Included in protection programs against scab throughout the secondary contamination of scab in summer, it also contributes to a reduction in fungicide applications and as such allows reducing residues on apples.

A019 "BioMolChem", a tool to assess the defence status of grapevines after stimulation, or not, of cultivar or resistant genotypes: from genes to the field

Corio-Costet MF[1], C. Lambert[2], S. Cluzet [2], D. Merdinoglu[3], et MC Dufour[1].
1-INRA, UMR Santé et Agroécologie du vignoble (SAVE-1065), ISVV, BP 81, 71 rue Bourlaux, 33883 Villenave d'Ornon, France. coriocos@bordeaux.inra.fr.
2-Université de Bordeaux, ISVV, Gesvab-EA 3675, CS 50008, 33882 Villenave d'Ornon, France,
3-INRA, UMR1131 Santé de la Vigne et Qualité du Vin INRA, BP 20507, 68021 Colmar, France

Stimulating plant defences, or resistant plant varieties is of interest as an alternative method to limit pesticide use in agriculture. To assess the defence status of the grapevine we have developed a triple approach called "BioMolChem":

- **Bio**logical tests that measure the efficacy of the grapevine defenses against two major biotrophic pathogens (*Erysiphe necator*, *Plasmopara viticola*),
- **Mol**ecular assays by q-RT-PCR show the expression patterns (over-expression or repression) of twenty genes involved in the grapevine defences, and these can then be correlated, or not, with the protection level,
- Bio**Chem**ical analyses by HPLC of phenylpropanoides quantify and to identify molecules of interest, and correlate them with specific gene expression (stilbene biosynthesis) and with the acquired protection.

This tool was tested on leaves (cv. Cabernet-Sauvignon) after stimulation by different elicitors (benzothiadiazole, phosphonates), on grapevine genotypes resistant to powdery and downy mildew, and in the vineyard. We obtained correlations between the expression of PR-protein genes and genes coding for biosynthesis pathways or (stilbene, tryptophan) or with the efficacy of protection. Similarly, there were correlations between the presence of known and unknown molecules, and the efficacy of protection. We found that resveratrol, a well known phytoalexine of the grapevine, is a good marker of defence status, but is not a good marker of protection. Today, we therefore have a tool for understanding the defence and protection status of the grapevine in laboratory or in field experiments.

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A020 (P011) OAK EXTRACTS APPLICATION TO GRAPEVINES: A NEW TOOL TO MODULATE THE WINE QUALITY

Pardo-García,A.I.;Martínez-Gil,A.M.;Zalacain,A.;Carmona,M.;Alonso,G.L.;Salinas,M.R.*
E.T.S.I.Agrónomos, Universidad de Castilla-La Mancha, Avda.España, s/n, E02071, Albacete, Spain. *e-mail: Rosario.Salinas@uclm.es.

The grape quality is the primary factor that determines the wine quality, being their differentiation, one of the objectives pursued carrying out specific agronomic practices. The grape compounds responsible of wine differences are those related to the aroma, color and stability. Grapevines are able to capture exogenous substances which induce changes in the chemical composition of the berries and therefore the wine; an example might be the "fingerprint" of the so called *terroir* effect in many wines, although few scientific results support this fact. Among them, some plant extracts applied to the vineyard showed their efficacy as polyphenolic biostimulants, as they increase grape anthocyanin content resulting in a better color quality of wines (Carmona et al., 2001. Agrícola Vergel, 703-707; Parrado et al., 2007. J. Sci. Food Agric. 87, 2310–2318). It has also been demonstrated that grapevines growing near forest fires, manifested a smoke flavor notes in their wines (Kennison, et al., 2008. J. Agric. Food Chem., 56, 7379-7383).The aims of this work was to determine the effectiveness of foliar applications to grapevines of an aqueous extracts of toasted oak, to modify the chemical composition of grapes and improve the quality of its wines. To achieve this, several studies on white and red *Vitis viniferas* were carried out along 2009 and 2011 seasons. Results shown that oak extract, properly applied, improve the quality of wines and even can achieve an increase in woody aromatic notes.

A021 Biological activity of different botanical extracts as evaluated by an array of in vitro and in vivo bioassays

Vanina Ziosi[1], Stefania Biondi[2], Fabiana Antognoni[2], Ferruccio Poli[2], Antonio Di Nardo[1]

[1]Biolchim S.p.A., via San Carlo 2130, 40059 Medicina (BO), Italy ziosi@biolchim.it - dinardo@biolchim.it)[2]Università di Bologna, Dipartimento di Biologia Evoluzionistica Sperimentale, via Irnerio 42, 40126 Bologna, Italy stefania.biondi@unibo.it – fabiana.antognoni@unibo.it - ferruccio.poli@unibo.it

During the past 10 years, researchers and industry have been mainly focused on the biostimulant effect of humic acids, seaweed extracts, and amino acids. Recently, increasing interest has been paid to plant extracts as they have been shown to increase crop yield and quality by improving plant growth and tolerance to abiotic stress. Plant extracts are complex matrices containing many different compounds which perform multiple functions. Thus, the in-depth understanding of their biological activity and possible use in the agronomical industry requires the evaluation of several factors, including biochemical, physiological and growth parameters, and field performances. In the present paper, biostimulant properties of different botanical extracts were investigated by means of an array of *in vitro* and *in vivo* bioassays. Hormone-like activity was assessed in several *in vitro* tissue/cell culture model systems: dormant *Helianthus tuberosus* tubers (activation of cell division), tobacco cell cultures (stimulation of cell proliferation), tobacco leaf explants (root and shoot organogenesis). Antioxidant activity was determined by means of different assays, namely the DPPH, ABTS, deoxyribose, and -carotene tests. Stimulation of plant growth and improved tolerance to abiotic stress under controlled (*in vitro* and *in vivo*) conditions were evaluated by testing the effects of plant extracts on seed germination, seedling growth, and root development under optimal and stress-inducing conditions (e.g. chilling). Trials under different pedoclimatic conditions were also set up to assess agronomical performance in the open field.The investigated plant extracts showed biological activity and beneficial effects on several plant developmental processes (root and leaf tissue growth, fruit set, fruit development and ripening); their possible mode of action is discussed by relating results obtained *in vitro, in vivo* and in the field.

A022 (P006) SUNRED, a botanical extract-based biostimulant, enhances polyphenols and improves quality of musts

Vanina Ziosi[1], Duilio Porro[2], Franco Vitali[1], Giulio Giovannetti[1], Antonio Di Nardo[1]

[1]Biolchim S.p.A., via San Carlo 2130, 40059 Medicina (BO), Italy (ziosi@biolchim.it - vitali@biolchim.it - giovannetti@biolchim.it – dinardo@biolchim.it) [2] Fondazione Edmund Mach -Istituto Agrario di San Michele all'Adige- Centro di Trasferimento Tecnologico - Unità Viticoltura, via E. Mach 1, 38010 S. Michele all'Adige (TN), Italy duilio.porro@fmach.it

Oxylipins are cyclopentanonic compounds involved in plant responses to biotic and abiotic stresses. They are also involved in developmental processes including fruit growth and ripening. Exogenously applied to fruit, oxylipins enhance flavonoid and anthocyanin accumulation in apple, and resveratrol biosynthesis in grapevine. SUNRED is a biostimulant containing phenylalanine, methionine, monosaccharides and botanical extracts rich in oxylipins. SUNRED is effective in improving fruit colour development, anthocyanin biosynthesis, and soluble sugar accumulation in apple, cherry, plum, table grape, grapevine, and tomato.

The aim of present work was to investigate the effect of SUNRED application on grapevine polyphenol accumulation and quality parameters of musts.Trials were carried out in 2010 and 2011 on grapevines (*Vitis vinifera* L., cultivar Rebo, Teroldego, and Cabernet Sauvignon) grown in Trentino Alto Adige, Italy. Plants were sprayed twice, 30 and 15 days before harvest, with 400 mL/hL. At harvest, polyphenol content and quality parameters of musts (sugar content, titratable acidity, pH, potassium content, yeast available nitrogen) were determined by FT-IR spectrophotometer; berry firmness was assessed by Texture Analyzer, and chlorophyll content of leaves was determined by SPAD analysis.

In all of the cultivars, SUNRED enhanced anthocyanin and total polyphenol accumulation in musts without significantly altering pH, titratable acidity, malic acid, tartaric acid, and potassium content. SUNRED had no effects on berry firmness too. SUNRED increased yeast available nitrogen and positively impacted sugar content, probably as a result of the improved nutritional status of treated plants relative to controls. The extent of SUNRED effect on sugar accumulation was cultivar-dependent.

A023 (P009) BLUPRINS® induces advanced bud release from dormancy in sweet cherry fruit

Vanina Ziosi[1], Guglielmo Costa[2], Franco Vitali[1], Giulio Giovannetti[1], Lorenzo Laghezza[2], Antonio Di Nardo[1]

[1]Biolchim S.p.A., via San Carlo 2130, 40059 Medicina (BO), Italy ziosi@biolchim.it - vitali@biolchim.it - giovannetti@biolchim.it – dinardo@biolchim.it

[2]Dipartimento di Colture Arboree, Università di Bologna, via Fanin 46, 40127 Bologna (Italy) (guglielmo.costa@unibo.it - lorlag83@libero.it)

At the onset of the cold season, buds of woody plants suspend growth and enter dormancy. To overcome it and resume growth, buds require an adequate period of exposure to cold temperatures. In warm-winter regions, where plant chilling requirement is not satisfied, reduced and uneven bud-breaking is the major cause of low productivity in orchards. BLUPRINS® is dormancy breaking agent containing amino acids, polysaccharides, nitrogen and calcium; it has always to be associated with its activator BLUACT®. In table grape and kiwifruit, BLUPRINS® induces advanced and synchronous bud release from dormancy, leading to uniform sprouting and flowering.

In the present paper, the effect of BLUPRINS® application on bud breaking of sweet cherry (*Prunus avium* L., cv Ferrovia, Early Lory, and Symphonie) was evaluated.

Trials were carried out in 2010 and 2011 in commercial orchards located in Puglia (Italy), Oulmes (Morocco), and Extremadura (Spain). BLUPRINS® was applied at different concentrations (BLUPRINS®: 4-6%; BLUACT®: 15-20%) and times of applications (60, 45, and 30 days before flowering) and the effects on BLUPRINS® application, at all of the concentrations tested, significantly advanced (2-3 gg) and improved bud breaking, flowering and fruit setting relative to both untreated and hydrogen cyanamide-treated plants. The effect was more evident when BLUPRINS® was sprayed between 60 and 45 days before flowering. BLUPRINS® advanced cherry fruit developmental cycle up to harvest, as revealed by fruit quality parameters and the non-destructive ripening index DA. No symptoms of phytotoxicity due to BLUPRINS® treatment were recorded at any concentration and time of application tested.

A024 (P007) FOLICIST, a biostimulant based on acetyl-thioproline, folic acid and plant extracts, improves seed germination and radicle extension

Vanina Ziosi[1], Roberto Zandoli[1], Franco Vitali[1], Antonio Di Nardo[1]

[1]Biolchim S.p.A., via San Carlo 2130, 40059 Medicina (BO), Italy ziosi@biolchim.it - zandoli@biolchim.it - vitali@biolchim.it – dinardo@biolchim.it

Two major events are associated with seed germination: the rapid uptake of water followed by the resumption of intense respiratory and metabolic activity. Radical extension terminates germination and marks the beginning of seedling growth. FOLICIST is a biostimulant containing acetyl-thioproline, folic acid, glycine betaine and plant extracts. Its application has been shown to be effective in enhancing plant metabolism during flowering and fruit set.

In the present paper, the effects of FOLICIST on seed germination and radical extension were investigated.

Maize, oat, and sorghum seeds were sprayed with FOLICIST (15 mL/L) and dried at room temperature. Control and treated seeds were then placed on 9 cm diameter Petri dishes lined with water-soaked filter paper and kept a in germinator at 22°C. The number of germinated seeds and root length were recorded daily.

Results showed that FOLICIST significantly improved seed germination: in fact, following 24 (oat and sorghum) or 48 (maize)-hour incubation, the germination percentage of untreated seeds was 20% (oat), 40% (maize), and 80% (sorghum), while that of treated ones was 60% (oat), 65% (maize), and 87% (sorghum). FOLICIST also enhanced radicle elongation: at the same assessment date, root length of treated seeds was from 2-fold (oat) to 5-fold higher (maize) than that of control ones. FOLICIST effects on seed germination and radical elongation were maintained, although to a lesser extent, up to 120 (maize) and 72 (oat and sorghum) hours.

A025 (P008) NOV@, a botanical extract-based biostimulant for fertigation, promotes root development, plant growth and fruit enlargement

Vanina Ziosi[1], Giulio Giovannetti[1], Franco Vitali[1], Antonio Di Nardo[1]

[1]Biolchim S.p.A., via San Carlo 2130, 40059 Medicina (BO), Italy (ziosi@biolchim.it - giovannetti@biolchim.it – vitali@biolchim.it - dinardo@biolchim.it

NOV@ is a biostimulant containing organic acids, vitamins, chelated micronutrients, and plant extracts rich in phytosaponins, polysaccharides and glycine betaine. Phytosaponins are naturally occurring surface-active glycosides. They derive the name from their ability to form soap-like foams in aqueous solutions; they also have biological activities, including stimulation of root growth. Phytosaponins, glycine betaine, and organic acids act synergistically improving root formation and growth, nutrient uptake and soil structure; polysaccharides, amino acids, vitamins and chelated micronutrients complete the action by enhancing primary metabolism.

The aim of present work was to investigate the effect of NOV@ application on post-transplanting root development, plant growth and crop yield in strawberry.

NOV@ was applied on strawberry (cultivar Alba) grown in Emilia Romagna, Italy. Treatments were performed 27, 34, and 40 days before transplanting (20L/ha) and repeated at pre-flowering, petal fall, and fruit enlargement stages (15L/ha).

NOV@ stimulated post-transplanting root development and plant growth: in fact, treated plants showed increased number and length of roots as well as higher number of tillers per plant relative to controls. NOV@-treated plants also showed improved fruit set and fruit growth, leading to significantly increased crop yield as compared with control plants (+10%).

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A026 (P056) The WIN project: an international network for facilitating technology transfer and accelerating the development of innovative and effective biostimulants

Vanina Ziosi[1], Franco Vitali[1], Antonio Di Nardo[1]

[1]Biolchim S.p.A., via San Carlo 2130, 40059 Medicina (BO), Italy (ziosi@biolchim.it - vitali@biolchim.it - dinardo@biolchim.it)

In January 2012, Biolchim S.p.A. officially launched the WIN (Worldwide International Network) project, an international network of experimentation aimed to facilitate technology transfer between Research Centers and Industry and accelerate the development and the commercialization of innovative and effective biostimulants.

WIN started at the end of 2011 with the large-scale experimentation of BLUPRINS, the new Biolchim bud breaking agent. Currently, the WIN network branches through 11 countries worldwide and consists of 24 partners: Biolchim R&D Team, Biolchim subsidiaries (Brazil, Germany, Hungary), 15 European Research Institutes, and 5 business partners each characterized by its own solid technical and commercial structure.

Through the WIN network, Biolchim biostimulants will be developed in cooperation with the most advanced Research Institutes dealing with plant biology and high-tech agriculture, and then parallel tested in the different weather, soil, and crop conditions where the WIN partners are operating. WIN will bring scientific innovation directly to the field, constantly ensuring new biostimulants suitable for answering concretely and effectively the farmer needs. Biolchim S.p.A. and its partners will work together in the development of new products in each local background, streamlining and reducing their time to market and creating a wide database of technical information that will allow to select the most appropriate solution, in a WIN-WIN approach between the partners and the company.

WIN is a constantly developing project: in the next two years, its goal is to largely increase the number of partners to cover the widest variety of agronomical contexts where the Biolchim biostimulants will be tested.

A027 (P113) A New Method to Enhance Flowering and Bloom Precocity with a Specific Yeast Strain

Jean-Marc Sanchez[1], Bruno Sanchez[1], Olivier Cor[1]

[1] ITHEC, 4 route de Beaupuy, 31180 Castelmarou, FRANCE (jean-marcsanchez@ithec.fr);

Lallemand Group, www.lallemand.com, a leader in the production and development of yeasts and bacteria, has investigated the use of micro-organisms and their derivatives as Biostimulants or Plant Protection Products. Lallemand's Plant Care Unit has today 3 microbes registered as PPPs in Europe and North America, while some micro-organisms and yeast derivatives have been developed for use as fertilizer (4 fertilizer registrations in France).

We discovered unexpectedly that one specific strain of yeast (Florastyl®) increased the number of flowers or floral buds on some ornamental plants, and a patent was filed in 2009. The first trials were done with CNRS-INRA on tomatoes, and showed an increase between 9% and 27% in the number of fruits after 8 weeks (without improving the total yield). This was due to.shorter intervals between flowering of bunches. Several other plant species (e.g. Cyclamen, Geranium, Fuchsia) and different application rates have been tested, and often more than 20% increase in the number of floral buds/flowers as well as earlier flower development has been observed. To elucidate the mode of action, a study was done where the effect on tomato cells of the specific yeast strain was characterized at gene level. Five genes were selected for closer study, and we were able to demonstrate that Florastyl® induces a gene expression similar to cytokinin. Moreover, we found that the expression of genes can be inhibited by high application rates. Other uses of Florastyl® are also tested on different crops, with the specific aim of improving the bloom precocity.

A028 (P032) Preliminary results on growing tree roots in vitro in presence of humic substances

Tahiri Abelghani 1,2, Destain Jacqueline 1 ,Thonart Philippe 1, Druart Philippe 2
1 University of Liège, Gembloux Agro-Bio Tech, Walloon Center for Industrial Biology (CWBI). Passage des déportés, 2. B5030 Gembloux (Belgium).
2 Walloon Agricultural Research Centre (CRA-W), Dept.Life Sciences. Chaussée de Charleroi, 234. B-5030 Gembloux (Belgium).

Abstract

Humic substances (HS) are organic compounds resulting from the physical, chemical and microbiological transformations of organic residues. Present everywhere in the nature; they are taking part in basic functionalities in any ecosystems involving soils, sediments, water and landfills. They are heterogeneous and complex carbon macromolecules. Our study aims to determine the main biological properties of HS on plant growth in relation to their physicochemical properties. We want to compare HS extracted from landfill leachates to those from leonardite, as phytostimulant by using *in vitro* rhizogenesis process. Three woody species: apple as fruit tree species on one side and alder and birch as trees growing on river banks or wasted areas on the other side are respectively focused during our preliminary studies on the formation of primary and lateral roots.
Keywords : *Humic substances, humic acids, fulvic acids, rhizogenesis, biological activity, landfill leachates.*

A029 Oligosaccharide-triggered plant immunity and plant protection

Alain Pugin, Benoit Poinssot, Sophie Trouvelot, Marielle Adrian and Xavier Daire

UMR Agroécologie INRA/Université de Bourgogne/AgroSup Dijon- ERL CNRS 6300 17, rue Sully BP 86510 ; 21065 Dijon Cédex France

A future challenge for agriculture is the reduction of risks and impacts of pesticides on human health and environment.

One strategy is to take advantage of the innate immune response of plants which was shown to protect them against a large area of pathogens. Different oligosaccharides derived from plant cell walls but also microbes and algae are well-known P/MAMP or DAMP (Pathogen/Microbe/Damage-Associated Molecular Patterns) recognized by plant receptors and able to activate the innate immune system. Among them, β-1,3 glucans including a linear β-1,3 glucan extracted from the brown algae *Laminaria digitata* and its sulfated derivative, oligogalacturonides which are pectin fragments released from the plant cell wall by fungal polygalacturonases, chitin, a long-chain polymer of a N-acetylglucosamine, the main component of cell walls of higher fungi and chitosan have been reported to be effective in controlling various plant diseases in different plant species; the mode of action of these compounds has been studied and receptors have been identified. These oligosaccharides are interesting because they are generally non toxic and suitable for a production on an industrial scale.

This work, first summarizes our data on the mode of action of the β-1,3 glucan extracted from the brown algae *Laminaria digitata* and its sulfated derivative in protecting grapevine in controlled conditions against *Plasmopara viticola, Erysiphe necator and Botrytis.* Then, we report the efficacy of these compounds in vineyards trials for three years in comparison with other resistance inducers and fungicides. The improvement of their efficacy and particularly how to improve their bioavailability will be discussed.

A030 The effect of seaweed extracts on the yield and quality parameters of some vegetables in open field production.

J. Gajc-Wolska[1], T. Spiżewski[2], A. Grabowska[3]

Department of Vegetable and Medicinal Plants, Warsaw University of Life Sciences, Nowoursynowska 159, Warsaw 02 776, POLAND janina_gajc_wolska@sggw.pl

[2]Department of Vegetable Crops, Poznan University of Life Sciences, Dąbrowskiego159, Poznań 60-594, POLAND spizewsk@up.poznan.pl
[3]Department of Vegetable and Medicinal Plants University of Agriculture in Krakow, 29 Listopada 54, Krakow 31-425, POLAND atena8@interia.pl

The use of products based on seaweeds is becoming more and more common in vegetable production in Poland. Therefore more studies are needed to investigate the influence of seaweed extracts on the yield but also on some quality parameters important both for growers and consumers.

Experiments were carried out in the years 2011-2012 at trial stations of three leading Life Sciences Universities in Poland. Trials were conducted on 3 cultivars of cucumber, broccoli and onion. Seaweed cream and seaweed filtrate derived from *Ascophyllum nodosum* were applied as a foliar spray.

In the experiment conducted on cucumber, plants were treated with seaweed cream during flowering and fruit setting. Generally the marketable yield increased due to both higher number of fruits per plant and decreased number of unmarketable fruits (deformed, overgrown). Positive effect on the earliness was also noticed.

Seaweed filtrate application during early stage of broccoli cultivation resulted in higher weight of broccoli curds. The limitation of the occurrence of hollow stem was observed. Some positive changes in chemical composition of broccoli curds were noticed.In the experiment carried out on onion, plants were treated with seaweed cream just before bulb formation and bulb enlargement. The results show positive effect of the preparation on the yield and the yield structure – number of bulbs with diameter below 30 mm slightly decreased, the share of bulbs with diameter above 70 mm in total yield increased.The obtained results shown that extracts derived from *Ascophyllum nodosum* have positive effect on the yield therefore they are useful tool in modern vegetable production.

A031 (P090) Effects of Commercial Seaweed Extracts on Barley Growth and Yield

Srinivasan Krishnamoorthy[1], Henry Lyons[2] and Shane O'Connell[1]*

1. Shannon Applied Biotechnology Centre, Institute of Technology, Tralee, Ireland
2. Brandon Products Ltd, Tralee, Ireland

*Corresponding author: Srinivasan.krishnamoorthy@staff.ittralee.ie

Abstract

Several biological effects of seaweed extracts have been reported in different plant systems, including enhancement of plant growth and stress alleviation. The present research work investigated the effect of commercial seaweed extracts A & B and refined fraction 3 (RF 3) on barley growth and their yield improvements under field conditions. In total seven different treatments were studied; (i): commercial seaweed extract A (CSE A) @ 2.5 L/ha, (ii): CSE A @ 5.0 L/ha, (iii): commercial seaweed extract B (CSE B) @ 2.5 L/ha, (iv): CSE B @ 5.0 L/ha, (v): RF 3 @ 2.5 L/ha, (vi): conventional agrochemical and (vii): control (water) were applied twice (on 30 and 45 days old crop) as foliar spray to promote growth and improve yield parameters. The open field trials were conducted during the Irish spring season in consecutive years (2011 & 2012). Results of the study showed a significant difference in barley plant growth promotion and yield parameters in all the treatments. Treatment with CSE A @ 5 L/ha provided the best results as it improved the maximum shoot length, total grain yield/plot and total grain yield/ha. Moreover, the same treatment significantly ($P>0.05$) increased the additional yield/ha (237.9 kg), additional income/ha (€39.3) and benefit cost ratio (1.3) compared with conventional practice. This study concluded that the CSE A @ 5 L/ha, CSE B @ 2.5 L/ha and RF 3 @ 2.5 L/ha applications were superior in barley growth promotion and yield improvements to traditional fertiliser/agrochemical treatments.

A032 Seaweed Extracts and their Impact on Fusarium wilt in Tomato Plants

Srinivasan Krishnamoorthy[1], Henry Lyons[2] and Shane O'Connell[1]* David Barton

1. Shannon Applied Biotechnology Centre, Institute of Technology, Tralee, Ireland
2. Brandon Products Ltd, Tralee, Ireland
3.

*Corresponding author: Shane.OConnell@staff.ittralee.ie

Extracts of the brown seaweed algae, *Ascophyllum nodosum* have been used as biostimulants to promote growth and productivity in a number of agricultural production systems. The impact of these extracts on plants under the influence of biotic and abiotic stress in field conditions has been widely observed by end users. In the present study, a total of 12 treatments of commercial seaweed extracts (CSE A and CSE B) and their refined fraction (s) (RF 1 to 6), were used in three different inoculation methods (pre-, co- and post-inoculation) to control Fusarium wilt in Tomato caused by *Fusarium oxysporum* under glasshouse conditions. All the experiments included pathogen and healthy controls with 5 replications in randomized design. RFs 1 to 3 and RFs 4 to 6 were extracted from CSE A and CSE B, respectively. Percentage disease reductions ranged from 7.7 to 38.5%, 8.6 to 40.0% and 8.3 to 33.3% for pre-, co- and post-inoculated plants. when compared to control (pathogen treated) plants, respectively. Evaluation of classical ISR markers revealed treatment with CSE A provided the strongest induction as it significantly induced peroxidise, polyphenol oxidase, phenylalanine ammonia lyase, total phenol and total protein when challenged with pathogen. However, qRT-PCR data revealed increases in expression of PR1 and PR5 genes in treatments CSE A and RF 3 + pathogen compared with those of pathogen treated control plants at week 1 after pathogen inoculation. In conclusion, commercial seaweed extracts and their refined fraction(s) induced expression of ISR markers in treated tomato plants.

A033 (P106) Effect of seaweeds extracts and humic and fulvic acids on germination and early growth of Zea mays (L.) and Brassica napus var. oleifera (L.)

Kinga Matysiak, Sylwia Kaczmarek

Institute of Plant Protection – National Research Institute, Władysława Wegorka 20, 60-318 Poznań, Poland ior.poznan.kinga@gmail.com

Glasshouse and laboratory experiments were conducted during 2009-2010 in the Institute of Plant Protection – National Research Institute in Poland. The aim of these trials was to determine an influence of seaweed extracts consist of brown algae *Ecklonia maxima* and *Saragassum spp*. and a humic and fulvic acids mixture on the germination, early growth and development of maize and oilseed rape depending on the method of application. Trials involved soaking of seeds in aquaceous solution of seaweed extracts and humic and fulvic substances (variant A), soaking seeds and then foliar application (variant B) and finally, two foliar applications (variant C). Foliar applications were done at the growth stages BBCH 12-12 and 14-16 of plants. Experiments involved seed germination, chlorophyll content and fresh weight of shoots and roots. Results shows different action of tested substances on maize and oilseed rape depending on application method. Extracts from brown algae and humic and fulvic acids improved the germination capacity of seeds. The plants sprayed twice with the tested substances had the largest shoots and roots. Plants obtained from seeds soaked in solutions of seaweed extracts were characterized by a higher weight of shoots and roots, as compared with plants obtained from seeds soaked in solutions of humic and fulvic acids. Soaking seeds in solutions of the tested substances and an additional foliar application of extracts from seaweeds and the acids on plants stimulated growth of plants root system stronger in comparison with the growth of shoots. Humic and fulvic acids had a stronger effect on the roots.

A034 (P103) A seaweed biostimulant effect on fruit set and fruit yield on two pear cultivars in Spain

Asín, L.[1]; Torres, E.

[1]IRTA-Estació Experimental de Lleida, Avda. Rovira Roure, 191 25198 Lleida (SPAIN). luis.asin@irta.es

During two years it was studied a seaweed biostimulant (SB) effect on fruit set and fruit yield in Conference and Abate fetel orchards. Studied strategies were SB, SB +Prohexadione-Ca, SB+Prohexadione-Ca+GA3, a standard fruit set strategy (Prohexadione-Ca+GA3) and an Untreated Control (UTC). In Abate fetel GA3 was substituted by GA4/7+6BA (Promalin). Fruit set was evaluated on one hand on marked branches, from blossom until the end of June, and on the other hand another fruit set evaluation at harvest on the whole tree. It was also determined yield (kg/tree and fruits/tree), fruit weight.

SB increased fruit set in Abate Fetel-2007. There was a significant increase on fruits/tree at harvest, in the comparison UTC vs. SB. In Conference-2008 there was a significant increase in number of fruits/clusters on the marked branches, in the comparison UTC (1,3 fruits/cluster) vs. SB (1,6 fruits/cluster). In the same experiment it was detected a significant increase in the final fruit yield, with 30,3 kg/tree in the Standard strategy (Prohexadione-Ca+GA3) and 34,7 kg/tree in the Standard+ biostimulant strategy.

In reference to fruit weight, it was registered a significant increase in Conference-2007 in comparisons UTC vs. SB and Standard vs. Standard+SB with similar crop load. This improve average on fruit weight was around 10%. In Abate fetel-2007, there was difference on crop load in favor to SB, despite this situation there was no negative effect on fruit weight.

Finally, the studied seaweed biostimulant has showed the capacity to increase fruit set or fruit weight on both pear cultivars.

A035 In vitro and in vivo bio-stimulatory properties of a Lupinus albus L. seed suspension and identification of active substances

E. Van der Watt[1], J.C. Pretorius[1], R. Janse van Rensburg[2]

[1]Department of Soil, Crop and Climate Science, P.O.Box 339, University of the Free State, Bloemfontein, 9300, SOUTH AFRICA (vdwatte@ufs.ac.za – pretorjc@ufs.ac.za)
[2]Department of Plant Sciences, P.O.Box 339, University of the Free State, Bloemfontein, 9300, SOUTH AFRICA (JRensburgR@ufs.ac.za

Future food shortages may only be overcome by increasing productivity on available land as opposed to acquiring more arable land or by increasing irrigation practices. To achieve this, alternative techniques will have to be developed by which crop plants can be manipulated. Already a tendency towards organic farming, due to resistance of consumers towards transgenic plants and inorganic chemicals, has paved the way for screening wild plants in order to develop natural products for this cause. Natural bio-stimulants from plants might supply the solution. We screened extracts from wild plants for the potential to manipulate growth and productivity in agricultural crops. Initial screening tests included the stimulation of respiration rate in monoculture yeast cells and seedling growth in a variety of crops. This has lead to the identification of a *L. albus* L. seed suspension (SS) that showed highly significant *in vitro* bio-stimulatory properties. By means of *in vivo* field trials, using four vegetable crops and two row crops, growth and yield enhancement following treatment with SS confirmed its application potential for the agricultural industry. Subsequently, the active compound responsible for the bio-stimulatory activity was isolated and purified by means of activity directed chromatographic techniques. The active compound was identified as a triglyceride, glycerol-trilinoleate, and its structural formula elucidated by means of nuclear magnetic resonans (NMR) spectroscopy. It was additionally shown that foliar treatment of wheat with the active compound induced the fivefold expression of a novel chloroplast gene associated with a membrane stabilizing mechanism under heat stress.

A036 (P041) GROWTH, YIELD AND PHYSIOLOGICAL RESPONSE OF DIFFERENT CROPS TO TREATMENT WITH A PLANT GROWTH REGULATOR ComCat®

J.C.Pretorius[1], E. van der Watt[1], T. Hüster[2]

[1]Department of Soil-, Crop- and Climate Sciences, Faculty of Natural and Agricultural Sciences, University of the Free State, P O Box 339, Bloemfontein 9300, SOUTH AFRICA (pretorjc@ufs.ac.za – vdwatte@ufs.ac.za)

[2]AgraForUm Vertriebs GmbH, Kakenstorfer Weg 4, Dohren 21255, GERMANY (mail@agraforum.com)

A recently commercialized natural bio-stimulant, ComCat®, that contains three active brassinosteroids (BRs), was scrutinized for its potential to be applied in the agricultural industry under semi-arid conditions. Several bio-tests were employed to quantify the bio-stimulatory activity of ComCat® under laboratory and glasshouse conditions at different concentration levels. The 200 g ha^{-1} application repeatedly emerged as the optimum concentration in terms of contributing towards growth in all of the parameters measured. Treatment with ComCat® had little or no effect on seed germination, but especially root growth of seedlings from different crops was significantly and consistently induced. Subsequently, two cultivars for each of five test crops were treated with ComCat® over two growing seasons under field conditions in order to ascertain their yield response. Some of the test crops, but not all, showed cultivar sensitivity to treatment with ComCat®. However, overall the significant yield increases measured in one or both cultivars of the five different test crops and in one or both seasons confirmed the potential of ComCat® to be applied in agriculture. Physiological data on the effect of ComCat® on photosynthesis and respiration as well as genetic data on the resistance towards abiotic and biotic stress conditions will be supplied as partial explanation of its mechanism of action. It was concluded that ComCat® can be regarded as a useful tool to manipulate agricultural crops and to contribute to economic prosperity for a farmer.

A037 (P021) ROLE OF POLYAMINES ON FRUIT SETTING AND FRUIT GROWTH OF GRAPEVINE AND APPLE TREES

Laurence GENY and Cholet CELINE

Univ.de Bordeaux, ISVV, EA 4577,Unité de recherche Œnologie,INRA,ISVV,USC 1219 Œnologie,210 Chemin de Leysotte , CS 50008, Villenave d'Ornon 33 882, FRANCE laurence.geny-bordeaux2.fr

The involvement of polyamines (PA) in higher plant reproduction has been widely demonstrated in several crops of relevant economic importance. Polyamines are involved in the biochemical control of events leading to gametophyte formation and fruit development, and all processes that imply intensive growth rate and differentiation. Among the processes that regulate flowering and fruit setting, microsporogenesis and pollen tube growth are of a crucial importance affecting yield and regularity of the productivity.
The aim of the present research was to investigate PA involvement in pollen development and germination, in fruit setting and fruit growth in grapevine and apple tree. Pollen germination and tube growth, PA contents, PA biosynthetic enzymes activities (PAO, DAO) levels and fruit setting were investigated throughout flowering after exogenous PA or PA biosynthetic inhibitors applications.
Exogenous PA treatments increased pollen tube growth, PA contents and fruit setting while applications of PA inhibitors drastically reduced pollen germination and fruit setting. The present study therefore clearly demonstrates a positive correlation between polyamine metabolism, fruit setting and final fruit quality.
The results could have practical outcomes owing to the cultural practices, such as in treatments with physiological activators of nutrition and fruitsetting aimed to overcome the fruit quality problems related to fruit setting.

A038 Effects of CPPA on Plant Growth Under Abiotic Stress Conditions

Terry Hanson1, Kenneth S. Day2, John Bradley3, Rachel Sleighter4, and David Holden5

1FBSciences, 153 N. Main, Suite 100, Collierville TN, 38017, USA (terry@fbsciences.com)
2FBSciences, 153 N. Main, Suite 100, Collierville TN, 38017, USA (kday@fbsciences.com)
3FBSciences, 153 N. Main, Suite 100, Collierville TN, 38017, USA (jbradley@fbsciences.com)
4Old Dominion University, Department of Chemistry and Biochemistry, Norfolk, VA (rsleight@odu.edu)
5Holden Consulting, P.O. Box 1437, Camarillo, CA, 93011, USA (calcropdoc@yahoo.com)

Complex polymeric polyhydroxy acid (CPPA) is a biologically active heterogeneous mixture of organic compounds (CAS Number 1175006-56-0) isolated from natural organic matter. CPPA has been studied and characterized using advanced analytical techniques which reveal thousands of low molecular weight (200 to 700 daltons) compounds with high functional group content (primarily phenolic and carboxylic acid functionality).

Many studies have noted the ability of some naturally occurring materials to mitigate abiotic stress. Growth chamber, greenhouse and field studies with CPPA show similar results for abiotic stress induced by factors such as high salt, drought, cold, excess moisture, and nutrient deficiencies. These effects were observed for seed treatments as well as for foliar and soil applications. In the case of salt stress, synergistic effects were noted between CPPA and NaCl.

In replicated trials on various crops, CPPA significantly enhanced plant health as determined by plant vigor, plant size (root and shoot weights and height), and maturity versus untreated plants. Treated plants under drought stress were slower to show drought symptoms and recovered more completely when adequate watering was resumed. A celery study showed a significant decrease in bolting at harvest for treated plants, indicating mitigation of cold stress normally associated with this effect. In field studies conducted on corn with inadequate nitrogen, plants were larger and healthier and yielded significantly better when treated with CPPA. Treated soybean seeds planted in saturated soil emerged faster and more vigorously than untreated seed.

A039 (P033) Effects of CPPA on Plant Growth under Non Abiotic Stress Conditions

Kenneth S. Day1, John Bradley2, Terry Hanson3, Rachel Sleighter4, and David Holden5

1FBSciences, 153 N. Main, Suite 100, Collierville TN, 38017, USA (kday@fbsciences.com)
2FBSciences, 153 N. Main, Suite 100, Collierville TN, 38017, USA (jbradley@fbsciences.com)
3FBSciences, 153 N. Main, Suite 100, Collierville TN, 38017, USA (terry@fbsciences.com)
4Old Dominion University, Department of Chemistry and Biochemistry, Norfolk, VA (rsleight@odu.edu)
5Holden Consulting, P.O. Box 1437, Camarillo, CA, 93011, USA (calcropdoc@yahoo.com)

Complex polymeric polyhydroxy acid (CPPA) is a biologically active heterogeneous mixture of organic compounds (CAS Number 1175006-56-0) isolated from natural organic matter. CPPA has been studied and characterized using advanced analytical techniques which reveal thousands of low molecular weight (200 to 700 daltons) compounds with high functional group content (primarily phenolic and carboxylicacid functionality).

Numerous reports in the literature indicate that low molecular weight substances from natural organic matter can stimulate plant growth. Such effects on plants have also been documented through greenhouse, growth chamber and field studies for CPPA. Optimum rate responses occur as low as 1.0
gram per hectare when applied to either the foliage or soil. Genetic expression studies using microarray
analyses showed that CPPA significantly affected (at p=0.01) and strongly regulated (Fold change >1.5) 486 genes out of a possible 43,633 in *Arabidopsis*.

Greenhouse and field trials conducted on various crops showed significant increases in rooting (as measured by root mass) and vigor during early vegetative growth. Plants treated via soil applications had significantly higher chlorophyll density in greenhouse and field studies on corn and wheat.

In a growth chamber study, CPPA treated soybean seeds produced plants with significantly larger (20%) nodules, and in field studies, treated soybean seeds resulted in a significantly greater number of nodules, and higher yields. Ninety four replicated field trials on corn conducted across North America over a 5 year period showed yield increases in 80% of the trials with an average increase of 9.2 bushels per acre.

A040 (P020) IMPROVE THE EFFICIENCY OF USE OF FERTILIZERS BY THE PLANTS:

ACTION OF A PHYSIO-ACTIVATOR, EXAMPLE ON WHEAT Arnaud Labarre1

1 Laboratoires GOEMAR, Parc Technopolitain Atalante St Malo – CS 41908 St Jouan des Guerets, SAINT MALO, 35419, France (arnaud.labarre@goemar.com)

Each fertilizer contribution in the field is used by the plant with a certain efficiency. The increase of this efficiency of use can allow the plant to either reach higher yield or maintain it in a situation where fertilizer contribution is limited.

If the first hypothesis is crucial for the farmer, the second is nonetheless interesting for certain situations such as those subject to the Agro-Environmental measures. So, it's well advised to provide a solution that allows to increase the efficiency of use of fertilizers by the plants.

The interest of "Physio-Activator" Technology, developed by Goëmar Laboratories, was demonstrated at the laboratory as well as in the field, on its fructification, fruitset or even growth stimulation functions, on different plants. In addition, Goëmar Laboratories have tested in the field, since 2010, the efficiency of a Physio-Activator to improve the efficiency of mineral nutrition, first of all nitrogen on wheat. Tests were carried out on both hypothesis and show how Physio-Activators improve the efficiency of use of fertilizers by the plants.

A041 (P023) Title of Paper: PHOSCO – A Biological Nutrient Enhancer, can act as a Bio-Stimulant, a PGPR as well as Induce Systemic Resistance in the soil – roots – plants eco-system.

The main focus of my presentations/ talks is on:

The soil on Earth is a source of all nutrition, necessary for growth and development in plants, except Carbon. Numerous mineral and organic particles having different sizes, make up the soil structure, which is divided into pores by the presence of moisture and soil air. Mineral particles are included in soil agglomerates which are covered by colloids, organic-mineral gel and microorganisms. Micro-organisms play a great influencing role in soil fertility.

The use of phosphate solubilizing bacteria as biological nutrient enhancers increases Phosphorous uptake by the plant and thus, crop yield. The most powerful bacterial strains known for phosphate solubilisation are Pseudomonas, Bacillus and Rhizobium. The primary mode of action for mineral phosphate solubilization is the production and secretion of organic acids, and acid phosphatases into the soil, playing a major role in solubilising organic phosphorous in soil.

It is well studied that plant growth promotion is also done by bacteria being able to solubilise Phosphorus in the soil. The production and secretion of other metabolites beneficial to the plant, such as phytohormones(like auxins, gibberellins and cytokinins), antibiotics, or siderophores, reduction of membrane potential of the roots, synthesis of some enzymes (such as ACC deaminase) that modulate the level of plant hormones, expression profile of several plant defense-related enzymes/ proteins like superoxide dismutase (SOD), peroxidase (POD), catalase (CAT), polyphenol oxidase (PPO) and phenylalanine ammonia-lyase (PAL), chitinase and b-1,3-glucanase, enhanced hydrogen peroxide production, among others, has created confusion about the specific role of phosphate solubilisation in plant growth, yield stimulation and ISR leading to bio-control of diseases.

I will attempt to present PHOSCO a biological nutrient enhancer, which has been proven by means of Laboratory tests and field trials in Asia and Europe to:

- increase the availability of Phosphorus in the soil;
- produce phytohormones;
- secrete plant defense related enzymes/ proteins.

A042 (P110) Selection of plant growth promoting endophytic bacteria for lentil and chickpea plants

L. Oualkadi[1], E. Berraho[1] and J. Aurag[1]
[1] Laboratory of Microbiology and Molecular Biology, Faculty of Science, University Mohammed V-Agdal, BP 1014, Rabat, Morocco. (oualkadi.lamiae@gmail.com, berrahobek@yahoo.fr, auragjamal@yahoo.fr)

In order to understand the role played by plant endophytic bacteria and to screen for potential plant growth promoting strains, we have studied the biological activities of a collection of 104 endophytic strains isolated from nodules of chickpea and faba bean plants. Activities studied included phosphate solubilization (PS), siderophore production, indole-3-acetic acid production (IAA) and 1-aminocyclopropane-1-carboxylate (ACC) deaminase activity.

Most of the strains tested had some PS activity in Pikovskaya solid agar medium. Contrariwise in liquid medium, only few strains produced high levels of soluble phosphate like strains RM49, T22 and T16. The maximum amounts of soluble phosphate produced were respectively 228 mg/l, 99 mg/l and 79 mg/l for natural, tricalcium or bicalcium phosphates. These results may be explained by the ability of these strains to produce more powerful organic acids in the growth media.

Several strains are very promising for IAA production from tryptophan compared to the values reported in the literature, the highest strain (OLJ19) produced 142,5 µg/ml.

Most of the strains gave also positive reactions for siderophore production on an iron free medium (62%), while several strains showed a positive ACC deaminase activity (T11, RM49, T13 and T16 produced 0.22 mmol of α-ketobutyrate).

The most active bacteria are being tested under controlled conditions in inoculation experiments of chickpea and lentil, either alone or in association with rhizobia (co-inoculation), in order to evaluate their potential for a sustainable plant growth.

A043 (P069) Selenium in plant nutrition – essential micronutrients, biostimulants or toxic element?

L. Skrypnik[1], G. Tchoupakhina[2]

[1]Immanuel Kant Baltic Federal University, Universitetskaya str., 2, Kaliningrad, 236038, Russia, LSkrypnik@kantiana.ru .
[2]Immanuel Kant Baltic Federal University, Universitetskaya str., 2, Kaliningrad, 236038, Russia, GChupakhina@kantiana.ru .

Selenium is a trace element that is an essential nutrient for many organisms, especially for humans and animals. However the essentiality of selenium for higher plant is still under debate.
During last two decades the physiological and biochemical role of selenium in plants has been explored by researchers. There are a number of facts confirming positive influence of selenium on various life processes. Thus, it has been established that selenium increases antioxidant potential and stress-resistance of plants, stimulates their growth in the conditions of oxidation stress caused by high light intensity, plant's ageing, zinc- and copper-deficiency. There has been noted increase of yield level of barley plants further to application of low concentrations of selenium. Positive effect of selenium is also revealed in increased germinating capacity. In the presence of selenium lipid membrane peroxidation processes in conditions, for example of high light intensity, are reduced, testifying to the effect that selenium has an influence on oxidation-reduction cell status. Recently, the role of selenium as an antioxidant has generated a wide interest in it. In contrast at high concentrations, selenium acts as pro-oxidants and leads to drastic reduction in yield. So selenium addition in low concentration increased the stress tolerance of some plants, for example barley, celery cabbage, red clover, to different abitioc factors that it can be used as a biostimulant.

A044 (P034) Biostimulant enhanced ammonia provides cost reductions to agriculture production

Presenting Author[1]: Gary Murdoch-Brown

[1]EcoCatalysts Pty Ltd, 25/193 South Pine Rd, Brendale, 4500, Australia (gmb@ecocatalysts.com.au)

Abstract:

The use of biostimulants for enhancing efficiency of fertilizers has a chequered history with many field demonstrations leaving economic validation wanting. Success of the innovation Black Urea® prompted further research into using carbon bio-catalysts for improving the production economics of irrigated agriculture in Queensland, Australia, where anhydrous ammonia is a common fertilizer used in flood irrigation systems.

Anhydrous ammonia is a toxic gas applied to soil under temperature controlled pressure. This has a deleterious impact to the soil organic matter and biota which facilitate fertiliser use efficiency. By mixing a modified humate base and bio-catalysts (EnhanceMax™) with anhydrous ammonia during its application, we can reduce the impact and stabilise the ammonia as ammonium complexed with organic matter and stored as heterotrophic protein.

This capture, control and store mechanism can reduce the environmental losses of fertilizer nitrogen and promote a more sustained availability of nitrogen to the rhizosphere. Current two year commercial scale demonstrations in irrigated cotton have produced equivalent yields to usual practice even when reducing application rates by 20%. This has reduced the cost of nitrogen per production unit (bales of cotton lint) by >10%.

This improved nitrogen use efficiency not only improves the growers' production economics, but improves global goals by directly impacting the reduction in carbon footprint due to fertilizer use.

KeyWords:

biostimulants, anhydrous ammonia, humate, nitrogen use efficiency, Black Urea

A045 (P091) Effects of a specific seaweed extracts on growth, yielding and fruit quality of sweet pepper growing in non-heated tunnels

Agnieszka J.Stepowska
Research Institute of Horticulture, Konstytucji 3 Maja 1/3, Skierniewice 96-100, POLAND (agnieszka.stepowska@inhort.pl)

The annual production of sweet pepper in Poland counts 70-80 thousand tons, from cultivation with limited stem cutting system, in non-heated tunnels. Due to uncontrolled climate conditions the plants are exposed to different types of stress. The use of biostimulants is an opportunity to improve the physiological condition of plants and enable them to make the best yield in difficult growing conditions.
In 2007 and 2008, a seaweed filtrate was applied to pepper's seedlings. The measurement results of morphological parameters showed that the tested filtrate had a positive impact on the growth of roots, stem and leaves of seedlings as well as the yield of first harvest in comparison to only watered young plants.

In a second experiment, from planting to first harvest (May-July), plants were watered three times at 0.1% filtrate concentration, and during flowering (June-July) and sprayed with 0.1% seaweed cream. Separately, plants were only watered with the filtrate or sprayed with the seaweed cream. The average weight of Ist class fruit, Ist class yield, marketable and total yield was evaluated at Ist picking time and during the whole harvest period.
The best influence on all fraction of pepper's yield had plant sprayed with seaweed cream and treated with both extracts of Ascophyllum nodosum.

In 2009-2011, 0.5% Seaweed cream was also used during pepper fruiting stages. Fruit colouring acceleration was obtained as well as improvement of sensory attributes (QDA met.)

A046 (P042) Innovative bioorganic preparations for agriculture.Experience of practical use in Russia.

Victor Mokhov and Elena Fomicheva, “GREENTEC LTD”, Russia, kvartal 95-2, Volzhsky blv., Moscow, 109125, e-mail: info@greentecltd.ru

Company “GREENTEC” is engaged in development of innovative technologies for treatment of various organic wastes since 1996. Our targets are to utilize waste and to use waste as raw material for production of new value added products.High level of our investigations is proved by a number of Patents.New approaches to implementation of process of microbiological processing of organic substance and a number of the applied design and technological innovations, have allowed intensifying the process significantly, to increase a degree of organic conversion and have led to development of the new technologies of microbiological synthesis. These innovative technologies provide a possibility to produce new unique bioorganic preparations (EAPO patent 014222, PCT publication WO 2011/084085 A1).By now the company has developed, tested and prepared for wide use at the different markets the following preparations:

- for presowing treatment of seeds, tubers and bulbs – “PRORASTYN”
- for foliar application – “POLISTYN”.
-

High efficiency of preparations is caused by their unique composition. Both of preparations contain significant amounts of plant hormones having natural origin (auxins, gibberellins and cytokinins) in a combination with humic and fulvic acids. The above preparations combine properties of an effective plant growth and crop stimulator, of adaptogen and immune response modifier. They possess activity against a wide spectrum of phytopathogens and provide improvement of quality and ecological purity of a crop.The above is proved by the results of field tests carried out during the seasons 2007-2011 in different areas of Russia. All results are statistically significant. These results have allowed us to develop an effective treatment programs for corn, wheat, potato and others. Economic efficiency of application of preparations is caused by the follows:

- cheap cost of preparations,
- low consumption rate per hectare,
- Increment yield and improvement of crop quality are guaranteed.

They have no competitors throughout the world on price-quality ratio.

A047 (P049) EVALUATION OF THE USE OF A BIOSTIMULANT IN ZUCCHINI CROP UNDER GREENHOUSE

Martínez-Gaitán[1], C.C.; Sánchez[1], C.; Galera[1], M.C.; Manjón[1], M.C.; Verde[1], D.

Foundation for the Auxiliary Agriculture Industry TECNOVA, Ctra. Sacramento S/N, La Cañada de San Urbano, Almeria, 04130, SPAIN (ensayos@fundaciontecnova.com)

The greenhouse-based vegetable production industry of the province of Almeria (Southeastern of Spain) is one of the largest concentrations of greenhouses of Europe. It currently has a surface area of 28,500 ha and is responsible for producing 2.5 millions of tonnes of vegetables annually. Zucchini is the third most important crop in this industry. By now it has been customary in this system the use of exogenous hormones (auxins and gibberellins) applied to the crop to promote fruit set of zucchini. New management practices are being adopted in this system for fruit set, alternatives to the use of hormones, such as the use of pollination insects (*Bombus terrestris* and *Apis mellifera*) and contributions of biostimulants. An experimental work is being undertaking during a spring zucchini crop under greenhouse with drip irrigation and fertigation system, to evaluate the effect of combined use of the pollinator insect *Bombus terrestris* and a biostimulant produced from industrial waste meat in zucchini crop. Flowering, fruit set, biomass production, quantity and quality of fruits obtained are being measured. The evaluated biostimulant is being applied weekly, via leaf and by the drip irrigation system. Three doses of the biostimulant are being applied and its effects are being compared with those obtained with other biostimulant widely used in the area of study.

A048 (P052) Jasmonic acid and benzoic acid may to induce changes on watermelon fruit quality under greenhouse conditions.

Fernando Toresano-Sanchez[1], Humberto Bojórquez-Pereznieto[1-2], Fernando Diánez Martínez[1], Francisco Camacho-Ferre[1]*

[1] *Research Group of Plant Production in Mediterranean Crop Systems, Superior Engineering School, University of Almería, 04120 Almería, Spain.*

[2] *Agricultural Sciences Academic Division, Juarez Autonomous University of Tabasco. Centro, Tabasco, México. Tel (34) 950015928*

**e-mail: fcamacho@ual.es*

Abstract

The abiotic stress is one of the most important cause of the lower production In watermelon crops of southeastern of Spain, It is the cause of fruit quality limitation, so is important to study the behavior of some bio-stimulants on the crops. JA & BA have influence in many fisiological process in plants (flowering, madurity, elicitation and defense), JA+BA induce this natural protection and may to reduce the effect of abiotics stresses. We assessed two treatments and a control test. One of them consisted of, T1 (500 JA + 500 BA ppm), and the other one consisted of T2 (2000 JA +2000 BA ppm), using an experimental design of randomized blocks with four replications. It was planted watermelon (*Citrullus lanatus)* cv. queen of hearts. The results obtained for the parameters assessed showed some statistically significant differences during the experiment (2008-2010) The results showed increase in some parameters such as the average fruit weigth, color of pulp and diameter.

Key words: *Citrullus lanatus*, *bio-stimulant*, abiotic stress, Jasmonic acid, Benzoic Acid.

A049 (P053) Effect of biostimulator ASAHI SL on fruit set, yield and fruit quality in apple trees suffered because of spring frost

Basak Alina (1) Mikos -Bielak M. (2) Podymniak A. (3)

1 -Research Institute of Horticulture, 96-100 Skierniewice, str. Pomologiczna 18, POLAND (abasak@insad.pl)

2 - Agricultural University in Lublin, Poland

3 - Commercial Orchard Gosniewice Grojec, Poland

Abstract

Asahi SL, product of Asahi Chemical MFG Co., LTD, is the biostimulant most often used in commercial fruit production in Poland. The active ingredients of this preparation: sodium para-nitrophenolate, sodium ortho-nitrophenolate and sodium 5-nitroguaiacolate, occurre in plants in natural form. Currently, Asahi SL is commonly used in Poland in many crops, including fruit protection against spring frost. The data of six experiments conducted are presented. Two experiments were carried out in 2001. Asahi SL was sprayed on in cvs. Jonagold and Elstar at two locations, at rates 0.1 and 0.05% at four times:1) early spring at bud bursting, 2) at pink bud stage, 3) at the end of blooming, 4) 2 weeks after blooming. In experiment 1 the temperature of – 8^0C occurred and caused damage on 10% of orchard area. Asahi SL significantly increased fruit set and yield in both tested varieties. In experiment 2, no spring frost occured and effect of Asahi SL was less evident. Other four experiments were conducted in 2007 when whole Poland suffered seriously spring frost. In that year average yield of apples was about 25% of the average yield in 2006. In these experiments spring frost occurred two times: -4^0C at green to pink bud stage and between -3 to -8^0C at beginning to full bloom. At such extreme weather condition Asahi SL significantly increased fruit set and yield of all tested cvs. Golden Delicious, Ligol, Early Geneva and Jonagored. In numerous experiments and commercial practice, positive effect of Asahi SL was shown in apples, strawberry, black current and raspberry.

A050 (P043) Comparative study of PGR treatments on Grape Skin and Wine Quality in Vitis vinifera L. cv. Cabernet-Sauvignon in Maipo (Chile) and Bordeaux (France)

González A.S.1, Bordeu E.1, Alcalde J.A.1, Geny. L2
1Facultad de Agronomía e Ingeniería Forestal, PUC, Casilla 3006-22, Santiago CHILE (agonzalr@uc.cl)
2Université de Bordeaux, ISVV, EA 4577,Unité de recherche Œnologie. INRA, ISVV, USC 1219 Oenologie, 210 Chemin de Leysotte, 33882 Villenave d'Ornon Cedex, FRANCE (laurence.geny@oenologie.u-bordeaux2.fr)

Treatment of wine grapes with plant growth regulators is a potential tool for modifying grape and wine composition. Hormonal balance of developing grapes depends on environmental conditions and impacts phenolic composition of grape skins. In the present work, we report the effects of low dose abscisic acid (ABA) and 2-chloroethylphosphonic acid (CEPA) treatments, applied ten days after anthesis and at veraison, in two contrasting environmental conditions as are Bordeaux (France) and Maipo (Chile). The effects of treatments were different in the two regions (Bordeaux and Maipo), probably as a consequence of undetermined environmental conditions. At Bordeaux, early-CEPA treatment increased TSS levels (+ 1.6ºBrix) and total and 3-O-glycosylated anthocyanin compounds (up to + 101%), while veraison CEPA treatment reduced TSS levels (– 2.43ºBrix) and had no impact on anthocyanins. Early-ABA treatments increased tannin content (+47%) at veraison and veraison ABA treatment reduced tannin content at ripeness (-55%). The effects of treatments on Maipo grapes and wine chemical composition were limited, but some effects on sensory parameters were found: early-ABA and veraison CEPA treatments increased vegetal aroma, whereas early-ABA treatment reduced bitterness.

A051 (P108) Characterisation of microbial and agronomic effects of biofertilizers

Najat NASSR

RITTMO Agroenvironnement 37 rue de Herrlisheim, 68000 Colmar- France (najat.nassr@rittmo.com)

Plant rhizosphere is a preferential niche for various types of microorganisms in the soil. In the context of increasing environmental quality the use of biofertilizers for reducing chemical inputs in agriculture is a potentially important issue. Plant growth-promoting rhizobacteria (PGPR) are known to influence plant growth by various direct and indirect mechanisms. In search of efficient biofertilizers with multiple activities, microbial inoculants were evaluated either alone or together with organic and inorganic fertilizer.

For this purpose different bioassays were conducted at the laboratory scale in well controlled conditions on fertilizer formulations: (i) to assess the bioassociative effect on seed germination and root length using whinRhizo or plant growth and nutrients uptake, (ii) to screen the efficient formulation by evaluating the solubilisation of minerals such as phosphorus and by chelation of iron to make it available for the plant, (iii) to measure the effect of biofertilizers on the activity of nitrifying bacteria and the genomic structure of the bacterial communities of soil through Thermal Temporal Gel Electrophoresis (TTGE).

In addition standards based on the soil nitrification potential and the growth of microbial plant symbiosis could be performed to check the compatibility of the biofertilizer with soil microorganisms.

Examples of all these assays conducted on various biofertilizers in the framework of putting them on the market via French registration (homologation) will be presented.

A052 (P061) "Aurora Tropical": integrating the use of biostimulants in ecological horticulture, the case of fruit extracts and chitosan in pepper seedling production

Ramirez-Guerrero, H.O.*(1), Santana-Gudiño, Y.A. (1), Meza-Figueroa, C.A.(1)(1) Departamento de Fitotecnia, Decanato de Agronomia, Universidad Centroccidental Lisandro Alvarado. Zip Code 400, Cabudare estado Lara, Venezuela.

Corresponding author: hramirez@ucla.edu.ve

Abstract

Despite recent reports pointing to the fact that tropical countries will suffer most from the negative impacts of climate change and therefore all the numerous educational and research campaigns, current surveys examining trends in good horticultural practices use show that the majority of the tropical vegetable growers are still using the conventional way for production. Thus, in this tray experiment a commercial horticultural substrate (peat moss, P) was enriched with watermelon (WJ) and orange (OJ) juices and Chitosan (CB, Biorend®: Bioagro, Chilean company) for producing bell pepper seedlings. Six different doses (v/v) of biostimulants (B) were tested: control dose (Do: without B. 5 P: 1 water; 5:1), D1 (5 P: 1 OJ), D2 (5 P: 1 OJ solid wastes), D3 (5 P: 1 WJ), D4 (5 P: 2 WJ) and D5 (5 P: 1 CB solution at 5 %). Various seedling growth parameters were measured in order to assess the seedling quality. The height of seedlings cultivated in D3 and D4 performed better than in all the other treatments, followed by D5 and D1. Also greatest total number of leaves (nol) and fresh weight of aerial organs (afw) were achieved with D3 and D4. The treatments Do, D1 and D2 showed the lowest nol and afw. Root fresh weight was significantly higher in D3 and D4 than in the others, including the control treatment. It was found that root dry weight was significantly similar in all the evaluated treatments. No differences observed between Do and D1, D2 and D5 could be associated to their high and toxic concentrations (mainly citric acid, OJ case). Results from the study suggest that introducing new, appropriate and balanced biostimulants doses is a crucial horticultural practice for the production of vegetable seedlings. Further research is recommended on integrated seedling biofortification, using other commercial biostimulants.

A053 (P024) Tomato seedling growth and leaf nutrient uptake using biostimulants and different nutrient solutions in the tropics

Meza-Figueroa, C.A.[(1)], Bullones-Montilla, F.J., Ramirez-Guerrero, H.O.*[(1)]

[(1)] Departamento de Fitotecnia, Decanato de Agronomia, Universidad Centroccidental Lisandro Alvarado. Zip Code 400, Cabudare estado Lara, Venezuela.

*Corresponding author: hramirez@ucla.edu.ve

Abstract The use of a proper nutrient solution is a key factor in achieving the production of vigorous seedlings and subsequently obtaining profitable yields. It is true indeed when producer says: "A good seedling is 50% of the production". However, management of vegetable seedlings nutrition in Venezuela and most tropical countries is seldom practiced, or it is carried out empirically, without any planning. The influence of biostimulants and different nutrient solutions on the growth of tomato seedlings and leaf nutrient uptake was investigated in an experiment conducted at a commercial nursery farm located in Quibor, Lara state. The treatments were (1) tap water alone (TW); (2) conventional grower nutrient solution (C); (3) Wye nutrient solution (W); (4) W+TW (dW; concentration of 50 %), and (5) biostimulant solutions (Viva from Valagro S.p.a, sugarcane molasses, Carbo-Vit from Humus Liquidos-Mexico, Liquid Vermicompost from cattle manure and honey bee) using individual 200-plastic transplant trays filled with the conventional growth media (Canadian peat + coir dust). It was found that the seedling height was significantly higher in dW solution than in the other treatments, including the control (TW) solution. Similar response was found with the stem diameter and dry weight of aerial organs for the W solution. There were no differences on the total number of leaves and root dry weight. The lowest seedlings leaf area (LA) was showed with TW. Regarding leaf nutrient uptake; plant tissues accumulated more Nitrogen and Potassium when W was used. There were no differences on the total nutrient uptake of Phosphorus, Calcium and Magnesium. No differences observed among biostimulant solutions, C and TW could be associated to some nutrients supplied from peat mainly. Further research is recommended on balanced, integrated and planned seedling fortification and fertilization, using other biostimulants and nutrient solutions (organic and mineral) and alternative substrates.

A054 (P057) Rapid Evaluation of the Effects of Biostimulants using Algal Outdoor Pond Cultures

G Karthik Vijayakumar, J Sharon Mano Pappu, M Fazila Jamina and V Ramamurthy

PSG College of Technology, Coimbatore 641004, India (ram@bio.psgtech.ac.in)

Abstract: Development of inputs for sustainable agriculture has opened new avenues for crop management. It calls for new approaches to augment plant nutrition which are cost competitive, enhance agricultural output and at the same time maintain soil and water ecosystems. Biostimulant development calls for testing systems with short turnaround time during which both agricultural productivity as well as impact on ecosystems could be assessed. Towards this objective we have initiated a simpler photoautotrophic test system.

The effects of supplementing three different products - Megacal™, BioPhos™ and New Suryamin™- on the growth of *Spirulina platensis* were evaluated. These could be studied in short cycles of 7 to 10 days for many cycles. Megacal enhances availability of divalent cations during the vegetative growth phase of crops; BioPhos provides essential phosphates; New Suryamin is an organic nitrogen and nutrient complex. Observations over a period of three cycles of growth showed average yield improvement over untreated control cultures of 9.0% for Megacal, 10.4% for BioPhos and 16.0% for New Suryamin, respectively. Assimilation of Megacal and New Suryamin and increased growth rates were without any delay. However, in the case of BioPhos the algae required about 7 days to adjust to the supplementation followed by higher growth rate. Nutrient uptake studies indicated accelerated uptake of phosphates in the case of BioPhos and New Suryamin, in proportion to the biomass produced. In summary, algal test systems provide a facile and rapid test system to evaluate performance of Biostimulants.

A055 (P025) Biostimulation used on a systematic way for improving production and quality in the rose business

Christian Hiller-Bernal

Foligrin S.A., Elia Liut OE 3-92, Quito, Ecuador. (christian@foligrin.com)

There are productivity limits with traditional ways of plant fertilization. A novel approach of physiological optimization is required to obtain increases. This can be reached using nontraditional options in its metabolism.

We propose a scheme of systematic use with 6 biostimulants. The main strategy is based on maintaining the entire plant components permanently hydrated. These biostimulants have been designed specifically to fulfill certain commercial goals. That includes the following: synchronization in demand-supply in amount, quality and time, handling physiological goals as general increase and vertical conformation of foliar area, coordinated sprouting, stable metabolic operation during adverse climate, correct formation of the flower button and coloration according to variety, among others.

The mentioned biostimulants consist of: A rooter that maintains the capacity of absorption by diffusion, a located inducer of sprouting and another of foliar use, an enlarger of stem and leaf that in addition maintains the production cycle, a thickener of stems and an activator of phytoalexins compose the program weekly used in the plantations. These products include raw materials such as carbohydrates, hormones, amino acids, vitamins and humic material.

This program assumes an efficient method on fertigation, sanitary and environmental handling in every farm where the products were applied.Production increases vary from plantation to another, depending on the efficiency of the management to react to changes.

One plantation that uses the whole concept since last year has increased its exportable quarterly production between Jan- Mar, 2011- 2012 in 35% with increase of length of 5.6%.

A056 (P104) Activity of laminarin in control of strawberry diseases

Beata Meszka

Institute of Horticulture, Skierniewice 96-100, Pomologiczna street 18, Poland (beata.meszka@inhort.pl)

Grey mould (Botrytis cinerea), leaf spot (Mycosphaerella fragariae) and powdery mildew (Sphaerotheca macularis) are the most common and important strawberry diseases in Poland. Depends on cultivar susceptibility, age of plants and weather conditions, 2 – 5 applications are needed. Resistance problem, residue of fungicides in fruits and protection of environment have required the search for alternative control methods. In the presented research the efficacy of laminarin (linear β-1,3glucan), which is extracted and purified from the brown alga Laminaria digitata, in control of strawberry diseases under field conditions was examined. Experiments were conducted in 2006 and 2008. Laminarin applications reduced B. cinerea infection from 50 to 80% depending on disease severity. Its effectiveness in reduction of leaf spot was about 50% and of powdery mildew 70- 80%. Laminarin can be successfully included in commercial fungicide program. It gives possibilities to reduce number of chemical sprays against strawberry diseases, which is very important in Integrated Pest Management (IPM) strategy.

A058 (P058) Root image analysis, a useful tool for the characterization of root stimulant performance

Ludovic Faessel, Laurent Kremer, Jessica Haas, Myriam Sadir

RITTMO Agroenvironnement, ZA Biopôle, 37 rue de Herrlisheim, 68025 COLMAR
ludovic.faessel@rittmo.com

The plant's root system is the organ that ensures hydric and mineral nutrition as well as its anchoring. Many plant stimulants (humic substances, lignosulfonates, seaweed or plant extracts, PGPR/PGPF) claim for root system stimulation. Investigations on the root system are complex because roots are the hidden, underground part of plants. Historically, works on root systems were limited to biomass measures, providing no informations on root morphology. Nowadays, techniques based on image analysis allow very sharp analysis of the root system, which appear very useful to characterize the stimulant efficiency.

The technique used consists in the WinRHIZO® system (Régent Instruments, Québec, CANADA), which is based on the scan of a previously washed root system either in transmitted light (transparency) or in reflective light (basic scan). The image acquisition is followed by a software analysis able to measure five parameters : length, diameter, surface, volume and number of terminals. Indicators are given in total and in detail (by diameter class or colour class). The technique has been tested in our laboratory on several stimulants (plant extracts, lignosulfonates, PGPR…) on different crops (corn, soybean, wheat, barley). For example, it allowed us to prove a significant increase of thin roots (diameter comprised between 0,05 and 0,2mm) when treated with a stimulant. These thin roots correspond to the most active roots in terms of nutrition.

A059 (P111) RhizoVital 42 – Ensures that your plants grow strong and healthy

Reto Fluckiger

Co- author: Philipp Kessler

Andermatt Biocontrol AG, Stahlermatten 6, 6146 Grossdietwil, SWITZERLAND (kessler@biocontrol.ch reto.fluckiger@biocontrol.ch)

RhizoVital 42 contains the soil borne bacteria *Bacillus amyloliquefaciens.* These bacteria use plant sugars and amino acids for their own growth, and compete in the root area with other bacteria and fungi for nutrients and space. Thus, the application of RhizoVital 42 can effectively suppress soil borne diseases caused by Fusarium, Rhizoctonia, Verticillium or Phytophthora. Furthermore B. *amyloliquefaciens* promotes root growth by releasing hormones and enzymes for nutrient mobilisation, which leads to a healthier growth of young plants and better yield. RhizoVital 42 can be applied in horticulture and agriculture by spraying, drenching, coating or injecting into hydroponics. A large number of field trials on a broad range of different crops reveal the positive effect of RhizoVital 42, which will be presented in a review of results from selected crops.

A060 Rhamnolipids elicit plant defense responses and enhance resistance against biotrophic and necrotrophic phytopathogens

Sanchez Lisa, Courteaux Barbara, Clément Christophe, Baillieul Fabienne and Dorey Stéphan

URVVC-EA 4707, Stress, Défenses et Reproduction des Plantes, Université de Reims Champagne-Ardenne, BP 1039, F-51687 Reims cedex 2, France stéphan.dorey@univ-reims.fr

Rhamnolipids (RL) are amphiphilic secondary metabolites produced by some bacteria including Pseudomonas species. They are involved in biofilm formation, swarming motility, hydrocarbon uptake and are also known as virulent factors. Because they are potentially at the plant cells-bacteria interface, we investigated their role as MAMP (Microbe-Associated Molecular Pattern) recognized by plant cells. The effect of RL was first assessed in grapevine. In this plant, RL stimulate Ca2+ influx, mitogen-activated protein kinase activation and reactive oxygen species production that form part of early defense signalling events. RL also induce the expression of a wide range of defense genes. In Arabidopsis thaliana RL stimulate the production of signal molecules like salicylic acid (SA) and jasmonic acid (JA) and the expression of typical defense marker genes. RL efficiently protect grapevine plants against the necrotrophic pathogen Botrytis cinerea. Arabidopsis plants treated with RL are more resistant to this fungus, to the biotrophic oomycete Hyaloperonospora arabidopsidis and to the hemibiotrophic bacterium Pseudomonas syringae pv. tomato. Using Arabidopsis mutants and transgenic lines we found that RL-mediated resistance involves separated signalling pathways that depend on the type of pathogen. In addition to the activation of plant defense responses, antimicrobial properties of RL are thought to participate in the protection against the pathogens. RL are well known as biosurfactants in the industry. They are used for a wide range of applications including bioremediation of pollutants. Because they have both, elicitor and direct antifungal properties, RL have the potential to be part of alternative strategies in order to reduce or replace pesticides.

A061 BIOSTIMULANT ACTIVITY OF HYDROLYZABLE TANNINS FROM SWEET CHESTNUT (*Castanea sativa* Mill.)

Bargiacchi E.[1], Miele S.[2] , Bertola R.[3]

[1]*Consortium I.N.S.T.M., Via G. Giusti 9, I-50121 Firenze;* [2]*Department of Agronomy & Agro-ecosystem Management, University of Pisa, I-56124 Pisa;* [3]*Gruppo Mauro Saviola, I-Viadana (Italy)*

Sweet Chestnut raw extracts, high in hydrolyzable tannins (HTs), hot water-extracted from untreated wood and reverse osmosis-concentrated, are presently used in transplanted crops as a starter treatment. In comparative tests, they proved to be as good as an ordinary starter fertilizer application, to boost early plant growth, rooting, phosphate uptake, and enhance plant resistance to nematodes. In soils infested with gall nematodes, an application program includes: a treatment in drench water, and 3-4 applications in microirrigation. Mechanisms of the increased plant resistance are presently under investigation, and some preliminary hyphotheses are presented. These raw extracts represent an interesting, natural alternative for agrochemical residue-free crop products, and agro-environmental-oriented crop programs of advanced agricultures. The brand name "*Saviotan. Nutraceutical for crops*" well describes their action.

To formulate more use-oriented products, several whole water extracts and process streams, obtained by membrane separation technology, were analyzed and characterized, using HPLC/DAD/ESI-MS methods. Individual polyphenols were identified using their retention times, and both spectroscopic and spectrometric data; quantitation was directly performed by HPLC/DAD, using regression curves built with the available standards. Each one of the analyzed fractions was tested for its antioxidant and antiradical activity. The properties of the extracts, streams, and selected fraction mixtures were evaluated as biostimulants. Improved formulations of standardized tannin fractions had more consistent positive effects on plant resistance to biotic stress, and particularly nematodes. Fractions for direct spraying on crops, to inhibit some biochemical-related spoiling processes, and improve safety and quality of plant products, are presently under investigation, and patent pending.

A062 ENDOPHYTIC COLONIZATION OF BACTERIA INDUCE DROUGHT-STRESS TOLERANCE IN MAIZE

Birgit Mitter[1], Naveed Muhammad[1] and Angela Sessitsch[1]

[1]AIT Austrian Institute of Technology GmbH, Bioresources Unit, Konrad-Lorenz-Strasse 24, Tulln an der Donau, A-3430, AUSTRIA birgit.mitter@ait.ac.at

Drought is a potential major constraint to maize production in all areas where it is grown. Global warming, deforestation, and urbanization will all increase the severity and frequency of drought in the future, leading to a possible decrease in global food production at the same time that increasing human population demands an increase in food supplies. Therefore, there is an urgent need for drought stress tolerance to ensure optimal yield.

We here present our work on the use of bacterial inoculants to increase drought stress tolerance in maize. The plant-growth promoting endophyte *B. phytofirmans* PsJN was tested on two different maize cultivars (Kaleo and Mazurka). Surface-sterilized maize seeds were primed in bacterial suspension for 4 hours. Control seed were soaked in sterile broth. The seeds were planted in pots filled with 15 kg soil and recommended dose of NPK fertilizers were applied. Drought stress was applied by withdrawing water after 48 days of planting for 14 days. Agronomic and physiological data were recorded before/after harvesting. Plant colonization by the applied bacteria was monitored by microscopy and plate-counting assays.

Microbial inoculation resulted in up to 55% increase in the biomass of maize as compared to the untreated control under drought stress. The photosynthesis activity was up to 67% higher in inoculated plants than in the untreated control. In conclusion, our study clearly demonstrates that bacterial inoculants could be used to minimize the negative effects of drought stress on growth and photosynthesis of maize.

A063 (P027) Effect of Sowing date, Variety and Rate of Growth Stimulant on overwinter Survival and Yield of Winter sown Oilseed rape in Poland.

Jaroslaw Skoczynski[1] Roman Krawczyk [2],Kazimierz Adamczewski[3],David Foster[4],Dr David Cameron[5].

[1]Dalgety Agra Polska, ul. Heleny Szafran 6, 60-693 Poznan, POLAND jaroslaw.skoczynski@dalgety.com.pl

[2,3] Institute of Plant Protection, 60-318 Poznan, ul. Wladyslawa Wegorka 20, POLAND (roman.krawczyk@ior.poznan.pl).

[4,5] De Sangosse Ltd,Hillside Mill, Quarry Lane , Swaffham Bulbeck, Cambridge ,CB25 0LU, UNITED KINGDOM.(david@desangosse.co.uk-dfoster@desangosse.co.uk)

Abstract

Winter Oilseed rape is an important crop in Polish agriculture with up to 600 thousand hectares drilled (5.5% of the total arable area). Lack of winter hardiness can be a problem if establishment in the Autumn is poor or delayed ; and survival is positively correlated to short distance between root collar and apical bud , and increasing diameter of root crown .This work carried out over three years (2005-2007) investigated the effects of delayed sowing , open pollinated versus F_1 hybrid varieties , and three rates of a trace element / growth promoter formulation, which in previous trials had shown positive effects on increasing winter survival and yield . Weather conditions and especially supplies of adequate moisture, had the greatest effect on crop development pre-winter, closely followed by drilling at the recommended date. Both gave increased dry weight of leaves, roots and thicker root collars. The extra vigour of the hybrid variety gave increased leaf and root weight compared with the open pollinated variety , but was offset by increased apical bud to root collar distance, which resulted in a similar winter hardiness to the open pollinated variety. . The application of increasing rates of the trace element formulation 'Route' to either plots sown at the optimum time , or with the delayed sowing date, showed increased leaf and root dry weight, reduced apical stem to root collar height , and improved winter hardiness and increased yield compared with similar treatments without the 'Route' application.

A064 Characterization of a new phyto-stimulating preparation: mode of action and evaluation of agronomic performance

Bernard Dumas1, Sophie Vergnes1, Faouzi Attia2, Dominique Noël3

1 Laboratoire de Recherche en Sciences Végétales, UMR 5546 CNRS Université Paul Sabatier, France (dumas@lrsv.ups-tlse.fr)

2 Agronutrition, Parc Activestre 3 avenue de l'Orchidée, Carbone, 31390 France (f.attia@agro-nutrition.fr)

3 Barenbrug Négadis Route de BOURRET 82600 Mas-Grenier, France (dn@barenbrug-recherches.fr)

Agriculture must respond to an increasing demand of food, feed and bioenergy requiring Increasing yield and quality of crops. Low-input agricultural practices are urgently needed and include the use of phytostimulants obtained from natural sources. These products can optimize plant physiological responses leading to an increase resistance to biotic and abiotic stresses as well as to an improvement of crop quality. To identify and optimize new products, we engaged a multi-approach study comprising the development of large-scale genomic approaches as well as the development of high-throughput screening tests based on the use of genetically-modified reporter plants. To identify compounds able to stimulate plant immunity, transgenic *Arabidopsis thaliana* lines, expressing the -glucuronidase gene under the control of defense gene promoters were grown in 96-wells multiplates and use to screen various collections of natural compounds. Activity of one selected candidate was further studied using large-scale gene expression profiling. This approach showed specific effect of this new product on plant defense mechanisms including stimulation of the production of secondary metabolites. To further explored efficiency of this product and its potential agricultural use, field tests were conducted on several crops upon foliar and seed treatments. The main results obtained on various agronomic traits will be described.

A065 (P026B) Using some potential osmoprotectants and antioxidants for improving plant growth under saline conditions: Mechanisms and applications

Habib-ur-Rehman Athar[1,2], M. Ashraf[3] and Giles N Johnson[2]

[1] Department of Botany, Institute of Pure and Applied Biology, Bahauddin Zakariya University, Multan 60800, Pakistan (habibathar@yahoo.com – habib-ur-rehman.athar@manchester.ac.uk)

[2]Department of Plant Sciences, Faculty of Life Sciences, The University of Manchester, M13 9PT, UK (giles.johnson@manchester.ac.uk)

[3]Department of Botany, University of Agriculture, Faisalabad, Pakistan

Abstract:
Salinity is one of major constraints for agricultural production world-wide. To acclimatize salt stress, plants generally accumulate various organic compatible solutes such as proline, glycinebetaine, trehalose or up-regulate antioxidant system. Furthermore, it has been found that salt tolerant cultivars accumulate more these osmoprotectants more than those in salt sensitive cultivars. Likewise, salt tolerant cultivars have more efficient antioxidant system compared with that of salt sensitive cultivars. Thus, it is suggested to breed or genetically engineer crops for salt tolerance using these osmoprotectants or antioxidants. However, breeding for salt tolerance is a long way to improve crop salt tolerance. Secondly, the low efficiency of this approach is due principally to the difficulty of recovering elite genotypes with salt tolerance traits. Alternatively, exogenous application of these osmoprotectants and antioxidants as a foliar spray or through seed soaking is one of the possible suggested means to induce salt tolerance. Comparative effect of exogenous applications of osmoprotectants and antioxidants in inducing salt tolerance has been discussed. Since among compatible solutes, glycinebetaine is studied extensively on its role in maintenance of osmotic potential and photosynthetic capacity, how glycinebetaine affects photosynthesis that results in improved salt tolerance is also discussed. In view of the reports available in the literature, major limitations to use it on large scale are also thrash out for future implications.

A066 (P001) Effect Of Foliar Application Of Biozyme On Yield And Quality Of Tomatoes

Benjamin Robles Sanchez[1], Carlos A. Ramos Barreto[2], Virgilio Valdés Caballero[2], David Hernadez[3], Benoit Genot[4]

[1]Arysta Lifescience México. Jesús Valdés Sanchez 2369. Saltillo 25290, México. Tel. +52 8444380500 benjamin.robles@arystalifescience.com
[2]Arysta Lifescience México. Jesús Valdés Sanchez 2369. Saltillo 25290, México.Tel. +52 8444380500 carlos.ramos@arystalifescience.com
Virgilio.valdes@arystalifescience.com
[3]: Global Development Manager for Biostimulants and value-added Plant Nutrients, david.hernandez@arystalifescience.com
[4]: Head of Global Marketing for Biostimulants and value-added Plant Nutrients benoit.genot@arystalifescience.com

Biozyme® is a biostimulant especially formulated to improve general plant health and production. When applied at the development stage of plants, Biozyme® accelerates vegetative plant growth and increases flower and fruit set and final fruit size, thus enhancing yield and quality. Biozyme is a product of natural origin based on plant extracts as well as specific micronutrients. The objective of these studies was to evaluate the effect of Biozyme® at different rates on yield and quality of harvest of tomatoes. Field trials were established in randomized complete blocks with 4 – 6 replications per treatment. Untreated plots served as absolute controls. Plots were evaluated and harvested throughout the season, measuring flower and fruit set, weight and size of fruits, soluble solids, marketable and total yield and phytotoxicity. Results showed a significant effect on the most important variables, such as fruit weight, overall yield, number of fruit and precocity and soluble solids. . No phytotoxic or deleterious effects were observed as a result of the treatments applications. Overall, Biozyme® provides a number of benefits to tomato production.

A067 (P012) Aminoacids biostimulants of varietal aromas of sparkling vine

Mario Fregoni1, Donato Lanati2, Dora Marchi2, Lorenzo Gallo3

1Università Cattolica del Sacro Cuore di Piacenza - Via Emilia Parmense, 84 - Piacenza (PC) - 29122 - ITALY (mario.fregoni@unicatt.it)

2Enosis srl - Via per Cuccaro, 19 - Fubine (AL) - 15043 - ITALY (direzione@enosis.it)

3Green Has Italia S.p.A. - Corso Alba, 85/89 - Canale d'Alba (CN) - 12043 - ITALY (l.gallo@greenhasitalia.com)

Abstract The bio-stimulants may act at the soil and plant level, but the relationship between amino acids and aromas of berries and juice is poorly studied. In vine aminoacids stimulate the molecules of resistance to thermal and water stress, pest, the activity of enzyme, fertilization, flower, etc., as well as they maintain the equilibrium of DNA sequences (mRNA) genome.

The vines aminoacids intervene to establish the level of "readily available nitrogen", that must be contained in the must between 140 and 250 mg / l, so that can allow yeasts (which use aminoacids for feeding) to carry on a normal fermentation.

Aminoacids are precursors of many flavors, such as isoamyl acetate (fruity aromas), ethyl acetate (pleasantness sensory), propanol, etc.

The lack of "readily available nitrogen" reduces superior alcohols, esters, while increase sulfur compounds and molecules that combine SO2. Furthermore it creates problems to the malolactic fermentation and may cause secondary fermentation.Many of these aromas are formed at the end of ripening cycle of the berries, but many other are produced during alcoholic fermentation of the must.Many studies were carried out on varieties for sparkling wines with the aim to increase the content of certain varietal aromas. In these studies were applied three foliar treatments in pre-veraison and veraison with biostimulants based on aminoacid.

After harvest were analyzed unfermented grape must, to rule out the aromas of fermentation produced by yeast and to exclude the aroma of the peel, where is known to be placed the majority of genetic flavors

A071 (P054) Effect of application Asahi SL biostimulator in winter oilseed rape growing

Marcin Kozak[1], Władysław Malarz[1], Adam Słowiński[2], Andrzej Jarosz[2]

[1] Wrocław University of Environmental and Life Sciences, pl. Grunwaldzki 24 A, 50-363 Wrocław, POLAND (marcin.kozak@up.wroc.pl – wladyslaw.malarz@up.wroc.pl

[2] Arysta LifeScience Polska Sp z o. o., ul. Przasnyska 6 b, 01-756 Warszawa, POLAND (adam.slowinski@arystalifescience.com – andrzej.jarosz@arystalifescience.com

The aim of the experiment was to assess the effects of the Asahi SL biostimulator, applied at different growth stages, on morphological features and seeds yield of winter rape.

The experiments were set up in a single-factor design, with four replications. They were carried out at the Experimental Station Pawłowice of the Wrocław University of Environmental and Life Sciences in the years 2005-2008. The experimental factor were: three treatments related to application of Asahi SL (a – control, without any application; b – sprays with Asahi SL at the spring stage in start plants vegetation; c – sprays with Asahi SL at the spring stage in start plants vegetation and at full buttoning stage).

Varying weather conditions in the years significantly affected yield of seed and the morphological characteristics studied. Asahi SL did not show any effect on the course of growth stages of two winter rape under study. Compared to the control, the Asahi SL biostimulator increased the number of primary laterals, number of siliques per plant and seeds yield.

A072 (P055) Effect of application Asahi SL biostimulator in spring oilseed rape growing

Marcin Kozak[1], Władysław Malarz[1], Adam Słowiński[2], Andrzej Jarosz[2]

[1] Wrocław University of Environmental and Life Sciences, pl. Grunwaldzki 24 A, 50-363 Wrocław, POLAND (marcin.kozak@up.wroc.pl – wladyslaw.malarz@up.wroc.pl

[2] Arysta LifeScience Polska Sp z o. o., ul. Przasnyska 6 b, 01-756 Warszawa, POLAND (adam.slowinski@arystalifescience.com – andrzej.jarosz@arystalifescience.com

The aim of the experiment was to assess the effects of the Asahi SL biostimulator, applied at different growth stages, on yield of two spring rape cultivars.

The experiments were set up in a two-factorial split-plot design, with four replications. They were carried out at the Experimental Station Pawłowice of the Wrocław University of Environmental and Life Sciences in the years 2006, 2007 and 2008. The experimental factors were: (1) – two spring rape cultivars (Mozart and Trend); (2) – four treatments related to application of Asahi SL (a – control, without any application; b – sprays with Asahi SL at the stage of 5-6 leaves; c – sprays at full buttoning stage; d – sprays both at the stage of 5-6 leaves and at full buttoning stage.

Varying weather conditions in the three years significantly affected yield of seed and the morphological characteristics studied. The yield of seeds per ha was higher than observed in the cultivar Mozart. Asahi SL did not show any effect on the course of growth stages of two spring rape cultivars under study. Compared to the control, the Asahi SL biostimulator increased the number of primary laterals, number of siliques per plant, weight of 1000 seeds and seeds yield.

A074 (P105) Kelpak® effect on yield and quality of fruit, on a Cherry orchard cv. Bing over Gisela 6 rootstock, located in Los Lirios, Requinoa, VI Region, Chile.Season 2010.

Oscar Aliaga O.[1]Cristina Pardo M.[2]

Author1: Oscar Aliaga, Experimental Station Santa Amelia. Casilla 17, Correo Los Lirios, Chile. email: oscar.aliaga.ortega@gmail.com

Author2: Cristina Pardo, Experimental Station Santa Amelia. Casilla 17, Correo Los Lirios. email: cristipardom@gmail.com

Presenting:Pedro Larrain(*), Kelp Products Latin America. Av. El Golf de Manquehue 9755-13, Lo Barnechea, Santiago de Chile.Phone: +56993252638.pedro.larrain@kelpak.com

(*) Pomologist:fruit and grape nutrition advisor, Technical and Marketing Latin America Responsible of Kelp Products (Pty) Ltd.

Key words: Auxin, IAA, Cherry, Fruit Set, Fruit Retention, Fruit Size.

Abstract: After many trials done with Kelpak® (high natural auxinactivity based seaweed extract) by different authors in Australia, Chile, France and USA; and based on the best result in California, USA in 2004, was done in Chile in 2010 season a trial obtained an interesting result.

Treatments of foliar applications of Kelpak® at 300 ml/100 L (0.3%) to cherry at full bloom, petal fall and sepal fall stages and five applications at full bloom, petal fall, sepal fall, straw (color change) and 7 days after straw stages resulted in fresh market yield increases averaging 22% and 61% respectively. The yield increase of the five sprays was significantly higher than the untreated control. In spite of the high increase of yield per hectare, Kelpak® treatments did not have detrimental effect on fruit size, maintaining an excellentaverage size of the fruit: 29,6mm of Control versus 29.0mm of the both treatment, fruit firmness (Durofel®) also did not have detrimental effect: Control: 86.3 versus 84.8 and 82.0 respectively. The Yield performance (grams of fruit per trees/cm2 of trunk cross section area) was significantly higher with 5 sprays of Kelpak®. Fruit sugar level of the three sprays was numerically higher at 6,3% (23.6 brix) and for the five sprays was numerically lower 6.8% (20.8) than the control (22.2 brix). With regards on fruit set, were not obtained a clear and conclusive results, more investigation are suggested.

The role of IAA on relation with fruit set, retention and development of *Prunusavium* fruit is deep discussed.

A075 Title of abstract: Discrete roles for seaweed extracts in enhancing plant growth, yield and tolerance to abiotic and biotic stresses.

Prouteau P[1], BSc., Guinan KJ, PhD[1]., O'Sullivan, JT[1]

[1]BioAtlantis Ltd., Kerry Technology Park, Tralee, Co. Kerry, Ireland. (jtos@bioatlantis.com)

Elucidating the precise roles of seaweed extracts in agriculture has been limited due a widespread 'one-size-fits-all' approach to extraction, development and functional validation. In this study, we stratify extracts of seaweed species on the basis of extraction, biochemical and functional properties therein and demonstrate discrete roles for seaweed extracts in enhancing plant growth and tolerance to abiotic and biotic stresses. In brief, the biochemical properties of extracts were characterised and their potential influence on plant growth and health was investigated in controlled laboratory and trial settings. Higher antioxidant levels are observed for high temperature-derived extracts (HTE) compared with low-temperature-derived extracts (LTE), with an almost 20-fold difference detected (FRAP assay), therefore suggesting benefits conferred by HTE in abiotic stress situations. Analysis of performance parameters in conditions of low and high salinity gave contrasting results. In low salinity, no statistical difference between treatments was observed. However, in conditions of high salinity, a 42% increase in lettuce growth on treatment with HTE was observed compared to 28.6% with LTE. In contrast, biotic stresses were alleviated more by LTE than HTE, with LTE achieving three and two-fold reductions in diameters of *Sclerotinia* and *Alternaria* induced lesions respectively. Trials carried out in nematode infested ground demonstrate significant increases in performance (potatoes) on treatment with LTE derived from different species of seaweed versus controls. In conclusion, this study demonstrates high specificity and discrete roles for seaweed extracts in agriculture and supports a 'fitness-for-purpose' approach to validation of seaweed extract properties and their specific applications in agriculture.

A076 Effect of seaweeds extracts and humic and fulvic acids on germination and early growth of Zea mays (L.) and Brassica napus var. oleifera (L.)

Kinga Matysiak, Sylwia Kaczmarek

Institute of Plant Protection – National Research Institute, Władysława Wegorka 20, 60-318 Poznań, Poland (ior.poznan.kinga@gmail.com)

Glasshouse and laboratory experiments were conducted during 2009-2010 in the Institute of Plant Protection – National Research Institute in Poland. The aim of these trials was to determine an influence of seaweed extracts consist of brown algae *Ecklonia maxima* and *Saragassum spp*. and a humic and fulvic acids mixture on the germination, early growth and development of maize and oilseed rape depending on the method of application. Trials involved soaking of seeds in aquaceous solution of seaweed extracts and humic and fulvic substances (variant A), soaking seeds and then foliar application (variant B) and finally, two foliar applications (variant C). Foliar applications were done at the growth stages BBCH 12-12 and 14-16 of plants. Experiments involved seed germination, chlorophyll content and fresh weight of shoots and roots. Results shows different action of tested substances on maize and oilseed rape depending on application method. Extracts from brown algae and humic and fulvic acids improved the germination capacity of seeds. The plants sprayed twice with the tested substances had the largest shoots and roots. Plants obtained from seeds soaked in solutions of seaweed extracts were characterized by a higher weight of shoots and roots, as compared with plants obtained from seeds soaked in solutions of humic and fulvic acids. Soaking seeds in solutions of the tested substances and an additional foliar application of extracts from seaweeds and the acids on plants stimulated growth of plants root system stronger in comparison with the growth of shoots. Humic and fulvic acids had a stronger effect on the roots.

A077 (P082) Screening of fungal candidates for the control of Phytophthora infestans on potato.

Pierre-Louis Alaux[1], A. Sipel[1], H. Dupré de Boulois[1], E. Enaud[1], S. Declerck[1],

[1]Université catholique de Louvain (UCL), Earth and Life Institute, Mycology, Croix du Sud, 2 box L7.05.06, Louvain-la-Neuve 1348, Belgium (pierre-louis.alaux@uclouvain.be ; stephan.declerck@uclouvain.be)

Numerous challenges are threatening the development of organic potato production. Among these, the control of *Phytophthora infestans,* which is responsible for potato late blight, is of tremendous importance due to the high yield loss it can cause if no proper control is applied. Under organic farming, *P. infestans* is mostly controlled by using copper-based formulations. However, these fungicides will be banned in Europe in the coming years. Thus alternative solutions are urgently needed. A potential mean to control plant pathogens is the use of microorganisms that can act directly (e.g. parasitism, antibiosis) or indirectly (e.g. induction of plant defense) on the pathogen. Previous results have shown that several fungi could be good candidates in controlling various potato pathogens, among which *P. infestans*.

The objective of our research is therefore to (1) conduct a two-step selection (literature and biological tests) of fungi that have the potential to control *P. infestans* (2) determine their modes of actions, (3) combine these modes of action for potential synergetic effects on *P. infestans*, (4) develop innovative technologies to assemble the best combinations of biological control agents in a single formulation and (5) test the developed product(s) under farm conditions. Here we will present the first results obtained in the frame of this research project with an emphasis on the selection procedure to obtain a list of the most promising candidates against *P. infestans.*

A078 (P019) Effects of Biostimulants Containing Fermentation Metabolites and Nutrients on Plant Response to Abiotic Stress

D.E. Gates[1], C. Parker[1], C.L. Boston[1], A. Allen[1], A. Pabon[1], M.L. Nelson[1], A.G. Blaszczak[1], M. Sweeney[2], D.W. Galbraith[2] and E.M. Wozniak[3]

[1]InnovaBio, SLCC, Jordan Campus, 9301 South Wights Fort Road, West Jordan, Utah 84088, USA (adam.blaszczak@slcc.edu)

[2]University of Arizona, BIO5 Institute, 1657 East Helen Street, Tucson, Arizona 85721-0240, USA (galbraith@arizona.edu)

[3]Cytozyme Laboratories, Inc. 134 South 700 West, Salt Lake City, Utah 84104, USA (ewozniak@cytozyme.com)

Abiotic stress is one of the main causes of yield reduction in crops. Improved resistance of many crops to drought, cold, high temperature and oxidative stress has been reported in the field trials after application of biostimulants containing fermentation metabolites combined with nutrients. To understand the mechanism of action at the molecular level, nine fermentation metabolite-based biostimulants were tested for their effects on *Arabidopsis thaliana* plants, using microarray analysis to identify changes in transcript levels. Plants were grown in a controlled environment and treated with the biostimulants one week and 24 hours before sampling. One-half of the plants, randomly selected, were treated, with the other half being left untreated as a biological control. To compare the gene expression of the treated and the control plants, extracted RNA was transcribed into cDNA, labeled with Cy5 and Cy3 fluorophores and hybridized to microarrays. Relative intensities of each fluorophore were used in ratio-based analysis to identify up-regulated and down-regulated genes. Genes with high log ratio averages and low standard deviations were identified. Significant changes were predicted using Z-score analysis. Out of 27,400 screened genes, nine were identified as significantly up-regulated by the tested biostimulants. These up-regulated genes are involved in plant response to several abiotic stresses including photo-oxidation, cold, salt and drought. The signaling pathways activated by the tested biostimulants involved in stimulation of the response of plants to the abiotic stress are suggested. Confirmation of the pathway activation using qPCR analysis is discussed.

A079 A Commercial Extract of the Brown Seaweed *Ascophyllum nodosum* Suppresses Avocado Thrips and Persea Mites in Field-Grown Hass Avocados, A Practical Field Perspective

David Holden[1],Robin E. Ross[2]

[1] *Holden Research and Consulting, Camarillo, CA*

[2] *Acadian AgriTech (a division of Acadian Seaplants Limited.), Dartmouth, NS, Canada*

Thrips cause damage to vegetables, fruits, and flowers and are found worldwide. They directly damage crops by feeding, vector viruses, and my also cause respiratory and skin irritation to workers. Effectively managing thrips with non-toxic materials has proven to be one of the most challenging aspects of natural pest control. An extract from the brown seaweed, *Ascophyllum nodosum*, reduced Avocado Thrips (*Scirtothrips perseae*) by 68% compared to the control in field-grown Hass avocado trees. This reduction in thrip numbers was not significantly different from abamectin; the most common chemical control for this insect in avocados. In addition, there were 87% less colonies of Persea mites (*Oligonychus perseae*) per leaf in the *A. nodosum*-treated trees compared to the control, which was also not significantly different from the abamectin standard. The following year there was no thrips pressure due to weather however *A. nodosum* extract again reduced Persea mite colonies compared to the control. In addition, the numbers of fruit per tree were significantly increased. *A. nodosum* extract applications result in significantly less feeding damage by thrips and mites on field-grown avocados as well as improves yields.

A080 (P092) A Commercial Extract of the Brown Seaweed *Ascophyllum nodosum* Suppresses Western Flower Thrips in Greenhouse-Grown Peppers and Cucumbers and Avocado Thrips in Field-Grown Hass Avocados

Will Neily[1], David Holden[2] Gerald Brust[3], **Robin E. Ross**[1]

[1] *Acadian AgriTech (a division of Acadian Seaplants Limited.), Dartmouth, NS, Canada*

[2] *Holden Research and Consulting, Camarillo, CA, USA*

[3] *University of Maryland, Upper Marlboro, MD, USA*

Thrips are found worldwide and cause damage to vegetables, fruits, and flowers. Some thrips are vectors of viruses such as Tomato Spotted Wilt Virus. A proliferation of thrips may also cause respiratory and skin irritation to workers. Effectively managing thrips with non-toxic materials has proven to be one of the most challenging aspects of natural pest control. An extract from the brown seaweed, *Ascophyllum nodosum*, harvested sustainably in Nova Scotia, reduced leaf deformation from Western Flower Thrips (*Frankliniella occidentalis*) based on leaf area measurements by 158% compared to the control on greenhouse-grown jalapeno peppers. Similarly, in studies on greenhouse grown bell peppers, treatments with *A. nodosum* reduced thrips feeding as well as the organic standard, spinetoram. Trials on greenhouse-grown cucumbers demonstrated a 54% reduction in the amount of leaf area damaged by thrips when plants were treated with *A. nodosum* extract compared to the water-treated control. Field-grown Hass avocado trees had 68% fewer Avocado Thrips (*Scirtothrips perseae*) per leaf compared to the control. This reduction in thrips numbers was not significantly different from abamectin; the most common chemical control for this insect in avocados. This data suggests that *A. nodosum* extract reduces thrips damage on greenhouse grown vegetables and field grown avocados.

A081 (P059) Procedure to assess impacts of organic fertilizer products and biostimulants on plant growth and nutrition

Ansa Palojärvi[1], Sanna Kukkonen[2], Mauritz Vestberg[2], Liisa Maunuksela[3], Päivi Parikka[1], Tapio Salo[1]

[1]MTT Agrifood Research Finland, Plant Production Research, FI-31600 Jokioinen, FINLAND (ansa.palojarvi@mtt.fi, paivi.parikka@mtt.fi, tapio.salo@mtt.fi)
[2]MTT Agrifood Research Finland, Plant Production Research, FI-41330 Vihtavuori, FINLAND (sanna.kukkonen@mtt.fi, mauritz.vestberg@mtt.fi))
[3]Finnish Food Safety Authority Evira, Mustialankatu 3, FI-00790 Helsinki, FINLAND (liisa.maunuksela@evira.fi)

Organic fertilizers, biostimulants and other soil improvers are a potential source of nutrients and enhanced growth for agricultural crops. Recently, the fluctuations in global markets have increased variation in prices of fertilizers and agricultural products. The interest for new fertilizer products and plant growth promoting biostimulants that are often either recycled from municipal waste or functioning in new and complicated ways has increased in recent years. Thus, the controlled use of new fertilizer products has become one of the main concerns in agriculture. In Finland, the legislation of fertilizer products was renewed in 2006-2007. During this period, the areas of research and monitoring needs were indicated. The aim of the study is to develop a test system for organic fertilizer products and biostimulants. Further, the goal is to present guidelines for assessment of new products. The test system is specially targeted to facilitate the national authority for national registration process on national market, In addition, the users and manufactures of organic fertilizers and soil improvers can benefit from the developed methods. The focus is on the analyses of chemical and biological composition of the products, the methods to analyze the main properties and growth promotion, and the instructions for safe use. Special focus is on the availability of nitrogen and phosphorus from organic sources. Biological composition will be studied by microbiological and molecular biological methods. The results from laboratory analysis are calibrated against laboratory incubations, pot and field experiments.

A082 (P044) High Throughput Plant Phenotyping: a new and objective method to detect and analyse the biostimulant properties of different products

Stephan Summerer[1], Angelo Petrozza[1], Francesco Cellini[11] Metapontum Agrobios s.r.l. s.s. Jonica 106, km 448,2, Metaponto (MT), 75010, Italy (apetrozza@agrobios.it – ssumerer@agrobios.it – fcellini@agrobios.it)Currently the biostimulant activity on plants of a substance is determined in laboratory via bioassays. These methods are based on simple physiological responses that allow a comparison of the inducing potential of chemical substances (i.e. hormones) with molecules of proven biostimulant activity. Examples of bioassays tests include the measurement of inhibition of watercress root or chicory hypocotyledon growth. By comparing the effect of the examined substance with reference hormones possible biostimulant activities can be inferred. One limitation of these bioassays is that the type of application, the dose, or the timing of the application of the biostimulant are not taken into consideration. On the other hand, experiments carried out on plants concentrate on end points, detecting only the biostimulant effect at the end of growth, for example the biomass production. A large gap in knowledge for the biostimulant effect still exists, environmental variability is not taken into account and large differences between the laboratory and field tests may exaggerate or hide the real biostimulant effect. For these reasons we propose that the determination of biostimulant activity of a substance, other than the traditional analysis techniques, be conjugated with high throughput image analysis. Through this new technology it is possible to dynamically study the effect of biostimulants on both the areal and root component of a plant. In this way traditional bioassays can be associated with a growth-morphology study in an experimental set-up that is highly efficient and not operator biased. This technology then permits the acquisition of new knowledge of a particular biostimulant's activity along plant development such as root architecture and activity or early detection of physiological plant stress responses.Currently biostimulants have limited legislative regulation and are classified as specialised fertilizers. With increased claims of biological activities new methods will be required to verify their authenticity. The development of a new legislation to assess biostimulant claims will require additional methods for testing and validation. Due to robustness, relatively low cost, impartiality, and reasonable analysis time, we propose the use of high throughput pant image analysis as a supplement to the current bioassays for the classification of biostimulants.

A083 (P083) Pathogenicity of 18 entomopathogenic or plant growth promoting fungal isolates to *Delia radicum* L., cabbage root fly, and their rhizosphere competence

Razinger Jaka[1,2], Lutz Matthias[1], Schroers Hans-Josef[2], Urek Gregor[2], Grunder Jürg[1]

[1] Zurich University of Applied Sciences, Campus Grueental P.O.Box 335, Waedenswil, CH-8820, SWITZERLAND (jaka.razinger@zhaw.ch, lutm@zhaw.ch, grng@zhaw.ch)

[2] Agricultural Institute of Slovenia, Hacquetova ulica 17, Ljubljana, SI-1000, SLOVENIA, (jaka.razinger@kis.si, hans.schroers@kis.si, Gregor.Urek@kis.si)

ABSTRACT The entomopathogenicity of 9 entomopathogenic or potentially plant growth promoting fungal species was assessed against cabbage root fly (CRF) in soil and *in-vitro* laboratory bioassays. The fungal strains were isolated from various substrata in Slovenia. The soil experiments mimicked natural exposure pathways of the various insect life stages to the fungal strains. Spore concentrations used in soil tests were comparable to economic rates for in-furrow application ($3.85x10^6$ spores/g dry soil). The *in-vitro* tests were designed to screen aggressiveness of the various isolates to CRF. In *in-vitro* tests, spore suspensions with a concentration of $1x10^8$ spores/ml were directly applied to CRF eggs. The following fungal species were tested: *Trichoderma atroviride* (2 strains), *T. koningiopsis* (1), *T. gamsii* (3), *Beauveria brongniartii* (1), *B. bassiana* (2), *Metharhizium robertsii* (1), *M. anisopliae* (4), *Purpureocillium lilacinum* (2) and *Clonostachys solani* (2). All isolates tested were infective to one or more of the tested life stages of CRF (eggs, larvae, imago or pupae). Abbott's corrected mortality in soil experiments ranged from 20.0±13.2% to 75.0±13.2% and in the *in-vitro* experiments from 15.4±6.5% to 57.9±9.6%. The 5 most pathogenic isolates (*T. atroviride, B. bassiana, M. anisopliae and C. solani*) were further tested for their rhizosphere competence. The preliminary results showed that rhizosphere competence varied considerably, possibly due to the ecological preferences of the different fungal species. The use of these fungi as an alternative to chemical insecticides in organic and integrated management programs is discussed.

A084 (P002) Evaluation of the effect of RADIFARM® treatment on the morpho-physiological characteristics of root systems via image analysis

Angelo Petrozza[1], Stephan Summerer[1], Gianluca Di Tommaso[2], Donata Di Tommaso[2], Alberto Piaggesi[2]

[1] Metapontum Agrobios s.r.l. s.s. Jonica 106, km 448,2, Metaponto (MT), 75010, Italy (apetrozza@agrobios.it – ssumerer@agrobios.it)

[2] Valagro S.p.A, via Cagliari 1, Atessa (CH), 66041, Italy (g.ditommaso@valagro.com–d.ditommaso@valagro.com - a.piaggesi@valagro.com)

Dr. Angelo Petrozza, head unit of agricoltural services in Metapontum Agrobios.
Phone: +39 0835740321

The formation of a healthy root system for plants is an essential requirement for good crop production. The production of secondary roots, those necessary for nutrient uptake, being of particular importance. It has been shown that the administration of some biostimulant products to young rye plants determined a significant increase in the chlorophyll levels and the regenerative capacity of the roots. Therefore from a nutritional point of view, the biostimulants promote plant growth, modify root architecture, increase root development and therefore predispose the plant toward a greater capacity for the absorption of nutrients.With respect to these results, a new study with tomato plants was conducted to measure the effect of Radifarm® on root development via image analysis. Tomato plants were grown in clear plexiglass tubes files with earth that permitted monitoring of root system development without disturbing the plant. Results from the analysis showed that a double Radifarm® treatment program (root bath and a subsequent irrigation with diluted Radifarm®) resulted in a greater root system development and a greater presence of secondary root. Additional soil analysis with near infrared illumination, which measures the presence of water in the soil, showed that plants treated with the same double application regime of Radifarm® also had a greater absorption capacity.

A085 (P003) An evaluation of tomato plant root development and morpho-physiological response treated with VIVA® by image analysis

Angelo Petrozza[1], Stephan Summerer[1], Gianluca Di Tommaso[2], Donata Di Tommaso[2], Alberto Piaggesi[2]

[1] Metapontum Agrobios s.r.l. s.s. Jonica 106, km 448,2, Metaponto (MT), 75010, Italy (apetrozza@agrobios.it – ssumerer@agrobios.it)

[2] Valagro S.p.A, via Cagliari 1, Atessa (CH), 66041, Italy (g.ditommaso@valagro.com – d.ditommaso@valagro.com - a.piaggesi@valagro.com)

Dr. Angelo Petrozza, head unit of agricoltural services in Metapontum Agrobios.
Phone: +39 0835740321

Some biostimulant products exert their action by influencing the microbial activity of the surrounding soil. Thus permitting a greater absorption of nutritional elements by the root system of plants. Such products can contain, seperately or in combination, soil bacteria, fungi, actinomycetes, algi, amino acids, humic substances, potassium silicates, and salicylic acids. Due to the diversity of ingredients the mechanisms of action of these biostimulants can include, the stimulation of microbial action on the soil, activation of various enzymes found in the soil or the plants themselves, increase in hormone and other plant growth regulator production.With this in mind, a study of VIVA®, a biostimulant composed of polysaccharines, polypeptides, aminoacids, selected humic acid and vitamins, on the root activity and the development of the aerial part of the plant was conducted.The results demonstrated that double VIVA® treatments used on plants under water stress had increased the biomass of plants approximately double with respect to untreated, a result confirmed by measuring plant fresh biomass at the conclusion of the growth study. Furthermore plants treated with VIVA® under drought stress conditions had a greater leave surface area and a greater photosynthetic response. Finally roots treated with VIVA® had a greater distribution of root biomass with respect to those of non-treated plants.

A086 Physiological responses to Megafol® treatments in tomato plants under drought stress: a phenomic approach

Angelo Petrozza[1], Stephan Summerer[1], Gianluca Di Tommaso[2], Donata di Tommaso[2], Antonietta Santaniello[3], Eleonora Paparelli[3], Alberto Piaggesi[2], Pierdomenico Perata[3], Francesco Cellini[1]

[1] Metapontum Agrobios s.r.l. s.s. Jonica 106, km 448,2, Metaponto (MT), 75010, Italy (apetrozza@agrobios.it – ssummerer@agrobios.it – fcellini@agrobios.it)

[2] Valagro S.p.A, via Cagliari 1, Atessa (CH), 66041, Italy (g.ditommaso@valagro.com–d.ditommaso@valagro.com-a.piaggesi@valagro.com)

[3] PlantLab, Scuola Superiore Sant'Anna, Piazza Martiri della Liberta` 33, Pisa, 56127, Italy (a.santaniello@sssup.it – e.paparelli@sssup.it – p.perata@sssup.it)

Dr. Angelo Petrozza, head unit of agricoltural services in Metapontum Agrobios.Phone: +39 0835740321

Drought is one of the most important abiotic stresses which limit growth and productivity of crop plants. In the present study, we investigated the physiological and molecular responses of tomato plants treated with Megafol® (Valagro S.p.A), under specific drought stress conditions. The goal of this study was to evaluate the effects of this product, a biostimulant composed of a complex of vitamins, aminoacids, proteins and betaines, in attenuating the negative physiological responses of drought. Tomato plants were grown in a greenhouse and physiological parameters were collected using Scanalyzer 3D (Lemantec, GmbH.), a plant phenomics platform for plant phenotyping. Analysis of the data showed that drought stressed plants treated with Megafol® were healthier as measured by several parameters, such as biomass produced and chlorophyll flourescence. Plants treated with Megafol® appeared healthier, highlighting the higher tolerance of the treated plants to drought stress. The effects of Megafol® were also studied at the molecular level by analysing the induction of the genes which are typically involved in drought stress responses. The phenotypical and molecular data demonstrate the strong effects of Megafol® treatment in reducing the drought-stress related damages on tomato plants.

A087 Transcript profiling of chitosan-treated Arabidopsis seedlings

Giovanni Povero[1], Elena Loreti[2], Chiara Pucciariello[3], Antonietta Santaniello[3], Donata Di Tommaso[1], Gianluca Di Tommaso[1], Dimos Kapetis[4], Francesca Zolezzi[4], Pierdomenico Perata[3]

[1] Valagro S.p.A, via Cagliari, Atessa (CH), 66041, Italy (g.povero@valagro.com - d.ditommaso@valagro.com– g.ditommaso@valagro.com– a.piaggesi@valagro.com)

[2] Istituto di Biologia e Biotecnologia Agraria, National Research Council, Via Moruzzi 1, Pisa, 56100, Italy (e.loreti@ibba.cnr.it)

[3] PlantLab, Scuola Superiore Sant'Anna, Piazza Martiri della Liberta` 33, Pisa, 56127, Italy (c.pucciariello@sssup.it - a.santaniello@sssup.it – p.perata@sssup.it)

[4] Genopolis Consortium, Universita` di Milano Bicocca,Piazza della Scienza 2-4, Milan, 20126, Italy (dimos.kapetis@genopolis.it - francesca.zolezzi@genopolis.it)

Dr. Giovanni Povero is now a Research Assistant for the Business Innovation Department at Valagro S.p.A. PhD at the Scuola Superiore S.Anna (2011)
Mobile : +39 366 5834540

In nature, plants can recognize potential pathogens, thus activating intricate networks of defense signals and reactions. Inducible defense is often mediated by the detection of microbe or pathogen associated molecular pattern elicitors, such as flagellin and chitin. Chitosan, the deacetylated form of chitin, plays a role in inducing protection against pathogens in many plant species. We evaluated the ability of chitosan to confer resistance to Botrytis cinerea in *Arabidopsis* leaves. We subsequently treated *Arabidopsis* seedlings with chitosan and carried out a transcript profiling analysis using both ATH1 GeneChip microarrays and quantitative RT-PCR. The results showed that defense response genes, including camalexin biosynthesis genes, were up-regulated by chitosan, both in wild-type and in the chitin-insensitive cerk1 mutant, indicating that chitosan is perceived through a CERK1-independent pathway.

A088 (P093) Quantification and identification of major phlorotannins in *Ascophyllum nodosum*

Donata Di Tommaso[1], Alberto Piaggesi[1], Paola Galletti[2], Chiara Samorì[2], Emilio Tagliavini[2].

[1] Valagro SpA, via Cagliari, 1, Atessa (Ch), 66041, Italy, on behalf of ALGEA AS, Omagata, Kristiansund, Norway (d.ditommaso@valagro.com – a.piaggesi@valagro.com)

[2] CIRI (Centro Interdipartimentale di Ricerca Industriale) Energia-Ambiente, via S. Alberto 163, Ravenna, 48100, Italy (paola.galletti@unibo.it – chiara.samori3@unibo.it - emilio.tagliavini@unibo.it)

Dr. Donata Di Tommaso is the Head of Chemical Laboratories of Valagro S.p.A.

Phone +39 0872 881418

Thalli of the brown alga *Ascophyllum nodosum* were collected on the Norvegian coast; the samples were freeze-dried or subjected to a procedure of dehydration in ALGEA's facilities, in Norway. The dehydrated product is used in agriculture as it is (Algeafert Meal, Algeafert Special) or suspendend in water (AlgeaBase). Due to the well-renowed use of *A. nodosum* as a biostimulant product in agriculture, our aim was to determine the kind and amount of phlorotannin content in the algal material and check the influence of sample treatment exploiting quantitative ^{1}H NMR and HPLC-MS. For sake of comparison, the well-known spectrophotometric measurements with Folin–Ciocalteu's phenol reagent (FC-method) were also carried out. Quantitative analysis revealed that the amount of phlorotannins is 4 times higher in fresh samples than in dehydrated ones. This indicates that the drying procedure at high temperatures partially degrade the phlorotannins originally present in *A. nodosum*. Structural NMR and MS investigation indicates that both fresh and dehydrated samples contain the same mixtures of 4 condensed units of phloroglucinol-derivatives with C-O bridges, with a structure similar to that of tetraphloroethol B. Therefore, we can conclude that the drying procedure at high temperatures does not modify the structure of remaining phlorotannins.

A089 (P094) Comparative analysis of two kind of *Ascophyllum nodosum* extraction procedures: similarity and differences

Donata Di Tommaso[1], Alberto Piaggesi[1], Daniele Fabbri[2], Emilio Tagliavini[2].

[1] Valagro SpA, via Cagliari, 1, Atessa (Ch), 66041, Italy, on behalf of ALGEA AS, Omagata, Kristiansund, Norway (d.ditommaso@valagro.com – a.piaggesi@valagro.com)

[2] CIRI (Centro Interdipartimentale di Ricerca Industriale) Energia-Ambiente, via S. Alberto 163, Ravenna, 48100, Italy (dani.fabbri@unibo.it - emilio.tagliavini@unibo.it)

Dr. Donata Di Tommaso is the Head of Chemical Laboratories of Valagro S.p.A.

Phone +39 0872 881418

Ascophyllum nodosum extracts are widely used in agriculture due to their widely recognized biostimulant activity. The aim of this work was to assess, using GC-MS, HPLC and ^{1}H NMR, two different extracts made by ALGEA as. on *Ascophyllum nodosum*, in order to evaluate the effect of the extraction procedures on the bioactive components in both products.Extract AN001 is realized in strong basic conditions with high temperature, while AN002 is realized in mild basic conditions and with low temperature.The extracts AN001 and AN002 gave very different results when analyzed through GC-MS: uronic acid content was higher in AN002 (8-9%) than in AN001 (1%), fucose, xylose and D-glucuronic acid present in AN002 but non-detectable in AN001, mannitol higher in AN001 (4%, compared to 1.6% in AN002). ^{1}H NMR confirmed the presence of high amount of mannitol in AN001 (10%), while sugars and uronic acids were found to be abundant in AN002 but not in AN001. Through ^{1}H NMR the signals of betains could be detected in AN002 but non-detectable in AN001. In conclusion, AN002 was remarkably higher in bioactive components derived from *Ascophyllum nodosum* than AN001, and it is advisable to use this extraction procedure in the industrial production to assure the quality of the final product.

A090 Genomic approaches to unveil the physiological pathways activated in *Arabidopsis* treated with plant-derived raw extracts

Antonietta Santaniello[1], Federico Giorgi[2], Donata Di Tommaso[3], Gianluca Di Tommaso[3], Alberto Piaggesi[3], Pierdomenico Perata[1].

[1]PlantLab, Scuola Superiore Sant'Anna, Piazza Martiri della Liberta` 33, Pisa, 56127, Italy (a.santaniello@sssup.it – p.perata@sssup.it)

[2]Istituto di Genomica Applicata, J.Linussio 51, Udine, 33100, Italy (fgiorgi@appliedgenomics.org)

[3]Valagro S.p.A, via Cagliari 1, Atessa (CH), 66041, Italy (d.ditommaso@valagro.com–g.ditommaso@valagro.com a.piaggesi@valagro.com)

Dr. Antonietta Santaniello is now a PostDoc at the PlantLab of Scuola Superiore Sant'Anna.
PhD at the Scuola Sant'Anna (2009)
Phone +39 0502211583

Microarrays can be used to gain detailed information about transcriptional changes involved in a specific pathway. They can also be used to obtain a fingerprint of the transcriptional status of the plant/ cell under a given condition and may be useful for characterising the pathways used in response to novel stimuli, induced by a specific treatment. The further bioinformatic analysis, of all the data produced by the microarrays, can clearly highlight the most affected pathways by the treatment. This approach has been used to investigate the effects induced by the treatment of different plant-derived row materials, provided by Valagro S.p.A, on *Arabidopsis* seedlings. A clear example is represented by treatment with a raw plant-derived protein extract (VAL-P001). In this case the treatment induced genes related to ABA and osmotic stress treatment. It demonstrated that VAL-P001 was able to mimic in plant the same pattern of responses linked to ABA treatment or osmotic stress, making the plant stronger against possible further stresses. On the other hand a treatment with an extract from *Asparagaceae* (VAL-P002) induced a pattern of genes linked to the ethylene response processes, revealing a possible regulative role in the senescence process in plants.

A091 (P095) The effect of a seaweed biostimulant, Kelpak®, on banana (*Musa paradicica*) yields in South Africa.

Lourens Adriaan F.[1], Tozer Errol L.[2]

[1] Kelp Products (Pty) Ltd, P.O. Box 325, Simon's Town 7995, South Africa (riaan.lourens@kelpak.com)

[2] Agrisearch, P.O. Box 868, White River 1240, South Africa (tozer@mweb.co.za)

Adriaan Lourens: PhD in Plant Physiology, UC Davis. Technical manager, Kelp Products. Phone +27824661401

Key words: seaweed, biostimulant, bananas.

Abstract:

The effect of Kelpak seaweed biostimulant on Williams variety banana yield was evaluated in statistical trials conducted in Mpumalanga, South Africa. In the 2005 season Kelpak applied twice as soil drench, or trunk injection, or bell injection, did not show any increase in fruit bunch mass. Kelpak applied foliarly at 4 L/ha at five, four, three and two months before harvest, increased bunch mass significantly, 15% above the control.

In the 2009 season a 1% Kelpak soil drench applied twice, at 1 m plant height and 4 months later, increased the bunch mass 10% above the control. A 50 ml bell injection with 1 and 2% Kelpak solutions increased bunch mass with 15 and 12% respectively. Four foliar applications at 2 and 3 L/ha gave the best result increasing yield with 16 and 17% above the control.

In the 2011 season a bell injection with 1% Kelpak increased the bunch mass significantly by 11%. Foliar applications again gave the best result, with four 2 and 3 L/ha applications increasing bunch mass with 11 and 17% respectively. Two foliar applications at 3 L/ha five and three weeks before harvest also gave a 17% yield increase, while two 3 L/ha applications four and two months before harvest had no effect on yield. None of the treatments had an effect on hands per bunch or fingers per hand, indicating larger fruit.

A092 (P013) Effectiveness of Amino Acids Based Fertilizers to Improve Stress Tolerance of Vegetable Crops under Adverse Environmental Conditions

Eva Svecova[1], Mariateresa Cardarelli[1], Daniela Borgognone[1], Youssef Rouphael[2], Elvira Rea[3], Giuseppe Colla[1*]Email: giucolla@unitus.it

[1]Department of Agriculture, Forests, Nature and Energy (DAFNE), University of Tuscia, 01100 Viterbo, Italy. [2]Department of Crop Production, Faculty of Agricultural Engineering and Veterinary Medicine, Lebanese University, Dekwaneh, Beirut, Lebanon. [3]Agricultural Research Council - Research Centre for the Soil-Plant System, 00184 Roma, Italy

Keywords: biostimulants, disease resistance, environmental conditions, nutritional status.

AbstractVegetable crops are frequently cultivated under unfavourable soil and environmental conditions. Plants exposed to biotic and abiotic stresses exhibit various physiological and pathological disorders leading to stunted growth and sever loss in fruit quality and yield. One environmentally friendly technique able to produce quality crops with competitive yields and ensure plant health even under stress conditions is the application of biostimulant compounds in small amounts to the soil or directly to the foliar surface. Amino acid–based biostimulants have been used by farmers more than 30 year due to the numerous beneficial effects found on several crops like increasing plant tolerance to abiotic stresses, improving nutrient use efficiency, inducing defence responses, and raising crop yields. Moreover, advanced products containing vegetal amino acids and mineral nutrients have been recently developed allowing a better uptake, translocation and utilization of nutrients by plants. The current study report the results of several research trials aiming with testing the benefits of using advanced products containing vegetal amino acids in combination with mineral nutrients to improve vegetable crop performances under biotic and abiotic stress conditions. The amino acids based products showed to improve plant resistance against several pathogens and to promote crop growth under adverse environmental conditions. Several physiological and biochemical mechanisms involved in the crop tolerance against abiotic and biotic stress factors are also discussed

A093 COMPO Frost Protect – A new biostimulant to protect plants from frost damages

Georg Ebert1, Bert Jaeger1

1COMPO GmbH & Co. KG, Gildenstrasse 38, 48157 Muenster, Germany georg.ebert@compo.de

Frost is a serious threat for crop production in many areas around the world. Most high value crops such as fruit trees, grapevines and vegetables are susceptible to freezing temperatures. Frost incidents often result in significant yield or quality losses. At lower latitudes the occurrence of frost during the spring season is very common, but they also occur in the mountain regions of the tropics and subtropics. Young and soft plant tissues are more susceptible than mature tissues, therefore flowers, young fruits and growing shoots are the most endangered parts of the plant.

Stress factors such as heat, solar radiation or frost induce the formation of reactive oxygen species (ROS) in the plant tissue. These species cause the oxidation of cell membranes in a chain reaction and finally lead to cell death. Plants respond to oxidative stress with the formation of antioxidants, which are able to eliminate ROS and prevent the cell membranes from disintegration. Among the natural antioxidants compounds in plants, α-tocopherol is the most effective.

COMPO Frost Protect has been created to prevent flowers and other susceptible plant parts from frost damage. It combines cryo-protectants with the most effective natural anti-stress compound α-tocopherol. While α-tocopherol eliminates free radicals and stabilizes the cell membranes, whereas cryo-protectants prevent the extracellular formation of ice. This is crucial because of the fact that ice crystals in and around the cell walls cause desiccation of the cytoplasm and consequently lead to a toxic accumulation of solutes such as salts and organic acids.

A094 Plant-growth-promoting rhizobacteria emit volatiles compounds with biostimulation activity in dicot and monocot plant species.

Patrick du Jardin1, Pierre Delaplace1, Sébastien Varin1, Magdalena Saunier de Cazenave1,
Elena Ormeño-Lafuente1*, Stijn Spaepen2, Jean-Paul Wathelet3

1 Plant Biology Unit, Gembloux Agro-Bio Tech-University of Liège, 2, Passage des Déportés, B-5030 Gembloux, Belgium (patrick.dujardin@ulg.ac.be, +32 81622456)
2 Centre of Microbial and Plant Genetics, K.U.Leuven, Bio-incubator, Heverlee, Belgium
3 General and Organic Chemistry Unit, Gembloux Agro-Bio Tech-University of Liège, 2,Passage des Déportés, B-5030 Gembloux, Belgium
** Current address: Centre National de la Recherche Scientifique, IEE, IMEP, UMR CNRS*
6116, Laboratoire DFCV, Marseille, France

Despite the demonstrated capacity of certain soil bacteria to stimulate plant growth and stress response, much has still to be discovered on the mechanisms underlying these effects. In order to better understand how roots and bacteria may interact in the rhizosphere, an experimental system was designed, allowing the co-cultivation of seedlings with PGPR bacteria on compartmented Petri dishes in a shared atmosphere, with no physical contact between both organisms and with no diffusion of water-soluble compounds betweencompartments. Two plant species were used, *Arabidopsis thaliana* as a dicotyledonous model, and *Brachypodium distachyon* as a monocotyledonous (graminaceous) model.
Regarding the bacterial partners, 19 strains belonging to 8 genera (*Azospirillum,Azotobacter, Bacillus, Burkholderia, Paenibacillus, Pseudomonas, Raoultella, Serratia*) were selected. Plant growth and development parameters were measured after pre-germination and ten days of co-cultivation, including biomass production and root/shoot partitioning, and architectural parameters like root branching and adventitious root production. Volatile compounds emitted by the PGPR bacteria demonstrated a strong capacity to influence all of the assessed parameters, the effects being dependent on the strains. The observed biostimulation effects include significant changes in total biomass, root / shoot ratios, and in the number of secondary and adventitious roots per plant. Altogether, the results point to the capacity of bacterial volatile compounds to strongly biostimulate plants and roots *in vitro*, in both dicot and monocot species. Profiling of the volatile compounds is in progress, using SPME-GC-MS (Solid Phase Micro-Extraction / Gas Chromatography / Mass Spectometry), in order to identify the bioactive components involved.

A095 (P035) Effect of lignosulphonate-humate on *Zea mays* L. Metabolism

Andrea Ertani[1], Ornella Francioso[2], Adriano Altissimo[3] and Serenella Nardi[1]
[1]University of Padova, Department of Agronomy, Food, Natural Resources, Animal and Environment, Agripolis - Viale dell'Università, 16, 35020 Legnaro (PD) mail: (andrea.ertani @unip.it). and serenella.nardi@unipd.it

[2]Department of Agroenvironmental Sciences and Technologies, University of Bologna, Alma Mater Studiorum, V.le Fanin 40, 40127 Bologna, Italy. Mail: (ornella.francioso@unibo.it).[3]Landlab Studio Associato, via Quintarello 12/A, 36050 Quinto Vicentino, Vicenza, Italy. Mail: (a.altissimo@landlab.net).

Abstract Lignosulphonate-humate a and Lignosulphonate-humate b, derived by an industrial process from lignin, were studied chemically and biologically, and their effects on maize metabolism compared with the responses induced by humic substances obtained from leonardite. Lignosulphonate-humate a and Lignosulphonate-humate b elicited hormone-like activity and Leonardite displayed giberellin properties. To improve our understanding of their biological action, Lignosulphonate-humate a, Lignosulphonate-humate b and Leonardite were supplied to maize plants and their effect was studied on growth, nitrogen metabolism and photosynthesis. All products increased root and leaf growth. Glutamine-synthetase, glutamate-synthase enzyme activities and protein content were all increased. The treatments also increased chlorophyll content, glucose, fructose and Rubisco enzyme activity, suggesting a positive role of Lignosulphonate-humate a, Lignosulphonate-humate b and Leonardite in the photosynthetic process. In addition, an increase in phenols content was observed. In the light of these results, the present work showed that the application of lignosulphonate-humates, derived by an industrial process, to hydroponically grown maize seedlings, led to effects comparable to those produced by the treatment with a proven biological activity compound (humic acid from leonardite). Continued use of N-P-K fertilizers in soils poor in humic substances has caused many serious ecological problems. Emphasizing the importance of humic substances and their value as fertilizer ingredients has never been more urgent than it is today. Indeed, the use of commercial humates can contribute to contrasting the organic matter deficiency in soils and reducing inorganic fertilizer pollution in agriculture.

A096 (P004) Use of a fabaceae plant-derived biostimulant to alleviate salt stress in Zea mays L.

Andrea Ertani1, Adriano Altissimo2 and Serenella Nardi1

1University of Padova, Department of Agronomy, Food, Natural Resources, Animal and Environment, Agripolis - Viale dell'Università, 16, 35020 Legnaro (PD) mail: andrea.ertani @unip.it . and serenella.nardi@unipd.it

2Landlab Studio Associato, via Quintarello 12/A, 36050 Quinto Vicentino, Vicenza, Italy. Mail: a.altissimo@landlab.net

Abstract

A recent research suggests that active molecules contained in biostimulants can induce the pathway of phenylpropanoids in plants. On this account, the use of biostimulants during agricultural practices may help plants to overcome stress situations, including salinity. In this study a fabaceae plant hydrolysate-based biostimulant (ILSACON) containing endogenous triacontanol (TRIA) and indole-3-acetic acid (IAA) was used to alleviate salt stress in maize. For this aim plants were grown for 2 weeks in the absence of NaCl or in the presence (25, 75 and 150 mM). On the 12th day, plants were additionally supplied for 48 h with 1.0 mg L-1 ILSACON or with 11.2 µM pure TRIA. Results showed that ILSACON and TRIA stimulated the growth and nitrogen assimilation of control plants at a similar degree. The treatment with ILSACON or TRIA restored plant biomass under salinity conditions, except when plants were grown with 150 mM NaCl. Furthermore, ILSACON induced the activity of enzymes functioning in nitrogen metabolism. The activity of antioxidant enzymes and the synthesis of phenolic compounds, were induced by salinity, but decreased after ILSACON treatment. The enhancement of phenylalanine ammonia-lyase activity and gene expression by ILSACON was consistent with the increase of flavonoids. Our results indicate that the use of ILSACON can represent a promising tool for the amelioration of the adverse effects of salinity in plants. The positive effects of ILSACON on plant growth and metabolism might be ascribed not only to the formulation of the product, but also to the content of important plant growth regulators.

A097 Long term research activity on the biostimulant properties of natural origin compounds

Andrea Ertani1, Adriano Altissimo2, Serenella Nardi1

1University of Padova, Department of Agronomy, Food, Natural Resources, Animal and Environment, Agripolis - Viale dell'Università, 16, 35020 Legnaro (PD) mail: (andrea.ertani @unipd.it) and (serenella.nardi@unipd.it)

2Landlab Studio Associato, via Quintarello 12/A, 36050 Quinto Vicentino, Vicenza, Italy. Mail: (a.altissimo@landlab.net)

Abstract

Since ten years the Department of Agricultural Biotechnology, University of Padua, supported by the company ILSA SpA, Arzignano, (VI), Italy, is evaluating, via different methodologies, the biostimulant properties of products derived from different organic raw materials. The research activity includes the development of specific bioassays designed for understanding the biological activity of the various compounds and the evaluation of the effect on the metabolism of plants, grown under controlled conditions. First, 8 prototype products were assessed for their bioactivity using a specific bioassay (Audus test). The obtained results showed either the auxin or gibberellic like activity of the products depending on the raw materials. Maize plants treated with these products confirmed the biological activity in terms of capacity to increase plant growth and stimulate plant metabolisms. Another products tested were derived from seaweed extracts. The results evidenced that their biological activity was not only related to the algal hormone-like activity but also to the level of antioxidant compounds. In light of this, the effects of phenol-containing organic substances derived from agro-industrial by-products were assayed on maize metabolism. The products increased plant biomass, exerted a positive role on nitrogen metabolism and stimulated the activity and gene expression of phenylalanine ammonia-lyase, a key enzyme of the phenylpropanoid pathway. Our results indicate that biostimulants may be used as bioactive products in agriculture to increase plant yield and resistance to stress conditions. Phenol-containing products, in particular, can lead to the enrichment of plants in antioxidants, key elements for human health.

A098 Science and regulation of Biostimulants : outcomes of a scientific review at the request of the European Commission

Patrick du Jardin[1], Eric Liégeois[2]

[1]Gembloux Agro-Bio Tech-University of Liège, 2, Passage des Déportés, B-5030 Gembloux, Belgium (patrick.dujardin@ulg.ac.be, tel +32 81622456)
[2]European Commission, DG Enterprise and Industry, Unit Chemicals - Classification & Labelling, Specific Products, Competitiveness, BREY 11/232, Avenue d' Auderghem, 45, B-1049 Brussels, Belgium (eric.liegeois@ec.europa.eu)

With the aim to set a sound regulatory framework for biostimulants in the EU, the European Commission contracted a scientific review on their nature and modes of action. The objectives were to evaluate the scientific robustness of the concept of plant biostimulants, to identify the substances and materials covered by the term biostimulant in the scientific databases, to propose a definition based on the modes of action described by the scientific literature, and to draw conclusions on their possible future status in the EU legal framework, based on these elements. This review is publicly available on the EC (DG Enterprise) web site.From the more than 250 peer-reviewed articles using the word biostimulant in their titles, keywords or abstracts, typologies and modes of actions of biostimulants were defined, and the following definition was proposed :*"Plant biostimulants are substances and materials, with the exception of nutrients and pesticides, which, when applied to plant, seeds or growing substrates in specific formulations, have the capacity to modify physiological processes of plants in a way that provides potential benefits to growth, development and/or stress response ".* This definition was confronted with the current definitions of *Fertilisers* and of *Plant Protection Products* in the EU law and conclusions were drawn on the possible options for the future regulation of plant biostimulants. The report was submitted to the consultation of stakeholders and EU Member States competent authorities during a session of the Commission Fertilisers Working group. The outcomes of the consultation will be summarized.

A099 (P112) Effect of diazotrophic bacteria inoculating in *in vitro* growth of Oncidium pumillum Lindl.

Moacir Pasqual[1], Aparecida Gomes de Araujo[2], Fernanda de Carvalho[1], Fátima Maria de Souza Moreira[1]

[1]Federal University of Lavras, UFLA's Campus, Lavras-MG, 37200-000, BRAZIL mpasqual@dag.ufla.br - fmoreira@dcs.ufla.br - fernandacarva@hotmail.com

[2]EMDAGRO, Aracaju-SE, 49080-190, BRAZIL (agaraujo2003@yahoo.com.br

The aim was to investigate the effect of diazotrophic bacteria inoculating in *in vitro* growth of *Oncidium pumillum* Lindl. under suitable conditions for expression of BNF and other processes. *O. pumillum* seedlings, germinated from *in vitro* seeds, were inoculated in test tubes containing Jensen medium with addition of myo-inositol, vitamins, and sucrose from WPM and activated charcoal. Two experiments were conducted for 180 days. The first experiment was conducted under N-limited conditions to test the effect of BNF. In the second experiment, all of the treatments received mineral-N to test the effect of other processes. In both experiments, 0.5 mL of each bacterial strain (per test tube) was inoculated. In both experiments, a completely randomized distribution was applied, where treatments consisted of inoculation of 24 strains; two separate uninoculated control treatments, one with and one without mineral nitrogen added. The number of leaves, shoots, and roots; shoot and root length; and plant fresh biomass were evaluated. In the first experiment, there was no effect of the strains on any of the parameters evaluated, indicating no contribution of the N_2-fixing bacteria. In the second experiment, the strains, UFLA 181S, UFLA 16, 56, 61, and 64, promoted better responses to most of the variables assessed. However, for the acclimatization period a larger root system is a key feature for success of this step, thus, the UFLA 69 strain stood out exhibiting a root length of 4.0 cm. This study shows selected diazotrophics bacteria may contribute for *O. pumillum* growth through other processes.

A100 (P096) A survey on efficiency of Stimplex®, a bioproduct of Ascophyllum nodosum, on yield production of pomegranate in Iran

Hossein Kishani Farhani1,2, Alireaz Pashaee2, Sahar Saeed2, Ali Reza Ghafouri2

1Department of plant protection, faculty of Agriculture, University of Tehran, 31587-77871,Iran kishani@ut.ac.ir

2Research and Development Section, Arman Sabz Adineh Co., Tehran, 1993764551,Iran (s.saeed@armansabz.adinehgruop.com , Pashaee57@yahoo.com , Alirezaghafouri83@gmail.com , kishani@ut.ac.ir

Pomegranate, Punica granatum L., is native to the region of Persia. Iran is the second largest, producing around 35% of global production. No chemical pesticide and fertilizer have been used in pomegranate orchards in Iran thus pomegranate production is an organic cultivation in Iran. Ascophyllum nodosum has showed biostimulant effects on plant growth in different surveys. To find an organic fertilizer alternative and biostimulant, this study was conducted to show efficiency of Stimplex®, a bioproduct of Ascophyllum nodosum, in comparison with common procedures such as cow-dung in 2010-2011. Pomegranate grove was approximately one hectare, with trees spaced at 5 m within rows and 5 m between rows, totalling around 400 trees per hectare and 125 trees were randomly selected. According to our results, using Stimplex® (2.5 lit/ha) had a significant effect on weight of 100 pomegranate ripened fruits of trees. Stimplex® treatment increased number of blossom significantly in comparison with cow-dung fertilizer. Number of cracked fruits decreased significantly in comparison with common fertilization procedures. Ripening Speed of fruits of treated trees with didn't show significance differences. According to our results common fertilization procedures can be replaced by this material.

A101 (P097) A survey on efficiency of Acadian®, a bioproduct of *Ascophyllum nodosum,* on yield production of olive in Iran

Alireaz Pashaee[1] , Hossein Kishani Farhani[1,2], Sahar Saeed[1], , Ali Reza Ghafouri[1]

[1]Research and Development Section, Arman Sabz Adineh Co., Tehran, 1993764551,Iran (Pashaee57@yahoo.com, s.saeed@armansabz.adinehgruop.com, Alirezaghafouri83@gmail.com, kishani@ut.ac.ir)

[2]Department of plant protection, faculty of Agriculture, University of Tehran, 31587-77871,Iran (kishani@ut.ac.ir)

Olive (*Olea europaea L*, Oleaceae) is a long-lived, evergreen tree native to the Mediterranean basin. It is valued for its fruit and oil. Olives are picked late in autumn or winter, as the oil content and fruit characteristics change with ripening. An extra 10,000 acres have been added to Iran's olive groves over the past 13 years in Iran. Different fertilization methods are using in olive orchards based on chemical fertilizing. *Ascophyllum nodosum* has showed biostimulant effects on plant growth in different surveys. To find an organic fertilizer alternative and biostimulant, this study was conducted to show efficiency of Acadian®, a bioproduct of *Ascophyllum nodosum,* in comparison with common fertilization procedures in 2010-2011. Olive grove was approximately one hectare, with trees spaced at 4 m within rows and 4 m between rows, totaling around 620 trees per hectare and 125 trees were randomly selected. According to our results using Acadian (1.5 Kg/Ha) showed significant differences on mean weight of 100 ripened fruits of treated trees in comparison with chemicals treatment. This amount was 392.5±0.59 in Acadian treatment while this amount was 316±0.98 in chemical treatments. Yield production was increased significantly (53.2±2.5 kg) and this amount was (40.1±1.9). Fruits oil content of dry material increased significantly in Acadian treated in comparison with chemical treatments.

A102 (P098) Effects of Stimplex® on some bionomics of Gerbera jamesonii

Sahar Saeed1, Hossein Kishani Farhani1,2, Alireza Pashaee1, AliReza Ghafouri1

1Research and Development Section, Arman Sabz Adineh Co., Tehran, 1993764551,Iran(s.saeed@armansabz.adinehgruop.com Pashaee57@yahoo.com , Alirezaghafouri83@gmail.com , kishani@ut.ac.ir

2Department of plant protection, faculty of Agriculture, University of Tehran, 31587-77871,Iran (kishani@ut.ac.ir)

Msc. grade of soil science and president of research and development section of Arman Sabz Adineh Co., corporatizing in 5 academic research program and certified as a scientific expert from Acadian Agritech Company. Tel: 00989131936895

Gerbera jamesonii is a perennial herb with deeply lobed leaves covered with silky hairs arising from a crown. The striking inflorescence is borne on a long stalk and the outermost petals (ray florets) may be cream, red, orange or pink, while the central flowers (disc florets) are cream. To find an organic fertilizer and biostimulant, this study was conducted to show efficiency of Stimplex®, a bioproduct of Ascophyllum nodosum, on some bionomics of Gerbera jamesonii in 2010-2011. Green house area was approximately 2000 square meter, ten plots with 10 square meter area were selected and five plants in each plot were selected and bud height, bud diameter, stem diameter and leaf area was measured in comparison with chemical fertilizers. According to our results, using Stimplex® (2.5 lit/ha) had not a significant effect on bud height (3.37± 0.31 cm) in comparison with chemical fertilizer (3.5 ± 0.46 cm). Bud diameter parameter (16.12± 1.18 cm) showed a significant difference in comparison with chemical treatment (13.2± 0.45 cm). Stem diameter and leaf area had not significant differences in comparison with chemical treatments. According to our results Stimplex® can be a good alternative for replacing chemical fertilizers.

A103 (P022) Biostimulants – Role and Importance in Crop Production

Gargeyee Iyengar Agri Life , 154/A5 , SVCIE , IDA BOLLARAM , MEDAK DIST , 502325 , ANDHRA PRADESH , INDIA

Abstracts

Biostimulants – Role and Importance in Crop Production

The Context

Commercial agriculture across the world in the last few decades has promoted and emphasized use of chemical inputs and chemical fertilizers. High yielding varieties and seeds have been engineered to be responsive to large doses of chemical inputs. The ecological cycle disruption is a result owing to soil, water and air pollution by these products . In addition , these chemicals breakdown after a long period and also enter the food chain thus having serious implications on human health.

BioStimulants as possible solutions

Seaweed derivatives can be used as an effective input for promoting initial vegetative growth and tillering. Actives derived from vermicompost can be used to promote flowering and better organoleptic properties. Protein hydrolysates of vegetative origin play an effective role in increasing yield parameters such as grain weight and grian size.

Thus naturally available BioStimulants can effectively and slowly replace high doses of chemical fertilizers leaving no residue and promoting a healthy soil environment for micro fauna and flora.

Soil health restoration is now a priority as reckless use of chemicals has made it an unfit environment for beneficial micro organisms to thrive. Restoring this soil health, creating a rhizosphere that is congenial for root growth and establishment is important for healthy crop establishment and yield.

The Paper will look at discussing various BioStimulants that can be used to encourage residue free farming and promote a healthy environment for plants and humans.

A104 (P018) An evaluation by image analysis of the biostimulant Megafol® to mitigate different forms of abiotic stress on the physiology of tomato plant.

Angelo Petrozza[1], Stephan Summerer[1], Gianluca Di Tommaso[2], Donata Di Tommaso[2], Alberto Piaggesi[2]

[1] Metapontum Agrobios s.r.l. s.s. Jonica 106, km 448,2, Metaponto (MT), 75010, Italy (apetrozza@agrobios.it – ssummerer@agrobios.it) Phone: +39 0835740321

[2] Valagro S.p.A, via Cagliari 1, Atessa (CH), 66041, Italy (g.ditommaso@valagro.com – d.ditommaso@valagro.com - a.piaggesi@valagro.com)Dr. Angelo Petrozza, head unit of agricoltural services in Metapontum Agrobios.

In modern agriculture biostimulants have contributed significantly toward the prepartion of quality agricultural products. Their actions have been frequently associated with elevated resistance of plants to abiotic stress. Genetic analysis has uncovered many of the biochemical mechanisms that are at the heart of the biostimulant effects. As a consequence it has become possible to characterize a biostimulant by associating it with defined mechanisms of action. At the same time, due to the necessity of longer periods for evaluation, it is much more difficult to determine the plants phenotypic response to biostimulants. With respect to this problem tomato plants were evaluated for their phenotypic response to different types of abiotic stress following differnt Megafol® treatment regimes via image analysis. Megafol® is a biostimulant composed of a complex of vitamins, aminoacid, proteins and betains.It has been shown that its biostimulative effect involves genes in abiotic stress response of *Arabidopsis thaliana*. In this study tomato plants were subjected to five types of abiotic stress; 1) drought stress, 2) flooding stress, 3) mechanical stress, 4) excessive heat, and 5) cold stress. The effect of the stress with and without Megafol® treatment were evaluated by image analysis (Scanalyzer 3D System, LemnaTec) using visible light (RGB), florescence, and near infra-red (NIR) chambers. These chambers respectively permitted the evaluation of growth and colour, photosynthetic efficiency, and plant water content. For all of the examined parameters a regime of two Megafol® treatments resulted in the greatest biostimulation effect.

A105 Stimulatory Effects of Fermentation Metabolites on Plant Defense Response to Biotic Stress and Their Impact on Crop Production

A.G. Blaszczak[1], C. Parker[1], D.E. Gates[1], C.L. Boston[1], A. Allen[1], A. Pabon[1], M.L Nelson[1], M. Sweeney[2], D.W. Galbraith[2] and E.M. Wozniak[3]

[1]InnovaBio, SLCC, 9301 South Wights Fort Road, West Jordan, Utah 84088, USA (adam.blaszczak@slcc.edu)[2]University of Arizona, BIO5 Institute, 1657 East Helen Street, Tucson, Arizona 85721-0240, USA (galbraith@arizona.edu)[3]Cytozyme Laboratories, Inc. 134 South 700 West, Salt Lake City, Utah 84104, USA (ewozniak@cytozyme.com)

Improved resistance of several crops to biotic stress after application of biostimulants containing non-viable fermentation metabolites were reported in the field trials. To understand the mechanism of action on molecular level, seven fermentation metabolite-based biostimulants were tested for their effects on *Arabidopsis thaliana* plants, using microarray analysis to identify changes in transcript levels. Plants were grown in a controlled environment and treated with the biostimulants one week and 24 hours before sampling. Half of randomly selected plants were treated and the other half was left untreated as a biological control. To compare the gene expression of the treated and the control plants extracted RNA was transcribed into cDNA, labeled with Cy5 and Cy3 fluorophores and hybridized. Relative intensities of each fluorophore were used in ratio-based analysis to identify up-regulated and down-regulated genes. Genes with high log ratio averages and low standard deviations were identified. Significant changes were predicted using Z-score analysis. Out of 27,400 screened genes 21 were identified as significantly up-regulated by the tested biostimulants. These up-regulated genes are involved in activation of Systemic Acquired Resistance (SAR) in the plants leading to enhanced broad-spectrum resistance of plants to biotic stress. The signaling pathways responsible for the elicitor effect of the tested biostimulants are suggested. Activation of selected pathways was confirmed using qPCR analysis. Impact of the discovery on improvement of crop resistance to biotic stress is discussed.

A107 MICROORGANISMS MEDIATING PHOSPHORUS AVAILABILITY IN NEW ZEALAND PASTURE SOILS

Maureen O'Callaghan1, Steve Wakelin1, Sandra Young1, Emily Gerard, Leo Condron2 and

Carolyn Mander1

1AgResearch, Private Bag 4749, Christchurch 8140, NEW ZEALAND
maureen.ocallaghan@agresearch.co.nz

2Lincoln University, PO Box 84, Lincoln 7647, NEW ZEALAND

A range of microbial taxa are believed to play important roles in soil P cycling based on the ability of various bacteria and fungi to solubilise P in in vitro assays and a few selected isolates have been developed as biofertilisers for annual crops. However, there is surprisingly little information regarding the diversity and activity of P-solubilising microorganisms in soil. In the first study of P-solubilising bacterial (PSB) populations in pasture soils, rhizosphere bacteria were isolated from pasture plants grown under high and low P levels at three long-term fertiliser trial sites in New Zealand. The frequency of the P-solubilisation phenotype was highly correlated to soil P status, with lower frequency of P-solubilisation in high P soils. Diversity was higher in the high P treatment compared with the low P soil, where Pseudomonads and Actinobacteria predominated. More detailed investigation of the P-solubilising communities at one site found that Actinobacteria and mycorrhizal fungi were clearly associated with the underlying P fertility gradient, with abundance of some mycorrhizal species being greater in high P soils than in unfertilised soils. Greater understanding of the diversity and ecology of P-solubilising microorganisms is informing strategies for selection and deployment of potential biofertiliser strains for use in pasture.

A108 Humic substances as tool to optimize crop production

G. Verlinden[a], J. Bries[b], G. Baert[a], F. Debersaques[a], S. De Neve[c] and G. Haesaert[a]

[a] Department of Plant Production, Faculty of Applied Bioscience Engineering, University College

Ghent, Belgium
[b] Soil Service of Belgium, Heverlee, Belgium
[c] Department of Soil Management, Faculty of Bioscience Engineering, University Ghent, Belgium

Many of the beneficial characteristics of soil organic matter are associated with humic substances which are recognized as the most chemically active compounds in soils. During 6 years the potential of humic substances to affect yield and nutrient uptake of maize, grass and potato was studied under field and laboratory conditions. The effect of humic substances on soil characteristics (CEC, water holding capacity, e.g.), mineralization and soil microbial community structure were also investigated. To allow joined conclusions throughout the different experiments, the overall effect of the treatments with humic substances for all experiments was analyzed by means of a formal meta-analysis.

In case of permanent grassland humic substances promoted mainly the production of the first cut, which has the best grass quality compared to all other cuts. Tuber production of potatoes showed a high positive response on the application of humic substances. The effect on maize was rather limited. The formal meta-analysis revealed a consequent increase in nitrogen and phosphorus uptake of all studied crops. The effect on potassium and magnesium uptake was mainly positive while sodium and calcium uptake were not affected by the treatments. The effect on soil characteristics, mineralization and microbial soil population were less consistent. In general a positive effect on CEC and water holding capacity could be observed while a soil treatment with humic substances showed no significant effects on mineralization and microbial soil community structure.

A109 (P102) Cytoplant®-400: a natural biostimulant for increase yield and quality on fruit trees.

Eitan Martin[1], David Bernad[1], Carlos Solans[1]

[1] Daymsa, Camino de Enmedio, 120, Zaragoza, Spain (mail@daymsa.com)

CYTOPLANT®-400 is a natural biostimulant manufactured and marketed by DAYMSA. **Cytoplant®-400** is certified for its use in Organic Agriculture by different European certification bodies.

The activity of **Cytoplant®-400** is due to the combination of several active substances contained in the natural extracts. This activity is determined and controlled by bioassay of what is called equivalent cytokinin activity. By means of this bioassay, the activity of a product can be compared with the activity that a synthetic cytokinin would have, as kinetin is, at a determined concentration. **Cytoplant®-400** possess a cytokinin activity equivalent to 400 ppm of kinetin.

Cytoplant®-400 is used in several crops: in table grapes is shown an effective tool for seedless cultivars, improving berry size without a reduction in color and improving the fertility of the buds, in vegetables the product increase the number of marketable fruits, etc.
As an illustrative example, we show the trial was made to evaluate the application of **Cytoplant®-400** on production on cherry tree cv. 3-13. The trial consisted of **Cytoplant®-400** compared to control (untreated). Two foliar applications were made, separated 14 days, at dosage of 2 L/ha, with a spray volume of 1000 L/ha. The assessed parameters were: yield per tree and caliber distribution and weight of fruits.
The results show **Cytoplant®-400** increased a 8,9% total yield per tree and increased bigger calibers. **Cytoplant®-400** increased a 47,30% the calibers bigger than 28 mm.

As a conclusion, **Cytoplant®-400** is a natural tool to improve quality parameters of harvest, without the negative effects in some cases synthetic plant growth regulators may produce.

A110 (P071) Effectiveness of the plant strengthener ILSAC-ON in inducing resistance in tomatoes against Phytophthora infestans

Maria R. Finckh, Kalpana Sharma, Andreas F. Butz, Christian Bruns

Faculty of Organic Agricultural Sciences, Department of Ecological Plant Protection, University of Kassel, Nordbahnhofstr. 1a, D-37213, Witzenhausen, Germany. (mfinckh@uni-kassel.de)

Exploitation of induced resistance is a potentially desirable strategy in plant protection since it involves enhancing natural defence mechanisms in plants. The plant strengthener ILSAC-ON, based on an aqueous extract of Alfalfa and several experimental products were compared with BABA (DL-3-amino-n-butyric acid) for their ability to induce resistance to various isolates of Phytophthora infestans (Mont) de Bary on various tomato varieties with detached leaflets and on whole plants. Treatment with the plant strengthener ILSAC-ON and BABA induced resistance in most variety*isolate combinations. There were highly significant variety*isolate interactions, however indicating that resistance induction may be variety specific and that not all isolates result in the same type of resistance reaction. Often, isolate mixtures were more effective in inducing resistance than single isolates. Resistance induction was more reliable at lower inoculum densities indicating that there are limits to the effectiveness of resistance induction. This was true for BABA and the other products.

A111 (P028) New Technology in Stress Reduction and Drought Amelioration

Wilson Boardman
Micromix Plant Health Ltd, Langar, Nottingham NG13 9HP UK. tech@micromix.com www.micromix.com

New Technology in Stress Reduction and Drought Amelioration

The change in climatic conditions and weather patterns in many parts of the world have highlighted the need to support crop growth and development (where economically feasible) with biostimulants. There are two areas of existing biostimulant technology at Micromix which have been well-proven over many seasons on many crops, and recent work to evaluate combining them has produced some exciting results that have generated patent applications and further on-going trials work. One development shows promise in assisting drought resistance in field crops of cereals, and a second related development is showing promise in effectively ameliorating heat stress in glasshouse grown crops.

A112 (P036) Micronutrient Formulations Contribute to Disease Control

Wilson Boardman
Micromix Plant Health Ltd, Langar, Nottingham NG13 9HP UK. tech@micromix.com www.micromix.com

Micronutrient Formulations Contribute to Disease Control

Over the last twelve years we have consistently tested our micronutrient formulations for their ability to enhance the activity of fungicides in tank-mixes with the AMIX formulations from Micromix. These unique humic-lignate complexed formulations have been observed in many trials in the UK, Holland, Ireland and Germany to both improve and extend the activity of fungicides on cereals. In Germany Kiel University trials over a three year period conclusively demonstrate the biostimulant activity of these micronutrient formulations enhancing fungicide performance. Agronomist familiar with the activity of these formulations regularly use them to facilitate reduced rate fungicides and improve activity under adverse conditions. A leading independent trials contractor in the UK having worked with these formulations over a number of years fully replicated trials work produced an un-prompted written endorsement of this activity.

A113 (P037) ACTIVITY OF HUMIC SUBSTANCES IN SOIL-PLANT INTERFACE: IMPLICATIONS ON PLANT MINERAL NUTRITION AND CROP PRODUCTION

V Mora[1], R Baigorri[1], M Fuentes[1], E Bacaicoa[1], J Erro[1], O Urrutia[1], AM Zamarreño[1], P Etienne[2], P Laîné[2] , A Ourry[2], JC Yvin[3] and JM Garcia-Mina[1,4*]

[1]CIPAV-Roullier Group Poligono de Arazuri-Orcoyen, Calle C, n°32,E-31160 Orcoyen, Spain

[2]INRA, UMR 950 Ecophysiologie Végétale,Agronomie et nutritions N, C, S. Esplanade de la paix,14032 Caen Cedex, France

[3]CRIAS-Roullier Group 55 boulevard Jules Verger,35800 Dinard,

[4]Department of Chemistry and Soil Chemistry. University of Navarra *Contact: jgmina@timacagro.es; Phone: 0034948324550

ABSTRACT

A number of studies have shown the ability of natural organic matter (NOM) in general and humic substances (HS) in particular, to affect the development of plants and microorganisms in many different natural ecosystems and agro-ecosystems. Regarding plants, these NOM and HS effects were expressed in both root growth and architecture, and shoot growth. However, these effects were different in intensity and quality depending on several intrinsic and extrinsic factors associated with HS structure and concentration, plant species and soil properties. Two main mechanisms have been proposed to explain the beneficial action of NOM and HS on plant growth. An indirect effect expressed through the improvement of plant nutrition by increasing soil nutrient availability, principally some micronutrients (mostly P and Fe); and a possible direct action affecting the transcriptional and post-transcriptional regulation of several enzymes and molecular transporters in the root. These biological effects within the plant seem to be associated with both nutrient root uptake ability and the efficient use of the nutrient in plant leaves.

In this communication, the relationships between the effects of HS on root development, shoot development, plant nutrition, and soil properties; are discussed. This study is developed in the context of the links existing between the signal role of some nutrients and the hormonal balance in both root and shoot.

A114 (P099) Effect of seaweed extract as biostimulant on plant mineral uptake and development

Alessandra Trinchera[1], Elvira Rea[1]

[1] Consiglio per la ricerca e la sperimentazione in agricoltura – Centro di ricerca per lo studio delle Relazioni tra Pianta e Suolo, Via della Navicella 2, Rome, 00184, ITALY (alessandra.trinchera@entecra.it)

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Many naturally-derived products are used as growth promoters or biostimulants on plants, even if their mechanisms of action are still now unknown.
In our work, we would assess the biostimulant properties of a seaweed extract (SE) on both plant nutrition and development by a bioassay and greenhouse experiments.
A preliminary model test was performed on *Zea mais* L., in order to evaluate the effect of SE on root and shoot of early-stage maize plantlet. After that, greenhouse pot trials were conducted on two horticultural crops (*Lactuca sativa* L. and *Pelargonium* L.), by applying SE at 1/250 and 1/500 v/v rates to the 50% Hoagland and Arnon nutrient solution. Plant root length and weight, plant shoot height and yield, tissue dry matter, number of lettuce leaves/number of pelargonium flowers, leaf nutrient (N, P, K, Ca, Mg, Fe, Na, Mn, Cu, Zn, B) and chlorophyll content were determined. Obtained results evaluated by ANOVA.
Bioassay showed a good distribution of maize biomass (as shoot/root ratio), an increase of root caliper and an increase of plantlet total biomass. The mechanism induced towards plant nutrition determined the increase in Ca, Na, Cu and Mn uptake by roots and the increase of Mn and B uptake by shoot. Greenhouse experiments gave an improvement of plant quality both for lettuce and pelargonium, together with a significant increase in plant dry matter, leaves chlorophyll and, on general terms, nutrient use efficiency. Moreover, a positive effect on root development was recorded on both the crops, that means an increase of root dry matter.
Such promising results address to SE optimization for improving nutrient use efficiency in relation to specific plant mineral uptake.

A116 (P029) Effect of biostimulants on some herbaceous species under conventional and organic cropping systems

G. Disciglio, E. Tarantino[1]

[1]Agro-Environmental Sciences, Chemistry and Crop Protection Department – Faculty of Agriculture - University of Foggia - 71122 Foggia, Italy

e-mail of corresponding author: g.disciglio@unifg.it phone: +39 0881589337

Abstract

In recent years many efforts were put into developing new fertilizers and fertilization systems, also for the organic farming, to increase nutrient uptake, growth and development of plants and to improve quality, productivity and the environmental positive impacts. For such purpose products such as biostimulants have appeared on the market.
Several reports have point out the positive effects of organic biostimolants on growth health and stress tolerance of plants, improving the yield and reducing the impact on environment.
In Capitanata area (southern Italy) have been carried out a trials on some herbaceous species (cauliflower and pepper) under conventional and organic cropping systems, grown in pots, to verify the effects of biostimulants (Siapton®10L, Linea Ergofito and Prodig4) on quanti-qualitative characteristics of yield, in comparison with the ordinary cultivated crop.
Quali-quantitative parameters such as total and marketable yield, mean weight, dry matter, pH, soluble solids, and color for pepper, and marketable head weight, dry matter, nitrogen content, nitrate content of lettuce or for corymbs of cauliflower were determined.
All experimental data were subjected to analysis of variance (ANOVA) and the mean values were compared using Turky's test at 1% and 5% significance level.
Results showed great differences of yield characteristics obtained conventional and organic crops, showing in the organic one a lower yield, whereas quite variable results were generally observed when biostimulants were applied.

A117 (P030) The Valagro® prototype Pt08 improves productivity, gluten and protein content in wheat

Daniele Pezzolato[1], Giovanni Povero[1], Gianluca Di Tommaso[1], Alberto Piaggesi[1],

[1]Valagro SpA, Via Cagliari 1 (Zona Industriale), Atessa (CH), 66041, ITALY (d.pezzolato@valagro.com)

Wheat is one of the main sources of vegetable proteins for human use and animal feed. For this species, grain protein and gluten content determines nutritional value, processing properties and quality of the end-product.
In this study, the effect of the prototype Pt08 on productivity, protein and gluten content was evaluated on both durum and tender wheat (*Triticum durum* Desf., *cv.* San Carlo, and *Triticum aestivum* L., *cv.* Trofeo, respectively). The experiment was carried out in Emilia Romagna, Northern Italy. A single foliar application (3 l/ha) of Pt08 prototype was applied when 5% of the anthers were visible (corresponding to BBCH 61-63).
Average of two years results showed a positive and significant response to Pt08 application. In particular, for the cv. San Carlo the application resulted in: +4.2% production (ton/ha); +2.4% proteins; +1.3% gluten; +4.0% specific weight (kg/hl) in comparison with the untreated control. Also for the *cv.* Trofeo an increase of protein (+2.5%) and gluten (+3.4%) content was observed.
In parallel, we also assessed the effect of Pt08 on gene expression in the model plant *Arabidopsis thaliana*. Thanks to a "transcript-profiling" approach we found that several genes (eg. At5g44120, At4g27140) involved in storage protein synthesis and growth/development (eg. At5g09530) were induced more than 5 times in comparison with the control.
Taken together, our results suggest a positive role of Pt08 for the improvement of wheat productivity and quality, and open new perspectives for the use of specific biostimulants aimed to increase protein content in wheat and other species.

A118 (P017) Use of biostimulants to increase bud break of table grape in Sicily

Raffaele Nobile, Giovanni Marrollo, Gianluca Di Tommaso, Alberto Piaggesi

Valagro SpA, Via Cagliari 1 (Zona Industriale), Atessa (CH), 66041, ITALY (r.nobile@valagro.com)

During winter, plants enter in a dormancy period where growth and other metabolic activities are suspended. The coming out of buds dormancy takes place following a certain period of exposure at low temperatures, after the “cold requirement” has been fulfilled. However, if the winter is not long or cold enough to allow a normal completion of dormancy in vegetative organs, lateral buds may fail to open or there may be a delayed or gradual germination.

In this study, a 3 years trial was performed to evaluate bud break when winter chilling requirements are not satisfied, taking Sicilian (Southern Italy) climatic conditions as a model.

ERGER® and Hydrogen-Cyanamide were applied to improve table grape bud break on Victoria variety cultivated in open field and under polyethylene cover system. A 7% ERGER® spray solution + 16% ACTIVE ERGER®, and Hydrogen-Cyanamide were applied 60 days and 30 days before natural bud break respectively.

Our results show that the percentage of bud break (from wool stage to first leaf unfolded) was increased by ERGER® in all varieties compared to untreated test: + 19% on Victoria-open field, +36% on Victoria-polyethylene cover. Interestingly, the effect of ERGER® was comparable to the one of Hydrogen-Cyanamide.

The application of ERGER has determined the satisfaction of cold requirements, thus reducing disparities in the shooting and the number of 'blind' buds with a consequent increase in production.

A119 (P015) Use of Valagro biostimulants to increase fruit size in kiwifruit

Daniele Pezzolato, Giovanni Marrollo, Gianluca Di Tommaso, Alberto Piaggesi
Valagro SpA, Via Cagliari 1 (Zona Industriale), Atessa (CH), 66041, ITALY (d.pezzolato@valagro.com)

Kiwifruit has a relevant impact for Italian agriculture. For this species, fruit size is the biggest determinant parameter of what consumers are willing to pay. Moreover, there is also a positive relationship between fruit size and other qualitative factors.
A two years experimental trial was performed in Northern Italy to evaluate productive and qualitative parameters during harvest using BENEFIT® PZ plus MC CREAM biostimulants. BENEFIT® PZ is a natural product that contains nucleotides, proteins, amino acids and vitamins; while MC CREAM is a formulation with high concentration of active phytoingredients including betaine, amino acids and growth factors of natural origin (cytokinins, auxin and gibberellins). From the end of flowering, 2 applications of BENEFIT® PZ 4 l/ha plus MC CREAM 3 l/ha every 7 days were done on Hayward variety.
The following parameters were increased compared to untreated test: fruit weight +10.8 %; hardness + 9.2 %. Regarding the distribution of the caliber classes, treated plants presented a 20% of the fruits in the class above 105 grams, whereas for untreated plants only 3.8% of fruits were in this class.
This study suggests that the synergic action of BENEFIT® PZ plus MC CREAM is an effective solution to increase and standardize fruit size classes leading to superior caliber sizes without affecting fruit consistency or shelf-life.

A120 (P016) First experiences with MEGAFOL® to improve rice production in China

Vincenzo Lorito, Gianluca Di Tommaso, Alberto Piaggesi
Valagro SpA, Via Cagliari 1 (Zona Industriale), Atessa (CH), 66041, ITALY (v.lorito@valagro.com)

Rice has always been the most important food crop in China. New investigations on biostimulants use are required considering their effectiveness on plant growth and crop yield increase. In this work we tested Megafol®, a product composed of specific proteins and amino acids, growth factors of natural origin, vitamins and betaines, and able to promote plant development, reduce abiotic stress and improve production. In order to analyze Megafol® efficacy on rice production, field investigation was conducted in *Jiangmen City* (*Guangdong province)*. Low-rate applications of Megafol® were done after transplant, at tillering stage and before booting stage. Looking at the average results obtained, Megafol®, had a good effect on plant development (+ 8% of tillering) and increased production in comparison with untreated (+ 9.3% of Yield/ha) through a larger number of total ear (+ 4%), productive ear (+12 %), total grain/ear (+11%), setting percentage (+ 14%).
Considering the increase of population, the use of biostimulants such as Megafol® could be a good opportunity to obtain a significant production increase.

A121 (P070) KENDAL NEM® improves endogenous resistance mechanisms

Gianluca Di Tommaso1, Vincenzo Lorito1, Alberto Piaggesi1,

1Valagro SpA, Via Cagliari 1 (Zona Industriale), Atessa (CH), 66041, ITALY

g.ditommaso@valagro.com

Interaction of soilborne pathogens with roots determines the activation of inducible mechanisms of resistance. This kind of biotic stress often elicits SA-independent pathogenesis-related gene expression in roots, and triggers the production of lignin in root epidermis. This creates a sort of barrier able to confer resistance to biotic stress agents. In this study we evaluated the ability of biostimulant KENDAL NEM® to induce the activation of genes involved in soilborne pathogens responses. An experiment was carried out in Arabidopsis seedlings treated with KENDAL NEM® and we obtained a transcript profiling analysis using both ATH1 GeneChip microarrays and quantitative RT-PCR. Results show that genes At2g19990, At2g19970, At1g50060 involved in pathogenesis-related protein were up-regulated. At the same time some genes related to lignin biosynthesis process such as At2g47260, were more expressed than untreated. Results suggest that is possible to increase endogenous resistance mechanisms in root through the application of biostimulant KENDAL NEM® .

A122 (P038) The influences of Humic Substances (Humic and Fulvic Acids) on Soil fertilities and plant growth

Dr. Yasser Dergham, Humintech , Germany

Humic Substances (Humic and Fulvic Acids) play a vital role in soil fertility and plant nutrition. Their physical, chemical and biological influences on soil and plant growth are well known. Plants, which grow on soils containing Humic Substances are less subject to stress, healthier and produce higher yields with superior quality. The value of Humic Substances in soil fertility and plant nutrition relate to their complex organic compounds performing as a part of the life cycle on earth. The effect of Humic and Fulvic Acids on limiting the development of some pathogens is also known. The stimulatory effects of Humic Substances are enhancing the uptake of macronutrients and micronutrients through the stimulation of microbiological activities in the soil.

Humic Substances derived from lignite (Leonardite) are the most practically used Humic Substances within the agricultural sector. Studies of the direct and indirect effects of Humic Substances on plant growth and seed germination in different areas and soil conditions (e.g. high temperature and salinities stress) have repeatedly shown positive effects on germination ratios and on plant biomass as long as there is sufficient mineral nutrition. Stimulation of root growth is generally more apparent than stimulation of shoot growth.

A124 (P046) Effect of a biostimulant product containing macronutrients and a carboxylic acid (AMEC®) on citrus fruitlet abscission

Aurelio Gómez-Cadenas[1], Ricardo Pérez-Santamarina[2], Riadh Ghorbel[2]

1. Universitat Jaume I, Department of Agricultural Sciences, Campus Riu Sec, Castelló, E-12071, SPAIN (aurelio.gomez@uji.es)
2. Codiagro S.A., Pol. Ind. Caseta Blanca, Manzana 5 - Parcela 49, Vall d'Alba, Castellón E-12194 , SPAIN (rpsf@codiagro.com, riadh@codiagro.com)

Many fruit trees blossom with high profusion and thereafter exhibit massive fruitlet abscission. In citrus, it has been suggested that after hormonal activation of initial fruit growth subsequent development is mostly supported by nutrient supply. Thus, competition for photoassimilates is responsible for fruit drop. In this work, the effect of a biostimulant product on citrus fruit abscission was tested. The biostimulant contained N, P, Mg, B and a carboxylic acid (AMEC®) and was sprayed to trees of Citrus clementina (Cv Clemenules) 4 times every 15 days from flower anthesis. Fruit and leaf drop, leaf nutrient content, gas exchange parameters and hormone contents were measured. The product application decreased fruit abscission during the physiological drop. Treated plants showed a reduction in the substomatal CO_2 concentration which accounts for an increase in the photosynthetic efficiency. Endogenous levels of abscisic and jasmonic acids decreased in leaves of treated plants. No differences between control and treated plants were observed in terms of leaf number, shoot length, hormonal contents in fruitlets, and leaf nutrient content. These data indicate that the beneficial effects of the biostimulant are achieved through the increase in the photosynthetic efficiency that leads to better transport of carbohydrates from leaves to fruitlets. Data exclude any direct effect of the product on fruit abscisic acid levels although a better performance of the plant is suggested by the decrease in the leaf contents of stress-related hormones. The product did not have any effect on the general nutrient status of the plant and did not accelerate the change from reproductive to vegetative growth.

A125 (P114) Screening of Commercially Available Micro-Organisms for the Use in Substrate

Key words: potting soil, mycorrhiza, bacteria, algae extracts, plant growth

Maaike Perneel, Oliver Grunert, Cedric Abriat, Stefaan Vandaele

Peltracom n.v.

In West-Europe, there is an increasing interest for the use of micro-organisms in substrates for the production of plants. Plant producers hope through the introduction of micro-organisms in their substrates to stimulate plant growth and to apply less fungicides. In order to obtain a homogenous repartition of the micro-organisms in their substrate, plant producers ask their substrate-producing company to mix the products in advance. Little research, however, has been carried out on these commercially available micro-organisms and substrate-producing companies are often not aware of what they mix in their substrate.

In this study, more than 9 different commercially available micro-organisms were screened for their beneficial effect on plant and root growth. Micro-organisms were mixed with several substrates at the recommended dose. Results of this study demonstrate a great variety in quality between the different products available on the market. Only in a few cases improved plant growth could be observed. Analysis of the roots could not always demonstrate the presence of the introduced microorganism, despite the fact that the recommended dose was applied. One product based on hyphae of mycorrhiza suppressed even plant growth. Analysis of the plant roots showed the presence of the plant pathogen Olpidium, which might have been a contaminant during the production of the mycorrhiza.

In conclusion, this study shows that there is a great difference in quality between the commercially available micro-organisms. Despite the fact that the recommended dose was applied, an enhanced effect on plant growth could not always be observed. Furthermore, an important effect of plant type and substrate could be observed.

A126 (P073) Induced resistance (IR) as a strategy for controlling grapevine diseases

Xavier Daire[1], C. Guillier[1], M.-C. Héloir[1], B. Poinssot[1], S. Trouvelot[1], M. Adrian[1]

UMR 1347 Agroécologie AgroSup-INRA-Université de Bourgogne. Pôle IPM-ERL 6300 CNRS. 17 rue Sully BP 86510 21065 Dijon cedex France (xavier.daire@dijon.inra.fr)

Grapevine (*V. vinifera*) is susceptible to many diseases, the control of which relies on frequent fungicide applications. IR represents an attractive way to reduce the use of fungicides. Here, we present an overview of our research devoted to the study of the mechanisms of IR and to the development of IR in crop protection strategies.

We aim at deciphering defense events underlying resistance induced by elicitors. As perception is essential to trigger defenses, we are now attempting to identify grape PRRs (Pattern Recognition Receptors) responsible for MAMPs (Microbe-Associated Molecular Patterns) recognition using functional genomic. In addition, using microarray approaches, we are looking for grape genes involved in IR.

Since IR often suffers inconsistency in practical application, we also try to identify factors that may affect its efficacy. Among them, we found age of grape tissues to greatly influence defense response to elicitor treatment.

As an endeavour to perform applied research, we have launched collaborations with firms interested in IR. We have set up an evolutive screening process of molecules that has proved useful to screen inducers effective in protecting grape against downy and powdery mildew. This includes medium throughput resistance tests, image analysis devices and qPCR-based monitoring of defense gene expression.

A127 (P067) Biofertilisers for solving Food Security

Kartik Laijawala

Nico Orgo Manures, Opp Railway Station, Dakor, 388225, INDIA

Abstract:

Biofertilisers, i.e. microorganisms that have the ability to make available the primary and secondary nutrients in the soil are the clear solution to amending soils that have been assaulted by chemicals for decades. This presentation attempts to show how the use of Bio N, P and K products can help replace a part of the necessity for NPK in the soil. It shows what the fate of 100kg of DAP and MOP is post-application and the advantages of replacing a part of that requirement with biofertilisers. It discusses the opportunities for nations with small, below-poverty-line farmers such as India and where a manufacturer can benefit. Finally, it discusses a particular product, and its results in Indian conditions.

A128 (P084) Mineral oil and plant protection

MOUNIA KHELIFA[1,2], SOLENE GARSON[2], MARIA MARTOUB[2], PHILIPPE GIORDANENGO[2], CHRISTINE RUSTERUCCI[3] and ARNAUD AMELINE[2]

[1]*Semences Innovation Production, Recherche et Environnement, Avenue François Mitterrand, Beaurains, 62217, France, mounia.khelifa@u-picardie.fr.*

[2]*Unité de Recherche EA 4698- EDYSAN*-Ecologie et Dynamique des Systèmes Anthropisés, *Université de Picardie Jules Verne, 33 rue St Leu, Amiens, 80039, France*

[3]*Unité de Recherche EA390-BIOPI Biologie des plantes et innovation Université de Picardie Jules Verne, 33 rue St Leu, Amiens, 80039, France*

ABSTRACT

Mineral oil spray has been considered for several decades as an effective mean to protect crops against pathogens and insects. Weekly sprays control the spread of the non-persistent virus *Potato virus Y,* one of the main potato pathogens, involving aphids as vector. Nevertheless, the mechanism by which mineral oil prevents viral outbreaks is still poorly understood. Globally, it was reported that the mineral oil somehow interferes with virus attachment to aphid mouthparts and it affects aphid feeding behavior or causes a disruption of the host selection process. However, to date, mineral oil effect on plant responses has not been investigated further than the observation of leaf necrosis.

In our study we assessed Vazyl mineral oil (CCL, France) impact on each partner of the potato plant (*Solanum tuberosum*) – aphid (*Myzus persicae*) – virus (PVY ^{NTN}) system.

As expected the treatment of potato plant by Vazyl prior to viruliferous aphid infestation, led to significantly reduced virus Y^{NTN} transmission. We showed that this treatment slightly modifies the vector feeding behavior at the intracellular punctures activity, but it has no direct effect on aphid fitness. It has no effect on the virus itself or its infectious proprieties. At the opposite, it affects both the virus acquisition step by the aphid and the plant immunity inducing plant defense responses, thought the reduction of the viral infection could not be explained by systemic resistance.

Thus mineral oil treatment protects plant against viruses mainly preventing the interaction between aphid mouthparts and the virus during the acquisition process, and it elicits plant defenses.

A129 (P064) Economical assessment on integrated pest's management of potato early blight disease S. M. Khalife Soltani* [1], M. Nasresfahani [2]
1- Islamic Azad University - Khomaeni Shahr Branch, 2- Agriculture and Natural Research, Isfahan- Iran * khalifehsoltani@iauksh.ac.ir

The early blight disease of potato, causing by a fungus, *Alternaria* is one of the worldwide disease which occurs epidemically in potato growing areas. Thus, because of the economic importance of potato, in Iran, there is a great need for the management planning to be taken into consideration. Movements toward a sustainable agriculture need to consider the managements which are to be economical, free of chemical hazards, applicable in large scales and adoptable by the farmers. Thus, searching for resistant sources, breeding and cultural practices become important as far as the economy of the disease and pest's managements are concerned. In this study, with special reference to economical aspects of the above scales, the factors including type and date of sowing, irrigation types, genetic sources and chemical controls by few systemic and non-systemic fungicides were assessed against the early blight disease of potato for 3 continuous years in Freidan, Isfahan, Iran. The results revealed that, almost all the treatments were having a great effect on disease reduction economically with significant effects individually, and or in combination. Also, enhance the potato productions from economical point of views. Planting of susceptible cultivars, Markies, Kennebeck, Premiere, Atlantic, Sante, Sonate and or Agria caused the higher inputs in terms of 4-6 times replication of fungicides. Whereas, sprinkler and dripper irrigation was effective and also water use efficiency in comparison to furrow one significantly and respectively. Also, single and double rows had no any considerable effects. Late sowing by about a month and or two weeks later were significant respectively. The resistance sources, Granula, Diamont, Picasso, Maradona and or Kayzer cultivars reduced the fungicide application into 1-2 time(s) respectively. In respect to fungicides with lower dosage and longer durability, Flinit with 200g/ha reduced the cost of production by replication time and the amounts to be used. Investigation on the integration of these scales economically, showed that the integration of various methods of control, resistant source, cultural practices and chemical measurements, not only causing the reduction of the cost product greatly, but also, chemical hazards with a very high significant effects.

A130 (P014) Response of vegetative growth and chemical constituents of *Calendula officinalis* L. plants to foliar application of Bio-stimulators

Hanieh Rafiee[1*], Hasanali Naghdi Badi[2], Ali Mehrafarin[2], Sepideh Kalate Jari[3]

[1]M.Sc. student of Horticulture, Islamic Azad University, Science and Research branch, Tehran, Iran (hanieh_r20032003@yahoo.com)
[2]Department of Cultivation and Development, Institute of Medicinal Plants, ACECR, Karaj (Naghdibadi@yahoo.com – a.mehrafarin@gmail.com)
[3]Department of Horticulture, Islamic Azad University, Science and Research branch, Tehran, Iran (Kalatejari@yahoo.com)

Calendula officinalis L. from Compositae family as an important medicinal plant is used in Homeopathic methods and treatment of scalds and skin illnesses. Biostimulators are liquid formulas containing up to nineteen free amino acids and oligopeptides, biologically active for rapid absorption which activates and regulates the plant metabolism. This investigation is planned for the desirable effect of bio-stimulators foliar application on morphological and phytochemical parameters of plants. The experiment with completely randomized blocks design was conducted in 10 treatments with 3 replicates in 1390. Treatments of experiment included bio-stimulators with commercial formulations of Aminol forte, Kadostim, Fosnutren, Humiforte (0.75 and 1.5 $L.ha^{-1}$) and chemical fertilizer N, P, K (70 $kg.ha^{-1}$ before sowing) and control treatment (without foliar application). Results showed that effect of these treatments was significant ($P<0.01$ & $P<0.05$) on morphological and phytochemical parameters (except for leave width) in a way that the most plant height (134.10 mm), stem diameter (6.64mm) with Kadostim 1.5 L/ha and crown diameter (7.57 mm), number of leaves/plant (25), leave length (111.64 mm) with Humiforte 1.5 L/ha and The highest value for N (2.077%) with Humiforte 1.5 L/ha, P (112.50 mg/100g DW) and K (213.59 mg/100g DW) with Kadostim 1.5 L/ha was obtained. Therefore Commercial formulations of Humiforte and Kadostim 1.5 L/ha are recommended for promoted growth and phytochemical parameters.

A132 DEVELOPING APPLICATION FOR OLIGOSACCHARINS IN AGRICULTURE

Cabrera J. C.1, Napoles M.C.2, Falcón A.2 Diosdado E.3, González S.3, González L.4, González G.5, Rogers H.J.6, Cabrera G.7, Onderwater R.11-Unité biotechnologie-MATERIA NOVA, Rue des Foudriers, 1, 7822 Ghislenghien, Belgium , Juan-Carlos.Cabrera@materianova.be, rob.onderwater@materiavova.be 2-Laboratorio de Oligosacarinas, INCA, carretera Tapaste, Km 3 y 1/2 San José de las Lajas, Mayabeque, Cuba tere@inca.edu.cu , alfalcon@inca.edu.cu 3-Plant Biology Department, Faculty of Biology, University of Havana, Havana City, Cuba. ediosdado@fbio.uh.cu, sjglez@fbio.uh.cu 4-Escuela de Ciencias Biológicas, Pontificia Universidad Católica del Ecuador (PUCE), Quito, Ecuador. liengonza@yahoo.es 5-Rizobacter Argentina S.A. Parque Industrial, Pergamino, Buenos Aires, Argentina B2702HDA. gganta@rizobacter.com.ar 6-School of Biosciences, Cardiff University, Cardiff, United Kingdom. RogersHJ@cardiff.ac.uk 7-IONA Ltda. Carretera General San Martín, Paradero 24 1/2, 3ª entrada, parcela 9-A, San Vicente de lo Arcaya, Colina, Santiago, Chile. gcabrerab@gmail.com

Since the first review on the bioactivity of cell wall derived oligosaccharides (oligosaccharins) in plants (P. Albersheim, A.G. Darvill. 1985. Sci. Am. 253(3): 58-64), their potential use as regulators of plant defence, growth and development was stated. In this work, we summarise the results obtained by a consortium of research institutions and companies in the preparation, bioactivity studies, and practical uses of different oligosaccharides in agriculture. Oligogalacturonides (OGA), prepared from citrus pectin, can partial or totally substitute phytohormones in the culture “in vitro” of sugar cane, citrus, coffee, tomato, rice and banana plants, reducing the time required for plant propagation, avoiding culture-induced genetic changes and increasing field survival percentage of these plants. OGA also induces rooting and plant growth. Xyloglucan oligosaccharides (XGOs), derived also from the plant cell wall not only promoted plant growth but they also differentially regulated divers biotic and abiotic stress-related genes, part of the positive growth effects have been attributed to increases in cell division rates. In field experiments, foliar application of lipo-chitooligosaccharides, a nodulation factor in the soybean-rhizobium symbiosis, has shown to be effective to enhance plant growth and yield in soybean, but also in wheat and corn. On the other hand, fungal cell wall-derived chitosan and chitooligosacharides as well stimulate plant growth and improve crop yield and quality in many species. We honestly believe that the agricultural use of oligosaccharins will increase within the next years as these bioactive are somewhat easy to produce and may face general acceptance because of their natural origin.

A133 (P068) (Growth and yield stimulation of winter wheat (*Triticum aestivum L.*) and winter oilseed rape (*Brasssica napus L.*) by Mg-Titánit fertilizer

Peter Kováčik[1], Marek Skawiński[2], Martin Vician[1]

[1]Slovak University of Agriculture in Nitra, Department of Agrochemistry and Plant Nutrition, Tr. A. Hlinku 2, Nitra, 949 01, SLOVAKIA (Peter.Kovacik@uniag.sk – xvicianm@is.uniag.sk)[2]Intermag Sp. z o. o., Osiek 174 A, Olkusz, 32-300, POLAND (marek.sk@intermag.pl)

The effect of the application of liquid fertilizer Mg-Titánit (MgTi) on phytomass of winter wheat and winter oilseed rape was investigated in a small plot field trial realized on the haplic chernozem (48°42´ N, 17°70´ E) during two years (2010 and 2011). Experiment consisted of 5 treatments (0; $2xTi_{0,2}$; $3xTi_{0,2}$; $2xTi_{0,4}$; $3xTi_{0,4}$). 0 – control treatment without MgTi fertilizer; $2xTi_{0.2}$ – two applications of MgTi in the dose of 0.2 $l.ha^{-1}$; $3xTi_{0.2}$ – three applications of MgTi in the dose of 0.2 $l.ha^{-1}$; $2xTi_{0.4}$ – two applications of MgTi in the dose of 0.4 $l.ha^{-1}$; $3xTi_{0.4}$ – three applications of MgTi in the dose of 0.4 $l.\ ha^{-1}$. The fertilizer was applied during this growth stages: for winter wheat in BBCH 29, BBCH 32, BBCH 55–59, and for winter oilseed rape in BBCH 50–52, BBCH 59, BBCH 66.

The obtained results showed that the first and the second applications of Mg-Titánit fertilizer stimulated the formation of phytomass of winter wheat and oilseed rape. Effect of the third spraying on phytomass production was less noticeable. Fertilizer positively influenced the total chlorophyll content in leaves of both crops. The higher wheat grain yields were achieved at lower fertilizer application rate (0.2 $l.ha^{-1}$) than at higher one (0.4 $l.ha^{-1}$) regardless of the number of applications. The highest grain yield of wheat was found in $3xTi_{0,2}$ variant. Use of MgTi, regardless of application rate and number of sprays, had a positive effect on yield of oilseed rape. Higher yields of oilseed rape had been achieved when MgTi was used three times. The highest yield of oilseed rape seeds had been achieved in variant $3xTi_{0,2.}$

A134 Evaluation of 2,4-diacetylphloroglucinol fluorescent Pseudomonas for plant growth promotion

Claire Prigent-Combaret1, Jordan Vacheron1, Floriant Bellvert1, Daniel Muller1, Yvan Moënne-Loccoz1
1UMR CNRS 5557 Ecologie Microbienne - Université Lyon 1, Bât. Mendel 16 Rue Dubois, Villeurbanne, 69622, FRANCE claire.prigent-combaret@univ-lyon1.fr

2,4-diacetylphloroglucinol (DAPG) is a broad spectrum antimicrobial metabolite produced by Plant Growth-Promoting Rhizobacteria (PGPR) of the fluorescent Pseudomonas group. These biocontrol PGPR are effective in controlling diseases such as take-all of wheat, black root rot of tobacco, by inhibiting soilborne pathogens and triggering systemic resistance pathways in plant that render the host less susceptible to pathogen infection. We hypothesize that besides their ability to regulate populations of phytopathogenic microorganisms in many soils, DAPG-producing pseudomonads have the capacity to enhance the growth and development of plant, in both an indirect and a direct fashion. To address this hypothesis, we developed two distinct strategies. First, we studied the impact of DAPG and DAPG-producing Pseudomonas on other PGPR like Azospirillum, which are able to stimulate plant growth through the production of phytohormones. We evidenced that DAPG stimulates indirectly plant growth, by enhancing expression of Azospirillum's plant beneficial functions such as the biosynthesis of indole-3-acetic acid (auxin family), thereby improving the growth of the plant. Second, we explored rhizosphere bacterial diversity to isolate DAPG-producing Pseudomonas harboring several distinct plant growth promotion properties (production of phytohormones, phosphate solubilisation, etc.) and thus able to stimulate plant growth directly. Combining PCR amplification and biochemical approaches, several isolates harboring both biocontrol and phytostimulation properties have been identified and phenotypically characterized, and their impact on the plant is being evaluated in gnotobiotic conditions. These strategies should allow the development of promising bioinoculants (based on several or single PGPR strains) sharing both biocontrol and phytostimulation properties.

A135 (P074) Response of vegetative growth and chemical constituents of *Calendula officinalis* L. plants to foliar application of Bio-stimulators

Hanieh Rafiee[1*], Hasanali Naghdi Badi[2], Ali Mehrafarin[2], Sepideh Kalate Jari[3]

[1]M.Sc. student of Horticulture, Islamic Azad University, Science and Research branch, Tehran, Iran (hanieh_r20032003@yahoo.com)
[2]Department of Cultivation and Development, Institute of Medicinal Plants, ACECR, Karaj (Naghdibadi@yahoo.com – a.mehrafarin@gmail.com)
[3]Department of Horticulture, Islamic Azad University, Science and Research branch, Tehran, Iran (Kalatejari@yahoo.com)

Calendula officinalis L. from Compositae family as an important medicinal plant is used in Homeopathic methods and treatment of scalds and skin illnesses. Biostimulators are liquid formulas containing up to nineteen free amino acids and oligopeptides, biologically active for rapid absorption which activates and regulates the plant metabolism. This investigation is planned for the desirable effect of bio-stimulators foliar application on morphological and phytochemical parameters of plants. The experiment with completely randomized blocks design was conducted in 10 treatments with 3 replicates in 1390. Treatments of experiment included bio-stimulators with commercial formulations of Aminol forte, Kadostim, Fosnutren, Humiforte (0.75 and 1.5 $L.ha^{-1}$) and chemical fertilizer N, P, K (70 $kg.ha^{-1}$ before sowing) and control treatment (without foliar application). Results showed that effect of these treatments was significant ($P<0.01$ & $P<0.05$) on morphological and phytochemical parameters (except for leave width) in a way that the most plant height (134.10 mm), stem diameter (6.64mm) with Kadostim 1.5 L/ha and crown diameter (7.57 mm), number of leaves/plant (25), leave length (111.64 mm) with Humiforte 1.5 L/ha and The highest value for N (2.077%) with Humiforte 1.5 L/ha, P (112.50 mg/100g DW) and K (213.59 mg/100g DW) with Kadostim 1.5 L/ha was obtained. Therefore Commercial formulations of Humiforte and Kadostim 1.5 L/ha are recommended for promoted growth and phytochemical parameters.

A136 (P065) EU-project CO-FREE: Innovative strategies for copper-free low input and organic farming systems

1Schmitt, A., 1Mazzotta, S., 2Pertot, I., 3Köhl. J., 4Markellou, A., 5Andrivon, D., 6Kowalska, J., 7Isambert, C., 8Kelderer, M., 9Lammerts van Bueren, E., 10Bruns, C., 11Smith, J., 12Simon-Levert, A., 13Pujos, P., 14Trapman, M., 15Doornbos, R., 16 Van Cutsem, P., 17Pedersen, R., 18Caceres, S., 19Kleeberg, H., 20Peters, A., 21Tamm, L.1Julius Kühn-Institut, Bundesforschungsinstitut für Kulturpflanzen, Institut für Biologischen Pflanzenschutz, 64287 Darmstadt, Germany;annegret.schmitt@jki.bund.de; Sara.Mazzotta@jki.bund.de 2Fondazione Edmund Mach, Italy; 3Wageningen UR - Plant Research International (DLO), The Netherlands; 4Benaki Phytopathological Institute, Greece; 5Institut National de la Recherche Agronomique, France; 6Instytut Ochrony Roslin-Panstwowy Instytut Badawczy, Poland; 7Institut Technique de l'Agriculture Biologique, France; 8Centro di Sperimentazione Agraria e Forestale Laimburg Azienda, Italy; 9Louis Bolk Instituut, The Netherlands; 10Universität Kassel, Germany; 11Progressive Farming Trust Ltd T/A The Organic Research Centre, United Kingdom; 12AkiNao SAS, France; 13Agro-Levures et Dérivés SAS, France; 14Bio Fruit Advies BV, The Netherlands; 15Ceradis BV, The Netherlands; 16FytoFend SA, Belgium; 17Nor-Natur ApS, Denmark; 18Seaweed Canarias SL, Spain; 19Trifolio-M GmbH, Germany; 20E-Nema GmbH, Germany; 21Forschungsinstitut für Biologischen Landbau Stiftung, Switzerland;The EU-project CO-FREE was launched in January 2012 (grant agreement number 289497, duration 54 months)

. Aim of this project is the development of innovative strategies for replacement of copper in European organic and low input fruit, grapevine, potato, and tomato production systems. Focus is set on most copper-relevant diseases, including Venturia inaequalis, Plasmopara viticola and Phytophthora infestans. A collaboration of 21 partners, including 11 academic and 10 industry partners from 11 European countries, is working towards achievement of this goal. The project follows a construction kit system consisting of different tools, including e.g. decision support systems, disease tolerant varieties, cropping systems (including agro-forestry) and alternative agents. Starting points of CO-FREE were results of former national and international projects. Twelve of the most promising and advanced pipeline compounds of plant and microbial origin, derived from these projects, and from R&D funded by SMEs were selected for further investigation in CO-FREE. These comprise agents with biostimulant effects. The chosen agents fulfill the following criteria: (i) proven efficacy against at least one of the major copper-controlled diseases, with specific, aspects remaining to be improved in the frame of the project (e.g formulation, optimization of application parameters etc.), (ii) novelty, and (iii) involvement of a leading/innovative SME company ensuring further development and marketing. The CO-FREE partners are further developing these control agents, and identify their impact on diseases. Following the construction kit system, control agents are combined with other above mentioned tools, so that finally practice-relevant control strategies will be generated.

A137 (P107) Innovation and regulation in France and in the EU

Fertilizing material traditionally include nutrient fertilizers and soil improvers but also innovative products that improve the nutritional process of the plant and do not necessarily contain nutrients. Plant nutritional improvers are not replacing nutrients, they basically help root or leaf uptake for a more efficient use of nutrients in soil or stimulate nutrient transfer and use in physiological growth processes.

These innovative products, applied as such or mixed with nutrient fertilizers or soil improvers, are not included in recognized c categories in the EU or the French fertilizer regulation. In France an individual company who wants to market these kinds of products has to register them by the ministry of agriculture after an evaluation of a technical dossier by an independent agency for food security (ANSES). These procedure takes up to 9 months. B But in practice, companies have to wait longer than normal to access the market.

UNIFA believes that innovation must be supported with a clear and harmonized regulation. We have organized an event in Paris in September 2009 with the French ministries and the Commission. UNIFA is participating to the European working groups on new w regulation and in the French bureau of standardization: BN FERTI which groups all kind of fertilizing materials. UNIFA also proposes an evaluation guide of fertilizing materials that would facilitate the innovation to access the EU market in a simple and efficient way.

A139 (P079) The green revolution protein RGA-LIKE 3 modulates pathogen resistance by enhancing jasmonate-regulated defence responses

Michael Wild[1], Jean-Michel Davière[1], Soizic Cheminant[1], Nicolas Baumberger[1], Dimitri Heintz[1], Rachel Baltz[2], Pascal Genschik[1]* and Patrick Achard[1]*

[1]Institut de Biologie Moléculaire des Plantes, UPR2357, conventionné avec l'Université de Strasbourg, 67084 Strasbourg, France.

[2]Bayer CropScience, 69263 Lyon, France.

Gibberellins (GAs) are plant hormones involved in the regulation of plant growth in response to endogenous and environmental signals. GA promotes growth by stimulating the degradation of nuclear growth repressing DELLA proteins. Mutations in DELLA genes (rendering the proteins resistant to GA-mediated degradation) as well as in the GA biosynthesis pathway played a major role during the green revolution by reducing dramatically the height of the plants. The term "Green Revolution" refers to the huge increases in grain yields after the 1960's, resulting from the introduction by breeding of dwarfism genes into wheat, giving the plants a stronger and shorter stem that resist lodging. Today, chemicals such as Paclobutrazol (inhibitor of GA biosynthesis) are widely applied in agriculture to further decrease plant height. In the plant model *Arabidopsis thaliana*, DELLAs consist of a small family of five proteins that display distinct but also overlapping functions in repressing GA responses. During my Ph.D. we revealed that the "green-revolution" protein RGL3 is essential to fully enhance the jasmonate- (JA) regulated defense responses. In contrast to the other DELLA genes, we show that *RGL3* is directly induced by JA or by inoculation with pathogens, which in turn enhances the expression of JA-responsive defense genes. Hence, RGL3 positively regulates JA-mediated resistance to the necrotroph *Botrytis cinerea* and susceptibility to the hemibiotroph *Pseudomonas syringae*. We propose that JA-mediated induction of *RGL3* expression is of adaptive significance and might represent a recent functional diversification of the DELLAs.

A140 (P062) Shale water as a natural biostimulant

Rafael da Silva Messias[1], Vanessa Galli[1], Mariana da Luz Potes[1], Carlos Augusto Posser Silveira[1], João Peterson Pereira Gardin[1], Cesar Valmor Rombaldi[2]

[1]Embrapa Clima Temperado, Postal address 403, Post code 96001-970, Pelotas, Rio Grande do Sul, Brasil (rafael.embrapa@yahoo.com.br)

[2]Universidade Federal de Pelotas, Agronomia, Pelotas, Rio Grande do Sul, Brasil

Biofortification strategies, such as the use of biostimulants, are been widely used aiming to improve nutritional and quality of food. Shale water (SW), the water extracted from shale rock throughout the pyrolysis process to obtain fuel oil and other products, shows a composition based on organic compounds, mainly phenolic compounds, and a wide range of mineral nutrients and other trace elements with important functions in plant metabolism, including Si, S, Se, Na, Cl, among others. Thus, the effect on quality of maize and lettuce crops resulted from the foliar application of SW was evaluated based on chemical and molecular biology techniques. SW shows to induce the accumulation of N, K, Cu, Fe, Mn and Zn as well as the aminoacids tyrosine, valine, asparagines, proline and alanine, increasing also the yield of maize grains, compared to control (without foliar fertilization). Furthermore, antioxidant activity and the content of phenolic compounds and carotenoids were improved, and genes coding for phytoene synthase (*psy1*), β-carotene hydroxylase (*Hyd3*), and carotenoid ε-hydroxylase (*Cyp97c*) were upregulated in these grains. In lettuce leaves an increase in fresh and dry weight, as a result of the accumulation of K, Cu, Fe and Mn, was observed. Antioxidant activity, phenolic content and the expression of the gene coding for phenylalanine ammonium lyase (*phal*) were also positively affected in lettuce leaves after the application of SW. Taking together, these results indicate that SW has potential to be used in agriculture as a biostimulant aiming biofortification of crops.

A141 (P063) Shale water as a natural biostimulant

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A142 (P109) High throughput methodology to characterize phytohormones produced by PGPR

Floriant Bellvert, Jordan Vacheron, Yvan Moënne-Loccoz, Daniel Muller, Gilles Comte, ClairePrigent-Combaret.UMR CNRS 5557 Ecologie Microbienne, Université Lyon 1, 69622 Villeurbanne, France

Engineer (IE CNRS) in Plant chemistry and metabolomics; technical manager of theplateforms CESN (Center of natural substances studies) from the UMR CNRS 5557;research topic : chemical ecology of plant microbial interactions; Co founder of PO2N group.Tel (33) 4 26 23 45 33

Intensive cultivation of some cereals is consuming water and fertilizers, leading not only to depletion of water resources, but also to important chemical pollution of groundwater and soil. In a context of sustainable agriculture, crop phytostimulation can be carried out by plantbeneficial microbes that may enhance root uptake of water and/or minerals, or reduce the effects of stress in the plant (Richardson et al., 2009; Yang et al., 2009). Among them, certain bacteria known as PGPR (for Plant Growth-Promoting Rhizobacteria) can stimulate the growth of plants by enhancing root ramification and elongation, which may take place via bacterial production of phytohormones. Bacteria of the genera *Azospirillum* and *Pseudomonas* are well-known as phytostimulators, producing different growth regulators such as auxins and cytokinins (Bashan et al., 2010). In order to screen PGPR with high phytostimulation activity and able to produce large quantities of phytohormones, we have developed a chromatographic analysis by UHPLC/DAD/ESI-QTOF to detect and quantify more than ten distinct phytohormones of the auxin and cytokinin families in less than 15 min, with detection threshold in adequacy with the concentrations of phytohormones naturally produced by bacteria. No treatment of bacterial supernatant (purification, concentration) needs to be performed prior to the analysis. This method thus applies to high throughput screening of the production of phytohormones by bacteria.

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A143 (P048) The use of agro-industrial syrups rich in organic carbon to enhance crop productivity:

Marta Delgado [1], Patrícia Correia[1], Luís Carvalho[1], João Casto Pinto[2], Manuela Carolino [1], Pedro Antunes[3], Cristina Cruz[1].

[1] Faculdade de Ciências da Universidade de Lisboa (Centro de Biologia Ambiental - CBA), Campo Grande, Bloco C2, 1749-016 Lisboa, Portugal (mfdelgado@fc.ul.pt).
[2]ADP-Fertilizantes, Santa Iria de Azoia, Portugal (castropinto@adp-fertilizantes.pt)
[3]Algoma University Sault Ste. Marie, Ontario Canadá (pantunes@gmail.com).

One of the major challenges of this century is to meet requirements for food and feed of a growing population while decreasing the environmental impacts of production. The use of biostimulants becomes of considerable importance, as it can increase agricultural productivity, reducing fertilization costs and its impacts. Moreover, such biostimulants can be agro-industrial sub products, increasing its utilization efficiency and value-addition, and helping solving the pollution problem, which otherwise their disposal may cause. We propose to assess the effect of biostimulants (syrups) rich in organic carbon, on soil microbial activity and on maize productivity under real agronomic conditions. The syrup SYR1 was previously tested in a pot experiment using soils from three maize fields with distinct textures. It was shown that that SYR1 was able to persistently enhance microbial activity and potassium availability on soils from maize fields with low organic matter content. SYR1 seems to work through a stimulation of the soil microbial activity, which releases soil nutrients in agreement with the plant needs and allows the use of lower doses of fertilizers. Field trials of the behavior of SYR1 are being developed on a poor soil with low fertilization plot in Southern Portugal. Maize productivity and quality will be assessed, as well soil microbial activity and functionality. Results will be discussed in an integrative way, taking in consideration the two pillars of agriculture: food security and environmental sustainability. Contradictory results between pot and field trials will be discussed.

A144 (P010) Application of Actiwave for improving yield and quality of vegetables and floricultural crops

Antonio Ferrante[1], Paolo Vernieri[2], Alberto Piaggesi[3]

[1] Dip. Scienze Agrarie e Ambientali, Università degli Studi di Milano, Italy
[2] Dip. Biologia delle Piante Agrarie, University of Pisa, Italy
[3] Valagro S.p.A., Piazzano di Atessa (CH), Italy

Abstract

The agricultural growing systems have been evolving towards organic, sustainable or environmental friendly systems. The biostimulants usually are able to improve mineral use efficiency and enhance plant tolerance to biotic and abiotic stresses. In our studies, Actiwave was tested in floricultural and horticultural crops with aim to increase yield and quality. In vegetables such as rocket and lettuce, the application of Actiwave allowed reducing fertilizers without affecting yield ad quality. In the floating systems, the addition of Actiwave directly in the nutrient solution lowered the nitrate accumulation in rocket leaves, improving the quality and respecting the limits imposed by EU regulations. In leafy vegetables it increased plant growth by stimulating root growth. Actiwave increases leaf pigments (chlorophyll and carotenoids), enhancing the antioxidant potential of plants. In floriculture crops, the Actiwave used in bedding plants production stimulated the growth of plants, reaching earlier bloom and the commercial stages. In this way this biostimulant also improves the use efficiency of space in the greenhouse. The application of Actiwave to cuttings or rooted Camellia cuttings, enhanced the roots formation and the shoot development. The effect of biostimulant Actiwave is due to betaines, alginates, and a vitamin K derivate, the kayhydrin.

A145 (P039) Naturvital-16: Daymsa humic acids auxin-like activity assessment.

David Bernad[1], Carlos Solans[1], Eitan Martin[1]

[1] Daymsa, Camino de Enmedio, 120, Zaragoza, Spain (mail@daymsa.com)

Daymsa, Europe's leading producer of leonardite, manufacture and market Naturvital-16, exclusive formulation reference in humic acids sector. Humic acids contained in Naturvital-16 are natural substances that contribute to the development of the plant through their effect in the physical, chemical and biological properties of the soil and in the physiology of the plant. Humic acids of Naturvital-16 have direct effect on the plant physiology: it is recognized and documented that humic acids increase permeability of membrane of plant roots, improving uptake of nutrients. Other important property of humic acids is their rhyzogenetic action, promoting development and growth of roots and root hairs. Evidence for hormonal (-like) effects has been provided recently. The auxin (-like) activity assessment was made through bioassay using oat coleoptiles (López-Modejar et al., 2009, Subler et al., 1998). Activity of Naturvital-16 is compared with the provided with an auxinic substance: indoleacetic acid.

Three replicates of 10 coleoptiles were used. Lenght of coleoptiles after 24 h of incubation was the variable measured. Auxin (-like) activity was extrapolated from correspondence with results obtained All data were subjected to an analysis of variance with the Statistical Analysis System (SAS). Turkey test was employed for mean separation. Results show a clear auxin (-like) activity, assessed as 119 ppm, which proves the interest of Naturvital-16 for improve and enhance root development in crops.

A146 (P115) MICROBIAL CONTENT OF AERATED COMPOST TEA AFTER VARIATIONS OF INGREDIENTS OR PROCEDURES

Mario Lanthier 1, Sonja Peters 1

1 CropHealth Advising & Research, P.O. Box 28098, Kelowna BC, Canada (office@crophealth.com)

Abstract: Compost tea describes a procedure where compost is mixed with water. The mixture may be left to stand with minimal disturbance, also called "compost extract" or "steepage", or actively supplied with oxygen by an aquarium pump to stimulate population growth of aerobic microbes.

This project examined actively aerated compost tea. Over a 3-year period, 25 trials were conducted where a standard recipe was compared to variations of ingredients or procedures. Identification and count of microbial content was done by direct microscopy.

The "standard recipe" was 15 liters of tap water (pH 7.0), 485 grams of composted yard waste, 285 grams of commercial worm castings, 30 ml of humic extract, 30 ml of commercial kelp Ascophullum nodosum and 30 ml of fish fertilizer 2-3-1. The procedure was to aerate water for 60 minutes in a commercial brewer, add ingredients then remove after 5 hours, and maintain brewing for 17 hours at room temperature 20oC.

Laboratory results indicated relatively consistent results for the same recipe from trial to trial.

For ingredients, results indicated that addition of humic acid stimulated fungi activity; addition of kelp stimulated protozoa activity; addition of fish fertiliser stimulated fungi activity and increased nutrient content; increased fungi content with worm castings; and higher protozoa activity by mixing protein food with compost ahead of brewing.

For procedures, longer aeration resulted in higher flagellate numbers; higher numbers of fungi and protozoa with commercial brewers compared to build-your-own; and large impact from longer brewing time.

A148 (P075) The efficiency of elicitors in protecting tomato against *Botrytis cinerea* is modulated by the plant variety and its physiological status

[1]Jérôme Guerrand, [1]Maymoune Aljabal,[1]Adeline Picot, [1]Sonia Hallier

[1] Vegenov-BBV, Penn ar Prat, St Pol de Léon, 29 250, FRANCE (contact@vegenov.com)

Tomato gray mold is a disease caused by the fungus *Botrytis cinerea* and causes severe yield losses. The best way to face this disease and still respect the environment is to combine complementary solutions: "low risk" cultural practices, disease resistance and alternative products including elicitors. The efficiency of such products is often reduced when trials are conducted under real condition productions compared to controlled conditions, suggesting that the interaction with cultural conditions may influence the outcome of the efficiency. It is essential to better understand the influence of biotic and abiotic stresses that may affect the protection efficiency. In addition, the influence of the plant genotype has been poorly studied. The goal of this study was to evaluate the influence of various abiotic stresses, including the hydric stress, nitrogen deficiency and stress caused by wounds, in affecting the efficiency of 5 elicitors. In addition, the effect of the plant genotype was also tested, using 5 varieties that differed in susceptibility to *B. cinerea*. Trials were conducted on young tomato plants treated with products 5 days before inoculation. 7 days after inoculation, disease severity was rated according to the length of necrosis.

The protection efficency was significantly reduced on stressed plants, whatever the type of stress, suggesting an interference between the abiotic stresses and the elicitor efficiency, most probably due to an antagonistic interaction between the defense pathways induced by the abiotic stress and the elicitor. In addition, a significant positive correlation was found between the genotype resistance to *B. cinerea* and the protection efficiency, indicating a synergistic effect between the product and the varietal resistance. More experiments are needed to better understand the mechanisms involved in the loss of efficiency on stressed plants. In addition, the identification of the major plant genetic determinants involved in the interaction with elicitors could allow breeding for tomato genotypes with enhanced ability to respond to elicitors.

A149 (P100) Early Water Stress and Foliar Biostimulant Effects on the Bearing Capacity of Almond Trees

Sebastian Saa[1], Sebastian Castro, Patrick Brown
[1]Department of Plant Sciences, UC Davis. MS#2, One Shields Avenue, Davis CA
530 219 2137, 530 752 8502 (fax), ssaa@ucdavis.edu

In Almonds, fruit growth begins with flower fertilization and ends 2 months later (late April or early May in California), coinciding with leaf development as well as with root growth. Past studies have shown that the competition between developing fruits and leaves occurs and results in reduced leaf area, reduced return bloom and reduced yield potential (Heerema et al., 2008). The aim of this project was to attempt to mitigate the negative impact of fruit on return bloom through applications of foliar nutrients and bio-stimulants under well-irrigated and moderate water stress conditions during early fruit growth.
A thirty percent reduction in irrigation at the commencement of spring crop growth rapidly resulted in differences in stem water potential by early kernel fill (last week of April) and resulted in significant impact on interception of photosynthetic active radiation, with resultant reductions in yield, and fruit set %. Foliar application of a micronutrient and seaweed based biostimulant mix (Valagro Enhanced-VE) significantly improved leaf area on double fruited spurs ($p=0.0166$), with greatest benefit occurring in the moderately water stressed trees. The increment in leaf area with the VE application averaged from + 26 cm^2 to + 40 cm^2 per spur and resulted in greater spur survival of single fruited ($p = 0.0538$) but not double fruited spurs. Foliar application of VE also significantly improved the probability of return bloom ($p = 0.029$). Application of foliar nutrient mixes to mimic the nutrient element components of the VE treatment had no significant effects on leaf area or return bloom.

These results suggest that the presence of fruit on a spur significantly decreases leaf, return bloom and spur survival. The reduction in return bloom and spur survival can be partly ascribed to decreased leaf expansion on spurs bearing fruit. Foliar application of VE positively effects this relationship by increasing leaf area and hence improving spur survival.

A150 (P076) INDuced RESistance network (INDRES)

Xavier Daire[1]

UMR 1347 Agroécologie AgroSup-INRA-Université de Bourgogne. Pôle IPM-ERL 6300 CNRS. 17 rue Sully BP 86510 21065 Dijon cedex France (xavier.daire@dijon.inra.fr)

INDRES is a recent French public scientific network dedicated to the study of plant induced resistance (IR) by biostimulants like elicitors for crop protection. Stimulating plant resistance is a promising strategy that could be further included in Integrated Pest Management. This network aggregates skills from academic teams belonging to INRA (French Institute for Agronomical Research), to French universities and to CNRS (French National Center for Research).The main objective is to decipher the processes leading to acquired resistance to pests on a wide variety of plant of agronomical interest. This includes mechanistic approaches at lab level as well as field assays to understand induced resistance and improve its efficacy. IR is a well documented mechanism mainly on model plants like *Arabidopsis* or tobacco. However, little is known on crops both from plant and their corresponding active biostimulant standpoints. The main projects are (i) identification of biotic and abiotic factors affecting IR efficacy in the fields (ii) discovery of new compounds acting as elicitors ("biostimulants") of plant resistance. Within the INDRES network, many pests are studied including fungi, Oomycetes, bacteria and insects.

INDRES also aims to promote research on IR with private partnership. The main issue is to be a recognized task force able to propose solutions for sustainable agriculture. This requires strong connections with companies, legislation and technical sectors to put forward general up-dated information about IR.

A151 (P077) Elicitra – integrated French network promoting the strategy of plant resistance induction by elicitors through research, training and development

Berthelot R.[1] and Hallier S.[2]

[1] ARVALIS-Institut du végétal, Station expérimentale, F-91 720 Boigneville

[2] Vegenov-BBV, Penn ar Prat, F-29 250 St Pol de Léon
Contacts : r.berthelot@arvalisinstitutduvegetal.fr hallier@vegenov.com;

Agriculture must face challenging and apparently contradictory issues: become both competitive and sustainable. The current reduction plan of pesticide use, occurring throughout Europe, must therefore be accompanied by the development of efficient environmentally friendly methods in crop protection. Among them, the enhancement of plant defence mechanisms by elicitor treatments seems a very promising strategy and has become a major topic of current research.

Elicitra is a French network co-animated by ARVALIS-Institut du vegetal and Vegenov. Its main mission consists of understanding, developing and promoting strategies based on treatments of plants with elicitors. This network is dedicated to large range of plants productions: field crops, vegetable, fruits, vine, ornamental plants and medicinal plants . It includes partners from public research, technical institutes, universities, agricultural colleges, various actors of the crop industries and competitive clusters. By bringing together various partners with different skills ranging from field to lab and from research to training, the understanding and development of this alternative approach will be accelerated.Elicitra is supported and financed by the French ministry of agriculture and was launched in 2011. The objectives of this network are:

- collect data and information of i) the expectations and needs of plant production sector actor; ii) elicitors, their characteristics and efficiency iii) the barriers to their development and use
- initiate discussion to improve our understanding of i) their modes of action; ii) the optimal conditions of their use under production conditions; iii) their impact on the environment and human health
- participate in the development of innovating tools directed to both professionals and scientists including a guide of standardized protocols for a reliable evaluation and good practice
- display information through a website and publications, and participate in the training of both professionals and students

A152 (P101) The influence of Kelpak® and Pentakeep-V® on the root formation of *Pelargonium zonale* 'Serena' cuttings

Viktória Köbli[1], Péter Honfi[2], Mária Túróczy[3], Andrea Tilly-Mándy[2]

[1]Department of Floriculture and Dendrology, Faculty of Horticultural Science, Corvinus University of Budapest, Villányi street 29-43., Budapest, 1118, HUNGARY (viktoria.kobli2@uni-corvinus.hu)

[2]Department of Floriculture and Dendrology, Faculty of Horticultural Science, Corvinus University of Budapest, Villányi street 29-43., Budapest, 1118, HUNGARY (andrea.mandy@uni-corvinus.hu - peter.honfi@uni-corvinus.hu)

[3]Department of Floriculture and Dendrology, Faculty of Horticultural Science, Corvinus University of Budapest, Villányi street 29-43., Budapest, 1118, HUNGARY (disz@uni-corvinus.hu)

In our study we tested the effect of two biostimulants (Kelpak® and Pentakeep-V®) in two treatment ways (soaking+spraying and only soaking) on the rooting of *Pelargonium zonale* 'Serena' cuttings, under greenhouse conditions. Cuttings were taken from mother stock plants, rooting medium was a mixture of peat and perlite. Five groups were created as follows: 1. Kelpak® 0.2%, soaked; 2. Kelpak® 0.2%, soaked + spraying; 3. Pentakeep-V® 0.5%, soaked; 4. Pentakeep-V® 0.5%, soaked + spraying; 5. Control. Soaking of the cuttings took 5 minutes before the planting and leaf spraying treatments were made 3 times during the research. Control group received only tap water. During the evaluation the number of roots, root length and root weight were measured. Our results showed that cuttings treated with Pentakeep-V® had significantly more and longer roots, and also root weight was significantly higher compared to the control group. Measurements after 2 weeks showed that Pentakeep-V® treatments fasten the rooting of the cuttings compared to the Kelpak® and Control groups. While Control group had rootless cuttings after 4 weeks, the biostimulant treated cuttings all rooted well by that time (both Kelpak® and Pentakeep-V®) and their habit looked nicer and greener as well. Considering the way of treatment, no significant differences were obtained between soaking+spraying and only soaking by either treatment groups. We observed that in the end of the research cuttings treated with Pentakeep-V® began to develop new shoots, they were homogeneous and ready to potting.

A153 (P080) Increase of Plant Resistance to Diseases, Pests and Stresses by the Use of New Biostimulants with Bioprotective Properties

S. P. Ponomarenko[1], V. A. Tsygankova[2], A. P. Galkin[3], Ya. B. Blum[3], T. R. Stefanovska[4]

[1] Interdepartmental Science & Technology Center "Agrobiotech" NAS and MES of Ukraine. Kharkivske sh., 50, Kyiv, 02160 Ukraine (sponom@ukr.net).

[2] Institute of Bioorganic Chemistry and Petrochemistry NAS of Ukraine. Kharkivske sh., 50, Kyiv, 02160 Ukraine (vtsygankova@ukr.net).

[3] Institute of Food biotechnology and Genomics NAS of Ukraine. Osypovskoho str., 2a, Kyiv, 04123 Ukraine (iht@i.kiev.ua).

[4] National University of Bioresources and Environmental Management of Ukraine. Heroyiv Oborony str., 13, Kyiv, 03041 Ukraine (Steftat@hotmail.com)

The natural biostimulants (Stimpo, Regoplant, Biolan) with immuno-protective properties are developed in Ukraine. They strengthen plant growth and development, increase plant resistance to diseases, pests, stresses and promote increase of efficiency and quality of production. It is achieved by stimulation of biosynthesis of small regulatory si/miRNA – immune components of the system of plant protection.

Long-term tests of these preparations at cultivation of winter and spring wheat, barley, corn, soybean, sugar beet, potato, etc., including on the infected soils and soils polluted by ions of heavy metals and radionuclids have shown expediency of their application.

A154 (P085) Effect of arabinogalactan proteins from the root caps of *Pisum sativum* and *Brassica napus* on *Aphanomyces euteiches* zoospore chemotaxis and germination.

Marc Antoine Cannesan[1], Carole Burel[1], Marie-Laure Follet-Gueye[1], Christophe Gangneux[2], Patrice Lerouge[1], Karine Laval[2], Eric Nguema-Ona[1], Azeddine Driouich[1*] and Maïté Vicré-Gibouin[1]

[1]Laboratoire Glycobiologie et Matrice Extracellulaire Végétale (Glyco-MEV). Grand Réseau de Recherche VASI de Haute Normandie. PRES Normandie Université. Université de Rouen. 76821 Mont Saint Aignan, Cedex. France. [2] Laboratoire Biosol, Esitpa76134 Mont-Saint-Aignan, France. E-mail: maite.vicre@univ-rouen.fr

Root tips of many plant species release a number of border, or border-like cells that are thought to play a major role in the protection of root meristem (Hawes et al., 2000; Vicré et al., 2005; Durand et al., 2009; Driouich et al., 2010). Here, we have characterized cell walls from root caps, border cells and border-like cells of *Pisum sativum* the plant model for studying border cell function (Hawes et al., 2000) and *Brassica napus*, a species that produces border-like cells (Cannesan et al., 2012). We found that root caps and border-like cells / border cells contain significant amounts of arabinogalactan proteins (AGPs). AGPs are plant proteoglycans heavily glycosylated, located at the periphery of the cell surface and in the rhizosphere, which are known to play several functions in root biology, including plant morphogenesis and plant microbe interactions (Nguema-Ona et al., 2007; Nguema-Ona et al., 2012). Furthermore, we have taken advantage of the pathosystem *P. sativum – Aphanomyces euteiches* to investigate the effects of arabinogalactan proteins from root caps on zoospore behaviour and development. Common root rot due to the oomycete *A. euteiches* is considered as the major destructive soil borne disease of pea, whereas, on the contrary root-infecting oomycetes are not naturally-occurring pathogens of *B. napus* crops.

We found that arabinogalactan proteins are involved in early root infection. We also show these proteoglycans selectively induce chemotaxis, zoospore encystment and a significant inhibition of cyst germination. These findings provide evidence for a novel role of arabinogalactan proteins in root-zoospore interaction.

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A155 (P060) Proposal of bioassay for biostimulant properties

Anna Benedetti

Consiglio per la Ricerca in Agricoltura –Cenro di Ricerca per lo Studio delle relazioni tra Pianta e Suolo

Via della Navicella 2, 00184 Rome , Italy, anna.benedetti@entecra.it

Biostimulants are products which, alone or mixed with other fertilizers, contribute to improve plant growth by exploiting different physiological processes.
Aim of this paper is the examination of analytical methods possibly flexible and generic, of brief and easy execution and interpretation, in order to characterise the biostimulating properties of fertilisers of both vegetal and animal origin and to detect the doses necessary for the effectiveness of biostimulants.
These methods permit to achieve a preliminary screening among biostimulants, hormones and fertilisers, with no care to the specific physiological processes they operate (i. e. fruit ripening, vigour or flower senescence).
The study of the detailed physiological processes needs specific methods and precise markers.
The use of bioassays was chosen because biostimulants activate metabolic processes, and their activity can be detected by measuring their action on the metabolism of living organisms. Particularly the metabolic activity of indicators such as micro-organisms , or vegetal, or tissue cultures in vitro, was investigated.
In this paper four different bio-tests and four different doses were selected to check out the efficiency of the products:definitive results are obtained by interpretation of the combination of the outcomes from each test at all the testing doses.
Beside the description of the methodologies, the results of characterization of several products of vegetal, animal or mixed origin of the national or European market are synthetically described.
The results obtained demonstrate that the tests used on living organisms are sensitive to the treatments applied: their results depend on the properties and the doses of the product.