INTERNATIONAL BIOHERBICIDE GROUP

IBG NEWS

VOL. 12 NO. 2 December 2003

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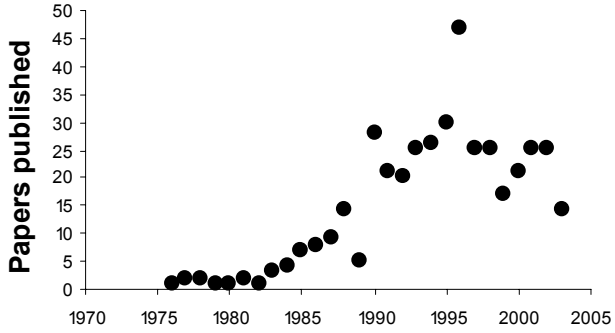
THE CHAIRMAN'S COMMENTS

As we head into a new year with new challenges, we should reflect a little on past achievements. I recently searched CAB Abstracts using bioherbicide and mycoherbicide as search terms. The results reveal a rapid rise in bioherbicide research publications during the late 1980s early 90s to a more or less steady rate of about 25 papers per year. We can congratulate ourselves on this persistent output during a time when research funds have often been difficult to secure. I'm reminded of a quote made in the 1800s by English solicitor and political philosopher, Benjamin Disraeli…." The secret of success is constancy of purpose". With that thought, and on behalf of the International Bioherbicide Group, I wish you all a very happy and prosperous new year.



Graeme Bourdôt

CHAIR
Dr Graeme Bourdôt
AgResearch, Gerald Street, PO Box 60, Lincoln, New Zealand
Phone: 64 3 983 3973; Fax : 64 3 983 3946; e-mail: graeme.bourdot@agresearch.co.nz. www.agrsearch.co.nz

VICE CHAIR
R. Charudattan (Charu)
Plant Pathology Department, University of Florida, 1453 Fifield Hall, PO Box 110680, Gainesville, FL 32611-0680 USA
Phone: 1-352-392-7240; Fax: 1-352-392-6532; e-mail: rc@gnv.ifas.ufl.edu

NEWSLETTER EDITOR
Maurizio Vurro
Institute of Sciences of Food Production - C.N.R. - Viale Einaudi, 51 - 70125 - Bari - ITALY
Phone: +39.0805912817 - Fax: +39.0805486063 - e-mail: maurizio.vurro@ispa.cnr.it

MEETINGS

20-23 June 2005 Bari – Italy

13TH Symposium European Weed Research Society

Invitation

Dear Colleagues,

it is our great pleasure to invite you to attend the *13th Symposium of the European Weed Research Society*, that will be held in Bari, Italy from 20 to 23 June 2005.

The Symposium is the latest of a long and historical series, and provides traditionally a forum for scientists to present their work on a broad range of weed science topics either as oral presentations or posters.

Venue

The Symposium will be held in Bari, Italy, at the Villa Romanazzi Carducci, a top quality Hotel that offers excellent congress facilities (http://www.villaromanazzi.com), located closely to the city centre. Bari is easily accessible by air (Bari-Palese Airport) and by train and has a range of Hotel accommodations to suit all budgets. We will strive to keep registration fees and costs as much as possible in line with those of previous EWRS Symposia.

Website

All information about scientific programme, venue, accommodation, registration, abstract and papers submission, travel, social events, tourist information, will be available at the official website: http://www.EWRS-Symposium.com

Abstracts

Authors are kindly encouraged to submit a short summary (250 words) of their intended contributions together with the preliminary registration, through the Symposium official website: http://www.EWRS-Symposium.com. The summary should include the objective and main findings. Contributions will be refereed and published in the Proceedings, which will be available at the Symposium on CD-ROM. All accepted contributions will be published as two-page abstracts. Offers of papers in all areas of weed science (crop and non-crop situations) are welcome. We also invite contributions in current innovative and emerging areas, including research methodologies.

Pre-Registration

You are invited to pre-register by **15 June 2004** at the official Symposium website: http://www.EWRS-Symposium.com.

Workshops
A number of workshop on specific topics of Weed Science will be organised as satellite meetings. If you are interested in organising one, please contact the Symposium Secretariat.

Sponsors and Exhibition
Sponsors for the Symposium are very welcome. Space in the official website and in all the official documents will be available. Desks or stands for material exhibition will be available to interested companies at the Symposium venue. Please contact the Symposium Secretariat for further information.

The following Symposium deadlines are planned:

- **15 June 2004**: preliminary registration and submission of summary (250 words)
- **15 September 2004**: communication of paper acceptance
- **1 December 2004**: submission of draft papers (2 pages) for review
- **January 2005**: release of second circular
- **15 March 2005**: electronic submission of final papers and revised summaries

We very much look forward to meeting you in Bari for the 13th EWRS Symposium.
Pasquale Montemurro and Maurizio Vurro (p.montemurro@agr.uniba.it – maurizio.vurro@ispa.cnr.it)
(Local organizing committee)

PEOPLE & PLACES

University of Florida, Gainesville (R. Charudattan - rc@gnv.ifas.ufl.edu)

Two graduate students are working on the TMGMV project: **Jonathan Horrell** is studying the molecular mechanisms of virus-incited plant death in the TSA-TMGMV system. **Dr. Ernest Hiebert**, a molecular virologist, is a co-advisor / co-principal investigator on this project. **Sarah Clark** has initiated a project to study the impacts of the use of TMGMV on *Gratiana boliviana*, a South American chrysomelid that has been recently released in Florida to control TSA. In addition, Sarah will examine whether this host-specific beetle and two other non-specialist insects can help disperse TMGMV from infected tobacco (a systemic host to TMGMV) and TSA plants. It is known that TMGMV, like other tobamoviruses, is mechanically transmitted and not insect transmitted; nonetheless, Sarah's proposed studies are intended to help understand the epidemiology of this virus disease.

Dr. S. Chandramohan is leading the efforts to test the feasibility of using a fungal bioherbicide system to suppress invasive grasses such as cogongrass (*Imperata cylindrica*), guineagrass (*Panicum maximum*), and torpedograss (*Panicum repens*) in natural areas. Typically, these invasive grasses form large monocultures, smothering native flora. In collaboration with State of Florida agencies, Chandra has demonstrated that the bioherbicide could be used to selectively suppress the weedy grasses while promoting the re-establishment of desirable flora. These results have been enthusiastically received by state agencies and mining industries charged respectively with managing natural resources and reclaiming minelands. Chandra, who developed this this bioherbicide system, has described it in the following publications:

- Chandramohan, S., and Charudattan, R. 2001. Control of seven grasses with a mixture of three fungal pathogens with restricted host ranges. Biol. Control 22: 246-255.
- Chandramohan, S., Charudattan, R., Sonoda, R.M., and Megh Singh. 2002. Field evaluation of a fungal pathogen mixture for the control of seven weedy grasses. Weed Sci. 50: 204-213.
- Chandramohan, S. and Charudattan, R. 2003. A multiple-pathogen strategy for bioherbicidal control of several weeds. Biocontrol Sci. Technol. 13: 199-205.
- Chandramohan, S., Charudattan, R. 2001. Enhanced bioherbicidal control of weeds using multiple pathogens. U.S. Patent No. 6,265,347 B1. July 24, 2001.

Chandra's research is supported by grants from the Florida Department of Environmental Protection, Tropical Agriculture-TSTAR, and South Florida Water Management District.

Dr. Jose Pablo Morales-Payan, along with **Dr. William Stall**, University of Florida, Horticultural Sciences Department, is leading our efforts to use *Dactylaria higginsii* and *Phomopsis amaranthicola* in integrated management of purple nutsedge (*Cyperus rotundus*) and pigweeds (*Amaranthus* spp.), respectively. Pablo's most recent publications include:

- Morales-Payan, J.P., Charudattan, R., Stall, W.M., and DeValerio, J.T. 2003. Efficacy of *Dactylaria higginsii* to suppress purple nutsedge (*Cyperus rotundus*) in pepper (*Capsicum annuum*) is affected by some surfactants. Phytopathology 93 (Suppl.): S63 (Abstr.).
- Morales-Payan, J.P., Charudattan, R., Stall, W.M., and DeValerio, J.T. 2003. *Dactylaria higginsii* as a postemergence bioherbicide for purple nutsedge (*Cyperus rotundus*) in bell pepper (*Capsicum annuum*). Abstracts of the XII Int. Symp. on Biol. Control of Weeds, April 28-May 2, 2003, Canberra, Australia (Abstr.).
- Morales-Payan, J.P., Charudattan, R., DeValerio, J.T., and Stall, W.M. 2003. Surfactants affect the efficacy of the mycoherbicide *Phomopsis amaranthicola* to suppress *Amaranths lividus* in bell pepper (*Capsicum annuum*). Abstracts, South. Weed Sci. Soc. 2003.
- Morales-Payan, J.P., Charudattan, R., Stall, W.M., and DeValerio, J. 2003. Effect of surfactants for *Phomopsis amaranthicola* on the weed livid amaranth competitiveness (*Amaranthus lividus*) with bell pepper (*Capsicum annuum*). Phytopathology 93 (Suppl.) S63 (Abstr.).
- Morales-Payan, J.P., Charudattan, R., Stall, W.M., and DeValerio, J. 2003. Surfactants affect the efficacy of the potential mycoherbicide *Phomopsis amaranthicola* to control the weed livid amaranth (*Amaranthus lividus*) in cilantro (*Coriandrum sativum*). Phytopathology 93 (Suppl.) S63 (Abstr.).
- Morales-Payan, J.P., Charudattan, R., Stall, W.M., and DeValerio, J.T. 2003. *Phomopsis amaranthicola* as a postemergence bioherbicide in pepper (*Capsicum annuum* and *C. frutescens*) and eggplant (*Solanum melongena*). Abstracts of the XII Int. Symp. on Biol. Control of Weeds, April 28-May 2, 2003, Canberra, Australia (Abstr.).
- Morales-Payan, J. P., Stall, W. M., Charudattan, R., DeValerio, J. T. 2003 Competitiveness of livid amaranth (*Amaranthus lividus*) with basil (*Ocimum basilicum*) as affected by *Phomopsis amaranthicola* applied with different surfactants. HortScience 38(5):770.
- Morales-Payan, J. P., Stall, W. M., Charudattan, R., DeValerio, J. T. 2003 Integrating plant growth regulators and a mycoherbicide to enhance the competitive ability of bell pepper with the weed livid amaranth. Plant Growth Regul. Soc. Am. 31(2):34.
- Semidey, N., Charudattan, R., Morales-Payan, J.P., DeValerio, J.T. 2003 Response of *Cyperus rotundus* and *Allium cepa* to *Dactylaria higginsii* in Puerto Rico. XVI Congreso Latinoamericano de Malezas y el XXIV Congreso Nacional de la Asociación Mexicana de la Ciencia de la Maleza, Nov. 10-12, 2003, Manzanillo, Colima, Mexico.

Dr. Erin Rosskopf, USDA-ARS-USHSRL, is directing additional work on *Dactylaria higginsii* at Ft. Pierce, Florida. Erin's research is focused on development of systems to integrate bioherbicides as an alternative to methyl bromide for the management of purple nutsedge. In this effort, she is assisted by

Dr. Camilla Yandoc, a research associate with the USDA-ARS. The following publications describe the work from Erin's lab:

- Rosskopf, E.N., Yandoc, C.B., Kadir, J.B., and Charudattan, R. 2003. Evaluation of *Dactylaria higginsii* as a component in an integrated approach to pest management. Abstracts of the XII Int. Symp. on Biol. Control of Weeds, April 28-May 2, 2003, Canberra, Australia (Abstr.).
- Rosskopf, E., Yandoc, C., DeValerio, J., Kadir Jr., and Charudattan, R. 2003 Evaluation of the bioherbicidal fungus *Dactylaria higginsii* as a component of an IPM approach to pest management in tomato. Phytopathology 93 (Suppl.): S75 (Abstr.).
- Yandoc, C., Rosskopf, E., and Charudattan. R. Effect of selected pesticides on *Dactylaria higginsii,* a potential bioherbicide for purple nutsedge. Phytopathology 93 (Suppl.): S92 (Abstr.).

Jennifer Cook, a graduate student, is developing an integrated weed management system for dodders (*Cuscuta* spp.). This work, supported by a Tropical Agriculture-TSTAR grant, includes **Dr. Tom Zimmerman**, University of the (U.S.) Virgin Islands and **Erin Rosskopf** as research partners. Jennifer is testing *Alternaria destruens* as a component of the integrated system, along with glyphosate and ammonium sulfate. *Alternaria destruens* was discovered and developed as a bioherbicide by **Dr. Thomas Bewick** while he as at the University of Wisconsin and University of Florida. It is awaiting EPA registration under the commercial name "SMOLDER."

Recent visitors to Charudattan's lab: **Mariano Fracchiolla**, from University of Bari, Italy, completed a 5-month visit. Mariano made preliminary characterization of putative phytotoxins produced by three fungal pathogens: *Drechslera gigantea, Exserohilum longirostratum,* and *E. rostratum.* These fungi are used in the grass bioherbicide system described above. By producing and assaying crude filtrates as well as partially purified extracts from liquid cultures of these fungi, Mariano established that there are three or four active compounds produced by these fungi. He developed methods for extraction, concentration, and thin layer chromatography of culture filtrates. He also developed preliminary data showing that cell-free extracts from *D. gigantea* synergize and enhance the activity of spores of the fungi on weeds such as *Imerata cylindrica, Panicum maximum, Lolium multiflorum, Phalaris brachystachys, Phalaris canariensis,* and *Avena* spp.

Lynley Hayes and Nick Waipara, Landcare Research, New Zealand spent a couple of days in early November in Charudattan's lab. They visited several sites to see some weed problems in Florida and ongoing field trials with TMGMV. They also discussed the prospects for using *Araujia mosaic potyvirus* as a biological control agent for *Araujia sericifera* (moth plant, a vine in the Asclepiadaceae family) in New Zealand. This virus from Argentina was described and patented as a potential biocontrol agent for another milkweed vine, *Morrnia odorata* (described in: Charudattan et al., Phytopathology 70:909-913, 1980; Hiebert and Charudattan, Phytopathology 74:642-646, 1984; and Charudattan, U.S. Patent No. 4,162,912. July 31, 1979).

Agriculture and Agri-Food Canada, Saskatoon Research Centre

(Susan M. Boyetchko - boyetchkos@agr.gc.ca)

The biocontrol group at Saskatoon has hired Dr. **Russell Hynes** as a Formulation Chemist for the weed and insect biocontrol programs and he has joined the group in September 2003. Dr. Hynes has a background in microbiology and has been a senior research scientist with industry working on formulation of legume inoculants (*Rhizobium*) for field pea, lentil and dry bean in Western Canada. As a Research Associate in Applied Microbiology at the University of Saskatchewan, he has also conducted research on biological control of plant diseases, including formulation development to promote survival of microorganisms and fungicide compatibility with formulated microbes.

Dr. **Gavin Ash** from Charles Sturt University, Wagga Wagga, NSW Australia visited Saskatoon from November 12-15. Dr. Ash has a program on biological control of weeds on discovery, biological characterization, mass production, and formulation, similar to that in Saskatoon. He visited the Saskatoon group while on sabbatical at McGill University with Dr. Alan Watson, where he has been working on developing molecular markers for environmental fates studies with a fungus to control dandelion in turfgrass.

Dr. **Susan Boyetchko** was an invited speaker at the 57th annual meeting of the Canadian Weed Science Society in Halifax, Nova Scotia, November 30 – December 3, for the Symposium titled "Weed Management in Transition". Her topic was "Biological Herbicides in the Future" that highlighted progress in inundative microbial weed control, presented challenges due to a range of constraints, and proposed several innovative strategies for future research and development. It was a great opportunity to promote biocontrol among weed science colleagues, and many people were pleased with the information received. It was emphasized that success in biocontrol would likely succeed through the integration with other weed management strategies, and therefore collaboration with weed ecologists and agronomists would be an important step towards the development of biological weed control.

Dr. **Wayne Pitt** recently completed the requirements for a Ph.D. from Charles Sturt University, Wagga Wagga, NSW under the supervision of Dr. Gavin Ash. He was awarded an NSERC Visiting Fellowship to work with Dr. Karen Bailey at Agriculture & Agri-Food Canada in Saskatoon on developing *Phoma macrostoma* for biological control of broadleaf weeds in turfgrass.

University of Hohenheim, Stuttgart, Germany
(Abuelgasim Elzein - gasim@uni-hohenheim.de)

On November 1, 2003, Dr. **Paul S. Marley**, a Nigerian Plant Pathologist, has started an "Alexander von Humboldt" Research Fellowship to conduct research entitled "Production and evaluation of *Fusarium oxysporum* isolates based mycoherbicides (Pesta granular formulation and seed treatment) for *Striga hermonthica* control in West Africa" in the laboratory of Professor Dr. J. Kroschel, Department of Agronomy, Institute of Plant Production and Agroecology in the Tropics and Subtropics (380), University of Hohenheim, Stuttgart, Germany. This research project is based on the results of the PhD study carried out recently by Dr. Abuelgasim Elzein (see this volume of IBG News for more details) at University of Hohenheim, Germany.

The proposed research seeks to produce and evaluate Pesta granules and seed treatment mycoherbicide from *Fusarium oxysporum* isolates for *Striga hermonthica* control. Inoclum mass production, Pesta granules of, and coated seeds of sorghum and maize crops with, *Fusarium oxysporum* isolates from Nigeria and Ghana will be produced using the methodologies and approaches recently developed and optimised at University of Hohenheim. These mycoherbicidal formulations will be evaluated in the glasshouse (Germany) and under field conditions in Nigeria in the 2004 cropping season. (Abuelgasim Elzein, Paul S. Marley, Jürgen Kroschel).

BIOHERBICIDE RESEARCH - STATUS REPORTS

University of Florida, Gainesville **(R. Charudattan - rc@gnv.ifas.ufl.edu)**

We are making excellent progress in our attempts to develop *Tobacco mild green mosaic tobamovirus* (TMGMV) as a bioherbicide for tropical soda apple (TSA; *Solanum viarum*). TSA is an invasive weed of South American origin that is ranked as the number one threat to ranchlands and natural areas in

Florida. Cattle producers in Florida suffer the most serious economic damage from this weed. We have shown that TMGMV incites a lethal hypersensitive response in TSA and can provide 85-99% control of this weed within a short period of 2-3 weeks after a single application. We have set up methods and tools to produce and apply TMGMV in the field. A large host range study has been completed by **Mark Elliott**, a Senior Biologist in Charudattan's program. The results indicte that TMGMV will pose some threat to pepper and tobacco, but, based several biological and epidemiological attributes of the virus, the risk is considered to be easily manageable. **Jim DeValerio**, another Senior Biologist has designed and tested several application tools for commercial use. This TMGMV-TSA project is supported by a grant from the Florida Department of Agriculture and Consumer Services.

With help and encouragement from the University of Florida, **R. Charudattan** has formed a company, ***BioProdex, Inc.,*** to register and commercialize TMGMV.

A new cooperative project between the International Institute for Tropical Agriculture (IITA), Benin and Charudattan's lab got underway in October 2003. **Dr. Fen Beed**, IITA, Benin and Charudattan are co-principal investigators on this IITA/USAID-funded project. Fen has begun to collect and test putative pathogens from the African continent in Benin. **Alana den Breeyen,** until now a member of the ARC Plant Protection Research Institute, Stellenbosch, South Africa, will join this project as a graduate research assistant and pursue her Ph.D. degree at the University of Florida. Alana will examine the variability in susceptibility of cogongrass (*Imperata cylindrica*) accessions from the southren USA and Africa to the bioherbicide pathogens mentioned above (under the grass bioherbicide system) and determine the biological control potential of selected pathogens from Africa.

Agriculture and Agri-Food Canada, Saskatoon Research Centre

(Susan M. Boyetchko - boyetchkos@agr.gc.ca)

Sue Boyetchko and **Gary Peng** initiated an ADF project titled "Survey and screening bacterial pathogens for Canada thistle in Saskatchewan and from centre of weed origin". This project is a collaboration with Dr. Andre Gassmann, CABI Bioscience Center, Delemont, Switzerland. Several bacterial strains have been isolated from various locations in Europe and in the Canadian prairies and are currently being evaluated for their bioherbicidal potential against Canada thistle.

Faye Dokken started her M.Sc. program in May 2003 under the co-supervision of Gary Peng and Karen Bailey in conjunction with Dr. Louise Nelson in the Dept. of Applied Microbiology and Food Science (U of S). She is conducting research on submerged fermentation of *Colletotrichum* sp. for biocontrol of scentless chamomile. The objective is to develop a feasible process for mass production of the biocontrol agent. An MOU is being signed with the Saskatchewan Research Council and AAFC to facilitate collaboration in this research.

The 2003 field program for the weed biocontrol group has been challenging, due mostly to the drought conditions. Some field testing included:

i) Weed/crop competition studies using pre-emergent soil bacteria in a pesta granule at different rates of application and crop seeding rates in Saskatchewan and Alberta with Eric Johnson, Neil Harker and George Clayton. (Boyetchko)

ii) Two years of field trials were conducted in Alberta, Saskatchewan, and Ontario to look at a fungus to control broadleaf weeds in turfgrass. Work continues on methods for mass production and investigations are planned to look at a new application for the fungus in seed grass production in Beaverlodge. (Bailey)

iii) Competition studies for the evaluation of *Pyricularia setariae*, a post-emergent biocontrol agent for green foxtail control, in combination with several post-emergent chemical herbicides, were conducted. (Peng)

iv) Biocontrol agents for scentless chamomile were evaluated in the field for the first year. Experiments included synergy with several chemical herbicides. (Peng)

AgResearch, Lincoln, New Zealand (Graeme Bourdôt - graeme.bourdot@agresearch.co.nz)

Giant buttercup in New Zealand dairy pastures

Giant buttercup (*Ranunculus acris*) causes losses in milk solids revenue in New Zealand dairy pastures of $156 million per annum at 2001-02 prices. The weed is poorly controlled by chemical herbicides. A bioherbicide alternative based on *Sclerotinia sclerotiorum* is being explored by Graeme Bourdôt and his team at AgResearch, Lincoln and PhD student Brenda Pottinger at Lincoln University. Currently the AgResearch team is focussing on optimising the size of a mycelium-infested grain-based granule that can be applied to pasture with a conventional fertiliser spreader. The aim is to explore the trade-off between granule size and coverage within the constraint of an application of 50 kg/ha, a rate that is believed to be commercially viable.

Effects of single spring applications in dairy pastures in 2002 gave very promising results with up to 90% reduction in the weed's ground cover and 60% plant mortality by 100 days after treatment. Variation between sites and season of application occurred.

Brenda Pottinger's PhD is focussing on understanding the infection process of the fungus in giant buttercup as a basis for explaining variability in the response of field populations of the weed. A recent revelation has been that the virulence of the fungus on giant buttercup is inhibited by lime, commonly used as a fertiliser by dairy farmers, possibly through neutralising the oxalic acid that is produced by the fungus during infection, thereby inhibiting the activity of important cell wall degrading enzymes such as polygalacturonases.

The project is funded by FRST, the NZ dairy industry and a joint venture company Encoate.

graeme.bourdot@agresearch.co.nz, Pottinb1@lincoln.ac.nz

Gorse in New Zealand

Chondrostereum purpureum

AgResearch, Landcare Research and the Forest Research Institute have joined forces to evaluate the potential of the 'silver leaf' fungus for control of woody weeds, with an initial focus on gorse, one of NZ's major woody weeds of pastures, plantation forests and natural ecosystems. An experiment conducted during the last two years has shown that the regrowth of decapitated gorse stems is reduced significantly by applying the fungus to the cut stump of gorse stems. Further research is planned to screen the fungus against a wide range of woody weeds in New Zealand, risk analysis, storage, formulation and application technology. The programme is funded by FRST.

graeme.bourdot@agresearch.co.nz, fowlers@landcare.cri.nz, Tod.Ramsfield@forestresearch.co.nz

Insect vectoring of bio-control pathogens using pheromones
A new weed bio-control project has been established by the National Centre for Advanced Bio-Protection Technologies, under the Directorship of Professor Alison Stewart at Lincoln University. This is a multi-organisation project lead by Dr Max Suckling of HortResearch, and supervised by Dr Eirian Jones of Lincoln University, Dr Graeme Bourdôt of AgResearch, Dr Nick Waipara of LandcareResearch and Dr Ecki Brockerhoff of the Forest Research Institute. The objective is to develop and commercialise a new third generation biopesticide system for key weeds of national significance by using insects, manipulated by pheromones, to vector plant pathogens to their weed hosts. Insect pheromones are bioactive compounds secreted in minute quantities by the insect themselves for the purpose of mating. Presently, pheromones are used as an alternative environment-friendly method in controlling insect pests as well as monitoring and surveillance of beneficial insects identified as bio-control agents. In New Zealand, Dr Max Suckling and his colleagues have successfully identified pheromones and attractants of several insect pests of economic importance. These semiochemicals have been used in various control and eradication programmes. PhD student Emmanual Yamoah and Post Doc researcher Dr Alvin Hee will be conducting this research based at Lincoln University and HortResearch Lincoln. The model system is gorse (*Ulex europaeus*), various insects associated with gorse and *Fusarium tumidum*. The project is funded by the Royal Society of New Zealand.

msuckling@hortresearch.co.nz, yamoahe@lincoln.ac.nz, hee@lincoln.ac.nz

Institute of Sciences of Food Production, Bari, Italy
(Maurizio Vurro – maurizio.vurro@ispa.cnr.it)

A new european project on biological control
An European Project entitled "Enhancement and Exploitation of Soil Biocontrol Agents for Bio-Constraint Management in Crops" has been recently accepted by EU, within the VI EU's Framework Programme for Research and Technological Development, Priority 5, Food Quality and Safety. Using a combination of strategies, the main aim of the project is to study some of the already available or the most promising biocontrol microorganisms (i. e.: *Fusarium, Trichoderma or Coniothyrium* sp.) against plant diseases, such as those caused by *Sclerotinia*, *Fusarium* or *Pythium* spp., or some noxious plants, such as parasitic and perennial weeds. Studying the genetic and physiological enhancement strategies, the ecological fitness of the agents, the production, formulation and application methods, the integration with other organisms and with control methods, and assessing their quality and the risk of release into the environment, it will be possible to improve the efficacy of fungal biocontrol agents, allowing their wider use at the European level, and giving new important tools to support the production of safer and healthier foods. The three-year project, coordinated by the Institute of Sciences of Food Production, Bari, Italy, includes 9 different work-packages, with the involvement of 9 partners (7 Scientific Institutions and 2 Industries) from 7 Countries.

CLASSICAL BIOLOGICAL CONTROL OF WEEDS WITH PATHOGENS

CSIRO Entomology, Weed CRC, Canberra, Australia
(Louise Morin - Louise.Morin@csiro.au)

Biological control program against bridal creeper (*Asparagus asparagoides*) in Australia

Research conducted by CSIRO and the Cooperative Research Centre for Australian Weed Management (Weed CRC) over the last decade towards the biological control of bridal creeper, one of the worst environmental weed of southern Australia, is bearing fruits. Three biological control agents originating from South Africa and specifically attacking bridal creeper have now been released in Australia: a leafhopper (*Zygina* sp.) in 1999, a rust fungus (*Puccinia myrsiphylli*) in 2000 and more recently a leaf beetle (*Crioceris* sp.) in 2002.

Funding from the Australian Commonwealth Government via the Natural Heritage Trust in 2001-02 and 2002-03 has provided a major boost towards increased involvement of schools, community groups and land managers in the fight against this major weed and the delivery of biological control agents in areas heavily infested by bridal creeper. Workshops/field days have been held across the country to train on-ground groups in redistributing the agents to infested areas in their regions. For example, in the 2002 growing season 13 field days/workshops were conducted across temperate Australia attracting 327 attendees.

More than 1500 releases of the rust fungus and leafhopper have now been made across the country since their introduction into Australia.

Reports of natural spread of the rust fungus of up to 360 m from release sites after 1 year and up to 2.5km after 3 years are very encouraging. The rust has also been seen this year, in particular in Western Australia, New South Wales and Kangaroo Island, South Australia, to cause severe defoliation of plants in the middle of the growing season for bridal creeper. This extensive damage will prevent bridal creeper to flower and produced fruits in spring, and also severely diminish the underground reserves. These are fantastic outcomes towards significantly reducing the spread of this weed and the density of existing populations.

Visit our web site for more information: http://www.ento.csiro.au/bridalcreeper/index.html

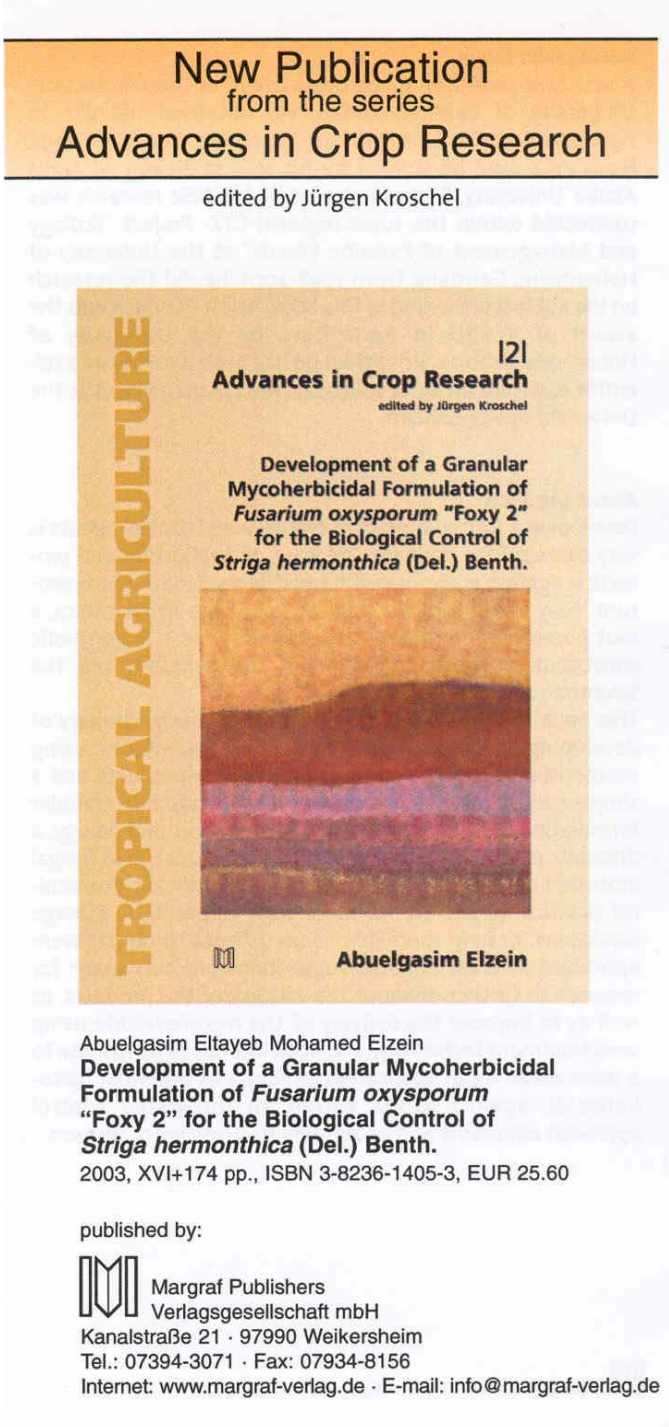
BOOKS

HANDBOOK OF FUNGAL BIOTECHNOLOGY
http://sdm3.rm04.net/servlet/ClickThru?kn=2&m=178519&r=MjQzNzMxMDg1S0
Second Edition, Revised and Expanded (Mycology Series/20)

edited by DILIP K. ARORA National Bureau of Agriculturally Important Microorganisms,
New Delhi, India

Description

The last decade has seen fungal biotechnology flourish from the practical returns of advanced techniques like genetic recombination and robotics. Reenvisioned to account for developments in fungal ecology, physiology, and biochemical processes‹and the mounting list of industrial and semi-industrial applications‹the Handbook of Fungal Biotechnology, Second Edition reigns as the top source on current molecular, biochemical, and medical technologies and commercial usages for fungi.



PAPERS

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Giant Hogweed (*Heracleum mantegazzianum*): Limiting its Spread in Denmark by a Bioherbicide?[1]

Introduced into Western Europe during the 19th century, Giant Hogweed, *Heracleum mantegazzianum* Sommier et Levier, is nowadays developing as a persistent invasive weed along water ways, road verges, and foot paths, both in open land and forest gaps. Most European countries are now banning or severely reducing the use of chemical pesticides in certain habitats such as water ways and nature reserves, which hampers a quick and cheap control of Giant Hogweed. At these sites, the most common practice to handle Giant Hogweed is annual mowing. However, this does not prevent the plant to regrow and even flower. A biological way to control this plant may open new possibilities. An EU-project aiming to develop an integrated management strategy that comprises effective, practicable and sustainainable means of controlling Giant Hogweed was started in 2002 (Seier, 2003). In this project, the Danish partners collect insect herbivores and pathogens of Giant Hogweed, and investigate and evaluate presently applied chemical and mechanical control methods.

In September 2003, the Danish Institute of Agricultural Sciences, the Royal Veterinary and Agricultural University, and the Danish Centre for Forest, Landscape and Planning, was visited to discuss prospects of a novel mycoherbicide based on *Sclerotinia sclerotiorum* to control Giant Hogweed. During our stay in Denmark we also visited six sites that were investigated by Charlotte Nielsen for research into damaging insects and fungal pathogens. The plots differed from each other by light intensity, ground-water level and soil type. This gave an impression of the varieties in the Danish landscape, and differences in phenotypes of Giant Hogweed, as well as possible sensitiveness of the host to several biotic and abiotic factors.

Only seedlings and dead flowering stems of Giant Hogweed were present during time of visit (22 September to 6 October, 2003). One plot had been surveyed two years ago on fungal pathogens of Giant Hogweed (Ernebjerg, 2002). Although at that time a severe infection by *S. sclerotiorum* of Giant Hogweed was encountered, the fungus was not detected in 2003. Nonetheless Charlotte Nielsen found a few sclerotia of *Sclerotinia* sp. at a nearby site inside a flowering stem in late summer of 2003. Barend de Voogd found during the visit pathogenic fungi inside a stem tissue after splitting a number of stems of Giant Hogweed at the lower part. Only in one flowering stem at the 3rd visited location, he found hitherto unidentified small sclerotia. After isolation and subsequently cultivating we can state that it is probably *S. sclerotiorum*, and looks on PDA the same as the sclerotia found earlier by Charlotte Nielsen.

During the visit to the 4th sampling site, with half of the stand cut after flowering, we frequently found on the cut half old roots with new leaf sprouts. The non-cut half had decaying roots. Seedlings were present in the whole plot.
Beside these extensive field surveys, the Dutch had many fruitful communications with their Danish collaegues about a promising new way of biologial control of Giant Hogweed. The efficacy of *S. sclerotiorum* to control Giant Hogweed was studied in 2002-2003 by Barend de Voogd in a roadside vegetation in the municipality of Zutphen, the Netherlands, where it was established for more than five years. A new mycoherbicide, based on mycelium of *S. sclerotiorum,* was applied as a liquid mycelial suspension early spring 2002, before leaves were unfolded. First results appeared in August 2002, when in the treated plot only dwarf-plants developed with chlorotic yellowing leaves, after regular cutting of the flowering plants in June 2002. Untreated plants recovered after the June cutting. The subsequent year, some plants recovered, but when cut in June 2003, the great majority disappeared, and only 4 plants out of 17 inoculated plants showed some weak regrowth. **Thus the great majority was killed by the bioherbicide** (76%). The open spot was taken over by several herbs, indicating that treatment was not detrimental for other dicotyledonous plants. Plants in the untreated plot recovered with large leaves.
Inoculation later in 2002 (May, August, October) did not result in a significant growth reduction. We think that a combination of optimal development of both Giant Hogweed and the pathogen, *S. sclerotiorum*, is crucial. When growth activities of the host cease in winter time and those of the pathogen are far better off, we may expect best control.
An alternative explanation of effectiveness of the pathogen to control Giant Hogweed is due to its **quasi perennial character** of its root system. Once entered, the pathogen is apparently capable as a sort of **systemic bioherbicide** to infect the root system. If the plants life cycle was strictly biannual, the root should die after flowersetting, also in the absence of a pathogen, which clearly was not the case. We observed in our experimental plot that Giant Hogweed can manifest as a perennial, which was also suggested by Tiley et al. (1996). This perennial nature may be stimulated by mowing plants before flowering. During the visit to a sampling site in Denmark, with half of the stand cut just after flowering, we frequently found on the cut half old roots with new leaf sprouts. The noncut half had only decaying roots. Seedlings were present in the whole plot. Although these results are only from one experiment and on a small scale, they look quite promising. More research is **indeed** needed, but the results indicate that spread of Giant Hogweed can be limited by *S. sclerotiorum*.

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W. Barend de Voogd*, Meindert D. de Jong* and Charlotte Nielsen**
* Biological Farming Systems, Wageningen University, Marijkeweg 22, 6709 PG Wageningen, The Netherlands. Fax: +31-317 478313 e-mail: barend.devoogd@wur.nl meindert.dejong@wur.nl, respectively.
** Danish Centre for Forest, Landscape and Planning, Kongevej 11, DK-2970 Hørsholm, Denmark. e-mail: chn@kvl.dk
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PhD Thesis

Development of a granular mycoherbicidal formulation of *Fusarium oxysporum* Foxy 2 for the biological control of *Striga hermonthica* (Del.) Benth.

ABUELGASIM ELZEIN (e-mail: gasim@uni-hohenheim.de)
Institute of Plant Production and Agroecology in the Tropics and Subtropics (380), University of Hohenheim, 70593 Stuttgart, Germany

Introduction: Developing a formulation of microbial weed control agents is very essential for their storage, ease of application and protection against environmental constraints. *Fusarium oxysporum* Foxy 2 is a fungal antagonist of *Striga hermonthica,* a root parasite of cereal crops that constitutes a major biotic constraint to food production in the Sahelian and the Savannah zones of Africa, where the livelihood of 300 millions of people is adversely affected. The principal objective of this study was to develop a granular formulation of Foxy 2, in order to ease its application and to reduce the amount of inoculum required for adequate infection in the field to a practicable level.

Outline of the study: Chapter 1 describes the agricultural significance of *Striga* as a pan-african weed problem, summaries the advances in the biological control of *Striga*, and outlines the specific objectives of the study. As a prerequisite, an attempt was made to assess the host specificity of Foxy 2 by quantifying its ability to attack non-target species, i.e. other closely related species to the target weed *S. hermonthica*, some selected Poaceous crops, crop species reported to be highly susceptible to *Fusarium* diseases in tropical and subtropical regions, as well as economically important cultivated crops (chapter 2). Since a critical requirement for the development of a mycoherbicide is inoculum mass production, different substrates (agricultural by-products and synthetic) and the conditions that influence the production of spores, especially chlamydospores, of Foxy 2 were investigated and optimized in chapter 3. The substrates tested were maize straw; cotton seed cake, wheat and triticale stillage as well as Czapek (Cz) broth. The efficacy of different granular formulations of Foxy 2 including sodium alginate pellets; vermiculite; and Pesta granules in comparison to the fungal inoculum propagated on wheat grains on *S. hermonthica* is described in chapter 4. Furthermore, chapter 4 deals with the effect of the propagule type, inoculum concentration and application dose on the efficacy of wheat flour-kaolin Pesta granules for the control of *S. hermonthica*. The propagules tested included dried and freshly prepared chlamydospore-rich biomass, microconidia and a mixture of mycelia and microconidia. Maximizing the shelf-life of the Pesta products containing Foxy 2 is very essential for commercialization, therefore, the effect of inoculum type and concentration, temperature, granule size and water activity on the viability of Foxy 2 encapsulated in Pesta granules during storage was investigated and optimized as well (chapter 5). A general discussion, implications and future prospectives for Foxy 2 as a potential mycoherbicide for *Striga* is presented in chapter 6.

Results and conclusion:

- Foxy 2 was able to control more than one *Striga* species (*S. hermonthica* and *S. asiatica*). All tested non-target plant species were immune, none developed any symptoms of infection when inoculated with Foxy 2. The ability of Foxy 2 to control more than one *Striga* species provides an opportunity to control both parasites simultaneously in those regions where they are co-existing (e.g. Tanzania and Kenya). This advantage together with the non-susceptibility of a wide range of non-target test plant species to the fungus, may probably encourage the regulatory authorities to accept and introduce the antagonist for field testing.
- The strategy of developing inoculum mass production techniques using agricultural by-products, which are inexpensive and readily available in the Sahelian and Sub-Saharan zones of Africa where *Striga* is a major problem, proved to be effective, time-saving and it is very attractive for the economic feasibility of the Pesta formulation.
- With the application of 2 g of the formulated Pesta granules per pot (4 kg of soil) the same promising level of efficacy of *Striga* control was achieved as when 40 g of inoculum propagated on wheat grains were used. Such enormous reduction (95%) in the amount of fungal inoculum as a result of adopting Pesta formulation technology could offer a significant economical practical possibility for large-scale application. Moreover, further dose reductions could be achieved through a proper placement of the formulated product to the target weed e.g. in planting hole or in-furrow application.
- The results indicated that storage temperature and inoculum type had pronounced effect on the shelf-life of the formulated Foxy 2 in Pesta granules during storage. The 85-100% shelf-life of Pesta granules made with chlamydospore-rich biomass (i.e. half-live time ($t_{0.5}$) ranging from 37.6 to ∞ months) for at least one year at 4ºC is adequate for commercialization. Moreover, the stability of dried chlamydospores inoculum entrapped into Pesta granules during the first six months (100-51%) of storage at room temperature is sufficient for storage, handling and delivery under realistic conditions. Such kind of knowledge has significant applications to better understanding of the conditions for optimizing and prolonging shelf-life of biocontrol products, specially of Pesta formulations.
- Valuable suggestions are also made for research to further enhance the efficacy of the products, as well as to improve the delivery of the mycoherbicide using seed treatment technology. Foxy 2 met the criteria of being a promising candidate for controlling *Striga* when applied as a seed treatment. These findings are the basis for future investigations which should concentrate on testing the efficacy of the seed-treatment approach under field conditions in order to be integrated with existing *Striga* control measures. If these results would be confirmed under field conditions, seed treatment might contribute to a more meaningful application of Foxy 2 as antagonist for *Striga* within an integrated control approach.

In conclusion, the results of the present study demonstrate the safety of non-target test plant species and suitability and economic feasibility of Pesta technology for formulating Foxy 2. The promising levels of *Striga* control and of the substantial increase in sorghum yield obtained with Pesta granules containing fresh chlamydospores inoclum of Foxy 2 under glasshouse conditions justify a further development of Pesta granules for field testing. The preparation of Pesta as free-flowing granules enable them to be applied using existing agricultural equipment, and to be easily integrated with existing *Striga* control methods e.g. cultural, mechanical and use of resistant varieties. Additional advantages of Pesta formulation are: non-toxic; relatively cost effective; can be produced on a large scale; convenient to store; and simple to use. These promising results of Pesta granular formulation and seed treatment might contribute significantly to the development of an effective integrated *Striga*-control approach adoptable and acceptable to subsistence farmers.

The thesis was supervised by Prof. Dr. Jürgen Kroschel and is published within the Book Series Tropical Agriculture (12), - Advance in Crop Research (2). The book can be ordered directly from Margraf Publisher: www.margraf-verlag.de, under ISBN 3-8236-1405-3, ISSN 0932-3074.

Pesta granular formulation made with different propagules of *Fusarium oxysporum* Foxy 2 using the method of W.J. Connick, et al. (1991): Microconidia (top left); Mycelia + Microconidia (top right); Fresh chlamydospore-rich biomass (bottom right), and dried chlamydospore-rich biomass (bottom left).

Disease symptoms on *S. hermonthica* shoots caused by *Fusarium oxysporum* Foxy 2 (right), control (left).

EDITOR'S CORNER

Dear All,

many thanks for your kind support in preparing this issue of the newsletter.

I wish you all the best for the New Year.

Maurizio Vurro