GLOBAL INITIATIVE ON LATE BLIGHT

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GILB'05 Conference

The next GILB international conference will be held 3 - 6 December 2005 in Cairo, Egypt, immediately following the 7th Biennial Conference of the African Crop Science Society to be held 27 November - 2 December 2005. More information will be available on the new GILB website at: http://gilb.cip.cgiar.org

New strategies to control late blight in Huánuco, Peru

In Peru close to 42% of the 268,000 ha in potato production has high or very high levels of late blight requiring more than six fungicide applications each growing season for an economically acceptable yield (Egúsquiza and Apaza, 2003). The department of Huánuco is a major potato producing area. During 2001–2004, monitoring and surveys during several growing seasons by the author, agricultural knowledge experts from AFDR (Asociación para el Fortalecimiento y Desarrollo Rural, a non-governmental organization in Huánuco), along with other collaborators revealed that growers use from eight to 30 fungicide applications to control late blight (AFDR, 2002). Many of these applications are homemade cocktails that are often ineffective due to problems of dosage, quality, spraying procedure and timeliness. Throughout the growing season, growers commonly use mixes of systemic fungicides from different manufacturers — but with the same active ingredient. An apparent loss of effectiveness of systemic fungicides observed in farmers fields' during 2001–2004 was first shown experimentally in 2001 (Villodas and Fernández-Northcote, 2001). Another problem is the wide use of tin-based fungicides throughout the growing period, which control blight effectively, but cause yield losses due to phytotoxicity. In addition, tin poses a threat of contaminating the aquatic environment.

In 2001 a collaborative effort began to adjust and validate in Huánuco the chemical control strategies developed by PROINPA (Foundation for the Promotion and Research of Andean Products) in Bolivia (Fernandez-Northcote and Navia, 2003). The participants included growers, agricultural experts and students from the local university UNHEVAL (Universidad Nacional Hermilio Valdizan), the university UNALM (Universidad Nacional Agraria La Molina), Papa Andina (a regional collaborative project between the International Potato Center and the Swiss Agency for Development and Cooperation) and AFDR. Funding was provided by the Peruvian Ministry of Agriculture through INCAGRO, Papa Andina and agrochemical suppliers, who also provided logistical support.

One important control strategy for susceptible cultivars is prevention. The first application is at 80% emergence if emergence is uniform or at 50% and 100% emergence when not uniform. For resistant cultivars, the first application is made when the first symptoms are observed.

Another strategy is the alternation of a systemic fungicide with a contact fungicide until 50% flowering and then continuation with only a contact fungicide. The number of systemic fungicides used is another component of the strategy — each systemic should only be used three times during the growing season and care must be taken not to use another systemic with the same active ingredient. Usually in areas or growing seasons of high incidence of late blight, two systemics, each in alternation with a contact fungicide, are needed to protect the crop. In this case, systemics are used until the flowers start to fall or the foliage starts to change color. To reduce costs, one of these is a translaminar fungicide.

Generally, for susceptible cultivars the spraying interval is 5 to 7 days after a contact or translaminar fungicide, and 7 to 14 days after a systemic, the intervals depending upon whether or not the conditions are favorable for late blight development. For resistant cultivars, spraying takes place when the disease is seen to be progressing.

Using these strategies, it was possible to reduce the number of applications by 30–50% for susceptible cultivars and by 44–70% for resistant cultivars in comparison to local practice. Fewer applications of fungicides reduce the chances of contamination of the grower and of the environment. Yield increases were at least 50% higher in comparison to the growers who used their own "cocktails" and more numerous applications.

Enrique Fernandez-Northcote, Coordinator of this collaborative effort, Universidad Nacional Agraia La Molina, Lima, Peru

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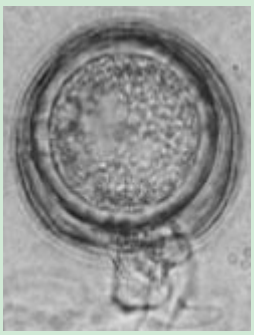
First International Workshop for the Morphological and Molecular Identification of the Straminipiles: *Phytophthora* and *Pythium*



The Department of Plant Pathology at North Carolina State University, Raleigh, NC, USA, is pleased to announce the "First International Workshop for the Morphological and Molecular Identification of the Straminipiles: *Phytophthora* and *Pythium*", 23–27 July 2004, organized by the Plant Pathogen Identification Laboratory.
For information on the workshop, contact Gloria Abad, email: gloria_abad@ncsu.edu or visit the website: http://www.cals.ncsu.edu/plantpath/PPIL/Index.html

Induced Systemic Resistance (ISR): Its impact on defense mechanisms as components of integrated disease control strategies for potato late blight

Andreu[1] A B, Guevara[1] M G, Wolsky[1] E A, Daleo[1] G R and Caldiz D O.[2]

Although strategies for controlling leaf and tuber diseases have been introduced over the years, serious losses still occur. As one alternative, chemicals that induce disease resistance have been tested. Our interest is focused on the molecular mechanism of induced systemic resistance (ISR), using potato – potato late blight as a model system, and on developing ISR technology for use as part of an integrated disease control strategy. In particular, the purpose of this work was to study the effect of ß-aminobutiric acid (BABA) and fosetyl aluminium (Aliette) on late blight development, and on the production of resistance related molecules in potato varieties of industrial importance.

First, the resistance level of tubers and foliage of commercial cultivars to potato late blight, caused by *Phytophthora infestans,* was determined. Updated information on the late blight susceptibility of commercial cultivars is needed by crop managers and growers to optimize a successful use of integrated crop management strategies.

The commercial cultivars showed remarkable differences in their defense response to *P. infestans* isolate MC355 (a very aggressive Argentinean isolate) in laboratory, greenhouse, and field tests. Shepody was highly susceptible and Kennebec was moderately susceptible. Russet Burbank was moderately resistant. Santana and Russet Ranger were resistant and Innovator was highly resistant. Foliage of Russet Burbank and Santana was more susceptible than tubers from the same plants.

For chemical induction of resistance, foliage of potato cultivars was sprayed with BABA, Aliette or water (as a control). After three days the foliage was inoculated with *P. infestans*. The following parameters were evaluated: a) development of disease symptoms in foliage, b) development of disease in the tubers, c) the protein level of two enzymes, a ß-1,3-glucanase and an aspartil protease, in tubers and d) the phenol and phytoalexin content in tubers.

The two chemical compounds tested were unable to protect either the resistant Russet Ranger or the highly susceptible Shepody. The

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moderately susceptible Kennebec and the moderately resistant Russet Burbank were protected after these treatments. High levels of protection against *P. infestans* were observed in foliage during early stages of growth (plants 30 days old). The resistant Santana was protected during early stages of growth, during which it is moderately resistant. Subsequently, a decrease in late blight protection of foliage resulted in plants 45–50 days old and at the initiation of tuberization, which could be the result of the downward mobility of photosynthates to tubers.

An increase in resistance to late blight was detected in both recently harvested tubers and tubers stored at 8°C for three months of susceptible Shepody and moderately susceptible Kennebec, and to a lesser degree, of the moderately resistant Russset Burbank.

Immunological analysis of crude extracts from disks taken from tubers of plants treated with foliar applications of Aliette or BABA were performed using an antibody against a basic isoform of ß-1,3-glucanase (36 Kda) purified from intercellular fluid of potato leaves infected with *P. infestans* and an antibody raised against an aspartil protease (AP) purified from intercellular fluid of potato tubers infected with *P. infestans*. Western blot tests showed that AP and ß-1,3-glucanase were induced in the tuber disks from susceptible to moderately resistant cultivars in a similar induction pattern. When the intensity of the immunological reaction was estimated by densitometry, the levels of ß-1,3-glucanase and AP were 3-4 fold in highly susceptible Shepody for both enzymes, and 6 fold for ß-1,3-glucanase and 2 fold for AP in moderately susceptible Kennebec. No significant differences were observed in the resistant Santana, which is moderately resistant in early growth stages.

Slices from tubers of plants treated with foliar applications of Aliette or BABA were inoculated with *P. infestans.* Seven days after inoculation, the phytoalexin and phenol content was determined. A higher accumulation (5 fold) of these compounds was detected in the infected tuber slices of plants of Shepody and Kennebec treated with Aliette or BABA, compared to the control tubers from untreated plants. The diameter of growth of *P. infestans* on the tubers slices was one tenth that of the control.

Induced systemic resistance treatments may offer the possibility of controlling both foliage and tuber blight and could have a major impact in reducing the over-wintering survival of *P.infestans* in tubers. Chemical activation of disease resistance in plants represents an additional option for growers to protect their crops from losses due to plant diseases. It may be the best chemical control option for some pathogens, when genetic resistance is not available or is insufficient. A synthetic chemical resistance activator must meet the same stringent set of criteria as fungicides regarding environmental and toxicological safety and reliability under practical conditions, and it must be economically advantageous for agrochemical producers, farmers and suppliers. Integration of this novel tool of induced plant defense into existing crop management programs may be possible.

INTERNATIONAL POTATO CENTER (CIP)

The GILB Newsletter is supported in part by the International Potato Center and through the coordinator and secretariat of GILB.

Biological Control in Late Blight Management

Although biological control is not commonly used for foliar diseases, numerous organisms capable of antagonizing fruit and leaf pathogens have been reported in recent years. Formerly, little attention was given to bio-control of foliar pathogens, principally because the foliar microflora was known to consist of relatively few organisms whose populations fluctuate dramatically according to environmental conditions. These may be daily temperature, relative humidity and ultraviolet radiation, which vary amply and rapidly, especially in the Andean mountains. Additionally, the rapid growth of foliage provides better opportunities for pathogen growth rather than organisms in the phyllosphere (Fry, 1982).

One example of biological control of an airborne foliar disease is the use of the antagonistic bacteria *Pseudomonas cepacia* and *Bacillus subtillis* to control *Monilia* pod rot in cacoa. *P. cepacia* and *B. subtillis*, applied every two weeks from March to August 2001 in field studies in Los Rios, Ecuador, reduced the disease by 55 and 62%, respectively, compared to the untreated control (Falconí et al., 2002). Concurrently, formulations of biopesticides, tests for tolerance of the antagonists to agrochemicals and tests for toxicity of the antagonists to cacao were carried out. Cost-Benefit analysis demonstrated a major economic benefit in using biological control as compared to chemical control (Falconí et al., 2003).

Ramos et al. (1993) and Sanchez et al. (1998) reported that certain microorganisms in the phyllosphere are antagonistic to *Phytophthora infestans*. These include the yeast *Sporobolomyces* spp., and isolates of *Pseudomonas* spp. and *Bacillus* spp. Jongebloed et al. (Sanchez et al., 1998) found that *P. fluorescens* isolate 148 and *Bacillus* sp. isolate B39 inhibited *P. infestans* in tomato maintained in a growth chamber. De la Vega and Perez (2004) tested the efficiency of isolates of *P. fluorescens* antagonistic to *P. infestans* and their tolerance to the principal fungicides used to control potato late blight in the greenhouse. At least two of these isolates significantly reduced infection and had some tolerance to the systemic fungicide Fosetyl-Al.

Streptomyces violaceusniger strain YCED-9 was strongly antagonistic to isolates of *P. infestans* in vitro (Trejo et al., 1998). *S. violaceusniger* produces geldanamycin, a benzoquinoid polyketide highly inhibitory of mycelial growth of *Pythium* and *Phytophthora* spp.

Interest in the biological control of *P. infestans* abounds. Hopefully, more effort will be made to continue studying these organisms as a future component of integrated control of late blight.

Prepared by Cesar Falconi, The Army Polytechnic School, Sangolqui, Ecuador. Translated from Spanish by GILB.

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Late Blight Abstracts

First report of *Solanum physalifolium* as a host plant for *Phytophthora infestans* in Sweden

Andersson B, Johansson M and Jönsson B. 2003. Plant Disease 87:1538.

In the early summer of 2003, lesions resembling those caused by *Phytophthora infestans* (Mont.) de Bary on potato were observed on *Solanum physalifolium* Rusby var. nitidibaccatum (Bitter) Edmonds (2) that was growing as a weed in a parsnip (*Pastinaca sativa*) field in sourthern Sweden. When infected leaves of *S. physalifolium* were observed under the microscope (x200 magnification), sporangia with the same shape and size as those of *P. infestans* were observed. Pieces of infected leaves of *S. physalifolium* were put under tuber slices of *S. tuberosum* (cv. Bintje) in petri dishes and kept at 20°C. After 4 days, mycelium grew through the slices and sporulated profusely. The sporangia on the slices were of the same shape and size as those observed on the infected *S. physalifolium* leaves. In Sweden, the ratio of A1 and A2 mating types is 50:50, and oospores are commonly found in infected potato crops (1), so isolates from *S. physalifolium* were tested for mating type by growing them together with reference isolates of a known mating type on agar plates. Nine of the tested isolates were A1 mating type and six were A2 mating type. One self-fertile isolate was found. Naturally infected leaves of *S. physalifolium* were incubated at 20°C at 100% relative humidity so the lesions could coalesce and to facilitate oospore formation. After 5 days, oospores identical to those of *P. infestans* were observed under the microscope (x200 magnification). Sporangia produced by isolates originating from *S. physalifolium* and *S. tuberosum* were harvested, and a suspension containing 10^4 sporangia from from each isolate was prepared. Five leaves each of *S. nigrum*, *S. physalifolium* and *S. tuberosum* (cv. Bintje), were inoculated with 10 µl of each sporangial suspension. Inoculated leaves were incubated in sealed petri dishes at 15°C. After 4 days, all *S. tuberosum* leaves were infected. After 7 days, two of five leaves of *S. physalifolium* leaves inoculated with the *S. tuberosum* isolate and two of five *S. physalifolium* leaves inoculated with the isolate from *S. physalifolium* were infected. All lesions produced sporangia similar to those formed by *P. infestans*. *S. nigrum* was not infected by any of the isolates. The ability of *S. physalifolium* to act as a host plant for *P. infestans* producing sporangia during the growing season

Workshop on simulating potato late blight in the tropical highlands

A workshop on late blight simulation was held 13-16 April 2004 at the International Potato Center (CIP), Lima, Peru. Participants included Jorge Rivadeneira (INIAP, Instituto Nacional de Investigaciones Agropecuarias, Ecuador), Peter Kromann and Arturo Taipe (CIP, Ecuador), Jeni Barboza, Henry Juarez, Wilmer Perez and Rubi Raymundo (CIP, Lima), and Tomas Melgarejo (UNALM, Universidad Nacional Agraria La Molina, Lima). Jorge Andrade-Piedra (Cornell University) and Greg Forbes (CIP, Lima) coordinated the workshop. The participants became familiar with a version of the LATEBLIGHT simulator (Bruhn and Fry, 1981, Phytopathology 71:612–616) adapted for the tropical highlands by Andrade-Piedra et al. (*in preparation*). The topics included collection of data in the field, preparation of data for the simulator, selection of parameters, validation of data produced by the simulator and analysis of results.

and oospores for survival between growing seasons may increase the problems of controlling late blight in potato in Sweden.

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Root and foot rot on tomato caused by *Phytophthora infestans* detected in Belgium

Lievens B, Hanssen I R M, Vanachter A C R C, Cammue B P A and Thomma B P H J. 2004. Plant Disease 88:86.

In January 2003, a severe root and foot rot was observed on 2-month-old wilted tomato (*Lycopersicon esculentum* Mill.) plants in a large-scale (2.5 ha) commercial greenhouse setting in Belgium. Tomato plants (10%) produced from healthy nursery-grown seedlings and planted to new, clean rockwool and drip irrigation with UV-disinfected water developed symptoms. Symptom development was restricted to lower plant parts with severe rotting of the entire root system and dark lesions girdling the stem base. No symptoms of disease were observed on the foliage or upper stems. Cross sections of the stem base revealed brown discoloration of internal tissue, including the vascular tissue and pith. Dark brown lesions also occurred on the roots. Sections of the stem base, the upper roots (sampled near to the stem base), and the lower roots (sampled on roots deeper in the rockwool) were plated separately on corn meal agar. The oomycete pathogen *Phytophthora infestans* (Mont.) de Bary was identified in each sample on the basis of morphological characteristics observed directly with light microscopy. Branched sporangiophores with slight swellings and characteristic lemon-shaped sporangia (35 x 20 µm and ratio length/width of 1.75 µm) at their tips were obvious after incubation in darkness at 24°C. Oospores and chlamydospores were not observed. After multiple soil treatment with oomycete-specific fungicides, the plants recovered. Since the occurrence of *P. infestans* on roots is unusual, the identity of the pathogen on the diseased plant tissues was confirmed with three techniques, DNA array identification, internal transcribed spacer (ITS) sequencing, and a polymerase chain reaction (PCR) amplification using *P. infestans*-specific primers. DNA was directly processed from separate samples of upper and lower root and stem base tissue. The DNA array used was originally developed to detect and identify the key fungal pathogens of tomato (2). Among detector probes for other tomato pathogens, this array contains oligonucleotide detector probes for *P. infestans* (PIN1: 5′-GGT TGT GGA CGC TGC TAT T and PIN2: 5′-AAT GGA GAA ATG CTC GAT TC). These probes are based on ITS sequences (ITS I and ITS II). Using conserved ribosomal primers OOMUP18Sc (5′-TGC GGA AGG ATC ATT ACC ACA C) and ITS4, oomycete DNA was amplified by PCR and simultaneously labeled with alkaline-labile digoxigenin (2). All generated amplicons strongly hybridized to the oligonucleotide detector probes for *P. infestans* and not to any other pathogen-specific detector probe present on the array. The pathogen could not be detected in roots and stem bases of symptomless plants. In addition, the ITS-region was sequenced and showed 100% homology with multiple GenBank accessions of *P. infestans* sequences. As a third confirmatory test, a PCR was performed on DNA extracts from infected root and stem base tissues using a primer set specific to *P. infestans* (O8-3/O8-4 [1]). A band of the expected size was produced for the infected stem base and root samples. Until now, this pathogen was known worldwide to cause late blight on potatoes and tomatoes. To our knowledge, this is the first report of root and foot rot of tomato caused by *P. infestans*.

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Soilborne oospores of *Phytophthora infestans* in central Mexico survive winter fallow and infect potato plants in the field

Fernández-Pavía S P, Grünwald N J, Díaz-Valasis M, Cadena-Hinojosa M and Fry W E. 2004. Plant Disease 88:29-33.

Survival and infectivity of oospores in soils naturally infested with *P. infestans* oospores were studied in central Mexico. Sporangia were selectively eliminated from soil samples to determine infectivity attributable to the presence of oospores. Selective elimination of sporangia was achieved by two cycles of wetting and drying the soil. Oospore concentration, viability, and infectivity varied among soils collected during the winter fallow in different locations of central Mexico. In some soils, oospores were infective regardless of the time at which they were collected during the winter fallow. However, oospore viability and infectivity decreased following 2 years of intercropping. The number of stem lesions and initial disease severity were significantly higher in soils with moderate (20 to 39 oospores g^{-1} soil) oospore infestation compared with soils with low (0 to 19 oospores g^{-1} soil) infestation. Our study confirms that oospores can survive winter fallow and serve as a source of primary inoculum in the central highlands of Mexico. Oospore survival appeared lower in the Toluca Valley soil, which may be an indication of soil suppressiveness.

The ALAP Congress

Marcelo Huarte, Coordinator of the Potato Subprogram at INTA, Balcarce, Argentina and a member of the GILB Steering Committee, was elected president of the Latin American Potato Association (ALAP, Asociación Latinoamericana de la Papa) during their XXI Congress held 7–12 March 2004 in Valdivia, Chile. Greg Forbes, GILB Coordinator, gave a talk at this congress describing GILB accomplishments to date. Approximately 40 participants attended this session. A poster describing the new GILB website generated substantial enthusiasm for the quantity and breadth of information available. Participants suggested that this information be available in printed form, as many of them lack Internet access. They wanted to know how GILB could provide: 1) training, especially in pathogen characterization, 2) resistant materials and 3) strategies for integrated disease management. They were in favor of revitalizing the Latin American GILB regional group, which was formed at GILB'99, and has met since at the ALAP Congress 2000 held in La Habana, Cuba; the ALAP Congress 2002 in Quito, Ecuador; and at GILB 2002 in Hamburg, Germany.

Tolerance of mycelium of different genotypes of *Phytophthora infestans* to freezing temperatures for extended periods

Kirk W W. 2003. Phytopathology 93:1400-1406.

Mycelium of *Phytophthora infestans*, the causal agent of potato late blight, can initiate crop infections over successive years by overwintering in infected potato tubers that survive as seed in fields or within cull piles. This study used four different genotypes of *P. infestans* to evaluate the influence of freezing temperatures on survival of mycelium in vitro. Sporangium-free mycelium of *P. infestans* US1, US8, US11, and US14 growing on rye agar plates was exposed to temperatures ranging from -20 and 0°C (experiment A) for different periods up to 24 h and from -5 and 0°C (experiment B) for periods up to 5 days. Cultures were incubated at 12°C after exposure, and survival of the cultures was estimated after 28 days by a digital image analysis technique that measured the average reflectance intensity (ARI) of images of the mycelium of temperature-treated cultures. The ARI values of treated cultures were compared with the growth of mycelium in negative controls (mycelium not present) and positive controls (mycelium exposed to 12°C for an equivalent period), and determination of recovery was based on statistical differences from the controls. There were significant differences in ARI values among genotypes, temperature treatment, and exposure periods in all experiments. An index of recovery was calculated for each genotype at all treatment temperatures and exposure periods for both experiments. In experiment A, exposure of mycelium of *P. infestans* (all genotypes) to -20 and -10°C proved lethal for exposure periods of more than 1 h. All genotypes showed some degree of recovery up to 24-h exposure at -5 and -3°C. In both experiments, exposure of mycelium of *P. infestans* to 0°C was not lethal to any genotype tested for any exposure period. In experiment B, all of the genotypes survived exposure up to 3 days at -3°C to some degree, but at -5°C, exposure of 1 day was lethal to all genotypes. Tolerance of freezing temperatures by mycelium of *P. infestans* may be an ecologically important survival mechanism and the increased tolerance of US8 and US14 may explain their predominance in cooler climates such as north-central United States.

A *Phytophthora infestans* G-protein ß subunit is involved in sporangium formation

Latijnhouwers M and Govers F. 2003. Eukaryotic Cell 2: 971–977. © 2003 American Society for Microbiology

The heterotrimeric G-protein pathway regulates cellular responses to a wide range of extracellular signals in virtually all eukaryotes. It also controls various developmental processes in the oomycete plant pathogen *Phytophthora infestans*, as was concluded from previous studies on the role of the G-protein α –subunit PiGPA1 in this organism. The expression of the *P. infestans* G-protein ß-subunit gene *Pigpb1* was induced in nutrient-starved mycelium before the onset of sporangium formation. The gene was hardly expressed in mycelium incubated in rich growth medium. The introduction of additional copies of *Pigpb1* into the genome led to silencing of the gene and resulted in transformants deficient in PiGPB1. These *Pigpb1*-silenced mutants formed very few asexual spores (sporangia) when cultured in rye sucrose medium and produced a denser mat of aerial mycelium than the wild type. Partially *Pigpb1*-silenced mutants showed intermediate phenotypes with regard to sporulation, and a relatively large number of their sporangia were malformed. The results show that PiGPB1 is important for vegetative growth and sporulation and, therefore, for the pathogenicity of this organism.

A Gα subunit controls zoospore motility and virulence in the potato late blight pathogen *Phytophthora infestans*

Latijnhouwers M, Ligterink W, Vleeshouwers V G A A, van West P and Govers F. 2004. Molecular Microbiology 51: 925-936. © 2003 Blackwell Publishing Ltd.

The heterotrimeric G-protein pathway is a ubiquitous eukaryotic signaling module that is known to regulate growth and differentiation in many plant pathogens. We previously identified *Pigpa1*, a gene encoding a G-protein α subunit from the potato late blight pathogen *Phytophthora infestans. P. infestans* belongs

The New GILB website

In an effort to reach the goal stated in the Hamburg Conference (GILB '02) of having the best portal to late blight information on the web, GILB coordination has developed a new website **[http://gilb.cip.cgiar.org]** based on state-of-the-art, user friendly, open source technology called PHP-Nuke. We hope the new website will be much more flexible and allow for more frequent information updates! To start, we ask for your input on these two features.

New Member Search Facility. We're hoping to make this the WHo's WHo of late blight research and development. If you want to know who is interested in late blight in any part of the world, this is the place to start. Check it out here and let us know of any missing names. Also please confirm your own information. If any modifications are due, you can do it yourself by logging in using your first initial and last name together (ej.Tom Jones would be tjones) and the Password is "users" (without the parenthesis).

How to Resources. We'd like this to be a good starting point on late blight management, field work, lab work, etc. Check it out and give us feedback, information and new links.

Thank you!!

Mini-symposium on late blight management

The International Potato Center (CIP) and GILB sponsored a mini-symposium on late blight management at CIP Headquarters, Lima, Peru, on 20 April 2004. Fifty-two participants from Peruvian universities and from the national potato program and plant quarantine laboratory attended. Greg Forbes, GILB Coordinator from CIP, gave a short overview of GILB. Dani Shtienberg from the Department of Plant Pathology, ARO, the Volcani Center, Israel, presented some intriguing results of research on developing means to cope with late blight in organic production of tomatoes with reduced rate of copper compounds. Jorge Andrade-Piedra from Cornell University described the modification, validation and qualification of the pathogen sub-model of the LATEBLIGHT simulator. LATEBLIGHT was developed in the early 1980's at Cornell University and has been extensively used to generate and test hypotheses about the epidemiology of potato late blight in the temperate region. The modifications were made to accommodate the diverse environmental conditions that occur in the dramatically rugged topography of the tropical highlands. The resulting version of LATEBLIGHT can accurately predict the effect of weather and host resistance on late blight epidemics. For more information see Research/Disease Management/Epidemiology and Disease Simulation on the GILB website at http://gilb.cip.cgiar.org.

to the class oomycetes, a group of organisms in which signal transduction processes have not yet been studied at the molecular level. To elucidate the function of *Pigpa1*, PiGPA1-deficient mutants were obtained by homology-dependent gene silencing. The *Pigpa1*-silenced mutants produced zoospores that turned six to eight times more frequently, causing them to swim only short distances compared with the wild type. Attraction to the surface, a phenomenon known as negative geotaxis, was impaired in the mutant zoospores, as well as autoaggregation and chemotaxis towards glutamic and aspartic acid. Zoospore production was reduced by 20-45% in different *Pigpa1*-silenced mutants. Transformants expressing constitutively active forms of PiGPA1, containing amino acid substitutions (R177H and Q203L), showed no obvious phenotypic differences from the wild-type strain. Infection efficiencies on potato leaves ranged from 3% to 14% in the *Pigpa1*-silenced mutants, compared with 77% in wild type, showing that virulence is severely impaired. The results prove that PiGPA1 is crucial for zoospore motility and for pathogenicity in an important oomycete plant pathogen.

Agrobacterium tumefaciens mediated transformation of the oomycete plant pathogen _Phytophthora infestans_

Vijn I and Govers F. 2003. Molecular Plant Pathology 4:459-467. © 2003 Blackwell Publishing Ltd.

Agrobacterium tumefaciens is widely used for plant DNA transformation and, more recently, has also been used to transform yeast and filamentous fungi. Here we present a protocol for *Agrobacterium*-mediated DNA transformation of the oomycete *Phytophthora infestan*, the causal agent of potato late blight. Binary T-vectors containing neomycin phosphotransferaxe (*npt*) and ß-glucuronidase (*gus*) fused to oomycete transcriptional regulatory sequences were constructed. Seven days of co-cultivation followed by transfer to a selective medium containing cefotaxim to kill *Agrobacterium* and geneticin to select for transformants, resulted in geneticin resistant colonies. Under optimal conditions with *Agrobacterium* supplemented with a ternary plasmid carrying a constitutive *vir*G gene and in the presence of acetosyringone as inducer, up to 30 transformants per 10^7 zoospores could be obtained. The majority of these transformants contained a single T-DNA copy randomly integrated at a chromosomal locus. Using a similar protocol, geneticin resistant transformants of two other other oomycetes species were obtained, *Phytophthora palmivora* and *Pythium ultimum.*

Oomycetes and fungi: similar weaponry to attack plants

Latijnhouwers M, de Wit P J G M and Govers F. 2003. Trends in Microbiology 11: 462-469. © Elsevier Ltd.

Fungi and Oomycetes are the two most important groups of eukaryotic plant pathogens. Fungi form a separate kingdom and are evolutionarily related to animals. Oomycetes are classified in the kingdom *Protoctista* and are related to heterokont, biflagellate, golden-brown algae. Fundamental differences in physiology, biochemistry and genetics between fungi and Oomycetes have been described previously. These differences are also reflected in the large variations observed in sensitivity to conventional fungicides. Recently, more pronounced differences have been revealed by genomics approaches. However, in this review we compare the mode of colonization of the two taxonomically distinct groups and show that their strategies have much in common.

The ***GILB Newsletter*** is distributed in print and electronic formats to selected members in the scientific community, including GILB collaborators, researchers ad donors. Past and current issues of the Newsletter are also available on the GILB homepage of the International Potato Center (CIP) website at http://gilb.cip.cgiar.org

The objective of the newsletter is to facilitate and increase communication and cooperation among persons and organizations working to combat *Phytophthora infestans*, the causal agent of potato late blight disease.

Please consider sharing a brief write-up on your current work related to late blight with other GILB Newsletter readers. Short articles (250 words or less) are particularly welcome, as are news items, notices of coming events, and summaries of research underway.

Direct submissions or comments to GILB Editorial Committee members: Edward French, Charlotte Lizarraga or Greg Forbes through the general GILB newsletter E-mail address (GILB@cgiar.org).

Potato Web Links

Agriculture Network Information Center
www.agnic.org
Agronomic Links Across the Globe
www.agry.purdue.edu/links
American Phytopathological Society
www.apsnet.org
APSnet, Plant Pathology On-Line
www.apsnet.org/online/feature/lateblit/
CRP-Gabriel Lippmann CREBS, Luxembourg
www.crpgl.lu/fr/index.php3
Cornell-Eastern Europe Mexico Potato Late Blight Project (CEEM)
www.cals.cornell.edu/dept/plantbreed/CEEM
EUCABLIGHT (Potato Late Blight Network for Europe)
www.eucablight.org/EucaBlight.asp
European Association of Plant Breeders (EUCARPIA)
www.eurcarpia.org
European Association for Potato Research (EAPR)
www.agro.wau.nl/eapr
Global Potato Focus
www.potatofocus.com
Global Potato News
www.potatonews.com
Idaho Plant Disease Reporter/Late Blight
www.uidaho.edu/ag/plantdisease/lbhome.htm
Integrated Management of Late Blight on Potatoes
www.gov.mb.ca/agriculture/crops/diseases/lateblight/index.html
Integrated Management of Late Blight on Potatoes (PMRA, Canada)
www.hc-sc.gc.ca/pmrarlala/english/pdf/spm/spm_s9602-e.pdf
International Center for Genetic Engineering & Biotechnology (ICGEB)
www.icgeb.trieste.it/biosafety
International Potato Center (CIP)
www.cipotato.org
Maine Potato Board
www.mainepotatoes.com
Malheur Experiment Station. Potato Late Blight
www.cropinfo.net/Potatoblight.htm
Michigan State University
www.lateblight.org/
Minnesota Certified Seed Potato Growers Association
www.mnseedpotato.org/
Monsanto
www.monsanto.com
National Potato Council
www.npcspud.com
New Agriculturist
www.new-agri.co.uk
North American Potato Late Blight On-line Workshop
www.apsnet.org/online/lateblite/
North Dakota Pesticide Quarterly
www.ext.nodak.edu/extnews/pestqtrly
Oregon State University
http://plant-disease.oregonstate.edu/index.htm
PICTIPAPA
http://ppathw3.cals.cornell.edu/Fry/pictipap.htm
Plant Pathology Internet Guide Book
www.ifgb.uni-hannover.de/extern/ppigb/
Potato Association of America
www.ume.maine.edu/PAA
Potato Engine
www.potatoengine.com/thinkpotato.html
Potato Information Exchange
www.css.orst.edu/potatoes/main.htm
Potato Research Online
www.potatonews.com/potatoresearch.asp
Red Electrónica de la Papa Redepapa)
http://redepapa.org
Plant Research International
www.plant.wageningen-ur.nl
Resource Center, Cornell University
www.nysipm.cornell.edu/
Scottish Agricultural College (SAC)
www.sac.ac.uk
Scottish Crop Research Institute (SCRI)
www.scri.sari.ac.uk/trial/
Universidad Agraria La Molina, Peru
www.lamolina.edu.pe/investigacion/programa/papa
University of Idaho
www.uidaho.edu/ag/plantdisease/plbstem.htm
University of Florida. Late Blight On Potatoes And Tomatoes.
http://edis.ifas.ufl.edu/scripts/htmlgen.exe?DOCUMENT_VH008
University of Wisconsin
www.hort.wisc.edu/usdavcru/
Wageningen University
www.wau.nl
World Potato Congress
www.potatocongress.org/

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