

Verticillium are found so that the farm advisor in turn can contact the project leader, thus helping Dr. Subbarao conduct his study.

Commission Report (continued from page 1)

shape, with the income from marketed peppers increasing each of the past two seasons. Over the past four years, in an attempt to be conservative, the Commission has budgeted on the basis of receiving income from the equivalent of 270,000 tons of fresh peppers, which would bring in \$135,000 at the \$.50 per ton rate. However, the actual income during those years has ranged from the low of \$149,772 in 1993-94 to the high of 1992-93's \$171,782 which was the highest income ever recorded by the Commission. Actually, the 1995-96 income missed that high by only \$60, so the Commission has been able to carry over those surpluses from year to year, thus making it somewhat easier to fund the needed research projects.

California Pepper Commission Financial Report

Fiscal Year: May 1, 1995 through April 30, 1996

Account Name	Amount
INCOME:	
Carry-over from 1994-95	\$83,965
Assessment Income, 1995-96 (Based on combined rate of \$.50/ton)	171,723
Prior Year Assessment Credit	(4,179)
Interest	5,382
Total Income	\$ 256,891
EXPENDITURES:	
Management Services	28,800
Audits	1,600
Office Supplies	1,521
Telephone	337
Postage	878
Travel & Mileage	171
Meetings	280
Insurance, Taxes & Bonds	898
Marketing Branch	8,775
Production Research	114,852
Total Expenses	\$ 158,112
Carry-over Reserve to 1996-97	98,779
Total Expenses & Reserve	\$ 256,891

Insofar as the Commission's expenditures during the 1995-96 year were concerned, they were almost entirely within the budget, with the only exception being a slight overrun on Insurance and Taxes. The Commission earned over \$5,300 on its reserve funds, but that and the excess assessment amount was offset to a certain extent by \$4,179 paid out for refunds on prior year assessments due to auditing procedures.

The Commissioners have always prided themselves on squeezing the last ounce of usefulness out of each dollar collected from the industry, and last year they were able to show that 72.9% of the Commission's expenses went

directly to research projects, with only about 27% spent on overhead items, which include the management, as well as the State's monitoring of the Commission's activities.

During the 1995-96 year, the Commission funded seven research projects costing a total of \$114,852, and the layman's reports for those projects are included with this report. Anyone wanting copies of the full, technical report can obtain a copy by calling the Commission office.

1995-98 Pepper Commission

Producer Representatives

Members		Alternates
District 1		
Burt Silva King City 408/385-1428		Marvin Borzini King City 408/385-5441
District 2		
Frank Luenser Arroyo Grande 805/489-2508		Chris Darway Arroyo Grande 805/489-1817
District 3		
Mike Mantelli Gilroy 408/848-9228		Fred Rohnert Hollister 408/636-4898
District 4		
Bob Giampaoli Le Grand 209/389-4576		Joe Marchini Le Grand 209/389-4528
District 5		
Randy Johnston Lemoore 209/924-5339		Richard Bradford Coachella 619/398-6187

Public Representative

Don Nelson Modesto 209/527-8444	VACANT
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Handler Representatives

Members	Alternates
Bell Pepper Processors	
Tom Busenbark Modesto 209/538-5437	Dave Veneman Manteca 209/823-3181
Dehydrated Chili Processors	
Steve Banta King City 408/385-5406	Paul Gniffke Greenfield 408/674-5571
Other Pepper Processors	
Glen A. Fischer Saticoy 805/647-5266	VACANT
Fresh Market Pepper Handlers	
Chuck Filice Hollister 408/637-7491	Tim Baloian Fresno 209/485-9200
Pepper Seed Handlers	
Robert Heisey San Juan Bautista 408/623-4554	Ken Owens Woodland 916/666-0931



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- ANNUAL REPORT ISSUE -

Commission Report

This annual report marks the end of the seventh successful year of the Commission's existence. With a report to the industry issued only annually, a lot can happen during the year regarding personnel on the Commission, and this past year was no exception. In comparing this annual report to last year's, it is rather obvious that while most of the same Commissioners are still serving, job changes, attrition and the nomination meetings held just prior to the 1994-95 year have all caused us to lose several Commissioners who had served the industry faithfully for several years.

The Commission roster printed in this issue shows that former Producer members or alternates Mike Mondelli and Tom Obata of Gilroy, Carl Lindgren of Irvine, and the previous public representatives, David Ferguson and Ken McCorkle of Fresno are no longer serving on the Commission. Also missing from the current roster are former Handler Members or Alternates George Stuit of Manteca, Jerry Schwab of Gilroy, and Fred Podesta, Jr. of Linden, while former Handler Member Don Nelson of Modesto is now serving as the Commission's Public Member--as well as Chairman of the Research Committee.

Further changes in the Board structure have shown Steve Banta replacing Paul Gniffke as Chairman for the 1995-96 year after Gniffke served a one-year term, while Jerry Munson replaced Dana Dickey as Manager last June. Since Banta and Munson were in those respective positions during the Commission's first few years of operation, it is not an unfamiliar spot for either of them, and both were glad to see the Commission's continued progress toward its original goals during their hiatus. In fact, the Commission had continued to flourish, not only under the leadership of Gniffke for his year at the helm, but also with Frank Luenser, who served two one-year terms as Chairman just prior to Gniffke's election.

Banta was re-elected for another one-year term at the April, 1996 meeting of the Commission, and he will be backed by Vice-Chairman Bob Giampaoli of Le Grand, who is serving his second consecutive term in that position. In another move this year, Jim Melban was named Assistant Manager of the Commission, which continues to be managed under contract by the Monfort Management Services, Inc. firm in Dinuba.

The financial report shows the Commission is in excellent financial
(continued on page 4)

Improved Methods in Screening Capsicums and Evaluation of Germplasm for Verticillium Wilt Resistance (\$27,180)

Paul W. Bosland, Professor, and Mary K. Riley, Research Assistant,
New Mexico State University Department of Agronomy & Horticulture

Verticillium Dahliae is a soil-borne fungus that causes the disease Verticillium wilt on peppers. In pepper fields infested with the fungus, yield losses range from 20 to 90%. Once the soil has been invaded by the fungus, the resting spores, or microsclerotia, can survive in the soil for up to 20 years, making crop rotation an unreliable method of control. Biological control, using other fungi or bacteria to attack the *Verticillium*, has not been successful, and soil fumigation and chemical applications are not economically practical for the grower. Therefore, production of resistant varieties is the best approach for controlling Verticillium wilt of peppers.

The Pepper Breeding Program at New Mexico State University identified a source of resistance, and this resistance is being transferred to three commercial pod-types: bell, jalapeno, and New Mexican. The most resistant plants with the most desirable pods have been selected from each generation. In 1995, we improved all three populations and released to the California Pepper Commission seed from the jalapeno line and from the original resistant source for field testing. In an effort to find peppers with even greater resistance, we screened several hundred different pepper lines for resistance. Preliminary observations indicate that some pepper lines have greater resistance than the original source.

Also in the past year, we tested and developed new techniques for improving the efficiency and consistency of testing peppers for resistance to Verticillium wilt. Our newly developed method of pouring the fungus in trenches next to the seed row reduces time and labor resources. Previously, we had relied on the use of a cement mixer to properly distribute the fungus with the soil. Our second improvement enables us to use a commercially available soil mix instead of the unique soil at New Mexico State University. The commercial soil mix allows other research programs to use our new screening method with a soil that is easily acquired. Both of these screening techniques have been employed and are making the search and testing of Verticillium wilt resistant peppers much simpler.

Epidemiology of Pepper Stip (\$5,802)

Richard Smith and Bob Mullen, Farm Advisors in San Benito and San Joaquin Counties, and Tim Hartz, Warm Season Vegetable Specialist, U.C. Davis

Pepper Stip is a physiological disorder manifested as gray-brown to greenish spots occurring on fruit of bell, pimento, Anaheim and other types of peppers, most noticeably on red fruit that matures in the fall. The spots are approximately 1/4 inch in diameter and occur singly or in groups; the occurrence of the spots decreases the marketability of the fruit for either fresh market or processing uses. The factors controlling the occurrence or severity of the disorder are not well understood and, to date, the best control has been achieved primarily by the use of varieties that are tolerant or resistant to the problem.

In 1995, replicated plots of susceptible ("Yolo Wonder L" and "Grande Rio") and resistant ("Galaxy" and "King Arthur") cultivars were grown in seven commercial fields in San Joaquin, San Benito, Santa Clara and Monterey Counties. Galaxy and King Arthur were essentially free of symptoms, while Yolo Wonder L and Grande Rio showed significant damage at all sites, with 23-88% of fruits affected at the mature red stage. Analysis of the petioles showed that the resistant cultivars consistently had lower nitrogen (N), and potassium (K), and higher calcium (Ca), concentrations than susceptible cultivars; the same trend was apparent in fruit tissue. *Stip* was most severe at sites with low soil Ca and/or very high N and K fertilization rates. Based upon this data, we hypothesized that Ca nutrition significantly influences *Stip* expression and we will further test the effect of Ca nutrition on *Pepper Stip* in 1996.

Strategies to Control Powdery Mildew on Peppers (\$4,870)

Richard Smith, Frank Laemmlen, Steve Koike and Krishna Subbarao, University of California Cooperative Extension

Powdery Mildew was first reported on chili pepper in California in the Santa Clara Valley in 1983. Since 1991 powdery mildew has spread and become a potential problem in all pepper production districts in California. *Bayleton* is the primary chemical control that is used for this disease and has been registered under a Section 18 for some fifteen counties in the State since 1992. The Commission has funded an IR-4 Project to secure a full label for *Bayleton* on Peppers and has funded work to explore other strategies to control powdery mildew. The 1995 tests consisted of the following treatments: testing the efficacy of sulfur and of stylet oil applied prior to the onset of the disease with subsequent applications applied on a 10- or a 20-day basis; *Bayleton* and *Rally* applied at the first sign of the disease and again one month later; two experimental materials, *AQ-10* and *Procure*; and an untreated control. In addition to chemical control strategies, several resistant seed lines from three sources were also examined.

Powdery mildew was first detected on September 5, 1995 at one of the test sites and developed steadily, and by October 19 the untreated control plots were 50 to 70% defoliated. Two applications of *Bayleton* and *Rally*

completely controlled the disease as did sulfur (@ 5 lbs./A) applied on a 10- and 20-day schedule. The 20-day sulfur treatment had significantly greater yield than the untreated control. No phytotoxicity was observed in the *Bayleton*, *Rally* or sulfur treatments; however the stylet oil treated plots developed necrotic spots on the leaves. The results indicate that sulfur can provide good control of powdery mildew if the applications begin prior to the onset of the disease (i.e. beginning at flowering and continuing through the season) and on a regular schedule. It is important to keep in mind, however, that these results are from small experimental test plots. While we were able to achieve excellent coverage at all application dates, the temperatures were moderate and the hazard of phytotoxicity (burn) from the sulfur applications was low. In 1996 we will test the efficacy of sulfur applied on a commercial scale. In addition, we will continue to test new chemical control materials.

With regard to powdery mildew resistant pepper varieties, two lines from Bryce Falk's virus resistant material showed complete resistance to powdery mildew; however, these lines are wild type chilies. The HV-12 line from France also showed complete resistance to mildew; it is a long "Anaheim" shaped pepper. 94-128, a line from Sakata Seed, showed some slight susceptibility to mildew.

Maintaining and Improving a Collection of Pepper Viruses (\$10,000)

Rodrigo A. Valverde, Associate Professor, Dept. of Plant Pathology and Crop Physiology, Louisiana State University Agricultural Center

Plant viruses such as pepper mottle virus, potato virus Y, tobacco etch virus, and cucumber mosaic virus cause yield losses in most pepper producing areas of the world. Therefore, the development of virus resistant peppers is an important aspect of any pepper breeding program.

At the Louisiana State University Agricultural Center, we have begun a screening program for resistance in pepper to over 100 strains of pepper viruses from many different geographic locations. Moreover, with the financial support of the California Pepper Commission we have begun to put together a "Pepper Virus Bank". This consists of a properly identified collection of pepper virus strains from different locations in the United States and the Western Hemisphere. Viruses are being stored as dried plant tissue in a laboratory refrigerator. These virus strains will be of practical use to pepper breeders breeding virus resistant peppers.

Development of Plant Virus Protected Capsicum spp. using Induced Resistance (\$10,000)

John F. Murphy, Joseph W. Klopper and Michael Guerini, Department of Plant Pathology, Auburn University

Viral diseases pose a serious threat to pepper production and this problem is exacerbated by the difficulties associated with management of these pests. Cucumber mosaic virus (CMV) is one of the more difficult viruses to manage, in part due to its extremely broad natural host range and

its ability to be vectored by a large number of aphid species. Alternative approaches that may be used alone or as part of an integrated program must be developed and implemented in an attempt to manage viral diseases in peppers.

Plants are able to respond defensively to pathogen attack. This response may be localized to the site of infection, or it may also be systemic whereby tissues dated from the site of infection express some form of resistance. This latter form of resistance, referred to as induced systemic resistance, tends to be rather nonspecific, i.e., the resistance protects the plant from numerous different types of pathogens. Induced systemic resistance has been shown to occur in response to pathogens and certain chemical treatments; however, treatment of a crop with a pathogen to induce resistance is not practical and the resistance induced by chemicals tends to be short lived. Plant growth-promoting rhizobacteria (PGPR) have been shown to induce systemic resistance as well as enhance growth characteristics of some plant species. The use of PGPR as an approach to manage plant pathogens circumvents the use of a pathogen as an inducing agent and since PGPR colonize plant roots, the induced resistance may persist throughout the growing season.

We have initiated studies to determine whether PGPR-induced systemic resistance can be used with pepper against infection by CMV. We have shown that application of some strains of PGPR by injection into the stem of young pepper plants (at the soil level) resulted in a delay in spread and accumulation of CMV into uninoculated plant tissues by 3-4 weeks, relative to control treatments. Evaluation of ten selected PGPR strains revealed that treatment with three of the strains provided complete protection, i.e., no plants became infected with CMV, while for another strain only 2 of 10 plants became infected. These studies have been extended to evaluate additional PGPR strains. The observation that PGPR can induce resistance in pepper against CMV is very promising, although application via stem injection is not practical. A significant effort is presently focused on use of PGPR as a seed treatment. This approach allows the bacteria to associate with the roots at an early stage in plant development which, based on preliminary studies, appears to be essential for induction of resistance.

Development of Improved Selection Strategies, Sources of Resistance and Breeding Lines for Resistance to Pepper Viral Diseases (\$45,000)

Dr. Molly Kyle, Assistant Professor, Department of Plant Breeding & Biometry, Cornell University

The primary goal of this project is to develop bell, Anaheim and jalapeno breeding lines that combine the best sources of resistance to cucumber mosaic virus (CMV) together with resistance to tobacco mosaic virus (TMV) and the potyviruses, tobacco etch virus (TEV) and pepper mottle virus (PeMV). The commercial parent we are using for the bell type is Verdel (a Rogers hybrid); for the Anaheim/paprika type we are using an obsolete Cal-Compact variety, 648; and for the jalapenos, a potyvirus-resistant selection from the former PetoSeed. In each type, we have made crosses and backcrosses to improve levels of CMV resistance. We are harvesting our fourth and fifth generations since the grant began two years ago, and expect that we should be able to get two more generations this next year, thus we should continue steady progress towards adding CMR to these

three commercial types.

In addition to the straight backcross programs, we are using several sources of resistance that have not been widely exploited to date in the trade. Also, we are set up to expedite standard screening and breeding procedures with lab-based strategies, where appropriate. Due to the genetics of the resistance, some generations cannot be screened with CMV, so with excellent cooperation from commercial California pepper breeders, we have been able to evaluate other characters. Drs. Paul Gniffke, Robert Heisey and Ken Owens have planted these generations and selected for type, adaptation to California field conditions, and other resistances where possible.

Detection of Curly Top Virus in Peppers & Screening for CTV Resistance (\$12,000)

Dr. Robert L. Gilbertson, U.C. Davis Pathology

The objective of this project is to develop a rapid and effective method for detecting and characterizing curly top virus in peppers, and to develop an efficient method to screen peppers for resistance to curly top. We have developed two rapid and sensitive methods that provide rapid and specific detection of the CTV virus in 24-48 hours. One of these involves the use of a DNA probe that we have made to the pepper CTV and the other method is based on the polymerase chain reaction. Both methods have been working consistently in the laboratory. We are now actively seeking growers who have suspected CTV infections in their fields to send us plants to be tested for CTV using these methods. We would be happy to visit fields and sample plants for testing.

Considerable progress has been made in identifying the type of CTV that is found in peppers in California. The pepper CTV is different than the strains that are commonly found in sugar beets. We are in the process of determining if the pepper CTV is similar to the CTV found in tomatoes in California. Based on this information, we have obtained the genetic material (DNA) of the pepper CTV and we are in the process of testing whether we can infect plants with this material in the laboratory in the absence of the leafhopper vector. If this genetic material is infectious, we will proceed to develop the pepper plant inoculation method that will hopefully allow us to screen large numbers of pepper plants for CTV resistance. This will be a significant advance because it will not require breeders to use leafhopper transmission or have to rely on unpredictable natural inoculum to screen peppers for CTV resistance.

1996 Project on Verticillium Approved

Acting on a suggestion made at the April Commission meeting, the Research Committee has approved a new project for 1996 on *verticillium wilt*. With Paul Bosland working in New Mexico on evaluating verticillium wilt resistance, the Commission decided it would be wise to learn the parameters of verticillium problems here in our growing areas. They have contracted with Krishna Subbarao of U.C. Davis to "assess the severity of *Verticillium wilt* on peppers in coastal California and collect *Verticillium dahliae* isolates for further study." The reason we're reporting on this before any results are forthcoming is that we'd like to have pepper industry members inform their farm advisors when suspected incidences of