

was hampered by difficulty in finding good fields in which to work. If you will be planting peppers in an area where you have had a symphytan problem in the past and are willing to cooperate in a trial, please call Chaney at 831-759-7359 or Dlott at 759-7374.

Financial Report

At the 2005 annual meeting the Commission changed their fiscal year to begin March 1st and end February 28th. The old year ran from May 1st through April 30th. Due to that change, the following report represents a ten month period.

Fiscal Year: May 1, 2004 thru February 28, 2005

INCOME	
Carry-over from 2003-2004	\$153,428
Assessment Income, 2004-05	114,335
Interest Income	<u>3,201</u>
Total Income	\$270,964
EXPENDITURES	
Management Services	29,000
Legal Counsel	1,237
Audits	1,611
Office Supplies	598
Telephone	1,107
Postage	954
Reports & Publications	88
Travel & Mileage	5,298
Meetings	322
Insurance & Taxes	415
Marketing Branch	7,342
Ca Minor Crop Council	5,500
Production Research	80,491
Chemical Research	<u>12,396</u>
Total Expenditures	\$ 146,359
Carry-over to 2005-06	<u>124,605</u>
Total Expenses & Reserve	\$ 270,964

California Pepper Commission 2004-07 Producer Representation

MEMBERS	DISTRICT	ALTERNATES
Burt Silva <i>Baraga Ranch</i> King City	1	Peter Iverson <i>Anthony Farms</i> King City
Ryan Talley <i>Talley Farms</i> Arroyo Grande	2	Danny Pereira <i>Rio Farms</i> Oxnard
Mike Chuck <i>Chuck & Frasseti Fms</i> Gilroy	3	Dan Fiorio <i>Dan-Rich Fmg</i> Gilroy
Fred Podesta Jr. <i>Podesta Farms</i> Linden	4	Bob Giampaoli <i>Live Oak Farms</i> Le Grand
Richard Bradford <i>Sterling Ag Group</i> La Quinta	5	Abel Balderrama <i>Prime Time Int</i> Coachella

Handler Representation

Dave Veneman <i>Eckert Cold Stg</i> Escalon	Bell Pepper Processing Frozen/Dehy	Mark Thompson <i>Eckert Cold Stg</i> Escalon
Daniel Brotslaw <i>Sensient Dehydrated</i> Turlock	Chili Pepper Processing Frozen/Dehy	Mark Edsall <i>Gilroy Foods</i> Modesto
Glen Fischer <i>Saticoy Foods</i> Ventura	Bell/Chili Pepper/Other Processing	Jerry Hensley <i>Saticoy Foods</i> Ventura
Tim Baloian <i>Baloian Packing</i> Fresno	Fresh Pepper Handler	Edward Chell <i>Sun Rise Farms</i> Camarillo
Terry Berke <i>Seminis Seed</i> Woodland	Pepper Seed Handler	Bob Heisey <i>United Genetics</i> Hollister

Public Representative

Dave Nirenberg, Camarillo, *The University Corporation, California State, Northridge*



Pepper News

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April, 2005

Pepper Commission Continued

Glen Fischer, Saticoy Foods
Chairman, California Pepper Commission

In January and February of 2004 the California growers and handlers of peppers were asked to vote in a continuation referendum. The continuation referendum is held every five years and determines whether the Commission is meeting the needs of the industry and should be continued. Producers voted overwhelmingly in support, with a 73% favorable vote. Of the handler volume voted, 91% voted in favor of continuation of the Commission.

With the strong backing of the industry, the new Commission met in February, 2004 (see roster, back page) for the annual meeting to determine which research areas to support. The Commission met again in February of 2005 to review last years research projects and make decisions on the research for the upcoming year.

The Commission was able to fund these projects without an increase in the assessment rate. (See complete list of current projects on page 7)

This newsletter includes updates on the 2004-05 projects, along with other matters the Commission staff have been working on. As you will read, the Commission has been and continues to be very active on critical issues for the industry.

The Commission is committed to aggressively addressing the research, regulatory, and information needs of the pepper industry.

If you have any questions, suggestions or complaints about anything the Commission is doing, please feel free to call the Commission office at (559) 591-3925. You can speak with Jerry Munson, Commission Manager, or Ken Melban, Director of Crop Protection Services.

Research on Powdery Mildew of Peppers

Mike Coffey, UC Riverside

We are in the second year of a program funded by the California Pepper Commission. Our research covers basic biology and pathology, epidemiology, host range, resistance and fungicides.

Perhaps one of the surprising facts to emerge in the last 18 months was the lack of data on fungicide efficacy against powdery mildew of peppers. Last year we set out to get some good baseline data on different fungicides used as preventive treatments. The research conducted in a screenhouse at UC Riverside involved inoculating pepper plants with spores of an aggressive strain of the mildew fungus two days after initial fungicide treatment.

This year we are simulating the conditions more likely to be met by a grower in the field. Here the initial application of a fungicide may go on after the first sightings of mildew. So we will be inoculating with mildew and then two days later treating with a range of different fungicide products. Our aims are to come up with some good practical insights into which fungicides are effective and also evaluate their limitations. We will also be monitoring field populations of mildew for resistance to fungicides. With other crops in California fungicide resistance to mildew strains is emerging as a problem. Our research will look at the situation in peppers and based on the results obtained, develop strategies to minimize the development of fungicide resistance.

A second aim of our program has been to screen different breeding lines and different Capsicum species for resistance to powdery mildew. Last year we identified several pepper lines with near immunity to the disease. Our research on this is continuing this year. In the long-term high resistance to powdery

mildew, especially durable resistance that is not strain-specific, can be a major tool in combating the disease.

We have little knowledge of how environmental conditions influence the development of powdery mildew in peppers. What are the temperatures and relative humidity conditions that favor development? What factors, especially temperatures, inhibit development? Using temperature/relative humidity controlled environments we are seeking answers to some of these questions. The purpose of this work is to accurately define the weather conditions that may trigger the onset of mildew and favor or inhibit its further development. Ultimately, we hope to develop accurate disease forecasting systems that will allow the grower to determine if or when to apply fungicides. The advantages of such effective disease management programs are in reducing the need for costly fungicide applications when mildew is not a threat.

Where does pepper powdery mildew come from? How does it survive between crops? Are the strains on pepper different from those on tomato or asparagus? Are there important weed hosts that can harbor the pathogen between pepper crops? How diverse are the strains of pepper powdery mildew. Are we dealing with one or many distinct strains? These are some of the additional questions we are trying to answer. The results of this work should improve our capacity to control this troublesome pepper disease.

Rally Future Still Uncertain

As reported in last year's newsletter, a full registration of the fungicide Rally is being delayed based on the Environmental Protection Agency's (EPA) review of Triazole, one of the materials found in Rally. We had hoped this review would be completed by the end of 2004, but that was not the case. Ken Melban, Commission staff, traveled to Washington D.C. in February and met with EPA officials regarding the status of Rally. They indicated the review is moving along, and stated the outcome looks favorable for the continued use of Rally.

The current Section 18 will expire on May 31, 2005. The Commission submitted a renewal application in January and as of this publication EPA has indicated they will approve the application in late May, which will prevent any gap in usage. The

Commission attempted to have the rotation requirement changed. It currently requires the use of a Strobilurin (Cabrio, Flint, or Quadris) prior to a Rally application; our request was to allow for the Rally application to be first in the rotation, but we were unsuccessful in our attempt for this change. We are continuing to work on this situation and will keep you informed if anything changes.

Treating for Powdery Mildew

Growers and Pest Crop Advisors need to be aware of some timing concerns regarding the use of fungicides to control powdery mildew. As discussed in the article above, the Section 18 label for Rally is very prescriptive and reads as follows: "when sulfur can no longer be used due to temperature, one of the following fungicides, Quadris, Flint, or Cabrio shall first be used at the highest recommended use rate. If further applications are necessary, Rally shall be used as the next treatment, followed by a second application of Quadris, Flint, or Cabrio at the maximum use rate, followed by a second application of Rally, if needed."

If the cycle of the Strobilurin's (Quadris, Flint, or Cabrio) followed by Rally is begun too soon in the season, and powdery mildew pressure continues late into the fall, there may be no lasting activity from the Rally. As in the past, you should continue to use sulfur early in the season until high temperatures become a concern.

Potential New Fungicide

The Commission is in discussions with Dow AgroSciences regarding their new fungicide Quintec (Quinoxifen). Quintec provides a different mode of action from Rally, and if effective could be used in rotation. The Commission is looking to facilitate two to three acre-size trials this year evaluating Quintec as a stand-alone. If Quintec is effective, the Commission would then work to expedite its registration.

17th International Pepper Conference

In November, 2004, Commission Chairman Glen Fischer (Saticoy Foods) and members Terry Berke (Seminis Seed), Bob Heisey (United Genetics) and Dave Venemen (Eckert Cold Storage), along with staff member Ken Melban attended the 17th

We found large populations in plantings of fresh market tomatoes in San Diego County, Orange County, and as far north as Hollister, California this year.

Remarkably little is known about monitoring, economic injury levels (numbers of insects per plant that result in crop loss), alternative pest control strategies, or plant resistance to the psyllid or the toxin. Al-Jabar (1999), studied monitoring and control of the psyllid in greenhouses and showed that yellow, orange or green sticky traps will catch psyllids. He also determined that a trap placement near the tops of the plants is optimal. So, at the current time, yellow sticky cards can be used as an early indicator of psyllid movement into an area, and plants on the field margins can be visually checked for eggs and nymphs.

Naturally occurring biological control of the psyllid has not been studied in detail under California conditions, but the potential may not be great as beneficials have not proven effective elsewhere for suppression.

Relatively few reports are available on control using chemicals other than organophosphates or pyrethroids. We know that use of these materials in California causes a loss of biological control agents, resulting in outbreaks of secondary pests such as *Liriomyza* leafminers and spider mites. Most reports indicate that carbamates cause psyllid populations to increase, so these materials should be used with caution if psyllids are present. We have a large field trial planned in 2005.

References – Al-Jabar, A. 1999. Integrated pest management of tomato/potato psyllid. *Paratrioza cockerelli*
Wallis, R. L. 1955. Ecological studies on the potato psyllid as a pest of potatoes. USDA Tech.

Research Update on Symphylan Work in Peppers

William Chaney and Franklin Dlott, Monterey County

Symphylans have been an increasing problem in recent years for pepper growers, especially in the Hollister/San Juan area. By their nature, they are not only difficult to see but their biology is not well understood. We have a good sampling procedure that allows us to measure changes in symphylan populations with confidence. This is critical to assessing the impact of our candidate management options.

Since populations of these pests usually appear in the same fields year after year, identifying such fields with cooperative growers is key. Many, if not all, candidate management options will be pre-plant. If symphylans do not appear after the pre-plant efforts are made, the research effort is lost. From our observations, it is clear that relatively small plots can be used for chemical treatments, and slightly larger plots may be necessary to tillage options.

Pyrethroids show effectiveness against these pests, but the method of application still needs to be refined. Because pyrethroids adhere tightly to the soil, incorporation of some type will be necessary unless they can be placed below the seed. Last year's work

List of projects funded by the Commission for Fiscal Year 3/1/04 – 2/28/05:

Project	Researcher	Funding
1. Garden Symphylan Management	Bill Chaney	\$2,400
2. Biology and Control of Powdery Mildew of Pepper	Mike Coffey	30,000
3. Breeding for CMV tolerance in an OP bell pepper type	Molly Jahn	27,500
4. Evaluation of new fungicides as a potential management tool for <i>Phytophthora</i>	Michael Matheron	6,000
5. Tomato Spotted Wilt Research (Characterization of resistance-breaking strains from CA)	Jim Moyer	5,000
6. Evaluation of Field Isolates of <i>Phytophthora</i> for Resistance to Fungicides	Jim Prince	6,500
7. Pre-emergent Weed Control Trials	Richard Smith	8,360
8. Insect Pest Management (Control methods for psyllids)	John Trumble	17,000
	Total	\$102,760

pollinated bell pepper types adapted to California production. We have conducted a breeding program to transfer tolerance to *P. capsici* root rot tolerance/resistance from a widely used source of resistance called Criollos de Morelos 334 and Paladin (Rogers/Syngenta variety with crown blight and root rot tolerance) to two varieties selected by the CPIF. During the first year and a half of this program, we made the initial crosses and first backcrosses with Early Cal Wonder 300 and Yolo B. More recently we have worked with Aristotle, Ex Caliber and Baron. In general, we take plants that show resistance or tolerance to disease caused by an isolate of *Phytophthora capsici* from a commercial California production field and we cross those plants to the varieties selected by the CPIF. After the cross is made, the seed is grown, evaluated and selected for type, and self-pollinated before another round of disease screening. We get about two generations per year and have returned breeding lines for evaluation in California under greenhouse screens and in the field.

Section 18 on Oberon*

After over a year since the first application was submitted to the California Department of Pesticide Regulations, the Commission was successful in their application for a Section 18 on the Bayer insecticide Oberon (Spiromesifen). The registration was issued on March 30, 2005 for control of Psyllids and covers the counties of Imperial, Orange, Riverside, San Benito, Santa Clara, and Ventura*. The decision to pursue the registration was based on the increase in Psyllid pressure over the last three years and the fact that there were no effective controls. In response to this continuing pest problem, the Commission is funding a project with Dr. John Trumble, UC Riverside, to determine the efficacy of specific chemistries and to identify cultural practices which might be effective in lessening the population. (See next article).

**As of this publishing, the U.S. EPA had not established a time-limited tolerance for this Section 18. U.S. EPA expects to be able to establish the necessary time-limited tolerance for this use in the near future. However, U.S. EPA's decision to allow this use does not guarantee that a time-limited tolerance will be established at a later date. If residues are found on the commodity, and a time-limited tolerance has not been established, the residue levels will be considered illegal.*

Pepper/Tomato/Potato Psyllid: A New Problem on Peppers in California

John Trumble, UC Riverside

The adult psyllid is a small insect (about 1/8th inch) that resembles a cicada. The adults have white or yellowish markings on the thorax, clear wings, and lines on the abdomen that separate segments.

The eggs are laid on stalks, and look a lot like green lacewing eggs. However, the eggs of the psyllid turn a pink color a few hours after oviposition. The eggs can be laid anywhere on the leaves, but are most common on the undersides and along the leaf margins. Eggs on the leaf margins are easiest to see. A hand lens is useful for observation. The nymphs feed most often on the undersides of the leaves. The larger nymphs have wing buds, which makes them easy to distinguish from whitefly nymphs. In addition, psyllids do not cover themselves with a wax, as is seen with whiteflies and pepper psyllid nymphs can move if disturbed.

In the past two to three years, major outbreaks of the psyllid have occurred. In Ventura County, pepper growers experienced significant losses due to build-up of honey dew and sooty mold on the fruit. The problem appears to be increasing in both geographic scope and economic importance.

Our research has recently shown that the psyllids occurring in California and Baja Mexico are genetically different than the populations occurring in the Central USA and eastern Mexico. This means that the chemical studies conducted in the rest of the USA may not apply in California. However no data are available on thresholds causing psyllid damage on current commercial pepper varieties, but tomatoes and potatoes are damaged by as few as 30 nymphs per plant. The rapid developmental times coupled with a maximum oviposition in excess of 1400 eggs/female allows populations to build explosively. These pests also have an extensive range of acceptable hosts, including species in 20 plant families, but solanaceous species (tomatoes, potatoes, nightshade) are preferred (Wallis 1955). The lack of information on reliable monitoring techniques makes early detection of these insects very difficult, leading growers in many areas to apply prophylactic pesticide treatments.

Given the recent outbreaks in California, we believe populations in California originated in Baja, Mexico, but appear to be overwintering in Ventura.

International Pepper Conference in Naples, Florida. The Conference brought together those with an interest in the current status of pepper research, extension and technology. Over 350 attendees listened to presentations on such topics as: Breeding and Genetics (germplasm evaluation and utilization, crop physiology and technology), Horticultural Management and Production (production methods, cultural systems and sustainable approaches), Integrated Pest Management (insect and disease management, biological control), and Post Harvest Issues (post harvest physiology and technology, economics, marketing and trade).

Melbangave a short presentation on California pepper production and the California Pepper Commission (CPC). He covered current research projects and discussed needed research, and from that presentation the CPC received a proposal from Mike Matheron of Arizona State. The project is entitled *Evaluation of new fungicides as a potential management tool for Phytophthora*.

California to Host Eighteenth International Pepper Conference

As reported in the previous article, a contingent of Commission members attended the 17th International Pepper Conference in Naples, Florida, in November of 2004. Based on that involvement, California was successful in our bid to host the conference in 2006. The conference is held every 18 months, and is preliminarily scheduled to be held in May, 2006, in the Palm Springs area.

The tentative schedule will have presentations on the first day and field/greenhouse/research tours on the second day. This is a great opportunity to showboat the advances in California pepper production and research, along with gaining information from researchers worldwide. We hope you will plan now to join us for this great event.

Managing Pepper Diseases by Breeding for Resistance

Bob Heisey, Pepper Breeder, United Genetics Seed Research Chairman, California Pepper Commission

Managing pepper diseases by the use of genetic resistance, if such resistance is available, is

usually the simplest and most cost-effective method of disease control. However, years of research and thousands of research dollars are spent in finding, characterizing, and introgressing these resistances. Breeders, pathologists, and technicians work to bring these resistances from unadapted, sometimes wild relative species into types with the proper horticultural type for the California pepper industry.

Currently our pepper breeding program is developing varieties of sweet and hot peppers with resistance to five major diseases that affect pepper crops in the Coastal area of California: Tomato Spotted Wilt Virus, (TSWV) vectored by thrips; Cucumber Mosaic Virus (CMV), vectored by aphids; *Phytophthora* Root and Crown Rot, caused by *Phytophthora capsici*; Verticillium Wilt, caused by *Verticillium* species; and Powdery Mildew, caused by the fungus *Leveillula taurica*.

To develop improved varieties with the desired resistance we need 1) a method of inoculation of the disease onto the breeding lines to differentiate resistant from susceptible plants, 2) a source of resistance, usually a wild or relative species of the cultivated pepper plant, and 3) adapted lines or varieties to use as parents in the breeding process so as to end up with acceptable resistant varieties. Regarding each of the diseases mentioned above, I will describe the methods, progress, and timetable for our breeding efforts.

TSWV – Currently there are varieties available with resistance to TSWV, "Heritage" and "Stiletto", however they are not adapted to California. The resistance to TSWV is inherited as a single dominant gene, so the resistance is easily transferred. However, the inoculation process is not so easy, with many "escapes" in our screens. Screening by "molecular markers" is also not very effective. Fortunately we have a nearly endless supply of inoculum in the Gilroy area each year.

CMV – The original resistant lines are from Asia and from wild species. Although the inoculation procedure is fairly simple and effective, the resistance appears to be multigenic, with penetrance problems in addition. There may also be linkages with small fruit size. The California Pepper Commission funded work during the mid 90s with Cornell University to characterize and introgress the resistance. We are cooperating with the CPC and Cornell to move the

resistance into better types.

Phytophthora Root Rot – There are currently several varieties with fair to good levels of resistance and decent fruit type, including "Paladin" and "Aristotle". However, neither of these has been accepted in California. The inheritance of resistance is complex and multigenic; probably the resistance will have to be homozygous (both parents of a hybrid) to be effective in CA. The screening technique is time-consuming, although not technically difficult. It requires experienced pathology support.

Verticillium Wilt – Verticillium wilt is a complicated disease. We think we have found a decent source of resistance, but the inheritance of the resistance is not clear. We will need to do more work this year to confirm the resistance, and refine our inoculation and screening technique. So far the results have looked promising, and the source of resistance is easily crossed with cultivated peppers.

Powdery Mildew – There are many sources of resistance to PM according to work done by Dr. Mike Coffey at UC Riverside. This research was funded by the Pepper Commission. However, most of the sources are wild relative species which cannot be crossed easily with cultivated peppers. We are working with one source of resistance we got from a breeder from outside the US, which is close to a bell pepper in type. Dr. Coffey's screens indicate that the resistance of this line holds against our local isolates of PM, however we need to confirm that this year in the field. This resistance is supposedly inherited as a dominant gene.

Several other diseases which are generally not serious problems in the Central Coast area can also be controlled with the use of genetic resistance. **TMV**, Tobacco Mosaic Virus, is a common problem in peppers but generally not under field conditions in CA. **Bacterial spot** is occasionally a problem in transplant nurseries and fields which are irrigated by overhead sprinklers, but the disease is usually halted when furrow or drip irrigation is initiated. The **potyvirus** complex Pepper Mottle Virus (PeMV), Potato Virus Y (PVY), and Tobacco Etch Virus (TEV), are vectored by aphids and can occasionally be a problem in our area, but generally the damage is not as severe as with CMV or TSWV. Excellent resistance to PeMV, PVY, and some races of TEV is available in newer varieties, however these diseases are generally

not production-limiting problems.

Although there is hope that many of our major disease problems can be controlled by breeding genetic resistance into adapted varieties, there is a lot of breeding work to be done in the next few years. We also know very little about the variability of the pathogen populations that cause these diseases; the resistance currently available might not hold against our local isolates of these diseases. (For example, there is currently some evidence that the resistance to TSWV can be broken by an isolate collected from fields in this area). To help prevent this from occurring, we at United Genetics are using local isolates in our screening programs, and we re-isolate frequently from diseased plants.

Preemergence Weed Control Trials in Peppers

By Richard Smith and Michelle LeStrange, Farm Advisors in Monterey and Tulare Counties, resp.

Peppers are long-season vegetables that have many weed control challenges. There are notable gaps in the weeds controlled by key preemergence weed control materials and because the season for peppers is long, they can be subject to pressure from cool season weeds and warm season weeds. As a result, it is not uncommon for growers to spend in the range of \$200 to 350/acre in weed control and still have many escaped weeds at the end of the season.

We initiated trials in Santa Clara County (Coastal production district) and Fresno County (Central Valley production district) to examine various pre and post transplant herbicides on peppers. One material tested, Goal 2XL (oxyfluorfen) is currently registered for use 30 days prior to transplanting at 1 to 2 pints per acre. However the soil must be worked to a depth of 2.5 inches prior to transplanting, thus destroying the layer of herbicide on the soil surface. The reason for this requirement is that Goal 2XL can "lift off" from the soil, a process called co-distillation, and can damage the leaves of newly planted peppers.

A new formulation of oxyfluorfen, Goal Tender 4F, has been developed by Dow AgroSciences which has less risk of co-distillation. We have examined its use on shaped pepper beds 15 to 30 days prior to transplanting as is allowed by the current Goal label. We did not work the beds, thereby leaving the herbicide layer intact, and transplanted the peppers

directly into these beds. This use is not currently allowed on the label and would require working with Dow AgroSciences to adjust the label to allow this use pattern. We were encouraged by our 2003 results and expanded the evaluations to the Central Valley to give this technique a more thorough evaluation. In both counties in the 2004 trials, Goal Tender 4F and 2XL at the 0.50 lb a.i./A rate applied 15 to 25 days prior to transplanting provided good broadleaf and grass weed control for the first 30 to 35 days following pepper transplanting.

Dual Magnum (s-metolachlor) received a five year 24C registration through the efforts of the Pepper Commission and was first used by growers in the 2002 growing season. It provided useful weed control on nightshade and yellow nutsedge. Our objective was to examine if Goal could provide weed control for the first 30 days following transplanting and then apply Dual Magnum as a layby application to extend the period of weed control until the crop has a chance to close canopy. In the 2004 trials the combination of Goal (applied pretransplant) + Dual Magnum (applied at layby) looked promising

as an extended season weed control system for peppers. Unfortunately, Dual Magnum is not registered for layby use on peppers at this time, but discussions are underway with Syngenta Corp. to modify the wording of the 24C label to allow this use.

Other layby materials that looked promising included Outlook (BASF Corp.) and this material will be more thoroughly evaluated in 2005. In addition, a granular formulation of flumioxazin called Broadstar (Valent Corp.) looked promising as an over-the-top weed control application at transplanting. Broadstar will not be registered on vegetables, but Valent is supportive of research efforts to evaluate flumioxazin coated fertilizer which can be used in the same way as Broadstar. These data indicate that a viable pretransplant and post transplant system can be achieved in peppers and alleviate early and late season weed control issues. It is hoped that this data can be useful in securing label adjustments and/or registrations for these herbicides on peppers.

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Evaluation of Field Isolates of *Phytophthora capsici* for Resistance to Various Fungicides

James P. Prince, CSU Fresno

Our lab has a collection of 34 isolates of the pepper root and crown rot pathogen, *Phytophthora capsici*, approximately half of which were collected over the last two years from fields in California. The goal of our project was to test our isolates to see how effective various fungicides were at preventing growth and sporulation of the pathogen. The primary fungicide used was metalaxyl (Ridomil). We also used famoxate and cyazofamide.

There is clearly variability for metalaxyl sensitivity in *P. capsici*, ranging from highly sensitive to highly resistant. The isolates that showed the highest degrees of resistance to metalaxyl were collected from the field in California, so growers should be aware that they may increasingly be dealing with pepper root and stem rot that will not respond to this fungicide.

Smaller-scale studies were also done on two additional fungicides, famoxate and cyazofamide. Neither was very good at inhibiting growth of the pathogen, but cyazofamide was highly effective at preventing sporulation. These studies are going to be repeated on a larger scale.

Some greenhouse studies showed us that plants may still harbor the root rot pathogen, even if they don't show symptoms and have been treated with fungicide. This work will also be repeated and expanded.

We will expand our work in this coming year to test four additional fungicides: azoxystrobin (Quadris), dimethomorph (Acrobat), fluazinam, and fosetyl-Al (Aliette).

Improving *Phytophthora* tolerance in open-pollinated pepper varieties for California production

Molly Jahn, Professor, Dept. of Plant Breeding & Genetics, Cornell University

This round of funding concludes our work over the past nearly 4 years for the California Pepper Improvement Foundation (CPIF) and the California Pepper Commission towards the goal of improving tolerance/resistance to *Phytophthora* root rot in open-