

Fruit, Vegetable and Cereal Science and Biotechnology

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Scope and target readership: *Fruit, Vegetable and Cereal Science and Biotechnology* provides a complete analysis and understanding of any aspects of fruit, vegetable, and cereal science and biotechnology.

Fruit, Vegetable and Cereal Science and Biotechnology primarily wishes to examine the following in fruits, vegetables and cereals:

- 1) *In vitro* propagation (micropropagation, somatic embryogenesis, tissue culture, bioreactor system production), tissue culture;
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Guest Editors

Dr. Paula Tennant

Dr. Noureddine Benkeblia

University of the West Indies, Jamaica

In co-operation with

University of the West Indies, Jamaica



Cover photos: Left plate: Coleopteran pests of potato; Right plate: Hemipteran pests of potato (Wraight *et al.*, pp 25-38).
Bottom, right Hydroponically-produced potato tubers in Brazil (Corrêa *et al.*, pp 133-139).

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The Guest Editors

Dr. Paula Tennant is a research plant pathologist working with virus diseases of fruit crops at the University of the West Indies, Mona, Jamaica. She received a BSc degree in Botany from the University of the West Indies and her PhD in Plant Pathology at Cornell University. Post doctoral experience working with *Papaya ringspot virus* and the efficacy of pathogen-derived resistance for the control of the virus in Jamaica was at Cornell University and the Biotechnology Centre, University of the West Indies, Mona. These efforts and close collaboration with the Jamaica Agricultural Development Foundation (JADF) have led to the establishment of the appropriate regulatory structures to oversee the use and importation of agricultural biotechnology products in Jamaica and the development of a bio-engineered agricultural product of the Caribbean. She joined the Staff in the Department of Life Sciences in 2001, continuing work with papaya and more recently initiating work on the characterization of *Citrus tristeza virus* isolates and citrus viroids in Jamaica. In 2001, Dr. Tennant received the Young Agriculturist Award from the Inter-American Institute for Cooperation on Agriculture (IICA) for her work on papaya. She co-teaches a graduate course, Plant Diseases and their control, and undergraduate courses in Molecular Biology, Virology and Plant Biotechnology at the University of the West Indies, Mona.



Dr. Noureddine Benkeblia is a scientist involved in postharvest plant biochemistry and physiology, including preservation technologies for horticultural crops. His work is mainly devoted to the metabolism of the carbohydrate, fructooligosaccharides (FOS), during plant development and storage periods. A few years ago, he introduced the new concept of system biology – Metabolomics – to investigate the mechanisms of biosynthesis and accumulation of FOS in Liliaceous plants. Dr. Benkeblia first received his BSc, MSc and Doctorate (PhD) from INA (Algeria), and Doctor in Agriculture (PhD) from Kagoshima University (Japan). After few years teaching in Algeria, he joined INRA, Avignon (France) as a Postdoctoral Scientist from 2001. From 2002 to 2008, he worked as a Visiting Professor in the University of Rakuno Gakuen, Ebetsu (Japan) and also as a Research Associate in Hokkaido University from 2005 to 2007. Dr. Benkeblia joined the Staff in the Department of Life Sciences University of the West Indies, Mona, Jamaica in 2008, continuing his work on the physiology, the biochemistry and metabolomic of fructan-containing plants in Jamaica. He also works on the postharvest physiology and biochemistry of local fruits such as ackee and sorrel. Dr. N. Benkeblia is teaching plant physiology, horticulture and postharvest management of crops.



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Potato 2

Dennis Halterman, Shelley Jansky, Doug Rouse (USA) Potato Early Dying: Molecular Perspectives on Pathogenicity and Host Resistance (pp 1-5)

ABSTRACT

Invited Mini-Review: Potato early dying is a widespread disease that consistently causes yield losses in almost all potato-growing regions worldwide. Despite this, it does not have a reputation as a devastating disease of potato since symptoms and yield losses are subtle and infection does not lead to complete crop loss. However, the interaction between the vascular fungus *Verticillium dahliae* and the root lesion nematode *Pratylenchus penetrans* to form the early dying complex makes studying this disease very interesting to plant pathologists. The ability of *Verticillium* spores to survive in the soil for many years, and the difficulty in properly treating infested soil makes this one of the most persistent and widespread diseases of potato. The purpose of this short review is to provide readers with an update on recent research developments relating to our understanding of this disease complex and approaches used to control potato *Verticillium* wilt. This review is not meant to be comprehensive, since several excellent review articles with information about the potato early dying complex and *Verticillium* wilts in general are already available. Rather, we have chosen to focus on the impact molecular biology has had on our understanding of this disease and how it has provided opportunities for improvement of resistance in potato cultivars. Although various isolates of *V. dahliae* are important pathogens of multiple plant species, here we will focus mainly on the relationships among *V. dahliae*, *P. penetrans*, and potato.

Alexandra Blanchard, Mathieu Rolland, Agnes Delaunay, Emmanuel Jacquot (France) An International Organization to Improve Knowledge on *Potato Virus Y* (pp 6-9)

ABSTRACT

Short Communication: The *Potato Virus Y* (PVY) is one of the most economically important potato pathogens. PVY isolates are described according to their biological, serological and molecular characteristics. Such data have been used to classify PVY isolates in groups (including the PVY^N and PVY^O main groups) and variants (PVY^{N-W} (also described as PVY^{N:O}) and PVY^{NTN}). However, the high variability of the PVY genome, together with the restricted knowledge on molecular determinant(s) linked to PVY biological properties and the characteristics of commonly used detection tools have impaired the description of several PVY isolates. Indeed, numerous studies have reported isolates with a set of properties that do not fit in the already described classification. It has been shown that most of these unconventional isolates result from original genomic recombination events between PVY^N- and PVY^O-like sequences. These viral isolates have to be more efficiently detected and characterized to 1) improve the description of the diversity of this potato pathogen, 2) better understand the PVY evolutionary processes and 3) identify selection pressures applied to the PVY genome during its evolution history. To reach these aims, 22 scientists and team leaders from European, African and American laboratories have created the "PVY^{wide} Organization" (www.inra.fr/pvyorganization). Through this organization, members coordinate research on variability and evolution of PVY and analyse jointly the characteristics of thousands field-collected isolates. In addition to the studies of the plant-virus-vector interactions (e.g. pathogenicity, aphid transmission, host range, etc.), viral genomes of PVY isolates will be analysed using either an innovative technology for viral genotyping (multiplex icosasNaPshot) or a regular sequencing procedure. All together, the resulting data could potentially offer new understandings on PVY.

Andrei Alyokhin (USA) Colorado Potato Beetle Management on Potatoes: Current Challenges and Future Prospects (pp 10-19)

ABSTRACT

Invited Review: The Colorado potato beetle, *Leptinotarsa decemlineata* (Say) (Coleoptera: Chrysomelidae) is the most important insect defoliator of potatoes that can completely destroy potato crops. Its current range covers about 16 million km² in North America, Europe, and Asia and continues to expand. A complex and diverse life history, combined with an impressive

ability to develop insecticide resistance, make the Colorado potato beetle a challenging pest to manage. Beetle populations on commercial farms are usually suppressed by insecticides, which are likely to remain the predominant approach for the foreseeable future. In addition, the beetles can be controlled through the use of relatively common cultural practices, with crop rotation being the most effective and easily implemented approach. In spite of a long history of breeding efforts, no commercial cultivars resistant to the Colorado potato beetles are currently available on the market. Natural enemies are usually incapable of reducing beetle densities below the economically damaging levels and have to be used in combination with other control techniques. Unfortunately, there will never be a “silver bullet” solution to preventing the damage caused by this insect. The only sustainable way to protect potato crops is to integrate multiple control techniques into a scientifically sound management approach. This is not an easy task, but the only alternatives are recurrent crop losses in combination with environmental degradation.

Lawrence A. Lacey (USA), Jürgen Kroschel (Peru), Stephen P. Wraight (USA), Mark S. Goettel (Canada) An Introduction to Microbial Control of Insect Pests of Potato (pp 20-24)

ABSTRACT

Invited Mini-Review: A wide variety of insects are pests of potato plants and tubers. Several insect-specific pathogens have demonstrated efficacy for control of some of the more economically important insect pests of potato. *Bacillus thuringiensis* (*Bt*) and a granulovirus (PoGV) are effective in controlling potato tuber moth, *Phthorimaea operculella*, a serious pest of potato foliage and stored tubers in the tropics and subtropics. Naturally occurring PoGV has been reported in several countries where potato is grown. Colorado potato beetle (CPB), *Leptinotarsa decemlineata*, is a serious pest of potato in many countries worldwide. *Bt* var. *tenebrionis* effectively controls CPB when applied against first and second instar larvae. The fungus, *Beauveria bassiana*, has also been reported to control CPB under certain environmental conditions. Andean potato weevils, *Premnotrypes* spp., are pests of potatoes grown at high altitude in the Andes. An entomopathogenic nematode, *Heterorhabditis* sp., appears to be a potential candidate for microbial control of the weevil. A variety of other candidate entomopathogens are proposed for control of several additional insect pests including leaf miner fly, wireworms, lepidopterans, aphids, potato psyllid, leafhoppers, and other insects. The further development and use of microbial control agents will ultimately provide components for the integrated and sustainable control of insect pests of potato and in other agroecosystems. Although factors limiting the adoption and use of microbials include high cost and low efficacy, compared to most chemicals presently used, these costs could be offset by the premium price paid for safer food and a greener approach.

Stephen P. Wraight, Lawrence A. Lacey (USA), J. Todd Kabaluk, Mark S. Goettel (Canada) Potential for Microbial Biological Control of Coleopteran and Hemipteran Pests of Potato (pp 25-38)

ABSTRACT

Invited Review: Numerous insects in the orders Coleoptera and Hemiptera are major pests of potato, *Solanum tuberosum* L., worldwide. Although these pests are currently managed almost exclusively with chemical insecticides, there is continuing demand for alternative controls that pose lower environmental and health risks. Biological control agents represent one such alternative, and in this review we assess the potential for use of various microbial biological control agents for control of Colorado potato beetle, wireworms, aphids, leafhoppers, and psyllids. The Colorado potato beetle (CPB) and wireworms feed by chewing plant tissues and pass substantial portions of their life cycles both above and below ground. Consequently, they can be targeted with a broad range of microbial control agents, including bacteria, fungi, and nematodes. Aphids, leafhoppers, and Psyllids, on the other hand, feed by piercing plants and sucking sap, and most species pass their lives entirely above ground; these pests are susceptible to few pathogens other than fungi. Investigations to date indicate strong potential for microbial control of CPB, using integrated applications of *Bacillus thuringiensis* and *Beauveria bassiana*. Microbial control of wireworms and hemipteran pests is farther from realization. Important constraints include: difficulties in targeting soil-inhabiting pests with microbial control agents, limited efficacy/recycling potential of nematodes applied against wireworms, limited epizootic potential of fungal pathogens in early-season, low-density hemipteran pest populations, and problems with mass production and formulation of key fungal pathogens of Hemiptera. Latest research efforts aimed at overcoming these constraints are reviewed.

Harry K. Kaya (USA), Jesús Alcázar (Peru), Soroush Parsa (USA), Jürgen Kroschel (Peru) Microbial Control of the Andean Potato Weevil Complex (pp 39-45)

ABSTRACT

Invited Mini-Review: The Andean potato weevil consists of at least 14 species with 12 in the genus *Premnotrypes* and two in two other genera. The most important species attacking potato are *Premnotrypes suturicallus* Kuschel, *P. vorax* Hustache, and *P. latithorax* (Pierce). The weevil larva feeds and develops within the potato tuber resulting in yield loss. Although the weevil is native to the Andes, no parasitoids have been identified but predators like carabids affect the weevil population. In addition, entomopathogenic fungal and nematode species have been isolated in nature from these weevils. The fungus, *Beauveria bassiana* (Balsamo) Vuillmen, has been evaluated against the larvae and adults in the laboratory and field. Although effective under laboratory conditions, *B. bassiana* was not effective against weevil adults in the field because of the cold temperatures in the high Andes where potatoes are grown. It did show potential to control the weevil adults in potato storage areas, but its application did not provide sufficient benefits to farmers to adopt this biological control agent. On the other hand, the entomopathogenic nematode, *Heterorhabditis* species Alcázar-1, appears to be a potential candidate for biological control of the weevil. Its natural association with the Andean potato weevil complex, adaptation to cold, high virulence, superb host-finding abilities, high recycling potential and ease of mass rearing makes it a promising resource for Andean potato farmers. To be a practical control agent for large farms, investigations into large-scale production technologies for nematodes are required, whereas farmers with small farms could profit from the application of insect cadavers containing the nematode.

Lawrence A. Lacey (USA), Jürgen Kroschel (Peru) Microbial Control of the Potato Tuber Moth (Lepidoptera: Gelechiidae) (pp 46-54)

ABSTRACT

Invited Review: The potato tuber moth (PTM), *Phthorimaea operculella* (Zeller), is considered the most damaging potato pest in the developing world. Larvae mine potato leaves and stems, but more importantly is the feeding damage in potato tubers, which also can cause rapid rotting in non-refrigerated storage. Insect-specific pathogens (biopesticides) offer control alternatives to chemical pesticides that provide a variety of benefits including safety for applicators, other natural enemies, the environment and food supply. The most researched and practically used for control of PTM are a granulovirus and the bacterium *Bacillus thuringiensis* Berliner. The PTM granulovirus (*PoGV*) is species specific and has the potential to play a key role in the management of PTM in stored tubers and in field crops. The virus kills infected larvae within 2-3 weeks. Application of *PoGV* for control of field populations of PTM has been relatively limited and the results have been variable. However, it provides very good protection of treated tubers, especially in non-refrigerated storage. *Bacillus thuringiensis* (*Bt*) is the only bacterium that has been evaluated for PTM control. *Bt* subsp. *kurstaki* (*Btk*) is the most commonly used against lepidopteran pests. *Btk* has been reported to be effective for control of PTM infestations under field conditions and in rustic stores. An integrated control approach comprising *Btk* applied at the beginning of the storage period in combination with early harvest has been effective and eliminated reliance on chemical pesticides. The implementation of biopesticides will ultimately depend on an increased awareness of their attributes by growers and the public.

Christine Noronha, Mark S. Goettel (Canada) Differential Susceptibility between Diapausing and Non-Diapausing Colorado Potato Beetles (*Leptinotarsa decemlineata*) Treated with *Beauveria bassiana* (pp 55-58)

ABSTRACT

Original Research Paper: A laboratory-based study was conducted to examine the difference in mortality in non-diapausing and diapausing Colorado potato beetle (*Leptinotarsa decemlineata*) adults, following inoculation with *Beauveria bassiana* conidia. Results showed a higher percentage of mortality among laboratory-reared, non-diapausing beetles as compared to laboratory-reared, diapausing beetles. At the end of 30 days, 85% mortality attributed to *B. bassiana* infection was observed among the non-diapausing beetles and 20% among the diapausing beetles at a 10^6 conidia /cm² inoculation level. Beetles inoculated with 10^4 conidia/cm² showed 20% mortality due to *B. bassiana* infection among the non-diapausing beetles and no mortality among the diapausing beetles. No mortality due to *B. bassiana* was observed in the untreated controls. A similar study conducted with field-collected diapause-ready beetles gave similar results, with higher mortality due to *B. bassiana* infection being observed in the laboratory-reared, non-diapausing beetles. Our results suggest that management of the beetle by targeting pre-diapause beetles with the fungus *B. bassiana* may be a difficult proposition.

Christine Noronha, Mark S. Goettel (Canada) The Effect of Digging by the Colorado Potato Beetle (*Leptinotarsa decemlineata*) (Coleoptera: Chrysomelidae) on the Acquisition and Retention of *Beauveria bassiana* Conidia (pp 59-64)

ABSTRACT

Original Research Paper: The fungal pathogen, *Beauveria bassiana*, may play an important role in the management of overwintering Colorado potato beetles. Prediapause beetles dig into the soil in the fall where they overwinter. The loss or removal of conidia from the integument during the digging process may decrease the chance of disease development and subsequent mortality. We evaluated the number of fungal conidia that were acquired and retained by the beetle after burrowing into soil that was surface-treated with *B. bassiana* conidia. In addition, we evaluated beetles for disease initiation after exposure to conidia at the soil surface. Results showed that beetles acquired significant numbers of conidia from the surface treatment; however there was a linear decrease in the number of conidia retained on the integument as the beetles' burrowing depth increased. Almost half the population (54% and 46%) lost all conidia when the burrowing depth was between 21 and 30 cm. *B. bassiana* application method, spraying vs mixing conidia into the soil surface, did not significantly incite disease; however the inoculation concentration significantly affected mortality. More insects became infected when adults were exposed to surface concentrations of 10^7 compared to 10^6 conidia per cm^2 . Fall application of *B. bassiana* to reduce overwintering populations may not be a viable option because beetles tend to lose the conidia that are acquired on the surface during digging, thus reducing the chances of disease occurring during the overwintering stage. Soil treatments in the spring may be more beneficial in reducing the Colorado potato beetle colonizing population.

Kent F. McCue (USA) Potato Glycoalkaloids, Past Present and Future (pp 65-71)

ABSTRACT

Invited Mini-Review: The steroidal glycoalkaloids are naturally occurring specialty metabolites of questionable desirability in the vegetable crop, potato. Although glycoalkaloids undoubtedly originated under selection as feeding deterrents against herbivorous pests, they no longer function as the primary feeding deterrent. Moreover, due to their potential toxicity, guidelines persist as to the maximal allowable concentrations for newly developed cultivars. The origins of the glycoalkaloids lie in the ancient relatives of the modern potato, which continue to be used in breeding programs because of the wealth of genetic diversity for performance, nutrition and disease resistance. In recent years, the genes encoding the enzymatic steps responsible for glycoalkaloid synthesis have begun to be elucidated. This in turn has presented the possibility of manipulating these genes to control glycoalkaloid accumulation and increase the availability of diverse biological resources for the development of new and improved cultivars with enhanced agronomic, processing and nutritional characteristics. This article will discuss the origin and diversity of glycoalkaloids in the potato, why they are a concern and what is being done about them, and how the advancement of biological information and technologies will impact potato glycoalkaloids in the future.

Seok Jun Moon (Korea), Edna Y. Ardales (The Philippines), Dongjin Shin, Se Youn Han, HyeEun Lee, Sang Ryeol Park, Mi-Jeong Jeong, Seong Kon Lee, Hawk-Bin Kwon, Hyowon Seo, BuYoung Yi, Soo-Chul Park, Myung-Ok Byun (Korea) The EREBP Gene from *Solanum tuberosum* Confers Resistance against an Oomycete and a Bacterial Pathogen in Transgenic Potato and Tobacco Plants (pp 72-79)

ABSTRACT

Original Research Paper: Transgenic potato and tobacco lines overexpressing the *StEREBP1* gene from potato (*Solanum tuberosum*) were generated by *Agrobacterium*-mediated transformation. Leaves of two transgenic potato plants, overexpressing *StEREBP1* under the control of the CaMV 35S promoter, exhibited resistance to the late blight pathogen, *Phytophthora infestans*. No symptoms of late blight were observed on the leaves of the transgenic plants after infection with the oomycete pathogen, unlike the leaves of the wild type plant that showed symptoms typical of late blight. Tuber slices of these transgenic plants and another transgenic potato plant carrying the gene driven by the rd29A promoter, displayed delayed disease development. Decreased mycelial development was obtained on tuber slices from the rd29A-*StEREBP1* transgenic plant compared with growth on the tuber slices from 35S-*StEREBP1* transgenic plants. The *StEREBP1* overexpressing transgenic tobacco lines also showed delayed symptom development after infection with the oomycete pathogen *Phytophthora parasitica* var. *nicotianae*. Smaller necrotic lesions were produced on the leaves of the transgenic tobacco plants compared with those formed on the leaves of the wild type tobacco plant. Growth of *Pseudomonas syringae* pv. *tabaci* on one transgenic tobacco line was inhibited relative to the growth of the bacterial pathogen on wild type tobacco. Our results suggest that *StEREBP1* may be involved in biotic stress or defense response. The enhanced resistance of the transgenic plants to their respective pathogens may be due to the upregulation of the expression of stress-response genes encoding pathogenesis-related proteins that may have been induced by the overexpression of *StEREBP1*.

Eveline Gomes Vasconcelos, Priscila de Faria-Pinto, Fabricia Aparecida Rezende-Soares, Marcus Luiz de Oliveira

Penido, Sylvio Celso Gonçalves da Costa, Paulo Marcos Zech Coelho (Brazil) Potato Apyrase: A New Tool for Parasitic Disease Research (pp 80-88)

ABSTRACT

Invited Mini-Review: Recent investigations on *Solanum tuberosum* (potato) apyrase, a protein of biomedical interest, are presented along with a discussion on the possible biological application for the study of interactions between parasites and the host immune system. Potato apyrase (PA), one of the first proteins of the ATP diphosphohydrolase family to be purified, has immunostimulatory properties. Polyclonal antibodies against PA show strong cross-immunoreactivity with native ATP diphosphohydrolase isoforms isolated from either *Schistosoma mansoni* egg and worm or *Leishmania (Leishmania) amazonensis* promastigotes. These results were confirmed by immunoprecipitation assays in which antibodies against different PA isoforms, immobilized on Sepharose-Protein A, depleted the ATPase and ADPase activities from parasite preparations. The data suggested that potato and parasite proteins share specific epitopes. Furthermore, sera from both experimentally infected-mice and patients showed cross-immunoreactivity with PA, which also suggests that the antigenicity of these conserved epitopes exists. Distinct humoral immune response profiles of IgG antibodies from American cutaneous leishmaniasis, schistosomiasis and Chagas disease patients, associated with the distinct life-cycles of the parasites. Presumably, these antigens are processed and presented to effectors cells from the host immune system by different pathways. *In silico* studies demonstrated evolutionary and close structural relationships between PA and parasites ATP diphosphohydrolases. Specific protein domains were suggested to be potentially involved in the host immune response. Schistosomes may live for several years in the host, evading hemostatic and immune responses. Leishmanias can persist at the scar after clinical cure for long time. Further studies of both parasite and PA conserved domains could contribute to a better understanding of host-parasite interactions, and may to be explored as a new tool in parasitic disease research.

Erika A. Wolski, Samanta Korgan, Silvia Capezio, Marcelo A. Huarte, Adriana B. Andreu (Argentina) Biochemical Markers involved in Horizontal Resistance to *Phytophthora infestans* in Potatoes (pp 89-94)

ABSTRACT

Original Research Paper: Potato Late Blight is the main pathogen which affects potatoes. Due to unavailability of effective chemical control methods and the intensive use of fungicides, the introduction of resistant cultivars represents a safe strategy. The sources of horizontal resistance to Late Blight in the Argentinean Potato Breeding Program have been varied. One of the interesting species to evaluate is *Solanum tarijense* since its adaptation to long days is promissory, producing tubers of good size and aspect. In this study, the enzymatic activity of different PR proteins in the specie *S. tarijense* was measured. These clones were more resistant to Late Blight than 'Bintje' and 'Pampeana INTA' cultivars. The activity of glucanases, chitinases, peroxidases and polyphenoloxidases were 15, 1.5, 2 and 3 times higher respectively, in *S. tarijense* than in 'Bintje' and 'Pampeana INTA'. These results suggest that some PR proteins can be used as biochemical markers to assist breeders in the selection of horizontal resistant cultivars.

Xin Song, Manjula Bandara, Bobbi Nash, Jill Thomson, Julie Pond, Jazeem Wahab, Karen K. Tanino (Canada) Use of Essential Oils in Sprout Suppression and Disease Control in Potato Storage (pp 95-101)

ABSTRACT

Original Research Paper: Sprout suppression and disease control are essential in assuring potato tuber quality. The increasing concerns regarding the safety and environmental impact of residues of chlorpropham (CIPC), the standard sprout suppressing compound used in potatoes, have increased interest in investigating the potential of alternate sprout inhibitors as well as disease suppressors, including essential oils. A series of studies were conducted to evaluate the suppression effect of essential oils on sprouting and fungal growth in storage. The effect of S-(+) and R-(-) carvone isomers, S-(+) containing caraway seed extracts on sprout growth in potatoes under 10°C storage was studied. Results suggested that carvone could be applied in powder, aqueous or vapour form to suppress sprout growth and sprout number without affecting tuber weight loss in 'Norland' and 'Snowdon' potatoes. Both S-(+) and R-(-)-isomers of carvone under all three methods of treatment application were effective in controlling sprout growth. Double applications of 4% dill and caraway extracts at 5-weeks apart, were able to completely suppress sprouting for at least 15 weeks, equivalent to the standard controls, CIPC and maleic hydrazide. Both isomers were effective in suppressing all diseases tested (*Fusarium solani*, *F. sambucinum*, *F. culmorum*, *F. sclerotiorum*, *Rhizoctonia solani*) with most effective control of *F. culmorum* and *R. solani*. Comparison between S-(+) and R-(-) carvone using *in vitro* conditions at 23°C determined R-(-)-carvone to be more effective on suppressing the growth of *F. culmorum*.

R-(-)-carvone treatments almost completely suppressed the growth of *R. solani* throughout the 25 day observation period. R-(-)-carvone treatments also significantly suppressed the growth of *F. sambucinum*, *S. sclerotiorum* and *R. solani* at 4, 10 and 23°C *in vitro*. Under *in vivo* conditions, after 6 weeks at 10°C, R-(-)-carvone significantly inhibited depth of *F. sambucinum* infection in inoculated potatoes. None of the carvone treatments produced any unacceptable flavour in baked, boiled or chipped potatoes. These studies indicate the potential of using these natural plant extracts in suppressing sprouting and controlling disease under commercial storage conditions. Since caraway, dill and spearmint crops can be produced in the Canadian prairies, it represents a potential economic opportunity for essential oil extraction.

Carlos Ariel Cardona, Carlos Eduardo Orrego, Isabel Cristina Paz (Colombia) The Potential for Production of Bioethanol and Bioplastics from Potato Starch in Colombia (pp 102-114)

ABSTRACT

Invited Review: Potato is an important product in Colombian agriculture. About 10% of total production is lost due to partial damages incurred during the processes of harvest, storage and transport, and to imperfections in form, color and size, which are undesirable for the food industry and fresh consumption in the market. On the other hand, the production costs of this crop have been increasing in recent years. The exploitation of remnants of potato crops for the production of bioethanol and bioplastics is therefore a viable solution to address these problems. In this review we assess the situation of potato crop in Colombia, the perspectives of bioethanol as a high-impact product for the economy of our country, and the advantages that potato starch offers in the production of alcohol and other materials, such as bioplastics.

Eva Gregorová, Zuzana Živcová, Willi Pabst (Czech Republic) Porous Ceramics Made Using Potato Starch as a Pore-forming Agent (pp 115-127)

ABSTRACT

Invited Review: Starch, in particular potato (*Solanum tuberosum*) starch, is a common auxiliary material in ceramic technology. Beside its traditional function as a pore-forming agent, which is pyrolyzed and burned out during the heat-up stage of the ceramic firing process, it has become an important body-forming agent for ceramics during the last decade. In particular, the so-called starch consolidation casting process is based on the ability of starch to swell in aqueous media at a moderately elevated temperature (below 100°C) and thus on the ability of starch granules to absorb free water from a particulate suspension, which leads to the transformation of the more or less viscous ceramic suspension to a viscoelastic (and finally elastic) solid after heating. In this contribution we give a brief review of the uses of potato starch in ceramic technology, especially as a pore- and body-forming agent in traditional slip casting and starch consolidation casting. The discussion includes the most important aspects of using potato starch in ceramic technology, ranging from size and shape characterization, suspension rheology, swelling kinetics and burnout behavior to the characterization of the resulting ceramic microstructures and the properties of the final ceramic materials.

Hyun Soon Kim, Jae Heung Jeon, Hyouk Joung, Jung Won Youm, Young Ho Kim, Hee Kim, Kisung Ko (Korea) Potato-derived Antigens for use as a Vaccine against Alzheimer's Disease (pp 128-132)

ABSTRACT

Invited Mini-Review: An alternative vaccine, developed from plant-derived antigens of transgenic crops, is considered to be a good candidate for the next generation of vaccines. A plant-derived vaccine could be orally administered by consumption of the antigen-transformed plant product, ultimately inducing an immune response in the recipient. In the past ten years, a number of antigens have been successfully expressed in plants and orally delivered to animals, where they elicit an immune response. To date, efforts to produce antigen proteins in plants have focused on potato, tobacco, alfalfa, and maize hosts. The choice of plant species is extremely important, and is generally determined by how the vaccine is to be applied in the future. Potato tubers are likely to have fewer phenolic compounds and a less complex mixture of proteins and lipids than green leaves, which might be an advantage during purification. Another advantage of tubers is their ability to be stored for long periods of time. Also, the transformation of potatoes is technically easy and the expression of foreign genes is relatively stable, and the deletion of transgenes is rare since potatoes are propagated vegetatively. The successful development of a potato-derived vaccine would allow manufactures to meet huge, steady demands. Studies have focused on the generation of transgenic potatoes expressing the main antigens related to Alzheimer's disease (AD) and an analysis of potatoes. AD is a neurodegenerative disorder in the elderly characterized by memory loss and cognitive impairment. As AD progresses, insoluble amyloid plaques forms are

deposited in the brain. Suppressing the generation of beta-amyloid ($A\beta$) is considered an effective strategy for preventing and treating AD. Here, we report on the feasibility of potato-derived antigens for use as a vaccine against AD.

Ricardo M. Corrêa, José Eduardo B. P. Pinto, Valdemar Faquin, César Augusto B. P. Pinto, Érika S. Reis (Brazil) The Production of Seed Potatoes by Hydroponic Methods in Brazil (pp 133-139)

ABSTRACT

Invited Mini-Review: In recent years, hydroponics has proven to be a very successful strategy for the production of pre-basic seed potatoes. Hydroponic techniques are much more efficient than the more traditional methods of cultivation of seed potatoes (i.e. in fields, planting beds or containers) and productivity can be three times greater (15 vs. 5 tubers/plant, respectively). Hydroponic methods not only facilitate the adequate supply of nutrients to the plants but also permit multiple harvesting of mini-tubers, a procedure that can be performed at specified intervals throughout the production cycle. The number of mini-tubers obtained via systematic harvesting is high in comparison with a single harvest strategy and the product obtained will be of uniform size. Since hydroponic cultivation avoids attack by pests and the dissemination of pathogens, the resulting tubers are normally disease-free. The main aspects concerning the production of seed potatoes are presented in this review.