INTERNATIONAL BIOHERBICIDE GROUP

IBG NEWS

June 2008

TABLE OF CONTENTS

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CHAIRMAN’S COMMENTS

Hello everyone. Firstly let me thank Maurizio, our newsletter editor, for all of his hard work in chasing us along for our contributions and for assembling and distributing this latest IBG News. Maurizio’s tenacity is pivotal to the ongoing success of our newsletter – so a big thankyou Maurizio on behalf of all IBG members. But our contributions are also essential. These have dwindled in recent years and I suspect one reason may be that much of our research these days is subject to IP agreements that preclude disclosure to other parties? We should consider this issue at our next workshop.

I’d like to thank you all, rather belatedly, for helping to make the VIIIth IBG workshop held in La Grande Motte, France, in April last year (2007), such a success. The effort you all put into your presentations and the discussions that followed made for a thoroughly worthwhile meeting. Special thanks to Geoff Hurrell, Jane Barton, Mic Julien and Maurizio for helping with arrangements. I look forward to our IXth workshop in Florida in February next year under the stewardship of Joel Neal.

I accepted the role of IBG Chairman in 2003 and have had the privilege of presiding over several highly successful workshops during the last 5 years. But its now time for me to pass this responsibility on to someone else. It is my intention to formally step down as Chairman at the IXth workshop.

Looking forward to seeing you in Florida in February 2009.

Graeme Bourdôt

MEETINGS

IX International Bioherbicide Group Workshop
8 February 2009 - Orlando, Florida, USA

(by Joe Neal - joe_neal@ncsu.edu)

The IXth International Bioherbicide will be held as a satellite conference in conjunction with 2009 annual meeting of the Weed Science Society of America (WSSA) . Information on the WSSA annual meeting is available on the Society's web site: www.wssa.net. In addition to the volunteer presentations at the IBG workshop, a field tour of weed biocontrol sites is planned for Monday February 9th; a WSSA symposium on biological control of weeds has been proposed for Tuesday, February 10th; and general poster and oral sessions at the WSSA conference will include a biological control of weeds session. We hope many IBG members will plan to attend. Funding has been secured from the US Department of Agriculture to reduce the registration costs for non-WSSA members and to encourage graduate student participation. Registration and conference details are still being decided and will be forthcoming soon. In the mean time if you have any questions about the workshop contact Joe Neal, chair of the WSSA biocontrol committee – joe_neal@ncsu.edu.

Conference
"Managing Parasitic weeds: integrating science and practice"

21 - 26 September 2008

Grand Hotel Masseria Santa Lucia, Ostuni - Italy

Organisation for Economic Co-operation and Development

EWRS

Parasitic plants (e.g. *Striga* - witchweeds and *Orobanche* - broomrapes) severely constrain Mediterranean and Tropical agriculture, affecting major crops, yet the efficacy of available means to control had been minimal. Control strategies had centred on agronomic practices and the use of herbicides, although success has been marginal. There is, thus, an urgent need to re-evaluate novel integrated control programmes in the light of recent basic research successes in understanding the enemy. There are also many other aspects such as their origin and evolution from non parasitic plants, their population structures, their evolutionary pathways towards becoming crop parasites, their molecular biology, the structure, function and development of the haustorium, their ecology, the physiology of parasitism, that are becoming of great help in developing new integrated and effective control strategies.

A group of experts using "advanced approaches" to parasitic weed management having backgrounds in the different aspects of biotechnologies will be expected to give highly qualified and advanced lectures, followed by long periods of discussions. A further aim of the conference is to create a network of young and experienced scientists that could have, find or create new opportunities to collaborate in this field of science that requires a “global” collaborative approach.

Location: Grand Hotel Masseria Santa Lucia, Ostuni, near Bari http://www.masseriasantalucia.it/.

Programme: The conference will be organized to have in each day one main theme with some lectures. Many lecturers of high and internationally recognized scientific level have been invited. Several specific workshops or round tables will also be organized during the Conference. Time will be reserved for short presentations and poster sessions by the other participants.

Costs/Awards: The costs for the whole conference, based on a single or shared double room occupancy, full board, excursion, bag, scientific material, and shuttle bus to airport on days of arrival and departure, will be 1,000 or 1,200 Euro, respectively. There is no additional registration fee for attending the Conference, that is not open to the public. Beside the list of the invited speakers, only a limited number of attendees could be admitted. To be invited, interested scientists and students are requested to contact Maurizio Vurro by e-mail.

Limited support is available from the **EWRS** (European Weed Research Society), for a few young European scientists interested to the Conference. These funds are limited and will cover only a limited part of the required fee. To apply for this partial support please send a cv, publications list, and a short statement about why you wish to attend. All participants must be accommodated at the Grand Hotel Masseria Santa Lucia.

Participation / Further Information / Application Form: http://www.ewrs.org/ewrs-pw.htm

Invited lecturers: Harro BOUWMEESTER, The Netherlands; Consuelo DE MORAES, USA; Philippe DELAVAULT, France; Jonathan GRESSEL, Israel; Maria HARRISON, USA; Sarah HEARNE, UK; Tony HOOPER, UK; Daniel JOEL, Israel; David LYNN. USA; Giles OLDROYD, UK; Alejandro PÉREZ DE LUQUE, Spain; Brian RECTOR, France; Diego RUBIALES, Spain; David SANDS, USA; Julie SCHOLES, UK; Maurizio VURRO, Italy; Alan WATSON, Canada; James WESTWOOD, USA; John YODER, USA; Koichi YONEYAMA, Japan; Binne ZWANENBURG, The Netherlands.

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PEOPLE & PLACES

(by Karen Bailey - BaileyK@AGR.GC.CA)

Dr. Karen Bailey visited Landcare Research in Auckland and Christchurch, New Zealand in February 2008. She presented the Agriculture and Agri-Food Canada model for biopesticide development in Canada and discussed factors such as legislative changes, consumer attitudes, industry participation, and regulatory encouragement that have created a climate supporting biopesticide registrations. Karen also gave two presentations at the Australia New Zealand Biocontrol Conference in Sydney, Australia: i) Social and economic drivers of biological control: A Canadian perspective and ii) Canadian initiatives in biopesticides.

Dr. Stan Bellgard from Landcare Research in Auckland, NZ visited the bioherbicide team (Karen Bailey, Sue Boyetchko, Gary Peng, and Russ Hynes) at AAFC in Saskatoon for 3 weeks in June 2008. Stan spent time with each of the scientists and the technicians to learn about the bioherbicide programs using bacteria and fungi for annual and perennial weeds and about their platform technologies in fermentation, formulation, and application.

BIOHERBICIDE RESEARCH - STATUS REPORTS

SARRITOR Granular Bioherbicide

(by Alan Watson - alan.watson@mcgill.ca)

In the recent past, control of common dandelion and other broadleaf weeds in turfgrass has been readily achieved with phenoxy herbicides. The herbicide option has been revoked through municipal and provincial legislation across much of Canada, necessitating alternative approaches. Finally there is an effective biological option. SARRITOR is the first bioherbicide developed for control of dandelion and other broadleaf weeds in turfgrass. SARRITOR granular bioherbicide has received temporary registration by Health Canada's Pest Management Regulatory Agency (PMRA) and is proceeding towards full registration. A limited amount of Sarritor was available for the 2008 season and full production will not be achieved until 2009/10.

The active ingredient of SARRITOR is a naturally occurring fungal plant pathogen, *Sclerotinia minor* (IMI 344141). *Sclerotinia minor* is widespread in the environment, yet there are no published reports of disease associated with *Sclerotinia minor* in birds, wild mammals, earthworms, honeybees and other arthropods, aquatic invertebrates or fish. Many soil organisms, including nematodes, earthworms, mites, bacteria and fungi feed on or parasitize fungal sclerotia. Human and environmental toxicological studies have established that *S. minor* IMI 344141 is neither toxic nor pathogenic to non-target organisms. SARRITOR active ingredient is not toxic or pathogenic to birds, honeybees and earthworms. SARRITOR granules have low dermal toxicity and are non- to minimally irritating to the skin and eyes.

The bioherbicide product is produced by growing the fungus on ground cereal grains followed by drying and vacuum packaging. The small (1.5-2.0 cm diameter) bioherbicide granules are broadcast or spot applied to weed infested turf in the spring and/or the autumn. To work, the fungus must grow out of the granules and invade and colonize dandelion and other broadleaf weeds. Favourable conditions for germination and infection are daytime high temperatures of 15-24C and rainfall or irrigation within 12 hours. The product should not be applied when temperatures are above 25C or during periods of dry weather. Disease develops quickly and complete kill of dandelion and other broadleaf weeds can be achieved within 7 days, about twice as fast as the standard 3-way chemical herbicide. The product is compatible with normal lawn maintenance operations such as mowing, fertilization and irrigation.

Foliar damage and dandelion mortality caused by SARRITOR are affected by plant age and the presence of grass competition. Dandelions of all ages are more severely affected by *S. minor* in the presence of grass competition. A healthy grass sward provides a microenvironment favouring the success of SARRITOR as a biological control agent of dandelion. Thus proper management of the turfgrass environment is complementary to the efficacy of *S. minor* as a biocontrol for dandelion and other broadleaf weeds.

Most broadleaf plants are susceptible to infection with *Sclerotinia minor* strain IMI 344141 following broadcast or spot treatment with SARRITOR granules. SARRITOR destroys all above-ground plant foliage and reduces root biomass, but dandelions with large tap roots may re-sprout and need re-treating. Variation in damage amongst weed species is a reflection of different growth habit (upright vs prostrate vs creeping); leaf size, leaf orientation – all features that affect the degree of direct product contact onto plant stem and leaf surfaces. Plants with the rosette form of growth intercept more bioherbicide particles than do plants with upright growth habit. Less bioherbicide product achieves direct contact with upright plants. SARRITOR granules and *Sclerotinia minor* strain IMI 344141 do not persist in the environment and are not readily dispersed from the site of application. Mycelia of the fungus do not survive beyond 11 days in the turfgrass environment. Thus SARRITOR does not persist and has no residual activity, although SARRITOR will kill dandelion seeds that the fungus contacts on the soil surface. Turf grasses are not harmed by SARRITOR. Kentucky bluegrass, creeping red fescue, perennial ryegrass, annual ryegrass, creeping bentgrass, colonial bentgrass, chewing's fescue, tall fescue and hard fescue are resistant to infection following both pre- and post-emergent applications of SARRITOR. The risk to non-target plants is limited to those growing in or adjacent to treated turf. Users are advised to avoid direct application to desirable broadleaf species.

Spring after 40g/m^2 SARRITOR in previous fall

Spot application of 0.4g on bull thistle


Three days after spot application of 0.4g of SARRITOR on broadleaf plantain.


Seven days after spot application of 0.4g of SARRITOR on broadleaf plantain.

Plant Growth-Suppressing Rhizobacteria for *Cyperus rotundus* Control

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Cyperus rotundus (Family: Cyperaceae) or purple nutsedge continues to carry the 'world's-worst-weed' tag (Holm *et al*., 1977), in spite of extensive research on its control across the world. The difficulty in managing this weed lies in the inability of chemical or cultural methods to destroy its intensive system of underground rhizomes and tubers. Biological control in various forms, however, seems to have the potential to overcome many of these inherent features associated with this weed.

Unfortunately, even in India -the putative home of *C. rotundus*- unlike many other native weeds this sedge is not under natural suppression, indicating that the natural enemies, both pathogens and arthropods, could not compete with the weed's phenomenal growth rate and spread. A few natural enemies have however been identified to have promise as augmentative biocontrol agents in India. The indigenous, lepidopteran stem borer *Bactra venosana* is an arthropod example. Among the plant pathogens, the rust *Puccinia canaliculata* (=*Puccinia romagnoliana*), which occurs on an epiphytotic scale every year, has also been proved to be an effective biocontrol agent. The other rust species, viz. *Puccinia cyperi* and *P. cyperi-tegetiformis*, recorded in the Neotropics, and the *Uredo* spp. reported from the Old World, have so far not been found on the weed in India and therefore could be considered for importation and evaluation as classical agents.

Presently, a specific sub-project within the Indian Council of Agricultural Research (ICAR)-funded network project on "Application of Microorganisms in Agriculture and Allied Sectors (AMAAS)" is being undertaken at our Directorate to formulate a mycoherbicide-based strategy for *C. rotundus*.

So far a fungal pathogen infecting the tubers of *C. rotundus* has been found to have scope for development as a mycoherbicide under this project. Apart from this, two other soil-borne pathogens (*Macrophomina phaseolina* and *Sclerotium rolfsii*) are also being evaluated as candidate organisms. Species of *Curvularia*, *Drechslera*, *Fusarium*, etc. have also been isolated from infected *C. rotundus* plants collected from Punjab and Karnataka.

Interestingly, for the first time, we have identified a few soil-borne bacteria that possess inhibitory activity against *C. rotundus.* Since these bacteria from the root zone have shown immense potential in suppressing the plant growth, we introduce the term 'plant growth-suppressing rhizobacteria' (PGSR) in lieu of 'deleterious rhizobacteria' (DRB) (Suslow and Schroth, 1982).

Out of the many PGSR isolates obtained from the soil samples collected from different places in Karnataka, Kerala, Maharashtra and Punjab, only five could efficiently suppress *C. rotundus.*

In the laboratory, these bacteria showed differential levels of resistance in several antibiotic sensitivity tests. Only one candidate strain (PGSR3) was found to have hydrogen cyanide (HCN)-producing ability, which has been demonstrated to be a growth retardant by earlier workers. In the greenhouse, all the five rhizobacterial isolates could reduce the seedling growth and eventually bring about complete debilitation in the plants when tested at lower and higher concentrations. Symptoms such as necrotic lesions, distortion of emerging leaves, stunting of plants and general wilting were observed during the course of the experiments. At the higher dose, PGSR5 was the best (Fig. 1) as it could reduce the fresh and dry weights of the plant by 82% and 79%, respectively.

The 16S rDNA sequence data indicated that these isolates are species of *Acinetobacter*, *Bacillus* and *Stenotrophomonas*.

Over the years, the immense opportunities offered by rhizobacteria have mostly been overlooked in weed biological control in spite of the demonstration of their use in the biocontrol of several weeds (Kremer and Kennedy, 1996). Based on the encouraging early results from our studies, we are looking at the possibility of engineering microbial interactions in the rhizosphere for biological control of *C. rotundus*.

Concurrently, these identified rhizobacteria should be thoroughly investigated for their host-specificity to ensure they do not cause any deleterious effect on non-target crop plants, before recommending them for field use under various cropping systems.

Fig. 1: Effect of PGSR5 at two concentrations on *Cyperus rotundus* in the greenhouse

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Can a pathogen-infested organic mulch be an alternative to the plastic mulch-methyl bromide system for suppressing purple and yellow nutsedges in tomato production?

(by Yasser Shabana - yassershabana2@yahoo.com)

R. Charudattan, Yasser Shabana and Waldemar Klassen at the University of Florida, IFAS; Erin Rosskopf of the U.S. Department of Agriculture, and Jose Pablo Morales-Payan of the University of Puerto Rico evaluated 14 types of organic mulches for growing *Dactylaria higginsii*, a bioherbicide agent for nutsedge. Ten of these mulches were also tested for nutsedge suppression in a tomato field.

Purple and yellow nutsedge are among the world's most problematic weeds which have been reported to cause yield losses of 20-89% in various horticultural crops. Production systems based on plastic mulch and methyl bromide soil fumigation are used for nutsedge suppression in many conventional vegetable cropping systems. In these studies, 10 organic hays (shoot straw of bahiagrass, cogongrass, cowpea, millet, nutsedge, sorghum Sudangrass, sunnhemp, rye, corn, and sugarcane bagasse), four green mulches (cowpea, millet, sorghum Sudangrass, and sunnhemp), and two plastic mulches (black and IRT) were tested for their efficacy in suppressing purple and yellow nutsedge growth in a raised bed tomato (cv. Tygress) field. The beds were fumigated with methyl bromide prior to treatment establishment and a randomized complete block design was used with four replications. Nutsedge tubers were seeded, with yellow and purple nutsedge tubers seeded alternately at 1″ depth and 3″ space in two lines parallel to tomato rows (one line on each side with 2″ spacing from tomatoes). Only the plot of weed-free control treatment in each block was not seeded with nutsedge. After seeding the nutsedge tubers, the hays and green or plastic mulches were spread in each plot. The black plastic mulch consistently reduced nutsedge emergence and growth more than the organic mulches and the IRT plastic mulch. All green organic mulches, except the green sunnhemp, were more suppressive to nutsedge emergence and growth than hay mulches. Among the organic mulches, the greatest suppressive effect on nutsedge was found when using green sorghum, green millet, and cogongrass hay. Although cogongrass hay did not enhance the total yield, it influenced the proportion of larger fruits. The highest yield of extra large tomatoes per plant was obtained when cogongrass hay was used as mulch. However, the use of black plastic increased the total yield and the proportion of larger fruit.

For mass production of *D. higginsii*, 14 solid substrates in the form of dried, cut shoots/foliage of various plants were tested solely or amended with 0.01% indole-3-butyric acid (IBA), potato dextrose broth (PDB), or with PDB + 0.01% IBA. Conidial yield from these substrates was measured 4 and 12 weeks after inoculation. Those that were harvested after 4 weeks had a second spore harvest 4 weeks after the first harvest. Conidia were tested for virulence on purple and yellow nutsedges in the greenhouse. Conidial yields were highest when the fungus was grown on purple nutsedge hay alone without any amendments for 4 weeks but conidia produced on this substrate had low virulence. Conidia produced on sorghum and cogongrass were significantly more virulent than those produced on any other medium. Conidia produced on sorghum and cogongrass were larger and had a thicker wall than those produced on other hay media.

Dactylaria-infested hay is now under evaluation in the field. The aim is to find the combination that best discourages nutsedge, providing mechanical barriers plus a dose of the fungus for any nutsedge plants that emerge.

Funding of this research was provided by a USDA-CSREES RSTAR grant and special funding from the Senior Vice President for Agriculture and Natural Resources, College of Agriculture, University of Florida, IFAS.

Yasser Shabana is pointing to the most suppressive mulch (cogongrass; right) and the most inducing mulch (sugarcane bagasse; left) for nutsedge growth in tomato beds at UF's Plant Science Research and Education Unit in Citra (3 wk after planting) – Nutsedge, one of the most troublesome weeds in Florida agriculture, was deliberately planted with the tomatoes as part of a study to determine which mulches best suppress its growth.

Yasser Shabana, Professor of Plant Pathology, Faculty of Agriculture, Mansoura University, Egypt, joined **Dr Charudattan's** research team as a Program Manager of Weed Biocontrol at Plant Pathology Department, University of Florida. Yasser started his position in July 2006 and he is managing all fungal bioherbicide program focusing on purple nutsedge and yellow nutsedge, weedy grasses, and glyphosate-resistant Palmer amaranth. Yasser was awarded The Arab Fund Distinguished Scholar Award for the academic year 2005/2006 and spent this research fellowship at **Dr. Steve Hallett's** lab, Botany & Plant Pathology Dept., Purdue University, West Lafayette, IN for one year working on the formulation of *Microsphaeropsis amaranthi* as a mycoherbicide for the common waterhemp weed, *Amaranthus tuberculatus*. He has also been awarded an Alexander von Humboldt (AvH) Research Fellowship and spent a year and a half in the laboratory of **Prof. J. Sauerborn** at the University of Hohenheim, Stuttgart, Germany, working on formulation of a mycoherbicide for sunflower broomrape, *Orobanche cumana*. He was awarded the 1998 Shoman Prize in Agricultural Sciences for the Young Arab Scientists in recognition of his research work on biological control of weeds with plant pathogens and microbial pesticides. Yasser is a recipient of the 1998 National Prize of Egypt for Distinction for Young Scientists, the 1997 Award of Merit by the University of Mansoura, Egypt, and the 1993 IFS/King Baudouin Award by the International Foundation for Science (IFS), Sweden. Yasser received his Ph.D. degree in 1992 under a joint supervision system between University of Mansoura and the University of Florida. He was a Postdoctoral Associate from November 1994 to April 1997 in the laboratory of **Prof. R. Charudattan** at the University of Florida, Gainesville. He is a co-author of two U.S. patents on a broad-spectrum bioherbicide for controlling pigweed species. He served as a regional editor for Plant Pathology Journal and currently is serving as a regional editor for Journal of Biological Sciences. He has been an elected scientific advisor for IFS, Sweden since 1989.

Tunisian Journal of Plant Protection

(by Robert Kremer - KremerR@missouri.edu)

The Tunisian Journal of Plant Protection might be an appropriate outlet for weed biological control reports, especially concerning the Mediterranean region. The website where one can view recent issues is http://www.iresa.agrinet.tn/tjpp/

Here we host the Editorial appeared in Vol. 2 N. 2, December 2007 by *Prof. Robert J. Kremer, U.S. Department of Agriculture, Agricultural Research Service, University of Missouri-Columbia, Missouri, USA*

Courtesy of Prof. Bouzid NASRAOUI
Editor-in-Chief of Tunisian Journal of Plant Protection (http://www.iresa.agrinet.tn/tjpp)

Biological control of weeds, the intentional use of natural enemies to reduce the vigor, reproductive capacity, density, and impact of weeds, has been promoted as a potentially effective weed management strategy for over 100 years. Classical biological control entailed the introduction of host-specific organisms (insects, pathogens, nematodes) from a weed's native range into regions where the weed established, requiring several years for organism populations to build up to significantly damage the weed infestation. A modification of classical biological control, developed in the 1970's as the "bioherbicide" approach, used application of massive numbers (inundation) of selected pathogens to attain weed control, especially in annual crops, within one growing season. Bioherbicides were considered potential alternatives to conventional weed control with synthetic herbicides because of better environmental compatibility and lower risks to human and animal health. Thousands of microbial cultures have been screened as potential bioherbicide agents in numerous laboratory, greenhouse, and field studies. However, only a few bioherbicides were fully developed for in-field weed management; many biological control agents remain cataloged but not fully exploited. Thus, deployment of successful and effective biological control products for reducing herbicide use has been extremely limited despite significant inputs of scientific effort, time, and funding into biological control programs. Why has the implementation of bioherbicides as an alternative weed control strategy experienced such limited success?

The very nature of bioherbicides as living products that attack specific weeds at a critical growth stage is a major limitation to adoption for use in most cropping systems. The use of a bioherbicide to control one species in a mixture of weeds in the field is questionable if producers have access to broad-spectrum herbicides to control multiple weed species. The complex and dynamic conditions of temperature, moisture, dew period, wind, radiation, and soil properties interact to depress effective biological agent activity. Unique formulations were developed to assure an optimum environment for bioherbicide pathogens to withstand adverse conditions when applied in the field and promote subsequent infection and disease. The primary purpose of improved formulations is to provide adequate moisture on the weed surface to prevent desiccation of the pathogen during infection and initiation of disease. To assure adequate infection, massive numbers of pathogen cells are suspended in the formulations. Using improved formulations combined with massive numbers, about 10 bioherbicides have been commercialized world-wide for control of specific weeds in specialty crops or defined ecosystems. For example, 'Camperico' contains the bacterial pathogen *Xanthomonas campestris* pv *poae* for controlling annual bluegrass (*Poa annua*) in turfgrass production; 'Biochon' contains the wood-decay fungus *Chondrosterum purpureum* for controlling undesirable woody vegetation in timber plantations. Similar bioherbicides are under development specifically for cropping systems plagued by single-species weed infestations. These include crops infested with the parasitic weeds dodder (*Cuscuta* spp.), witchweed (*Striga* spp.), and broomrape (*Orobanche* spp.), which are problematic in regions of the world where herbicides are ineffective and where rather low-cost bioherbicides could be readily adopted. Non-agricultural situations suitable as bioherbicide targets include natural ecosystems infested with invasive weeds (i.e., leafy spurge [*Euphorbia esula*]) in grasslands of North America), allergenic or nuisance weeds (i.e., common ragweed [*Ambrosia artemisiifolia*]), and narcotic plants (i.e., coca [*Eriythroxylum coca* var *coca*]), where the 'crop' would actually serve as the target weed.

The future seems promising for management of individual weeds with bioherbicides in specific ecosystems, however, improvement is still needed for adaptation of bioherbicides to control multiple weeds in conventional cropping systems. Extensive research on formulation development already provides a basis for delivery, application, and field persistence of bioherbicide agents. Combinations of 'core strains' of pathogens that suppressed growth of three or more dominant weed species within a site has been successful on a limited scale. Nutritional manipulation by altering C/N ratios of culture ingredients or concentrations of specific nutrients resulted in enhanced virulence of a few selected biological control pathogens infecting certain weeds. Further, genetic enhancement of virulence by causing the pathogen to overproduce toxins, enzymes, or other metabolites was successfully demonstrated to expand the spectrum of weeds susceptible to growth suppression by the bioherbicide. However, because of increased public concern about other genetically-modified products used in agriculture, the acceptance of similarly modified bioherbicides applied to fields for weed control may be met with considerable resistance. Assuming potential broad-spectrum bioherbicides become available and are accepted by the public, will the level of weed control efficacy be acceptable by farmers? Most bioherbicides significantly suppress weed growth and reduce competitiveness but do not necessarily result in complete kill. Whether farmers and landowners are willing to accept visible scattered weeds in fields that would otherwise be completely free of weeds using herbicides is questionable. Better opportunities for incorporation of bioherbicides into conventional cropping systems include their integration with herbicides for control of herbicide-resistant weeds. Nearly 70% of the global area cropped to soybean (*Glycine max*), maize (*Zea mays*), cotton (*Gossypium hirsutum*), and canola (*Brassica campestris*) are planted with transgenic, glyphosate-resistant varieties, thus development of glyphosate-resistant weed biotypes is inevitable. Currently, at least 10 glyphosate-resistant weed biotypes have been reported, which are ideal targets for future bioherbicides deployed to attack weeds escaping herbicide control in transgenic cropping systems.

We must realize that bioherbicides are natural products and are expected to perform in drastically altered environments created by conventional cropping in which soils are disturbed, chemical inputs are routine for fertilization and pest control, and plant and microbial biodiversity are reduced. Bioherbicides may be most effective in sustainable agricultural systems with organic inputs via various amendments, crop rotation and crop residue management, and/or cover cropping. Weed infestations are inherently low because management with organic inputs allows development of indigenous weed pathogens and beneficial insects resulting in natural or 'conservation biological control.' Bioherbicides can supplement or enhance natural weed control through: integration with cover crops thereby establishing biological control pathogens in soil for subsequent infection of germinating weed seedlings; combination with allelopathic crops such as rye (*Secale cereale*) or barley (*Hordeum vulgare*) to extend overall weed suppression through the crop growing season; and integration with various organic amendments including composted animal manures, corn gluten meal, and composted dried distiller grains to facilitate or supplement weed control in soils. Other possibilities for expanding the utility of bioherbicides involve development of "multiple-function" products containing agents that simultaneously suppress weed growth and specific crop pathogens, or provide weed growth suppression and nutrients for crops by nitrogen fixation, phosphorus solubilization, etc.

In conclusion, considerable opportunity exists for practical application of bioherbicides in agricultural and natural ecosystems. Improvement through virulence enhancement and expanding the spectrum of weed control is critical for adoption in cropping systems. However, increasing costs of petroleum-based inputs (fertilizers, pesticides) and gradual integration of sustainable production practices into crop management, will drive adoption of effective bioherbicides as supplemental, if not major, components of weed management systems.

Can Californian thistle (*Cirsium arvense*) be controlled in New Zealand pastures by mowing it during rainfall?

(by Graeme Bourdôt - graeme.bourdot@agresearch.co.nz)

(the following article appeared in the Landcare Research newsletter "What's New in Biological Control of Weeds" , Volume 44, page 4, published May 2008)

Declaring Mycological Warfare on Californian Thistle

As an addition to work done by Landcare Research to develop an effective classical biological control programme against Californian thistle (*Cirsium arvense*), AgResearch scientists Bob Skipp and Graeme Bourdôt are exploring another way to help beat this persistent prickly pest. Their complementary approach focuses on identifying fungal pathogens that occur naturally in New Zealand and attempting to develop them into mycoherbicides.

The pathogen that they identified back in the early 1990s as a potential mycoherbicide candidate, *Sclerotinia sclerotiorum*, has not yet made it through to becoming a commercially available product. While this fungus is highly damaging to the thistle, finding a cost-effective formulation remains a stumbling block and the project is currently "sitting on the back burner".

A country-wide survey to identify other potential candidates began in 2005/06, funded by Meat and Wool NZ. This survey of about 150 farms was prompted by the difficulties with *Sclerotinia* and the hopes that a more easily manipulated pathogen, and possibly even one that attacks the thistle's roots, may exist. The survey did uncover some pathogens of interest.

"One of the fungi we found may be responsible for the anecdotal evidence that mowing Californian thistle in the rain leads to its demise," revealed Graeme. The AgResearch team has revisited some of the surveyed farms this autumn to seek the help of the farmers with a field trial. We have asked these farmers to mow an area of the thistle in the rain and another area when it is dry, while leaving a third patch unmown. Estimates of the ground cover of the thistle and samples of stems and roots taken before and after the mowing will confirm whether mowing in the rain does bring about the demise of the thistles and also determine the role that the pathogen plays in this.

Back in the laboratory the AgResearch team is also investigating the biocontrol potential of over 30 other fungi and bacteria that were found in leaf, stem or root tissues collected during the survey. One of these fungi is of particular interest because it is easily cultured, and its spores infect the thistle without the need for added nutrients. These two characteristics are highly desirable for mycoherbicide development, and AgResearch scientists are now studying this promising fungus in detail.

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Geoff Hurrell (geoff.hurrell@agresearch.co.nz).

Image: A diseased thistle that yielded the fungus believed to be responsible for the thistle's demise when mown in the rain.

Journals

PHYTOPATHOLOGIA MEDITERRANEA

An International Journal Edited by the **Mediterranean Phytopathological Union**

The journal deals with the main areas of plant pathology as epidemiology, control, biochemical and physiological aspects, application of molecular biology techniques, applied to fungi, bacteria, phytoplasmas, virus, viroids, nematodes, etc.

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The journal includes 3 issues per year in which a review paper, original research papers, short notes and new disease reports are published. It also includes Book reviews of interest for Mediterranean phytopathologists.

Articles on biological control of weeds are very welcomed

Phytopathologia Mediterranea is indexed by **ISI, CAB, BIOSIS, AGRIS, Chemical Abstracts, CSA**

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Available on-line at: www.fupress.com/pm/
or at: www.mpunion.com

In 2007 Phytopathologia Mediterranea got an **Impact Factor of 0.446**

NEW BOOKS

(by Maricela Martinez - mmartine@tlaloc.imta.mx)

IMTA, The Nature Conservancy, Conabio, Aridamérica, GECI. 2008
Especies invasoras de alto impacto a la biodiversidad, Prioridades en México.
Jiutepec, Morelos. México.
ISBN 978-968-5536-92-9
Ignacio J. March Mifsut y Maricela Martínez Jiménez (Editores)

EDITOR'S CORNER

Dear All,

Thanks for the contribution received for the preparation of this issue of the bulletin.

In particular, please let me thank:

- Karen Bailey
- Graeme Bourdôt
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- Maricela Martinez
- Yasser Shabana
- Joe Neal
- Alan Watson

Although not so many, I have preferred to prepare this issue of out newsletter, hoping that in this way and with this obstinacy, the future issues will contain much more contributions and information.

Please remind that this bulletin is prepared on a voluntary basis and it contains only the information sent by the newsletter subscribers, under their responsibility, so this is not an official journal and cannot be considered exhaustive. Please also remind that the mailing list can be used as a moderated list for distributing information related to weed biocontrol at any time during the year.

Maurizio