



International Symposium on Growing Media, Composting and Substrate Analysis

17-21 October, 2011 - Barcelona

Book of Abstracts

F. Xavier Martínez Farré

Convener

ISHS International Symposium on
Growing Media, Composting and
Substrate Analysis



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International Symposium on Growing Media, Composting and Substrate Analysis

17-21 October 2011

Convener: F. Xavier Martínez

Held at:

**Escola Tècnica Superior d'Enginyeria
Industrial de Barcelona (ETSEIB)
UPC - Barcelona Tech
Diagonal 647
08028 Barcelona**

Book of abstracts of oral presentations and posters

Under the auspices of:

**International Society for Horticultural Science
International Peat Society**

ISBN: 978-84-694-9997-9

Hosted by:

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11:00-11:30	Coffee Break	Coffee Break		Coffee Break	Coffee Break
11:30-12:30	Oral S1	Poster viewing S1-4		Oral S5	Working Groups Meeting
12:30-13:00		Oral S3			Closing Session
13:00-14:30	Lunch	Lunch	Technical Visit	Lunch	Lunch
14:30-15:00				Special Conference	
15:00-16:00	Oral S2	Oral S4		Poster viewing S5-6	
16:00-16:30	Coffee Break	Coffee Break		Coffee Break	
16:30-17:00					
17:00-18:00	Oral S2	Oral S4			
19:00-20:00				Official Reception (City Hall)	
20:00-23:00				Symposium dinner	

Programme

Monday, 17 October

08:00 – 09:30 Registration and poster hanging

OPENING SESSION

09:30-10:15 Welcome Ceremony

10:15-11:00 **Opening lecture:** Challenges of composting for growing media purposes in Spain and Mediterranean area. Raúl Moral*, Concepcion Paredes, Maria Angeles Bustamante, Maria Dolores Perez-Murcia, Aurelia Perez-Espinosa (Spain)

11:00-11:30 *Coffee Break*

Session 1: ADVANCES IN ANALYTICAL TECHNIQUES FOR GROWING MEDIA AND COMPOSTING

11:30-12:00 **Invited paper.** European standardization of growing media - A critical review
Andreas Baumgarten (Austria)

Oral presentations

12:00-12:15 pH in rockwool propagation blocks: a method to measure the pH buffer capacity of rockwool and other mineral rooting media. Blok, Chris*; Kaarsemaker, Ruud (The Netherlands)

12:15-12:30 E-values of common greenhouse root substrate components. Evans, Michael R.*; Cavins, Todd; Zanin, Paolo (USA; Italy)

12:30-12:45 Colour of peat as an indicator of chemical, biological and physical properties of peats. Prasad, Munoo* (Ireland)

12:45-13:00 Spanish legislation on growing media. Pérez Minguijón, Mariano; Rodríguez Sendón, Bibiana María* (Spain)

13:00-14:30 *Lunch*

Session 2: NOVELTIES IN MATERIALS, USES AND PROPERTIES OF GROWING MEDIA

14:30-15:00 **Invited paper.** *A view beyond traditional growing media uses.* Silvia Burés (Spain)

Oral presentations

15:00-15:15 Spatial arrangements and physical properties of granular mineral materials and composted green waste in green roof growing media. Graceson, Abigail*; Hall, Nigel; Hare, Martin; Monaghan, Jim (United Kingdom)

15:15-15:30 A pragmatic approach to wettability and hydration of horticultural substrates. Fonteno, William*; Cassel, Keith (USA)

15:30-15:45 Water irrigation regimes and their consequences on root development and physical properties evolution in peat growing media. Michel, Jean-Charles*; Kerloch, Eric; Bozon, Emmanuel; Cannavo, Patrice (France)

15:45-16:00 Effect of physical characteristics of coir on the productivity of greenhouse tomatoes. Duggan-Jones, Damian; Nichols, Mike A.* (New Zealand)

16:00-16:30 *Coffee Break*

16:30-16:45 Producing a horticultural growing media peat replacement/additive through retention of plant structure in composted food-processing waste. Bragg, Neil*; Moates, Graham; Wilson, David; Waldron, Keith (Ireland; United Kingdom)

- 16:45-17:00 Storage properties of bark-based peat-free growing media containing PAS 100 green compost. Coules, Anne*; Carlile, Bill; Ni Chualain, Dearbhail (United Kingdom; Ireland)
- 17:00-17:15 Clays as amendments for improving the rewettability of peat-based growing media: Optimization of clay application by determination of surface coverage degree expressed as the C/Si-ratio and rewettability. Dultz, Stefan*; Below, Malte; Walsch, Jochen; Schmidt, Eva; Schellhorn, Matthias; Schmilewski, Gerald (Germany)
- 17:15-17:30 Contributions to nutrients and liming materials in growing media from addition of recycled materials. Carlile, Bill*; Ni Chualain, Dearbhail; Hynes, Colman; O'Haire, Ray; Doyle, Owen (Ireland)
- 17:30-17:45 Wood substrates in United States horticultural crop production: Development and use. Jackson, Brian*; Fonteno, William; Bilderback, Ted; Kraus, Helen (USA)
- 17:45-18:00 A preliminary study of the effect of biochar from maple (*Acer*, spp.), on root growth of selected agronomic crops. Borsari, Bruno* (USA)

Tuesday, 18 October

Session 3: NEW DEVELOPMENTS IN COMPOSTING AND COMPOST PRODUCTS

- 09:00-09:30 **Invited paper.** SWOT Analysis of compost as growing media component. Michael Raviv (Israel)

Oral presentations

- 09:30-09:45 CompoBall: Novel on-line composting monitoring system. Casas, Óscar*; López, Marga; Quílez, Marcos; Huerta-Pujol, Óscar; Martínez-Farre, F. Xavier (Spain)
- 09:45-10:00 Comparing organic fraction changes of one composting and two vermicomposting processes aimed to produce quality compost and vermicomposts for soilless cultivation. Belda, Rosa M.*; Mendoza-Hernández, Daicy; García-de-la-Fuente, Rosana; Abad, Manuel; Fornes, Fernando (Spain)
- 10:00-10:15 Composting of posidonia, solid fraction of olive mill wastewater and chicken manure. Khanfir Ben Jenana, A. Raoudha*; Haouala, B. Rabiaa (Tunisia)
- 10:15-10:30 Composting of *Acacia longifolia* and *Acacia melanoxylon* invasive species. Brito, Luis Miguel*; Saldanha, Joana; Mourão, Isabel; Nestler, Hartmut (Portugal)
- 10:30-10:45 Evaluation of physicochemical, biochemical and phytotoxicity of tunisian mature agricultural wastes composts. Kammoun Rigane, Manel; Michel, Jean-Charles*; Medhioub, Khaled; Morel, Philippe (France; Tunisia)
- 10:45-11:00 Physicochemical properties of food waste compost and its use as a component of growing media. Ansorena, Javier*; Batalla, Eugenio; Merino, Domingo; Moreno, Amaia (Spain)

11:00-11:30 *Coffee break*

11:30-12:30 **POSTER VIEWING SESSION. Subjects related to sessions 1, 2, 3 and 4**

Session 3: NEW DEVELOPMENTS IN COMPOSTING AND COMPOST PRODUCTS (Cont.)

- 12:30-12:45 Characterization of compost produced from separated pig manure and a variety of bulking agents at low initial C/N ratios. Nolan, Tereza; Troy, Shane*; Healy, Mark G.; Lawlor, Peadar (Ireland)
- 12:45-13:00 Use of green compost as the basis of peat free growing media. Rainbow, Arnie* (United Kingdom)
- 13:00-13:15 Origin of compost salinity and its constraints for compost uses. López, Marga*; Huerta-Pujol, Oscar; Gallart, Montserrat; Martínez, F. Xavier; Soliva, Montserrat (Spain)

13:15-14:30 *Lunch*

Session 4: WATER AND NUTRITION MANAGEMENT IN SOILLESS CULTURE

- 14:30-15:00 **Invited paper.** State of the art and new trends of soilless culture in Spain and in emerging countries. Miguel Urrestarazu (Spain)

Oral presentations

- 15:00-15:15 Compost tea from vegetable crops used in fertilization of lettuce (*Lactuca sativa*, L.). Marín, Francisco*; Diáñez, Fernando J.; Santos, Mila; Carretero, Francisco; Yau, José A. (Spain)
- 15:15-15:30 Improving gardeners' understanding of water management in peat and peat-free multi-purpose growing media: An assessment with fuchsia. Alexander, Paul*; Nevison, Ian; Williams, Roger (United Kingdom)
- 15:30-15:45 Oxygen diffusion in relation to physical characteristics of growing media. Verhagen, Hans* (The Netherlands)
- 15:45-16:00 Fertilizer and water use efficiency: Effect of container size and growing media in a *Gerbera jamesonii* cut flower crop. Lorenzo, Gabriel*; Mascari, Libertad; Svartz, Héctor; Pesenti, Sabrina; Amado, Silvia (Argentina)
- 16:00-16:30 *Coffee break*
- 16:30-16:45 Improved productivity by split root fertigation in greenhouse-grown cucumber. Jokinen, Kari; Särkkä, Liisa; Näkkilä, Juha*; Tahvonen, Risto (Finland)
- 16:45-17:00 Boron in rockwool grown sweet pepper. Voogt, Wim* (The Netherlands)
- 17:00-17:15 Manganese contained in substrate-clays - Harmful for plants? Binner, Inga*; Schenk, Manfred K. (Germany)
- 17:15-17:30 The use of the inhibitor of the nitrification 3,4-dimethylpirazol phosphate (DMPP) on the growing of rose plants cultivated in coconut fiber and soil. García-Castro, Alexandra; Restrepo-Díaz, Hermann*; Florez, Víctor; Ramírez-Godoy, Augusto (Colombia)
- 17:30-17:45 Water disinfectants such as chlorine and ozone interact with plant nutrient solutions in soilless culture. Fisher, Paul R.*; Huang, Jinsheng; Meador, Dustin P.; Mohammad-Pour, Gavin (USA)

Wednesday, 19 October

Technical visit

- 07:45-08:00 Departure from the venue
- 08:00-08:45 Coach trip
- 08:45-10:00 Visit "Sala-Graupera" nursery
- 10:00-10:30 Coffee break
- 10:30-11:30 Coach trip
- 11:30-13:00 Visit "Agromillora" nursery
- 13:00-13:30 Coach trip to the restaurant
- 13:30-15:30 Lunch
- 15:30-16:15 Coach trip
- 16:15-17:45 Visit "Burés S.A.U." composting and growing media factory
- 17:45-18:00 Trip to Campus Baix Llobregat (UPC) – Reception by the Hosting Institutions

- 18:00-18:30 Reception and Welcome by the Hosting Institutions. Escola Superior d'Agricultura de Barcelona and Departament d'Enginyeria Agroalimentària i Biotecnologia. Castelldefels (Barcelona)
- 18:30-19:00 Guided Tour around the Campus
- 19:00-22:00 *Paella* Tasting
- 22:00 Bus Departure to Barcelona

Thursday, 20 October

Session 5: HORTICULTURAL PRODUCTION: SUSTAINABLE USES OF GROWING MEDIA AND COMPOST

- 09:00-09:30 **Invited paper.** Towards sustainability in growing media production and use. Bill Carlile (Ireland)

Oral presentations

- 09:30-09:45 Environmental and agronomic evaluation of containerized substrates developed from sewage sludge compost for ornamental plant production. Vecchietti, Lorenzo; de Lucia, Barbara; Russo, Gianni; Rea, Elvira; Leone, Antonio (Italy)
- 09:45-10:00 Ground cork as a top coat substrate material for seed germination. Evans, Michael R.*; Bozzolo, Arianna (USA)
- 10:00-10:15 Castor bean fruit husks as substrate for palm seedlings. Mendes Jasmim, Janie*; Ferreira dos Santos Jr, Carlos Eduardo; Guilherme Eugênio, Machado Lopes; Duarte Vieira, Henrique (Brazil)
- 10:15-10:30 Use of organic amendment as substrate in table grape *Thompson seedless*: effect on root system and soil indicators. Martínez, M.M.; Janssens, M.; Angulo, J.*; Ortega, R. (Germany, Chile)
- 10:30-10:45 The effect of vermicompost on the growth of vegetables. Alsina, Ina*; Dubova, Laila; Steinberga, Vilhelmine; Zarins, Daumants (Latvia)
- 10:45-11:00 Use of ground bamboo as a replacement for pine bark in nursery substrates. Altland, James* (USA)
- 11:00-11:30 *Coffee break*
- 11:30-11:45 Suitability of different composts for container production of ornamental shrubs. Domínguez, Gloria; Reñaga, Laura; Gallart, Montserrat*; López, Marga; Huerta-Pujol, Oscar; Soliva, Montserrat; Martínez, F. Xavier-Farré (Spain)
- 11:45-12:00 Effect of zeolite and vine vinasse on rose seedling growth. Trinchera, Alessandra*; Rinaldi, Simona; Epifani, Rosanna; Rea, Elvira (Italy)
- 12:00-12:15 Effect of composts on growth, production and fruit quality of tomato crop. Khanfir Ben Jenana*, A. Raoudha; Haouala, B. Rabiaa (Tunisia)
- 12:15-12:30 Effect of vermicompost, *Azotobacter* and biophosphate on growth, nutrient uptake and essential oil content of dragonhead (*Dracocephalum moldavica* L.). Mafakheri, Sudabeh*; Omidbaigi, Reza; Sefidkon, Fatemeh; Rejali, Farhad (Iran)
- 12:30-12:45 Substrate quality, irrigation management and the production of high performance plants in greenhouse. Nemati, M. Reza*; Fortin, Jean-Pierre; Massé, Joëlle (Canada)
- 12:45-13:00 Success of rehabilitation trials in a bog peatland in Quebec. Marchand-Roy, Mylène; Fortin, Jean-Pierre*; Nemati, M. Reza (Canada)

- 13:00-14:30 *Lunch*

- 14:30-15:00 **Special conference.** Strategies for sustainability in nursery production. Ted. E. Bilderback*, Elizabeth D. Bridges, Brian E. Jackson, Helen T. Kraus, William C. Fonteno and James S. Owen Jr. (USA)

- 15:00-16:30 **POSTER VIEWING SESSION. Subjects related to sessions 5 and 6**

- 16:30-17:00 *Coffee break*

- 19:00-20:00 Official Reception

- 20:00-23:00 **Symposium dinner**

Asador de Aranda. Avda. Tibidabo 31. 08022 Barcelona

Friday, 21 October

Session 6: BIOLOGICAL INTERACTIONS AND PLANT PROTECTION

- 09:00-09:30 Invited paper: Recent advances in microbial aspects of compost production and use. Joaquin Moreno (Spain)

Oral presentations

- 09:30-09:45 Capacity of composts made from agriculture industry residues to suppress different plant diseases. Borrero, Celia*; Castillo, Silvia; Castaño, Raúl; Segarra, Guillem; Casanova, Eva; Trillas, M^a Isabel; Avilés, Manuel (Spain)
- 09:45-10:00 Controlling *Rhizoctonia solani* in cucumber using compost of agro-industrial wastes. Reis, Mário*; Coelho, Luisa (Portugal)
- 10:00-10:15 Efficacy of the microbial control agent *Trichoderma asperellum*, strain T34 amended with different growing media, against soil and leaf plant pathogens. Segarra, Guillem*; Casanova, Eva; Noguera, Rosa; Castillo, Silvia; Borrero, Celia; Sant, Dolores; Avilés, Manuel; Trillas, M^a Isabel (Spain)
- 10:15-10:30 Effect of algal inoculum on growth of pot plants. Riahi, Hossein*; Shariatmadary, Zeinab; Khangir, Maryam (Iran)
- 10:30-10:45 The effect of the foliar application of surround WP® on the population of arthropods and growing of the rose plant established in rice husk. Sotelo-Cuitiva, Yuly Marcela; Restrepo-Díaz, Hermann*; Ramírez-Godoy, Augusto (Colombia)
- 11:45-11:30 *Coffee break*
- 11:30-12:30 *Working Groups Meetings*
- 12:30-13:00 **CLOSING SESSION**
- 13:00-14:30 *Lunch*

Opening Session

CHALLENGES OF COMPOSTING FOR GROWING MEDIA PURPOSES IN SPAIN AND MEDITERRANEAN AREA

CHALLENGES OF COMPOSTING FOR GROWING MEDIA PURPOSES IN SPAIN AND MEDITERRANEAN AREA

Raul Moral, Concepcion Paredes, Maria Angeles Bustamante, Maria Dolores Perez-Murcia and Aurelia Perez-Espinosa

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Growing media market is mainly based on natural resources like peat, perlite, vermiculite, etc. Thus, this implies the consideration of sustainability issues in any scenario. Recently, there is an increasing search for alternative materials to reduce the dependence of these incomes, with a questionable availability in the near future due to environmental constraints. Also, the EU research programmes are promoting and supporting these objectives to achieve an environmental friendlier agriculture in intensive production.

In the Mediterranean countries, the horticultural sector has achieved a high relative importance, specifically Spain being one of the greatest horticultural producers, where curiously the natural resources for growing media are negligible. In this scenario, composting is a routine, efficient and sustainable treatment to obtain stabilized organic resources that can be used in extensive and intensive agriculture for amendment and background fertilising purposes.

However, in soilless cultivation conditions, the growing media must accomplish specific high standards of quality, environmental and safety issues, and moreover specific conditions depending on the type of cultivation requirements (seedling-propagation-growing).

For this reason, huge research has been done to establish the potential substitution of peat or perlite with routine-commercial compost, using as a most referenced range of substitution around 20-30% in volume without any negative effect.

In this contribution, the challenges to develop more efficient compost to substitute in higher proportion peat or perlite in the growing media are discussed, based on co-composting and additive strategies. In addition, the leading agricultural role of Spain in Mediterranean cropping give us the opportunity to reuse in these purposes associated waste fluxes coming from agricultural and agroindustrial production (wine, olive oil production, etc.), with specific properties that can increase compost value and quality.

The future challenges of advanced composting can be grouped into functional, limiting, added-value and quality issues:

- Functional issues: aspects that are linked to the development of compost with physical properties similar to peat or perlite.
- Limiting issues: aspects that must consider the potential specific problems of compost compared to peat and perlite, such as excess of soluble salts, high pH values and high concentration of potentially toxic trace elements.
- Added-value issues: aspects related to the obtaining of added value properties compared to the traditional media, such as peat or perlite. This includes the development of compost derived products with a balanced nutrient value for a specific use or crop, and specially the potential suppressive capacity against different phytopathogenic microorganisms.

- Quality issues: aspects that include the achievement of high standards in demanded properties, but also the maintenance of these properties in time. Existence of standard reference values for the main properties of a substrate, obtaining according to the procedures defined by European Standard.

Finally, economic and environmental challenges must be also taken into account. These are mainly associated to the reduction of the cost of advanced composting processes and the obtaining of a positive life cycle analysis for the compost-based substitution strategy.

Keywords: composting, peat substitution, soilless cropping, added-value properties

Session 1

ADVANCES IN ANALYTICAL TECHNIQUES FOR GROWING MEDIA AND COMPOSTING

Invited Paper

EUROPEAN STANDARDISATION OF GROWING MEDIA – A CRITICAL REVIEW

Andreas Baumgarten

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Comparable methodologies for analytical methods are a prerequisite for comparable results and thus for a successful and meaningful interpretation. This apparently self evident statement cannot be taken for granted though. Whereas in the scientific community the development and discussion of new methodologies is an inherent subject, both for scientists and producers a set for the basic characterization of growing media should be out of question.

During the last decade, the European Standards Organisation (CEN) has put a lot of effort into the development of such an assembly of essential methods, of course with the main focus of CEN – to facilitate trade. Nevertheless, these fundamental parameters are of importance for academia as well! Even so, the national practices and demands with regard to the characterization and declaration of growing media are still largely diverging.

Additionally to the work of CEN, a European research project – HORIZONTAL –has tried to prepare “universal” draft standards for organo-mineralic matrices like soil, sludge and treated biowaste.

Although growing media have been excluded from the scope, two methods (determination of weeds and impurities) will have the chance to be accepted for growing media as well. Two other subject areas not successful in the horizontal approach – “phytotoxicity” and “stability” – have been developed further by the CEN technical committee (TC) 223, responsible for growing media and soil improvers and launched for approval.

CEN work nowadays mainly faces two problems: First the acceptance by the European countries – although all CEN members are obliged to withdraw national standards if a matching CEN standard is being published. Still, a lot of national regulations prevents a successful implementation of CEN methodology. Nevertheless, European legislation increasingly refers to CEN standards, thus assuring the recent technical state of the art and avoiding frequent revisions to implement possible changes of methods. Therefore, a European regulation for the declaration of growing media could help to enforce a unique characterization. Currently, the European Peat and Growing Media Association (EPAGMA) is launching an initiative for such a regulation.

Secondly, a prerequisite for a European standard is a sufficient validation. Whereas for the already existing CEN methods data are available, the performance of new ring tests mainly has to cope with financial problems – who is to pay for the accomplishment? CEN sees its role only as a mediator, industry is mostly reluctant and the member states hardly can find money. Recently, an initiative of Germany seems to provide some support. Nevertheless, in some cases, the drafts had to be published without validation data only as technical specifications instead of standards.

Despite all technical and also administrative problems (temporarily lacking of a secretariat), CEN TC 223 has been able to provide a number of scientifically sound methods for growing media analysis, that, if commonly acknowledged, could serve as a basis for a consistent and coherent characterisation of growing media.

Keywords: Growing media, Standardisation, CEN, analytical methods

NOTES

pH IN ROCKWOOL PROPAGATION BLOCKS: A METHOD TO MEASURE THE pH BUFFER CAPACITY OF ROCKWOOL AND OTHER MINERAL ROOTING MEDIA

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Within the framework of the international KIWA quality label for rooting media representatives of plant propagators and the rockwool industry agreed to develop a method to characterize the influence of the rooting medium materials on the pH in cultivation. A method for the characterization of building materials was studied and the instrumental set up was replicated in a laboratory. In a series of experiments various parameters were optimized to characterize the pH buffer capacity of rockwool and perlite. In the final method a solution of pH 5 was recirculated at a set pace over a sample of rockwool. Dissolution of the material resulted in a gradual pH raise which was corrected by the addition of hydrochloric acid every hour for five minutes. After nine cycles of pH rise and correction, the total consumption of acid per unit weight of sample was calculated. A norm proposal includes a maximum acceptable pH level to be reached and a maximum consumption of acid per unit weight of sample. Typical safe values for pH buffer capacity were 5-10 mmol hydrogen ions per kilogram of dry rockwool and 10-20 mmol of hydrogen ions per kilogram of perlite.

Keywords: Stone wool, dissolution

E-VALUES OF COMMON GREENHOUSE ROOT SUBSTRATE COMPONENTS

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Water-holding capacity is a time-specific measurement that is limited to the status of the substrate immediately after saturation and drainage. Water-holding capacity only accounts for whether or not a pore is small enough to retain water at container capacity. It does not take into account that the water being retained occurs in pores of different sizes which hold water at different tensions. These different populations of water evaporate at different rates as a result of the different pore sizes. Therefore, two substrates can theoretically have the same water-holding capacity, but lose water to evaporation at different rates and the two substrates would dry at different rates. Therefore, water-holding capacity does not provide information regarding how quickly water is lost from the substrate, the substrate water status over time, or the irrigation frequency required for a substrate under specific conditions, all of which are important characteristics of a substrate. The E-value was developed as a substrate measurement that takes into account a substrate's water-holding capacity and drying rate to create a single value description of substrate wetness. The E-value allows for describing and comparing substrate components and substrates, and the higher the E-value, the wetter the substrate. The E-values of various substrate components were determined and compared to one another.

The E-values ranged from a low of 6 for parboiled fresh rice hulls to a high of 63 for vacuum-harvested peat. The E-values of all grades of perlite tested were higher than that of parboiled fresh rice hulls. The E-values of perlite decreased as the particle sizes increased. Likewise, as the particle size of vermiculite decreased, the E-value increased. The E-values of block cut peats were lower than those of vacuumed harvested peats, and the finer the peat, the higher the E-value.

Keywords: water-holding capacity, wetness, substrates, potting media, E-values.

NOTES

COLOUR OF PEAT AS AN INDICATOR OF CHEMICAL, BIOLOGICAL AND PHYSICAL PROPERTIES OF PEATS

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Biodegradability of peats is an important for long term cropping. Lignin content is an important property in predicting the susceptibility of peats to biodegradability. However lignin analysis is time consuming and can be expensive. Consequently tests were carried to see if determinations of peat colour using a colour meter in combination with other simple tests could be used to predict lignin content. Two trials are reported here. In the first trial more than 20 peat samples were taken of different degrees of decomposition from seven peat producing European countries. After drying and sieving of the peat material, colour was determined using a Minolta Chrome meter using a Hunter .Lab colour scale. It defines colour numerically in terms of lightness ("L" 0= black 100= white, "a" redness, "b" yellowness). Other tests on the peats included lignin content E4/E6 measurement, organic matter, respiration activity and bulk density. A very strong correlation was found between "L" and "b" values with lignin content. There was also a very good correlation between these "L" and "b" values and colour.

In a second trial two peats of different degrees of decomposition from three peat producing European countries were incubated for 18 months. Initial measurements of the samples included colour and lignin. Shrinkage was measured four times during the period. There was a strong correlation between colour and shrinkage, colour and lignin and colour and fibre content.

These preliminary results indicate that colour measurements could be used as an indicator of susceptibility of peat to shrinkage. It could be of practical value insofar as peats of high degree of structural stability are used for crops of long duration needing a high aeration requirement.

Keywords: FTIR, bulk density

NOTES

SPANISH LEGISLATION ABOUT GROWING MEDIA

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Royal Decree 865/2010, of 2nd July, regulates the characteristics of growing media or their components, for their utilization in agriculture, forestry, gardening or other related activities.

These types of products, that are materials, other than soils “in situ”, in which plants are grown, are widely used, mainly in seedbeds, nurseries and protected crops. This legislative provision, which was published in the State Official Journal (BOE) on the 14th July of 2010, regulates for the first time growing media in Spain.

The Royal Decree contains the following chapters:

1. General issues. Definitions, scope, requirements, etc.
2. Packaging and identification of growing media.
3. Placing on the market. Manufacturer requirements, internal quality control...
4. Raw materials. Definition of components, biodegradable organic materials, pathogen microorganisms' content, heavy metals content.
5. Adaptation of the annexes to technical progress.
6. Official control measures.

It is completed by seven annexes:

- I. Classification of growing media or components of growing media.
- II. Identification and labelling.
- III. Analytical methods.
- IV. Tolerances.
- V. List of biodegradable organic wastes.
- VI. Maximum level on microorganisms and heavy metals.
- VII. Guide to a technical sheet on applications to register a new type of growing medium.

In the near future, a harmonization of the national legislations from Member States of the European Union can be achieved, by the establishment of an EC Regulation regarding to growing media.

Keywords: classification, requirements, labelling.

NOTES

Session 2

NOVELTIES IN MATERIALS, USES AND PROPERTIES OF GROWING MEDIA

Invited Paper

A VIEW BEYOND TRADITIONAL GROWING MEDIA USES

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Horticultural crops, both edible and ornamental, have been traditionally considered to be the main users of growing media. For this reason, growing media developments have been mostly undertaken by horticultural sciences that deal mainly with production techniques. Beyond traditional uses, new areas of application of growing media are being developed as new applications of the landscape industry are being encouraged.

While cities grow in inhabitant number and increase their building ratios, surface is even more scarcely available for landscaping purposes. Thus, vegetation uses the vertical dimension to increase landscaped surface. This is fostered by city planners as sustainability of the urban environment is taken into consideration, to which plants can certainly contribute by adding energy efficiency and insulation to buildings while improving air quality and increasing biodiversity, to mention some benefits. Also growing vegetables in buildings might add to the philosophy of sustainable growth by lessening the need for long distance transport of food.

Besides scientific and socioeconomic considerations, growing plants on the top (green roofs), on the walls (green walls, vertical gardens) or inside the buildings (vertical farms, hydroponic gardens) are considered as practical means to increase usable landscaped area without increasing soil surface, while enjoying the environmental, economical and social benefits of plants.

Architecture with plants is thus a new area of application of growing media. The fact that, in this environment, plants are grown in a shallow layer of substrate while they are exposed to non-controlled environmental conditions, adds difficulties when compared to those plants grown under controlled environments.

Growing media studies include horticultural applications, container-grown plants and hydroponics. Most of these applications are related to plant propagation and culture, but when a plant is cultivated in a green roof or wall, several meters high, subjected to various evapotranspiration conditions along the wall, and with a thin substrate layer, intensive research has to be conducted to ascertain the feasibility of the system.

This work examines the recent applications of growing media as well as the research that is being conducted in order to assess their performance.

Keywords: green walls, vertical gardens, vertical farms, green roofs, plant architecture

SPATIAL ARRANGEMENTS AND PHYSICAL PROPERTIES OF GRANULAR MINERAL MATERIALS AND COMPOSTED GREEN WASTE IN GREEN ROOF GROWING MEDIA

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Green roofs create unique challenges for growing media development. It is important for the growing media to supply green roof vegetation with sufficient oxygen and water to encourage plant growth and development. Green roof growing media must be able to maintain a low bulk density in order to minimise the impact on load bearing capacity of the supporting building. The water holding capacity of green roof growing media also has an important role in relation to the water retention function of a green roof system. A greater understanding of the processes that occur in the structural matrix of green roof growing media could inform substrate material selection and lead to improvements in the environmental functions and performance of a green roof system.

Green roof growing media mixes were prepared using 80% (v/v) of either; crushed brick, crushed tile or pelletised power station fly ash mixed with 20% (v/v) composted green waste. Physical properties such as particle size distribution, air filled porosity, water holding capacity and dry bulk density were analysed using traditional methods for composted materials. Polished block and thin sectioning techniques were also used to observe the spatial arrangements between particles and the pore space architecture.

The formation of stable aggregates created between the different mineral materials and the composted green waste is discussed in relation to the prevention of physical degradation of the growing media. In addition, the effect of spatial arrangements on pore space architecture and physical properties of green roof growing media is considered.

Keywords: stable aggregates, physical degradation, pore space architecture, structural matrix, green roof substrate

NOTES

A PRAGMATIC APPROACH TO WETTABILITY AND HYDRATION OF HORTICULTURAL SUBSTRATES

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Moisture retention has been a key property in substrate analysis for many years. More recently, the ability of a substrate to acquire that moisture has been studied. These parameters help describe the efficiency of a substrate and can affect the method and frequency of irrigation. This work explores the relationship between wettability and hydration using a low cost, practical system. Wetting curves (described in previous work) were used to determine a hydration index for substrates. This work separates wettability and hydration for more precise descriptors to include a wettability index, initial hydration, and a more descriptive hydration index. Initial hydration and wettability index can be used to describe hydrophobicity and to determine surfactant concentrations necessary to ameliorate water repellency. The hydration index now incorporates both wettability and the ability to retain moisture for a better description of water efficiency. For example, peat (with surfactant) and sand can have equal ability to hydrate with wettability indices over 0.9. However, including the ability to retain water, the hydration indices were 0.8 for peat and 0.45 for sand. As new substrate materials and water application techniques are developed these additional descriptors may prove useful in describing the efficiency of substrates to capture and retain water.

Keywords: wettability, moisture retention, hydrophobicity, physical properties.

NOTES

WATER IRRIGATION REGIMES AND THEIR CONSEQUENCES ON ROOT DEVELOPMENT AND PHYSICAL PROPERTIES EVOLUTION IN PEAT GROWING MEDIA

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NOTES

The impact of root growth on peat substrate hydraulic properties was investigated under different water irrigation regimes (constant water potential equal to -1 kPa and water potential varying between -1 and -10 kPa). “Knock Out” Rosae were grown in cylindrical pots during 5 months in a greenhouse under controlled climate and fertilization. Three particle size distributions coming from a same original slightly decomposed peat were used in order to have different water retention properties and pore size distribution. Water retention and hydraulic conductivity curves were monthly measured, in addition to root biomass and volume, and aerial biomass.

Results indicated a maximal root volumetric content similar to peat volumetric content. Root development leads to a slight decrease in the total porosity of growing media, with no significant changes in water availability for plant, but with a large decrease in air-filled porosity. The unsaturated hydraulic conductivity $K(\theta)$ decreased as a result of root growth that colonized the macroporosity. Root growth also modified pore size distribution and pore organization.

Keywords: air filled porosity, water retention, peat, root

EFFECT OF PHYSICAL CHARACTERISTICS OF COIR ON THE PRODUCTIVITY OF GREENHOUSE TOMATOES

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Coir is a relatively new growing medium, and little information is known of the relationship between particle size and particle size distribution on crop productivity. Particle size significantly affects the physical properties of coir, particularly the air-water relationships. The air filled porosity (AFP), total porosity (TP) and easily available water (EAW) increases with increasing particle size. An experiment was designed to compare the yield, water use efficiency and nutrient uptake of a tomato (*Solanum lycopersicum*) crop grown in coir using a range of particle sizes. Seven treatments based on combinations of small (S), medium (M) and large (L) sized particles, together with a commercial ungraded coir dust. Two irrigation frequencies were used, but the same quantity of water and nutrients were applied each day.

Physical properties of the different coir treatments along with the yield data from the tomato crop for these treatments will be presented.

Keywords: air filled porosity, easily available water, yield, quality

NOTES

PRODUCING A HORTICULTURAL GROWING MEDIA PEAT REPLACEMENT/ADDITIVE THROUGH RETENTION OF PLANT STRUCTURE IN COMPOSTED FOOD-PROCESSING WASTE

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For 30 years there has been a continuing quest in the UK to identify sustainable additives or replacements for the horticultural use of peats in container mixes used for growing plants on nurseries. After an initial feasibility study in 2004, a full project was run between 2006 and 2010, funded by the UK Government (DEFRA 'HortLINK' program and Technology Strategy Board) designed to match fund projects which drew Industrial and academic partners together to address specific problems.

The first part of the work evaluated the characteristics of Sphagnum peat and then compared these properties with those of aerobically composted materials.

The second phase of the work developed approaches to control the composting process in order to retain sufficient plant structure for a high quality growing medium.

The third part of the work comprised an extensive program of plant growth trials using the materials generated in part two of the project in order to demonstrate the performance of the materials.

Results clearly indicated that inclusion of the materials (so far up to 75%) in a peat-reduced medium produced quality plant growth. Analysis of specific physical properties indicated how physically close the new mixes were to the normal nursery mixes and give confidence that this work can now be commercially exploited.

Keywords: physical analysis, aerobically composted, growth trials

NOTES

STORAGE PROPERTIES OF BARK-BASED PEAT-FREE GROWING MEDIA CONTAINING PAS 100 GREEN COMPOST

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In the U.K. in 2010 the Department of Environment Food and Rural Affairs (DEFRA) published proposals for a phase out of bagged peat-based composts by 2020. In the UK coir, composted bark, wood fibre and green compost have been included as diluents in peat based media, and these materials also form the basis of peat-free products. However, in the most recent trials of retail products by Gardening Which? consumer group in the U.K. peat-free materials performed very poorly. Bagged media in retail outlets can be stored for over a year before being sold. Alternatives and diluents therefore need to be stable during storage. The principal aim of this study was to investigate the performance of five peat-free mixes containing up to 50% green compost within bark-based substrates over a period of 12 months. Nutrient status of the media was undertaken alongside germination and growth studies. Bimonthly growth trials showed very marked differences in performance between the second and third sampling dates. During this time the bags of media had been exposed to temperatures between 40-45°C which had a profound effect on the nutrient status from the third sampling date onwards. The nitrogen status had been affected and major differences in nitrate-N concentration in the bags were observed.

The exposure to the temperatures may have promoted microbial development and activity resulting in the differences in nutrient status and the possibility of the formation of phytotoxic substances. Those mixes with higher proportions of green compost (40-50%) had high plant yields and this suggested greater stability and amelioration of the effects of the high temperatures. In conclusion manufacturers and retail outlets are advised to store bagged peat-free products in cool conditions.

Keywords: Nitrogen, microbial activity

NOTES

**CLAYS AS AMENDMENTS FOR IMPROVING THE
REWETTABILITY OF PEAT-BASED GROWING MEDIA:
OPTIMIZATION OF CLAY APPLICATION BY DETERMINATION
OF SURFACE COVERAGE DEGREE EXPRESSED AS THE C/Si-
RATIO AND REWETTABILITY**

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Peat is an important growing media component which exposes hydrophobic properties if getting dry. The addition of clay induces a coated surface with hydrophylic properties which improves the rewettability. The formation of an effective clay coating on peat constituents during production depends besides others on the amount of clay applied, aggregate size and microstructure of clay aggregates and mineral parameters. As peat surfaces consisting mainly of C are covered with clay minerals rich in Si, the degree of coverage can be described as C/Si ratio, determined by energy dispersive X-ray spectroscopy.

A moderately decomposed sphagnum peat was amended with seven different clays from the Rhenish Massif, Germany (10, 20, and 30 kg/m³ of each clay). Aggregate size was varied from 0-0,063 to 2,0-4,0 mm and water-uptake characteristics determined with a capillary-rise method.

Water uptake is improved for all samples by amendment of clay, strongly depending on clay parameters. At C/Si ratios <20, where the surfaces of peat are most completely coated with clay minerals, all clay-peat systems show the highest water uptake rate. Saprolithic and translocated clays, consisting mainly of illite and kaolinite, have the strongest effect on surface coverage. Here already 20 kg/m³ are sufficient to reach lowest C/Si ratios indicating maximum coverage degree. These clays show fastest water uptake (50 vol.% within 10 min), whereas bentonites show only minor effects (1,47 to 3,63 (%v/v)/min). The translocated clay is most effective to improve water uptake rate with small amended amounts.

The results show a good correlation of the C/Si ratio and rewettability. The determination of the ratio in a relatively short procedure is a method to estimate the water uptake rate of different growing media for horticultural purposes. The combination of these methods can be used to identify suitable clays for improving rewettability and the amount of clay needed.

Keywords: peat-based growing media, clay amendments; surface coverage degree; C/Si ratio; rewettability

NOTES

CONTRIBUTIONS TO NUTRIENTS AND LIMING MATERIALS IN GROWING MEDIA FROM ADDITION OF RECYCLED MATERIALS

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Growing media based entirely on peat have traditionally required addition of lime, major nutrients and trace elements for production of high quality plants, particularly in professional markets. However, in the U.K retail markets are responsible for around two-thirds, by volume, of growing media sales. Increasing demands in the U.K for peat-reduced and peat-free growing media has led to increased use of recycled materials such as green compost, wood fines and other materials in bagged growing media for retail markets. Recycled materials may contain significant amounts of macronutrients, trace elements as well as having the potential to raise the pH of growing media. Studies undertaken over several years show that composted materials produced in Ireland based on spent brewery grains, green materials and dairy by-products contain significant quantities of DTPA extractable N, P and K as well as trace elements, and also may contribute to the pH requirements of retail growing media. Furthermore, lower grade fertilisers are often used in growing media for the retail market, and these too may contain significant concentrations of trace elements.

Finally, recycled sources of liming materials, such as fly ash from peat-fired power stations, may be used to raise pH in growing media for retail markets as well as contributing trace elements.

Keywords: green compost, spent brewery grains, trace elements, lime, macronutrients, fertilisers

NOTES

WOOD SUBSTRATES IN UNITED STATES HORTICULTURAL CROP PRODUCTION: DEVELOPMENT AND USE

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The use of wood and wood-based substrates in the United States have received much interest in the past six years from both horticultural crop producers (greenhouse and nursery) as well as from substrate manufacturers. Traditional peat-based and bark-based substrates are still predominately being used, but with an increased demand for alternative substrate materials that are cheaper and more regionally abundant, wood is proving to be one of the most successful and feasible options. Based on years of previous research across the United States, questions and issues surrounding the use of wood substrates are being answered by numerous researchers. Research at North Carolina State University is focusing on several specific areas including identifying viable wood sources, wood processing techniques, engineering wood to possess desirable and consistent physical properties, and wood-based substrate stability issues. Results show that in addition to pines (*Pinus*) other tree species and waste wood materials can be utilized as substrate components if processed and handled correctly. Studies have also confirmed that many tree species and wood sources are unacceptable for consideration as a substrate component. The processing of pine or any other tree species is greatly affected by the machinery used to reduce the wood particle size enough so that it is capable of being used as a substrate.

The processing and engineering of wood materials can have a great effect on the total porosity (air space and water holding capacity) of substrates as well as their stability in containers during plant growth. Substrate degradation/stability is influenced by several factors including tree species and wood particle size. Growth trials of greenhouse and nursery crops have shown that wood-based substrates are stable over short and long production periods while maintaining acceptable substrate physical properties, specifically air space. Research has also shown that wood particles can be specifically engineered and used as an alternative aggregate in peat substrates at a reduced cost compared with other inorganic aggregates, with no loss of plant growth or quality. Much is still to be learned about the utilization of wood-based substrates in commercial horticulture production but there is now a greater understanding and acceptance of these new substrates in the industry.

Keywords: wood fiber, peat alternative, substrate aggregates, growing media, wood processing

NOTES

A PRELIMINARY STUDY OF THE EFFECT OF BIOCHAR FROM MAPLE (*Acer*, spp.), ON ROOT GROWTH OF SELECTED AGRONOMIC CROPS

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Biochar is any type of stable, organic matter that is incompletely burned with little to no oxygen until the material reaches a charcoal-like stage. It has been employed for centuries by pre-Colombian civilizations in Latin America as a fertilizer yet its value in modern agriculture remains still to be verified. The purpose of this study was to evaluate roots elongation and development of pea (*Pisum sativum*) and wheat (*Triticum aestivum*) seedlings as indicators of growth when biochar was applied, at different concentrations (10%, 20%, 100%), in rhizotrones where these were grown. Thirty six rhizotrones were employed in four trials conducted in 2010. The biochar was placed in 3cm layers at a depth of 0cm, 5cm, and 10cm, along the rhizotrone. The seeds were germinated in water baths for seven days and then transplanted in the rhizotrones. The seedlings were grown until the leading root would have reached the bottom of the rhizotrone. At this point seedling growth was interrupted, and the numbers of roots and their lengths were measured. The data were analyzed with JMP software and ANOVA tests were employed. No statistically significant difference occurred in the root growth of the two plant species and both achieved maximum root elongation when growing in soil with 10% biochar. Wheat seedlings developed more secondary and tertiary roots when passing through soil with 20% biochar. More trials are needed however, to better understand the optimal percentage of biochar, which most enhances root growth.

Keywords: organic matter, rhizothrone, root elongation, seedling

Session 3

NEW DEVELOPMENTS IN COMPOSTING AND COMPOST PRODUCTS

Invited paper

SWOT ANALYSIS OF COMPOSTS AS GROWING MEDIA COMPONENTS

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SWOT analysis is a method used to evaluate the **S**trengths, **W**eaknesses, **O**pportunities and **T**hreats involved in a project or a process. In the context of growing media (GM) this paper will analyse the strengths, weaknesses, opportunities and threats involved with the use of various composts in GM. Each SWOT analysis must start with defining a desired end-result. Peat moss serves as the main organic component of GM due to its superior physical properties. Recently a rising demand for peat substitutes is driven by the need to recycle organic wastes in an environmentally-sensitive manner, by the high cost of peat and due to the understanding of the role of peat bogs in the global carbon cycle. Also, frequently peat is conducive to soil-borne diseases. The desired end-result is therefore the maximization of compost use as peat substitutes in GM, based on the understanding of the role composts can play. In addition to the above-mentioned weaknesses of peat, the strengths of composts are its low cost, its potential nutritional contribution and its suppressive effect against several root pathogens. Weaknesses of composts are a result of lack of uniformity, salinity and inferior physical properties, as compared to peat. The opportunities that are linked to the use of composts are related to the need of the society to recycle wastes in a sound environmental manner. The threats stem mainly from potential zoonotic pathogens.

A well-controlled composting process is, in most cases, essential in order to obtain a good peat substitute, showing acceptable stability and minimal shrinkage. The composting process should be aerobic to prevent formation of acidogenic, phytotoxic compounds.

The compost should be exposed to thermophilic conditions in order to eradicate human and plant pathogens and weed seeds. Other important objectives of the process are the lowering of C/N ratio in order to prevent N immobilization and minimization of oxygen demand by microorganisms. The results of the SWOT analysis suggests a bright future for the use of composts in GM. Required future research includes the study of the linkage between feedstocks and composting techniques on the one hand, and compost characteristics and expected performance on the other hand. The effect of compost storage on the shelf life of its desirable properties should also be studied.

COMPOBALL: NOVEL ON-LINE COMPOSTING MONITORING SYSTEM

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Transformation of organic wastes into a resource through composting has been proven as an effective method to reduce weight, volume and biodegradability, and to obtain a stabilized product -compost- useful as soil improver and/or growing media component. The quality of the compost obtained is related both with the raw materials and the control of the process. The effectiveness of the composting process is dependent upon the environmental conditions present within the composting system, i.e., oxygen, temperature, moisture, material disturbance, organic matter and the size and activity of microbial populations. Accurate control of composting is a main factor in optimizing the process, and different parameters can be monitored.

While the main biological and chemical parameters affecting the composting process are well known, the technological solutions available for monitoring and controlling the process are very limited. Two of these essential parameters, temperature and moisture in the core of the composting material, are barely measured along the process and in few points. Moreover, temperature is usually measured manually inserting a probe, and the moisture is measured by extracting samples that need to be analyzed in a laboratory.

The COMPO-BALL project is developing an on-line wireless system for the measurement of temperature and moisture at various points in the composting material. The proposed solution consists of a set of independent sensor nodes. The nodes will not require any external connections to feed or read the sensors and will be encapsulated in an inert material. The batteries will be rechargeable with an inductive method. All information is transmitted to one external node (pile-hub) and a standard wireless communication system sends information from this external node to the control computer.

Keywords: composting, temperature, moisture, parameter monitoring.
Autonomous sensor system

NOTES

COMPARING ORGANIC FRACTION CHANGES OF ONE COMPOSTING AND TWO VERMICOMPOSTING PROCESSES AIMED TO PRODUCE QUALITY COMPOST AND VERMICOMPOSTS FOR SOILLESS CULTIVATION

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One composting and two vermicomposting processes applied to a vegetable waste mixture were compared at selected stages for their chemical characteristics. The starting material consisted of a mixture of milled residual tomato crop biomass and ground almond shells (75:25, v:v). The compost (C) was produced by a combined system (Rutgers + pile turning) (COM process). For one of the vermicomposts, V1, the fresh waste mixture was first composted (only active phase) and then vermicomposted with *Eisenia andrei* and *E. fetida* earthworms (C+V process). Finally, for the second vermicompost (V2), the fresh waste mix was directly vermicomposted with *E. andrei* and *E. fetida* earthworms (VER process). The three materials were analysed at five stages of each process for a selection of parameters with organic character (total organic matter, total organic carbon, C/N ratio, extractable carbon, humic and fulvic acid carbon, water-soluble carbon, lignin, hemicelluloses and cellulose). COM, C+V and VER showed significant differences in organic matter, extractable carbon, humic and fulvic carbon, water-soluble carbon, lignin and cellulose contents between the mixtures under treatment.

The study of the changes underwent throughout the three processes allowed to determine the evolution of the maturity and stability parameters of the investigated materials and helped understanding the final characteristics of the compost and two vermicomposts, proving to be a useful tool in the choice of the most appropriate compost/vermicompost for use as substrates or substrate constituents for soilless cultivation.

Keywords: horticultural waste, substrate, substrate constituent, containerized crop production

NOTES

COMPOSTING OF POSIDONIA, SOLID FRACTION OF OLIVE MILL WASTEWATER AND CHICKEN MANURE

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Posidonia (*Posidonia oceanica*) is a Mediterranean marine phanerogam. Its leaves are rejected in enormous quantities on the Tunisian beaches. Chicken Manure (CM) accumulation is accompanied by serious environmental problems. The solid fraction of olive mill wastewater (SOMW) is accumulated each year in the Tunisian oil mills. Despite its various uses, the available quantities are still huge (Fourati et al. 2001). The objective of this study is to contribute to resolve these environmental problems by the valorization of the mentioned organic waste through composting. Three mixtures of these wastes were composted. At the end of the composting process, three composts were obtained: i) C1: 50% (SFOMW), 20% Posidonia (P), 30% (CM). ii) C2: 35% (SFOMW), 35% (P), 30% (CM). iii) C3: 20% (SFOMW), 50% (P), 30% (CM). Each compost pile weight was 20 tons. During the composting process, we measured the following parameters: physical parameters (temperature, pH and salinity) and chemical parameters (OM, TOC, TN, CaO, MgO, K₂O, P₂O₅, Fe, Cu, Mn and C/N). For compost analysis, sampling was made by mixing three sub-samples taken from three different points in the pile. Each sub-sample was a mixture of three samples taken from the top to the bottom of the pile in each sampling pile. The analysis of the results was performed by using the general linear model procedure of SPSS (SPSS 16.0). Results show that at the end of the composting process salinity, C/N ratio,

MgO, K₂O and P₂O₅ decreased; nitrogen contents however, increased during composting. The results confirm also that Posidonia, (SOMW) and Chicken Manure might be considered as valuable ingredients of compost mixtures. We conclude that composting of posidonia mixed with chicken manure and olive mill residues shows some interesting outcomes and the physical and chemical characteristics of the final product may allow their use in crop media.

Keywords: posidonia, chicken manure, solid fraction of olive mill wastewater, composts, physical parameters, chemical parameters

NOTES

COMPOSTING OF *Acacia longifolia* AND *Acacia melanoxylon* INVASIVE SPECIES

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Acacia longifolia and *Acacia melanoxylon* were introduced as ornamental plants in Portugal and were also used in the soil restoration to fix biological nitrogen. However, these invasive leguminous species are highly competitive and a serious threat to local biodiversity. They also represent a significant fire risk. Therefore, new valorization approaches for these shrubs or trees are needed taking into account their high availability and low cost. Composting acacia to produce horticultural substrate components appears to be one solution. However, acacias have slow decomposition rates because of their relatively large recalcitrant lignin content which does not contribute to increase microbial degradation and to raise composting temperature. This can be a problem if acacia seeds remain viable after composting, as they can survive 6 days at temperatures ranging from 55 to 70°C. To investigate if composting shredded (particles <4 cm) acacia leaves and branches may reach high enough temperatures to destroy seed viability and become a substrate component; two big piles (100 m³) were set up in January 2011 to analyze physical-chemical characteristics during composting with different turning frequency.

Initial pile moisture content was 62%. After a short mesophilic phase of composting there was a fast raise of temperatures up to a maximum of 76°C found in the top of one pile two weeks after composting was initiated. Temperatures were initially increased from the bottom to the top of the piles. One month after composting, piles were turned and moisten. After the initial drop, temperatures raised again to thermophilic temperatures after 2-5 days up to 77°C in the top of the same pile twelve days after turning. Chemical characteristics including pH, electrical conductivity, C/N ratio, organic matter losses, N-NH₄⁺/N-NO₃⁻ ratio and nutrient contents are discussed to evaluate the composting process and final compost quality for substrate use.

Keywords: C/N ratio, compost, mineral N, pH, temperature

NOTES

EVALUATION OF PHYSICOCHEMICAL, BIOCHEMICAL AND PHYTOTOXICITY OF TUNISIAN MATURE AGRICULTURAL WASTES COMPOSTS

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The co-composting of agricultural waste is a new management in Tunisia. Composts were prepared by the pile system. In this study six final products of co-composting were evaluated by comparing the changes in measured physicochemical, biochemical properties and phytotoxicity of different mature composts obtained by composting agricultural wastes CI, CII, CIII, C, CH and CA after eighteen months of composting.

- CI was composed of almond and sesame shell at the ratio of 75/25 (wet weight based)
- CII was prepared by mixing olive Husk and sesame at the ratio 75/25 (wet weight based)
- CIII was the compost of olive Husk, sesame, and almond shell (coarse) as a bulking agent. The chosen ratios were 55/25/20 (wet weight based)
- C represented a mixture of olive mill waste water sludge and poultry manure at the ratio of 70/30 (wet weight based)

- CH is composed of olive mill waste water sludge, olive Husk and poultry manure at the ratios of 50/20/30 (wet weight based).
- CA compost was prepared by mixing OMWWS, poultry manure and almond shell (coarse) as a bulking agent at the ratios of 55/35/10 (wet weight based).

The studied composts had basic pH, EC values ranged from 1.6 to 3.6 mS/cm, OM and C/N ratio of composts ranged from 20 to 46 and 10 to 21 respectively.

The biological stability of composts was evaluated using Van Soest method by measuring cellulose, hemicelluloses, and lignin and weende cellulose contents to calculate BSI and Tr (Francou, 2003). The BSI ranged from 0.13 to 1.31 and Tr ranged from 9.4 to 37.54. Phytotoxicity of composts was studied by determining cress seed growth in a mixture of relative compost and peat. Physical properties were determined according to de Boodt's et al. (1974) methods. Diversity of studied properties is related to the nature of used agricultural wastes. Some of these properties are compatible with valorizing composts as constituents in substrates for horticultural and soilless culture, other are compatible with using composts as soil fertilisers.

NOTES

PHYSICOCHEMICAL PROPERTIES OF FOOD WASTE COMPOST AND ITS USE AS A COMPONENT OF GROWING MEDIA

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The composition of biowaste, as defined in the Waste Frame Directive 2008/98, strongly depends on the urban environment, as it includes two streams of a very different nature: food waste (FW) and green waste (GW). FW is the largest component of the biowaste collected from families living in flats, whereas GW accounts for the largest component of the biowaste collected from houses. In a pilot scheme carried out in Gipuzkoa between June 2008 and December 2009, FW of a very high purity (about 99%) from about 4700 households was collected. The origin of the high electrical conductivity of compost from FW (FWC) was investigated, as salinity severely limits its application as a growing media component. After carbonates and bicarbonates, chloride is the anion which most contributes to salinity, in concentrations much higher than nitrate. With regard to cations, the macronutrient potassium is predominant, followed by sodium. Therefore, we conclude that sodium chloride added to foods is a relevant source of salinity in FWC.

A field trial was carried out, growing seedlings of *Pelargonium zonale* and *Begonia semperflorens* on mixtures of white peat and 10-20-40-60-100% FWC as the growing medium, in order to determine the optimum rate of FWC in the mixture.

Keywords: biowaste, salinity, sodium chloride, electrical conductivity, VFG compost, *Pelargonium zonale*, *Begonia semperflorens*

NOTES

CHARACTERIZATION OF COMPOST PRODUCED FROM SEPARATED PIG MANURE AND A VARIETY OF BULKING AGENTS AT LOW INITIAL C/N RATIOS

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The aim of this study was to investigate the composting of separated pig manure (SPM) solids with or without a variety of bulking agents at a low initial carbon (C)/nitrogen (N) ratio of 12.5 to 23.3. Two trials were conducted, each with four treatments and each treatment was replicated four times. Trial 1 comprised SPM only (T1); SPM + sawdust (SD) (T2); SPM + shredded green waste (T3); and SPM + chopped barley straw (T4). Trial 2 comprised SPM only (T1); SPM + SD (T2); SPM + woodchip (T3); and SPM + SD + woodchip (T4). Sixteen insulated compost tumblers were used for each trial. The temperature of the pile was recorded daily. Aeration was provided by manually turning the tumblers. Both trials lasted 56 days. Compost stability was investigated using an oxygen uptake rate (OUR) test and compost maturity was investigated using a germination index (GI) test. Temperatures above 60°C were achieved by Day 2, followed by a thermophilic phase (50-60°C), which lasted for 1 to 2 weeks, and a cooling phase. The degradation of the C fraction of the materials composted resulted in a lower C/N ratio at the end of the composting process, as the N content remained relatively unchanged. In both trials, T1 lacked a bulking agent to absorb the high initial moisture content of the SPM which negatively affected its stability.

In Trial 2 OUR values at day 56 were 25.2, 11.0, 12.3 and 13.3, s.e. = 1.28 mmol O₂ .kg⁻¹ OM hour⁻¹ (P<0.01) for treatments T1, T2, T3 and T4, respectively and GI was 101, 99, 100 and 97, s.e = 3.4 % (P>0.05), respectively. Adding a bulking agent to the SPM reduced water content below 60%, increased C/N ratio and produced a compost of good stability with low phytotoxicity.

Keywords: oxygen uptake rate, germination index, sawdust, woodchip, stability

NOTES

USE OF GREEN COMPOST AS THE BASIS OF PEAT FREE GROWING MEDIA

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For historic reasons green compost is often regarded as having little potential in growing media. A series of growing trials – some commercial, some scientific – over ten years has shown that green compost from an enclosed, well-controlled process can form up to 50% v/v of the growing media and provide all base nutrients except nitrogen.

Greenwaste (approximately 95% ex-garden, 5% ex-kitchen) is composted in 40cum mobile ventilated containers for 1 week @ 75°C, followed by 1 month in indoor aerated static piles (all in accordance with UK Animal By-products Regulations 2002). The matured compost is size-graded to 6, 8, 10, 25 and 40mm then matured further by daily turning of stockpiles.

Temperature and fan output are monitored and recorded throughout the process. Size-graded green compost is blended with composted conifer bark (UK FSC sources only), plus a proteinaceous meal which acts as a slow-release source of nitrogen, giving excellent storage-life and in-use life.

Analysis of the green compost for plant-available nutrients (using CAT-extraction) confirms that, with the exception of nitrogen, no nutrient supplements are required.

The process has resolved long-standing problems, including failure of ericaceous subjects, nitrogen lock-up, weed contamination and high bulk density.

Several new benefits have been realised, notably: suppression of liverwort in Container Nursery Stock, flavour enhancement in tomatoes, improved handling properties and in-use stability. Sales of Peat-Free growing media based on green compost and composted conifer bark are now increasing rapidly in several market sectors, notably Retail, Container Nursery Stock and green roofing: due partly to eco-status but largely to performance benefits and competitive pricing. Further refinements are expected in the bedding sector, indoor food crops and propagation.

Keywords: liverwort, weeds, flavour, stability, ericaceous

NOTES

ORIGIN OF COMPOST SALINITY AND ITS CONSTRAINTS FOR COMPOST USES

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Compost is a useful term to define materials of specific characteristics, but it does not relate to its composition or the uses. One of the parameters that can help in the differentiation for use is the salinity, which is very dependent on the raw material and on the biological process.

Composting of organic wastes causes the concentration of mineral components due to decomposition or transformation of the organic fraction. When materials are highly degradable, as organic fraction from municipal solid waste (85-90% of degradable organic matter), generate an important increase in concentration of the mineral part, increasing then the salinity. In the other hand, vegetable materials with high content in lignin and cellulose are far less degradable, leading to a lower increase in the salinity.

Moreover, it has to be taken into account that mineral composition of many organic materials such as fruit and vegetable waste, green waste or yard trimmings are strongly influenced by soil and water composition. In the case of Mediterranean areas, some of the organic wastes can show a different composition to same kind of waste from countries from central or northern Europe.

It should be considered also the variations due to handling during biological process, where mixtures, watering, leachates management, etc., can affect composition, and particularly the salinity (which can vary between 2 and 14 dS m⁻¹ for compost), being then a parameter to be monitored along the process and before a land application of the product, because high values can negatively affect germination and crop growing.

Electric conductivity in compost is mainly due to cations Na⁺, K⁺, Ca²⁺ and Mg²⁺ and anions HCO₃⁻, Cl⁻ and SO₄²⁻, being approximately the 98% of total soluble salts. Also, ammonium can appear during decomposition and while nitrates most at the end of the process. The content in these salts is dependent on extraction and initial conditions of the material (pretreatment, moisture, etc.) which should be adequately known to interpret the results and compare them with other.

Keywords: mineral content, composting, mineral concentration, electric conductivity

NOTES

Session 4

WATER AND NUTRITION MANAGEMENT IN SOILLESS CULTURE

Invited paper

STATE OF THE ART AND NEW TRENDS OF SOILLESS CULTURE IN SPAIN AND IN EMERGING COUNTRIES

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Professional soilless cultivation systems are competitive agrosystems that use energy and materials efficiently to achieve the highest level of sustainability that exists in modern agriculture. In Spain, soilless cultivation appeared in the 1980s. By the beginning of the 1980s there were less than 100 ha of this type of culture, while now we can estimate that the areas covered reach 5500 ha. Technical improvements in these systems have not only led to technological advances in horticulture and vegetable production, but also in gardening, and landscaping. For example, soilless cultivation technology has contributed to fertigation and to the global microclimatic control of greenhouses, advances that have subsequently been extrapolated to global horticulture.

Originated in Central European countries, soilless cultivation systems were extended to other parts of the world, like in the Spanish Southeast. From this Spanish area, the technologies have been also extended to other regions while incorporating particularities that have been developed in the area, like the greenhouse structures (Parral) and the management of the irrigation and nutrient systems or also climatic control.

We specifically reference the extension of soilless cultivation in Spain, in three specific areas: 1) Mexico from the US border (e.g., Monterrey, the Sonora Desert, Tijuana, etc) to the border with Guatemala and Belize, 2) the Maghreb (the area including Morocco, Tunisia, and nearby nations), and 3) China, the country that could become the greatest commercial power in the world.

The second great green revolution consists of the application of hydroponic techniques and soilless cultivation to urban architecture. We assume that the second great green revolution has not yet occurred but will be applied to urban environments that emulate the mythical city of Babylon in terms of development and three-dimensional architecture.

There have been some recent advances in soilless cultivation, and technologies from other fields are being adapted to soilless cultivation. These new technologies include the following: 1) the use of renewable energy (e.g., solar, solar-thermal, biomass-fired cogeneration, and geothermal), 2) more efficient artificial lighting and lower CO₂ emissions, and 3) the identification of the contrast between fertigation and other activities using thermal imaging cameras.

Keywords: hydroponics, plant architecture, developing countries

COMPOST TEA FROM VEGETABLE CROPS USED IN FERTILIZATION OF LETTUCE (*Lactuca sativa*, L.)

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Intensive horticultural production in Almería province (Spain) generates high volumes of crop wastes every year. The management of which has resulted in serious environmental and economic issues. The composting of this waste has partially solved this situation. The valuation of composted vegetable residues as the base material for the preparation of tea or water extracts of compost could partially solve this situation and lead to less use of inorganic fertilizers in the adjustment of nutrient solutions for different crops. We obtained aerated compost teas (ACT) and non-aerated compost teas (NCT), both in the ratio 1/4 weight/volume (w/v). An air injection pump was introduced into the mixture to facilitate aeration, in the case of ACT, while NCT was kept at rest. The incubation time was 24 hours in both, at 25° C. A nutrient solution was also prepared for hydroponic lettuce which had 2.3 dS/m of electrical conductivity, and a series of progressively diluted nutrient solutions was prepared as well, based on the reduction of 0.3 dS/m by adding tap water. Compost teas were added to these solutions (2.3, 2, 1.7, 1.4, 1.1 and 0.8 dS/m) in the volumes needed to raise the EC to the reference of 2.3 dS/m. Solutions were used for fertirrigation of lettuce plants, transplanted individually in containers of 1 L capacity with a commercial mixture of peat as substrate.

On the other hand, another group of plants was fertirrigated with the diluted nutrient solutions and foliar sprayed with pure compost tea (ACT/NCT) or tap water. We performed 5 repetitions per treatment and the assay lasted 40 days after transplantation. Morphological parameters were measured (plant height, number of leaves, stem size and fresh and dry weight of aerial parts), as well as the final EC and pH of the substrate in the saturated extract. The results showed that we can decrease 0.9 dS/m of EC in the reference nutrient solution (2.3 dS/m) by adding NCT and 0.6 dS/m by adding ACT, with no differences in morphological parameters. The obtained results indicated that the use of compost tea allows decrease inorganic fertilizers consumption on lettuce production.

Keywords: composted vegetable residues, hydroponic, compost teas

NOTES

IMPROVING GARDENERS' UNDERSTANDING OF WATER MANAGEMENT IN PEAT AND PEAT-FREE MULTI-PURPOSE GROWING MEDIA: AN ASSESSMENT WITH FUCHSIA

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With increasing pressure to adopt peat-free growing media, UK gardeners need sound advice regarding water management of such media. Our understanding of water relations in peat, built up over many years of practice and research, needs to be matched for all of the peat alternative materials being used in growing media.

This experiment examined the performance of fuchsia 'snowcap' when grown in 4 different commercially available products (based either on peat, coir, woodfibre or green compost). Five different irrigation regimes, determined by regulated deficit irrigation over the preceding 24 hour period, were adopted. The control watering treatment replaced the water lost in this period while the other application rates increased or decreased that amount by 25% and 50%. Growth index, flower counts, upper plant biomass (dry) and two forms of visual plant assessment were undertaken.

The results indicated, in terms of growth index, the peat and the coir grown plants were generally comparable in size to each other across all irrigation regimes and significantly larger ($P < 0.001$) than those grown in the wood fibre and green compost mixes. When examining the effect of watering regime, the flower number in both peat- and coir-based media significantly declined ($P < 0.01$) when under-watered.

In the green compost and woodfibre grown plants, flower number declined in both over- and under-watered plants compared to the control watering regime but this was not always statistically significant ($P < 0.05$). There was no statistical evidence ($P > 0.1$) of inferiority of coir grown to peat grown plants across any of the irrigation regimes for both marketable size and quality. In the wood fibre only the control regimes produced plants close to marketable quality but these were not considered as good as the peat and coir grown plants.

Keywords: regulated deficit irrigation, coir, green compost, woodfibre

NOTES

OXYGEN DIFFUSION IN RELATION TO PHYSICAL CHARACTERISTICS OF GROWING MEDIA

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NOTES

For many years oxygen diffusion is known as an important parameter for root development in growing media. Bunt (1988) did describe that coarser graded growing media showed a higher oxygen diffusion rate. In practice a first rule is that a growing medium with an air filled porosity of 20% does provide an optimal oxygen diffusion. In various research carried out in the last years measurements were carried out on the availability in various growing media as well as under various culture conditions. A general conclusion was that optimal oxygen diffusion takes place when the actual air filled porosity is at least 20-30%. The outcomes will be discussed in frame of strategies for irrigation in combination with continuous measurement of the water content with sensors in a root ball. Also aims for production of growing media with respect to oxygen diffusion will be discussed.

Keywords: oxygen diffusion, physical characteristics, air filled porosity, deficiency

FERTILIZER AND WATER USE EFFICIENCY: EFFECT OF CONTAINER SIZE AND GROWING MEDIA IN A *Gerbera jamesonii* CUT FLOWER CROP

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Water is a limited resource, thus its efficient management becomes an important factor concerning sustainability of intensive crops. Moreover, in soilless culture fertilizers and water are applied together, then good practices are required in order to get environment friendly crops. Two containers (4 and 8 L plastic pots) and three growing media mixture types (0/100, 25/75 and 50/50 % of peat/perlite) were used, with the aim of determining the optimum combination for gerbera cut flower crop, considering both commercial productivity (yield and quality of cut flowers) and environmental impact, (water and fertilizer use efficiency). The best combination in the first year of production was 8 L and 0/100, followed of 4 L with the same substrate, with a yield of 58.5 and 40.5 flowers m⁻² respectively. In the mixture 50/50 in both container size the yield were near 23 flowers m⁻² and in 25/75 the yield were 39.6 and 34.6 flowers m⁻² in 4 and 8 L respectively. Commercial cut flower quality was acceptable in all treatments. Considering the ratio water used per flower harvested, 8L 0/100 was the most efficient treatments with a value of 1.23 L/flower and, therefore, less quantity of fertilizer applied.

The other treatments were between 2.17 y 4.14 L/flower, keeping relation as much with container size like with growing media mixture. The importance of these results is the simultaneous consideration of many factors which affect both commercial profitability and development of sustainable technology for intensive crops.

Keywords: sustainable agriculture, soilless crop, perlite, peat

NOTES

IMPROVED PRODUCTIVITY BY SPLIT ROOT FERTIGATION IN GREENHOUSE-GROWN CUCUMBER

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In greenhouse production, the optimal fertilization to maintain maximum production depends on the water use and nutrient requirements of the plants. A high concentration of nutrient salts in the fertigation solution (high EC) causes water stress whereas a low concentration (low EC) results gradually in nutrient deficiency in plants. Split root fertigation (SRF) approach may provide complementary benefits over traditional fertigation (TF). In the SRF approach variable fertigation EC values can be applied in the unconnected root compartments of a plant. In our four SRF experiments, plants of cucumber were grown in a high-wire cultivation system with supplemental lighting (top- and interlighting) and comparable with commercial production conditions. In a high-yielding environment the SRF method improved the overall water uptake and water use efficiency. In general, the water uptake was highest in the root part with the low EC values. In addition, the variable EC values modified the root morphology significantly. The experimental data revealed that the SRF method decreased flower and fruit abortion, leading to an improved fruit set with a small effect on vegetative growth. Under high radiation conditions in summer, the accurate management of the EC values in the SRF rooting medium resulted in the marketable yield enhancement by 17-20 % compared to TF. Experiments in winter with less radiation indicated smaller (5-10 %) but consistent yield advantages of SRF for cucumber.

The storage life of the cucumber fruits did not show any significant differences between the treatments. In summary, we have shown that in cucumber plants cultivated in paired peat boards with the split root fertigation method with low and high EC value in the two root compartments, significant yield increases can be gained compared to traditional fertigation (TF) with a constant EC value.

Keywords: peat, supplemental lighting, cooling

NOTES

BORON IN ROCKWOOL GROWN SWEET PEPPER

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Symptoms of B deficiency as well as excess are often manifest in rockwool grown sweet pepper crops in commercial practice. In particular the cause of the deficiency is obscure since the concentration supplied as well in the root environment is usually much higher than recommended and also in comparison with other fruit vegetables. Climatical conditions, fruit load and pH might affect B uptake and translocation in the plant. Investigations were carried out to gather background information. At first, data on B in the supply, the root environment and plant tissue were monitored at commercial holdings. Secondly four commercial sweet pepper crops were followed by sampling leaves from the same height and of the same age from February until July, together with monitoring data on fruit load and climatic conditions. After that, an experiment was set up to investigate the effect of B application, pH and fruit load. Sweet pepper was grown in rockwool, with reuse of drainage water. pH levels were 4.5, 5.5 and 6.5, Boron was applied at 25 and 60 $\mu\text{mol l}^{-1}$ and differences in fruit load was reduced from standard (100 %) to 66 and 50 %, by fruit pruning.

The results showed that in the first 15 weeks of the growing period, which coincides with the increasing fruit load period, the boron content in young leaves, decreases dramatically, moreover, in ageing leaves the B content does not accumulate.

After this period, B tends to accumulate easily, especially in old transpiring leaves, resulting even in B toxicity. This indicates that in the period of heavy fruit load, B uptake is restricted. pH had only minor effects. The B application had a significant effect on the uptake in the first weeks of the growing period. B deficiency can be avoided by a crop stage depended B application.

NOTES

MANGANESE CONTAINED IN SUBSTRATE-CLAYS - HARMFUL FOR PLANTS?

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Peat and peat/clay mixtures are commonly used as growing media for horticultural plant production. A threshold of 500 mg “active” Mn kg⁻¹ clay (sum of exchangeable and easily reducible Mn) in substrate-clays was defined in quality protocols to prevent Mn toxicity of pot plants.

This threshold value was validated in experiments with peat/clay blends and additionally nutrient solution experiments were conducted to improve understanding of Mn dynamics in pot substrates. Mn-sensitive bean plants were cultivated in different peat/clay substrates and in pure white peat under different moisture levels. Clays varied in their content of active Mn between 4 and 2400 mg Mn kg⁻¹ clay.

The results of the substrate experiments revealed that a threshold value for Mn in substrate-clays is not justified as plants grown in all peat/clay substrates developed no Mn toxicity even at high substrate moisture which increased Mn availability. Mn substrate tests did not well reflect the Mn concentration in plant dry matter and substrate solution.

Interestingly plants tolerated comparatively high Mn concentration in the substrate solution without toxicity symptoms. Possible reasons were i) that Mn was less phytotoxic because of complexation by dissolved organic matter (DOM) or ii) silicic acid dissolved in substrate solution alleviated the harmful Mn effects.

Thus the influence of silicon and DOM on Mn toxicity was characterized in nutrient solution experiments.

Mn toxicity was clearly diminished by silicic acid application but not by DOM. This explains the tolerance of bean plants in peat-substrates where high silicon concentration in the substrate solution was observed. Peat/clay blends even provided up to five times more silicon to plants than pure peat.

Keywords: silicic acid, peat/clay substrates, dissolved organic matter, Mn toxicity.

NOTES

THE USE OF THE INHIBITOR OF THE NITRIFICATION 3,4 DIMETILPIRAZOL PHOSPATE (DMPP) ON THE GROWING OF ROSE PLANTS CULTIVATED IN COCONUT FIBER AND SOIL

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Colombia is an important producer of cut-rose crops. As a result, it has been researching in crop techniques to improve the cut-flower quality and to be friendlier with the environment. Nitrogen Fertilizers can cause environmental issues due to nitrate leaching. 3,4-Dimethylpyrazole phosphate (DMPP) has been utilized to diminish nitrogen (N) loss from leaching or denitrification and to optimize N fertilization in crops. A greenhouse experiment was conducted to estimate the effects of DMPP on mineral N ($\text{NH}_4^+\text{-N}$ and $\text{NO}_3^-\text{-N}$) in leachates during ten weeks in two substrates (Soil and coconut fiber). Eight 'Charlotte' rose plants grafted on 'Natal Briar' were used per treatment. Two plants were cultivated in 8 L pots and were fertigated with $\frac{1}{2}$ Hoagland solution (without nitrogen). Each treatment was constituted by four pots. Each pot was daily irrigated with 850 ml of solution. Two treatments including Urea alone (UA) and urea + 1% DMPP (UDMPP) at a rate of 170 ppm were established. Results indicated that UDMPP reduced the $\text{NO}_3^-\text{-N}$ concentration in the leachate in both substrates. On the other hand, $\text{NH}_4^+\text{-N}$ leaching concentration was higher when rose plants were fertirrigated with UDMPP. These results suggest that DMPP can be an useful tool in cut-rose fertilizers programs in order to diminish nitrate losses.

Keywords: ammonium, nitrates, nitrogen fertilization, leaching

NOTES

WATER DISINFESTANTS SUCH AS CHLORINE AND OZONE INTERACT WITH PLANT NUTRIENT SOLUTIONS IN SOILLESS CULTURE

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Recycling of irrigation solutions to conserve water and reduce runoff increases the risk of plant pathogens, algae, and high microbial load spreading through the crop system. A range of water disinfestant technologies are being used in greenhouses, such as chlorine, chlorine dioxide, copper, ozone, and ultraviolet radiation. When these technologies are applied to a recirculating nutrient solution, or are injected in-line with water-soluble nutrients, detrimental oxidation or substitution chemical reactions with micronutrient chelates or nitrogen can occur, affecting the applied nutrient solution and potentially plant health. Because the nutrient solution can create a demand on the disinfestant active ingredient, there is reduced efficacy to control target microorganisms. Data will be provided on these interactions, including displacement of iron from chelates by copper, oxidation of iron chelates and manganese by ozone, and oxidation of ammonium or urea and formation of chloramines by chlorine. This research has practical implications when selecting, managing, and monitoring an appropriate disinfestant for different cropping situations.

NOTES

Session 5

HORTICULTURAL PRODUCTION: SUSTAINABLE USES OF GROWING MEDIA AND COMPOST

Invited Paper

TOWARDS SUSTAINABILITY IN GROWING MEDIA PRODUCTION AND USE

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Sustainability is commonly defined as the capacity to endure, with the World Summit of 2005 defining the major features of sustainable systems as a reconciliation of environmental, social and economic demands.

In terms of sustainability of growing media, peat has been identified by environmental lobbyists as an unsustainable constituent in terms of habitat destruction and potential contribution to climate change. Some of the most vociferous lobby groups occur in the U.K. where peatlands, particularly intact lowland raised mires, are rare, and peat extraction is seen as unsustainable. The activities of lobby groups have influenced the U.K. government: indeed a recent White paper issued by the U.K. government proposes phasing out peat in U.K. retail horticultural markets by 2020, and in the professional sector by 2030.

Manufacturers and retailers have reacted to the issue of peat use in growing media by developing alternative materials including wood fibre, green compost, composted bark and coir.

The consequent rapid use of alternative materials to peat within the U.K., despite innovative research by several manufacturers, has led to media of very variable quality arriving in retail markets, in turn giving rise to concern among many professional horticulturists.

This paper examines the rationale behind the proposals that peat is an unsustainable medium, and that other media are more sustainable. Sustainability is addressed not only in a narrow environmental sense in terms of climate change and biodiversity, but also in terms of social effects in terms of communities, and the economic sustainability of horticultural businesses that may face competition within a common trading bloc in the face of unilateral national decisions..

Keywords: peat, peat alternatives, climate change, biodiversity, social responsibility

ENVIRONMENTAL AND AGRONOMIC EVALUATION OF CONTAINERIZED SUBSTRATES DEVELOPED FROM SEWAGE SLUDGE COMPOST FOR ORNAMENTAL PLANT PRODUCTION

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A life cycle assessment (LCA) analysis of the aerobic and manufacturing processes of the mixed growing media and a growth test of *Bougainvillea glabra* Sanderiana in protected environment have been realized in order to evaluate the environmental and agronomical quality of a compost made of urban sludge and green waste.

The LCA has allowed to evaluate the environmental impact of the compost and the kind of growing media; the analysis has been done considering a composting process lasting 120 days, made by a firm specialised in waste recovery in Manduria. The structures and equipment together with all the inputs and outputs, both energetic and coming from the composting matter, have been considered. The transports of the composted waste, and the materials used to make the media have been evaluated. In order to make the growing media, the compost has been mixed with peat and pumice, which have constituted 30% of the volume of the mixtures in all of them. 70% in volume of the growing media has been obtained mixing peat and compost, this last one in percentages of 0%, 25%, 40%, 55%, 70 % of the volume.

The *Bougainvillea* plants have been grown for 180 days and fertirrigated with a different nutrient solution according to the compost percentage of growing media. The electric conductivity of the nutrient solution, and then its fertilizing ability, has been inversely proportional to the compost content of the growing media. The physical and chemical characteristics of the growing media have been determined. At the end of the cultivation trial, the best productive performances have been obtained using the growing medium with compost and inert media. Regarding the LCA analysis, the peat substratum productive process are the most impacting, this because by the extraction process and the relative transport of the peat in south Italy.

Keywords: LCA, *Bougainvillea glabra* "Sanderiana", pot cultivation, growing media characterization, peat free

NOTES

GROUND CORK AS A TOP COAT SUBSTRATE MATERIAL FOR SEED GERMINATION

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Seedlings are often germinated in plug trays by partially filling the plug tray with peat, sowing the seed on the base of peat and then covering the seed with a layer of fine vermiculite. This layer of vermiculite is usually referred to as a topcoat. Although vermiculite is commonly used as a topcoat for seedling plug production, it has disadvantages including high cost and the potential for contamination with undesirable components. Ground cork is a by-product resulting from the production of various cork products such as bottle corks and boards and can be ground to various particle sizes. The pore spaces in the cork particles are able to absorb and retain water which may allow it to serve as an alternative topcoat material to vermiculite. Mini plug trays consisting of 25 cells (5 x 5) with a volume of 5 mL were filled to within 3 mm of the cell rim with peat that had been adjusted to pH 5.7 using calcitic limestone. Seed of 'Orbit Cardinal' geranium (*Pelargonium x hortorum*), "Cooler Grape' vinca (*Catharanthus roseus*) and 'Dazzler lilac Splash' impatiens (*Impatiens walleriana*) were sown onto the peat surface and covered with 3 mm of either vermiculite or ground cork. Plug trays were placed in a greenhouse. Temperature set points were 18°C (65°F) for heating and 24°C (75°F) for cooling. Light levels averaged 350 - 400 $\mu\text{mol m}^{-2} \text{s}^{-1}$ at 12:00 HR. Plug trays were misted as required to maintain a moist topcoat.

After seedlings germinated and developed two true leaves, they were fertilized with a 25 mg L⁻¹ nitrogen solution twice weekly. For all plant species, days to germinate, percent germination, and dry shoot and root weights were not different between the seedlings germinated with a vermiculite top coat and those germinated with a ground cork topcoat.

Keywords: plugs, seedlings, cork, vermiculite, topcoat

NOTES

CASTOR BEAN FRUIT HUSKS AS SUBSTRATE FOR PALM SEEDLINGS

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Castor bean fruit husk is a residue which accumulates in high amounts in the castor bean oil industry. This research evaluated the use of composted castor bean fruit husks (CM) ground in different sizes (5 and 10 mm), either pure or in mixture with coconut fiber (FC) and with the commercial substrate (SC) PLANTMAX® as substrate for seedlings of the fishtail palms, *Caryota mitis* and *C. urens*. Two experiments were carried out. Experiment 1, with *Caryota mitis*, consisted of four treatments: S1- CM 10 mm and SC (1:1;v/v); S2 – CM 10 mm and FC (1:1; v/v); S3 – CM 5 mm and SC (1:1; v/v); S4 – CM 5 mm and FC (1:1; v/v); in four randomized blocks, with two pots per plot with one seedling each. The second experiment, with *Caryota urens*, consisted of three treatments: S1 – CM 10 mm; S2 – CM 10 mm and SC (1:1; v/v); S3 – CM 10 mm and FC (1:1; v/v), in three randomized blocks, each plot with two plastic pots (1L) containing one plant each. Fertilization was carried at three months after planting using 0.5 g per pot of (8-28-16). The number of leaves (NF), stem height (HC) and diameter (DC), the petiole (CP) and leaf (CL) lengths, the leaf width (LL), leaf (MSL), petiole (MSP), stem (MSC) and root (MSR) dry matter weights, and leaf SPAD index were evaluated.

Composition of CM was also determined. There was no difference among treatments on *C. mitis* NF, CL, LL, DC, MSL, MSP, MSC and MSR; substrates S1, S2 and S3 could be used indifferently considering most characteristics. There was no difference among treatments on *C. urens* NF, LL, DC, CP, MSL and MSR and, considering most characteristics, S2 was the best substrate. Castor bean fruit husk can be used as substrate for growing fishtail palm seedlings.

Keywords: *Ricinus communis*, growing media, *Caryota*, residues

NOTES

USE OF ORGANIC AMENDMENT AS SUBSTRATE IN TABLE GRAPE THOMPSON SEEDLESS: EFFECT ON ROOT SYSTEM AND SOIL INDICATORS

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Table grape is one of the most important export crops in Chile. The application of different organic matter (OM) as soil amendment and also as organic substrate for rooting sources is a common practice intended to decrease plant decay and stimulate root development. In order to evaluate the effect of the application of organic amendments on some soil quality indicators and agronomic variables in table grape (*Thompson seedless*) cultivated in a Chilean Limari valley soil, different treatments including compost from grape pomace, liquid humic acid, a commercial microbial inoculant, and chemical NPK fertilizers, was probed. Four C doses were evaluated: Compost, 500, 1000 y 2000 kg C/ha and for liquid humus, 100, 200 and 400 kg C/ha; compost and extracted humic substances at their maximum C rates were also evaluated in absence of chemical fertilization. The results indicated strong root development in plants with compost and inoculants application ($p=0,029$), obtaining 210% more root dry matter than the humus treatments, probably by production of indole acetic acid and the continuous mineralization of organic matter that causes the availability of nutrients for the plant; it was evidenced by the increase of the

enzymatic activities β -glucosidase ($p<0.0001$), acid phosphatase ($p=0.001$) and alkaline phosphatase ($p<0.0001$), in all compost treatment, been significantly higher than liquid humus treatments (56.6>13.8 UBG, 228.1>103.0 acid UP and 327.9>100.6 alkaline UP respectively); this can be explained by the fact that compost increased the total C, N and P, which stimulate the enzymatic activities. On the other hand, the humic acid applied caused suppression on the root biomass synthesis, probably because it had high pH, which indicates that this source of carbon has to be diluted or mixed with non humified sources of organic matter to expect benefits in further works

Keywords: compost, humic substances, root density, enzymatic activity, soil quality indicators

NOTES

THE EFFECT OF VERMICOMPOST ON THE GROWTH OF VEGETABLES

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Experiments were designed to clarify some physical, chemical and microbial properties of commercial vermicompost that had been mixed at proportions 1:1, 1:2, 1:4 and 1:8 by volume with neutralized peat. Control- neutralized peat mixed with inorganic fertilizer (NPK 11:11:22 with microelements) 50 g m⁻². The influence of mixed substratum on the growth of radish, cucumber and tomatoes seedlings under glasshouse conditions was tested. Microbial activity of substratum was assessed by soil respiration and enzymatic activity. Plant growth was tested by plant length, weight, leaf number and pigment content in leaves.

The growth of tomato and cucumber seedlings in the mixtures containing 50% vermicompost and 50% peat was reduced, possibly as a result of high soluble salt concentrations in the vermicompost. The best results were obtained with vermicompost and peat concentration 1:2 for all tested vegetables. Concentration of vermicompost 1:2 resulted in a significant increase in the growth of radish in comparison with inorganic fertilizer. Further dilution of vermicompost caused the decrease of plant parameters as well as pigment content in plant leaves as result of limited nutrient content in substratum.

Some of the growth enhancement in substratum seemed to be related to the combined effects of improved substratum physical, chemical and microbiological properties. Correlation of microbiological and enzymatic activity and vermicompost dose was observed.

Keywords: vermicompost , soil respiration, tomatoes, cucumbers, radish

NOTES

USE OF GROUND BAMBOO AS A REPLACEMENT FOR PINE BARK IN NURSERY SUBSTRATES

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Pine bark is the primary component used in container nursery production in the U.S. Availability of pine bark is decreasing, while cost is increasing. The objective of this research is to determine if ground bamboo could serve as a suitable replacement for pine bark in a short-production cycle nursery crop. Five substrates were mixed, each containing 15% (v/v) sphagnum peat moss and 5% (v/v) municipal solid waste compost. The remaining 80% (v/v) of container volume was filled with the following pine bark and bamboo ratios: 0:80, 20:60, 40:40, 60:20, or 80:0. All containers (2.8 L) were fertilized with 26 g controlled release fertilizer (Osmocote 18-6-12) and planted with a single hibiscus (*H. moscheutos*) plant from a 50-cell pack. With increasing pine bark in the substrate, air space decreased while water holding capacity increased slightly. With the exception of the treatment with 0% pine bark, all plants responded similarly in chlorophyll content over time. Early in the experiment, plants in 0% pine bark (80% bamboo) immobilized available N. After 4 weeks, the controlled release fertilizers provided sufficient N to overcome this immobilization. Substrate pH increased with decreasing pine bark fraction in the substrate. Substrates with at least 20% pine bark all had similar growth. Substrates with no pine bark (80% bamboo) were reduced in shoot growth and root mass. In all substrates, all foliar nutrients were well within or above the adequate range for this species. All substrates, including those with 80% bamboo and 0% pine bark, resulted in high quality and saleable plants, although those with 0% pine bark were smaller than others.

NOTES

SUITABILITY OF DIFFERENT COMPOSTS FOR CONTAINER PRODUCTION OF ORNAMENTAL SHRUBS

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Sewage sludge compost (SSC), municipal solid waste compost (MSWC), forest waste compost (FWC) and white peat (P) were used to formulate four growing media: SSC 100% v; MSWC+P, 1:1 v/v; MSWC+FWC, 1:4 v/v; and SSC+MSWC+P, 1:2:1v/v/v. The control substrate was a shrub nursery medium which is traditionally used for summer culture (mix of composted pine bark, sand, white peat and topsoil). Media were fertilized with a mix of slow release and controlled release fertilizers. Young plants of *Atriplex halimus*, *Nerium oleander* and *Pittosporum tobira* were potted in these five growing media and were cultivated at Mediterranean coast open air conditions from March to August. Physical and chemical properties of growing media were determined. At the end of the culture, plant growth was evaluated by measuring the following parameters: plant height, leaf number, leaf area, dry weight biomass (leaves, stems, shoots, roots and total), dry weight percentage of the organs and shoot:root ratio.

The best performance of *Nerium oleander* and *Atriplex halimus* was observed in plants grown in MSWC+P, showing the highest values in leaf area, dry weight of leaves, stems and total and also in shoot:root ratio. The worst results for oleander were obtained in the nursery medium, where individuals were shorter and presented the lowest figures in leaf area and dry weight of stems, root and total.

There were few significant differences among the others substrates in *Atriplex halimus* but it could be noted a decrease in leaves, stems and total dry weights in plants cultivated in MSWC+FWC. Growth results in *Pittosporum tobira* were affected by a fusariosis disease that was observed during culture. The best performance of *Pittosporum* plants was obtained in SSC medium, showing higher values in height, leaf area, and dry weight (total, leaves, stems and roots) than those observed in the nursery substrate, which was the worst substrate, similar to what was indicated for oleander. The beneficial effect of SSC could be related to *Fusarium* suppressive properties that had been proved for this compost.

The obtained results are discussed in relation to growing media properties and showed that the studied composts can be used as components for ornamental shrubs growing media.

Keywords: *Atriplex halimus*, *Nerium oleander*, *Pittosporum tobira*, sewage sludge compost, municipal solid waste compost, forest waste compost

NOTES

EFFECT OF ZEOLITE AND VINE VINASSE ON ROSE SEEDLING GROWTH

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In Italy, the production of ornamental plants in soilless growing media is an important cultivation system in nursery and rose is one of the most interesting grown species. One important aspect of cultivation in pot is the selection of the proper substrate for the cultivated variety in order to obtain an adequate nutrition leading to a positive effect on plant quality. The addition of biostimulant substances and organic fertilizers could optimize substrate properties, strongly influencing roots development and following nutrients uptake.

The objective of this study was to assess the effect of zeolite, alone or in combination with vine vinasse as organic fertilizer, on rose seedling growth in a model trial. We tested three varieties of rose, generally produced in Italian nursery: Fairy The Fairy (FTF), Bright 82 (B82), Double Knock Out (DKO). Granular (0.5-1 mm) or powdered (<30 micron) zeolite were alternatively added to quartz sand, as inert growing substrate, at dose 3% v/v, without or with addition of vine vinasse at concentrations of 1 g/L. Rose self-rooted cuttings were transplanted in pots containing the differently added substrates. After 70 days, plant height, number of stems, fresh and dry weight of aerial part, root length, root fresh and dry weight was determined.

The best results were obtained with FTF variety. The biometrical parameters of FTF variety were significantly influenced by both zeolite and vine vinasse application. In particular, the application of powdered zeolite with vine vinasse determined a significant increase of plant height and roots length in FTF variety, while this positive effect was not so evident in B82 and DKO varieties.

The addition of zeolite and vine vinasse to the substrate could improve its properties, representing a significant opportunity for optimizing plant root development.

Keywords: substrates, zeolite, root, ornamental plants

NOTES

EFFECT OF COMPOSTS ON GROWTH, PRODUCTION AND FRUIT QUALITY OF TOMATO CROP

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Composts increase concentration of soil organic matter and provide a long-term supply of nutrients with decomposition of their organic material (Evanylo and Daniels, 1999). Several composts from plant material were assessed by many authors for horticultural purposes. And several composts from animal material were also studied. Production and use of composts decrease the volume of wastes, offer a high potential substrate and reduce usage of peat in the market of growth media (Zoes et al. 2001). In this study, we tested the efficiency of three composts, made from *Posidonia* (*Posidonia oceanica*) (P), Chicken Manure (CM) and solid olive mill wastes (SOMW) on growth, production and fruit quality of tomato crop. Composts used in this study were produced in the Technical Center of Organic Agriculture in Chott Meriem-Sousse (Tunisia). Three composts (C1, C2 and C3) were tested, with the following combinations: i) C1: 50% (SOMW), 20% (P), 30% (CM). ii) C2: 35% (SOMW), 35% (P), 30% (CM). iii) C3: 20% (SOMW), 50% (P), 30% (CM). Three rates: 5%, 10% and 15% (v/v) of each compost were added to crop soil in 10L-containers and as control we used organic fertilizer at the same rates. Corresponding compost extracts were added to irrigation water. During six months, the following parameters were measured: shoot length, flower number, fruit number and yield. The following analyses were also done on tomato fruits: firmness, total sugar rate, pH and acidity. Results show that even with 10% of compost plant growth was significant. Fruit production was also significantly improved by compost fertilization.

Composts reduced the fruit firmness which allows premature harvest. Citric acid content was comparables with those in control and vitamin C content was close to literature values. As a conclusion, the use of composts based on (P), (CM) and (SOMW) as fertilizers is very promising.

Keywords: composts, growth, production, fruit quality, tomato crop

NOTES

EFFECT OF VERMICOMPOST, *Azotobacter* AND BIOPHOSPHATE ON GROWTH, NUTRIENT UPTAKE AND ESSENTIAL OIL CONTENT OF DRAGONHEAD (*Dracocephalum moldavica* L.)

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In order to study the effect of biofertilizers on growth factors, nutrient uptake (N, P and K) and essential oil content in Dragonhead (*Dracocephalum moldavica*), an experiment was conducted at Tarbiat Modarres University research station Tehran, Iran, at 2009 and 2010. The factors were vermicompost (0, 15 and 30 percent volume pot), *Azotobacter* (use and non use) and phosphate biofertilizer (use and non use). The experiment design was factorial experiment in the base of randomized complete blocks design with twelve treatments and four replications. Results showed that the highest concentration of nitrogen (2.27%), phosphorus (0.22 %) and potassium (2.51%), and the highest amount of fresh weight of vegetative part (44.26 g) and plant's height (49.25 cm) were obtained with vermicompost 30. Phosphate biofertilizer had a significant effect on phosphorus levels in the vegetation part of Dragonhead, so that the highest concentrations of phosphorus (0.22%) obtained with the application of biophosphate respectively and the highest essential oil content (0.74%) was obtained with Vermicompost-30. There were positive and synergistic interactions between factors, like interactions between vermicompost and phosphate biofertilizer on P concentration and interactions between vermicompost and *azotobacter* on seed weight per plant.

Keywords : *Azotobacter*, biophosphate, dragonhead (*Dracocephalum moldavica*), essential oil, vermicompost

NOTES

SUBSTRATE QUALITY, IRRIGATION MANAGEMENT AND THE PRODUCTION OF HIGH PERFORMANCE PLANTS IN GREENHOUSE

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Physical and hydrodynamic properties of a substrate play a key role in irrigation management in horticulture. Following irrigation, a high performance substrate should provide an adequate amount of water and air to the plant to ensure its optimal growth. Some producers pay less attention to the quality of the substrate. When working with low quality substrates with an insufficient aeration, they try to adapt the irrigation methods in order to produce high performance plants similar to those produced in well-aerated substrates. In this manner, producers adjust the amount of water during irrigation according to substrate quality. The objective of this study is to evaluate the impact of substrate quality in comparison with the impact of irrigation management on the growth and development of two popular species in greenhouse production (New Guinea impatiens and geraniums). According to our results, the use of a well aerated substrate combined with an appropriate irrigation method resulted in earlier maturity of the plants. This reduces the duration of plant growth and hence decreases the cost of energy by reducing the heating period in the greenhouse. The number of days saved using high quality substrates depended on irrigation management and were about 23 to 25 days for geraniums and 17 to 22 days for New Guinea impatiens.

The production of plants in well-aerated substrate improved the growth and the development parameters and resulted in high performance plants.

Keywords: substrate, physical properties, irrigation, management, greenhouse

NOTES

Special Conference

STRATEGIES FOR SUSTAINABILITY IN NURSERY PRODUCTION

STRATEGIES FOR SUSTAINABILITY IN NURSERY PRODUCTION

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A comprehensive literature search of industrial and agricultural by-products to replace or extend existing soilless substrate components would produce a seemingly endless list of materials from “garbage” to a plethora of manure-based composts. Many of these alternatives have shown promise, but most have limiting factors for integration and use as alternatives substrate components. Researchers are tasked with evaluating benefits that could improve current substrate physical or chemical characteristics. Substrate shrinkage, resulting in the loss of air filled porosity during 10 to 16 month production cycles is a common concern for container substrates used to produce woody ornamental crops. Conversely, highly porous substrates frequently retain little available water, potentially resulting in decreased crop growth. Components that meet criteria of low cost, ample and stable air filled porosity and sufficient available water are difficult to discover.

Researchers from throughout the United States are making a concerted effort to identify and evaluate regionally viable alternative soilless substrate components. At North Carolina State University we are investigating pine tree wood chips as well as agronomic crop residual (cotton stalks and gin trash) as “wrinkle free” alternatives to pine bark.

Colleagues at Auburn University are investigating the use of processed whole tree pine as a substitute for peat in production of floriculture crops. United State Department of Agriculture in Ohio is investigating the use biomass crops for temperate ornamental nursery crops.

Researchers at Kansas State University are investigating the use of an invasive species, Western red cedar, as a potential alternative substrate. Researchers in Oregon and Washington are utilizing forestry slash, Christmas trees, biosolids, and construction debris. Other researchers are evaluating quickly renewable sources including cereal crops and bamboo.

Objectives are to maintain or increase growth of nursery crops and to extend the longevity and acceptable physical properties for long-term woody ornamental crops. Results are determined using laboratory analyses and growth studies where physiochemical properties are monitored over days, weeks, and months to measure stability. Additionally, substrates are evaluated under industry conditions to determine impact on water, nutrient and pest management to better understand obstacles to adoption.

Keywords: container media, soilless substrates

Session 6

BIOLOGICAL INTERACTIONS AND PLANT PROTECTION

Invited paper

RECENT ADVANCES IN MICROBIAL ASPECTS OF COMPOST PRODUCTION AND USE

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Composting is the biological decomposition of organic matter under controlled, aerobic conditions, into a humus-like, stable product called Compost. Actually, a composting pile is a man-made ecosystem in which different microbial populations use organic compounds as nutrients and energy sources and as a result, some organic compounds are incorporated into microbial cells while some others are completely mineralized to simple inorganic molecules such as Carbon Dioxide, Ammonia and Water. This decomposition is extremely oxygen dependent since the microorganisms involved obtain energy through aerobic respiration. This fact is importantly related to the high amount of chemical energy produced, part of which is released as heat, increasing the entropy of the surroundings.

Many environmental factors affect the biodegradation of organic matter (temperature, nutrients and oxygen concentration, moisture, pH, etc.). In composting processes, these parameters are controlled and can be conveniently adjusted or fixed so microorganisms can find the best conditions to grow and develop their biological activities.

Most of the initial knowledge about the way in which a composting process had to be driven was empirically obtained. Today we know that all technological efforts made to control environmental parameters, are intended to encourage microbial growth and activity. Thus, if the right mix of raw materials is given and the environmental factors are conveniently controlled, the microorganisms will do their job and good compost will be obtained.

The results presented here were obtained from 3 composting piles made of tomato plant waste and pinewood shavings (C/N=25). Piles were actively aerated (7.5 – 9.0 L kg⁻¹ every 4 hours) and turned after thermophilic phases while there were fluctuations in temperature. During turning operations, water was added when necessary so moisture was maintained at 50%. Samples (there were 19 samplings) were taken following the temperature profile in the piles. At each sampling time, compound samples were withdrawn and main microbial groups (bacteria, actinobacteria and fungi) were determined by culture techniques using selective culture media and two temperatures for incubation (30 °C for mesophiles and 55 °C for thermophiles). At sampling times, some enzymatic activities were also determined.

Contrary to what could be expected, the different microbial populations maintained a similar presence throughout the process, although some parallelism with the temperature profile was noted. Only in the case of thermophilic fungal populations, there was a greater reliance on high temperatures.

This could indicate that most of the microorganisms involved are either thermotolerant or produce resistance forms (i.e. spores) that enable them to remain viable along the process. Initially, more than 5700 colonial morphotypes could be distinguished. With respect to the number of different morphotypes isolated on each sampling and for each of the microbial groups investigated, it could be noticed that biodiversity increased for Actinobacteria and Bacteria, whereas the fungal biodiversity markedly decreased throughout the process.

In general, all enzymatic activities related to carbon and nitrogen metabolism (amylase, β -glycosidase, protease, xylanase and urease) reached peak levels at the beginning of the process, when thermal fluctuation and microbial activity are at their highest, and stabilized during the maturation phase. Cellulase had a significantly different profile, as it increased at this late phase, indicating the degradation of lignocellulose persists even in the later stages of composting. High levels of alkaline phosphatase were also detected at the end of the process, which is beneficial for the nutritional quality of compost.

Another extraordinarily interesting aspect related to the compost microbiota is the ability to modify the properties of the final product by the inoculation of specific microorganisms during the process or at the end of it. In this way, it is possible to obtain composts as biostimulants, biofertilizers or bioprotectors of plant health.

Keywords: compost microbiota, compost biodiversity, compost enzymes, compost on demand

CAPACITY OF COMPOSTS MADE FROM AGRICULTURE INDUSTRY RESIDUES TO SUPPRESS DIFFERENT PLANT DISEASES

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Composted residues from different agricultural industries that are used as growing media have been shown to suppress different plant diseases. Those media are: cork compost (used alone or mixed with rice hulls); grape marc compost; olive marc and cotton gin trash (2/3, v/v) composted and mixed with rice hulls (1/1, v/v); and spent mushroom composted and mixed with peat or with rice hulls (1/1, v/v). This disease suppressive capacity was evaluated in bioassays involving pathogen inoculation and subsequent development in growth chambers or greenhouses. The diseases suppressed were tomato (races 1 and 2) and carnation Fusarium wilt, and three cucumber diseases caused by *Pythium aphanidermatum*, *Rhizoctonia solani* and *Botrytis cinerea*. In order to compare severities or incidences in other growing media, development in light peat and/or coir fiber was also evaluated.

Fusarium wilt severity was reduced by 99.9% in tomato and 99.2% in carnation.

The most effective compost in controlling these diseases was grape marc compost. All the composts suppressed *Pythium* damping-off even with different maturation times. Mature grape marc compost showed the greatest reduction in severity of this disease (97.8%). *Rhizoctonia* damping-off bioassays showed that suppressive capacity increases over time after composting, with mature cork compost the most suppressive (97.2% reduction). Finally the severity of *Botrytis cinerea* was also reduced by these composts, which shows their capacity to suppress soil-borne as well as foliar plant diseases.

Keywords: *Fusarium oxysporum*, *Pythium aphanidermatum*, *Rhizoctonia solani*, *Botrytis cinerea*, plant growth media

NOTES

CONTROLLING *Rhizoctonia solani* IN CUCUMBER USING COMPOST OF AGRO-INDUSTRIAL WASTES

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The objective of this work was to study the suppressivity of composts of agro-industrial wastes on *Rhizoctonia solani* in cucumber.

Composts were prepared with: orange wastes, olive pomace, and grass clippings, in the proportion of 2:1:1 (v/v). Two composting methods were used: static pile with forced ventilation and mechanically turned pile with natural ventilation.

Composts were tested for their suppressive capacity after 151, 375 and 700 days of composting. A commercial peat based substrate was used as control (Klasman Deilmann, Germany, high moor peat), previously inoculated and incubated at 25° and at 60°C.

Cucumber (*Cucumis sativus* L. "Negrito") was used as the test plant, sown in the substrates with and without inoculation of *Rhizoctonia solani*.

The germination percentage and the severity of disease incidence were determined for each substrate, as well as their physico-chemical and microbiological characteristics.

In the substrates with compost, the severity and incidence of *Rhizoctonia solani* were lower than in peat substrate. Lower biological control of the disease was obtained with 375 days old composts.

The studied composts can be used to reduce the effects of *Rhizoctonia solani*, thus reducing the use of fungicides and contributing to a more sustainable agriculture.

Keywords: suppressivity, severity, incidence, soil disease, substrate

NOTES

EFFICACY OF THE MICROBIAL CONTROL AGENT *Trichoderma asperellum*, STRAIN T34 AMENDED WITH DIFFERENT GROWING MEDIA, AGAINST SOIL AND LEAF PLANT PATHOGENS

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Suppressive composts are a viable alternative to fungicides for biologically controlling diseases of plants grown in pots. However, not all composts suppress plant diseases and also the range of pathogens affected and level of suppression vary. Moreover, formulation of composts is sometimes necessary in order to improve their physical and chemical characteristics and this leads to a reduction in their suppressive capacity. In this study, the efficacy of the biological control agent *Trichoderma asperellum*, strain T34 (amended to the growth media) is evaluated against different soil and foliar plant diseases. Amendment of T34 to conducive peat or perlite significantly reduces *Fusarium* wilt severity and/or incidence in carnation and tomato. Amendment of T34 to natural suppressive young cork compost significantly reduces *Rhizoctonia solani* incidence in cucumber plants. In the same set of experiments, amendment of T34 to conducive peat and to spent mushroom compost formulated with peat (1:1, v/v) resulted in the same levels of disease suppression as is found naturally in young cork compost.

Amendment of T34 to aged suppressive olive marc compost and spent mushroom compost improved their natural suppression capacity. However, T34 does not improve the high level of suppression of aged cork compost and grape marc. Moreover, T34 amended to hydroponic and sand potting soil significantly reduces disease caused by the foliar bacteria *Pseudomonas syringae* pv. *lachrymans* and pv. *tomato* and by the fungus *Plectosphaerella cucumerina* by induction of disease resistance in cucumber and *Arabidopsis* plants.

Keywords: biological control, compost, plant disease, suppression

NOTES

EFFECT OF ALGAL INOCULUM ON GROWTH OF POT PLANTS

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Much attention has been paid to study of nitrogen fixation by blue-green algae in paddy fields. Beneficial effects of cyanobacterial inoculation were reported for other crops. Beside nitrogen fixation, blue-green algae supply substances to promote plant growth like auxins, cytokinins, gibberellins, abscisic acid and ethylene. The effect of algal inoculum (*Anabaena*) on three vegetable plants (cucumber, tomato and squash) and three herbaceous plants (chamomille, garden savory and water mint) was studied. Monoalgal cultures were grown in BG11 nitrogen free medium in two liter container at 24°C and 12/12 h light-dark cycle at artificial illumination (2000-2500 lux) with constant stirring and aeration. After three weeks culture was harvested and used as inoculum. Five healthy seedlings of each species were grown in 1 liter pots (14 cm diameter) including 60% peat, 25% sand and 15% normal soil. No fertilizer was applied, but 400 milliliters of algal suspension (OD=3) or water was sprayed for treated and untreated pots, respectively. Pots were arranged in a completely randomized design in an experimental greenhouse. Growth of plants was evaluated by measuring plant height, root length, number of leaf and flowers 50 days after planting.

From the results described in this paper, it is clearly showed that the algal inoculum contained some substances that can promote plant growth, especially plant height and root length.

Keywords: cyanobacteria, algal culture, plant growth

NOTES

THE EFFECT OF THE FOLIAR APPLICATION OF SURROUND WP® ON THE POPULATION OF ARTHROPODS AND GROWING OF THE ROSE PLANT ESTABLISHED IN RICE HUSK

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NOTES

One experiment was carried out in greenhouse conditions on cut-rose plants (*Rosa* spp.) during ten weeks in Mosquera (Colombia) to evaluate the effectiveness of a Kaolin-based particle film (Surround WP®) on arthropods population. Five 'Charlotte' rose plants grafted on 'Natal Briar' were used per treatment. Plants were cultivated in 8 L plastic pot, containing burnt rice husk at 100% as substrate. Three treatments were established according the type of agrochemical compound. Treatments were the following: i) plants did not receive any agrochemical application (control plants); ii) plants treated with Kaolin-based particle film (Surround WP®) and iii) plants treated with a pyrethroid insecticide (Brigada®). Rose plants received kaolin particle film applications at beginning of experiment and fifth week after starting treatments. Pyrethroid applications were conducted at one week interval during ten weeks. Results obtained showed significances differences were not found between treatments arthropods populations. Mites were only arthropods population observed in the experiment. Results suggest that kaolin particle film needs more studies to be considered an useful tool in pest control programs in ornamental crops in Colombia.

Keywords: pest management, mites, floriculture, insecticide

POSTERS

Poster Session 1

ADVANCES IN ANALYTICAL TECHNIQUES FOR GROWING MEDIA AND COMPOSTING

INCUBATION TIME AND MICROORGANISMS INNOCULATION IN THE DETERMINATION OF NITROGEN IMMOBILIZATION INDEX IN GROWING MEDIA

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Microorganisms can immobilize mineral nitrogen in some growing media with high C/N rate. This process has been especially described in materials like wood fibre substrates. The nitrogen Draw Down Index-NDI (Handreck) is usually employed to determine the nitrogen immobilization in growing media. This method consists in replacing the free water of the substrate by a KNO_3 solution and in comparing NO_3 content at the beginning and after a incubation during four days. In this trial mineral N immobilization of seven organic growing media was measured by NDI methodology and by two variants of it. These variances are related to the incubation time and to the addition of microbial to the substrates. Growing media measured were peat, two kinds of pine wood fibre, oak wood fibre, coconut fibre, pine sawdust and oak sawdust. These growing media are different in terms of their raw materials and manufacturing processes. Results showed nitrogen immobilization in all materials tested, but the results were different depending on the methodology employed. The Nitrogen Immobilization Index changed along the incubation time in some substrates. Moreover, the addition of microorganisms to the substrates increased the immobilization of nitrogen in the substrates with pine wood fibre. These substrates reached temperatures higher than 80°C during the manufacturing process.

Beside this, to know the NDI evolution in a longer incubation time could be highly interesting for fertilization management in container crops. In light of these results we conclude that NDI original methodology should be adapted to the specific characteristic of some growing media.

Keywords: NDI, wood fibre, hydroponic crops

NOTES

ROOT OXYGEN USE DETERMINATION OF PROPAGATED CUCUMBER ON ROCKWOOL CUBES

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Cucumbers were propagated in rockwool cubes in a climate cell for four weeks. The complete root system of each cucumber was enclosed in an airtight box. Each box was connected to an air bag, which acted as an air reservoir. A peristaltic pump ensured air circulation in the system. Treatments included maintenance of oxygen levels at 21%, 7% and 2% in specific box-bag systems. The goal of this experiment was to measure the critical oxygen supply rate for normal production. Additional goals were to characterize plant and root growth affected by low oxygen availability. With a spectrophotometer it proved possible to measure and monitor the oxygen level in the box-bag system at various points. A critical oxygen re-supply level between 8 and 12% was found for this system. A maximum oxygen use of 5.8 mg/h was reached by plants with a growth equal to the reference plants. The above ground growth reaction to mild prolonged sub-optimal oxygen supply rates included a 20-50% reduction in leaf area, fresh and dry mass production and, less pronounced, a reduction in plant length and root dry mass production. The root growth reaction to mild prolonged sub-optimal oxygen supply rates included a decrease in root mass production rate in proportion to the above ground dry mass production rate. The root oxygen use rate during the light period was 5-10 times higher than during the night period. It is unlikely that the absolute oxygen level causes the growth reduction.

Local oxygen depletion in the substrate is a more likely cause. Local oxygen depletion might be the result of the interaction of oxygen supply rate and substrate diffusivity. Other possible causes are the accumulation of gasses as carbon dioxide and ethylene to phytotoxic concentrations.

Keywords: rhizosphere, tortuosity

NOTES

pH IN ROCKWOOL PROPAGATION BLOCKS: A BALANCE METHOD TO CALCULATE pH DETERMINING PROCESSES INCLUDING PLANT GROWTH

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Within the framework of the international KIWA quality label for rooting media representatives of plant propagators and the rockwool industry agreed to develop a method to characterize the influence of the rooting medium materials on the pH in cultivation. A series of experiments allowed discerning the effects of rooting media choice, plant growth and the influence of microorganisms on the pH in a block of rockwool or perlite. Sweet pepper and cucumbers were grown in four types of rockwool and one type of perlite. In order to make a balance of all possible acid producing or consuming processes in the propagation blocks, the nutrient solution was monitored for changes in:

- 1) Phosphate. A loss of phosphate was interpreted as precipitation of CaHPO_4 and was taken as the disappearance of 1 mmol acid per mmol PO_4 missing.
- 2) Bicarbonate. The appearance of bicarbonate, HCO_3 , was interpreted as the liberation of 1 mole of hydrogen per mole of bicarbonate.
- 3) pH. Any deviation between the measured and calculated pH was taken as an unexplained rest.

- 4) Nitrate. The disappearance of nitrate from the solution was interpreted as the conversion of nitrate into nitrogen gas by denitrification and calculated to have taken two mole hydrogen for every mole of nitrate.
- 5) Ammonium. The disappearance of ammonium from the solution was interpreted as the conversion into nitrate which delivers four moles of hydrogen per mole of ammonium disappeared

This balance showed that the main pH determining activity in propagation is plant growth. Another important process was the apparent denitrification which seemed to take place under a wider than expected range of circumstances. The influence of the propagation pot material is usually not determining the pH in a propagation block once roots reach the bottom of the material.

Keywords: sweet pepper, cucumber, exudation

NOTES

INFLUENCE OF MATERIAL ON THE PHYSICAL CHARACTERIZATION OF GROWING MEDIA USING STANDARD METHODS (CEN-EN)

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At first, methodologies for the study of physical properties of growing media were diverse. These methodologies were adaptations of those for other materials, mainly wastes and soils. Some of these methods evolved and have acquired their own identity as a methodology for studying the physical properties of growing media. European Standards for growing media and organic amendments characterization (CEN-EN) are an important step in the unification of terms and, above all, offer an analytical methodology that allows for a critical study of the properties, while providing an objective comparison of results. But applying the same methodology to different types of materials can cause errors in the results. In this paper a comparative study of implementation of CEN-EN Standards to samples of pine bark and vermiculite is carried out. The difficulties are specific to the composition of materials. Water Buffering Capacity values for pine bark show that the UNE-EN 13041:2001/A1:2007 Standard should undergo modifications in order to improve its adaptation to substrates with high water holding capacity (such as bark pine).

It could be said that some materials with slow air-water balance should increase the balance time at -50cm and -100cm above the 24 hours recommended by the UNE-EN 13041 to obtain results closer to expected values. In handling these materials, such as CP (pine bark) and some peat, wetting agents should be used in the substrate. On the other hand, when measuring TOM by ignition (UNE-EN 13030.2001) for mineral materials such as vermiculite, it would be necessary an alternative method for real density determination. We suggest picnometry as a feasible technique for these kinds of materials.

Keywords: pine bark, vermiculite, water retention, loss on mass on ignition

NOTES

ASSESSING COMPOST PHYTOTOXICITY USING COMPOST ELUTRIATES AND A COMPOST PLATE BIOASSAY

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Phytotoxicity tests are one of the most effective criteria for assessing compost quality for agricultural purposes and for determining the optimal application dose. With the former, the tests employed do not usually consider the effects of the solid phase on seed germination because compost aqueous extracts (elutriates) are used; with the latter, pot greenhouse experiments are normally laborious, costly and time-consuming. In this study, we used two methods: a modified Zucconi test (TZ) and a plate bioassay (BP) to assess the possible phytotoxicity of two composts; it is noteworthy that the seeds in the BP are deposited directly on 20 g of sample in a petri plate at 70% of the water-holding capacity; thus seed germination and seedling development take place in contact with the solid phase and liquid phase. The TZ test was done using *Lepidium sativum* L. while the BP test used *Hordeum vulgare* L., *Lactuca sativa* L. and *Lepidium sativum* L. The composts employed came from a treatment plant that processes the organic fraction of solid municipal waste with low stability (C1), and from agro-industrial waste composts with a good maturity index (C2) (Experiment 1). Moreover, the BP using barley and lettuce seeds was done to assess its effects as a soil amendment and to estimate the optimal compost C2 application dose on an agricultural *calcaric Fluvisol* soil type; the additional doses as percentages of fresh weight

were: 0%, 2%, 4%, 8%, 16%, 32% and 100% (Experiment 2). The results of Experiment 1 showed that both TZ and BP are useful for assessing the phytotoxicity degree of compost, and indicate phytotoxic effects for compost C1 and positive effects for compost C2. The results of Experiment 2 indicated differences in root elongation and shoot development for both barley and lettuce depending on the dose applied to the soil, which suggests that BP is sensitive for this type of test; in this case, the results reveal that doses of 2% for barley and 16% for lettuce lead to enhanced plant growth. After considering the simplicity, speed, low cost and sensitivity of BP, we suggest its use with seeds of species such as lettuce and/or barley to assess the phytotoxic effects of compost, and to estimate the most appropriate application dose.

Keywords: Zucconi test, compost maturity, soil amendment, optimal dose

NOTES

DEVELOPMENT OF A SENSOR TO MEASURE VOLUMETRIC WATER CONTENT AND PORE WATER ELECTRICAL CONDUCTIVITY OF SOILLESS SUBSTRATES

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Soil moisture sensors designed in the past have been primarily designed for use in agricultural applications. Horticultural scientists have used these sensors to improve precision irrigation, but have been frustrated by: 1) The lack of calibration curves in soilless substrates; 2) Prongs that compress substrates creating air gaps and 3) the inability of the sensors to be used to calculate pore water electrical conductivity (EC), which is a necessary parameter in fertilizer management and scheduling.

The goal of this research was to design a sensor that can be used to measure volumetric water content (VWC), temperature, and bulk electrical conductivity (EC) in soilless substrates. These values can thus be used to model pore water EC, a valuable metric for scheduling fertirrigation.

In order to do this, the sensor must:

- Accurately measure the variables necessary for calculating VWC of common soilless substrates
- Accurately measure the variables necessary to calculate the EC of the water in soilless substrates, or pore water EC

In order to check the accuracy of the VWC measurements done with the newly designed probe, the ϵ was measured in the ranges occurring in growing media. Later, a predictable relationship was established between a substrate's ϵ and VWC.

Regarding EC measurements, three types of EC are discussed in horticulture: 1) Pore water EC (useful in determining salt stress and fertilizer concentrations and it's commonly calculated from VWC, temperature and bulkEC data); 2) Saturation extract EC and 3) Bulk EC, this value is typically the value read by various sensors.

The greenhouse-specific sensor that has been developed measures EC directly with two of the tree steel needles at the same location that the ϵ is measured.

Further works includes creating a “best practices” methodology for installation and data interpretation.

NOTES

Poster Session 2

NOVELTIES IN MATERIALS, USES AND PROPERTIES OF GROWING MEDIA

ANALYSIS OF PHYSICAL AND CHEMICAL CHARACTERISTICS OF COMMERCIAL SUBSTRATES AND COMPARISON WITH A COMPOST OF ORGANIC MUNICIPAL WASTE

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For environmental reasons there is a growing pressure to reduce the use of peat as substrate component and to increase the use of other materials, such as municipal source separated organic wastes that very often go to landfill. In this study the physicochemical characteristics of 16 commercial substrates were compared with those of a compost of the source separated organic fraction of municipal solid wastes, with different periods of maturation, to identify compost constraints as a substrate component and to suggest composting adjustments to achieve more suitable characteristics in the final composts.

The main limitations of composts as substrate components identified were low C/N ratio, high pH and high electrical conductivity values, and very high contents of ammonia, sodium and potassium. These limitations may be minimized by raw materials selection for the composting process with increased C/N ratio and decreased electrical conductivity and maintaining compost moisture content during its maturation phase, to increase remaining organic matter mineralization and ammonia nitrification.

Due to above mentioned limitations the incorporation of this compost on substrates for block-peat based substrates and plug trays is limited. On the contrary, this compost may be used as substrate component for cultivation bags and pot plants, in different proportions, depending on the container size and on the crop characteristics, mainly if produced from organic materials with increased C/N ratios. In these circumstances, improving the quality of source separated organic waste composts together with the growing pressure to reduce the exploitation of peat it is likely to increase their use for the production of horticultural substrates.

Keywords: ammonia, C/N ratio, electrical conductivity, peat, pH

NOTES

GROWING MEDIA USED BY NURSERIES FOR CONTAINER-GROWN ORNAMENTAL PLANTS IN GIRONA (CATALONIA): A SURVEY OF 1996 AND TODAY

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Most of the ornamental plant nurseries in Catalonia are located in the northeastern Province of Girona. The estimated area of land devoted to growing ornamental plants in nurseries in 1996 was 900 ha, compared to the current area of 1600 ha. Based on information provided by business organizations and acquired from surveys of nurseries, the growing media most widely used in 1996 and today were identified and analysed. Changes have occurred in these growing media in terms of the nature of the components, how the growing media are made, and the properties and reproducibility of the mixtures. For example, forest litter and different fractions of fine sand were commonly used in 1996, but have since been replaced with peat moss, composted pine bark and smaller amounts of coconut fibre and trimming compost. In 1996, it was common to prepare growing media at the nursery using components from the nursery itself, which meant that the mixtures were not standardized and were difficult to reproduce. Most nurseries currently use growing media supplied by specialized companies that are prepared based on standardized, reproducible formulas.

The current trend is to use raw materials with a high degree of biostability to ensure the original properties of the growing medium are maintained during the entire growing period. Results show that the types of growing media used by the ornamental plant nurseries in the area studied, their reproducibility and properties have improved considerably in terms of agricultural results.

Keywords: growing media, biostability, substrate standardization and reproducibility

NOTES

BENEFICIAL EFFECT OF COCONUT FIBER AND PEAT ON PHYSICAL QUALITY OF NURSERY SUBSTRATE

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During the production of nursery plants in summer, when the plants are well developed, the water requirements can be very high. This can result in high frequency of watering. The principal challenge for development of the high quality substrates is usually the establishment of an optimal rate of air and water in the substrate. The purpose of this study was to evaluate the impact of the coconut fiber and peat on physical quality of nursery substrates. The performance of several organic substrates under *Rudbeckia goldsturm* production was evaluated by adding different rates of coconut fiber and peat. The substrate composed from bark and peat moss resulted in a 15% increase in easily available water (EAW) compared to other substrates. The EAW's improvement did not affect the number of watering; however, it had a beneficial impact on the growth and development of rudbeckies. The affected parameters were growth index (10%), the shoot dry weight (14%) and the root dry weight (11%). Inversely, the increasing rate of coconut fibre application up to 30% improved by 33% the relative gas diffusivity compared to control with no important impact on EAW.

Keywords: peat moss, bark, coconut fiber, physical quality, nursery substrate

NOTES

STRAWBERRY CULTIVATION USING GEOSYNTHETICS

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The geosynthetic is a pierceable flat textile material made up of fibres used in civil works as a separator plate for the conduction of drains, roads and roof gardens. Different types of substrates have recently been shown to be perfectly viable alternatives to other more traditional ones such as rockwool, perlite and some hydroponic systems. The study was conducted in a 375 m² polyethylene greenhouse in the "La Rábida" Campus of the University of Huelva, Spain (37° 12' N, 6° 57' W). Three different short-day strawberry cultivars ('Ventana', 'Camarosa' and 'Candonga') were grown in a closed soilless growing system from October 2008 to June 2009. A randomized complete block design with three replicates was performed to evaluate the effects of the use of geosynthetic in line and geosynthetic in bag, comparing them with rockwool, perlite and coconut peat in terms of yield and fruit quality characteristics of the strawberry. The aim of the present study was to optimize and improve strawberry soilless culture through the use of geosynthetic (polypropylene) as a substrate to achieve greater efficiency in water use and fertilizer; and to study the impact of these farming techniques on the nutritional quality of fruit and the postharvest conservation of the strawberry.

Keywords: *Fragaria x ananassa* Duch., yield, soilless, geotextil, hydroponic

NOTES

USE OF DIFFERENT POT CHAINS AND SUBSTRATES IN A NEW TRANSPLANT PRODUCTION SYSTEM

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A new integrated sowing-transplant system (Plant Tape System) for large-scale producers had been developed aiming for more efficiency on this kind of operations. The system seems a more efficient alternative for the conventional transplanting methods using seedling plugs and substrate blocks. The system has a lot of advantages such as fully automatic transplanting system which can reach a high speed, reduction of greenhouse space and cost, seeds are sowed in a small quantity of dry growing media and the germination process can be initiated at any desired point in time.

Substrate and its support materials are important for seedlings development due to the small volume as a whole. Our aim was the study of these materials to determine which are the most favorable for the germination and the development of lettuce plants.

Three substrates-supports (substrate: mix based on coconut and peats. Supports based on different celluloses) were tested. During the growth stage, parameters were analyzed to indicate the aerial quality (number of leaves, height, diameter, specific foliar area and the ratio of height/diameter) and the specificities of the root system (location of the roots and their occupancy within the substrate-support).

The results showed a better aerial and root growth for mix of peat substrate plus dark cellulose as a whole.

Keywords: seedling, sowing system, root quality

NOTES

FACTORS AFFECTING THE SWELLING CAPACITY OF PEAT BASED SUBSTRATES

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Peat, quite rarely is sold loose, more frequently is compressed in order to save volume and reduce the transport costs. The peat ability to regain the initial volume (swelling capacity) after compression is an important feature of this organic media and can influence dramatically the final volume. Sometimes the natural swelling cannot reach the volume expected and that can generate commercial controversial between producer and final user. The UNI EN 12580 norm clarify that sample must be prepared following the producer instruction before analyzing the commercial substrate but unfortunately precise information regarding this point is not so easy to collect. In order to understand if some factors play or not a role on peat swelling capacity some analytical trials has been carried out.

The following factors have been studied: peat degree of decomposition, water amount added, initial peat humidity, peat particle fractions and finally time spent between water application and volume measurement.

Results shows a great influence of nearly all the studied factor except for the time spent between water application and volume measurement. Practical applications could aid substrate producers and growers to optimize peat based substrates use.

Keywords: Von Post Degree, EN 12580, granulometry, peat humidity, peat compression

NOTES

WATER REPELLENCY OF ORGANIC GROWING MEDIA AND ITS INFLUENCE ON WATER RETENTION PROPERTIES EVOLUTION

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NOTES

As for soils, most of growing media can present more or less important hysteresis phenomena during drying/wetting cycles, which greatly affect hydraulic properties. In case of organic media, the acquisition of a hydrophobic character during desiccation could be considered as one of the main factors conditioning hysteretic behaviours.

To verify that, the respective evolutions of the wettability (by contact angle measurements) and of the water retention properties, θ (ψ) during several drying/wetting cycles with varying intensities ($0 \leftrightarrow -5$ kPa, $0 \leftrightarrow -10$ kPa, $0 \leftrightarrow -32$ kPa) were estimated on a slightly and highly decomposed peats and coco fiber.

Results show different physical behaviours depending on the material, with an unimodal (black peat) or bimodal porosity (white peat and coco). Whatever the growing media tested, water retention hysteresis was successfully modelled using a van Genuchten-Durner modified approach (VG_n model), which allowed taking into account local hydrophobicity of each poral domain of the porous media (1 or 2 depending of the material). The whole of these results seemed to indicate that water retention properties and their evolutions were strongly influenced by hydrophobicity of these organic substrates.

Poster Session 3

NEW DEVELOPMENTS IN COMPOSTING AND COMPOST PRODUCTS

THE EFFECT OF FEEDING FREQUENCY WITH MUNICIPAL WASTE ON HOME COMPOSTING PROCESS

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Home composting is an eco-friendly strategy in order to prevent organic municipal waste generation. More information is necessary to improve the process and to ensure the production of high quality compost susceptible to be employed without restrictions. One of the factors to be clarified is the effect of the feeding frequency of the compost bins with waste.

The aim of this work is to analyze the effect of compost bins feeding frequency on the evolution of the process and the quality of the final compost obtained.

Sixteen compost bins were fed with 100 kg of municipal waste applied at three different frequencies as follows: once a week, once every three weeks, or the entire amount in a single time at the beginning. On a fourth treatment the compost bins were completely filled every week. All treatments were repeated four times in compost bins of 320 L of capacity. They were fed with rubbish collected in a street market (mainly vegetables) and with woody garden waste from municipal parks mixed in a 1:0.7 weight proportion.

Temperature and volume evolution during composting cycle was measured. At the end of the experiment the composts were weighed and characterized. Therefore, different physical, chemical and biological parameters were analyzed.

In this work the effect of the different feedings frequencies on the above mentioned variables is discussed.

Keywords: prevention, kitchen wastes, garden wastes, on site composting, compost

NOTES

IN SITU COMPOSTING OF AQUACULTURE ANIMAL BY-PRODUCTS: COMPOSTING CONDITIONS AND COMPOST QUALITY EVALUATION

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Animal by-products not intended for human consumption are a potential source of risks to public and animal health. The revised Animal by-products Regulation (EC) No 1069/2009, which will enter into force in 2011, has introduced a formalised procedure for applications methods of use and disposal for animal by-products. Category 2 materials shall comprise, among other things, animals and parts of animals that died other than by being slaughtered or killed for human consumption, including animals killed for disease control purposes. In the case of material originating from aquatic animals, composting process is one of permitted management practices for this category. Moreover, in situ management is a cost savings for the aquaculture producer.

The aim of this work was the evaluation of aquaculture animal by-products (AAB) in situ compostability and the feasibility of its composting to produce quality end-products without biohazard problems. The AAB (mainly seabream (*Sparus aurata*) and seabass (*Dicentrarchus labrax*) wastes) was a low C/N ratio. Since the recommended initial value of the C/N ratio is in the range 25-35, pine (*Pinus pinea*) sawdust (S) was added as an additional carbon source.

Several composting assays on a pilot composter reactor were carried out in a fish farm located on a salt marsh. Several composting process variables were tested, such as fish pre-treatment (milling, chopping or whole fish) and ratio AAB/S (1/1,5 and 1/2 v/v). The selected composting conditions are a ratio 1/2 (v/v) AAB/S with whole fish. Composting fermentation phase had an average duration of 15-20 days in the reactor, and approximately two months of compost stabilization-maturation outside reactor at environmental conditions.

As maturation parameter germination index (IG) and Solvita® test were used. All produced composts presents an IG>110% and a Solvita® results that indicates its maturity, and physico-chemical characteristics that make suitable its use as fertilizer or substrate.

Keywords: *Sparus aurata*, *Dicentrarchus labrax*, Regulation (EC) No 1069/2009

NOTES

MINERALIZATION OF MANURES COMPOSTED UNDER DYNAMIC AND STATIC COMPOSTING SYSTEMS

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The application of compost to soil is a current environmental and agricultural practice for maintaining soil organic matter, reclaiming degraded soils and supplying plant nutrients. It avoids the problems caused by the soil-application of non-stabilized organic materials, which could provoke harmful nutrient losses and a poor plant growth and crops damages by competing for O₂ or causing phytotoxicity to plants due to insufficient biodegradation of organic matter. The compost quality to be safely used in soils depends on the composition of the waste material, the composting process and the maturity of the compost. Therefore, the main objective of this study was to characterize two different substrates (sheep and cattle manure) and two different composting systems (static and dynamic piles) and to study their behaviour on soil in laboratory conditions. The compost used were sheep manure composted in piles with forced aeration (C1) and cattle manure and sheep manure composted in dynamic piles (C2 and C3 respectively). Laboratory incubation essays at 28 °C were made to determine the amount of N mineralized in the first 30 days after 170 and 450 kgN.ha⁻¹ application rates for each compost. To determine the C mineralization, 42 days of laboratory incubation at 28°C was made.

No analytical differences were observed between composts obtained from static pile (C1) and dynamic pile (C3) composting systems, instead of the amount of lignin, 7.88 and 5.70 % respectively, but it seems not to influence their degradability, as both composts behaved the same way when they were applied on soil. The physico-chemical parameters of the 3 final composts, the respiration rates (measured by CO₂ evolution) were indicative of maturity and therefore indicative of quality composts for land application. However, the final C/N ratio of C2 was a slightly higher than C1 and C3 (14 vs 10 and 11) and also its respiration rate at high application rates, indicating that C2 could be less mature and stable than C1 and C3. This slight difference in C2 maturity could explain that samples treated with this compost behaved different in all essays, as they reached the highest N mineralization after the application of different doses of the compost (6.5 and 13.1 %). This low mineralization rates indicate that it could be reasonable to assess a quality compost application dose higher than 170 kg N.ha⁻¹ even in vulnerable areas, since the release of N after their application is very small and thus, also its leaching pollution potential.

Keywords: compost, static piles, dynamic piles, mineralization, dose

NOTES

MATURITY AND STABILITY OF COMPOSTED PIG MANURE USED AS A GROWING MEDIA

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Separated pig manure (SPM) can be composted and afterwards used as a growing media for seedling production. Hence, separated pig manure was passive composted in small piles and analysed at four different maturity stages (after 0, 30, 90 and 180 days of composting). Different physical (dry matter, ash, organic matter) and chemical (pH, EC, total C, total N, C/N ratio, and nutrient concentration) properties were determined to describe maturity and stability of composted SPM. Also, vermicomposted cow manure (VCM) and commercial potting mix (CPM) were compared to composted pig manure. The comparison was made by growing 14-days old seedlings of lettuce in different growing media: fresh pig manure, 30, 90 and 180 days old composted SPM, VCM, CPM, and 9 different 1:1 mixtures (VCM+CPM, 4 mixtures of SPM and VCM, 4 mixtures of SPM and CPM). Composting of SPM during 180 days resulted in organic matter decreasing (87,4 to 56,8 %), ash increasing (12,6 to 43,2 %), and pH decreased from 8,24 to 6,29. At the same time total C decreased from 42,0 to 29,5 %, total N increased from 2,26 to 2,94 %, and C/N ratio significantly decreased from 18,6 to 10,0 which indicates higher compost stability.

Respiration rate of unstable fresh manure was 10,9 mg CO₂-C g⁻¹ substrate-C day⁻¹, and decreased to 6,9 mg, 4,9 mg and 1,4 mg confirming the increased stability of composted SPM. The highest lettuce fresh mass was obtained on VCM as growing media, significantly lower at CPM, even lower on mixtures of SPM+CPM or SPM+VCM. The lowest lettuce mass was determined on SPM as growing media, but maturity of SPM increased lettuce mass since on fresh SPM lettuce didn't grow and the highest mass was on SPM after 180 days of composting.

Keywords: separated pig manure, C/N ratio, respiration, lettuce, vermicompost

NOTES

COMPOST PRODUCTION AND COMPOSTED MANURE QUALITY EVALUATION

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Composted manure can have an important role in production of substrate for growing seedlings, which would make the organic waste management more cost-effective, but also decrease the cost of seedlings production. Production of composted manure is of significant importance for family farms as well and even more so for farms practicing integral and organic agriculture. This research aims to establish the changes in physical and chemical characteristics of manure from cattle, horse, pig and poultry production during the composting process. The composting process lasted for 9 months. Analysis of physical and chemical characteristics was conducted according to TMECC 03.09-A methods.

Temperatures necessary for disinfection of the compost material were developed during the process. During the composting process the humidity decreased and the proportion of the dry matter increased (29.2% on average). The content of ash also significantly increased (37% on average) while the portion of the organic matter decreased. Compared to the initial material, the concentration of P, K, Ca and Mg after 9 months of composting was significantly increased in all composts, namely P and K 42% on average and Ca and Mg 71 and 72% respectively. At the end of composting, all the composts have C/N ratio below 20:1, which indicates their stability.

However, some researchers think that the ratio between the final and initial C/N (<0.6 to 0.75) is a better indicator of compost maturity, and according to that all the composts, with the exception of the chicken one (0.86), are mature. When using $\text{NH}_4^+\text{-N}/\text{NO}_3^-\text{-N}$ ratio as the indicator of compost stability (<0.16), the composts derived from cattle (semi-mature and fresh) and horse manure are stable (<0.14), composted pig manure is almost stable (0.64), while the composted chicken manure is still very unstable (14.75).

Keywords: manure, composting, chemical characteristic, quality evaluation

NOTES

MAY COMPOST LEAD TO INCREASED HORTICULTURAL PRODUCTION ON MIXED FARMS?

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Like in other transitional countries, farmers in Croatia are faced with numerous problems in their production: high prices of inputs, unfavourable agricultural structure (average farm size is 2,9 ha), uncollected market, unreliable prices of products, etc. All of that results in low productivity and unsatisfactory financial position of farmers. In Croatia small mixed farms (arable crop production and animal husbandry) with lack of horticultural production dominate. Besides that, producers have problems with manure disposal considering ecological requirements from EU and CAP. Mostly, farm manure is not disposed in a proper way and often farmers consider it as undesirable by-product. Moreover, production of compost from livestock manure almost does not exist in Croatia. Horticultural production is insufficient for domestic needs regardless convenient agro-ecological conditions. Most of these products are imported. Compost production from stock manure could solve two problems on mixed farms: solving manure disposal problem while use of compost in horticulture could contribute to increased farm income (via compost selling, nursery production or horticultural production). So, in this paper different models of mixed farms will be analyzed from economic point of view with different ratio of livestock, crop husbandry and horticultural production. Basic purpose of model will be to emphasize importance of horticultural production in small mixed farms profitability.

Therefore different scenarios of field vegetable, greenhouse vegetable and floriculture production based on mineral fertilizer, imported organic fertilizer or on-farm produced composts will be analyzed. Other important model elements are size of farm, soil productivity, and livestock production/arable crop/horticulture production ratio and investment level. The cost-benefit analysis will define which model is the most profitable for farmers and which model is the most optimal for compost production.

Keywords: vegetable, floriculture, profitability, manure disposal, farm size

NOTES

EVALUATION OF URBAN SOLID WASTE AND SEWAGE SLUDGE COMPOST AS A COMPONENT OF GROWING MEDIA

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Different types of compost can be used as growing media in containers fully or partially replacing traditional materials such as peat. Use as a growing media is the most demanding for a compost, as the success of the crop depends very directly on physical, chemical and biological characteristics of the substrate. Thus only the highest quality compost should be earmarked for this purpose, but it is possible to incorporate poor quality materials mixing them with others in appropriate proportions. The complete characterization of a material allows to estimate its usefulness as a substrate and to identify constraints. The aim of this work was the evaluation of different compost from organic fractions of urban solid waste and sewage sludge as an alternative substrate component as peat-substitutive.

Two compost from organic fraction of urban solid waste and two sewage sludge compost and wood chips were used, differing in the composting process for their generation. The degree of maturity of the compost was determined by a seed germination bioassay using aqueous extracts of the materials, whereas a self-heating test was used to measure the degree of stability. The moisture retention curve at low suctions was obtained in a sandbox and in a ceramic plate extractor (Richards) at higher tensions; the porosity and the bulk and particle densities were also determined. Total organic content, as well as pH, EC and soluble elements in both the saturation and 1:5 extracts were measured.

Differences in the maturity and stability of the tested materials were found, related to the composting process followed in each case. The composted organic fraction of urban solid waste had higher levels of heavy metals, salinity and soluble elements than those in sewage sludge. The salinity along with the immaturity is the main obstacle for the use of these materials, and should not consider in any case, more than 50% of the growing medium.

Keywords: alternative substrate, moisture retention, germination bioassay, maturity, stability

NOTES

COMPOST PREPARED WITH TWO PHASE OLIVE MILL WASTE “ALPERUJO” AS GROWING MEDIA

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The olive oil industry is very important in Mediterranean countries, and especially in Spain which is the main world producer. In Spain, the two-phase centrifugation system for olive oil extraction quickly replaced the three-phase system in the early 1990s. This olive oil extraction system has produced a solid waste called two-phase olive mill waste (TPOMW), “alperujo”. TPOMW is generated in large quantities during a short period of time. Approximately 4.000.000 Mg yr⁻¹ is produced in Spain, which caused serious management problems due to its phytotoxicity and semisolid texture. Composting as a method for preparing organic fertilizers and amendments is economically and ecologically sound and may well represent an acceptable solution for disposing of TPOMW. The objective of this work was prepared TPOMW compost and characterize the main physical and chemical properties to evaluate its potential as growing media. The compost was prepared in a pilot-plant using the turning-pile system using a mixture of TPOMW, olive leaf as bulking agents and urea as nitrogen source. Temperature and moisture were used as monitoring parameters to follow the composting progress.

The quality of the mature compost was assessed by the following parameters: moisture, bulk density, water-holding capacity, pH, electrical conductivity (EC), cation exchange capacity (CEC), organic matter (OM), salinity, N, P, K, C/N ratio, germination index (GI). The compost showed some physicochemical properties which may be valuable if used as growing media, such as a neutral pH and also an important quantity of other plant nutrients such as N, P and K. Another important advantage of this compost is the organic matter concentration and that it is free of heavy metals and other potential pollutants.

Keywords: olive oil industry, solid waste, composting, agriculture

NOTES

EFFECT AND CHARACTERISTICS OF FARM-MADE COMPOST TEAS ON NUTRITION SUPPLY

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Organic growers are using compost tea made with organic materials to supply the nutrients to the crop in Korea. But farm-made compost teas are not systemic like chemical fertilizer and pesticide in formulation methods and usage, and their effect were very variable according to cultural condition. This study was carried out to investigate fertilizer contents of component in compost teas collected from farm houses, made from four kinds of by-products of marine, four kinds of fish meals, two kinds of seaweeds and three kinds of young fruits. Each of compost teas were made by mixing and fermenting organic materials such as by-products of marine, fish meal, seaweeds, young fruits, and molasses. They were fermented for six months under aerobic condition in outdoors. In compost tea made from by-products of marine, major ingredients were 7.4 ~ 22.9 % total nitrogen, 0.107 ~ 0.332 % P_2O_5 and 0.094 ~ 0.73 % K_2O , respectively. In compost tea made from fish meal, major ingredients were 0.21 ~ 0.69 % total nitrogen, 0.001 ~ 0.071 % P_2O_5 and 0.142 ~ 0.338 % K_2O , respectively. In compost tea made from seaweeds, major ingredients were 0.19~0.49 % total nitrogen, 0.007 % P_2O_5 , 0.323~0.048 % K_2O , respectively. In compost tea made from young fruits, major ingredients were 1.18 ~ 0.17 % total nitrogen, 0.006 ~ 0.018 % P_2O_5 and 0.088 ~ 0.57 % K_2O , respectively. As a result of plant growth promotion test, most of compost teas promoted root and shoot growth of radish.

The plant promotion effect of the compost teas were in the order, high fish meal compost tea> marine by-products compost tea > seaweed compost tea> young fruit compost teas. The results of this study showed that effect and characteristics of farm-made compost teas was very variable depending on formulation method and used organic materials.

Keywords: farm-made compost tea, nutrient, plant growth promotion test, organic farming

NOTES

EVOLUTION OF BIOCHEMICAL INDICATORS IN GRAPE MARC COMPOSTING PROCESS AND THEIR RELATIONSHIP WITH HUMIFICATION PROCESS DURING MATURITY

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Pisco industry plays an important role in the economy of the Coquimbo region in Chile. It generates large quantities of liquid and solid wastes, including grape marc (skin and seeds) and bunch raquises, whose improper disposal may cause environmental problems. Grape marc represents approximately 20 to 30% of the total harvest of the Muscatel grape variety, and is produced from March to May. A system was proposed to recycle organic wastes into vineyard crops, by composting grape marc and bunch raquises, in co-composting process with goat manure and other available organic materials. The objectives of this work were to determine the evolution of enzymatic activities, related to changes in microbial population and production of humic and fulvic acids during a 180-day period including compost maturity. Nine treatments using grape-pomace and goat or horse manure as raw material were proposed. The open piles were maintained during winter-spring seasons with mechanical turns every 10 days; thermocouples were placed into the piles for temperature control.

Enzymatic activities for β -glucosidase, urease, acid and alkaline phosphatases were determined; fungi and yeast, celulolytic, amylolytic, proteolytic, and phosphate solubilizing bacteria, as well as fulvic and

humic acids (%) were also measured, in order to associate them to compost maturity. The results indicated an average HA/FA ratio = 0.5; Using correlation analysis, it was determined that β -glucosidase ($r=0.444$, $p=0.02$), C/N ratio ($r = -0.668$, $p<0.001$) and $\text{NH}_4\text{-N}/\text{NO}_3\text{-N}$ ($r=0.404$, $p=0.04$) were strongly correlated with production of humic acids, and the fulvic acids were correlated with fungi and yeast count ($r=-0.493$, $p=0.01$) and C/N ratio ($r=-0.423$, $p=0.03$). The composts obtained did not show phytotoxicity (% germination >80%), were free of *Salmonella* spp., and fecal coliforms and met the Chilean National Standard 2880/04 for quality of organic amendments.

Keywords: compost quality, grape marc, maturity indices, microorganisms, enzymatic activity, humic and fulvic acids

NOTES

Poster Session 4

WATER AND NUTRITION MANAGEMENT IN SOILLESS CULTURE

INFLUENCE OF DIFFERENT COIR COMPOSED MEDIA AND IRRIGATION MANAGEMENT IN SOILLESS SYSTEM ON AGRONOMIC BEHAVIOUR OF PEPPER

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The current experiment, with a factorial design, was carried out in soilless culture and under greenhouse with the cv. *Italverde* (Italian type). We compared three coir composed media (coir dust: coir chips) used during two years, in the following proportions (% in volume):

- 100: 0
- 60: 40
- 40: 60

At the same time we used 3 irrigation schedules: high frequency (HF), medium frequency (MF) and low frequency (LF) obtained respectively from a depletion ratio of 5%, 10% and 20 % of saturated substrate, in order to regulate using the nutrient solution more efficiently.

The main objectives of this experiment were:

- To study the agronomic response of pepper in commercial yield by analysing the incidence of two physiological disorders (blossom-end-rot and sunscald)
- To study the evolution of the main physical characteristics of these growing media.

The results showed that the highest commercial yield (early and total yield) was obtained with the 100% coir dust and 60 : 40 % of coir dust:coir chips growing media. Also the greatest commercial yield was achieved with MF and HF frequency irrigation. Moreover, some statistically interactions between factors have been detected for early commercial yield and total non- commercial yield.

Keywords: coir dust, coir chips, depletion ratio, yield, blossom – end –rot, sunscald

NOTES

EFFECTS OF SALINITY AND COMPETITION ON GROWTH AND ON ESSENTIAL OILS CONTENT OF *Thymus vulgaris* AND *Rosmarinus officinalis*

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Salinity affects both plant growth and concentration of essential oils in aromatic plants. *Thymus vulgaris* and *Rosmarinus officinalis* are Mediterranean plants which in nature grow typically subjected to soil salinity conditions. The aim of this work consists of determining growth and essential oil concentration in *Thymus vulgaris* and *Rosmarinus officinalis* cultivated in a substrate mixture (peat: coir; 2:1 vol:vol) where different salt concentrations were applied. Four treatments were evaluated: two of them using standard nutrient solution, 1.6 and 2.8 dS m⁻¹ (T0 and T1, respectively) and two more using as a basis the 1.6 dS m⁻¹ standard solution, adding NaCl in order to bring the solutions to 2.8 and to 3.8 dS m⁻¹ (T2 and T3, respectively).

Results suggest a decrease in growth and an increase in the concentration of essential oils as salinity is increased. Different behavior was observed between species, as well as due to the competition between different species.

Keywords: salinity, substrate, growing media, NaCl

This work was supported by FEDER AGL2010-18391

NOTES

ASSESSMENT OF TWO SUBSTRATES FOR GROWING POTTED BAY LAUREL WITH SALINE RECLAIMED WASTEWATER

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An experiment was carried out to assess the influence of two substrates (coconut fiber [CC] and urea formaldehyde foam [UF]) on the agronomical and physiological behavior of potted bay laurel (*Laurus nobilis* L.) irrigated with saline recycled wastewater (RW). Fresh water (FW) was used as a control. Clearly, root and leaf grew differently in each growing media. Under FW the plants cultivated in UF had higher root growth than those cultivated in CC, while no significant differences were observed in root biomass under RW. The plants grown in UF decreased their leaf area about 20% compared with those grown in CC regardless of the water quality. Water consumption in UF was lower than in CC, while both, leaching fraction and leachate electrical conductivity, were higher in UF in the two types of water; on the contrary, the pore electrical conductivity in UF was lower than in CC. The plants cultivated in CC had higher photosynthesis rate and stomatal conductance than in UF under FW; but under RW the photosynthesis rate was similar in the two substrates, while stomatal conductance was higher in UF. When RW was applied, the leaf Cl, Na and B contents in CC were higher than in UF.

Our findings indicate that growth and development response to RW was better in plants grown in CC than in UF. So, RW and UF resulted in a fall of ornamental quality, and therefore on the commercial value of the plants.

Keywords: water, salinity, growing media, photochemical, ornamental

NOTES

BEHAVIOUR OF VEGETABLE SEEDLINGS CULTIVATED ON PEATS WITH DIFFERENT DEGREES OF DECOMPOSITION

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In Italy, the production of vegetable seedlings on trays is undertaken using peats with low or medium degrees of decomposition. Several nurseries are located near the sea where the water quality used to grow plants is poor, due to the high salt content.

The degree of decomposition/humification of peat has a great influence on the physical and chemical properties of substrates such as total porosity, air and water ratio, bulk density, shrinkage, electrical conductivity, buffering capacity and humic acids.

The aim of these studies was to investigate the effects of peats of low and moderate degrees of decomposition on the growth of different vegetable seedlings irrigated with water differing salt contents.

Trials were carried out using two peats: a less decomposed peat of Northern European origin (H2-H3) in comparison with a more decomposed peat originating from the Republic of Ireland (H4-H5). Media were prepared solely from each peat type and in mixtures (25/75, 50/50, 75/25 v/v). Different vegetable species were cultivated in order to determine the influence of substrate on germination rate and length of production cycle. Species and substrates were irrigated with tap water (0,5 mS/m) and tap water amended with NaCl (3 mS/m). Data on the most important morphological and quality parameters were collected together with physical and chemical analysis on substrates before and at the end of the experiments.

Results confirmed that the use of saline water reduces plant growth: however even after irrigation with saline water, some seedling quality descriptors, such as sturdiness and compactness index, improved.

Substrates containing 50%, 75% or 100% v/v of more decomposed peat (H4-H5) gave superior results in terms of seedling quality and growth, both with high and low salt levels. That behaviour seems related to physical parameters and to the higher buffering capacity of media containing humified (H4-H5) peat.

Keywords: buffering capacity, salts, electrical conductivity, sturdiness index, compactness index

NOTES

EFFECT OF NUTRIENT SOLUTION COMPOSITION AND SUBSTRATES ON LETTUCE TRANSPLANT PRODUCTION

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Growing media composition and fertilization affect growth and quality of vegetable transplants. Peat has long been the main component of transplant substrates, but the use of alternative organic materials must be considered for sustainability reasons. Transplant fertilization can be done by adding base fertilizers in substrates and/or applying fertigation. The influence of two substrates and six fertigation regimes on growth parameters of lettuce transplants (*Lactuca sativa* L., var. longifolia Lam. cv. Romana Larga Rubia Galaica) were studied. The greenhouse trial was conducted in Spring using multi cell trays. Volumetric composition of substrates was: A) 50% white peat + 50% forest waste compost; and B) 60% white peat + 40% black peat (a mixture that was a commercial substrate for transplants). Media were base fertilized with 1000 g PG Mix m⁻³ and five overhead nutrient solutions (NS) were applied. The NPK ionic concentration (nitrate, ammonium, dihydrogen phosphate and potassium, in meq L⁻¹) of the studied solutions were: NS1) 9,5:0,5:1:5; SN2) half strength SN1; NS3) 9,5:0,5:2:9; NS4) half strength NS 3; and NS5) 6,5:0,5:2:7. Overhead irrigation with water was used as non- fertigated control (NS0). Physical, physicochemical and phytotoxic properties of substrates were determined. At the end of the trial, the following parameters were measured: height, leaf number, dry weights of leaves, stem, shoot (leaves + stem), roots and total biomass, dry weight percentage of the

organs, shoot: root ratio, leaf area index, specific leaf weight, leaf area ratio and leaf weight ratio.

Lettuce transplants grown in substrate A showed a decrease in shoot growth that clearly diminished when fertigation was applied. This phytotoxic effect was mainly caused by nitrogen immobilization, indicating that this forest waste compost was immature or insufficiently stabilized. Fertilization only with base fertilizer greatly decreased transplant quality. Ionic composition of NS1 disfavoured biomass partitioning to root, showing the highest value for shoot: root ratio and the lowest for % of root dry weight, and thus decreasing transplant quality. The relative increase in phosphorus and potassium in relation to nitrogen (NS 3, 4 and 5) tended to favour partitioning to root. The use of half strength solutions (NS 2 and 4) produced good quality transplants while decreasing the use of fertilizers. Given the obtained results, and taking into account not only quality aspects but also economical considerations, we suggest that the best approach would be to fertigate substrate B with NS2 or NS4

Keywords: forest waste compost, base fertilization, fertigation, ionic composition, nitrogen immobilization

NOTES

INFLUENCE OF P BUFFERING CAPACITY OF PEAT/CLAY-SUBSTRATES ON THE SAFETY OF PLANT CULTIVATION

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A buffered substrate can bind nutrients and release them again in the substrate solution when plants deplete the nutrient concentration. Pure white peat is nearly unbuffered and the buffering capacity can be increased by the addition of clay. The capacity to bind phosphorus varies widely between clay minerals and the choice of the “right” substrate clay is very important. The aim of the experiment was to investigate the influence of P buffering of peat/clay-substrates on the safety of pot-plant cultivation.

Impatiens walleriana plants were grown in four peat/clay-substrates with clays having different P buffering capacity. The CAT-soluble P concentration was adjusted to 25 mg P L⁻¹ substrate. The P concentration of the fertigation solution was varied from no P to excess P.

After ten weeks cultivation the treatments clearly differed in plant growth and quality. Without P fertigation the elongation of shoots, plant height and diameter were reduced in pure peat and in peat/clay-substrates with low P binding capacity compared to peat/clay-blends with high P binding capacity. Due to P deficiency dry matter yield and plant quality were decreased in the weakly P buffered substrates without P fertigation indicating that shortage of P is not a successful strategy for plant formation.

Highly P-buffered peat/clay-blends provided up to twice as much P to plants than those with a lower buffering capacity. In the weakly buffered substrates plants did not exhaust the P amount determined by CAT-extraction whereas in the highly buffered blends even more P was taken up than characterized as plant available by the extraction. Thus the extraction method underestimated the plant available P in peat/clay-blends with high binding capacity.

The results indicate that high P buffering capacity of peat/clay-blends levels fluctuations in P uptake and P fertigation and this contributes to the safety of plant cultivation.

Keywords: substrate-clay, *Impatiens walleriana*, CAT-extraction, P fertigation

NOTES

EFFECT OF FOLIARLY-APPLIED IRON COMPOUNDS ON DEVELOPMENT OF STRAWBERRY PLANTS

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Several plant species grown in calcareous soils in arid and semiarid regions are iron-deficient, a condition known as iron chlorosis. Foliar sprays can be a cheaper and environmental-friendly alternative to soil treatments to control iron chlorosis. The aim of the present study was to evaluate the effect of different foliarly-applied compounds on development of strawberry (*Fragaria x ananassa* Duch. cv. 'Splendor') plants. Plants were grown in polyethylene bags (100 cm x 30 cm x 12 cm) filled with coconut peat in a greenhouse under natural light and temperature. A completely randomized block design (4 treatments x 3 replications) was used in a hydroponic system. Each replicate consisted of 10 plants. The treatments were Fe (II) sulphate (IS; 2 mM), IS plus Citric Acid (CA; 10 mM), Grass Clipping Extract (GE; Patent PT/103584/2009) and distilled water as a control. A non-ionic wetting agent was used in all treatments (Etaldyne, Rhône-Poulenc, 0.5 ml L⁻¹). Treatments were applied with a manually operated sprayer by performing full wetting of the plants until the product dropped from the foliage to the ground. Treatments started on 30th April 2010, when the crown diameter was approximately 249 mm, and were made every week until 20th May, when the crop was harvested. The treatments were applied a total of 4 times. A total volume of 1.5 L was used to spray all the 30 plants treated.

The crown diameter and SPAD values were measured weekly and the number of leaves monthly. The main effects of treatments on vegetative parameters were evaluated.

Keywords: iron treatments, soilless, vegetative parameters, grass clippings

NOTES

EFFECT OF CONTROLLED-RELEASE FERTILIZERS ON CHEMICAL PARAMETERS OF TWO GROWING MEDIA DURING 12 MONTHS STORAGE

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In recent years the use of controlled-release fertilizers (CRFs) has increased in both the professional and the hobby market of growing media in Italy. The tolerance in the declared values of chemical characteristics of the growing media is set by national legislations. What is not well studied at present is the influence of CRFs as well as of external factors on the variability of such parameters. The aim of this study is to evaluate the influence of time, conditions of storage and growing media composition on the variation in chemical parameters of growing media added with CRFs. Two incubation experiments were carried out on a peat-based growing media and a mixture of peat and pumice (80% and 20% v/v). We tested 4 g/L of two differently coated fertilizers, with the declared release times of 7-8 months and 12-14 months, including a control without fertilizers and one with soluble fertilizers. Samples were maintained at 60% water content and kept at 21°C throughout the experiment (good storage conditions) or at 40°C for 15 days and then at 21°C until the end of the experiment (bad storage conditions). Three replicates of each treatment were analyzed each month for 12 months (1:5 extraction method).

We observed a marked increase in variability of pH, electrical conductivity, nitrate, ammonium and potassium in growing media added with CRFs. In the case of growing media added with soluble inorganic fertilizers all the investigated parameters remained fairly constant over the twelve months storage.

In all cases bad storage conditions had a marked effect on almost all of the chemical parameters. Types of growing media affected the nutrient releases from CRFs.

This study highlights that the compliance with existing legislative requirements of growing media added with CRFs depends strongly on storage procedures and on the components of growing media.

Keywords: storage, pH, EC, water soluble nutrients, legislative compliance

NOTES

BEHAVIOUR OF HOOF AND HORN DURING STORAGE OF PEAT-BASED AND PEAT/PUMICE-BASED GROWING MEDIA

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Hoof and horn represent one of the organic fertilizers more appreciated by the Italian substrate manufacturers. Hoof and horn is frequently used for substrates devoted to organic productions. Together with chemical fertilizers, it is widely used for long lasting conventional productions. A recent national law establishes a series of rules in substrate production and allows tolerance degrees for pH and EC. Unfortunately there are scarce information regarding the influence of organic fertilizers on pH and electrical conductivity (EC) during storage of growing media.

An experiment has been carried out in order to investigate the behaviour of hoof and horn added to two growing media, previously limed (a peat based media and a mixture of peat 80% and pumice 20% v/v.) These media, closed in bags, has been stored 12 months continuously at 21°C or kept at 40°C for 15 days and then at 21°C till the end of the trials.

pH. In any cases, it decreases dramatically exceeding the tolerance degree. The more aerated substrate (with 20% of pumice) promotes the fastest and widest pH reduction. The heat treatment has no significant effect on pH time course.

EC Results show marked differences between the studied growing media and a dramatic effect of temperature. The substrate containing pumice has induced an early increase in EC values while both the heated media showed the highest differences between initials and final values. In both growing media EC values exceeded the admitted tolerance.

A plant test with lettuce, performed after six months of storage, give information about the effects of the type of growing media and the storage conditions on the release of nutrients from the organic fertilizer.

Keywords: pH, EC, peat, pumice

NOTES

EFFECT OF SALINITY ON SEVERAL INDOOR PLANTS FOR GREEN WALLS

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When tropical ornamental plants are used in landscaping, some difficulties arise in semiarid zones because of water shortage and the low quality of irrigation water. Furthermore, when nutrient solutions are applied in hydroponic landscaping, high salinity of irrigation water results in a decrease of the ornamental quality of the plants.

Therefore, it is important to improve the efficiency of nutrient use in ornamental hydroponic systems, without diminishing the quality of the plants, while decreasing the emission of pollutants into the environment. In this experiment we tested 6 different plants: *Nephrolepis cordata* Hort., *Nephrolepis biserrata* (Sw.) Schott. cv. Macho, *Nephrolepis cordata* Hort., *Dryopteris erythrosora* (D. C. Eaton) Kuntze, *Nephrolepis exaltata* cv Boston Blue Bell, and *Philodendron erubescens* K.Koch & Augustin cv. imperial red, grown in containers, in a 2:1 vol:vol peat and coir growing medium.

The experimental design was a randomized complete block, with four blocks. Plants were treated with different nutrient solutions: T0, T1, T2, and T3. T0 consisted of a standard nutrient solution, whose electrical conductivity (EC) was equal to 1.6 dS m⁻¹; T1, T2, and T3 were based on the same nutrient solution as T0, but increasing the EC

with macronutrients to 2.75 dS m⁻¹ in T1; and NaCl to 2.75 dS m⁻¹ in T2, and NaCl to 3.6 dS m⁻¹ in T3. The dry and fresh weights of aerial parts are affected negatively by salinity and even more specifically by the NaCl application. Species showed significant differences in growth rate and salt tolerance. These results will allow us to develop prediction models when the plants are combined in one single space with the same saline conditions.

Keywords: salinity, soilless culture, sodium chloride, coconut fiber, specific salinity, greenery

NOTES

Poster Session 5

HORTICULTURAL PRODUCTION: SUSTAINABLE USES OF GROWING MEDIA AND COMPOST

EVALUATION OF SUBSTRATES FOR THE GROWTH OF CERTIFIED ORGANIC SEEDLINGS

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Seedling production for organic farming is regulated by European legislation (Regulation (EC) No 834/2007 and No. 889/2008), which limits the available substrates and prevents the use of synthetic chemicals. Furthermore, the use of peat, which is allowed, is unsustainable because it is a non-renewable material extracted from ecologically valuable ecosystems, and the destruction of peatlands releases greenhouse gases. Therefore, it is necessary to find alternative substrates. The assessment test consists of 12 mixtures of 6 basic materials: alperujo compost, vine pomace compost, vermicompost, vermiculite, white peat and coconut fiber, which were compared with the control: a mixture of white peat (45%), black peat enriched with chemical fertilizer (45%) and vermiculite (10 %). Selected properties were determined in the growing media: bulk density, pH, electrical conductivity (EC), organic matter, dry matter, N, P, K, NO³-N, C:N ratio.

Experimental design was randomized block with four replications per crop (tomato and lettuce). The trial was conducted in a greenhouse. We used polystyrene trays, which were introduced in plastic trays with water. Thus, substrate moisture and EC remain more constant.

We assessed the following characteristics of the seedling: emergence (percentage and earliness), height, stem diameter (tomato), number of

leaves, dry weight of stem (tomato), leaves and roots, leaf area per seedling, specific leaf area (SLA) and leaf area ratio (LAR). The measurement was performed in 30 seedlings per replication. We also measured the EC of water in plastic trays.

Vermicompost treatments (mixed with peat or coconut fiber) were better than the control. The results indicate that the mixture of coconut fiber-vermicompost can be used for organic seedling production replacing the peat and chemical fertilizers.

Keywords: organic farming, alperujo compost, vermicompost, vine pomace compost, coconut fiber

NOTES

PRODUCTION OF LETTUCE PLUGS IN COCONUT COIR AMENDED WITH COMPOST AND VERMICOMPOST

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The main objective of this study was to evaluate the use of compost (from dairy manure) and vermicompost (from pig slurry solids and forest residues) as substrate component for organic production of lettuce seedlings in coconut coir.

With this objective 8 substrates were tested: coconut coir only (without fertilization), 3 binary mixtures of compost and coconut coir (20, 40, and 60% by volume of compost: 20C; 40C and 60C), 3 binary mixtures of vermicompost and coconut coir (20, 40, and 60% by volume of vermicompost: 20V; 40V and 60V) and a commercially available substrate authorized in organic farming (control). *Latuca sativa* L. cv. Lollo Rosso seeds were sown in multi-cell plastic trays (17 cm³) filled with the 8 substrates and grown for 28 days.

Concerning substrates properties, increasing the percentage of compost and vermicompost on the mixture significantly increased the substrate electric conductivity (EC, water extract 1:6 by volume) from 0.176 mS cm⁻¹ (coconut coir) to 0.942 (60C) and 0.878 mS cm⁻¹ (60V), a result of the soluble salt content (K, Ca, Na and Cl) in the compost and vermicompost. However, 60C and 60V substrates reached values of EC higher than the recommended values for seedlings.

Compost and vermicompost did not affect the germination of lettuce seedlings but significantly increased the seedlings growth, namely dry and fresh weight, leaf number, and length and width of leaves, when compared with the coconut fibre only substrate.

No significant differences were found between growth of seedlings from commercial substrate (control) and seedlings from mixtures 20C and 20V. Moreover, seedlings growth on the mixtures 40C, 40V, 60C and 60V was higher than the growth on the control substrate.

Obtained results allow concluding that the materials used in this study can be successfully used, in the adjusted ratios, as substrate component for organic production of lettuce seedlings in coconut coir substrate.

Keywords: *Latuca sativa*, seedlings, organic, growing-media

NOTES

COMPOSTED MANURE AND SUBSTRATE MIXTURE IMPACT ON LETTUCE GROWTH IN HORTICULTURAL CONTAINER

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Considering similar physical and chemical properties, the compost could be used as a component of cheaper substitution for a commercial substrate. However, the compost may have some limiting factors (high salt and/or pH value). In order to determine the correct replacement of the substrate for vegetable seedlings, research was conducted using two different composts produced from chicken and pig manure. Both composts had high salt concentration and basic nutrients, including high pH value in composted chicken manure, and a lower pH in pig manure. From each of the composts, three different mixtures were made with the following contents: a commercial substrate as a control, compost alone, and mixtures of 25, 50 and 75% compost with commercial substrate. Testing was conducted on lettuce (*Lactuca sativa* L.) as a culture very sensitive to increased salt concentration ($> 2 \text{ dS m}^{-1}$). The following parameters of lettuce growth were observed: the number of seedlings, height, weight and seedling leaf area and dry matter produced. pH values of components were ranging from 6,27 on commercial substrate to 8,15 in chicken compost, or 5,55 in pig compost, and EC values from 0,74 in commercial substrate to 14,83 in poultry compost, and 8,76 in pig compost.

Effect of salt concentration on lettuce seed germination is already visible at 50% share of composted manure in mixture. Based on the results, it could be concluded that only the substrate in which the share of compost was 25% gives results similar to control. A higher share of compost increased the concentration of salts to toxic values. However, mixture of more than 25% compost with high EC and pH value may have depressive impact and reduce the lettuce growth. This compost could possibly be used as a fertilizer, but in limited share as a component of growing media.

Keywords: growing media, composted poultry manure, composted pig manure, lettuce

NOTES

UTILIZATION OF THE SOLID FRACTION OF DIGESTATE FROM ANAEROBIC DIGESTION AS CONTAINER MEDIA SUBSTRATE

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Digestate is the final by-product of methane production via anaerobic digestion of energetic crops, animal slurries, agro-industrial wastes. It consists in a stable organic material rich in fibers and mineral nutrients. It is utilized in agriculture unmodified or after separation of liquid and solid fraction: the first as inorganic NPK fertilizer, the second as an amendment rich in plant nutrients.

Two samples of digestate solid fraction (D1 from pig slurry, agro-industrial waste and maize; D2 from pig slurry and cow manure) mixed with sphagnum peat (0%, 25%, 50% and 100% v/v digestate) were investigated in order to replace totally or partially peat in growing media. They were analyzed for pH, EC, water soluble Ca, Mg, K, NH₄-N, NO₃-N, physical properties and submitted to germination (cress) and root elongation (barley) bioassays for phytotoxicity and quality evaluation.

Unmodified D1 and D2 showed high pH and salinity, induced negative effects on cress germination, slight decrease of barley root elongation; at pF1 the total porosity, quite similar to that of sphagnum peat, was equally filled by water and air. Mixing of digestate and peat strongly improved chemical characteristics, physical properties, level of plant available nutrients and results of bioassays.

In a plant growth greenhouse trial on lettuce (30 days long) the highest yields were obtained in the mixtures.

The results indicate it is feasible to partially replace peat in growing media with the solid fraction of digestate.

Keywords: solid fraction digestate, peat, EC, pH, bioassays

NOTES

**THE EFFECTS OF COMPOSTED SEAFOOD WASTE (CSW) ON
THE GROWTH AND DEVELOPMENT OF TOMATO TEST
PLANTS (*Lycopersicon lycopersicum* var. Shirley) IN PEAT
AND PEAT/COMPOSTED GREEN WASTE (CGW) BASED MEDIA
WITH A REDUCED FERTILISER LEVEL**

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The reduction in peat usage is an important issue in U.K. horticulture, a major destination for growing media produced in the Republic of Ireland. This study examined the possibility of using composted seafood waste (CSW) in a traditional peat based medium and in a peat reduced medium along with composted green waste (CGW). The growth and development of tomato test plants (*Lycopersicon lycopersicum* var Shirley), grown in peat based and peat/CGW media with reduced fertiliser rate (50%) amended with three levels of CSW added at rates of 0, 5 and 10% (v/v), was assessed. The objective was to examine if composted seafood waste could compensate for the reduced fertilizer level in these growing media. The plant parameters examined were plant height, plant spread; fresh shoot weight and percentage dry matter. Overall performance improved with the addition of CSW. The addition of CSW at 10% to the reduced fertilized peat medium and a 5% addition of CSW to the reduced fertilized Peat/CGW medium produced the most favourable results. Plants in these treatments were not significantly different from each other and only had one significant difference from their controls in terms of % dry matter.

The addition of CSW at 5% to the peat media also produced favourable results. The addition of CSW at 10% to the peat/CGW medium produced poor plants. It is concluded that the addition of CSW at an appropriate rate can produce tomato plants of acceptable quality.

Keywords: Composted green waste, composted seafood waste, fertiliser

NOTES

COMPOSTING AND CHARACTERIZATION OF ORGANIC SUBSTRATES USED FOR TOMATO PRODUCTION UNDER GREENHOUSE CONDITIONS

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This research was carried out in the company *Vegetales de Oaxaca S de PR de RL. La Trinidad Zaachila, Oaxaca (South Mexico)*), during the winter-spring 2010-2011. Nine substrates, resulting from composting maguey bagasse with pine bark and ground coconut husks and peanut hulls, were evaluated. Sawdust was used as the control. The trial was conducted with a variety of tomatoes of undertermined growth under greenhouse conditions. Data were analyzed using a completely randomized design. It was found that mixtures of pine bark + peat (70-30% v/v), bagasse maguey + peat (70-30% v/v) and maguey bagasse + pine bark (50-50% v/v) had a better aeration capacity, good moisture retention and increased production. In the production of fruits of the five clusters assessed, the mixing mixtures of maguey bagasse + peat (BM+T 70-30), pine bark + peat (CP+T 70-30) and maguey bagasse + bark of pine (BM+CP 50-50) showed better results with 4,954 kg.planta⁻¹, 4,727 kg plant⁻¹ and 4,631 kg plant⁻¹, respectively. The lower production accounted for treatment with sawdust with 3,281 kg plant⁻¹.

Keywords: compost, organic waste, maguey, pine bark

NOTES

USE OF FUNCTIONAL BIOSOLIDS-DERIVED COMPOSTS AS GROWING MEDIA FOR THE PRODUCTION OF LAVENDER (*Lavandula dentata*) AND ROSEMARY (*Rosmarinus officinalis*)

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Biosolids-derived composts usually show several characteristics that limit their use as substrates, such as poor physical properties and/or high salinity. The optimisation of the obtaining of biosolids-derived composts for their use as substrate mainly depends on several aspects, such as the appropriate choice of the co-composting and/or bulking agents, the assessment of compost quality and the suitable design of the growing medium. Currently, the incorporation-inoculation of beneficial microorganisms in the composting final stages provides added-value properties to compost, especially in the container cultivation sector.

The selection of Mediterranean autochthonous plant species, with low demands of inputs and that can be used in environmental restoration, such as lavender (*Lavandula dentata*) and rosemary (*Rosmarinus officinalis*), constitutes one of the main increasing fields in the ornamental plant production sector.

This work studies the use of compost from sewage sludge and vine shot pruning, inoculated at the composting maturity phase with beneficial

microorganisms (*Trichoderma harzianum* T78, *Aspergillus niger*, *Azotobacter vinelandii*, L512 *Penicilium chrysogenum* and RSU231 *Bacillus pumilis*), obtaining five functional composts and a compost without inoculation. The mature-inoculated composts were used as substrate components for lavender and rosemary production, through the total (100% v/v) or partial substitution (50% v/v) of the commercial substrate peat-coconut coir dust (TFC), used as control treatment. Each treatment was established with three replicates, developing a cultivation cycle from the seedling stage to commercial size in a commercial nursery. No fertilisation program was carried out compared with the fertilised commercial substrate to evaluate the fertilising capacity of the composts used. Physico-chemical, chemical and physical analyses of the different growing media established were carried out. Also, the evolution of the plant height, fresh and dry weight of the aerial and root areas, plant quality and the root morphology and quality were evaluated.

Keywords: sewage sludge, beneficial microorganisms, functional composts, substrate

NOTES

CHARACTERIZATION AND EVALUATION FOR ORNAMENTAL PRODUCTION OF COMPOST AND VERMICOMPOST FROM GREEN AND PRUNING WASTES

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Keywords: grass clipping, growing media, germination bioassays, physico-chemical properties

NOTES

The aim of this work was to study the use of grass clipping and pruning wastes compost (GPC) and vermicompost (GPV) as growing media for different ornamental and horticultural crops (*Petunia x hybrida*, *Viola tricolor*, *Rosmarinus officinalis*, *Cupressocyparis leylandii* and *Lactuca sativa*). The main physico-chemical characteristics of GPC and GPV were determined (E.C., pH, organic matter, C/N ratio, bulk and real density, air space, humidity, C.E.C. and nutrient contents). Phytotoxicity was evaluated by germination bioassays. Four growth substrates were prepared mixing peat with different proportions of GPC and GPV. A control of peat was included. Production and growth parameters were evaluated in plants cultivated in a greenhouse. The results of these experiments showed important differences among species, being *Cupressocyparis leilandii* and *Rosmarinus officinalis* highly sensitive to compost and vermicompost applications. Despite no phytotoxicity was found in germination bioassays, some deformation symptoms appeared in leylandi cypress stems. On the other hand, lettuce and temporal ornamental species (*Viola* and *Petunia*) showed good growth and production results with 50% GPC and 25% of GPV applications even raising this last one treatment an improvement of control results.

SUBSTITUTION OF PEAT FOR AQUACULTURE ANIMAL BY-PRODUCTS COMPOST IN GROWING MEDIA: EFFECTS ON GROWTH AND NUTRITION OF ORNAMENTAL PLANTS

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Research and development of new growing medium environmentally friendly, as peat substitutes, are demanded nowadays. The aim of this work was to evaluate the feasibility of using compost from aquaculture animal by-products (AAB) as alternative substrates of peat. The compost was obtained from seabream (*Sparus aurata*) and seabass (*Dicentrarchus labrax*) residues mixed with pine sawdust. The effects of different substrates on the growth in container of *Viola x wittrockiana* (V) and *Impatiens hawkeri* (I) were evaluated by parameters of growth of the plants: the development of the air part (fresh weight (V, I)), and commercial quality (number of leaves (V, I), number of flowers (V), number of branches (I) and degree of compaction (V, I)). The experiment was carried out to the production of plant in pots in a polyethylene greenhouse. The experimental design was randomize complete blocks with four replications and five treatments with each plant. The substrates tested were *Sphagnum* peat (P) (100%) as a control, and four mixtures of AAB compost and peat with different proportions (100%, 75%, 50%, 25%).

In relation to *Viola x wittrockiana* plants growing in high concentrations of AAB compost (75 and 100%), in general, showed less growth than control. The best results were obtained for 25% AAB/P substrate. This percentage presents a similar evolution than control in parameters fresh weight, number of leaves and compaction, and a higher number of flowers (30%). In relation to *Impatiens hawkeri*, plant growing in high concentrations of AAB compost (50, 75 and 100%) evidence plants injury due to oxygen deficiency in the root environment. This problem could be corrected by adding an organic or inorganic material to increase the drainage capacity of the substrate. However, the percentage 25% AAB/P presents, in general, no significant differences with peat control.

Keywords: alternative substrates, fish compost, *Viola x wittrockiana*, *Impatiens hawkeri*

NOTES

SUSTAINABLE MEDITERRANEAN LANDSCAPING USING COMPOST

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The conducted research is aimed at evaluating the chance of using compost as soil improver in the setting of three native mediterranean shrubs, verifying by laboratory analysis, the changes in the main physico-chemical properties of the conditioned soil after 180 days of cultivation. In particular, 12 treatments, coming from the factorial combination of four soil-compost mixes in the plantation hole and three shrub species were compared: Specifically soil-compost mixes (v:v) were: S1=100% soil +0%compost, S2=85% soil +15%compost, S3=70% soil +30%compost, S4=55% soil +45%compost and plant species were: C1= *Rhamnus alaternus*, C2=*Myrtus communis*, C3=*Phillyrea angustifolia*. The obtained experimental results stressed good aesthetical performances, regardless of the compost quantity added in the plantation hole; besides, a different adaptability of the different species to the use of compost has been observed. In S1 the salinity and the organic matter content, the total nitrogen, the assimilable phosphorus and the exchangeable potassium resulted 0.73 mS/cm; 11.84 g/kg of the fine soil (fs); 0.80 g/kg of the fs; 38 mg/kg of the fs and 423 mg/kg of the fs respectively.

The addition of the maximum compost quantity in S4 determined an increase of the values of all the physico-chemical parameters: the EC was 2.25 mS/cm; the organic matter 63.14 g/kg of the fs; the total nitrogen 3 g/kg of the fs; the assimilable phosphorus 64 mg/kg of the fs and the exchangeable potassium 829 mg/kg of the fs.

After 180 days of cultivation the EC showed values similar to the starting ones while for the organic matter and the total nitrogen we observed a decrease of about the 50% of the content. Regarding the assimilable phosphorus content found after 180 days from the setting, the obtained values showed an increase of 100% in S2 and S3 soil-compost mixes and of 50% in S4 one.

Keywords: sewage sludge, soil improver, shrub, soil physico-chemical properties

NOTES

PRODUCTION OF OLEANDER POTTED PLANT ON COMPOST BASED SUBSTRATES USING GROWTH STIMULANTS

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Lately, sewage sludge and animal and vegetal wastes have been used for the production of organic fertilizers, soil improvers and growing media components. The research has been aimed at evaluating the effect of sewage sludge compost and of a bio-stimulant on the *Nerium oleander* L. culture. The plants have been grown for 150 days. The used media were a commercial medium (control) and three sewage sludge compost based media with percentages of peat substitution of 10, 20 and 30%. In all the media half of the plants were treated with an animal origin bio-stimulant. The bio-stimulant was applied via root at a concentration of 0.25g/L. The plants were fertirrigated with a modified Hoagland solution. At the end of the growth, the morpho-biometrical parameters have been registered. The experimental data analysis has brought out that the growing media have significantly influenced average and maximum diameter (cm) of the plant, SPAD, leaf number and the total and unitary leaf area (cm²). The medium containing 30% of compost has allowed to obtain the best results regarding the plant average diameter, with an increase of 10% compared with the control. Regarding the leaf number and the total leaf area, the peat substitution percentage with the compost at 10%, 20%, 30% of the volume has determined a significant decrease of these features.

The bio-stimulant positive effect on the plant growth has been also confirmed by analyzing the values of SPAD, leaf number, total leaf area and also of fresh weight of the foliage. The leaf number (95.1 vs. 88.7) and the total leaf area (1120.7 vs. 1030) have been different in the plants grown with the bio-stimulant with respect to the non-treated plants. Besides, the fresh leaf, stem and total weight has been positively influenced by the bio-stimulant application showing higher average values (49, 23, 72g, respectively).

Keywords: sewage sludge, Animal and vegetal wastes, Animal bio-stimulant, *Nerium oleander* L., Growing media characterization

NOTES

INFLUENCE OF PEAT ELIXIR-1 AND *HUMIEXTRA* ON THE SEED GERMINATION AND GROWTH OF VEGETABLES

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Commercial products with humic substances have often been used for plant growth stimulation and yield improvement.

The aim of study was to clarify the effects of the commercial products Peat elixir-1, produced from peat, and HumiExtra, produced from vermicompost. Both preparations contain humic substances and are manufactured by *ZPRF Intellectual resources Ltd* in Latvia.

Seed germination, plant growth and yield formation of garden cress, onions and cucumbers was tested. Vegetation experiments were placed in pots with peat substratum or soil in greenhouses. The preparations were used once a month. The first treatment was done at sowing. Concentrations of 20, 2, 0.2 mL per m² in each treatment was used. Control was without the preparation.

Plant growth, biochemical parameters and biological activity (respiration and enzymatic activity) of soil and substratum was tested.

Seed germination was effected by the preparations. The best results were observed with cucumbers. Onions were less sensitive to preparations. No significant differences between the preparations were noticed.

Plant growth and yield quality depended on plant species and its development stage.

No significant effect of Peat elixir-1 or HumiExtra was observed on the biochemical contents of the vegetables. However increase of soil biological activity was detected as result of the treatment.

Keywords: humic substances, plant growth, vegetables, biological activity of soil and substrate

NOTES

DEVELOPING POT MEDIA FROM LOCAL FARM RESIDUES FOR GROWING POTHOS (*Scindapsus aureus* L.) PLANT

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Keywords: pot media, rice straw, sawdust, composting

NOTES

In the present study, rice straw and sawdust wetted for certain periods (0, 15, 30, 45, 60 days) were compared with peat moss as growing media for pothos (*Scindapsus aureus* L.) plant. A germination bioassay using lettuce seeds was conducted as a pre-growing test. The obtained results showed increasing germination percentage, global germination index and radical length of lettuce as the composting time was increased. A strong accordance was found between the germination bioassay and the plant experiment as increasing the composting time improved the vegetative and chemical characteristics of pothos plants, regardless of the composted material. No significant differences were detected between composting for 45 and 60 days in most cases. Nutrient element analysis showed a noticeable improvement in N, P, and K content of rice straw and sawdust as a result of composting process. This improvement was more obvious in rice straw where nitrogen content in the end-product reached 3 folds that of the raw material. The increment in nitrogen reflected on lowering C/N ratio and in turn resulted in better growth of pothos plants. The most effective treatment was composting rice straw and sawdust for either 45 or 60 days even though their pH value and nutrient elements content still were not as suitable as peat moss. Therefore, more efforts should be done to diminish their pH values and to enrich them with certain necessary nutrient elements or even to use mixtures of different farm residues in order to improve their physical properties.

HOW TO IMPROVE THE QUALITY OF COMPOSTED MATERIALS-RICE STRAW AND SAWDUST AS SUBSTITUTES FOR PEAT MOSS FOR GROWING POT PLANTS

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The present experiment was conducted using pothos (*Scindapsus aureus* L.) to test the possibility of using composted rice straw, sawdust and their mixture as growing media comparing to peat moss. The effect of the addition of certain amendments including sulphur 2% (w/w), ammonium nitrate 1.5% (w/w) and EM (effective microorganisms) 10% (w/w) in different combinations to improve the end-product quality was investigated. The obtained results showed that all of the used combinations of sulphur, ammonium nitrate and EM considerably improved the biological efficiency of composted sawdust, rice straw or their mixtures on growth of pothos plants compared to their control treatments. Rice straw was affected the most by the addition of any amendment compared to sawdust or sadwust and rice straw mixture. Plants grown in rice straw treated with sulphur alone showed a considerable enhancement in fresh weight of roots and leaf pigmentation of pothos plants. Incorporating rice straw with sulphur plus ammonium nitrate improved the vigor of pothos plants represented as number of internodes and leaves per plant as well as the total leaf area per plant. Applying sulphur plus EM to rice straw resulted in the highest values of leaf area and dry weight of roots. The combination of all the used amendments showed desirable effects in plant height, leaf pigmentation, plant biomass characteristics and leaf content of nitrogen and calcium.

Keywords: ammonium nitrate, em, sulphur, rice straw, sawdust, composting

NOTES

SPENT MUSHROOM COMPOST AS A PARTIAL REPLACEMENT FOR PLANT GROWING MEDIA AND MUSHROOM CASING SOIL

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Unavailability of peat is one of the main difficulties in green house plants and mushroom cultivation. Substitution or partial replacement of peat by alternative materials is environmental friendly and economically viable. One of the alternatives could be spent mushroom compost (SMC) which is the waste material of *Agaricus bisorus* cultivation. After mushroom production has been harvested, the growing materials are steamed and then removed from the growing beds as spent mushroom compost. This material that had been watered for two years was leached in order to reduce its salt content. The electrical conductivity of SMC was reducing from 7.1 to 1.8 m/S after 18-20 days leaching.

This study was conducted to evaluate the use of different proportion of leached SMC as a partial replacement of peat for cucumber plants growth and used in mushroom cultivation as casing soil.

For growing cucumber plants, leached SMC was mixed with peat in rates of 15, 25, 35 and 45%. The height, number of flowers and fruits were measured after 50 days. The largest height was observed in 15% and 25% where as number of fruit was more in rate of 25% leached SMC.

In mushroom growing process, *Agaricus bisporus* spawn is mixed with pasteurized mushroom substrate for about 14 days. After mycelial colonization of the substrate is complete, an approximate 2-inch layer called casing soil is applied on top of substrate.

The function of the casing soil is to provide an environment for fruit body formation. Different proportions of pasteurized SMC was mixed with peat and used as casing soil. Physical, chemical of casing materials and mushroom yield was estimated. The result of statistic analysis showed that there are no significant differences between peat and addition of 30% leached SMC to the casing soil.

NOTES

LONG TERM EFFECT OF ORGANIC FERTILIZATION IN VINEYARD: EFFECT ON YIELD AND SOIL CHEMICAL PROPERTIES

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Organic fertilization is considered to be a useful tool to reduce soil erosion and agriculture's environment impacts. These fertilizers promote sustainability through the decrease of nutrient input and significant increases in soil biodiversity. The application of composted organic waste is spread to at least 95,000 vineyard hectares in the European Union, about 2.5% of the total amount of vineyards at the end of 2006.

In the present work, we explore how production and soil properties are affected by different organic fertilizers. The study was carried out in an eleventh-year-old vineyard, located in Bargota (Navarre, northern Spain). The experiment design consisted in split plot with three repetitions. The area of each elemental plot was 108m², each one containing 15 plants of *Tempranillo* cultivar. Since 1997 every year, the three following different organic fertilizers were applied: composted urban solid residues, composted mixture of vegetable and pig manure, and composted sheep manure. Additionally a non-fertilized treatment and a mineral fertilized one were tested.

For all treatments, every year, fertilizers and soil chemical and physical properties were analysed. Also, plant nutrient contents were analysed in two stages, one in the flowering period and the second one in the veraison. In addition yield and production quality was measured each year. Furthermore, from the obtained production, microvinification and wine analysis were conducted.

In this work it is discussed the effect of the long term organic or inorganic fertilization on the above mentioned variables.

Keywords: compost, fertilization management, mineral fertilizer, grapevine

NOTES

INTEGRATED NUTRIENT MANAGEMENT ON CARROT THROUGH USE OF VERMICOMPOST

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In the present investigation, possibility of integrated nutrient management using carrot as test vegetable crop with vermicompost (VC) as a component of fertilization and manuring schedule has been assessed against traditional Farmyard Manure (FYM) along with various percentages of recommended inorganic NPK fertilizers. For this purpose, a field experiment was carried out in Randomized block design during 2009-10 at the Horticultural farm of Visva-Bharati University, Sriniketan, situated in the western lateritic region of West Bengal State, India (latitude 23°39' North and longitude 87°42' East with an average altitude at 58.90 m above the mean sea level). Eight treatments viz. Control; NPK₁₀₀ % (recommended dose of inorganic fertilizers @ 80:60:60 kg); FYM_{20t}; VC_{10t}; FYM_{10t} + NPK_{50%}; VC_{5t} + NPK_{50%}; FYM_{15t} + NPK_{25%} and VC_{7.5t} + NPK_{25%} /ha, respectively, were used. Application of nutrients in the form of organic and inorganic fertilizers improved vegetative growth and also increase the production of marketable roots to significant extent. Considerable variations in the contribution of VC and FYM were also observed. It is evident from the results that application of VC with judicious level of NPK improved growth and economic yield of carrot significantly. Application of VC_{5t} + NPK_{50%} resulted maximum economic yield (20.78 t/ha) with higher carotene content. It was also observed that the beneficial effect of VC is greater than FYM.

The salient conclusion emerging out from the present investigation is that judicious application of NPK along with VC is able to exert remarkable influence on growth, development and marketable root production including carotene content and thus helps in augmenting economic benefit through cultivation of carrot under red and lateritic soil condition.

Keywords: organic manure, farmyard manure, carotene, red and lateritic soil

NOTES

**ROLE OF ORGANIC MATTER IN IMPROVING PROPERTIES OF
CALCAREOUS SOILS OF CALCAREOUS OF IRAQ AS AFFECTED
BY LEVEL OF APPLICATION AND TYPE OF ORGANIC MATTER
ADDED**

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This study was conducted to determine the quantitative relationship between percentage of organic matter added and improvement in soil chemical properties as a first objective. Two types soils of Medium and heavy textured soils were used for they are the most common soils in Iraq. Peat, Barley Straw and Rice Husks are the three types of organic matter used. These three types of organic matter were added in 0%, 0.5%, 1%, 1.5%, and 2.0% on the basis of dry weight of soil. Organic matter was thoroughly mixed with assigned soil and transferred into plastic containers. Soil moisture was raised to field capacity level (1/3 bar) and incubated for 20 weeks at room temperature. Soil content of plant available N, P and K increased with the increase of level of organic matter added. Addition of organic matter at 1.5% level was the most effective level of addition irrespective with type of organic matter added. Increase in N, P and K in soils, as a percentage; however is the highest with Peat type of organic matter added and they were the least with Rice Husks type.

Keywords: plant nutrient, Peat, N, P, K available

NOTES

UTILIZATION OF IRAQI MARSH PEAT FOR GROWING CUCUMBER UNDER ORGANIC FARMING CONDITION

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Marsh area of Iraq is a major source for well decomposed material due to its abundance content of natural vegetation around the year. This coupled with the fact that organic farming depends mainly on the availability of natural organic material may legitimize conducting this work. The work was designed to develop organic farming system for Iraq in general and marsh area in specific. That is to increase the quality and quantity of the yield of the unit area and for preserve the environment as well. Organic farming is in the experience of the concerned country with the interaction among environmental, economical and production factors. Therefore a series of field and lab experiments were conducted to develop the most effective farming for the first time in Iraq. Yield, NO_3 and NH_4 content were used as a parameter for yield and healthy yield evaluation in addition to the fact that there are no chemicals used under organic farming practice. Results showed that yield of cucumber under organic farming using decomposed organic matter are 120 ha^{-1} while it was just 80 ton ha^{-1} under conventional farming system. NH_4^+ and NO_3^- content in soils under organic farming using decomposed organic matter was 25% and 10% less than that under conventional farming.

Keywords: *Cucumis Sativa*, nitrate pollutant, conventional farming, organic material, yield, plant quality

NOTES

EFFECTS OF VARIOUS LEVELS OF MUNICIPAL SOLID WASTE COMPOST ON GROWTH AND YIELD OF APPLE TREES

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In an attempt to decrease the use of chemical fertilizers and for extension of organic farming, an experiment was carried out in Ferdowsi University of Mashhad. Completely randomized factorial design (CRD) with four levels (0, 30, 45 and 60 ton per hectare) of municipal solid waste compost (MSWC) as the first factor and three apple rootstocks (EM9, EM106 & EM26) as second factor in five replications were used. Golden delicious apple cultivar was grafted on rootstocks. Results showed that application of urban compost improved the soil characteristics and consequently increased fresh and dry weigh of fruits. Application of compost at the level of 60 ton/per hectare increased the average yield and also the number of first grade fruits significantly. This paper reports experimental results obtained over 10 years.

Keywords: *Golden delicious*, urban compost, organic farming, soil characteristics, MSWC

NOTES

INFLUENCE OF LONG TERM APPLICATION OF DIFFERENT FERTILIZERS ON SOIL ACIDIFICATION AND SUGARCANE YIELD

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The present experiment was conducted to observe the changes in pH of the red soil subjected to long term application of different fertilizers. A long-term experiment was conducted with the sugarcane crop grown in red soils. The soils were given following fertilizer treatments: no fertilizer (control); chemical nitrogen, phosphorus and potassium fertilizer (NPK); NPK+ organic manure (NPKM); NPK+ sugarcane trash (NPKT). The soil characteristics such as exchangeable aluminium (E-Al), acidity (E-A) and hydrogen (E-H), soil P and K content, and the sugarcane yield have been analyzed. Under different fertilization applications, the E-Al, E-A and E-H increased, however, this increase was significantly lesser in NPKM and NPKT treatments compared to CK and NPK treatments. Yield data revealed a considerable increase during 15 years of different fertilizer application compared to CK, but this increase was very high in NPKM and NPKT treatments. Soil available P and K also showed the trend similar to yield data. Using organic manure and sugarcane leaf trash with chemical fertilizers, though enhanced the soil acidification, but its effects were significantly lesser than the chemical fertilizer application alone, and therefore, resulted in high yield of sugarcane. The soil pH was found positively and significantly correlated with cane yield.

Keywords: acidification, fertilization, red soil, organic manure, soil, trash

NOTES

Poster Session 6

BIOLOGICAL INTERACTIONS AND PLANT PROTECTION

FACTORS THAT AFFECT THE CAPACITY OF GROWING MEDIA TO SUPPRESS VERTICILLIUM WILT

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Diseases caused by *Verticillium dahliae* in crops such as artichokes, sunflowers, peaches, tomatoes, peppers, olives and cotton are of varying importance in Spain. Certain composts have the capacity to repress plant diseases while minimizing organic waste, thus leading to a reduction in the use of fertilizers and fungicides in crop production. In this work, we evaluate the potential of three growing media (grape marc compost, cork compost and a co-compost of olive mill waste and olive leafs) compared to a standard substrate (coir fiber) to suppress Verticillium wilt in cotton (VC) and olive (VO). In addition, we analyzed chemical properties (pH and electrical conductivity), enzymatic properties (β -glucosidase, alkaline phosphatase and arylsulfatase activities) and biological properties (oxygen uptake rate: OUR) at the start of the bioassays. The composts showed different suppressive capacities. The co-compost of olive mill waste and leafs was the most suppressive against VC and VO, delaying the onset of symptoms with respect to coir fiber (by 6 and 24 days, respectively). Grape marc compost only suppressed VO. The variables that were significantly correlated with disease severity were pH, β -glucosidase and phosphatase activities, and OUR. From the results, we conclude that pH and β -glucosidase activity can be considered predictors of the suppressive capacity of these composts against VA and VO. Moreover, OUR and phosphatase activity can only be considered predictors of suppressive capacity against VA and VO, respectively.

All these parameters showed positive correlations with the onset of symptoms of the disease. Indeed, β -glucosidase and phosphatase activities were best fit as a saturation-type response to the onset of symptoms of VO. This work indicates that composted olive by-products are very promising when it comes to controlling VO in organic and integrated agriculture systems. The addition of this compost to substrates used for the production of olive plants also seems recommendable.

Keywords: *Verticillium dahliae*, compost, olive, cotton, suppression

NOTES

COMPARISON OF COMPOST SUPPRESSIVENESS AGAINST CUCUMBER PYTHIUM WILT IN PEAT SUBSTRATE AND SOIL

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The ability of composts to reduce the symptoms of cucumber (*Cucumis sativus*) *Pythium* wilt was studied in two bioassays. Compost samples were gathered from commercial composting plants in Finland. The raw materials used were either chicken manure, biowaste or sewage sludge. The bioassays were carried out in greenhouse using 20% compost in growing medium. In the first experiment, compost was mixed with steam-sterilized sand and white peat (1+3) whereas natural silty soil from two fields was used in the second experiment. Sterilized and unsterilized controls were included in both experiments. Cucumber seedlings were inoculated with two pathogenic *Pythium* species (*Pythium ultimum* and *Pythium* sp). The length of cucumber shoots, number of normal and wilted leaves and shoot health was recorded once a week during the experiment (5 weeks). At harvest, shoot dry weight was measured and root health evaluated. *Pythium* decreased cucumber growth and root health but significant wilting or plant/leaf death was not recorded in any of the treatments. In sterilized peat, cucumber dry weight was decreased 33% by *Pythium* but natural peat was suppressive against this disease (4% growth reduction). There was little disease in field soil controls (4-10 %) and none of the composts showed increased disease suppressiveness compared to control.

This might be due to natural suppressiveness of soil or unfavourable conditions for the disease in the second experiment. Sewage sludge compost was most suppressive in all three substrates (no symptoms). Chicken manure compost accelerated wilt in sterilized peat but not in soil. Thus, at best, composts can suppress cucumber wilt as effectively as natural peat. However, wilt disease could not be further suppressed by composts in field soil since there was little disease without composts.

Keywords: plant disease, *Cucumis sativus*, sewage sludge, biowaste, chicken manure

NOTES

NOTES

THE EFFECT OF COMPOSTED GREEN WASTE (CGW), EITHER AS A SURFACE APPLICATION OR BY INCORPORATION INTO A PEAT-BASED GROWING MEDIUM, ON THE IMPACT OF *Pythium* SUPPRESSION ON THE GERMINATION AND GROWTH OF LETTUCE (*Lactuca sativa* cv. "LITTLE GEM")

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The control of plant diseases has become more challenging in recent years due to the reduction in the number of available plant protection products. Alternatives to chemical control of plant diseases are being sought. One of the most destructive plant diseases is damping off caused by *Pythium* species. This study examined the possible use of composted green waste materials as a potential control method for this disease. The study evaluated the effects of different growing media, containing composted green waste, on the occurrence and development of *Pythium*. Three separate experiments were undertaken using two isolates of *Pythium* and seeds of lettuce (*Lactuca sativa*) cultivar "Little Gem". The study found that the addition of CGW, either as a surface application or by incorporation into a peat-based medium diminished the impact of *Pythium* on the germination and growth of lettuce (*Lactuca sativa* cv. "Little Gem"). The effect is dependent on the sample of CGW used and varied between isolates of *Pythium*.

Keywords: disease control, *Pythium*, composted green waste, peat extraction

EVALUATION OF *Trichoderma* spp. AS A GROWTH PROMOTER IN A GRAPE MARC COMPOST AND PEAT MOSS SUBSTRATE

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Trichoderma spp. has been reported like a powerful biological control agent against plant pathogens. They are applied to agricultural crops as plant growth promoters and biofungicides. The purpose of this research was to study the growth promotion by two isolates of *Trichoderma* sp. from the North-western of Cádiz (Spain) using two different substrates, peat moss and grape marc compost as a component (20 %) of a peat moss based substrate. The inoculums of *Trichoderma* sp. were based in a suspension of conidia (4×10^7 conidia/plant) applied to the substrates by mixing. Plant assays were done with *Ipomoea alba*. Full assays were done with ten repetitions per combination of substrate and *Trichoderma* sp., and controls of peat moss without *Trichoderma* sp. or compost

Simple ANOVA (LSD 95 %) showed significant differences on parameters among the different treatments. Score scale was lower on controls. The Shoot Length of plants grown with compost or *Trichoderma* sp. treatments was higher than in the controls. Root Dry Weight and Total Weight of plants grown with *Trichoderma* sp. was higher than those grown in controls and substrate based in peat moss and compost. Finally, combination of *Trichoderma* sp. and compost was superior to the other treatments regarding the number of leaves.

For this one, Dickson Quality Index was over an 8 % higher than in controls. The enrichment of peat moss substrate with compost and especially with the selected microbes, develops a growth promoter effect on *Ipomoea alba*.

Keywords: grape marc compost, *Trichoderma* spp., growth promoter, *Ipomoea alba*

NOTES

THE INFLUENCE OF ARBUSCULAR MYCORRHIZAL FUNGI ON GROWTH OF STRAWBERRY PLANT IN SOILLESS GROWING SYSTEM

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Arbuscular mycorrhizal fungi can increase plant growth and uptake of nutrients and decrease yield losses. In micropropagated strawberry inoculation with arbuscular mycorrhizal fungi growth and fruit yield has increased. The aim of the present study was to evaluate the effect of different arbuscular mycorrhizal fungi inoculation methods on growth of strawberry (*Fragaria x ananassa* Duch. cv. 'Splendor') plant in soilless growing system. Plants were grown in 6 polyethylene bags (100 cm x 18 cm x 30 cm) filled with coconut fiber in a greenhouse under natural light and temperature. A completely randomized block design (2 treatments x 2 replications) was used in a soilless growing system. Each replicate consisted of 10 plants. The rhizosphere of plants was inoculated with a soil mixture of peat and sand, (4:1; v/v). The soil mix was inoculated with 20 spores g⁻¹ of two mycorrhizal fungi (*Glomus mosseae* and *Glomus intraradices*) (mycorrhizal substrate). Two different methods of inoculation were used: (S1 y S2). Two polyethylene bags of each treatment were applied. The treatments were S1: 50% of rhizosphere of plant was placed in a bag with 18-20 g of mycorrhizal substrate. S2: 100% of rhizosphere was inoculated with 18-20 g of mycorrhizal substrate. Two polyethylene bags were placed as control of each treatment. Control plants were set up without inoculation and with the same treatment, S1 and S2. The experiment was carried out in 2010-2011.

The experiment had a duration of seven months and was conducted in a greenhouse. The main effects of treatments on vegetative parameters were evaluated. The crown diameter, number of leaves, size of plants and SPAD values were measured weekly. Vegetative growth index was calculated from the size of plants. SPAD values could reflect the effect of different inoculation methods (S1 and S2). There were differences between micorrhizal plants and non micorrhizal plants; and between different inoculation methods (S1 and S2). This might be due to the micorrhizal dependency (plant response to colonization with respect to nutrient acquisition and plant growth). In summary, results indicate the effect of inoculation method on vegetative parameters, promoting growth in soilless growing system.

Keywords: *Glomus mosseae* and *Glomus intraradices*, soilless growing system, vegetative parameters

NOTES

EFFECT OF ARBUSCULAR MYCORRHIZAL FUNGI ON QUALITY OF STRAWBERRY FRUIT IN SOILLESS GROWING SYSTEM

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It has been shown that arbuscular mycorrhizae fungi not only stimulate the plants growth but also contribute in enhancing their tolerance to abiotic and biotic stresses. The aim of the present study was to evaluate the effect of different arbuscular mycorrhizal fungi inoculation method on growth of strawberry (*Fragaria x ananassa* Duch. cv. 'Splendor') plant in soilless growing system. Plants were grown in 6 polyethylene bags (100 cm x 18 cm x 30 cm) filled with coconut fiber in a greenhouse under natural light and temperature. A completely randomized block design (2 treatments x 2 replications) was used in a soilless growing system. Each replicate consisted of 10 plants. The rhizosphere of plants was inoculated with a soil mixture of both peat and sand. This soil mix (peat and sand) was then mixed with 20 spores g⁻¹ of two mycorrhizal fungi (*Glomus mosseae* and *Glomus intraradices*), this is then called mycorrhizal substrate. Two different methods of inoculation were used, S1 and S2. S1: 50% of rhizosphere of plant was placed in bagful with 18-20 g of mycorrhizal substrate; S2: 100% of rhizosphere was inoculated with 18-20 g of mycorrhizal substrate. Control plants were set up without inoculation and with the same treatment S1 and S2. Two polyethylene bags were applied in each treatment (control, S1 and S2). The experiment was carried out in 2010-2011 for seven months.

The main effects of treatments on weight and fruit quality parameters (pH, titratable acidity, total soluble solids and firmness) were evaluated. There were differences between mycorrhizal plants and non mycorrhizal plants; and between different inoculation methods (S1 and S2).

Keywords: *Glomus mosseae* and *Glomus intraradices*, fruit quality parameters

NOTES

EXPERIENCES OF USING COMMERCIAL ARBUSCULAR MYCORRHIZAL FUNGAL INOCULUM IN FINNISH NURSERY PRODUCTION OF WOODY PLANT SPECIES

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The aim of this study was to find out whether nursery produced woody plant species of Northern Europe are colonized by arbuscular mycorrhizal fungi (AMF) after inoculation into peat or soil substrates, and is there a benefit from inoculation in terms of better growth or improved winter hardening. The study was carried out at a commercial nursery. The AMF product Myco-Ympäri, produced by MTT, was used to inoculate plants grown in containers with peat and cuttings raised in cutting beds in mineral field soil. Plant species studied in containers included *Syringa vulgaris*, *Dasiphora fruticosa*, *Viburnum opulus*, *Prunus padus* 'colorata', *P. sargentii*, *P. domestica* and *Hippophae rhamnoides*. In the cutting bed experiment, *Rosa pimpinellifolia* and *Diervilla lonicera* were studied. In the container experiment, AMF inoculation caused root colonisation in all plant species varying from 2% in *S. vulgaris* and *P. domestica* to 62% in *H. rhamnoides*, but AMF did not improve growth. In the cutting bed experiment, AMF inoculation slightly increased AMF root colonisation, but the impact of AMF inoculation on growth attributes was also here negligible. In *Diervilla*, AMF inoculation had no effect on starch accumulation of stems measured in late autumn.

Sucrose accumulation in stems was slightly decreased due to AMF inoculation. After winter storage, the amount of starch in stems of *Diervilla* was slightly higher in AMF treated than in control plants. Higher chlorophyll fluorescence was also observed in the stems of AMF inoculated plants, indicating that AMF treated plants were less stressed after winter storage than non-inoculated plants. It can be concluded that AMF inoculation had few visible impacts on woody plants in prevailing nursery conditions, but that the impact of AMF can be "hidden" by increasing winter hardening. The role of peaty growing media used in nurseries for function of the AMF symbiosis is discussed.

Keywords: AMF root colonisation, peat, mineral soil, chlorophyll fluorescence, winter hardening

NOTES

CULTURE MEDIA PERFORMANCE ON THE DETECTION OF ACTINOMYCETE BACTERIA FROM COMPOSTS

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Keywords: antibiotic, actinomycete growth, orange, olive, clippings

NOTES

This study evaluated the performance of six culture media on the detection of actinomycetes that were present in composts of agro-industrial wastes, from the Algarve region. The composts were produced with orange wastes, olive pomace and grass clippings, in the proportion of 2:1:1 (v/v). Two compost piles were built with different ventilation systems, one with forced ventilation and the other with mechanical turning and natural ventilation.

In order to quantify the population of actinomycete bacteria six different growth media containing antibiotics and one culture medium containing only half of the concentration of the Plate Count Agar ($\frac{1}{2}$ PCA) were tested. The incubation took place at the temperature of 25° and 55°C.

Different results were obtained for the enumerations from the culture media. The population of actinomycete bacteria achieved higher values when incubated at 55°C and when the samples were inoculated in the $\frac{1}{2}$ PCA culture medium.

Thus, the antibiotics showed no beneficial effect in the tested culture media. The results suggest the use of the $\frac{1}{2}$ PCA culture medium as the most adequate in order to count the bacterial populations in these samples. This culture media is also the less expensive and the one that showed the fastest bacterial growth.

CHANGES IN PHYSICOCHEMICAL PROPERTIES AND MICROBIAL POPULATION DURING FERMENTATION OF FARM-MADE ORGANIC LIQUID FERTILIZER

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This study was conducted to investigate the changes in physicochemical and microbiological properties during aerobic fermenting process of farm-made organic liquid fertilizer made through mixing two organic materials, blood meal and molasses. The pH level of organic liquid fertilizer during the fermentation decreased from 7.2 to 4.3. The EC of organic liquid fertilizer was increased from 13.9ds/m to 99.3ds/m during the fermentation. The total population of aerobic bacteria was decreased from 8.2×10^5 cfu/mL to 3×10^4 cfu/mL but population of *Bacillus* species was increased from 2.1×10^2 cfu/mL to 80×10^2 cfu/mL during the fermentation. The bacterial isolates contained in organic liquid fertilizers were isolated on tryptic soy agar and identified by fatty acid-base typing. Among bacteria isolated, The genus *Bacillus* was dominant during the fermenting process. The denaturing gradient gel electrophoresis (DGGE) profile showed differences in bacterial communities among organic liquid fertilizers.

Keywords: aerobic fermentation, *Bacillus* species, DGGE, organic liquid fertilizer

NOTES

INCIDENCE OF LIVERWORT (*Marchantia spp*) IN CONTAINER NURSERY STOCK MEDIA CONTAINING GREEN COMPOST, AND IN POTS TOPPED WITH PINE BARK AND GREEN COMPOST

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The incidence of liverwort (*Marchantia spp*) colonisation has increased markedly in Ireland and elsewhere on container media in recent years, disfiguring pots and potentially inhibiting plant growth. Chemical control of liverwort may be achieved by the use of quinoclamine, but this product does not have approval in either the Republic of Ireland or the U.K. Thus control is based on cultural methods, principally by covering or dressing pot surfaces. Some U.K-sourced green composts have been reported to suppress liverwort growth. In the current study colonisation of pot surfaces by liverwort was not reduced in media containing up to 50% by volume of green compost. However, differences in colonisation were associated with individual species in pots. Of four ornamental species planted, pots containing *Photinia* showed the lowest degree of colonisation by liverwort, with *Prunus* and *Berberis* showing an overall higher level of colonisation, although differences were evident between plants in individual media. The basis of this variation is not clear. Pot dressings of green compost suppressed liverwort growth over one year almost to the same extent as pine bark dressings.

Keywords: liverwort, peat, green compost, pot dressings, pine bark

NOTES

INFLUENCE OF GROWING MEDIA ON PHYSIOLOGICAL DISORDERS INCIDENCE IN ORIENTAL RADISHES

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Some cultivar radishes of 'Daikon' or oriental radish (*Raphanus sativus* L. var *longipinnatus* L.H. Bailey) have largely replaced in Spain the cultivation of turnips (*Brassica napus* L.), due to the establishment of productive calendars throughout the year for supplying mixed vegetable trays, offered by supermarkets for elaboration of "cooked." Market acceptance of these roots can be affected by the incidence of various physiological disorders, such as the cracking, hollowness, malformation and the emission of secondary roots.

We used two korean cvs, Spring Favor and Spring White under greenhouse cultivation in two production cycles, autumn-winter and spring seasons, in containers of 25 L. filled with three substrates, perlite, coir dust and sand. All plants were fertigated with the same nutrient solution and the irrigation schedule was based on similar Eto, adjusted with radiation and drainage. In these experiments, designed according to a factorial program, we tried to establish the influence of cvs and growing media on the incidence of mentioned physiological disorders.

Spring White cv. was more susceptible to cracking and malformation than cv. Spring Favor, while Spring Favor cv. showed a greater susceptibility to hollowness and secondary roots emission.

Among the three used substrates, perlite behaved worse in the incidence of all studied physiological disorders, while sand and coir dust did not appear to adversely affect them. No significant interactions were detected between cvs x substrates.

Keywords: perlite, sand, coir dust

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