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18TH SYMPOSIUM OF THE INTERNATIONAL SCIENTIFIC CENTRE OF FERTILIZERS

MORE SUSTAINABILITY IN AGRICULTURE: NEW FERTILIZERS AND FERTILIZATION MANAGEMENT

8-12 NOVEMBER 2009
ROME, ITALY

BOOK OF ABSTRACTS
CIEC 2009

MINISTRY OF AGRICULTURE
FOOD AND FORESTRY POLICIES

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By
P. SEQUI, D. FERRI, P. ZACCHEO, E. REA, F. MONTEMURRO, M. DESANTIS,
A.V. VONELLA, F. FORNARO

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Agricultural Research Council
Research Centre for the Soil-Plant System, Rome

Donato Ferri:
Agricultural Research Council
Research Unit for Cropping Systems in Dry Environments, Bari

Patrizia Zaccheo:
Department of Plant Production, University of Milan

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PREFACE

It is with great satisfaction that I welcome both the regular members of the International Scientific Center of Fertilizers (CIEC) as well as the new attendants to the 18th Symposium organized in the spectacular Rome metropolis, a city world famous for its magnificent history.

CIEC, like Rome, also has a vibrant history. Not only is Rome the birthplace of CIEC but it seems to me, that the expression "all roads lead to Rome" certainly holds true for CIEC, as throughout its existence, CIEC keeps coming back to Rome. Founded in 1933 as a result of several international conferences held in Rome and Amsterdam, CIEC brought together different players involved in soil fertility and plant nutrition scientific research, chemical fertilizer technology and their application in agriculture. Two of the main founders of CIEC were Italian Professor *Francesco Angelini* – then Secretary General of International Federation of Agronomists and Professor in the University of Naples – elected at that time as Secretary General of the newly established *Centre International des Engrais Chimiques* (CIEC), and Dr. *Ernest Feisst,* then Minister of Agriculture of Switzerland, elected at that same time as President. They were both immensely dedicated to CIEC's formation. The most important event after its founding was the organization of the Ist World Fertilizer Congress held again, in Rome in 1938. I would like to take this opportunity to remember and give our heart felt gratitude to our predecessors' hard work and commitment to this organization.

After a nearly 10 years break in its proceedings caused by the 2nd World War, Prof. *Angelini* and Dr. *Feisst* succeeded in resuming CIEC's activity by organizing the second World Congress also in Rome, in 1951, after two previously preparatory character meetings held in Zurich and Paris, 1949-1950. This Congress infused CIEC with a new momentum in the research of the effects of fertilizers on the soil, on human and animal health, and exploring various methods of fertilizer application and the problems of fertilizer production and manufacturing.

Now, in 2009 we meet again in Rome, in the framework of the 18th International Symposium of CIEC, thanks to the generous efforts made by the Italian National Organizing Committee. I would like to recognize and extend my appreciation to Prof. *Paolo Sequi* from the Agricultural Research Council (CRA) - Research Centre for the Soil Plant System, Rome, Dr. *Donato Ferri* from CRA - Research Unit for Cropping Systems in Dry Environments, Bari, Dr. *Patrizia Zaccheo* from the Department of Plant Production, University of Milan, Dr. *Francesco Montemurro* from CRA - Research Unit for the Study of Cropping Systems, Metaponto, Matera, Dr. *Maurizio Desantis* from the Italian Ministry of Agriculture, Food and Forestry Policies, Rome and, also, to Dr. *Elvira Rea* and *Francesco Fornaro*. Please accept my warmest gratitude.

As President of CIEC, involved in the organization of its 18th Symposium, it is my duty and pleasure to highlight the prolific cooperation between the Italian National Organizing Committee and the International Organizing Committee, represented primarily by Professors *Ewald Schnug* and *Silvia Haneklaus* from Braunschweig, Germany, both strongly involved in CIEC's permanent activities.

Additionally, I express my deepest appreciation to all who devoted their time and effort in ensuring the success of the 18th International CIEC Symposium.

I believe CIEC somehow managed to carve a road of its own to keep its connection to Romania open ever since its inception. Romania was one of the 29 CIEC's founding countries, hosted the XIIth General Assembly in 1971 and the XIIth Symposium in 2000. Thus, it is with great pleasure and honor that I am now informing that the XVth CIEC World Fertilizer Congress will be held in 2010 in Bucharest, Romania. I am cordially inviting all of you to participate next year at this Congress.

I must confess that I am very proud of CIEC's evolution over time, of its capacity to function as a valuable bridge between the diverse specialists involved in fertilizer research, technical development and industry from almost all the countries of the world.

The 18th Symposium is a testimony to CIECs solid roots being deeply anchored in the reality of our time, offering us the opportunity to advance towards more sustainability in agriculture, while taking into account the new challenges we have to confront and the current legislation regulating consumer's rights and environmental demands.

The Symposium promises to explore and reveal the possibilities to use new fertilizers and make amendments to our conventional and organic agricultural systems, to inform us about the production, markets and economics of these fertilizers and by-products, site specific nutrient management, especially fertilizers and food quality under the new fertilizers use.

It is my hope and desire that the proceedings of this Symposium will be crowned with success, and will remain a rewarding and pleasant remembrance for us all.

Cristian HERA
President of CIEC

I SESSION

New fertilizers and amendments from industrial by-products and waste materials

(Chairman: Prof. C. Hera, Dr. F. Montemurro)

Oral Presentations

PROPERTIES AND PLANT AVAILABILITY OF PHOSPHORUS FERTILIZERS FROM SOURCE-SEPARATED URINE

S. Antonini[1], U.Arnold[1], J. Clemens[1]

[1]University of Bonn - Department of Plant Nutrition, Karlrobert-Kreiten Strasse 13, Bonn, Germany, E-mail: sam_antonini@uni-bonn.de, telphone: +49 228 732155, fax: +49 228 732489

I Session: New fertilizers and amendments from industrial by-products and waste materials

Abstract

Human urine is a potential substitute for mineral P-fertilizers, especially when it is processed to a solid form. Solids obtained by solar evaporation, chemically induced struvite precipitation and spontaneous precipitation during urine storage were evaluated as P sources for plant growth.

A greenhouse pot experiment was conducted using a P-deficient soil and ryegrass and maize as test crops. Single superphosphate and a replication with no phosphorus addition were used as references for comparison with the other P sources. The substrates were analyzed for their crystal structure by X-ray diffraction spectrometry and for their phosphorus solubility in water, in citric acid and in mineral acid. Plant growth morphology, dry weight, and total-P of the biomass were assessed.

The results indicate that all test substrates except the solids generated through solar evaporation were up to two times more efficient than superphosphate in increasing the dry matter yield and in supplying P to ryegrass and maize. When urine was mixed with sulphuric or phosphoric acid before evaporation, the agronomic effectiveness of the final products could be increased. Overall, the majority of test substrates exhibited a higher fertilizer efficiency as P sources when compared to commercial superphosphate, probably because of their additional micronutrient content.

ROLE OF BIOFERTILIZERS IN PLANT NUTRITION

N. Bákonyi[1], B. Tóth[1], É. Gajdos[1], É. Bódi[1], M. Marozsán[2], S. Veres[1], L. Lévai[1]

[1]University of Debrecen, Institute of Plant Science, Agricultural Botany and Crop Physiology Department, Böszörményi u. 138. H-4032 Debrecen, Hungary.
[2] Nyírerdő Nyírségi Forestry Corporation, H-4400 Nyíregyháza Kótaji u. 29.
E-mail: nora.bakonyi@gmail.com

I Session: New fertilizers and amendments from industrial by-products and waste materials

Abstract

The uptake of nutrients by the plants determines the final product, its quantity and quality. One of the main environmental factors determining the effectiveness of crop production is the soil pH. The aim of our studies was, to investigate the effect of bicarbonate, and the pH of nutrient solution on the growth of test plants in laboratory and to prove the positive role of bio-fertilisers on the nutrient uptake, grown and root morphology. The experimental plants (wheat, corn, cucumber) growing in climate chamber on nutrient solution. To minimize the input, new technologies were developed, as the use of bacterium containing fertilizers. To use these biofertilizers the uptake of nutrients, and the total organic matter production will be increased. It is proved by our experiments, that the growth and development of treated plants increased when the biofertilizer Phylazonit. The root development was more intensive, and consequently the green mass production was higher. The Phylazonit in the nutrient solution compensated the growth retardation, and had a stabilization effect on the pH of nutrient solution. When the bicarbonate treated nutrient solution was completed with bio-fertilizer the dry matter accumulation of shoots was increasing.

THE UTILIZATION OF SEDIMENTS ON AGRICULTURAL FARM LAND IN THE CZECH REPUBLIC

P. Čermák[1], M. Budňáková[2], E. Kunzová[3]

[1]Central Institute for Supervising and Testing in Agriculture, Hroznová 2, Brno, Czech Republic,
E-mail: pavel.cermak@ukzuz.cz; telephone: +420737267150; fax: +420569430438
[2]Ministry of Agriculture of the Czech Republic, Těšnov 17, Praha, Czech Republic,
E-mail: budnakova@mze.cz; telephone: +420725004331; fax: +420
[3]Crop Research Institute Name, Drnovská 507, Praha 6-Ruzyně, Czech Republic,
E-mail: kunzova@vurv.cz; telephone: +420602190195; fax: +420233310636

I Session: New fertilisers and amendments from industrial by-products and waste materials

Abstract

The sedimentation is a result of natural erosive and transport processes in the catchment area. Estimated total amount are 197 millions m^3 of sediments in small ponds and rivers in the Czech Republic. Generally sediments are valuable material as a fertiliser for agricultural farm land.

The rate of contamination of sediments by inorganic and organic pollutants is a deciding factor for their utilization on agricultural farm land. The content of available nutrients is very important for manurial effect of sediments too, eventually next parameters, i.e. the texture, the share of organic matter, the acidity etc.

Central Institute for Supervising and Testing in Agriculture provides a monitoring of sediments and simultaneously it is entitled organisation above inspection of sediments utilization on agricultural farm land in the Czech Republic.

Present results from monitoring of sediments show a very different analytical value practically in all parameters. Mainly the texture of sediments is very different. With a texture to a great extent correlates the chemical composition of sediments. In comparison with suggested limits of risk elements and hazardous substances (for sediments and soil) it is possible to say, that absolute majority of sediments is suitable for their using as a fertiliser on agricultural farm land in the Czech Republic.

PRODUCTION AND UTILIZATION OF SUPPRESSIVE COMPOST: ENVIRONMENTAL, FOOD AND HEALTH BENEFITS

M. de Bertoldi

Department of Industrial Microbiology, University of Udine, Italy
e-mail: m.debertoldi@virgilio.it

I Session: New fertilizers and amendments from industrial by-products and waste materials

Abstract

Since many centuries compost has been utilized in agriculture to replace organic matter and nutrients for different crops. Only recently, 30-35 years ago, particular composts, produced with selected starting material and with controlled processes, have been applied to suppress phytopathogenic agents. This compost can be used in the soil to control soil born pathogens or as a water extract (tea compost) to control air born pathogens. These particular applications have been tested, to control diseases, both in open fields and in laboratory on many different crops and conditions: greenhouse, horticulture, floriculture, pomology, grapes, container systems, pot culture, turfgrass, plant nursery, etc. Although mechanisms of suppression are still not fully understood, those postulated include a complex interplay of a range of abiotic (pH, temperature, C/N, organic matter quality, etc.) and biotic (predators, antagonists, competition for nutrients, antibiosis, production of lytic enzymes, microbial metabolites like siderophores, etc). There is a clearly relation between disease suppression and specific chemical, physical and biological characteristic in compost. In the following paragraphs compost characteristics related to disease suppression, the use of suppressive compost and economical benefits (reduced use of chemical fertilizers and pesticides) are discussed. The use of suppressive compost in agriculture will reduce or eliminate the application of pesticides to crops. Among the different class of chemicals present in the environment and to which human population is massively exposed, pesticides play an important role due to their wide use and biological toxicity. Pesticides pollute air, water and soil and enter in the food chain because of their persistence.

POTENTIAL USE OF OLIVE POMACE COMPOST AS AMENDMENT ON A CHICKPEA-EMMER ROTATION IN ORGANIC FARMING

M. Diacono[1], C. Vitti[1], G. Debiase[1], V. Verrastro[2], F. Ceglie[2], F. Tittarelli[3]

[1]CRA, Research Unit for Cropping Systems in Dry Environments, 70125 Bari, Italy,
E-mail: mariangela.diacono@entecra.it, telephone: +39-080-5475022, Fax: +39-080-5475023
[2] CIHEAM-MAIB, Mediterranean Agronomic Institute of Bari, Italy,
telephone: +39-080-4606259.
[3]CRA Research Centre for the Soil-Plant System, Roma, Italy

I Session: New fertilizers and amendments from industrial by-products and waste materials

Abstract

In Mediterranean countries, composting has shown to be a suitable method to recycle olive pomace, because it needs low technical and economical requirements.
The objective of this field trial was to evaluate the phytotoxicity and the agronomic performance of four types of olive pomace compost (OPC), on a chickpea-emmer rotation in organic farming.
Two different mixture of olive pomace blended with pruning wastes and cattle manure were prepared and processed in bio-containers. At the end of the active phase, each mixture was removed from the container and put outdoors to obtaine two splitted windrows and these were leaded to two phases of stabilization.
A bioassay was performed to assess the phytotoxicity both for the raw pomace and the OPCs by the measurements of seed germination percentage and root elongation of cress.
The field research was carried out by November 2008 in Foggia, on plots of 40 m^2. In a randomized-block design with three replications the following treatments were compared: OPC with an high C/N ratio, equal to 45, both instable and stabilized; OPC with a low C/N ratio, equal to 30, both instable and stabilized; a commercial organic-mineral fertilizer and an unfertilized control.
The results showed no phytotoxicity in OPCs as compared with raw pomace. The field application of OPCs could be an effective sustainable fertilizing strategy in organic farming, to a greater extent on graminaceous crop rather than on leguminous one. In particular, chickpea revealed a species-specific sensitiveness and best results with both the stabilized OPCs.

EFFECT OF BACTERIA CONTAINING BIOFERTILIZER ON CD-TOLERANCE OF SOME CROP PLANTS

É. Gajdos[1], S. Veres[1], L. Lévai[1], N. Bákonyi[1], B. Tóth[1], É. Bódi[1], M. Marozsán[2]

[1]University of Debrecen, Institute of Plant Science, Agricultural Botany and Crop Physiology Department, Böszörményi u. 138. H-4032 Debrecen, Hungary.
[2] Nyírerdő Nyírségi Forestry Corporation, H-4400 Nyíregyháza Kótaji u. 29.
E-mail: egajdos@agr.unideb.hu

I Session: New fertilizers and amendments from industrial by-products and waste materials

Abstract

Biofertilizers prompte nutrion uptake, but still there are a lot of questions about their application in polluted soils. In the course of the intensive plant growing, considerable quantities of cation leave the soil to lead to acidification, thereby enhancing the uptake of heavy metals by plants. Cadmium (Cd) toxicity is a major problem affecting crop productivity worldwide. The cadmium ion is easily collectable and also transportable inside plants. Thus the Cd get into the food-chain, causing public health problems. The aim of our work was to investigate the effects of biofertilizers on plant production and nutrient uptake in case of Cd-polluted nutrient solution. Cadmium accumulated primarily in the roots, transport to the shoots was rather low, but there were differences between the two investigated plants. Sunflower took up more Cd (because of the different nutrient-uptake system) and many have had larger stress-tolerance to Cd than maize. With the use of the bacterium-cintaining biofertilizer, the toxic effect of cadmium was moderated.

DEVELOPMENT OF A SEWAGE SLUDGE ASH BASED FERTILIZER: PHOSPHORUS FERTILIZER EFFICIENCY AND ZINC AVAILABILITY OF THERMO-CHEMICALLY TREATED SEWAGE SLUDGE ASHES AS ASSESSED BY ISOTOPIC METHODS

S. Nanzer[1], A. Oberson[1], C. Villard[1], E. Berset[1], L. Hermann[2] and E. Frossard[1]

[1]Institute of Plant Sciences, ETH Zurich, Switzerland, [2]ASH DEC Umwelt AG, Austria

I Session: New fertilizers and amendments from industrial by-products and waste materials

Abstract

Because of sanitary concerns and environmental pollution direct application of sewage sludge in agriculture is forbidden in Switzerland. Alternative waste management strategies such as sewage sludge incineration and sewage sludge ash (SSA) disposal in landfills present a net loss of the finite phosphorus (P) resource. SSA contains high quantities of P but no organic pollutants and is therefore a valuable resource for fertilizer production. However, heavy metal concentrations in SSA are excessive and environmentally hazardous. ASH DEC developed a thermo-chemical treatment to remove heavy metals from SSA and thus enables fertilizer production.

In order to asses the potential of an SSA based fertilizer we investigate untreated and thermo-chemically treated SSA addressing: i) heavy metal removal efficiency of the thermo-chemical treatment ii) recovery of P and Zn from SSA in plants using ^{33}P and ^{65}Zn radioisotope dilution techniques.

The thermo-chemical treatment leads to a removal of 90% of cadmium, Zn and lead, while copper, chromium and nickel removal is less efficient. Pot experiments done without radioisotopes suggest that the P plant availability of SSA is less than for a water soluble fertilizer, but more than a rockphosphate. The experiments using radioisotopes are in progress and will be presented at the conference.

PHOSPHOGYPSUM-BASED PRODUCTS FOR FARM SCALE PHOSPHORUS TRAPPING

L. Pietola and U. Kulokoski

Yara International ASA, R&D

Session I: New fertilizers and amendments from industrial by-products and waste materials

Abstract

Two environmental solutions in order to improve P use efficiency in agriculture will be addressed. The proposed products base on use of an industrial by-product. The products can be utilized especially in those areas and farming practises which contribute most to the current P discharge, i.e. erodible fields and intensive manure application.

These environmental products do not harm farming, rather vice versa. The technologies rely on the use of phosphogypsum from phosphoric acid plant which produces calcium sulphate dihydrate ($CaSO_4$ $.2H_2O$) as a by-product. The gypsum originating from Yara's Finnish apatite does not contain heavy metals or radioactive compounds.

Gypsum will be used for P-sorption in soils (as such) and P-fractionation in manures (as co-compound. On farm, gypsum as soil amendment can be spread like lime and tilled thereafter into the soil in autumn. During 1st winter, erosion will reduce even by 50%. For manure treatment, gypsum needs to be mixed with additive for pH increase. The product will bind and precipitate P down in a solid matter that sediments from the liquid. This P-rich sediment will then sink to the bottom of the slurry pit for a separate use of P for soils of low P-index. The upper liquid phase of low P concentration can be used in fields of high soil P-index.

Poster Presentations

MODIFIED ZN-LIGNOSULFONATE COMPLEXES AS ZN FERTILIZERS FOR NAVY BEANS (*PHASEOLUS VULGARIS* L.) IN HYDROPONICS

A. Benedicto, S. López-Rayo, L. Hernández-Apaolaza and J.J. Lucena*

Department of Agricultural Chemistry, Universidad Autónoma de Madrid.
C/ Francisco Tomás y Valiente 7. 28049 Madrid. Spain
**Corresponding author*: juanjose.lucena@uam.es

I Session: New fertilizers and amendments from industrial by-products and waste materials

Abstract

The objective of this study was to compare the quality of six lignosulfonates for their use as complexing agents in the formulation of zinc fertilizers. Two of the lignosulfonate samples were obtained through sulfite treatment, one of them from eucalyptus wood and the other from spruce wood. The other four lignosulfonates were obtained from the original lignosulfonate of eucalyptus by chemical modifications: oxidation, sulfonation, phenolation and ultrafiltration. Zn complexing capacity (ZnCC) of lignosulfonates was determined and its efficacy as Zn fertilizer for navy beans (Phaseolus vulgaris L.) under hydroponic condition was assessed in comparison with ZnEDTA, ZnSO4 and a control without Zn.

It was observed that ZnCC of lignosulfonate obtained from spruce was slightly higher that ZnCC of lignosulfonate obtained from eucalyptus. All the modifications of the original eucalyptus product improved its ZnCC, especially when phenolated groups are included into the molecule.

Biomass weight, SPAD index and Zn concentration in leaves indicated that the six Zn-lignosulfonate complexes had a similar effect than the ZnEDTA in providing Zn to the plants. Not many differences were found between the six lignosulfonate in the correction of the Zn deficiency of navy beans under hydroponic culture conditions. Since doses were calculated in function of the complexed Zn, those having a higher Zn complexation capacity were considered as more efficient. The six lignosulfonates can be a cheaper and environmentally friendly alternative to synthetic chelates, although new studies to relate chemical characteristics with agronomic value of Zn complexes of lignosulfonates are necessary.

CHARACTERIZATION AND NITROGEN USE EFFICIENCY OF PIG SLURRY TREATED BY ANAEROBIC FERMENTATION IN COMBINATION WITH ULTRAFILTRATION AND REVERSE OSMOSIS

C. Bosshard[1], R. Flisch[1], J. Majer[1], S. Basler[2], J.L. Hersener[3], U. Meier[4], W. Richner[1]

[1]Agroscope Reckenholz-Tänikon ART, Reckenholzstr. 191, Zurich, Switzerland,
E-mail: christine.bosshard@art.admin.ch, telephone +41 44 377 75 57, fax +41 44 377 72 01
[2]LZ Liebegg, Gränichen, Switzerland,
E-mail: Sonja.basler@ag.ch, telephone +41 62 855 86 14, fax +41 855 86 90
[3]Ingenieurbüro HERSENER, Untere Frohbergstr. 1, Wiesendangen, Switzerland,
E-mail: hersener@agrenum.ch, telephone +41 52 338 25 25, fax +41 52 338 25 28
[4]MERITEC GmbH, Postfach 1, Guntershausen, Switzerland,
E-mail: urs.meier@mertitec.ch , telephone +41 52 365 46 86, fax +41 52 365 46 83

I Session: New fertilizers and amendments from industrial by-products and waste materials

Abstract

Agriculture is one of the main emitters of nitrogen (N) compounds (e. g. ammonia, nitrate, nitrous oxide) causing negative impacts to the environment. Regional N excess due to high livestock density results in intensification of environmental pollution. Hence, N emissions from agriculture to the environment have to be further reduced. New technologies such as anaerobic fermentation (AF) of slurry in combination with ultrafiltration (UF) and reverse osmosis (RO) can be attractive for agriculture as it gives rise to i) optimization of nutrient management, ii) reduction of transport volumes of slurry and iii) production of renewable energy. In our study anaerobically fermented as well as fermented and mechanically separated pig slurry and products resulting from UF and RO, respectively, were characterized and their apparent N use efficiency was determined in pot and field experiments using the difference method. AF, UF and RO of slurry increased its ammonium-N concentration, which improved plant N availability, and its pH, which could increase the risk for ammonia N losses. Overall, such new technologies for slurry treatment in combination with an adequate application technique (e. g. trail hose) have potential to increase N efficiency of slurry and to reduce N emissions to the environment.

INFLUENCE OF POMACE APPLICATION ON THE EFFECTIVENESS OF A CHEMICAL FERTILIZER

R. Carbonell[1], R. Ordóñez[1], M.A. Repullo[1] and P. González[1]

[1]Área de Producción Ecológica y Recursos Naturales. IFAPA, Centro Alameda del Obispo. Apdo. 3092. 14080 Córdoba
E-mail: rosam.carbonell@juntadeandalucia.es

I Session: New fertilizers and amendments from industrial by-products and waste materials

Abstract

The excessive use of chemical inputs, exclusively, has propitiated a reduction in the effectiveness of chemical fertilizers.

There are advantages and disadvantages in both types of fertilization (organic and inorganic), so that a complementarity between them should be sought since neither of these two systems in isolation can make agriculture reach any sustainability.

The aim of this work is to evaluate the incidence of the application of an organic amendment, to be specific, pomace (a residue coming from the extraction of olive oil by a centrifugation system), on the main nutrients in the soil as well as on the quality and volume of harvests.

For this purpose, an assay was carried out by applying dried pomace in a dryland wheat-sunflower rotation on a farm in Andalusia (southern Spain), in which different doses of nitrogenous fertilizer together with the application of this organic amendment were considered.

The results obtained show increases in the contents of nutrients in the treated soils with respect to the control; in the specific case of potassium available increases of over 200 mg/kg.

With regard to harvest quality, the application of the amendment by itself did not produce any increases in the nitrogen content, but its combination with chemical fertilization did make the treated plots display higher amounts both in grain and in biomass compared to those exclusively treated with the fertilizer.

Finally, the yields were higher in the plots treated with the amendment for all the seasons studied.

NITROGEN RELEASE FROM AGRO-INDUSTRIAL BY-PRODUCTS IN SOIL: TEMPERATURE EFFECT

L. Cavani and C. Ciavatta

Department of Agro-Environmental Sciences and Technologies, Alma Mater Studiorum - Università di Bologna, viale Fanin n. 40, I-40127, Bologna, Italy,
E-mail: luciano.cavani@unibo.it, telephone +39 051 2096360, fax +39 051 2096203

I Session: New fertilizers and amendments from industrial by-products and waste materials

Abstract

Improved ability to predict the availability of N from organic sources, as agro-industrial by-products, would serve several complimentary purpose, at farm and environmental level. As example, loss of mineral N as NO_3^- could reduced by both eliminating unneeded application and better matching mineral N supply with crop demand. A 13-weeks incubation experiment was conducted at 5 and 23 °C to evaluate the N release from some agro-industrial by-products: (i) meat meal (MM); (ii) feather meal (FM); (iii) fruit waste + tannery sludge (FW) and (iv) leather meal + tannery sludge (LM). Products was incorporated at rate to provide 200 kg N ha^{-1} (or 100 mg N kg^{-1} soil). Soil NO_3^- and NH_4^+ concentrations were determined at weekly or biweekly intervals. The rate of inorganic N accumulation increase with increasing temperature, and could be predicted using a first order kinetic model [Nm = N0 * (1 – e^{-k*GDD})] and thermal units (GDD, growing degree days). N release was higher for FM and MM (70 and 55% of N added, respectively) than FW and LM (25 and 15%). This approach is useful for estimating N availability from agro-industrial by-products during the season, and also in improving the synchrony between N supply and crop demand.

RELATIVE EFFICIENCY OF SOURCES OF POTASSIUM IN THE FERTILIZATION OF CROP SYTEM PEAR MILLET AND SOYBEAN

A.M. Coelho[1], I.E. Marriel[1], D.M. Rocha[2]

[1]Embrapa Maize and Sorghum Research Institute, Sete Lagoas- MG, Brazil,
E-mail: amcoelho@cnpms.embrapa.br, telephone +55-31-3027-1145, fax +55-31- 3027-1188
[2]Eng. Agr. Embrapa Maize and Sorghum trainee, Belo Horizonte-MG, Brazil

I Session: New fertilizers and amendments from industrial by-products and waste materials

Abstract

In 2008, the consumption of potassium fertilizer in the Brazilian agriculture was seven million tons, of which 92 % was imported, representing a cost of US$ 5 billion. The objective of this study was to evaluate the efficiency of sources of potassium in the fertilization of pearl millet (as cover crop) and soybean. The experiments were conducted at the Embrapa Maize and Sorghum, Sete Lagoas, Minas Gerais state, in the 2006/2007 and 2007/2008 growing seasons, on a Dystroferric Red Latosol (clay Oxisol), cultivated with pasture of brachiaria and had Mehlich1 extractable K concentration of 25 mg kg^{-1} in the top 20 cm. Pear millet (Pennisetum glaucum) was sown in September over the residues of brachiaria, and Soybean (Glycine max) was sown in the first week of December, in the two growing seasons. The treatments consisted of three sources of potassium (Potassium Chloride-KCL, Rock-Biotite, and Byproduct-RMS) and four rates (0, 75, 150 and 300 kg K_2O ha^{-1}), applied in the first year, broadcast on the soil surface and incorporated into the soil at 10 to 15 cm depth. The experiment was in random blocks, using a split plot design with three replications. Pearl millet and soybean presented greatest response to K fertilization rates of 150 and 300 kg K_2O ha^{-1}, respectively. The efficiency of the soucers of K was KCl > RMS>Biotite.

ORGANIC AMENDMENTS APPLICATION ON MELON CROPS GROWN IN MEDITERRANEAN CONDITIONS: SOIL CHEMICAL PROPERTIES (SECOND NOTE)

G. Debiase[1], D. Ferri[1] , M. Mastrangelo[1], A. Fiore[1], F. Montemurro[2]

[1]C.R.A.- Research Unit for Cropping Systems in Dry Environments, Via C. Ulpiani, 5 - 70125 Bari, Italy, E-mail: giambatistadebiase@virgilio.it, tel. 0805475012, fax. 0805475023.
[2]CRA - Research Unit for the Study of Cropping Systems, c/o AASD "Pantanello", s.s.106 Jonica 448,2 - 75010 Metaponto (MT), Italy

I Session: New fertilizers and amendments from industrial by-products and waste materials

Abstract:

A three-year field experiment (2006-2008) was carried out in a Mediterranean environment to study the effects of organic amendments application (anaerobic digestate and composted municipal solid wastes) on chemical properties of the soil cultivated at melon.

The research was conducted at Metaponto (MT - Southern Italy) on a clay soil (Typic Epiaquerts according to Soil Taxonomy). In a strip-plot experimental design with three replications two irrigations (re-establishment 100 and 50% of the calculated maximum evapotranspiration) and the following four fertilizer treatments were compared: mineral fertilizer (Min); commercial stable manure (Org-min); anaerobic digestate based on wine distillery wastewater (WDD); composted municipal solid organic wastes coming from the separate collection (SUW). Each fertilizer treatment received 150 kg N ha^{-1}.

During the trial period the total organic carbon (TOC) content and the umification fractions (TEC and HA+FA), the macro-nutrient content (total N, exchangeable K, available P) and the heavy metal variation (Cu, Zn, Ni, Pb) were determined.

At the end of trial period, the WDD significantly increased TOC, TEC and HA+FA of the 19, 25 and 14%, respectively in comparison with the Min treatment.

Among the treatments, no significant difference for the content of Zn and Ni was found, while significant differences where observed for Cu and Pb, which reached the highest levels for treatments WDD and SUW, respectively.

On the whole, the experimental fertilizers seem to increase soil fertility, but their application require careful agronomical practices in order to reduce pollution risks.

ORGANIC FERTILIZERS APPLICATION ON MELON CROPS GROWN IN MEDITERRANEAN CONDITIONS: I. YIELD AND PRODUCTIVE PERFORMANCES

R. Leogrande, O. Lopedota, N. Losavio, F. Montemurro, A. Quaranta

CRA-Research Unit for the Study of Cropping Systems, c/o AASD "Pantanello",
s.s.106 Jonica km 448.2 - 75010, Metaponto (MT), Italy,
E-mail: rita.leogrande@entecra.it , telephone 0835745071, fax 0835745286

I Session: New fertilizers and amendments from industrial by-products and waste materials

Abstract

A three-year field experiment (2006-2008) was carried out in a Mediterranean environment to study the effects of organic fertilizers application (anaerobic digestate and composted municipal solid wastes) on yield and agronomic performance of melon crops (Cucumis melo cv. Inodorus).
The research was conducted at Metaponto (MT - Southern Italy) on a clay soil (Typic Epiaquerts according to Soil Taxonomy). In a strip-plot experimental design with three replications two irrigations (re-establishment 100 and 50% of the calculated maximum evapotranspiration) and the following four fertilizer treatments were compared: mineral fertilizer (Min); commercial stable manure (Org-Min); anaerobic digestate based on wine distillery wastewater (WDD); composted municipal solid organic wastes coming from the separate collection (SUW). Each fertilizer treatment received 150 kg N ha^{-1}. Mineral fertilizer (ammonium sulphate) was applied at transplanting while organic fertilizers were applied about twenty days before transplanting. At the harvest, yield, number of fruits/plant, average weight, pH, acidity and °Brix were determined.
After the three-year field experiment, the qualitative and quantitative melon performance showed no statistically significant differences among the four different treatments. Conversely, the highest irrigation treatment showed a significantly higher total yield (25.4%) and fruits number (21%) compared to the lowest irrigation one.

ANIMAL WASTE FOR PYROLYSIS-DERIVED FERTILIZERS

R. Marchetti, D. Bochicchio, G. Ponzoni, A. Marino

CRA-SUI, San Cesario Sul Panaro (MO), Italy, E-mail: rosa.marchetti@entecra.it

Session I: New fertilizers and amendments from industrial by-products and waste materials

Abstract

Introduction. Recent developments in fertilizer research have pointed out the beneficial effect of pyrolyzed organic matter, when incorporated to soil, on soil fertility and carbon sequestration. As far as the type of organic matter for use in thermal transformation is concerned, up to now the majority of the research work has focussed on plant material with low water content. However, the thermal treatment of animal waste could represent a potential solution to the problem of animal waste excess disposal. With the general goal of developing a method for evaluating the potential of pyrolysis as a technique to treat animal waste for fertilizer production, in this preliminary work we considered the influence of process conditions on selected properties of the pyrolysis solid products.
Materials and methods. In a lab experiment, animal waste with different composition characteristics was treated at different temperature levels in anaerobic conditions. Selected analytical parameters were applied for the description of its resulting physico-chemical characteristics.
Results. The influence of pyrolysis conditions on the characteristic of the solid products of the process was determined. The water content was a key factor for the process efficiency.
Conclusions. Further studies are needed in order to evaluate the fertilizing potential of the pyrolysis-derived solid fractions of animal waste.

IMPROVING QUALITY AND PRODUCTIVITY OF WHEAT USING DIFFERENT TYPES OF FERTILIZERS IN CONSERVATION AGRICULTURE

F. Márquez[1,2], J. Gil[1,2], R. Ordóñez[3,2], E. González[2,1] and M. Gómez[1,2]

[1]AGR-126. Grupo de investigación de mecanización y tecnología rural. Departamento de ingeniería rural. Universidad de Córdoba. Campus universitario de Rabanales. Nacional IV. Km 396. 14014. Córdoba. España. E-mail: fmarquez@aeac-sv.org, telephone +0034-957-422099
[2]Spanish Association for Conservation Agriculture / Living Soils. IFAPA Alameda del Obispo. Edif. 3. Olivicultura. Avenida Menéndez Pidal s/n. 14004. Córdoba. España. www.aeac-sv.org
[3]Área de Producción Ecológica y Recursos Naturales. IFAPA centro "Alameda del Obispo". Apdo. 3092. 14080 Córdoba. España

I Session: New fertilizers and amendments from industrial by-products and waste materials

Abstract

The increasing World population requires augmenting the crop production. The challenge is to achieve this objective by applying sustainable techniques, where conservation agriculture plays a key role. This work studies the effect of different types of fertilizers, not only conventional (urea, ammonium sulphate, etc.), but also new generation (with nitrification inhibitor, micronutrient or liquid fertilizers), in the amount and quality of wheat production under conservation agriculture (no tillage). The study was carried out during the 2006-07 and 2007-08 seasons, in two different fields situated in typical andalusian cerealistic areas. The surface of the elemental plot is 50x7.5 m^2, and the experimental design is randomized complete block, with 8 treatments and 4 repetitions. The results show that phosphorus micronutrient and the fertilizer with nitrification inhibitor maintain or, in some occasions, enhance the wheat production, without any statically significant differences, even decreasing the dose (130 UFN compared with 150 UFN with conventional fertilizers). In the grain quality appears some differences, as the nitrification inhibitor fertilizers showed less quality in comparison with the others.

COMPOSTING OF OLIVE MILL WASTES WITH UMICA TECHNOLOGY. RAW MATERIALS AND TESTED MIX, PROCESS MONITORING AND QUALITY OF PRODUCED COMPOST

L. Morra[1], M. Bilotto[1], F. Valentini[2], M.R. Ingenito[3]

[1] CRA-Unità di Ricerca per le Colture Alternative al Tabacco di Scafati (SA)
[2] GESENU SpA di Perugia
[3] Regione Campania, Assessorato Agricoltura e Pesca, settore SIRCA

I Session: New fertilizers and amendments from industrial by-products and waste materials

Abstract

The composting of olive mill solid wastes can represent an alternative option to their direct and difficult distribution on soils ruled by Italian Law n. 574/96. Yet, the composting has to satisfy some conditions to be feasible: 1. Accelerated times of treatment to match a flux of wastes concentrated in the short season of olive mills activity (3-4 months); 2. Economic feasibility of the whole process; 3. Production of a compost of quality according to Italian Law n. 217/06. In this contribution are discussed some results of a research funded by Campania Region, Assessorato Agricoltura e Attività Produttive. The research started on November 2008 and was located in Province of Avellino, an internal area of olive-oil production.

In order to achieve maximum control over the composting process parameters the active compostg time (ACT) phase of the experimental trials was carried out using the UMICA® technology: an in vessel modular insulated container where air supply, air recirculation, wetting and leachate recirculation are enabled and oxygen consumption, temperature and humidity of composting material are continuously monitored.

Raw materials treated were: olive mill solid wastes with different humidity concentrations, cattle manure, straw. Some different mixtures were tested out in four sequential cycles of composting until to the end of March 2009. The active phase in container lasted 20-30 days. The trends of some cycles and the chemical characteristic of compost after the slow maturation phase (3-4 months) are discussed.

NUTRIENTS RELEASED IN THE DECOMPOSITION OF THE RESIDUE OF DIFFERENT TYPES OF PLANT COVERS IN OLIVE GROVES

R. Ordóñez[1], R. Carbonell [1], M.A. Repullo[1] , C. Alcántara[2] and A. Rodríguez-Lizana[3]

[1]Área of Ecological Production and Natural Resources, Center "Alameda del Obispo"IFAPA, Apdo. 3092, 14080 Córdoba, Spain. E-mail: rafaela.ordonez.ext@juntadeandalucia.es
[2]Área of Crop Protection, Center "Alameda del Obispo"IFAPA, Apdo. 3092, 14080 Córdoba, Spain.
[3]Dept. of Agroforestry Sciences. University of Seville, Road Seville-Utrera, Km 1 41o13, Seville Spain.

I Session: New fertilizers and amendments from industrial by-products and waste materials

Abstract

The characterization of a residue and its decomposition dynamics is the starting-point for the establishment of an appropiate soil management strategy, in order to find a balance between the farmer's interests and the conservation of soil and water resources.

The aim of this work has been to evaluate the influence of the Mediterranean climatology on the decomposition dynamics of residues from different types of plant covers located between the lanes of an olive grove, and how their evolution over time affects the cover surface, the stubble biomass and the latter's capacity for being a source of nitrogen, of carbon and of soil nutrients.

An assay was carried out in an olive grove situated in southern Spain with a random block experiment design of 4 treatments with 4 replications. The cover species tested were: Brachipodium distachyon, Eruca vesicaria, Sinapis alba, and spontaneous grass. The samplings were done starting from the removal of the cover in the spring up to sowing the next one in the autumn.

After 186 days of decomposition, the species releasing the largest amount of nutrients was Brachipodium, with values of 36.4, 4.6 and 44.2 Kg ha^{-1} for N, P and K respectively. However, in most cases, the differences were not important ones compared to the rest of the species.

Stubble from the different species ensured a summertime protection of the soil since, in the worst of the cases (Sinapsis), only 21% of cover was lost until the following cover was established.

MICROBIAL CONTAMINANTS OF ORGANIC FERTILIZERS (COMPOSTED AMENDANTS) COMMERCIALIZED AND SAMPLED IN ITALY

A.F. Ragone[1], R.A. Mazzei[2], G. Benedettini[3], M.P. Nuti[4], S. de Bertoldi[1], M. Capparelli[1]

[1]Ispettorato Centrale per il Controllo della Qualità dei Prodotti Agroalimentari Ufficio di Firenze sede di PISA, Galleria Gerace 17, 56124 PISA Italy
E-mail: icq.pisa@politicheagricole.gov.it, telephone +39050 315671 fax +39050 560006
[2]Ispettorato Centrale per il Controllo della Qualità dei Prodotti Agroalimentari Laboratorio di Conegliano Viale Venezia 14, 31015 Conegliano V (TV) Italy
E-mail: icq.conegliano.laboratorio@politicheagricole.gov.it, telephone +390438 453512
[3]Agenzia Regionale Protezione Ambientale Toscana, Via Veneto 20, Pisa , Italy,
E-mail: g.benedettini@arpat.toscana.it, telephone +39 050835660
[4]Università di Pisa , D.B.P.A.- Labor. di Microbiologia Agro-alimentare e Ambientale, Via del Borghetto 80 56124 Pisa, Italy,
E-mail: mpnuti@agr.unipi.it, telephone +39050 2216642 fax +39050 571562

I Session: New fertilizers and amendments from industrial by-products and waste materials

Abstract

During the routinary activity of the Inspection Service for Quality Control of Agro-Food Products (*Ispettorato Centrale per il Controllo della Qualità dei Prodotti Agroalimentari*, ICQ), 35 samples of organic fertilizers obtained from waste products have been analyzed (with the collaboration of ARPAT Laboratory of Microbiology) in order to check their conformity to the legal limits set by the national law (Decree 217/06). The samples were taken during 2008 and 2009 at each level of the commercial chain: supermarkets, garden-shops, fertilizers factories and composting plants of urban and solid waste. One third of those products were designed for Organic Agriculture. All samples were analyzed for their chemical and microbiological traits in agreement with the legal provisions and official methods of analysis Approximately 95% of samples, which were found within the limits after the chemical analysis, was found above limits after the microbial analysis (viable and culturable cell counts of faecal Streptococci , Enterococcus and occasionally Salmonella sp). The results of this control activity are discussed in this work.

THE "IN FARM" OLIVE MILL RESIDUAL COMPOSTING FOR BY-PRODUCTS SUSTAINABLE REUSE IN THE SOILS ORGANIC FERTILITY RESTORATION

P. Toscano, T. Casacchia, F. Zaffina

CRA-Centro di ricerca per l'olivicoltura e l'industria olearia, Rende (CS)

I Session: New fertilizers and amendments from industrial by-products and waste materials

Abstract

A three phases olive mill and olive orchard by-products composting trial has been carried on for three years, to evaluate the efficiency of the "in farm" composting process, and the compost effectiveness on soil characteristics and olive tree productivity.

The aim of research will be the resolution of ecocompatibile reuse of olive mill residual, and the valorization of agro industrial by-products as amendants in the organic fertility restoration of soils, by using a low input technique, adoptable in situations where industrial installations are not proposable.

Notwithstanding the unoptimal trial conditions, a "ready" compost have been gotten that, spread on olive orchard soil at approx 80 t/ha, sensitively increased the organic fertility, improved the water retention and the nutrients availability, and enhanced the plants productivity.

Screening of micro organism, done in different steps of biomass fermentation, mean also the correct way of composting process.

The results collected in the trial period, confirm the agronomic and environmental validity of the olive mill residual composting, as alternative to the "as is" residual spreading into soil, also under not optimal process conditions.

EFFECTS OF CEMENT AND QUICKLIME POWDER ON GROWTH OF CORN AND SUNFLOWER SEEDLINGS

B. Tóth[1], N. Bákonyi[1], É. Gajdos[1], É. Bódi[1], M. Marozsán[2], S. Veres[1], L. Lévai[1]

[1]University of Debrecen, Institute of Plant Science, Agricultural Botany and Crop Physiology Department, Böszörményi u. 138. H-4032 Debrecen, Hungary. [2] Nyírerdő Nyírségi Forestry Corporation, H-4400 Nyíregyháza Kótaji u. 29. E-mail: t-gitta@freemail.hu

I Session: New fertilizers and amendments from industrial by-products and waste materials

Abstract

The protection of our environment is a common task. All pollution that exposes our soils, plants - or in the narrower and wider sense the environment - will appear in one of the members of the food chain and (sooner or later) in human beings, who is on the peak of the food pyramid. The pollution of many colours gives a reason for an increased attention to the environment. The purpose of this work is to examine the physiological effects of industrial powder originating from production technology of factories next to a large town, and the possibility of their use in plant nutrition. In the course of our work we put an emphasis on dust pollution that gets into the environment. The elements of the powders may modify the life cycle of the living world in the environment. We did not find toxic element accumulation in the drawn samples taken from the samples area. We found, that side products of cement and quicklime factories can be used for the nutrition of plants.

EFFECTS OF INDUSTRIAL ORANGE WASTE AS ORGANIC FERTILIZER ON GROWTH AND PRODUCTION OF DURUM WHEAT AND SUNFLOWER

R. Tuttobene[1], G. Avola[2], M. Marchese[1], F. Gresta[1], V. Abbate[1]

[1] Dipartimento di Scienze Agronomiche, Agrochimiche e delle Produzioni Animali, Via Valdisavoia 5, 95123 Catania, Italy

[2] CNR, Istituto per i Sistemi Agricoli e Forestali del Mediterraneo, Str.le V. Lancia Blocco Palma I, 95121 Catania, Italy. E-mail: giovanni.avola@cnr.it, telephone: 095292872, fax: 095292870

I Session: New fertilizers and amendments from industrial by-products and waste materials

Abstract

In the last ten years increasing attention has been paid towards resource conservation and by-product utilization, making 'waste' a resource to be utilized and not just discarded. In areas where citrus orchards are the prevalent crop, such as north east cost of Sicily, citrus-fruit processing produces a great amount of wastes. Its agricultural use is impeded by limited knowledge on its effect on crop performance. Initial results have proven that the amount of orange waste applied to arable crops needs to be defined according to crop requirements and soil conditions.

A research project was carried out to study the effects of two dried orange waste doses (3 and 9 kg/m^2), compared to a control without fertilization, on growth and productivity of durum wheat (*Triticum durum* Desf.) and sunflower (*Helianthus annuus* L.).

Our results show that the organic fertilization promoted crop growth, determining in both species a significant increase in leaf area development (LAI) and crop growth capacity (CGR) In wheat, grain yield was significantly and negatively influenced by the excessive vegetative growth induced by organic fertilization; while in sunflower grain yield was promoted.

II SESSION

Advances in formulation of growing media and their components

(Chairman: Prof. B. Carlile, Dr. A. Trinchera)

Oral Presentations

ORGANIC MATERIALS FOR GROWING MEDIA IN EUROPE: CURRENT AND FUTURE SCENARIOS

B. Carlile

Bord na Móna (Horticulture), Main Street,Newbridge, Co.Kildare, Eire,
E-mail: Bill.Carlile@bnm.ie

II Session: Advances in formulation of growing media and their components

Abstract

In the first decade of the twenty-first century, the principal organic constituent of growing media in Europe is peat: as it has been for almost the last fifty years. Northern Europe provides most of the peat used in horticulture, where Sweden, Finland and the Baltic states (Estonia, Latvia and Lithuania) produce mainly young, undecomposed peats. Germany still produces much so-called 'black peat', valued in potting mixes. Ireland's decomposed stable peat is highly valued for long-term crops. Peat fractions are commonly used in the professional market. Small fractions of 5-10/6-12mm are highly valued by the nursery stock industry, and these are commonly mixed with larger 10-20/12-25 mm fractions to provide good aeration in pots/liners. Less defined fractions (eg 0-14 mm) may be used for pot plants: fine fractions of 5 mm or less are used in production of seedlings or plug plants. Apart from peat, the only other organic medium used extensively in the professional sector is coir imported mainly from Sri Lanka and India. The use of coir is increasing, especially in the Netherlands. Bark is used in some countries and for specific plants, eg orchid growing.

Growing media for retail use dominates the market in some countries, for example France, where 64% of growing media are destined for the retail market: the figure for Spain is 73%; the UK 60%; this provides a contrast with Italy, where only 30-35% of media is sold on the hobby market. The trend is for retail blends to contain peat diluents, or even be peat-free. Diluents for the retail market include composted materials. These may be derived from several sources: garden and landscape waste ('green compost') is commonly used in the UK: garden, landscape and food wastes are used in some countries (Spain, Italy). Bark and wood fibre are used in the UK and France. Locally available materials such as pumice (eg in Italy, where it is also used in media for the professional market) rice hulls and perlite have also been used as diluents in production of media for the retail market. The variable performance of peat-free media has precluded their adoption by the professional market.

In the next ten years, the shift away from peat use in growing media may continue. Environmental pressures to reduce peat use first emerged in the UK in the late 1980s, and a strong lobby still exists there, being mainly responsible for the UK government's target of 90% peat replacement in horticulture by 2010. Such pressures are now being exerted at European level, and may result in reduced use of peat, perhaps initially in the retail sector but ultimately affecting the professional market. In some parts of the world eg the USA and Australia, nursery stock is raised in non-peat media, and this may extend to the production of ornamentals in Europe. However, within the advanced and highly automated systems of pot plant production In Europe, no substrate is as suitable or as cost-effective as peat. Here, it will prove difficult to find alternative materials of similar quality and in sufficient quantity to replace peat.

EVALUATION OF DIFFERENT SUBSTRATE FERTILIZERS IN ORDER TO IMPROVE THE QUALITY OF VEGETABLE SEEDLINGS

C. Cattivello

ERSA FVG - Laboratorio substrati, Via Sabbatini 5, 33050, Pozzuolo del Friuli (UD), Italy
E-mail: costantino.cattivello@ersa.fvg.it, telephone +390432529241, fax +390432529202

II Session: Advances in formulation of growing media and their components

Abstract

Different types of substrate fertilizers have been evaluated on vegetables, in order to improve some seedling quality parameters, like sturdiness and compactness index, foliage dry matter, rooting index and shelf life.

First results seem to confirm the role played by different nitrogen forms on sturdiness and compactness index of seedlings cultivated on peat based substrates. Likewise, the use of slow release fertilizers can be a tool to improve the shelf life of young vegetable plants.

AGRONOMICAL RESPONSES AND MINERAL COMPOSITION OF TWO CUCURBITACEAE SPECIES AS AFFECTED BY ORGANIC AND INORGANIC SUBSTRATES

G. Colla[1], Y. Rouphael[2], M. Cardarelli[1], E. Rea[3], A. Salerno[3]

[1]Dipartimento di Geologia e Ingegneria Meccanica, Naturalistica e Idraulica per il Territorio, Università della Tuscia, via S. C. De Lellis snc, 01100 Viterbo, Italy.
E-mail: giucolla@unitus.it
[2]Department of Crop Production, Faculty of Agricultural and Veterinary Sciences, Lebanese University, Dekwaneh-Al Maten, Lebanon
[3]CRA-Centro di ricerca per lo studio delle relazioni tra pianta e suolo, Via della Navicella 2-4, 00184 Roma, Italy

II Session: Advances in formulation of growing media and their components

Abstract

The expansion of hydroponics in many countries of the world in the last few decades may be ascribed to the ability of soilless growing systems to avoid various problems arising from the use of the soil. Cucumber (Cucumis sativus L.) and zucchini (Cucurbita pepo L.) plants were grown in closed-soilless culture under unheated-greenhouse conditions typically of the Mediterranean area at the Experimental farm of University of Tuscia, Central Italy to evaluate the effects of four substrates (rockwool, pumice, perlite, and coir) on growth, yield and plant mineral composition. For both cultures, plants grown in coir, perlite and pumice yielded more than those grown in rockwool. Similar results were obtained for dry weight of leaves, stems, and fruits. Use of cocofiber lead to the earliest yield compared to the other substrates due probably to the higher minimal temperatures recorded on the organic substrate. Concentrations of K and Mg of leaves were highest in coir treatment. The above findings may be explained by the different chemical and physical properties of substrates and their interaction with nutrient solution composition and plant nutrient uptake.

RE.LA.S.CO. PROJECT: ITALIAN PROFICIENCY TEST FOR GROWING MEDIA NATIONAL AND EUROPEAN METHODS

L. Crippa[1], D. Orfeo[2], M. Faccoli[1], P. Zaccheo[1]

[1]Department of Crop Production (DiProVe), University of Milan, Via Celoria 2, 20133 Milano, Italy, E-mail: laura.crippa@unimi.it, telephone +390250316536, fax +390250316521
[2] AIPSA, via Vittorio Veneto 9/E, 20091 Bresso (MI),
E-mail: segreteria@asso-substrati.it , telephone +393316456030 fax +390299989363

II Session: Advances in formulation of growing media and their components

Abstract

In 2009 the first two types of growing media with specific characteristics were inserted in the Italian legislation on fertilizers (D.Lgs. 217/06). Nevertheless no specific analytical methods are until now indicated for labelling declarations. This situation means that laboratories can adopt different methods of analysis (Italian official methods, EN methods, routine labs methods) and that substrate producers and growers can have doubts about reliability and comparability of analytical results. In this context, a voluntary Proficiency Test promoted by AIPSA (Italian association of growing media producers) was organized by DiProVe on growing media methods. Three different products (peat-based, peat+pumice, peat+compost) were tested for different parameters with different Italian and European methods : pH (3 methods), EC (3 methods), organic matter content, ash, organic carbon, soluble NO_3-N and NH_4-N, total copper and zinc, laboratory compacted bulk density (2 methods), dry bulk density, air volume, water volume, total porosity. For each sample and parameter, data were compiled and processed according to ISO 5725, obtaining: number of outliers, mean value, repeatability and reproducibility standard deviations. Nine laboratories participated to the test and their anonymous results were benchmarked by the Z-score. Results show poor reproducibility for NO_3-N, NH_4-N, Zn, EC (EN method), air volume and Cu. Only three labs performed physical determinations.

ARE BIOASSAYS USEFUL FOR PREDICTING GROWING MEDIA BEHAVIOUR?

P. Zaccheo[1], L. Crippa[1]

[1]Department of Crop Production (DiProVe), University of Milan, Via Celoria 2, 20133 Milano, Italy, E-mail: patrizia.zaccheo@unimi.it, telephone +390250316536, fax +390250316521

II Session: Advances in formulation of growing media and their components

Abstract

In traditional approach, bioassays exposed organisms to testing materials to determine presence and level of contaminants. As toxicity rarely occurs in growing media, it is more profitable to use bioassays for evaluating growing media quality . Physical properties of growing media are fundamental for the healthy growth of a plant, but their analytical measurements are time-consuming and not able to predict physical stability during cultivation. Bioassays based on root measurements seem to be appropriate because the main goal of a growing medium is to provide an ideal outer environment with good air and water supply. In the study, the barley root elongation test (ISO 11269-1) was applied to about twenty growing media before and after they had been subjected to alternate drying and rewetting cycles ('aged' samples), in order to simulate cropping effects. Samples were also subjected to ISO 11269-2 lettuce growth bioassay of 1 month. Results were compared with chemical and physical determinations. No correlations were found between analytical and bioassays results, indicating no overlapping information. The good correlation between the root elongation test on 'aged' samples and the lettuce test suggests that pre-treatment of growing media before applying to barley test provides information about structural stability.

Poster Presentations

PLANTED FILTER SYSTEMS IN VIETNAM FOR CLEANING DOMESTIC WASTEWATER AND PRODUCING FERTILIZER SUBSTRATES

M. Becker, A. Clemens, H. Hans, F. Mussgnug, J. Zywietz

Department of Plant Nutrition, Institute of Crop Science and Resource Conservation, University of Bonn, Germany

II Session: Advances in formulation of growing media and their components

Abstract

So far, biological wastewater treatment in constructed wetlands focused on a reduction of organic C compounds in the rhizosphere of reed grasses. Particularly in developing countries it is of additional interest to remove the nutrients and concentrate them in the biomass of the filter plants for a subsequent use as nutrient-rich amendments in agriculture.

A horizontal flow filter system was established on the campus of the University of Cantho in Vietnam and fed with wastewater from the adjacent student dormitory. An unplanted control was compared with filter compartments planted to *Phragmites australis* and *Sesbania rostrata*. Changes in wastewater properties and the dynamics of biomass accumulation and nutrient uptake by the filter plants were evaluated at bi-weekly intervals and at six positions along the filter. Additionally, the biological N_2 fixation of *Sesbania* was determined by $\delta^{15}N$ using *Phragmites* as reference species.

The nutrient elimination from the wastewater and its chemical oxygen demand (COD) varied by loading rate and the type and age of the filter plants. While *Phragmites* showed the best carbon elimination (COD reduction from 36 to about 12 mg l^{-1}), its nutrient removal capacity was <10% of the added amounts. *Sesbania rostrata*, on the other hand, showed a modered COD reduction but elmiminated >90% of the added nutrients. Eight week-old *S. rostrata* accumulated about 1.5 kg m^{-1} of dry matter (25-30 g N m^{-2}), irrespective of its position in the filter or the wastewater loading rate. It compensated a reduced N supply by an enhanced N_2 fixation. Consequently, *S.rostrata* provided an organic substrate of constant and high quality (C:N-ratio ~15, C:P ratio <150) and may thus be prefered over *Phragmites* for nutrient recycling in planted filters under tropical climatic conditions.

SIZE AND CHARACTERISTICS OF THE ITALIAN MARKET OF GROWING MEDIA

D. Orfeo[1], L. Orlandi[2]

[1] Italian Association of Producers of Growing media and Soil Improvers, via Vittorio Veneto 9/E, Bresso (MI), Italy,
E-mail: segreteria@asso-substrati.it, +39 3316456030, +39 0299989363
[2] Italian Association of Producers of Growing media and Soil Improvers - Vigorplant Italia srl, via Volta 2, Fombio (LO), Italy,
E-mail: luigi.orlandi@vigorplant.it, +39 3939672251, +39 0373430351

II Session: Advances in formulation of growing media and their components

Abstract

Growing media, material other than soils in situ in which plants are grown, are a fundamental technical instrument for the professional horticulture and the hobby market. In Italy, the main actors playing in the substrate supplying sector are local producers and traders of imported products, mainly from Germany, Netherlands, Finland, Ireland and, since the last years, Latvia, Estonia and Lithuania.

In 2007 AIPSA, the Italian Association of Producers of Growing media and Soil Improvers, was founded with the aim to promote the use of substrates of guaranteed quality. It gathers 17 companies, 13 local producers and 4 traders of products coming essentially from EU countries, that globally represent about 70% of the total turnover of the growing media sector.

In this paper, the activities of the Association and an estimation of consumption of substrates, matched with the analysis of related demand, will be reported. Exposed data were obtained i) from available information regarding the import of peat and the consumption of soil improvers and ii) from results of European research. The analysis of the two main substrate trade, professional market (greenhouse crops, ornamental breeding, landscape crops) and hobby market (garden center, large distribution) highlighted the technical features requested to the growing media.

EFFECT OF COMPOST BASED SUBSTRATE AND MYCORRHIZAL INOCULUM IN POTTED GERANIUM PLANTS

M. Tullio, F. Calviello, E. Rea

ARC, Agricultural Research Council – Research Centre for the Soil-Plant System,
Via della Navicella, 2-4, Roma, Italy,
E-mail: monica.tullio@entecra.it, telephone +39067002636, fax +39067005711

II Session: Advances in formulation of growing media and their components

Abstract

Two are the critical factors in the commercial production of ornamental plants: the substrate and the fertilization method since the "sustainable floriculture" discouraged the use of synthetic chemical fertilizers and of peat-based substrate. Compost can be used for reducing peat at least partly in growing substrates and a fertilizer mixture, made up of guano and mycorrhizal inoculum, could meet the plant nutrient demand.

The aim of this paper was to test a peat compost-based substrate and a guano-mycorrhizal inoculum fertilizer mixture in order to obtain a sustainable quality yield of geranium plants.

Geranium cuttings (*Pelargonium zonale* cv.real polaris and *Pelargonium grandiflorum* cv lotus) were grown for two months in a glasshouse. Peat, in the growing substrate, was replaced with high quality compost (20% and 40% as reduction percentuages). The fertilizer mixture was made up of guano (3 g/l) and mycorrhizal inoculum (7,5 l/m^3).

Data showed that the behaviour of plants to the alternative growing media was cultivar-dependent. Plants of *Pelargonium* cv Real polaris, grown on a substrate made up of peat and 20% of high quality compost, presented the better trade features so to satisfy the "sustainable floriculture" need.

III SESSION

New fertilizers and food quality

(Chairman: Prof. S. Haneklaus, Dr. M Valentini)

Oral Presentations

PLANT RESPONSE TO DIFFERENT URINE-BASED FERTILISERS

U. Arnold, S. Antonini, F. Gresens

University of Bonn, INRES Plant Nutrition, Karlrobert-Kreiten Str. 13 53115 Bonn, Germany,
E-mail: uarnold@uni-bonn.de, telephone: +49 228 73 2154, Fax: +49 228 2489

III Session: New fertilizers and food quality

Abstract

The demand for sustainability and declining phosphorus resources promoted the development of "new sanitation systems" during the last decade in Europe and in developing countries. Instead of handling large amounts of low concentrated mixed waste water, nutrient rich fractions are separated at the source and treated accordingly. By using these potentials, discharge and pollution of natural waters can be reduced. So far studies focused on nutrient amounts but rarely regarded fertiliser efficiency in dependence of consistency or chemical form.

Therefore fertiliser efficiency of six different urine-based fertilisers was tested in a pot experiment: Despite identical N and P amounts applied, yields and nutrient uptake differed significantly. Responses also differed according to the plant species although the general trend was alike for maize (*Zea maize*) and grass (*Lolium perenne*).

Highest biomass development was achieved by two precipitates - a MgO-induced MAP and a natural precipitate of yellow water - and two acidified evaporation residues. Lower yields were measured for a non-acidified evaporation residue and a MAP from mixed waste water. Depending on the substrate, N uptake ranged from 1.3 – 1.9 g (mean of 4 pots) for grass. N-concentrations varied from 4.8-5.2%. All substrates were better compared to the non-fertilised control and the super-phosphate/NH_4NO_3 variant.

EFFECTS OF SULFUR SUPPLY ON CADMIUM UPTAKE AND ACCUMULATION IN RICE

Z. Hu[1,2], Y. Wang[1], S. Haneklaus[3], X. Xia[2], C. Wu[2], J. Fan[2] and E. Schnug[3]

[1]College of Resources and Environment, Graduate University of Chinese Academy of Sciences, 19A, Yuquan Road, Beijing, 100049, P. R. China.
E-mail: zhyhu@gucas.ac.cn, telephone: 00861088256542, fax: 00861088256152
[2]State Key Laboratory of Soil and Sustainable Agriculture, Institute of Soil Science, The Chinese Academy of Sciences, No. 71, East Beijing Road , P. O. Box, 821, Nanjing 210008, P. R. China
[3]Institute for Crop and Soil Science, Federal Research Centre for Cultivated Plants (JKI), Bundesallee 50, D-38116 Braunschweig, Germany,
E-mail: silvia.haneklaus@jki.bund.de, telephone: 00495315962121, fax: 00495315962199

III Session: New fertilizers and food quality

Abstract

Anthropogenic activities, such as phosphate fertilizer, mining, irrigation with contaminated water etc. have significantly enhanced cadmium (Cd) levels in soil in many parts of the world. Obvious spatial variability of soil sufur (S) level was also determined in depended on difference of S input induced by atmospheric S deposition, fertilization, irrigation with waste water containing S etc. in China. A few greenhouse incubation experiments combined with a field experiment were conducted to investigate effects of S supply on Cd uptake and accumulation in rice cultivated in low and high Cd stress. Significant differences of Cd concentrations in rice plants were demonstrated in dependence on rice growing stages, plant tissue, S levels, Cd stress intensity. Supply of S resulted in increase of Cd in root, but increase of Cd in stem; and decrease of Cd in brown rice cultivated in high Cd stress soil (>1.5 mg Cd/kg), however increase of Cd in brown rice cultivated in low Cd stress soil. Sulfur could alleviate Cd stress on rice growth due to S-induce increase of GSH for synthesis PCs related to Cd tolerance, and Cd also could mitigate excessive S induced stress on rice due to CdS precipitation induced decrease of S^{2-}. Therefore, interaction of soil Cd and sulfur on Cd uptake and accumulation in rice should be paid more attention.

FODDER QUALITY OF MEADOW SWARD IN DEPEND ON THE NITROGEN FERTILIZATION APPLIED IN DIFFERENT DOSES

J. Jodełka, K. Jankowski, G.A. Ciepiela, R. Kolczarek

University of Podlasie Institute of Agronomy 08 – 110 Siedlce, Poland Ul. B. Prusa 14
E-mail: laki@ap.siedlce.pl, telephone: +48 25 643 1320, fax: +48 25 643 1309

Session III: New fertilizers and food quality

Abstract

The experiment was put on in four replicants in arrangement split-plot on the plots with surface $9m^2$. The base fertilization applied under first regrowth was the mixture of unary fertilisers (ammonium nitrate, superphosphate, potassic salt) or polifoska treated to the soil. One form of supplementary fertilisation were applied under the second and third regrowth. It was the stable form of fertilizer applied to soil..

This form of supplemented nitrogen gave respectively: 27,6 kg N ha^{-1}; 41,4 kg N ha^{-1}; 55,2 kg N ha^{-1} per each moving.

During the vegetation season three movings was harvested. From the each movings the samples of green matter were taken for the chemical analysis especially on the total protein content and net energy (NEL).

The obtained results showed big differences in fodder quality of the meadow sward fertilisated with three doses of nitrogen apply.

ASSESSMENT OF MUNICIPAL SOLID WASTE COMPOST AND SEWAGE SLUDGE APPLICATION USING WHEAT (*TRITICUM DURUM*) ANTIOXIDANT RESPONSE

A. Lakhdar[1,2], M.A. Iannelli[3], A. Massacci[4], N. Jedidi[2], C. Abdelly[1]

[1]Laboratoire d'Adaptation des Plantes aux Stress Abiotiques, Centre de Biotechnologies, Technopole Borj Cedria, BP 901, Hammam Lif 2050, Tunisia
[2]Centre de Recherches et Technologies des Eaux, Technopole Borj Cedria, BP 273, Soliman 8020, Tunisia
[3]Istituto di Biologia e Biotecnologia Agaria, Consiglio Nazionale delle Ricerche, Via Salaria, km 29.300, 00016 Monterotondo scalo, Rome, Italy
[4]Istituto di Biologia Agroambientale e Forestale, Consiglio Nazionale delle Ricerche, Via Salaria, km 29.300, 00016 Monterotondo scalo, Rome, Italy

III Session: New fertilizers and food quality

Abstract

The efficiency of composted municipal solid waste and sewage sludge to promote wheat (Triticum durum) growth was investigated under greenhouse conditions. Plants were cultivated under 0, 40, 100, 200, and 300 t ha^{-1} of MSW compost or S. sludge. Dry weight, heavy metals accumulation, and leaf antioxidant activities (ascorbate peroxidase APX, glutathione reductase (GR), catalase (CAT) and superoxide dismutase (SOD)) were determined. Plant showed a significant improvement of biomass production at 40 and especially 100 t ha^{-1} of compost amendment (48 and 78% respectively). However under S. sludge treatment the increase did not exceeded 18% at the two doses 40 and 100 t ha^{-1}. At higher amendment doses plants exhibited increasing heavy metal concentrations in shoot and root, correlated with yield decline. In addition, antioxidant activities showed a proportional stimulation with 200 and 300 t ha^{-1} of compost, and with 200 and 300 t ha-1 of S. sludge (APX: 26, 24, 24, and 20%; GR: 90, 97, 82 and 100% CAT: 31, 51, 36, and 40%; SOD: 30, 41, 37 and 36% respectively). The study reveals that, in greenhouse experiment, 100 t ha^{-1} of MSW compost seems to be the optimal dose for wheat growth without adverse effects.

EFFECTS OF DIFFERENT RATES AND FORM OF N SLOW RELEASE FERTILIZERS ON YIELDS OF FENNEL (*PHOENICULUM VULGARE* L.), N BALANCE AND N USE EFFICIENCY

L. Morra, G. Pizzolongo, M. Mascolo, M. Bilotto

CRA-Unità di Ricerca Colture Alternative al Tabacco di Scafati (SA), Italy

III Session: New fertilizers and food quality

Abstract

The research, carried out in the experimental farm of Scafati (SA), started on September 30, 2008 with transplantation of fennel, cv "Aurelio", in single rows 0,7 x 0,2 m apart with a density of 7,1 plants m^{-2}. Two experimental factors were applied: 1. rate of nitrogen (175, 122 and 0 kg ha^{-1}); 2. different N slow release fertilizers (ammonium nitrate fertilizer with nitrification inhibitor 3,4 DMPP –Entec-; fertilizer with slow release organic complexes –Rhizovit-; fertilizer with methilenurea –Record 55-; fractioned distribution of ammonium nitrate as control). A split-plot design with three replications was adopted, laying down the rate of nitrogen to main plots and the type of fertilizer to the sub-plots. The experimental unit had an area of 25 m^2. Fennels were harvested from 19 to 26 of February 2009, picking up a whole block in the same day. At harvest the number of marketable and not marketable fennels and their weights were recorded on a sampling area of 10,5 m^2. In order to estimate a simplified N balance in soil and some indexes of nitrogen use efficiencies, two samplings of soil were made in each plot before transplant and immediately after harvest on the 0-40 cm depth to detect the contents of $N\text{-}NO_3$ and $N\text{-}NH_4$. Besides, five whole plants per plot were sampled to determine total N content in leaves, roots and heart of fennel. The research was funded by Campania Region with the project Centro Orticolo Campano.

MAGNETIC RESONANCE IMAGING FOR EVALUATING THE EFFECTS OF FERTILIZERS ON FOOD QUALITY

M. Ritota[1], S. Cozzolino[2], A. Taglienti[2], A. Ciampa[2], P. Sequi[2], M. Valentini[2]

[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 2-4, 00184 Roma.
E-mail: mena.ritota@entecra.it
[2] Dipartimento di Chimica, Università di Roma "La Sapienza", Piazzale Aldo Moro 5, 00185 Roma.

III Session: New fertilizers and food quality

Abstract

Foodstuff quality evaluation can be done by means of several analytical techniques. In the last years Magnetic Resonance Imaging (MRI), known for its medical and diagnostic applications, has received general acceptance in food science thanks to its non-invasiveness and non-destructiveness. The opportunity of studying foodstuff in its wholeness, without any chemical and/or physical preparation of the sample, make MRI a powerful tool in food science, in particular for studying the effects of fertilizers on the morphological arrangement and changes occurring during storage period.

Effects of a new fertilizer containing bio-available silicon, in the form of stable monomeric orthosilicic acid, on fruits and vegetables were investigated by means of MRI. Comparison of T_2–weighted and spin density-weighted MRI images has highlighted the variations of the internal morphology, in terms of cellular tissues arrangement and their wateriness. Samples treated with orthosilicic acid led to the formation of tissues with higher consistency, characterized by a longer shelf-life. Studies took into account strawberry, kiwifruit, fennels and tomatoes, and for all of them results were in agreement.

LAYERED SILICATE NANOCOMPOSITES FOR CONTROLLED RELEASE OF NITROGEN FERTILIZER

V.J.M. Silva[1], E.S.A. Lima[2], J.C Polidoro[2], L.L.Y. Visconte[1], R.S.V. Nascimento[3]

[1]Institute of macromolecules professor Eloisa Mano of the Federal University of Rio de Janeiro, RJ, Brazil
[2]Brazilian Agricultural Research Corporation-National Soil Research Center, RJ, Brazil
[3]Institute of chemistry of the Federal University of Rio de Janeiro, RJ, Brazil

III Session: New fertilizers and food quality

Abstract

In this study, it was aimed the development of nanostructured materials capable of reducing the rate of solubilization of nitrogen in soil from a nitrogen agricultural fertilizer, leading to a more controlled release. Polymer composites granules were prepared with four different systems: (1) montmorillonite clay/ fertilizer, (2) montmorillonite clay/ fertilizer and plasticized starch, (3) montmorillonite clay/ fertilizer, plasticized starch and low density polyethylene (LDPE) and also (4) montmorillonite clay/ fertilizer, plasticized starch and polycaprolactone. It was verified the formation of a nanostructured material by elemental analysis (CHN) and X-ray diffraction (XRD). The compositions were processed in a Haake mixer and granulated between 4 and 8 mesh. The kinetics of nitrogen release was verified by colorimetric enzymatic analysis through ultraviolet visible spectroscopy. It was also characterized the kinetics of release of fertilizer using soil columns. The results from enzymatic analysis showed that the nitrogen release from the clay/fertilizer system reached 100% after 60 min. For the montmorillonite clay/ fertilizer and plasticized starch system, the release reached 100% after 3 h. The best systems (LDPE and polycaprolactone) had similar behavior with immediate and prolonged release over 3 h. It follows that all composites evaluated showed to function as controlled release fertilizers.

Poster Presentations

NITROGEN FERTILIZATION AND IRRIGATION COMPULSORY EFFECT ON SOYBEAN (*GLYCINE MAX* L. MERR) CULTIVARS

G. Barion[1], M. Hewidy[1], F. Zanetti[1], G. Mosca[1] and T. Vamerali[2]

[1]Department of Environmental Agronomy and Crop Sciences, University of Padova,
Viale dell'Università 16, 35020 Legnaro - Padova (Italy)
[2]Department of Environmental Sciences, University of Parma,
Viale G.P. Usberti 11/A, 43100 Parma (Italy)

III Session: New fertilizers and food quality

Abstract

Nitrogen fixation and soil residual nitrogen may not supply enough nitrogen for soybeans to maximise yield. It is not possible to predict soybean response to N fertilizer based on soil properties. Irrigation is an important practice for soybean yield maximisation under different conditions. Two year experiment was conducted during 2006-2007. Factors were distributed in split-split-plot design; irrigation, cultivar and nitrogen. Irrigation was applied starting from reproductive stage compared with rainfed. Nitrogen application in 2006 was applied in R1 stage and in 2007 in R3. Two soybean cultivars were chosen for yield component estimation on main and lateral shoot. Significant effect for irrigation was found on pod number and weight of main shoot. Irrigation increased yield significantly in both years of this study, about 30% compared with rainfed. Drought stress caused yield reduction of about 24%. The "irrigation x nitrogen" interaction for grain yield was significant ($P<0.01$). Grain yield was positively correlated with pod number and weight, seed mass and biomass dry weight. Germ and cotyledon weight was positively influenced by nitrogen application. Drought stress caused 2% reduction in protein content in soybean seed. Soybean yield can be maximised applying irrigation in compulsory way with nitrogen.

EFFECTS OF ORGANIC AND CONVENTIONAL N-FERTILIZATION ON QUALITY TRAITS IN CORIANDER (*CORIANDRUM SATIVUM* L.)

A. Carrubba, C. Catalano, M. Militello

DAAT - Dipartimento di Agronomia Ambientale e Territoriale - Facoltà di Agraria - Università di Palermo - Viale delle Scienze, I 90128 - Palermo ; E-mail: acarr@unipa.it

III Session: New fertilizers and food quality

Abstract

In organic cropping management of Medicinal and Aromatic Plants, the best quality expression is crucial to gain from cultivation a satisfactory income. Coriander (Coriandrum sativum L) is an annual herbaceous plant that dues its commercial value to the typical scent of its fruits (commonly termed "seeds"), rich in a pale yellow oil (1-2% in small seeded types, 0.2-0.5% in large seeded ones). Many works have studied the mean volatiles composition of Coriander, that was found to vary also as a consequence of cropping techniques including Nitrogen fertilization. In order to gain useful information about the real effect, if any, of organic N fertilization on Coriander quality traits, also detecting any systematic variation in volatiles composition pattern, a three-year trial (2004-2006) was carried out using different types and rates of organic and conventional N-fertilizers. Volatile composition of fruits was analyzed by means of GC-MS and all data were submitted to multivariate statistical analysis, The most represented compound was found to be linalool, followed by camphor, geranyl acetate and geraniol. The group partition was mainly due to different quantitative ratio of compounds; the differences in volatile composition, however, followed a scheme more resembling the cropping year than the fertilization management.

PRODUCTS EFFECTS ON WINE GRAPE STUDIED BY MEANS OF MAGNETIC RESONANCE IMAGING

S. Cozzolino[1], M. Ritota[1,2], A. Taglienti[1], A. Ciampa[1], P. Sequi[1], M. Valentini[1], A. Altissimo[3], C. Franceschi[4]

[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 2-4, 00184 Roma.
E-mail: sara.cozzolino@entecra.it
[2] Dipartimento di Chimica, Università di Roma "La Sapienza", Piazzale Aldo Moro 5, 00185 Roma
[3] Landlab studio associato, Via Quintarello, 12/A, 36050 Quinto Vicentino (VI)
[4] ILSA S.p.A., Via Quinta Strada 28, 36071Arzignano (VI)

III Session: New fertilizers and food quality

Abstract

In the field of food science Magnetic Resonance Imaging (MRI) is increasingly proving as attractive and powerful analytical technique. It allows to obtain highly resolved spatially images of the internal structure and morphology on samples in a completely non-invasive and non-destructive fashion.

MRI was used to study the effects of two different products used on wine grape *cv.* Pinot Grigio, and we considered the internal morphology, its changes with storage period and the shelf life. Water content-weighted and T_2-weighted MRI images were compared and we found large differences between treated grapes and untreated ones; the latter showed a faster water loss, with migration from the inner to the outer zones, and therefore a shorter shelf-life.

EFFECT OF DIFFERENT FERTILIZERS ON YIELD AND QUALITY OF NECTARINES IN AN ORCHARD OF BASILICATA REGION (SOUTH OF ITALY)

G. Lacertosa[1], G. Mennone[1], M. Rossini[2]

[1]Metapontum Agrobios, SS 106 km 448,2 - Metaponto (MT), Italy
[2] Compo Agricoltura Via Marconato n.8 - 20031 Cesano Maderno (MI), Italy

III Session: New fertilizes and food quality

Abstract

In a triennial experimental field trial, which started in the spring of 2006, the efficacy of 3 fertilizers (Nitrophoska Perfekt, Nitrophoska Top and Entec) has been evalued improving yield and quality characteristics of nectarines, var. Big Top. The fertilizers were yearly distributed, at 2 different doses (80 and 120 Kg/ha), at start of blossoming, while 50% of Entec thesis was distributed also at post harvest period. Results indicated, after tree trial years, statistical differences between all treatments and the untreated control for these parameters: Spad index, leaf N, solid soluble content, circumference and weight fruit, yield per plant (with increases in confront to the untreated, respectively, of 8,4 - 16,9 - 11,0 - 8,9 - 26,1 and 34,8 %). Moreover fertilizer higher doses did not obtain improved results respect to lower doses, indicating the lower doses as the most advantageous.

PLANT GROWTH REGULATORS IN KIWIFRUIT DETECTED BY MEANS OF MAGNETIC RESONANCE IMAGING

A. Taglienti[1], M. Ritota[1,2], S. Cozzolino[1], A. Ciampa[1], P. Sequi[1], M. Valentini[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 2-4, 00184 Roma.
E-mail: anna.taglienti@entecra.it
[2] Dipartimento di Chimica, Università di Roma "La Sapienza", Piazzale Aldo Moro 5, 00185 Roma.

III Session: New fertilizers and food quality

Abstract

Plant growth regulators (PGRs) are not allowed in organic farming, and in some cases also forbidden in the integrated one. Their use in fruits and vegetables is generally assessed by identifying the molecule, or its secondary metabolites, by means of HPLC and MS. Nevertheless, in fruits with long ripening and/or storage periods, the hormone residues are no longer present.
We used Magnetic Resonance Imaging (MRI) for elucidating the changes of the internal morphology of kiwifruit *cv.* Hayward due to hormones treatment.
Comparison of T_2-weighted MRI images of untreated and treated (with two different PGRs, i.e. auxin and cytoquinine) samples showed that the use of PGR can be determined, both at harvesting and commercialization step, with a precision of 100%. MRI images revealed large differences in terms of tissues' organization of the external part, with water arrangement and cellular wateriness playing a fundamental role. We observed that T_2-weighted MRI images of untreated kiwifruits are characterised by four regular concentric spherical crowns. Auxin-treated samples showed several 2-3 mm thick channels dark in colour, while T_2-weighted MRI images of cytoquinine-treated kiwifruits have darker stains in the outer zones.

IV SESSION

Fertilization and environmental quality

(Chairman: Prof. E. Schnug, Dr. L. Leita)

Oral Presentations

INFLUENCE OF SULPHUR FERTILISATION ON THE FLORAL SCENT OF FLOWERING CROPS

E. Bloem, S. Haneklaus, R. Daniels, E. Schnug

Institute for Crop and Soil Science, Federal Research Centre for Cultivated Plants (JKI), Bundesallee 50, D-38116 Braunschweig, Germany; E-mail: elke.bloem@jki.bund.de, telephone: 00495315962200, fax: 00495315962199

IV Session: Fertilization and environmental quality

Abstract

Macroscopic sulphur (S) deficiency in oilseed rape causes unique symptoms in flowers such as changes in colour, shape and size of the petals and a change in the pattern of emitted volatiles. So far it is not known if other crops react to S deficiency with a change in scent, which is relevant if insects are required for pollination. In the present study the influence of S nutrition on the release of volatiles was investigated and it was determined if such changes are restricted to glucosinolate-containing crops. Crops with (white mustard; oil radish) and without S containing secondary compounds (chamomile; field beans; peas) were grown on field plots with and without S fertilisation. The S status was determined and the volatiles emitted by flowers were characterised at three different dates during main flowering by employing an electronic nose. No symptoms of severe S deficiency were observed in the control plots though the S content was not sufficient for a high yielding crop. The S content in vegetative plant parts increased significantly with S fertilisation in all crops. In parallel, changes in the emission pattern of gaseous compounds were found. These proved to be significant for all crops except white mustard at least on one sampling date.

EVALUATION OF SPATIAL AND TEMPORAL VARIABILITY OF SOIL AGROCHEMICAL PROPERTIES

J. Černý, J. Balík, M. Kulhánek, O. Kozlovský, V. Nedvěd

Czech University of Life Sciences Prague, Department of Agroenvironmental Chemistry and Plant Nutrition, Kamýcká 957, Prague, Czech Republic, E-mail: cernyj@af.czu.cz

IV Session: Fertilization and environmental quality

Abstract

There are many different sources of heterogeneity of soil agrochemical properties. Combinations of all possible sources lead into different levels of spatial and temporal variation across the field. The investigation is focused on the illustration of the temporal changes and spatial variability of the available nutrients (Mehlich 3 available phosphorus, potassium and magnesium) and pH level in the field of an 21 ha area of the University Farm, located near Lány (Czech Republic). Soil samples were taken in 2004–2008 every year from the topsoil (0–30 cm) using the point sampling method with a regular grid square pattern 50 × 50 m. For the description of field variability of selected soil parameters coefficient of variation (CV), experimental variograms and relative nugget effect parameters have been used. A geostatistical analysis indicated that among all determined parameters soil pH showed the lowest variability. Higher variability was found in the nutrient status. Among them P and K fluctuation was the highest and Mg fluctuation was lower. Results shows, that available P, K, Mg and pH level are too little temporally variable on the field. The content of available nutrients was from low to good level.

CHANGES OF MINERAL SULFUR CONTENT IN SOILS AFTER $CASO_4$ FERTILIZER APPLICATION TO OILSEED RAPE

M. Kulhánek, J. Balík, J. Černý, O. Kozlovský, M. Kos, V. Nedvěd

Czech University of Life Sciences, Faculty of Agrobiology Food and Natural Resources, Kamycka 129, 165 21 Prague 6, Czech Republic, E-mail: kulhanek@af.czu.cz, telephone +420224382742

IV Session: Fertilization and environmental quality

Abstract

Precise field experiments were established on 3 sites with winter rape under different soil-climatic conditions in the Czech Republic. For this experiment, four fertilizing treatments were evaluated. Nitrogen rate was 200 kg N ha^{-1} for all the treatments. Treatment 1 was fertilized only with N, while treatment 2, 3 and 4 received 12.5 kg S ha^{-1} 25 kg S ha^{-1} and 50 kg S ha^{-1}, respectively. Each treatment was conducted in 4 replicates. Sulfur was applied as $CaSO_4$ (Lovofert®) fertilizer. Fertilizers were applied in two split doses: i) at the beginning of spring vegetation, ii) at the vegetation period BBCH 30-32. Soil samples (0-30, 30-60 cm) were taken after reaching periods BBCH 18-20, 30-32 and 50-52. The mineral S content was measured after water extraction. Water soluble S content at the treatment 1 didn't significantly change and reached ~3.50 mg S.kg^{-1}. Water-extractable S increased from 2.10 mg S kg^{-1} to 4.20 mg S kg^{-1} at treatment 2, from 1.80 mg S kg^{-1} to 5.40 mg S kg^{-1} at treatment 3 and from 4.20 mg S kg^{-1} to 11.2 mg S kg^{-1} at treatment 4. The differences in soil samples from 30-60 cm depth were not statistically significant. All obtained values related to soil were compared with S uptake by winter rape.

THE WHOLE-OF-BLOCK EXPERIMENTAL APPROACH FOR MEASURING SPATIALLY VARIABLE RESPONSES TO TREATMENTS

K. Panten[1,2] and R. Bramley[1]

[1]CSIRO Sustainable Ecosystems, PMB 2, Glen Osmond, SA 5064, Australia.
[2]Present Address: Julius Kühn-Institut (JKI), Bundesallee 50, D-38116 Braunschweig, Germany, E-mail: Kerstin.Panten@jki.bund.de

IV Session: Fertilization and environmental quality

Abstract

Precision agriculture offers opportunities for the development of new approaches to on-farm experimentation to assist farmers with site-specific management decisions. Farmers faced with variable conditions need to optimize their management to the variation over space and time on their farm, which is not aided by conventional approaches to experimentation. New designs for on-farm experiments were developed in the 1990s for cereal production in which the whole field was used for the experiment rather than small plots. We explore the extension of this type of experiment to a vineyard in the Clare Valley of South Australia to enable evaluation of options to increase grape yield and vine vigour. Manually sampled indices of vine performance measured on georeferenced 'target' grapevines were analysed applying geostatistical procedures. The major advantage of such an approach is that the spatial variation in response to experimental treatments can be examined. Treatment responses and the significant difference between them can be mapped over the experimental area. The results indicate that both treatment responses and the significance of differences between them are indeed spatially variable. Thus, we conclude that whole-of-block on-farm trials are useful in vineyards.

ABATEMENT OF NH_3 EMISSIONS FOLLOWING APPLICATION OF UREA TO GRASSLAND BY MEANS OF THE NEW UREASE INHIBITOR 2-NPT

M. Schraml, R. Gutser, U. Schmidhalter

Chair of Plant Nutrition, Technische Universität München, Am Hochanger 2, 85350 Freising, Germany, e-mail: schraml@wzw.tum.de, telephone: +49.8161.715006, fax: +49.8161.715094

IV Session: Fertilization and environmental quality

Abstract

Following the application of granulated urea to grassland, up to 30% of the contained nitrogen can get lost into the atmosphere as ammonia (NH_3). These emissions can be deposited into semi-natural ecosystems not only causing their eutrophication and acidification, but also entailing an increase in N_2O losses. As an immediate incorporation of the fertilizer is not possible on grassland, the addition of a urease inhibitor (UI) is the most promising alternative. Throughout the loss phase, this active substance should reversibly block the active center of the ubiquitous enzyme urease, which is responsible for hydrolysis of urea to CO_2 and NH_3. In 2007 and 2008, field experiments were conducted on intensive grassland. Granulated urea with and without the new urease inhibitor 2-NPT (N-(2-nitrophenyl) phosphoric acid triamide) in different concentrations was broadcasted. Ammonia emissions were measured for a period of 10 days using a dynamic chamber method. Without UI, on average 4.0% of the fertilized nitrogen are lost as NH_3, ranging from 1.5% to 7.4%. Addition of P101/04 strongly reduces these losses by 49% to 100%, allowing a safe top application of urea onto grassland.

IMPACT OF COPPER EXPOSURE ON PHYSIOLOGICAL FUNCTIONING OF CHINESE CABBAGE (*BRASSICA PEKINENSIS*)

M. Shahbaz[1], M.H. Tseng[2] , C.E.E. Stuiver[1], F.S. Posthumus[1], S. Parmar[3], A. Koralewska[1], M.J. Hawkesford[3], L.J. De Kok[1]

[1]Laboratory of Plant Physiology, University of Groningen, P.O. Box 14, 9750 AA Haren, The Netherlands
E-mail: l.j.de.kok@rug.nl, telephone: +31 503632277, fax: +31 503632273
[2]Department of Natural Science, Taipei Municipal University of Education, 1, Ai-Kuo West Rd., Taipei 110, Taiwan
E-mail: biomei@mail.tmue.edu.tw, telephone: +886 223113040, fax: +886 223897641
[3]Plant Science Department, Rothamsted Research, Harpenden, Hertfordshire, AL5 2JQ, U.K.,
E-mail: malcolm.hawkesford@bbsrc.ac.uk, telephone: +44 1582763133, fax: +44 1582763010

IV Session: Fertilization and environmental quality

Abstract

Arable soils may be contaminated with copper as the consequence of unbalanced fertilization with manure and organic fertilizers or the use of copper-containing fungicides. Exposure of Chinese cabbage (*Brassica pekinensis*) to elevated Cu^{2+} levels resulted in leaf chlorosis, a loss of photosynthetic capacity and lower biomass production at $\geq$ 5 µM. The uptake, distribution and metabolism of sulfur and the overall mineral nutrient composition was substantially affected $\geq$ 5 µM Cu^{2+}. However, the toxicity of copper was substantially reduced when the UV-B was filtered out.

PREDICTION OF NITROGEN MINERALIZATION FROM SOIL ORGANIC MATTER USING A COMBINED PHYSICAL AND CHEMICAL FRACTIONATION TECHNIQUE

S. Sleutel[1], J. Kanagaratnam[1] and S. De Neve[1]

[1]Universiteit Gent, Departement of Soil Management, Coupure Links 653, 9000 Gent, Belgium, E-mail: Stefaan.DeNeve@UGent.be, tel. +32 9 2646061, fax. +32 9 2646247

IV Session: Fertilization and environmental quality

Abstract

One of the main bottlenecks for increasing N use efficiency in intensive agriculture is the prediction of the N mineralization potential from soil organic matter. Despite an overwhelming number of studies, the prediction of nitrogen mineralization on the basis of chemical or biological indices remains difficult. Here, we used a combination of physical and chemical fractionations to isolate specific soil fractions that can be related to N mineralization. Twenty vegetable fields, from which we anticipated important differences in N mineralization, were sampled (0-30 cm layer) in the intensive vegetable growing areas of East- and West-Flanders, Belgium. Fresh soils were incubated under standardized conditions in the lab for four months for the determination of net N mineralization. The soils were also fractionated, starting with an ultrasonication at 30 J ml-1 for 64 s, followed by wet sieving on a 50 μm mesh screen to separate the silt- and clay sized fraction from the particulate organic matter and sand fraction. The silt+clay sized fraction was further fractionated chemically using sequential treatments with NaOCl and HF. Also, enzyme activities of β-glucosidase and dehydrogenase, and microbial biomass C and N were measured. We will present models for the prediction of net N mineralization based on the physico-chemical and biological fractions obtained.

IMPROVED MANAGEMENT OF NITROGEN TO RAISE PRODUCTIVITY OF FOOD CROPS

J.H.J. Spiertz

Wageningen University, Department of Plant Sciences – Centre for Crop System Analysis (CCSA), P.O. Box 430, 6700 AK Wageningen, The Netherlands. E-mail: huub.spiertz@wur.nl

IV Session: Fertilization and environmental quality

Abstract

Increased nitrogen use efficiency, raising yield potential and closing existing yield gaps to avoid yield stagnation are pivotal components of a sustainable agriculture that meets human needs and protects natural resources. The better the yield determination is understood the more likely the breeding or management strategies designed to raise productivity will efficiently apply. Improved efficiency of nutrient use at a field and farm scale, both aiming at increasing crop yield and reducing losses, is dependent upon the magnitude of matching nutrient supply and demand of the crop. Matching nitrogen and water supply to the demand of the crop requires knowledge of crop growth processes and critical phenological stages in crop development.

Two cases are presented: one on N use in irrigated lowland rice and another on nitrogen use efficiency in wheat under abiotic stress. Irrigated lowland rice cropping systems show low ANR-values of about 0.30, while high-yielding wheat and maize crops can show values as high as 0.80. The agronomic nitrogen use efficiency, derived from ANR and PNUE, amounts to 0.50 on average for crops under temperate conditions. Water availability strongly affects N-uptake and – recovery. A quantitative systems approach is needed to identify the prospects for improving the agronomic N-use-efficiency.

Poster Presentations

ECONOMIC AND ENVIRONMENTAL EFFECTS OF LOW INPUT FERTILIZATION MANNERS OF PERMANENT MEADOW

J. Barszczewski, H. Jankowska-Huflejt, M. Szatyłowicz

Institute for Land Reclamation and Grassland Faring, Department of Meadows and Pastures, Falenty, Al. Hrabska 3, 05-090 Raszyn, Poland, E-mail: j.barszczewski@imuz.edu.pl

IV Session: Fertilization and environmental quality

Abstract

Low input manner of grasslands fertilization become more and more popular among farmers, mostly for savings on expensive mineral fertilisers. Such manners are advisable because of expected increase in plant and animal biodiversity and better nitrogen utilization and consequently limitation of its dispersion to environment.

In order to recognise the changes in economic and environmental dimension on productive 40 years old meadow the field experiment was established. According to organic farming system rules the mineral fertilization was decreased and simultaneously the fertilization with the cow dung and liquid manure was introduced. Long term fertilization with N doses 130 kg per ha was diminished to 60 and 90 kg N·per ha both in the form of mineral fertilisers and organic manures. Three-years study showed the diverse decrease of yielding on each experimental fields with relation to the previous period. Progressive changes in botanical composition of meadow sward consisted mostly on the increase of some grass species and legumes plants participation and on the diminution of N-NO_3 content in upper layers of soil.

INFLUENCE OF TILLAGE, CROP ROTATION AND NITROGEN FERTILIZATION ON SOIL FERTILITY

G. Brunetti[1], K. Farrag[2] and D. De Giorgio[3]

[1]Dipartimento di Biologia e Chimica Agroforestale e Ambientale, Università di Bari, Via Amendola, 165/A, 70126 Bari, Italy
[2]Central Lab for Environmental Quality Monitoring (CLEQM), National Water Research Center, Ministry of Water Resources and Irrigation, Egypt
[3]CRA- Research Unit for Cropping Systems in Dry Environment, via Celso Ulpiani, 5, 70125 Bari, Italy - E-mail: donato.degiorgio@entecra.it - tel. +39 0805475015; fax +39 0805475023

IV Session: Fertilization and environmental quality

Abstract

For understanding how production systems can be better managed to sustain long-term soil productivity especially in semiarid climates, a long-term experiment was established at Foggia (Apulia, southern Italy) on a silty loam soil to evaluate the effects of tillage, crop rotation and nitrogen fertilization on soil fertility over a period of 17 years**.** Tillage treatments included conventional (CT), two layers (TLT), surface (ST) and minimum tillage (MT) were combined with nitrogen fertilizer rates as 0, 50 and 100 kg N/ha. During the long time of the experiment, different crops (durum wheat, sugar beet, broad been, faba been, triticale, etc.) have been alternated in different two-year rotation. The experimental design used was a split plot with three replications. The research was initiated in 1990 and has been going on with the same treatments, which are repeated every year so as to test their long-term effects. Soils were sampled at a depth of 0-20 and 20-40 cm in October, 2007. These samples were subjected to comprehensive physicochemical analyses. Data from this study showed, a longer period may have been required for differences between treatments to be observed. The tillage method did not influence the organic carbon, total nitrogen and available phosphorous contents of the soil, nor did crop rotations. Generally, the nitrogen fertilization at dose of 50 kg N/ha did not raise the total nitrogen content of the soil. When N was applied at rate 50 kg N/ha, surface soil (0-20 cm) organic carbon was either equal or slightly greater to that where no nitrogen was applied (0 kg N/ha). Relative increscent in total soil nitrogen throughout the soil depth (20-40 cm) was evaluated at the high nitrogen rates (100 kg N/ha) at all locations.

LONG-TERM EFFECTS OF DIFFERENT PRACTICES ON SOIL FERTILITY AND SOIL ORGANIC MATTER FRACTIONS IN ALMOND TREE CROPPING IN SOUTHERN ITALY

G. Brunetti[1], K. Farrag[2] and D. De Giorgio[3]

[1]Dipartimento di Biologia e Chimica Agroforestale e Ambientale, Università di Bari, Via Amendola, 165/A, 70126 Bari, Italy
[2]Central Lab for Environmental Quality Monitoring (CLEQM), National Water Research Center, Ministry of Water Resources and Irrigation, Egypt
[3]CRA- Research Unit for Cropping Systems in Dry Environment, via Celso Ulpiani, 5, 70125 Bari, Italy - E-mail: donato.degiorgio@entecra.it, tel. +39 0805475015; fax +39 0805475023

IV Session: Fertilization and environmental quality

Abstract

At present, there is a tendency to reduce tillage intensity in order to decrease soil erosion. In fact the conventional tillage and the absence of residue-incorporation has propitiated severe degrees of degradation, especially in arid and semiarid zones, where natural fertility is low, mainly due to the organic matter content. In the present study, a long-term field trial was carried out in Bitetto-Bari (Southern Italy) to estimate the effect of soil treatments included weed herbicides on soil fertility and soil organic matter fractions. Five systems in a randomized block design was used in the field with five replicates, in 147 m^2 unite plots with three almond plants (cv. Filippo Ceo) of the same age. The five systems and their respective approaches included (A) pre-emergence and (B) post-emergence herbicides applications; (C) sickle (hand-held agricultural tool for cutting the herbs); (d) broad bean (*Vicia faba* L.**)** green manure and (E) minimum tillage. The research was initiated in 1976 and has been going on with the same treatments, which are repeated every year so as to test their long-term effects. Soil samples (0-30cm) collected from the plots were subjected to soil characterizations and extraction of humic substances, which were used for chemical, spectroscopic (FTIR and fluorescence) and E_4/E_6 analyses. Results show that the use of green manure, adequate herbs management and soil tillage systems is crucial to conserve or increase soil fertility in term of organic matter and total nitrogen contents. Amendment with green manure caused a considerable increscent in soil organic carbon and total nitrogen comparing with the others treatments. Although there were no significant differences for soil available phosphorus among the used practices. The yields of HAs extracted from the five treatments were significantly different. Treatment containing persistent organic compound such as broad been green manure increased the humification process in samples and produced higher yield of HA. Spectroscopic analyses revealed that treatments, specially the green manure, changed the functional groups, alkyl C, and E_4/E_6 of HAs.

NITROGEN AVAILABILITY FROM ORGANIC FERTILIZERS

M. Cardarelli[1], A. Salerno[2], E. Rea[2], G. Colla[1]

[1]Dipartimento di Geologia e Ingegneria Meccanica, Naturalistica e Idraulica per il Territorio, Università della Tuscia, via S. C. De Lellis snc, 01100 Viterbo, Italy.
E-mail address: giucolla@unitus.it
[2]CRA-Centro di ricerca per lo studio delle relazioni tra pianta e suolo, Via della Navicella 2-4, 00184 Roma, Italy

IV Session: Fertilization and environmental quality

Abstract

Organic fertilizers represent an important source of nitrogen especially in organic cropping systems. However, the nitrogen release characteristics of organic fertilizers must meet the crop nitrogen requirements during the growing cycle in order to avoid nutrient deficiency or environmental pollution. The conversion of organic nitrogen into the mineral forms required for plant uptake depends on several factors including the type and nature of organic compounds, soil properties, water availability and soil temperature. Starting from the above considerations, the rate of net nitrogen mineralization from different organic fertilizers was compared in a laboratory incubation. The fertilizers were mixed with soil and incubated aerobically at constant moisture at 10 and 25°C. Nitrogen mineralization was determined weekly on samples extracted with a solution containing K_2SO_4. Rapid nitrogen mineralization was observed from all fertilizers especially at 25°C within the first three weeks. Moreover, organic fertilizers exhibited different nitrogen release pattern depending on the source of nitrogen.

DELINEATION OF MANAGEMENT ZONE USING MULTIVARIATE GEOSTATISTICS AND EMI DATA AS AUXILIARY VARIABLE

A. Castrignanò[1], M.T.F. Wong[2] and F. Guastaferro[1]

[1]CRA - Research Unit for Cropping Systems in Dry Environments,
via Celso Ulpiani, 5 - 70125, Bari, Italy, telephone +39 0805475001; fax +39 0805475023
E-mail: annamaria.castrignano@entecra.it,
[2]CSIRO Land and Water, Wembley, Western Australia WA 6014, E-mail: mike.wong@csiro.au

IV Session: Fertilization and environmental quality

Abstract

Crop yields often vary by a factor of ~3-5 across the field. This results in corresponding variation in nutrient requirement. When fertilisers are applied uniformly to cater for the field-average crop yield, excess nutrient remains in parts of the field at harvest while other parts may suffer from nutrient deficiency. Both financial and environmental gains can be achieved if fertilisers could be dosed more accurately according to site and season specific potential yield. Delineation of management zones to represent clustering of soil properties relevant to crop productivity allows increased precision in fertiliser management. An EM38 survey provides data on the apparent soil electrical conductivity of the soil profile and this is often locally correlated with soil properties such as pH. We carried out an EM38 survey of a 150 ha cropping field in Western Australia to delineate management zones. We applied a multivariate approach called multicollocated factor cokriging using pH measurement at four depths and EM38 in vertical polarization as auxiliary variable. The first factor explains 92% of total variance and allows us to partition the field into 3 main homogenious areas characterized by similar pH values. This information together with soil texture may be very useful for yield and fertiliser requirement prediction.

DURUM WHEAT AND COMMON VETCH PERFORMANCES UNDER CONVENTIONAL AND CONSERVATIVE CROPPING SYSTEMS

M. Charfeddine, F. Fornaro, A. Fiore, A.V. Vonella and D. Ventrella

CRA - Research Unit for Cropping Systems in Dry Environments,
Via C. Ulpiani, 5 - 70125 Bari, Italy, telephone +39 0805475011, fax +39 0805475023,
E-mail: monia.charfeddine@entecra.it

IV Session: Fertilization and environmental quality

Abstract

Cropping systems in the Southern Italy were characterized by continuous cereal monoculture, leading to environmental concerns, and fertility deterioration. To reduce those problems, a growing interest in conservative cropping systems has occurred. In this concern, under rainfed conditions and over the period 2004-2007, a field study was carried out in a Mediterranean environment (Foggia, Southern Italy), on a cereal-livestock farm to assess the effects of conservative agronomical practices on grain yield and quality of durum wheat (*Triticum durum* Desf.) cropped as continuous crop (CC) and in rotation (ROT) with common vetch (*Vicia sativa* L.).

On elementary plots of 350 m^2 each, laid out in a randomized complete block with three replications, two levels of crop management were evaluated: i) conservative (CONS): soil tillage 15-20 cm deep combined with organic-mineral fertilization and ii) conventional (CONV): deep soil tillage at 40-50 cm with mineral N fertilization.

The possible effect of common vetch on soil fertility was also evaluated, by comparing the productions of durum wheat in rotation with leguminous crops and under continuous cropping.

The results obtained during the three trial years showed either the effects of weather conditions , or the effectiveness of conservative practices on crops productions. In fact, for durum wheat cropped in CC and ROT, similar grain yields were obtained with the two levels of cop management (2.08 t ha^{-1} vs. 2.39 t ha^{-1} for CC, and 2.31 t ha^{-1} vs. 2.54 t ha^{-1} for ROT, respectively for CONS and CONV treatments). On the contrary, the responses of common vetch showed that the CONV treatment allowed the significantly highest dry matter production (5.64 t ha^{-1} vs. 4.80 t ha^{-1} of conservative treatment).

These results thus pointed out the possibility to apply a lower level of agro-techniques, almost always without compromise the crops performance, and appeared very satisfactory from both the economical and the environmental aspects, considering that the slightly lowest grain yields could be balanced by the lowest production costs and pollution risks.

SITE SPECIFIC SOIL FERTILITY MANAGEMENT OF AN OXISOL CULTIVATED WITH CORN FOR APPLICATION OF LIME AND GYPSUM

A.M. Coelho[1], G.J. de O. Lima[2], T.F. Cunha[2]

[1]Embrapa Maize and Sorghum Research Institute, Sete Lagoas- MG, Brazil,
E-mail: amcoelho@cnpms.embrapa.br, telephone +55-31-3027-1145, fax +55-31- 3027-1188
[2]Campo Agricultural and Environmental Analyses, Paracatu-MG, Brazil,
E-mail: ap@campoanalises.com.br, telephone +55-38-3671-1164

IV Session: Fertilization and environmental quality

Abstract

Due to the necessity to improve soil fertility diagnostic, the researches have been searched for more efficient technologies on agronomic and environmental aspects. One of these technologies is the use of the concept of site specific for soil fertility management. This research was conducted in a farm field (100 ha) located in Corinto, Minas Gerais state, in the 2007/2008 growing season. The soil is classified as Silt Clay Oxisol, cropped with corn and irrigated with a center-pivot sprinkler irrigation system. Grid cell of 1 ha, was used for collecting soil samples from 0 to 20 cm and 20 to 40 cm depths. Data of pH, Al^{3+}, Ca^{2+}, Mg^{2+}, CEC, base saturation (BS), Al^{3+} saturation and organic matter were submitted to geostatistical analysis and interpolated by point-kriging using the modeled semi-variograms. Based on the maps of BS and Al^{3+} saturation, it was possible to define zones of management for application of lime and gypsum. The threshold used to the definition of the rates of lime was 60 % of BS in the top of 20 cm. The criteria based on values of Ca (<0.5 $cmol_c/dm^3$) and Al^{3+} saturation (>25 %) in the subsoil (20 to 40 cm) were used for gypsum application. With these informations, maps of application of lime and gypsum at variable rate were generated. The rates of lime range from 0 to 3 t/ha and for gypsum of 0 and 1 t/ha. The costs of soil sampling with GPS, soil chemical analyses, field mapping with GIS and application of lime and gypsum, are evaluated.

SUPRA-OPTIMAL COPPER LEVELS MAY DISTURB THE REGULATION OF UPTAKE AND METABOLISM OF SULFATE IN PLANTS

L.J. De Kok[1], M.H. Tseng[2], M. Shahbaz[1]

[1]Laboratory of Plant Physiology, University of Groningen, P.O. Box 14,
9750 AA Haren, The Netherlands,
E-mail: l.j.de.kok@rug.nl, telephone: +31 503632277, fax: +31 503632277
[2]Department of Natural Science, Tapei Municipal University of Education, 1, Ai-Kuo West Rd.,
Taipei 110, Taiwan

IV Session: Fertilization and environmental quality

Abstract

Arable soils may be contaminated with copper as the consequence of unbalanced fertilization with manure and organic fertilizers or the use of copper-containing fungicides. Copper is an essential plant nutrient and it functions as redox-active transition metal in enzymes in many physiological processes, e.g. photosynthesis, respiration, oxidative stress response. However, at supra-optimal levels copper may become phytotoxic and the general symptoms are chlorosis and a stunted growth. For instance, exposure of Chinese cabbage (*Brassica pekinensis*) to supra-optimal Cu^{2+} levels (1-10 μM) resulted in leaf chlorosis, a loss of photosynthetic capacity and biomass production at ≥ 5 μM. The Cu content of the root increased with the Cu^{2+} concentration (up to 40-fold), though only a minor proportion (4 %) of it was transferred to the shoot. The nitrogen content of the root was hardly affected at suboptimal Cu^{2+} levels, whereas that in the shoot was decreased at ≥ 5 μM Cu^{2+}. The total sulfur of the shoot was increased at ≥ 2 μM Cu^{2+}, which could be attributed to an increase in sulfate content. Moreover, there was a strong increase in water-soluble non-protein thiol content in the root and to a lesser extent in the shoot at ≥ 1 μM, which could only partially be ascribed to a Cu-induced enhancement of the phytochelatins, thiol-rich compounds which may play a role in the homeostatic control of potential toxic metal ions in plants. The nitrate uptake by the root was substantially reduced at ≥ 5 μM Cu^{2+}, whereas that of sulfate was slightly enhanced or unaffected at 2 and 5 μM Cu^{2+}. The Cu-increased activity of the sulfate transporters was accompanied with an enhanced expression of sulfate transporters transcripts in both root and shoot. The up-regulation of the sulfate transporters could not be ascribed to a higher sulfur demand upon at supra-optimal Cu levels, but was more likely the consequence of the direct interference of Cu with the signal transduction pathway regulating the expression and activity of the sulfate transporters. The significance of gaseous H_2S as possible signal in the cross-talk between the sulfate reduction pathway in chloroplast/plastid and the transcription of sulfate transporters/sulfate-reducing enzymes will be discussed. The relevance of sulfur metabolism in the detoxification of copper will be evaluated.

OPTIMIZING NPK FERTILIZATION FOR COTTON IN SANDY SOILS OF THE CERRADO FROM BAHIA, BRAZIL

F.C. dos Santos[1], M.R. de Albuquerque Filho[1], G. Barbosa Ferreira[2], M. da Conceição Santana Carvalho[3]

[1]Researcher from National Maize and Sorghum Research Center. Rod MG 424, Km 45, s/n, Sete Lagoas, MG, CEP 35701-970. E-mail: fsantos@cnpms.embrapa.br, mricardo@cnpms.embrapa.br;
[2]Researcher from National Roraima Research Center, BR 174, Km 8, s/n, Distrito Industrial, Boa Vista, RR, CEP 69301-970, E-mail: Gilvan@cpafrr.embrapa.br;
[3]National Cotton Research Center, Rua Osvaldo Cruz, 1143, Campina Grande, PB, CEP 58107-720, E-mail: conceicao@cnpa.embrapa.br
Support: Fundeagro.

IV Session: Fertilization and environmental quality

Abstract

The Cerrado in Bahia is one of the main agricultural regions of Brazil and the second largest producer of cotton. There's a predominance of sandy soils, which have weak structure and require more refined management of fertilization. It's commom to apply larger NPK doses than recommended, often disregarding tools for diagnosis. In this context to optimize the use of products and ensure the sustainability of production, with less damage to the environment, experiments have been carried out in the region since the 2003 about the management of NPK maintenance fertilization for the cotton. Various field trials were performed on commercial farms involving times, doses and forms of NPK application. In general, we observed the possibility of reduction, and implementation of a single dose of N and K in pre or post planting, and 120 and 100 kg ha^{-1} were the economic doses of N and K_2O, respectively. For P, 80 P_2O_5 kg ha^{-1} are sufficient to ensure high productivity; the application may be made by broadcast spreading or in the planting furrow. It's recommended to use the concept of fertilization to return to soil the nutrients export through harvest, noting the analysis of the soil and plant in order to optimize the use of fertilizers in the region.

DYNAMIC OF NH_3 VOLATILIZZATION FOLLOWING DIFFERENT FERTILIZERS SPREADING

R.M. Ferrara[1], B. Loubet[2], N. Martinelli[1], C. Decuq[2], S. Génermont[2], P. Cellier[2], T. Bertolini[3], P. Di Tommasi[3], V. Magliulo[3], G. Rana[1]

[1]C.R.A. Research unit for Agriculture in Dry Environments, Via C. Ulpiani 5, Bari, Italy,
E-mail: rossana.ferrara@entecra.it, tel +39 080 5475026, fax +39 080 5475023
[2]INRA-Unité Mixte de Recherche Environnement et Grandes Culture, Thiverval-Grignon, France,
E-mail: loubet@grignon.inra.fr, tel. +33 (0)130815533, fax. +33 (0)130815563
[3]CNR-ISAFOM, Via Patacca 85, Ercolano (Na), Italy, E-mail: teresa.bertolini@gmail.com,
tel +39 081 7717325, fax +39 081 7718045

IV Session: Fertilization and environmental quality

Abstract

Ammonia (NH_3) losses by volatilisation following application of both organic and mineral fertilisers has to be investigated in order to both optimize N fertilizer usage and reduce the environmental issues such as acidification of soil and eutrophication in aquatic ecosystems. The monitoring of NH_3 fluxes in the continuum soil-plant-atmosphere have to be performed by means of non intrusive methodologies since NH_3 volatilization is a process strongly affected by microclimate. The micrometeorological approach has the right requirements for NH_3 studies. In particular, the results relative to two experimental campaigns carried out using the aerodynamic gradient method and the eddy covariance technique are presented. Considering the dynamic of NH_3 volatilization, the purpose is to compare what happen after the spread of slurry on bare soil and after the application of urea on a cropland. The fast dynamic of NH_3 volatilization following slurry spreading shows an extinction of the phenomenon in few hours, with the end of it after the incorporation of slurry into the soil. On the other hand, the application of urea is followed by NH_3 volatilization only when the soil moisture conditions are ideal and the hydrolysis starts.

AN INCUBATION METHOD TO DETERMINE NITROGEN AVAILABILITY IN SLOW RELEASE FERTILIZERS

L. Foschi, D. Piccotino, S. Magni., S. Miele

Department of Agronomy and Agroecosystem Management, University of Pisa, via San Michele degli Scalzi 2, Pisa, Italy, E-mail: smiele@agr.unipi.it,
tel. +390502218939, fax +392218970

IV Session: Fertilization and environmental quality

Abstract

The products of polymerization of urea have been used for decades as slow release nitrogen fertilizers. These are insoluble Nitrogen sources from which plant available compounds are released, upon the breakdown of the polymeric molecules into soluble Nitrogen mineral forms, such as ammonium. The "mineralization" is the result of soil microbial activity and it is a process that occurs naturally in soils. In order to evaluate the potential releasing rate of plant available Nitrogen from polymeric sources, several methods have been developed. One possible approach is the incubation in soil, with the aim of reproducing conditions similar to those of field application. A major drawback of this approach is related to the use of soil, that introduces an unpredictable variability in the resulting analysis, mainly due to problems of identifying a reference soil with standardized physical and chemical characteristics. In order to minimize the effects of the soil type and to obtain a more reproducible procedure, an incubation method was developed as a modification of that described by Stanford and Smith (1972). It uses a standardized and easily reproducible incubation medium, being used in place of natural soil. Validation tests indicated this method permit achieving consistent results, in good accordance with plant growth response.

WHOLE PLANT REGULATION OF SULFATE UPTAKE AND DISTRIBUTION IN *BRASSICA* SPECIES

A. Koralewska[1], C.E.E. Stuiver[1], F.S. Posthumus[1], M. Shahbaz[1], P. Buchner[2], M.J. Hawkesford[2], L.J. De Kok[1]

[1]Laboratory of Plant Physiology, University of Groningen, 9750 AA Haren, The Netherlands, e-mail: l.j.de.kok@rug.nl, telephone: +31 503632277, fax: +31 503632273
[2]Plant Science Department, Rothamsted Research, Harpenden, Hertfordshire, AL5 2JQ, U.K.
e-mail: malcolm.hawkesford@bbsrc.ac.uk, telephone: +44 1582763133, fax: +44 1582763010

IV Session: Fertilization and environmental quality

Abstract

Uptake and distribution of sulfate in Chinese cabbage and curly kale were modulated by the sulfate supply to the root and were coordinated with the sulfur requirement for growth. The uptake of sulfate by the root and the expression of the sulfate transporters in root and shoot were up-regulated when the sulfate supply to the root was limited. Prolonged sulfate deprivation led to depleted pools of sulfur metabolites and the development of sulfur deficiency symptoms, e.g. a decreased plant growth and shoot to root ratio. There was poor shoot to root signaling for regulation of expression and activity of the sulfate transporters in the root, whereas the presumed significance of sulfate and thiols as signal compounds in the regulation of sulfate transporters was ambiguous.

RISK ELEMENTS IN THE SOIL IN RELATION TO THE ENVIRONMENT

E. Kunzová[1], P. Čermák[2], M. Budňáková[3]

[1]Crop Research Institute Name, Drnovská 507, Praha 6-Ruzyně, Czech Republic,
E-mail: kunzova@vurv.cz; telephone: +420602190195; fax: +420233310636
[2]Central Institute for Supervising and Testing in Agriculture, Hroznová 2, Brno, Czech Republic,
E-mail: pavel.cermak@ukzuz.cz; telephone: +420737267150; fax: +420569430438
[3] Ministry of Agriculture of the Czech Republic, Těšnov 17, Praha, Czech Republic,
E-mail: budnakova@mze.cz; telephone: +420725004331; fax: +420

IV Session: Fertilization and environmental quality

Abstract

The results of the project from EU-European fund for regional development will be presented on the Symposium.

The main aims of the project are:

- soil properties (soil texture)
- organic pollutants determination in the soil: PCB, PAH, dioxins, DDT, HCH (in some samples and horizons)
- determination of heavy metals in soil–aqua regia extract (As, Cd, Cr, Cu, Ni, Pb, Zn) + Hg
- determination of essential nutrients-available forms of P, K, Mg, Ca+S
- pH value
- determination of Corg (+ humus), Ntot, CEC, soluble organic carbon
- deduction of critical loads
- forecasting inputs of risk matters to the underground and surface waters
- determination of buffering of soil in relation to acid deposition
- presentation of results in the form of cross-border

Based on LPIS was established monitoring grid 8 x 8 km, i.e. 278 monitoring points on the Czech territory. Each monitoring point has own identity (geographic-topographic) – by the satellite navigation system - GPS.

HBED/$^{57}FE^{3+}$, A NEW SOLUTION OF IRON CHLOROSIS IN DICOT PLANTS

P. Nadal, D. Hernández and J.J. Lucena*

Department of Agricultural Chemistry, Universidad Autónoma de Madrid. C/ Francisco Tomás y Valiente nº 7. 28049 Madrid. Spain.
*Corresponding author: juanjose.lucena@uam.es
Tel.: +34 914973968; Fax: +34 914973825

IV Session: Fertilization and environmental quality

Abstract

Fe fertilisers applied to the soil are widely used, and constitute the most common Fe chlorosis remediation technique. Among them, only the most stable chelates, especially chelates derived from polyamine-carboxylic acids, are able to maintain Fe in calcareous soil solution and to transport it to the plant root. Nowadays, o,o-EDDHA (Ethylenediamine-N,N´bis(o-hydroxy-phenylacetic) acid) and its analogues are the most efficient. HBED (N,N'-Bis(2-hydroxybenzyl)ethylenediamine-N,N'-diacetic acid), presents a similar structure to o,oEDDHA and forms a very stable Fe chelate. This chelating agent has been traditionally used in oral drugs to remove excessive Fe from humans but never had been used in agriculture due its elevate Fe stability constant and price. Now Fe-HBED is available as a pure and affordable product. In this work, different doses of o,oEDDHA/$^{57}Fe^{3+}$ and HBED/$^{57}Fe^{3+}$ were studied in soybean plants grown in a calcareous soil. Chelates prepared with the isotope ^{57}Fe were used to differentiate the iron uptake from the chelate and from other sources. Several parameters related to the plant nutritional status, such as plant growth, SPAD index, ^{57}Fe and total Fe concentration in leaf and root and Fe/Mn ratio were determined. Compared with o,oEDDHA/Fe^{3+} we conclude that EDDHA/Fe^{3+} presents a faster action than HBED/Fe^{3+} and HBED/Fe^{3+} presents more long lasting effect than EDDHA/Fe^{3+}.The results obtained show that HBED/Fe^{3+} can be a good chelate to correct Fe chlorosis.

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SOIL FERTILITY MONITORING PROJECT: A TOOL FOR IMPROVING THE FERTILIZATION PLAN

M. Piombino[1], G. Cabassi[2], P. Marino Gallina[2], G. Marzi[1], A. Magni[1]

[1]Pioneer Hi-Bred Italy, Via Pari Opportunità 2, Gadesco Pieve Delmona (CR), Italy,
E-mail: matteo.piombino@pioneer.com, Tel.: +39 0372841611, Fax: +39 0372838553
[2] Department of Crop Science, University of Milan, Via Celoria 2, Milan, Italy,
E-mail: pietro.marino@unimi.it

IV Session: Fertilization and environmental quality

Abstract

With the objective to improve the fertilization management, Pioneer Hi-Bred Italy started in 2001 the "Soil Fertility Monitoring Project".

First step of the project was the development of a new analytical system, based on NIR spectroscopy that allowed performing quick and reliable soil analyses for the determination of physical and chemical parameters useful to compiling fertilization plans. Capability of first NIR calibrations was enlarged in the following years, updating the databases with the reference data of the selected outliers. In 2009 the Standard Error of Validation and R^2 of the calibrations were respectively: 26.1g/kg and 0.90 for Clay, 87.0g/kg and 0.72 for Sand, 0.31 and 0.90 for pH, 1.96% and 0.98 for Total Lime, 3.60g/kg and 0.95 for Organic Carbon, 0.31g/kg and 0.97 for Total Nitrogen.

Fertilization plans have been prepared according to the guidelines provided by Emilia Romagna region. Nutrients uptake is defined taking into account also the specific Pioneer hybrids yield potentials, based on Pioneer field trial results across all Italian corn areas.

The most considerable impact of this project was the capability to set fertilization plans on a very large scale. More than 39,000 soil samples have been analyzed, involving about 17,000 corn growers, covering more than 200,000 corn hectares.

USE OF BIOCHEMICAL AND BIOLOGICAL INDICATORS TO MONITOR SOIL QUALITY IN AN AGRICULTURAL AREA UNDER INTENSIVE FARMING

R. Scotti[1], M.A. Rao[1], R. Marzaioli[2], R. D'Ascoli[2], F.A. Rutigliano[2], L. Gianfreda[1]

[1]Department of Soil, Plant, Environmental and Animal Production Sciences, University of Naples Federico II, via Università 100, 80055 Portici
[2]Department of Environmental Sciences, Second University of Naples, via Vivaldi 43, 81100 Caserta, Italy

IV Session: Fertilization and environmental quality

Abstract

Agricultural productivity is strongly affected by intensive agriculture, which often leads to substantial decline of soil fertility. The use of appropriate indicators usable as quantitative tools could allow to assess soil quality. Although soil physical and chemical properties have mainly received attention, soil biochemical and biological properties, such as soil enzymes involved in the cycling of the main nutrients or microbial biomass C, can behave as sensitive indicators of soil quality and health changes. The attention was focused on farms near Sele river (Campania region, Italy), an area characterized by an intensive agriculture. As common trait, the farms, all with greenhouse cultures, use no organic amendments but only mineral fertilizers. To better understand the role of intensive agricultural practices in each farm, control soils were chosen in orchards or uncultivated plots. All soil samples were characterized to evaluate physical, chemical, biochemical and biological properties. The obtained results showed a great variability among the farms. A clear evidence was that the control samples, not subjected to intensive farming, had always better values of chemical properties and higher enzymatic activities and biomass carbon to indicate a negative effect of the organic amendment lack in intensive agriculture practices on soil fertility.

INTERACTION BETWEEN ATMOSPHERIC AND PEDOSPHERIC SULFUR NUTRITION AND COPPER TOXICITY IN CHINESE CABBAGE

M. Shahbaz, L.J. De Kok

Laboratory of Plant Physiology, University of Groningen, P.O. Box 14, 9750 AA Haren, The Netherlands E-mail: l.j.de.kok@rug.nl, Tel. +31503632277

IV Session: Fertilization and environmental quality

Abstract

Sulfur is an essential element for plants and it has been known for several decades that foliarly absorbed sulfurous air pollutants (SO_2, H_2S) may be metabolized and may contribute to sulfur fertilization of plants. There is direct interaction between atmospheric and pedospheric sulfur utilization, for instance H_2S exposure may down-regulate the expression and activity of the sulfate transporters and APS reductase, the key regulating enzyme of the sulfate reduction pathway. Organic fertilizers may contain supra-optimal copper levels, which at strongly enhanced levels may become phytotoxic. It has been presumed that sulfur metabolites might play an essential role in copper homeostasis and detoxification in plants. In the present study the significance of the plant sulfur status in the detoxification of supra-optimal copper levels was evaluated. Chinese cabbage was exposed to supra-optimal levels of copper (5, 10 and 15 μM Cu^{2+}) in the root environment. and the impact of sulfate-deprivation and H_2S exposure (0.2 μl l^{-1}) on growth, the activity and expression of the sulfate transporters and sulfur assimilation in the presence of supra-optimal Cu^{2+} levels was investigated.

POTENTIAL BY A MINING WASTE TO RELEASE POTASSIUM AND OTHER NUTRIENTS UNDER CULTIVATION SUCCESSIVE SYSTEM

D.J. Silva, A. Monteiro Salviano Mendes, É. de Souza Martins

Brazilian Agricultural Research Enterprise (EMBRAPA)

IV Session: Fertilization and environmental quality

Abstract

A mining waste, a by-product of emerald and molybdenum extractions, containing phlogopitite, was evaluated according to its capacity to release exchangeable potassium (K) and other nutrients for soybean, pearl millet and melon plants under greenhouse conditions. KCl was used as reference source. The soil K availability was assessed by Ammonium Acetate and Mehlich 1 extractants. Soil analysis did after each crop showed low efficiency of the mining residue in release K to crops. However, there was an increase in soil phosphorus, calcium and magnesium levels, in those treatments that exclusively received the residue. The Mehlich 1 extractant was efficient to predict K availability in soils that receive mining waste application. After the third crop was evident the soil acidification, which can be observed by increasing the potential acidity (H + Al) values, as well as reducing the potassium and phosphorus levels, due to the extraction of nutrients by the three successive crops.

THE INFLUENCE OF CERTAIN METHODS OF REDUCED TILLING OF THE SOIL ON THE CONSERVATION AND REVALUATION OF WATER AND FERTILIZERS IN AUTUMN WHEAT

V. Simionescu[1], I. Bulica[2], F. Cosor[2], M. Tanc[2]

[1]Ovidius University - Constanta
[2]SCDA Valu Traian - Constanta

IV Session: Fertilization and environmental quality

Abstract

The researches regarding the soil tilling effects on its physical, chemical and biological characteristics are always topical. The structural state of the soil influences favorably the water, food and air regime in the soil, thus the size of aggregates constitutes an important element that conditions the activity of microorganisms and the biochemical processes.

The conventional agriculture uses techniques of intense cultivation that involve high energy inputs and contribute to soil degradation manifested through organic substance losses, erosion and compaction.

As alternative to the conventional agriculture system, other systems have been developed. Even though their purpose is mainly the increase of soil fertility and the production of healthy food, they apply reduced inputs in the conditions of supporting the sustainable agriculture.

The following soil tilling versions were tested: by plowing at 20 cm and with chisel plow at 20 cm and 10 cm, in the conditions of water insurance by irrigation at 50% IUA (A1), 50% of A1 and without irrigation and fertilization with four levels of nitrogen (N0, N50, N100 and N150).

From a technical point of view, the main restrictions which prevented the extension in production of the methods of reduced tilling of the soil, have been represented so far both by the lack of herbicides with wide spectrum of perennial weeds control and by the absence of machine systems appropriate for these soil tilling works.

PEAK PHOSPHOROUS - A NEW DIMENSION FOR FOOD SECURITY AND WATER QUALITY IN THE LAKE WINNIPEG BASIN

A. Ulrich and D. Malley

TUM - Technische Universität München, E-mail: andy_u@gmx.de

IV Session: Fertilization and environmental quality

Abstract

Awareness is growing that the global supply of phosphorus for fertilizers essential in agriculture and food production is declining. The term *peak phosphorus* has been applied to the situation that phosphorus, the first non-renewable, non-substitutable life-supporting element, will become scarce in the foreseeable future. This allows a new look at global food security as well as the relationship between agriculture and prevention of eutrophication in aquatic ecosystems. The objective of the study was to investigate the confluence of intensive management of phosphorus in agriculture with the goals of securing food productivity and water pollution prevention as symbolized by Lake Winnipeg, visibly the most eutrophic Great Lake in the world. The method was an action research approach designed to disseminate and gather information on existing and future challenges related to P management and social process of change. Based upon review of science, analysis of the basin and dialogue with stakeholders, action recommendations for best management practices, P recycling and stewardship were formulated. The results demonstrate the urgency and importance of establishing an integrated watershed management approach, including all aspects of Lake Winnipeg Basin-related water security, phosphorus recycling, traditional knowledge and governance.

V SESSION

New fertilizers and fertilization management in Organic Farming

(Chairman: Prof. R.L. Walker, Dr. G. Roccuzzo)

Oral Presentations

NEW FERTILIZATION STRATEGIES ON OLIVE-GROVES CROPPED AS TRADITIONAL AND ORGANIC AGRONOMICAL INTERVENTIONS IN SOUTHERN ITALY

G. Debiase[1], A. Fiore[1], F. Montemurro[2], D. Ferri[1]

[1]CRA- Research Unit for Cropping Systems in Dry Environments, Via C. Ulpiani, 5 - 70125 Bari, Italy, tel. +39 0805475001; fax +39 0805475023; E-mail: giambattistadebiase@virgilio.it
[2]CRA - Research Unit for the Study of Cropping Systems, c/o AASD "Pantanello", s.s.106 Jonica 448,2 - 75010

V Session: New fertilizers and fertilization management in Organic Farming

Abstract

The aim of this research was to study the alternative strategies of fertilization in olive trees cropped according to the principles to intensive and organic agriculture.
The trial was carried out in two experimental fields of olive trees in Apulia and Basilicata Regions (Southern Italy). The following four fertilization strategies were compared in the first research (Apulia Region): nitrogen and phosphorus mineral fertilizers, shallow applied; mineral fertilizers incorporated into the soil at 10 cm depth; organic fertilizer as olive pomace compost incorporated into the soil at 10 cm depth and the same organic fertilizer shallow applied.
In the second trial (Basilicata Region), four fertilizer treatments were compared: organic fertilization with olive waste water; organic-mineral fertilizer; organic fertilizer with olive pomace compost and green manure amendment.
The results show that the application of olive pomace compost positively affects olive performances in the intensively-cropped olive-grove with olive yields very similar to the values obtained through mineral fertilization.
Following organic farming approach, it appears that olive pomace compost and olive mill wastes can be useful organic fertilizers in substitution of green manuring, which is normally applied in organic farming in the experimental area.
The application of olive mill by-products (compost, wastes) increased the level of main chemical soil nutrients and improve the soil organic matter composition, while no significant accumulation was observed for soil heavy metal contents.

INOCULATION OF PLANT GROWTH PROMOTING RHIZOBACTERIA AS INFLUENCED BY ORGANIC FERTILIZATION: EFFECTS ON PLANT AND SOIL P CHARACTERISTICS

T. Krey[1], M. Caus[2], C. Baum[1], S. Ruppel[3], B. Eichler-Löbermann[1]

[1] Institute of Land Use, University of Rostock, Germany
[2] Institute of Plant Physiology, Moldovan Academy of Sciences, Moldova
[3] Institute of Vegetable and Ornamental Crops, Großbeeren, Germany

V Session: New fertilizers and fertilization management in Organic Farming

Abstract

Rhizobacteria are able to promote the phosphorus (P) supply of plants essentially, but their efficiency in interaction with organic fertilization is scarcely known. In a pot experiment under field conditions the effects of two plant growth promoting rhizobacteria (PGPR) *Pseudomonas fluorescens* strain DR 54 and *Enterobacter radicincitans* sp. nov. strain DSM 16656^T on plant growth and plant P uptake of *Zea mays* L. and *Brassica napus* L. as well as soil P characteristics were assessed depending on organic fertilization (without and with cattle manure or biowaste compost). As expected, organic fertilization increased the growth of both plant species. The bacterial inoculation generally resulted in small effects showing no significant differences regarding plant growth and plant P uptake. However, applications of both bacterial strains increased activities of phosphatases under both plant species. The magnitude of this effect varied between the different organic fertilization treatments and between the two bacterial strains. Our results indicate that the application of PGPR can response in significantly changed soil P turnover, and that organic fertilization has a limited capability to support the efficiency of applied rhizobacteria therewith.

YIELD, NUTRITIONAL AND SOIL CHEMICAL PROPERTIES AS RESPONSE TO CATTLE MANURE, REACTIVE NATURAL ROCK PHOSPHATE AND BIOTITE SCHIST IN MASSAI GRASS

A. Moreira[1], N. Kumar Fageria[2], G.B. de Souza[1] e A. Riberio de Freitas[1]

[1]Embrapa Cattle-Southeast, P.O. Box 339, 3560-970 São Carlos, São Paulo State, Brazil.
E-mail: adonis@cppse.embrapa.br, gilberto@cppse.embrapa.br, ribeiro@cppse.embrapa.br.
[2]Embrapa Rice and Bean, São Antônio de Goiás, Goiás State, Brazil.
E-mail: fageria@cnpaf.embrapa.br.

V Session: New fertilizers and fertilization management in Organic Farming

Abstract

In animal production, grasses planted in the pasture lands have especial value to improve aggregate value of products. This paper evaluates the effects of applying cattle manure, reactive natural phosphate and biotite schist on soil fertility, yield and nutritional content of *Megathyrsus* spp. cv. Massai. The experiment was conducted under field conditions, in a dystroferric Red Latosol (Oxisol). The experimental design was randomized blocks with the treatments confounding, with one replicate. The treatments consisted of three rates of natural reactive rock phosphate from Algeria - Djebel-Onk (0, 100 and 200 kg ha^{-1} of P_2O_5), three biotite schist rates (0, 150 and 300 kg ha^{-1} of K_2O) and three cattle manure rates (0, 20 and 40 Mg ha^{-1}). The application of reactive natural rock phosphate increased dry matter yield (DMY), however, this effect was not observed for cattle manure and biotite schist. The foliar contents of N, K and Mg (cattle manure), P and B (natural rock phosphate) and K (biotite schist) were significantly influenced by the treatments. The same effect was found forP levels in soil dry matter of the aerial part, Mg and B content in the dry matter.

EFFECTS OF CEREAL / LEGUME INTERCROPS WITHIN A ROTATION

V.A. Pappa [1] , R.L. Walker [2], R.M. Rees [1], J.A. Baddeley [2], C.A. Watson [2]

[1] SAC, West Mains Road, Edinburgh, EH9 3JG, UK.
E-mail: valentini.pappa@sac.ac.uk, tel: +44 (0)131 711000 fax: +44 (0)131 711293
[2] SAC, Craibstone Estate, Aberdeen, AB21 9YA,UK.
E-mail: robin.walker@sac.ac.uk, tel: +44 (0)1224 711000 fax: +44 (0)1224 711293

V Session: New fertilizers and fertilization management in Organic Farming

Abstract

Intercropping systems with legumes as a component can simultaneously provide symbiotically fixed nitrogen (N) and increase yield through improved resource use efficiency. Key objectives investigated in this project were: a) can the yield benefit of an intercropping phase in a rotation extend beyond its growth season and b) the relative contribution of legume derived N in both growing seasons. Experiments were established in 2006 in Scotland, UK. Treatments included a spring barley (*Hordeum vulgare* cv. *Westminster)* monoculture and intercrops of barley / white clover (*Trifolium repens* cv. *Alice*) and barley/ pea (*Pisum sativum* cv. *Zero4* or cv. *Nitouche*) followed by oat (*Avena sativa* cv. Firth; spring, 2007). No fertilisers, herbicides or pesticides were used. Above ground biomass, grain yields, land equivalent ratio (LER) and plant N accumulation were measured at key stages during the growing season of 2006 and 2007. The choice of legume cultivar or species is a key factor influencing the amount of N available to the system in the year of use and / or the following year, with this impacting significantly on the final grain yield in both years.

ORGANIC PLANT PRODUCTION – LIMITED BY NUTRIENT SUPPLY? AN OVERVIEW

H.M. Paulsen[1], S. Haneklaus [2], G. Rahmann[1], E. Schnug[2]

[1]Institute of Organic Farming, Johann Heinrich von Thuenen-Institute (vTI), Federal Research Institute for Rural Areas, Forestry and Fisheries, Trenthorst 32, 23847 Westerau, Germany, E-mail: hans.paulsen@vti.bund.de
[2]Institute of Crop and Soil Science - Julius Kuehn-Institut, Federal Research Centre for Cultivated Plants, Bundesallee 50, 38116 Braunschweig, Germany

V Session: New fertilizers and fertilization management in Organic Farming

Abstact

In organic plant production only the use of chemically untreated mineral fertilisers is permitted. Additionally a variety of by-products and process residuals - mainly from the food industry - can be used for fertilisation. Household-composts and sewage sludge were essential nutrient sources in the thoughts of the early Organic farming movement in the 20 century. Nowadays the awareness of the existence of toxic components in those products is hindering nutrient recycling. The vitality of plant production in a huge number of today's organic farms is mainly based on legume growth and internal nutrient flows - this against better knowledge on nutrient balances and nutrient depletion. Organic yields are keeping constant since long years. Residues from local bio-energy production could be the key to break up mental reservations against fertilisation with external recycling materials because the concept fits to organic baselines. Beyond that biogas residues e. g. from fallow-legumes are a new tool to optimise N-fertilisation in organic farms and could increase productivity. To optimise nutrient management in organic farms, future options and research fields are: Nutrient mobilisation from the soil by roots or mycorrhiza, improved nutrient conservation in plants and the efficient recycling of suitable waste-materials and its detoxification processes.

THE EFFECT OF NATURAL FERTILISATION OF GRASSLANDS ON SILAGE QUALITY IN ORGANIC FARMING SYSTEM

B. Wróbel, H. Jankowska-Huflejt

Institute for Land Reclamation and Grassland Farming, Falenty,
Al. Hrabska 3, 05-090 Raszyn, Poland

V Session: New fertilizers and fertilization management in Organic Farming

Abstract

The aim of study conducted in 2008 was the evaluation of the influence of fertilisation with different natural manures on quality and nutritive value of meadow sward and grass silage. Treatments were: i) mineral NPK fertilization (N-60 kg·ha-^{1}, P_2O_5-30 kg·ha^{-1}, K_2O-60 kg·ha^{-1}) as control; ii) cattle manure (22 t·ha^{-1}) and iii) liquid manure (25 m^3·ha^{-1} + 30 kg P_2O_5·ha^{-1}). Meadow sward was cut in May 2008 and after prewilting (40% DM) was ensilaged in big bales. The content of nutritive components in meadow sward and silage were evaluated. The fermentation products, count of chosen bacteria, yeast and moulds and mycotoxins level in silage samples were evaluated. Nutritive value of meadow sward fertilized with natural fertilisers was similar to value of sward fertilised with mineral fertilisers. No negative effect of natural fertilisation on fermentation quality was noticed. Obtained silages had similar pH value, ammonium concentration and lactic and volatile acids content. It was only stated that natural fertilisation is conductive to yeast and moulds development in silage and higher concentration of mycotoxins (aflatoxin B1).

Poster Presentations

ASSESSING THE IMPACT OF INTENSIVE FARMING MANAGEMENT REGIME ON SOIL FERTILITY

G. Bonanomi[1], V. Antignani[1], M. Capodilupo[1], R. D'Ascoli[3], R. Scotti[2], M.A. Rao[2], G. Puopolo[1], L. Cozzolino[1], A. Zoina[1]

[1]Dipartimento di Arboricoltura, Botanica e Patologia Vegetale, Università di Napoli Federico II, via Università 100, 80055 Portici, Italy
[2]Dipartimento di Scienze del Suolo, della Pianta, dell'Ambiente e delle Produzioni Animali, Università di Napoli Federico II, via Università 100, 80055 Portici, Italy
[3]Dipartimento di Scienze Ambientali, Seconda Università di Napoli, Via Vivaldi 43, 81100 Caserta, Italy

V Session: New fertilizers and fertilization management in Organic Farming

Abstract

Concern about groundwater contamination, pesticide residues in food, and soil fertility decay have fuelled vigorous debates about the sustainability of chemical-intensive agriculture. In this multidisciplinary study we compared the ecological soil properties of 25 farms classified either as in intense management regime (IMR, i.e. protected cultures under plastic cover) and with low input intensity (LMR, i.e. orchards). In each farm, 28 properties were studied including physico-chemical (bulk density, field capacity and texture, organic C, N, P, K, Ca, Mg, Na, EC, CSC, limestone,), enzymatic (arylsulfatase, β-glucosidase, dehydrogenase, phosphatase, urease), microbiological (Biolog^{TM}, potential respiration, microbial biomass, fungal mycelium, cultivable actinomycets, bacteria, pseudomonads, fungi and bacterial diversity assessed by DGGE fingerprinting of 16S-rRNA sequences) and a bioassay aimed at evaluating the soil suppressiveness on the *Rhizoctonia solani-Lactuca sativa* pathosystem. Reduction of soil organic C, microbial biomass, population and diversity of the microbial communities and a marked decrease of soil enzymatic activities were measured under IMR cultivation. Conversely management practices did not change CSC, pH, limestone, soil texture and *R. solani* suppression. Differences among soil parameters were robust enough to indicate a significant decline trend of biological soil fertility under the IMR cultivation.

N USE AND PARTITIONING IN CORIANDER *(CORIANDRUM SATIVUM* L.) AFTER ORGANIC AND CONVENTIONAL N FERTILIZATION.

A. Carrubba, M. Militello, C. Catalano

DAAT - Dipartimento di Agronomia Ambientale e Territoriale - Facoltà di Agraria - Università di Palermo - Viale delle Scienze, I 90128 - Palermo; E-mail: acarr@unipa.it

V Session: New fertilizers and fertilization management in Organic Farming

Abstract

In coriander, a well known spice herb, many studies concerning the effect of N fertilization have been conducted in special areas where the cultivation of such plant has a major importance, such as India. Limited information is available as concerns the response of coriander to N fertilization under Mediterranean climatic conditions, above all when organic N fertilizers (mandatory when organic cropping management is chosen) are used. This work refers about some observations driven from 2004 to 2006 by an experiment on organic and mineral N fertilization techniques in coriander, carried on in the experimental farm "Sparacia" (Cammarata, AG, Sicily). Similarly to what suggested for other species, each year at harvest time, for each fertilizer treatment, seeds yield and plant biomass were weighed and the respective N content was determined in order to compare N plant uptake with total and mineral N measured in the soil before and after cropping cycle. From such data a few indices were calculated in order to get information about the efficiency of use by plants of the tested N forms. Some differences in N partitioning and efficiency of use according to treatment showed up, suggesting an overall higher efficiency of N chemical fertilizers.

THE CONTROLLED GRASS-COVER SOIL MANAGEMENT IN SOUTHERN ITALY OLIVE ORCHARD ENVIRONMENTS

P. Toscano

CRA - Centro di ricerca per l'olivicoltura e l'industria olearia, Rende (CS)

V Session: New fertilizers and fertilization management in Organic Farming

Abstract

The influence of controlled grass-cover on soil characteristics and olive tree growing parameters has been tested for many years in two different olive orchard environments bring up in dry conditions, of southern Italy (Calabria). In hilly and slope soil, the permanent grass-cover improved both soil characteristics, with significant reduction of erosive phenomena, and olive trees yield, also reducing the alternate bearing, vs. the tilled soil management.

Another research has been carried out on flat environment, to evaluate the effects of two different soil grassing management on soil characteristics and olive trees productive parameters.

On the contrary to hilly environment, in flat soil the permanent grass management shows worse results vs. the temporary grassing, both on soil characteristics and olive trees responses.

These results confirms that the growing management techniques must be selected and applied in order to the specific environmental parameters, to optimize their effects.

BUCKWHEAT: POTENTIAL TO IMPROVE P USE EFFICIENCY IN SCOTTISH ORGANIC CROPPING SYSTEMS

R.L. Walker [1], O. Knox [2], C.A. Watson[1], P. Maskell[2], A. Edwards[3], E.A. Stockdale[4]

[1]SAC, Craibstone Estate, Aberdeen, AB21 9YA,UK. E-mail: robin.walker@sac.ac.uk
tel: +44 (0)1224 711000 fax: +44 (0)1224 711293
[2]SAC, West Mains Road, Edinburgh, EH9 3JG, UK. E-mail: oliver.knox@sac.ac.uk
tel: +44 (0)131 711000 fax: +44 (0)131 711293
[3]Nether Backhill, Ardallie, Aberdeenshire, AB42 5BQ, UK. E-mail: t.edwards25@btinternet.com
tel: +44 (0)1358 711244
[4]Newcastle University, Newcastle upon Tyne, NE1 7RU, UK. E-mail: e.a.stockdale@ncl.ac.uk
tel: +44 (0)191 2226867 fax: +44 (0)191 2227811

V Session: New fertilisers and fertilisation management in Organic Farming

Abstract

Organic farmers have limited options to overcome low P status soils, particularly if not linked to a livestock enterprise. In such cases, rock phosphate can be applied under the discretion of the organic certification body. However, the solubility of P from this source is extremely low, and consequently increases in P availability may take several years to have any appreciable effect on the crops. Literature reviews suggest buckwheat is capable of solubilising P more rapidly than many other crop species. This paper describes an experiment that investigated the ability of buckwheat to solubilise P under Scottish growing conditions. The experiment was based on an organic farm in SE Scotland, where soils were low P status. Treatments with and without rock phosphate were included, as well as comparison with other crop species. The experiment was designed to test buckwheat's suitability as either a green manure crop, or a cashcrop, which could be included in the rotation as a method of improving P efficiency of the system, particularly to following crops. Buckwheat was extremely efficient at mobilising and accessing P from the soil compared to the other test species and has potential in the roles described.

NITROGEN DYNAMICS IN LEGUME BASED ROTATIONS

R.L. Walker [1], C.A. Watson [1], K.Topp[2]

[1]SAC, Craibstone Estate, Aberdeen, AB21 9YA,UK. E-mail: robin.walker@sac.ac.uk
tel: +44 (0)1224 711000 fax: +44 (0)1224 711293
[2]SAC, West Mains Road, Edinburgh, EH9 3JG, UK. E-mail: kairsty.topp@sac.ac.uk
tel: +44 (0)131 711000 fax: +44 (0)131 711293

V Session: New fertilisers and fertilisation management in Organic Farming

Abstract

The inclusion of legumes within crop rotations provides an alternative to nitrogen fertiliser and the high energy costs associated with its manufacture. In some circumstances, legumes may also contribute to lower nitrogen losses and greenhouse gas emissions, although further research is required to quantify the magnitude of these benefits. In North West Europe crop rotations comprising a grazed legume based ley followed by a period of arable cropping are common. Stockless rotations based on legumes are of increasing interest given the rising price of fertiliser nitrogen. However, as grass-legume leys provide no economic return in a system without livestock, stockless systems will necessarily rely more on grain legumes and alternative management of forage legumes such as undersowing or companion cropping. In this paper we compare nitrogen flows in stocked and stockless rotations using the NDICEA model developed for ecological agriculture. The data used is from the long-term crop rotations trials at SAC at Aberdeen in North-East Scotland. This trial originally compared two contrasting stocked ley-arable rotations (Taylor et al. 2006). However, in 2006 one of the rotations was converted to a stockless system, including crops undersown with red and white clover and spring beans.

VI SESSION

Specialty Fertilizers

(Chairman: Prof. F. Márquez, Dr. A. Benedetti)

Oral Presentations

FERTILIZING EFFECTS OF BIOGAS SLURRIES

S. Bachmann and B. Eichler-Löbermann

University of Rostock, Institute of Land Use, Germany

VI Session: Specialty Fertilizers

Abstract

The substance and nutrient cycling is one criterion in sustainable bioenergy production. Mainly the reuse of the phosphorus (P) in bioenergy residues is important, since P is a limited resource and the prices of P fertilizers are going to increase. In green house experiments the effects of the residues of biogas production (biogas slurries) based on cattle slurry were investigated regarding their effects on crop P uptake, soil P pools and biological activities in soil. The results showed that biogas slurry has a similar P fertilizing effect like non-digested cattle slurry and high soluble Triple-Super-P. The highest biological activity in soil was found for the treatment with non-digested cattle slurry, whereas the application of biogas slurry and the mineral treatment resulted in a lower biological activity. The results underline the high P fertilizing potential of biogas slurries. But they also showed the effects on soil biological parameters, which may affect the microbial contribution on the P cycle.

SULFUR-INDUCED RESISTANCE (SIR): BIOLOGICAL KNOW-HOW FOR ENVIRONMENTALLY SOUND DISEASE CONTROL

S. Haneklaus[1], E. Bloem[1], Z. Hu[2,3], Y. Wang[2] and E. Schnug[1]

[1]Institute for Crop and Soil Science, Federal Research Centre for Cultivated Plants (JKI), Bundesallee 50, D-38116 Braunschweig, Germany, E-mail: silvia.haneklaus@jki.bund.de, telephone: 00495315962121, fax: 00495315962199;
[2]College of Resources and Environment, Graduate University of the Chinese Academy of Sciences, No. 19A, Yuquan Road, Shijingshan District,100049, Beijing, P.R. China;
[3]State Key Laboratory of Soil and Sustainable Agriculture, Institute of Soil Science, The Chinese Academy of Sciences, No. 71, East Beijing Road , P. O. Box, 821, Nanjing 210008, P. R. China

VI Session: Specialty Fertilizers

Abstract

Environmentally sound methods for disease control imply for instance soil tillage measures, crop rotation, mixed cropping systems and cultivation of resistant varieties. The targeted use of minerals offers yet another possibility to enhance resistance against pathogens. Here, the direct toxicity of nutrients and indirect impairment by minerals needs to be distinguished from nutrient-mediated, resistance mechanisms. Soil-applied sulfate fertilization proved to significantly reduce infection rate and severity of crops by fungal diseases. The term Sulfur-Induced Resistance (SIR) denotes the reinforcement of the natural resistance of plants against fungal pathogens through triggering the stimulation of metabolic processes involving sulfur by targeted sulfate-based and soil-applied fertilizer strategy. The potential efficacy of SIR expressed as a reduction of the disease index ranged from 5 - 50% and 17 - 35% in greenhouse and field experiments, respectively. Up-to-date research in the field of SIR from molecular to field level is summarized in relation to different host/pathogen systems. In addition, recommendations for on-farm implementation of SIR will be given.

MARINE ALGAE FILTRATES: PHYSIO-ACTIVATORS® THAT STIMULATE PLANT NUTRITION AND GROWTH

A. Bordier[1], M. Vitagliano[2], J.M. Joubert[3]

[1]Laboratoires Goëmar, Penn-ar-Prat, 29250 Saint Pol de Léon, France
adeline.bordier@goemar.com; tel. 0033-2-98-29-06-44; fax. 0033-2-98-69-24-26
[2]Italia prodotti Goëmar, In.Nova.Fert. Via Jappelli 4, 35031 Abano Terme (Pd), E-mail: m.vitagliano@innovafert.it; tel. 0039-335.8077920
[3]Laboratoire Goëmar, ZAC de la Madeleine, Avenue Général Patton, 35418 Saint Malo, France, E-mail: jean-marie.joubert@goemar.com;
tel. 0033-2-99-21-53 96; fax. 0033-2-99-82-56-17

VI Session: Specialty Fertilizers

Abstract

Biological effects of seaweed on plant growth and development have been investigating for more than 20 years: the studies showed that *Ascophyllum nodosum* (Fucales, *Phaeophyceae*) extracts stimulate plant growth and nutrition, which translates into nutrient enrichment and increased plant weight and yield (Klarzynski *et al.*, 2005; Klarzynski *et al.*, 2006).

It was demonstrated that these extracts (Physio-activators®), obtained by a patented industrial process, activate specific plant enzymes involved in absorption and assimilation of some important nutrients, thus acting as physiological activators. For instance, they stimulate the nitrate reductase and root phosphatase enzymes, involved in nitrogen and phosphorus nutrition, respectively (Klarzynski *et al.*, 2005; Klarzynski *et al.*, 2006). Furthermore, recent studies showed that *Ascophyllum nodosum* extracts implement the iron assimilation and translocation mechanisms, by stimulating both the Fe-chelate reductase activity - which reduces Fe^{3+} into Fe^{2+}, more easily assimilated - and the Fe-transporter gene (IRT1): this means an increase in iron uptake, reducing problems linked to the well-known ferric chlorosis (Euzen *et al.*, 2008).

Thus, the above describe processes lead to multiple biological effects, which determine higher leaf chlorophyll content (Klarzynski *et al.*, 2005), and, consequently, a better plant growth and development (Klarzynski *et al.*, 2005; Klarzynski *et al.*, 2006).

Unraveling the mechanisms of action of the extracts is essential to understand the observed effects and to allow integrating them in sustainable and profitable production programs by better controlling plant nutrition, which ends in increased crop performance.

ENRICHMENT OF DURUM WHEAT GRAIN WITH ZINCTHROUGH NITROGEN FERTILIZATION

U. Baris Kutman[1], B. Yildiz[1], L. Ozturk[1], I. Cakmak[1]

[1]Faculty of Engineering and Natural Sciences, Sabanci University, 34956, Istanbul, Turkey
E-mail: bkutman@su.sabanciuniv.edu, Tel: +90(216)4839524, Fax: +90(216)4839550

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Abstract

Enrichment of cereal grains with zinc (Zn) is a global challenge to cope with Zn deficiency-related health problems in human beings. The effects of soil- and foliar-applied nitrogen (N) and Zn fertilizers on Zn allocation within the shoot and grain Zn accumulation were studied in durum wheat (*Triticum durum*) grown on a Zn-deficient soil. When Zn supply was adequately high, soil nitrate and foliar urea applications significantly increased the grain Zn concentration, which was also greatly enhanced by Zn applications. A significant positive correlation was found between grain concentrations of N and Zn under Zn-sufficient conditions. Higher N supply increased both the total amount of Zn per plant and the ratio of Zn retranslocated from leaves and stems into grains. Moreover, staining studies showed a co-localization of Zn and protein within the grain, particularly in the embryo and aleurone. Apparently, increasing N supply contributes to grain Zn at least by enhancing both root uptake and retranslocation of Zn from vegetative tissues. Thus, N management represents an important agronomic tool to improve grain Zn concentration and will contribute to the alleviation of Zn deficiency in humans. Development of urea-containing foliar Zn fertilizers could be a promising way to biofortify food crops with Zn.

NEW FERTILIZERS AS A LEACHING CONTROL METHOD IN NO TILLAGE

F. Márquez[1, 2], R. Ordóñez[3, 2], J. Gil[1, 2], E. González[2, 1] and O. y Veroz[2]

[1]AGR-126. Grupo de investigación de mecanización y tecnología rural. Departamento de ingeniería rural. Universidad de Córdoba. Campus universitario de Rabanales. Nacional IV. Km 396. 14014. Córdoba. España. E-mail: fmarquez@aeac-sv.org, telephone: +0034-957-422099
[2]Spanish Association for Conservation Agriculture / Living Soils. IFAPA Alameda del Obispo. Edif. 3. Olivicultura. Avenida Menéndez Pidal s/n. 14004. Córdoba. España. www.aeac-sv.org
[3]Área de Producción Ecológica y Recursos Naturales. IFAPA centro "Alameda del Obispo". Apdo. 3092. 14080 Córdoba. España

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Abstract

As nitrogen contamination related to the incorrect use of fertilizers is one of the main environmental problems in Europe, the European Commission prepared the Directive 91/676 related to pollution caused by nitrates from agricultural sources. Guadalquivir river valley hosts the main cereal region in Andalusia. It is considered vulnerable to nitrate pollution, situation that restricted the nitrogen fertilization at farm level.

In the study, the nitrogen evolution in the soil was studied by soil sampling at different depths, until 70 cm, during 2006-07 and 2007-08 seasons, in two different fields located in the cerealistic andalusian areas. The experimental design is randomized complete block, with 4 repetitions and 8 treatments, with different fertilizers, not only conventional (urea, ammonium sulphate, etc.), but also new generation (fertilizer with nitrification inhibitor, micronutrient or liquid fertilizers). The surface of the elemental plot is 50x7.5 m^2, with the crop is wheat under no tillage. Results show that the diverse fertilizers do not produce important differences in the nitrogen evolution in the soil. In contrast, the structural improvements caused by conservation agriculture, produce the nitrogen surface accumulation, and enhance their assimilation by the crops.

FROM ANAEROBIC DIGESTION PLANTS A RENEWABLE POTENTIAL ORGANIC MATRIX FOR FERTILIZERS

S. Miele[1], E. Bargiacchi[2] and F. Boldrighi

[1]Dipartimento di Agronomia e Gestione dell'Agroecosistema, Università di Pisa, Via S. Michele degli Scalzi, 2, I-56124 Pisa, E-mail: smiele@agr.unipi.it
[2]Consortium INSTM, via G. Giusti, 9, I-50121 Firenze

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Abstract

Anaerobic digestion is a renewable energy production process been diffusing in Italy over the last years. Several on-farm 1 MWh electricity plants are under construction or already operating, using ag feedstocks (cereal silage), ag process byproducts, and livestock wastes. One of the major problem of these plants is related to disposing some 15,000 m^3 of the 10% DM fluid digested phase (DP), containing all the mineral components (P, K, Ca, Mg, etc.) and most Nitrogen of the feeding materials. Problems concerning DP are related to: 1) its dilution and actual composition; 2) continuous production through the year, but seasonal soil application (except some examples of compost production) ; 3) nitrates regulations imposing a larger area for application (higher logistic costs); 4) necessity to set clear rules for its use in a consistent legislative framework. DP could be easily formulated with nutrients to produce low and medium grade suspension fertilizers, or filter pressed to 35-40%DM and then almost dried by the recovered heat of the same biogas plant, to produce organic-mineral fertilizers. Presently DL 217/2006 includes several non renewable "organic matrices" for formulation of organic-mineral fertilizers (annex 5). DP could be a traceable and renewable material for a sustainable fertilizer production.

TARGETING NUTRIENT MANAGEMENT OPTIONS TO ADDRESS SOIL FERTILITY CONSTRAINTS IN WESTERN KENYA

F. Mussgnug, T. Diwani, F. Ngome, M. Becker

Department of Plant Nutrition, Institute of Crop Science and Resource Conservation, University of Bonn, Germany

VI Session: Specialty Fertilizers

Abstract

Widespread decline in food crop yields in Western Kenya is associated with soil fertility loss, aggravated by intensified land use in the absence of external inputs. The implementation of past approaches to soil fertility restoration failed as the availability of production factors in different farm types was generally not considered. We hypothesized that technology adoption depends on the effectiveness of addressing the soil-specific production constraints and the resource endowment of individual farms. Initially, a farm typology based of surveys on 192 farms was developed, taking into account the soil fertility status and production system attributes. Subsequently, technologies were evaluated in on-farm trials on the dominant soil types of Kakamega District, combining nutrient balances, yield gaps and productivity studies. Technologies comprised combinations of reduced tillage, mineral fertilizers and organic amendments. Key soil constraints were determined to be low organic C and N in Alfisols, and low P availability on Ultisols. These were most severe on small subsistence-oriented farms with mean maize yields 0.6 Mg/ha. Nutrient balances were generally negative for N and K while being neutral for P. The efficacy and adoptability of technologies differed by soil type and production system. Mineral fertilizers corrected the nutrient constraints and increased grain yields by 3.8 Mg/ha, but are unaffordable to low-input farmers. Farmyard manure and green manure legumes significantly increased maize yields on both soil types but differ in their resource requirements (labor implements, seeds). Based on six years of field research (2004-2009), a decision tool for site- and system-specific technology targeting is being developed.

GLASS-MATRIX BASED FERTILIZERS ON PLANT DEMAND: FIRST RESULTS

A. Trinchera[1], A. Marcucci[1], C. Rivera[1], P. Sequi[1] E. Rea[1]
B. Torrisi[2], A. Leonardi[2], F. Intrigliolo[2]

[1]Consiglio per la Ricerca e la sperimentazione in Agricoltura – Centro di ricerca per lo studio delle Relazioni tra Pianta e Suolo (CRA-RPS), Via della Navicella 2-4, 00184 Rome, Italy.
E-mail: alessandra.trinchera@entecra.it, tel. +39 06 77078141, fax +39 06 7005711
[2]Consiglio per la Ricerca e la sperimentazione in Agricoltura – Centro di ricerca per l'Agrumicoltura e le Colture Mediterranee (CRA-ACM), C.so Savoia 190, 95024 Acireale, Italy.
E-mail: francesco.intrigliolo@entecra.it, tel. +39 095 7653103, fax +39 095 7653113

VI Session: Specialty Fertilizers

Abstract

Glass-matrix based fertilizers (obtained by altering the crystalline structure of a mineral natural substance through a physical process) represent a typology of fertilizer able to release nutrients on the basis of plant-demand, being nutrients not soluble in water, but only in metal complexing solutions (~99%), similar to those of root exudates. Nutrient release could be increased by mixing the glass-matrix fertilizer to different organic biomasses, such as leather meal, digested vine vinasse, etc.

A short-term pot trial on *Zea mais* L. was conducted to verify the effect of different mixtures of glass-matrix fertilizer (GMF) with increasing percentages of digested wine vinasse (DVV - 5%, 20% and 50% w/w) on maize growth, also performing nutrient release-test for all considered mixtures, in different extractive conditions (H_2O, citric acid 0,2%, citric acid 2%, HCl 0,1% and HCl 1%).

Best results were obtained in relation to the mixture 80% GMF + 20% DVV, which gave the highest maize shoot weight and total produced biomass. Nutrient release was comparable in 2% citric acid and 1% HCl, confirming the importance of acidic root exudates in making available primary, secondary and micro-nutrients coming from GMF + DVV mixtures.

A parallel study was realized on "Tarocco scirè" orange trees [Citrus sinensis (L.) Osbeck] grafted on two different rootstocks [*Citrange carrizo* (L.) and *Citrumelo swingle* (L.)]. The research was conducted in 50 liter pots, utilizing tree different soils, fertilized with GMF and GMF mixtures, to verify the effects of treatments on growing plants. First results show that the mixture GMF + DVV seems to increase nutrient availability and plant development.

MID-TERM EFFECTS OF DIGESTATES APPLICATION ON YIELD AND N EFFICIENCY OF FODDER CROPS

C. Vitti[1], M. Diacono[1], F. Montemurro[2], F. Tittarelli[3], S. Canali[3], D. Ferri[1]

[1*]CRA-Research Unit for Cropping Systems in Dry Environments, Bari, Italy,
E-mail: carolina.vitti@entecra.it, Tel. +39-080-5475022, Fax +39-080-5475023
[2]CRA-Research Unit for Cropping Systems, Metaponto (MT), Italy,
[3]CRA-Research Centre for the Soil-Plant System, Roma, Italy

VI Session: Specialty Fertilizers

Abstract

Recycling of organic by-products through anaerobic digestion, originates a product that can be used as a fertilizer or as soil amendment, and may contribute to closing again the natural ecological cycles.

Two anaerobic digestates were compared with a mineral and an unfertilized control in a randomized-block experimental design with three replications. The organic materials were obtained by the wastewater treatment of wine derived process and by wastewater from frozen food processing. The effects of the different treatments were assessed on both alfalfa (*Medicago sativa* L.) and cocksfoot (*Dactylis glomerata* L.) crops.

During the crop cycles, fresh weight, dry weight allowing the calculation of cumulative production were determined.

In alfalfa, no significant difference was found for cumulative dry weight among mineral and organic treatments, besides the mean yield of anaerobic digestate treatments was higher than the unfertilized control in the second and third year (35.3 and 67.2% respectively).

In cocksfoot, the anaerobic digestates application increased yield in the first and second year (23.0 and 17.2%, respectively) in comparison with the unfertilized control.

The results indicate that the application of anaerobic digestates could be an effective sustainable option to provide nutritive elements for fodder crops and to substitute the mineral fertilizers, so reducing the environmental risk.

REACTIONS IN SOILS AND FERTILIZERS AFFECT THE AVAILABILITY OF MICRONUTRIENTS TO PLANTS

M. Yli-Halla[1*] and L. Pietola[2]

[1]Department of Applied Chemistry and Microbiology, P.O. Box 27, FIN-00014 University of Helsinki, Finland, *corresponding author: markku.yli-halla@helsinki.fi
[2]Yara International ASA /Yara Suomi Oy, Mechelininkatu 1a, P.O. Box 900, FIN-00181 Helsinki, Finland

VI Session: Specialty Fertilizers

Abstract

This review focuses on correcting micronutrient and selenium deficiencies in crop production with application of fertilizers to soil. The accessory compounds in the fertilizer can have a marked influence on the availability of the nutrients to plants. Their reactions are mostly unknown to fertilizer dealers and users, who make decisions only on the basis of physical quality and total concentrations of nutrients in the fertilizer. Therefore it is the manufacturer that has to take the responsibility of the proper functioning of the products.

Manganese (Mn), incorporated as manganese sulphate in NPK fertilizers, has been successfully applied to sugar beet in Finland. When incorporated into the NPK granule, Mn gets into the zone of root proliferation. In the rhizosphere, lower redox potential and slightly lower pH enhance Mn solubility. Separate application of Mn to soil is commonly of little use. When zinc (Zn) sulphate is incorporated into NPK fertilizers, sparingly soluble zinc phosphates may be precipitated, decreasing the immediate fertilizer effect of Zn. Instead, granulating with superphosphate keeps Zn easily soluble, owing to the very low pH upon dissolution of superphosphate. In soils of high phosphorus (P) status, application of superphosphate as the carrier is however no more ecologically acceptable. Granulation with gypsum ($CaSO_4$•2H2O) has proved to be a working way of Zn application. Copper (Cu) cannot be incorporated into NPK fertilizers containing nitrate because of a danger of decomposition. Gypsum can be used as the carrier of Cu as well. Boron (B) deficiency is successfully alleviated with NPK fertilizers containing Na-borate. Selenium (Se), incorporated into fertilizers as Na_2SeO_4 in Finland, is moderately available to plants and substantially increases the Se content of crop.

Fertilizer compounds can have indirect effects on the availability of soil micronutrients by manipulating the pH in the dissolution zone. Heavy nitrogen applications result in lowering of soil pH, decreasing molybdenum (Mo) uptake by the grass. Instead, this acidification can enhance Zn uptake. The pH around a dissolving diammoniumphosphate (DAP) granule is at 7.5-8 while monoammoniumphosphate (MAP) results in an acid solution (pH < 4). Particularly in arid soils, MAP can enhance solubility of micronutrients while the use of DAP may result in less available micronutrients and formation of different precipitates in drip irrigation systems.

Poster Presentations

OSMOPROTECTANS AMELIORATE TOMATO YIELD PERFORMANCE UNDER SALINE ENVIRONMENTS

R. Caputo, A. Maggio and S. De Pascale

Department of Agricultural Engineering and Agronomy - University of Naples Federico II
E-mail: rosanna.caputo@unina.it

VI Session: Specialty Fertilizers

Abstract

In coastal regions of Mediterranean areas growth and productivity of summer crops are often limited by irrigation with saline water. Tomato is considered moderately tolerant to salinity and it is typically cultivated in areas which are exposed to water and soil salinity problems. During two growth seasons (2007 and 2008), we evaluated the effects of increasing salinity of the irrigation water on field-grown tomato. The research was conducted in a long-term salinised field (a clay loam soil that had been irrigated with saline water during the summer since 1988) and in a short-term salinised field (a clay loam soil that had not been previously irrigated with saline water). In addition, the effects of the addition of PHYT-actyl (TIMAC-Agro) to the liquid fertilizers were investigated. Leaf gas exchanges, plant water relations and crop yield (quantity and quality) were measured on tomato for processing (Tampico F1) grown under three different irrigation treatments: a non-salinized control (NSC) and two concentrations of commercial sea salt in the irrigation water: 0.25% (SW1) and 0.5% (SW2), corresponding to electrical conductivities of 0.5 (NSC), 2.3 (SW1) and 4.4 dS/m (SW2). Two different fertirrigation treatments were compared: the conventional system (Control) and the conventional system plus 1% of PHYT-actyl (TIMAC). Leaf total, osmotic and pressure water potentials decreased at increasing salinity of the irrigation water, lower values were observed in the TIMAC *vs.* the Control treatment, in both fields and both years. The stomatal resistance increased with salinity in the long-term salinized field and upon TIMAC treatment. Salinity stress reduced both total and marketable yield. This effect was more consistent in the long- than in the short-term salinized field, whereas the use of PHYT-actyl ameliorated the crop performance with a yield increase of 10%. PHYT-actyl is a mixture of organic molecules that may have acted as compatible solutes inducing a partial stress protection. Although salinized tomato fruits were smaller than non-salinized control fruits, they had higher dry matter content, soluble solids and sugars content, which are all highly requested qualities for the processing tomato industry. In areas where fresh water supply is limited, the adequate utilization of moderately saline water may substantially increase the availability of usable water for agriculture. The addition of an osmoprotectants-based product to the irrigation water was beneficial since it partially counteracted the salinity induced yield loss in tomato. The implementation of physiology-driven strategies in agricultural productions should be further considered to improve resource use efficiency and to reduce the environmental impact of agricultural practices. The exact mechanism of action of osmoprotectants and similar compounds is not univocal, however, and it may depend on complex interactions with other environmental variables. Additional studies are needed to fully understand the physiological mechanisms that are involved in the observed enhanced crop salt tolerance.

SLOW RELEASE NITROGEN FERTILIZERS BY HYDROPHOBIC POLYMER COATING OF CLAY/UREA NANOCOMPOSITES

L.S. Cescon[1] , Y.P.P. Lima[1], J.C. Polidoro[2], R.S.V. Nascimento[1]

[1]Instituto de Química, Universidade Federal do Rio de Janeiro – IQ/UFRJ, CT bloco A, Cidade Universitária, Rio de Janeiro, RJ, Brasil. CEP: 21941-590.
[2]Empresa Brasileira de Pesquisas Agropecuárias – EMBRAPA Solos, Rua Jardim Botânico, 1024, Jardim Botânico, Rio de Janeiro, RJ, Brasil, CEP: 22460-000.
E-mail: lcescon@ufrj.br

VI Session: Specialty Fertilizers

Abstract

Large losses of nitrogen fertilizer by leaching and volatilization require the use of excessive amounts of fertilizers and cause economic and environmental impacts, which requires the use of controlled or slow release fertilizer so that these losses are minimized [1-3]. In this work, slow release nitrogen fertilizers were obtained by montmorillonite clay and urea nanocomposites formation with polyssulfone (PSF) and poly(vinyl cloride) coatings. Clay/urea nanocomposites were characterized by x-ray diffraction (DRX) with the purpose to detect increasing in the interlayer space of clay by the process of adsorption of urea. Polymer coatings were prepared by different techniques like direct application of polymer solution, phase inversion, and fluidized bed. Nitrogen release kinetic was evaluated for the fertilizer systems prepared by different techniques, with different coating thickness. The fluidized bed techniques presented better performance to produce coatings without craks on the surface and the possibility of the coating thickness control. The urea/clay composites did take 60 min for the total loss of urea in water and the system prepared with polyssulfone and also with poly(vinyl cloride) coatings presented total loss in about 180 min, while pure urea dissolves immediately. The immediate loss of urea was less than 20 % for coated systems and 60 % for non-coated systems.

NITROGEN FERTILIZER SOURCES AND MANAGEMENT IN THE SUCCESSION BRACHIARIA/COTTON UNDER NO-TILLAGE SYSTEM AND CROP-LIVESTOCK INTEGRATION IN THE BRAZILIAN CERRADO

M. da Conceição Santana Carvalho[1], A.Cunha de Barcellos Ferreira[1], F.C. dos Santos[2]

[1]Brazilian Agricultural Research Corporation/Embrapa Cotton.
E-mail: conceicao@cnpa.embrapa.br, acunha@cnpa.embrapa.br
[2]Brazilian Agricultural Research Corporation/Embrapa Maize and Sorghum.
E-mail: fsantos@cnpms.embrapa.br. Support: FIALGO, Fundação Agrisus, and Fundação Goiás.

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Abstract

The Cerrado region is responsible for more than 90% of the total area of about 1.1 million hectares of cotton cultivated in Brazil. Farmers have been searching for options regarding sources, timing, and method of fertilizer application, aiming mainly at higher operational yields, higher efficiency of fertilizer use, and cost reduction. The objective of this study was to evaluate the efficiency of applying all or part of the cotton nitrogen (N) fertilizer to the preceding grass species (Brachiaria brizantha), using different nitrogen fertilizer sources. A field study was carried out in the state of Goiás, in 2006/2007 and 2007/2008 growing seasons. The experiment consisted of 13 treatments in a randomized complete block design with four replications, in a 3x4+1 factorial arrangement: three N fertilizer sources (urea, urea+Agrotain, and urea+polymer kimberlit), four methods of fertilizer application (100% pre-planting; 50% pre-planting + 50% topdressing; 100% one topdressing application; 100% two topdressing applications), and one control. A dose of 100 kg/ha N was applied. It was concluded that 50% preplant and 100% one topdress application both resulted in the same yields as with conventional fertilization using two topdress applications. The fertilizers urea+Agrotain and urea+polymer Kimberlit showed higher N-use efficiency compared to urea.

BIOSTIMULANT ACTIVITY OF TWO PROTEIN HYDROLYSATE IN PEROXIDASE AND ESTERASE ACTIVITY OF MAIZE SEEDLINGS

A. Ertani[1], A. Altissimo[2], C. Franceschi[3] and S. Nardi[1]

[1]Dipartimento di Biotecnologie Agrarie, Università degli Studi di Padova, 35020 Legnaro, Padova, Italy.
[2]Landlab studio associato, 36050 Quinto Vicentino, Vicenza, Italy.
[3]Ricerca e Sviluppo Ilsa, R&S Ilsa S.p.A., 36071 Arzignano, Vicenza, Italy.

VI Session: Specialty fertilizers

Abstract

Two protein-hydrolysate-based fertilizers (PHFs), one from legume (LH) and one from the mixture of Spirulina spp. and alfalfa (SA), were studied chemically and biologically. LH and SA showed a different chemical composition and different degree of hydrolysis. The biostimulant activity was investigated using two specific and sensitive bioassays of auxins (IAA) and gibberellins (GA). Extracts of LH and SA elicited an auxin and gibberellin-like activity. To improve our understanding on the biostimulant activity of PHFs, LH and SA were supplied to maize plants and their effect on growth, chlorophyll and sucrose content was studied. Besides, the effect of PHFs was tested on peroxidase and esterase activity, enzymes notoriously used as markers in growth, differentiation and organogenesis- related processes.

The biostimulant products increased leaf growth and induced morphological changes in root architecture similarly to growth factors. Therefore, it may be supposed that PHFs and IAA and GA can share the same properties. LH and SA positively affected peroxidase and esterase activities, suggesting their important role in the induction of growth and cell differentiation. Moreover, the addition of PHFs to plants increased chlorophyll content and decreased the level of sugars, indicating a positive influence of the PHFs on the photosynthetic process.

THE IMPACT OF CONTROLLED UPTAKE LONG TERM AMMONIUM NUTRITION ON WINTER RAPE

M. Kos, O. Kozlovský, J. Balík, J. Černý, M. Kulhánek

Department of Agroenvironmental Chemistry and Plant Nutrition; Faculty of Agrobiology, Food and Natural Resources; Czech University of Life Sciences Prague, Kamýcká 129, Praha – Suchdol - 165 21, Czech Republic, telephone: +420 723 754 352,
E-mail: kos@af.czu.cz

VI Session: Specialty Fertilizers

Abstract

The Controlled Uptake Long Term Ammonium Nutrition (CULTAN) means local placement of ammonium fertilizer into the soil. High NH_4^+ concentrations at fertilized spots inhibit nitrification and N mobility is thus reduced. In CULTAN method, we do not have to divide the whole nitrogen amount for the vegetation into smaller doses. The impact of this method was examined in small plot field experiments with winter rape (Artus). The experiments were established in 2006 at 3 different reaserch sites and consisted of 2 convetional (var.1, var. 3) and 2 CULTAN variants (var. 2, var. 4). In each variant, 200 kg N. ha^{-1} was applied and sulphur was added in variants 3 and 4. The whole amount of fertilizer was divided into 3 doses in the conventional variants. In CULTAN treatments, all fertilizer were placed into 5 cm depth using the injector aplicator, during winter rape vegetation phase EC 26. The yield of winter rape were always higher in conventional variants. Their average yields were 4.08 t. ha^{-1} (var. 1) and 4.34 t. ha^{-1} (var. 3). The average yields of CULTAN variants reached the rate 3.49 t. ha^{-1} (var. 2) and 3.81 t. ha^{-1} (var. 3). The addition of sulphur caused increases of yields in both system of fertilization.

THE EFFECT OF INJECTION AMMONIUM FERTILIZATION (CULTAN) ON WINTER WHEAT YIELD AND QUALITY OF GRAIN

O. Kozlovský, J. Balík, M. Kos, M. Kulhánek, J. Černý

Department of Agroenvironmental Chemistry and Plant Nutrition; Faculty of Agrobiology, Food and Natural Resources; Czech University of Life Sciences Prague, Kamýcká 129, Praha – Suchdol - 165 21, Czech Republic, Telephone +420 776 722 838,
E-mail: kozlovsky@af.czu.cz

VI Session: Specialty Fertilizers

Abstract

The system CULTAN (Controlled Uptake Long Term Ammonium Nutrition) is based on the injection of ammonium fertilizer into the soil. The effect of the system CULTAN on winter wheat yield and quality characteristics was studied in 2-year small plot field experiments, which were set up on four experimental sites with different climatic and soil conditions in the Czech Republic. The experiment was carried with control and CULTAN treatments in four replications. The total dose of 150 kg N. ha^{-1} was divided into three applications at the control treatment. For the CULTAN treatment, the whole nitrogen dose of 150 kg N. ha^{-1} (in Urea Ammonium Sulphate) was apllied in a single application in the wheat growing period of BBCH 29-30 in 5 cm depth into the soil using the injection applicator GFI 3A (f. Maschinen und Antriebstechnik GmbH Güstrow). The average yield of winter wheat was 9.56 t. ha^{-1} for the control treatment and 8.78 t. ha^{-1} for the CULTAN treatment in year 2007 and 9.91 t. ha^{-1} for the control treatment and 9.63 t. ha^{-1} for the CULTAN treatment in year 2008. Differences were not statistically significant in year 2008. Nitrogen and gluten content were significantly lower for the CULTAN treatment. The Falling number, Zeleny index and grain volume weigh reached similar rate in both treatments.

AUTOMATED SCREENING OF LEAF TREATED ZUCCHINI PLANTS TO ASSESS GROWTH AND ABIOTIC STRESS

A. Petrozza[1], N. Armentano[1], G. Lacertosa[1], G. Di Tommaso[2], A. Piaggesi[2], D. Di Tommaso[2], F. Cellini[1]

[1]Metapontum Agrobios, S.S. 106 Jonica, Km. 448,2 Metaponto (MT), Italy
[2]Valagro S.p.A., Atessa (CH), Italy

VI Session: Specialty Fertilizer

Abstract

Drought stress is a significant problem affecting agriculture production worldwide and it is predicted to have a larger impact in the future, as a consequence of climatic changes. Organic leaf spraying, contributing to nutritional effects, could be used also to enhance plant's tolerance under drought stress conditions. This activity seems related to the reduction of stomatal opening and to the increase of antioxidant compounds.

An experimental test was conducted to evaluate nutritional and inhibitor leaf transpiration effects of several organic compounds (Valagro S.p.A.) on zucchini plot plants, after a leaf treatment. Zucchini plants, in 120 plots, were grew in a greenhouse under drought stress conditions. Non-destructive measurements were conducted by using image capture and processing technologies (LemnaTec Scanalyzer 3D system).

Two of tested products seem to be able to reduce plant stress. In fact, in some cases, moisture content of treated plants was about 40% more than the untreated. Similar results were obtained in the nutritional status assessments, confirming growing effects and enhance stress tolerance.

NS 32-5 – NEW FERTILIZER CONTAINING NITROGEN AND SULPHUR. THE FIRST RESULTS OF APPLICATION

A.V. Shevtsov[1], T.V. Grebennikova[1], M.V. Genkin[1]

[1]URALCHEM MC, LLC, block "B", 10, Presnenskaya Naberezhnaya,
123317, Moscow, Russia,
E-mail: alexandr.shevtsov@uralchem.com, Tel: +7 495 7218989, Fax: +7 495 7218585

VI Session: Specialty Fertilizers

Abstract

NS 32-5 – new fertilizer consists of ammonium nitrate and double salt of ammonium nitrate and ammonium sulphate $(NH_4)_5(NO_3)_3(SO_4)$ and contains 32% of total nitrogen and 5% of sulphur as nutrients. NS 32-5 excels ammonium nitrate and its blend with ammonium sulphate in many properties as resistance to caking, hygroscopicity, resistance to detonation. The fertilizer was tested on different types of soils (in Great Britain, Poland, Russia and Lithuania) on different crops (rape seeds, wheat, grasslands, vegetables, rye, and barley). It was shown that use of NS 32-5 results in getting higher crop capacities, yields and quality of crops than those with ammonium nitrate, and solve the problems of sulphur deficiency in plants. Applying of NS32-5 improves soils biogenity factor comparing with applying the ammonium nitrate with the same nitrogen rate. Moreover it was found that use of NS 32-5 on soils with low and average phosphorous levels increases the plants' phosphorous uptake from soils and satiation of crops with this nutrient. All obtained data confirmed by chemical analyses and agronomical effectiveness tests.

FERTILIZATION OF RICE: ASSESSING POTENTIAL N MINERALIZATION OF DIFFERENT FERTILIZERS IN TWO ITALIAN SOILS

A. Trinchera[1], F. Baroccio[2], S. Mocali[1], A. Benedetti[1]

[1]Consiglio per la Ricerca e la sperimentazione in Agricoltura – Centro di ricerca per lo studio delle Relazioni tra Pianta e Suolo (CRA-RPS), Via della Navicella 2-4, 00184 Rome, Italy.
E-mail: alessandra.trinchera@entecra.it , tel. +39 06 77078141, fax +39 06 7005711
[2]Ispettorato centrale per il controllo della qualità dei prodotti agroalimentari (ICQ)
Via del Fornetto, 00144 Rome, Italy.

VI Session: Specialty Fertilizers

Abstract

Fertilisation of rice is usually conducted by applying N-fertilizers: however, the nitrogen supply to the crop is strongly affected by the field water-management, since the anaerobic conditions and the related soil microflora have significant effect on nitrogen mineralization. This work would investigate, by studying N potentially mineralisation in laboratory conditions, the influence of aerobic/anaerobic environment on nitrogen release from some selected fertilizers, often used in rice cultivation in Northern Italy.

The experimental trials were performed taking into account two soils from Northern Italy, Carmagnola soil (TO) and Castello D'Agogna soil (VC): the first one was under durum wheat-maize rotation, while the second one sustained rice cultivation. Different nitrogen fertilizers were added to the chosen soils and then putted under controlled aerobic (Stanford and Smith method, modified by Benedetti, 1996) and anaerobic conditions (Canali, 2005). Tested fertilizers were: calciumcyanamide; mineral-N fertilizer containing urea and condensed urea; organo-mineral fertilizer from leather meal origin; organic fertilizer from horn and nails. The mineralized N was detected on time and the release N-curves were built for each fertiliser.

Obtained results indicated that both the aerobic/anaerobic conditions and the intrinsic characteristics of added fertilizers were effective in released N-fractions, being different and not complementary the N pools mineralized in presence or absence of oxygen supply. Also the soil played a key-role, since the alternative crops and management (cereals rotation or rice monoculture) probably selected the active microflora able to sustain the mineralization process.

INFLUENCE OF BIOLOGICAL FERTILITY OF SOIL ON METHYLENUREA BIODEGRADATION

A. Trinchera[1], P. Nardi[1], A. Benedetti[1]

[1]Consiglio per la Ricerca e la sperimentazione in Agricoltura – Centro di ricerca per lo studio delle Relazioni tra Pianta e Suolo (CRA-RPS), Via della Navicella 2-4, 00184 Rome, Italy.
E-mail: alessandra.trinchera@entecra.it , tel. +39 06 77078141, fax +39 06 7005711
[2]Ispettorato centrale per il controllo della qualità dei prodotti agroalimentari (ICQ)
Via del Fornetto, 00144 Rome, Italy.

VI Session: Specialty Fertilizers

Abstract

In the last decades, a large number of new fertilizers defined "environmental friendly", able to guarantee a nitrogen slow-release trend to avoid the nitrate leaching in the waters (Marashs, 2001), appeared on the market. The methylen-ureas are sparingly soluble products which evolved during the 1960 to 1970. The degree of polymerization of these products depend largely on urea /formaldehyde ratio chosen during the condensation process.

The objectives of this paper were to study the behaviour of different methylen-urea in soil, in comparison with other nitrogen mineral fertilizers.

The study was carried out in laboratory, by adding n.2 methylen-urea fertilizers, having the same molecular average-size, but obtained by different polymeric reactions, in comparison with urea and ammonium sulphate, to n.3 different soils, characterized by different biological fertility (on the basis of soil CO_2 evolution, C-microbial biomass and total organic matter contents, metabolic and mineralization quotients, etc.). The N-release fractions were determined according to different methodologies: (i) quartz send column leaching, (ii) EN 13286 sequential extraction and (iii) by biochemical leaching method (Stanford and Smith method, modified by Benedetti, 1983).

Obtained results showed the strong influence of soil biological fertility on nitrogen release: in the high fertility soil, during the first weeks of the experiment, the amount of nitrogen released by the methylen-urea fertilizers was significantly higher than that released in the median and low fertility soils, also in relation to the different typology of tested methylenurea. This information could be usefully utilized to make the best fertilizer choice when we need to reduce N leaching in soil, particularly active in microbial degrading of organic matter.

VII SESSION

Advances in fertilizer characterization and legislation – Miscellaneous

(Chairman: Prof. G. Hofman, Prof. C. Ciavatta)

Oral Presentations

COMPOSTING OF RABBIT BREEDING AND SLAUGHTERING BY-PRODUCTS: EXPERIMENTAL TESTS AND DEIGN CRITERIA FOR A TURNING OVER AND AERATING MACHINE

B. Bianchi[1], G. Debiase[2], D. Ferri[2], A. Tamborrino[1], D. Tarantino[1]

[1]Università di Bari, Dip. PROGESA, Sez. Meccanica, 70126 Bari, Italy.
[2]CRA-Research Unit for Cropping Systems in Dry Environments, 70125 Bari, Italy.
E-mail: biagio.bianchi@agr.uniba.it

VII Session: Advances in fertilizer characterization and legislation - Miscellaneous

Abstract

Rabbit manure and slaughtering by-products (treated in autoclave at 133 °C and 3 bar, per 20 min) have been used in a composting process. Three heaps of 4700 kg each have been investigated and experimental tests were carried out in an industrial horizontal axe reactor: 1) rabbit manure + rabbit slaughtering by-products + straw (C/N = 19); 2) rabbit manure + rabbit slaughtering by-products + straw (C/N = 17); 3) rabbit manure + rabbit slaughtering by-products (C/N = 15). The composting piles were turned by means of a protoype of turning machine. Temperatures profiles were obtained: air temperatures and temperatures at various points of the biomass. At the beginning, intermediate stage and the end of the composting process (each 10-15 days) the biomass was sampled and some physical-chemical characteristics and the humic parameters have been evaluated. The composting time lasted 85 days.

For each examined heap, we examined the progression of fermentation process, so also the plant limitations that did not allow a correct composting process.

The results allow for the identification of physical, mechanical and technical parameters. These are useful for the development of appropriate mixtures machines and plants assuring continuance and reliability in the transformation of the biomass coming from rabbit industry. Thereby, producing compost which conforms to the law.

NITROGEN TRANSFORMATION IN MULTY-LAYER SOIL COLUMNS TREATED WITH AN UREASE INHIBITOR

C. Giovannini[1], C. Ciavatta[1], S. Secco[2], C. Marzadori[1]

[1]Department of Agro-Environmental Science and Technology, Alma Mater Studiorum University of Bologna, Viale Fanin 40, Bologna, Italy,
E-mail: camilla.giovannini4@unibo.it, telephone: 39-0512096212, fax: 39-0512096203
[2]Timac-Agro Italia, S.P. 13 Loc. Cà Nova, Ripalta Arpina (CR), Italy,
E-mail: ssecco@timacagro.it , telephone: 39-0373669271, Fax: 39-0373669291

VII Session: Advances in fertilizer characterization and legislation - Miscellaneous

Abstract

Up to date, in agriculture, the urease inhibitors had been added to the soil incorporated in fertilizers containing either urea and the inhibitors, and the inhibitor concentration was calculated as a percentage on the urea weight.

The possibility to use urease inhibitor physically separated from urea-based fertilizers could afford more flexibility in its use. Particularly, the granulated inhibitor, could be utilized in soils treated with different urea based fertilizers, including livestock urine, and in an amount variable as function of soil characteristics and/or urea source (e.g mineral fertilizer, organo-mineral fertilizer or animal slurry).

In this study, multi-layer soil columns were used to study the effect of an experimental granular product (RV) containing an urease inhibitor (NBPT) and a extract of vegetable origin, with the capacity to protect NBPT by oxidation, on: (a) spatial variability of soil urease activity; (b) accumulation of residual urea and mineral-N forms (NO_2^-, NO_3^-, NH_4^+) after urea soil addition.

The results have clearly demonstrated that RV had influenced the soil urease activity along the soil columns profile and the inhibition power of RV was dependent on time and soil layer depht. RV had, furthemore, delayed urea hydrolysis and reduced the soil accumulation of ammonia and nitrite ions.

AVAILABILITY OF SELENATE AND SELENITE ADDITIONS IN PEAT SOIL

R. Keskinen, M. Yli-Halla* and L. Pulli

Department of Applied Chemistry and Microbiology, P.O. Box 27, FIN-00014 University of Helsinki, Finland, *Corresponding author: markku.yli-halla@helsinki.fi

VII Session: Advances in fertilizer characterization and legislation - Miscellaneous

Abstract

Prevailing hypotheses about the behaviour of added selenium (Se) in organic soils are conflicting.

On one hand, Se fertilization has been more effective in organic than in mineral soils, presumably due to the lower Se adsorbing oxide content in organic soils. On the other hand, organic soils have shown to fix Se. We examined the effects of these phenomena on Se bioavailability in a pot experiment by manipulating the oxide content of a poorly humified peat low in metal oxides. Iron oxide, $Fe(OH)_3$, was precipitated directly into the soil matrix from $FeCl_3$ by adding $Ca(OH)_2$. Se was added both as selenate (SeVI) and selenite (SeIV), after which Italian ryegrass (*Lolium multiflorum* L. cv. Meroa) was grown for six weeks. The leaf mass was harvested twice.

In the leaves harvested both from untreated and iron oxide enriched pots, 30-40% of added selenate was recovered. At the end of the experiment, the remaining, on average 60% was extractable from the soil with a salt solution. Thus, no irreversible retention was observed. On the contrary, less than 1% of the selenite addition was recovered in the leaves grown in untreated peat. The iron oxide addition increased the leaf Se content of selenite treated pots fivefold. Less than 10% of added selenite was extracted from both untreated and oxide enriched peat with salt and phosphate-buffer solutions. However, an ample addition of $Fe(OH)_3$ contributed a more reversible adsorption of selenite, phosphate buffer solubilizing over 70% of the added selenite.

The results indicate that selenate is easily taken up by plants, is not adsorbed neither on oxide surfaces or organic matter and is not readily reduced into selenite in an organic soil. Instead, selenite seems to be fixed efficiently into organic substances.

PRECIPITATION AND MINERAL FERTILIZATION EFFECTS ON POTATO (*Solanum tuberosum* L.) YIELD AND QUALITY

L. Marton

Research Institute for Soil Science and Agricultural Chemistry of the Hungarian Academy of Sciences, Herman O. u. 15., Budapest, Hungary,
E-mail: marton@rissac.hu, 0036-1-3558491

VII Session: Advances in fertilizer characterization and legislation – Miscellaneous

Abstract

Rainfall quantity, distribution and nitrogen (N)-, phosphorus (P_2O_5)-, potassium (K_2O)-, and magnesium (MgO) mineral fertilization effects were studied on a sandy acidic lessivated brown forest soil; WRB: Haplic Luvisol in the 47 year old Nyírlugos Field Trial (NYFT) in a Hungarian fragile agro-ecosystem in Nyírség region (N: 47^0 41' 60'' and E: 22^0 2' 80'') on potato (*Solanum tuberosum* L.) yield from 1962 to 1979. The experimental years were characterised by frequent extremes of climate under vegetation seasons. Drought and over rainfall negative effects were decreased by increasing N- treatments with combinations of potassium, phosphorous and magnesium from 13% to 32%. With the help of regression analysis it was found the polynomial correlation between rainfall quantity and yield could be observed in the case of NK ($Y' = 381.65 - 2.95x + 0.0056x^2$, $n = 72$, $R^2 = 0.95$), NPK ($Y' = 390.87 - 3.07x + 0.0060x^2$, $n = 72$, $R^2 = 0.96$) and NPKMg ($Y' = 390.45 - 3.06x + 0.0059x^2$, $n = 72$, $R^2 = 0.96$) nutrition systems. The optimum yield ranges between 17 - 20 t ha^{-1} at 280 - 330 mm of precipitation. Starch and crude protein contains of tubers were decreased of 22% and 18 % under a rany (556 mm rainfall $year^{-1}$ in 1979) climate conditions in compared with an average (452 mm rainfall $year^{-1}$ in 1969) year type on average of experimental (control:-18.9 and -10.8%, N:-21.0 and -15.4%, NP:-17.9 and -15.8%, NK:-24.6 and -16.8%, NPK:-23.9 and -21.6%, NPKMg:-23.4 and -24.0%) treatments. And in 1969 minimum (control) and maximum (NPKMg combination) starch yield was 1.9 t ha^{-1} and 3.3 t ha^{-1}, 0.5 t ha^{-1} and 1.8 t ha^{-1} in 1979. Crude protein minimum (control) and maximum (NPKMg combination) yield was 0.22 t ha^{-1} and 0.47 t ha^{-1} in 1969, 0.07 t ha^{-1} and 0.24 t ha^{-1} in 1979. From 1962 to 1979 the weather was highly variable with particularly frequent droughts and over rainfall effects resulting maximum losse in yield of 42%, in starch of 22% and in protein of 18% under this period. Thus it is important to analyse the consequences of possible future climate change on these crop in Hungary.

OCCURRENCE OF TRACE ELEMENTS IN MINERAL FERTILIZERS

J. Petersen[1] and L.F. Østergaard[2]

[1]Department of Agroecology and Environment, Faculty of Agricultural Sciences, University of Aarhus. E-mail: jens.petersen@agrsci.dk
[2]The Danish Plant Directorate, Ministry of Food, Agriculture and Fisheries. Present address: Haldor Topsoe.

VII Session: Advances in fertilizer characterization and legislation - Miscellaneous

Abstract

There is a current debate in the EU on setting common thresholds for extraneous elements in mineral fertilizer, often denoted heavy metals, which is misleading and inaccurate. The elements As, Cd, Co, Cr, Cu, F, Hg, Mo, Ni, Pb, Se, Th, Tl, U, V and Zn were analysed in 145 mineral fertilizers marketed in Denmark. The samples represent straight and complex phosphorus fertilizers (P, 9; NP, 9; PK, 33; NPK, 27), sulphur-containing nitrogen fertilizer (39), straight potassium fertilizer (23) and multi-micronutrient fertilizers (5).

The concentration of extraneous elements varies significantly, but most of the variation is linearly related to the P-concentration. Several P-containing fertilizers had a content of Cd that exceeds the Danish threshold of 110 mg Cd/kg P, where as some of the NPK and NP-fertilizer had a Cd-concentration below the detection limit.

Several NPK-fertilizers exceeded the proposed EU threshold of 120 mg Ni/kg, and straight P-fertilizers had high concentration of Cr, non-declared Cu, non-declared Zn, F, V og U. In contrast the concentration of As, Hg and Pb were well below the proposed EU threshold. It seems likely that extraneous elements were not related to any of the fertilizer components N, K or S. The results of this study may be taken into account in future control programmes.

NUTRIENT LEGISLATION IN FLANDERS (BELGIUM)

J. Salomez, S. De Bolle, S. Sleutel, S. De Neve, G. Hofman*

Faculty of Bioscience Engineering, Ghent University, Coupure 653, B-9000 Gent, Belgium
*Corresponding author: Georges.hofman@UGent.be

VII Session: Advances in fertilizer characterization and legislation - Miscellaneous

Abstract

The implementation of the Nitrates Directive has led to the set up of nutrient legislation and policy in all EU countries. As Belgium is a federal state, the legislation and policy in Flanders is completely different from the south of the country, i.e. Wallonia. The legislation has been introduced already in 1991 and after several changes and adaptations, a new Manure Decree has been adopted the 22th of December 2006. The most important measures to reduce nitrate losses (and to a certain extent also P-losses) will be discussed in the paper. They include:
Application standards for N and P_2O_5;
Periods of allowed application;
Methods of application of animal manures;
Storage capacity of animal manures;
Calculation of N and P production on farms;
Calculation of N and P surpluses on a farm basis;
Nutrient emissions rights;
Levies, etc.
The strong and weak points of the legislation will be discussed with some references to the legislation and policy in other EU countries.

POTENCIOMETRIC TRITATION FOR THE IDENTIFICATION OF MORE REACTIVE FUNCTIONAL GROUPS IN ORGANIC AND ORGANOMINERAL LIQUID FERTILIZERS

D. Xanchão Dominguez[1], L.C. de Santa Maria[2], V. de Melo Benites[3], B. Szpoganicz[4]

[1] MSc in Environmental Chemistry - UERJ, Brazil, E-mail: dxanchao@hotmail.com
[2] UERJ, Chemistry Institute, 20550-900, Rio de Janeiro, Brazil
[3] EMBRAPA, 22460-000, Rio de Janeiro, Brazil
[4]UFSC, Chemistry department, 88040-900, Florianópolis, Brazil

VII Session: Advances in fertilizer characterization and legislation - Miscellaneous

Abstract

In this work, six liquid samples of organic and organomineral fertilizers, commercialized in Brazil, have been selected being those of three materials of different origin: peat, leonardyte and hydrolysated organic residues derived from the food industry. Speciation of more reactive functional groups, present in the organic compounds, was made with potentiometric titration. This technique allows to identify different functional groups from pKa's values and to determine their contents in function of the quantity of titrant absorbed. It is possible determine the presence of phenol, cathecol, phthalic acids and carboxylic acids in the samples through the pKa´s referential values (Martell *et al.*, 2004). The results of total acidity presented a wide range among the samples. It was observed that samples of the same material of origin had similar pKa´s. The presence of carboxylic acidity was predominant in the fertilizer samples. This characteristic is important since carboxylic groups are more active in tropical soils (Stevenson, 1994).

Poster Presentations

LC/PDA/MS DETECTION OF PLANT HORMONES IN FERTLIZERS

G.L. Gambino, P. Pagano, M. Scordino, L. Sabatino, P. Traulo, G. Gagliano

Ministero delle Politiche Agricole Alimentari e Forestali, Ispettorato Centrale per il Controllo della Qualità dei Prodotti Agroalimentari, Laboratorio di Catania, Via A. Volta 19, 95122 Catania, Italy
E-mail: gl.gambino@politicheagricole.gov.it, Tel: +39 095 480411 (int. 250), Fax: +39 095 365066

VII Session: Advances in fertilizer characterization and legislation - Miscellaneous

Abstract

The Italian Legislative Decree 217/2006 concerning "New regulation about fertilizers", originates from European Regulation 2003/2003/EC, deals with fertilizer official control and market. An innovation of this decree consists in the introduction of fertilizer products updating with "Biostimulants", specifying that the stimulant effect is limited to the presence of natural compounds derived from algae, humic substances, amino acids, etc. These substances should improve the nutrients absorption and promote and stimulate the plant growth. Therefore it determines the new necessity to need analytical methods able to verify both the absence of added synthetic hormones and the effective biostimulant activity.

The present work describes a simple, reliable and routinely suitable LC/PDA/MS analytical method for the simultaneous detection, confirmation and quantification of several native and synthetic plant hormones (PGRs) in fertilizers such as: (4-indol-3-yl)butyric acid (IBA), 1-naphthaleneacetamide (NAD), α-naphthaleneacetic acid (NAA), β-naphthoxyacetic acid (β-NOA), 4-chlorophenoxyacetic acid (4-CPA), (4-chloro-2-methylphenoxy)acetic acid (MCPA), 2,4 dichlorophenoxyacetic acid (2,4-D), 4-(2,4-dichlorophenoxy)butyric acid (2,4-DB), indole-3-acetic acid (IAA), 1-naphthol, 1-phenyl-3-(1,2,3-thiadiazol-5-yl)urea (Thidiazuron), 2-(2,4-dichlorophenoxy)propionic acid (Dichloroprop).(1).

THE OFFICIAL CONTROL OF FERTILIZERS OBTAINED FROM BIOSOLIDS: CRITICAL POINTS AND POSSIBLE SOLUTIONS

A.F. Ragone [1], R. Francalanci [2], A. Iaderosa [1], B. Carli [3]

[1]Ispettorato Centrale per il Controllo della Qualità dei Prodotti Agroalimentari Ufficio di Firenze sede di PISA, Galleria Gerace 17, 56124 PISA Italy
E-mail: icq.pisa@politicheagricole.gov.it, tel. +39050 315671 fax +39050 560006
[2]Agenzia Regionale Protezione Ambientale Toscana, Via Porpora 22 Firenze, Italy,
E-mail: r.francalanci@arpat.toscana.it, tel. +39055 32061 fax +39055 3206324
[3]Agenzia Regionale Protezione Ambientale Toscana Via Veneto 20, Pisa , Italy,
E-mail: b.carli@arpat.toscana.it, tel. +39050 835660 fax +39050

VII Session: Advances in fertilizer characterization and legislation - Miscellaneous

Abstract

"Ispettorato Centrale per il Controllo della Qualità dei Prodotti Agroalimentari"(ICQ) is the technical body of the Italian Ministry of Agriculture and Forestry whose role is the control of the quality of fertilizers produced and commercialised in Italy.
The objective of this work is to analyse the main difficulties faced by ICQ in its control activity of fertilizers production from biosolids (urban and industrial origin).
These are the main critical points emerged by this work:
1) The difficulty to legally classify a fertilizer obtained from a biosolid when the parameters result irregular after analysis. Does it have to be considered as an ordinary fertilizer or again as a biosolid, not completely transformed, and therefore illegally drained?
2) The discontinuity of the Regulations on wastes (D. Lg.vo 152/06) and on fertilizers (D. Lgs.vo 217/06).
3) The different competences attributed to different supervisory bodies on biosolids (ARPA) and on Fertilizers (ICQ) cause a gap between the technical personnel of the two different organisations.
In order to overcome those difficulties, it could be helpful to re-organise the official controls under a new scheme already experimented in Tuscany from several years, of which we are going to discuss in this work.

COMPARISON OF XANTHYDROL AND HPLC METHOD FOR DETERMINATION OF UREA IN SOLID MINERAL FERTILIZERS

M. Scarangella[1], N. Barilaro[2], G. Filabozzi[2], G. Gagliano[1]

[1]Ministero delle Politiche Agricole Alimentari e Forestali, Ispettorato Centrale per il Controllo della Qualità dei Prodotti Agroalimentari, Laboratorio di Catania, Via A. Volta 19, 95122 Catania, Italy
E-mail: m.scarangella@politicheagricole.gov.it , Tel: +39095480411 (int.252), Fax: +39095365066
[2]Ministero delle Politiche Agricole Alimentari e Forestali, Ispettorato Centrale per il Controllo della Qualità dei Prodotti Agroalimentari, Laboratorio di Roma, Via del Fornetto 85, 00149 Roma, Italy
E-mail: n.barilaro@politicheagricole.gov.it, Tel: +390655341650, Fax: +390655341691

VII Session: Advances in fertilizer characterization and legislation - Miscellaneous

Abstract

This work reports a comparison between gravimetric xanthydrol and liquid chromatographic method for the analysis of urea in solid mineral fertilizers. The official method of analysis reported on European Regulation 2003/2003/EC is based on precipitation of urea with xanthydrol in acetic acid solution, filtration and weighting of the dixanthylurea precipitate. This method is not applicable to fertilizers containing cyanamide or the condensation products of urea and aldehydes. Instead the HPLC method was suitable for urea determination in all samples examined. Samples fertilizer were extracted in aqueous medium and diluted in acetonitrile:water solution (50:50 v/v). An amine chromatographic column was used to separate urea from condensation products. The quantification of the analita was carried out with an external urea standard calibration using UV detection at 195 nm. A single laboratory validation of the HPLC method was performed in terms of specificity/selectivity, limit of detection (0.22 %N w/w), limit of quantification (0.86 %N w/w), linearity and working range (2-46 %N w/w), recovery (>99 %N w/w), accuracy and measurement uncertainty. In addition, the maximum likelihood estimation (MLE) has evidenced that do not exist significant differences between the two methods in terms of mutual accuracy. Therefore, this method constitutes a valid alternative to the official method of analysis for the determination of urea in solid mineral fertilizer products.

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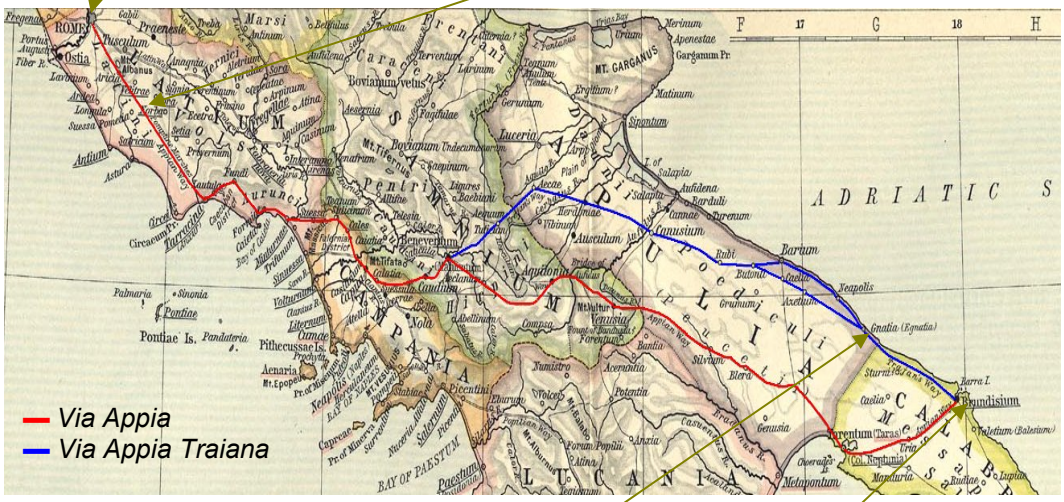

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