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Citrus blackfly in Florida: Eradication or bio-control?

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ABSTRACT

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The citrus blackfly (CBF) invaded south Florida in January 1976. It was considered by scientists to be a major threat to the Florida citrus industry located in the central part of the state. The CBF was successfully contained in a 1000 square mile tri-county quarantined area surrounding Ft. Lauderdale for several months before breaking out to an area near the commercial citrus production area.

During this time federal and state research agencies were evaluating a bio-control approach involving two tiny wasps which were introduced in south Florida in 1976 by the United States Department of Agriculture. By late 1978 it had become clear to most of the leading scientists and some of the industry leaders that the spray program for eradication was failing and that research showed conclusively that the bio-control agents (two wasps) could be a permanent solution to the problem.

After considerable deliberation, research administrators announced on 18 January 1979 that they were convinced that the CBF was under bio-control and was no longer a threat to the citrus industry. Although there was some resistance to giving up the concept of eradication with a spray program, it was announced on 8 March 1979, that the regulatory agencies would abandon the initial goal of eradication for a containment program and in August 1979 all spray programs were terminated.

The bio-control agents have successfully kept the CBF under bio-control for 10 years. It was a low-cost, environmentally sound solution of a serious threat to the Florida citrus industry.

The decision to support a bio-control program was approved (although perceived by some to be risky in 1979) and resulted in millions of dollars in savings to the people of Florida. Furthermore, since the bio-control agents continue to be well established in Florida at low levels, the state can be assured it will not be invaded again by CBF.

The success of the CBF bio-control program engendered an increased credibility in this approach to management of other foreign pests. Increased emphasis on bio-control research

will lead to more applications in Florida as well as worldwide with benefits of cost saving and reductions to environmental degradation.

INTRODUCTION AND STATEMENT OF PROBLEM

The first U.S. invasion of the citrus blackfly (CBF) (*Alurocanthus woglumi* Ashby) was in Key West, Florida in 1934 and was successfully eradicated in a period of 18 months. On 28 January 1976, the CBF was found in the Wilton Manors area of Ft. Lauderdale. The CBF was considered by Florida agricultural scientists to be potentially one of the most destructive pests to citrus. The Florida Department of Agricultural and Consumer Services (FDACS) immediately placed approximately 1000 square miles (≈ 2600 km²) under quarantine in Broward, Dade and Palm Beach Counties (Fig. 1). Fortunately, a relatively small portion of the state's commercial citrus

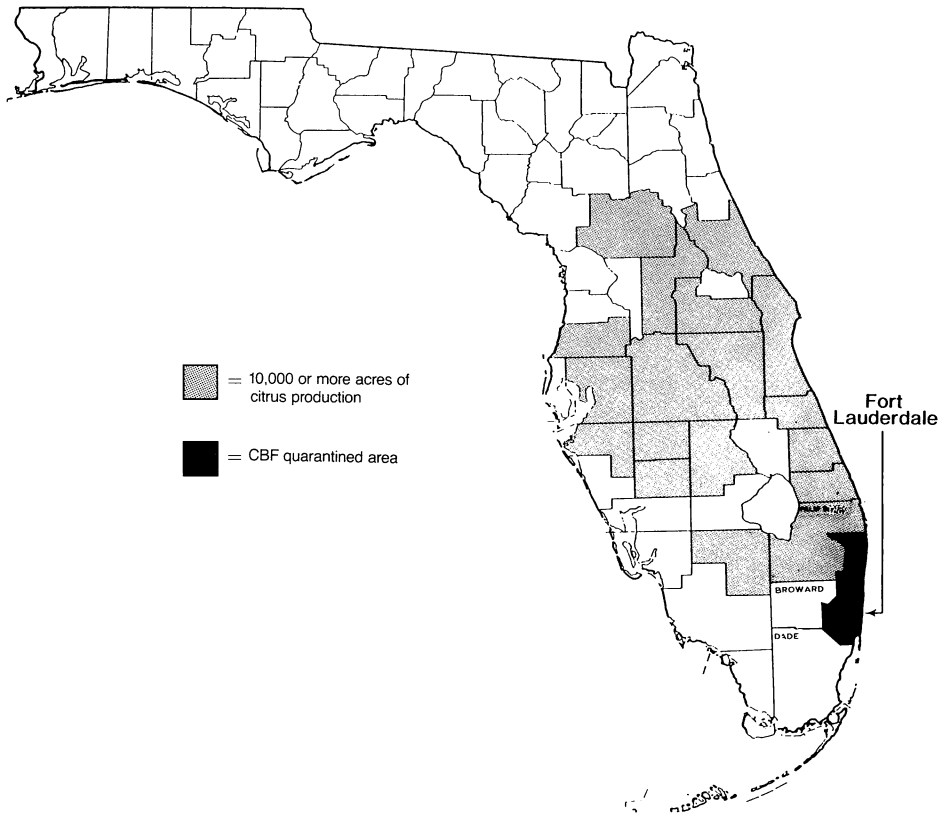


Fig. 1. Florida major citrus production counties (1976). Source: Florida Agricultural Statistics Service, Orlando, FL.

acreage was located in the infested area. Most of the citrus production areas were to the north and west of the quarantined area. There was an early agreement by the Florida citrus industry leaders and regulatory agencies to contain the CBF to the area of infestation.

There was great concern that if the CBF broke out of the quarantine area and infested the major citrus acreage the cost of control would be unacceptably high and the bio-control agents of important citrus pests (such as purple scale and Florida red scale) would be disrupted by the spray program required to control CBF. Although the area of infestation had a relatively small amount of commercial citrus production, it was and is Florida's most densely populated area. This was recognized as a problem in the early proposal for chemical eradication of CBF because it involved an urban backyard spray program.

The industry, state and federal agencies were facing a two-fold challenge; (1) containing the pest in the tri-county area until a more permanent solution could be found, and (2) developing a long-term solution to the problem.

Although this paper describes the total problem and multi-agency decision making that led to a permanent solution, it is primarily focused on the role the administration of the Institute of Food and Agricultural Sciences (IFAS), University of Florida, played in the decision-making process and its contributions to the solution of the problem. The Institute of Food and Agricultural Sciences is the research, extension and teaching unit for Florida's land grant university. The authors had access to records and first-hand knowledge of the complete role of IFAS. In the case of the other agencies there is general information about their decision-making processes but no first-hand information or detailed records of why and how they made decisions.

ORGANIZING AND FUNDING

From the beginning it was clear that it would be essential to have a multi-agency approach to solve the CBF problem. The Division of Plant Industry (DPI) of the FDACS and its federal counterpart, the Agricultural Plant and Health Inspection Service (APHIS) of the United States Department of Agriculture (USDA), accepted regulatory responsibility for the problem. Initially this included determining the extent of the infestation and the development of a containment program that would prevent the pest from reaching the major citrus producing areas of Florida. Likewise, research responsibilities involved both state and federal agencies. IFAS at the University of Florida and the Agricultural Research Service (ARS) of the United States Department of Agriculture accepted the responsibility to

cooperatively conduct the research to fully understand the nature of the CBF problem.

The four agencies met soon after the CBF was discovered in Ft. Lauderdale and launched a well coordinated approach to the problem. In the first meeting it was clear that a major effort with the four agencies working closely together would be required until a permanent solution to the problem was found through research and made operational. Entomology was the leading discipline in all four cooperating agencies. Horticulturists also played a key role through active joint research efforts with entomologists. Agricultural engineers, agricultural economists and statisticians contributed to the project in a supportive capacity. It was fortunate that one of the major IFAS research and education centers was located at Ft. Lauderdale as well as some ARS research activities and part of the DPI regulation programs.

In addition to having close cooperation among the four agencies, it was essential to have the multi-agency effort closely coordinated with the Florida citrus industry. Florida citrus leaders considered the pest to be a serious threat to the industry, a world leader in citrus production. Scientists of the IFAS Citrus Research and Education Center at Lake Alfred estimated it would cost the Florida citrus industry over \$80 million annually to control the CBF if a state-wide infestation occurred. This was considered unacceptable to the leaders of the Florida citrus industry. Soon after the CBF was discovered in 1976 an advisory council, an administrative committee and a technical committee were established to ensure close working relations among the involved agencies and with citrus industry and other interested groups.

The composition of the council and the two committees included members of the citrus industry, research agencies and regulatory agencies. The CBF council and the two committees met regularly throughout the life of the project. In addition to the council and the two committees, some of the agencies established a structure within their agencies to ensure internal coordination of the CBF programs. Adequate funding for the regulatory and research efforts received a great deal of attention during the early phase of the project and remained a serious issue for the duration of the project.

To initiate the CBF research program the SHARE (Special Help for Agricultural Research Education) Council, the private fund raising arm for agricultural research and education programs of IFAS contributed \$10,000 to fund needs of critical start-up research.

During the 4-year period from 1976 to 1980, the state and federal resources committed to the regulatory programs totaled over \$16 million. The research program was carried out with state and federal funds of approximately \$2.2 million for the same period.

A PERMANENT SOLUTION – ERADICATION OR CONTROL?

There was general agreement by the citrus industry, regulatory and research agencies and the public that the CBF should be contained in the quarantine area until a permanent solution could be found. However, there were different opinions about the appropriate approach to finding a permanent solution.

The words eradication, control, and containment had different meanings to individuals involved in the program. The lack of a common understanding of these terms contributed to some misunderstanding throughout the life of the project.

Eradication was generally viewed as chemically killing every CBF in Florida just as Florida had conducted several other successful eradication programs including the CBF eradication in Key West in 1934.

Control usually meant chemical bio-control agents or a combination of methods but generally was not thought to be a permanent solution to the problem.

Containment to most people meant keeping the CBF inside the quarantine or infested area. However, some considered a limited breakout of CBF to be a normal pattern of a containment program and did not necessarily mean that the program would not be successful. With the general agreement that a permanent solution was critically needed to avoid CBF infestation to the major commercial citrus production areas and a strong belief by many in industry and DPI that the only real permanent solution was eradication primarily by chemical methods, the CBF Project was launched in 1976.

There was real justification for concern by the industry as uncontrolled infestation of the CBF in other countries since its discovery in Jamaica in 1913 (Dietz and Zetek, 1920) had significantly reduced citrus production and resulted in the death of trees. However, in 1972 an invasion of the CBF in Texas was brought under control by parasites previously introduced into Mexico (Thompson et al., 1987).

The cooperating research agencies, IFAS and ARS, enjoyed a close working relationship in the testing of a large number of chemicals to be used for the spraying program to keep the CBF contained in the quarantined area. Also, these two research agencies had very productive cooperative efforts in introducing and testing two CBF bio-control agents into Florida. The Agricultural Research Service had extensive experience with CBF through their research programs in Mexico and Texas where they maintained colonies of parasites already proven to be effective in controlling the CBF.

In April of 1976, under the leadership of the USDA Agricultural Re-

search Service, populations of two tiny wasps (*Amitus hesperidum* and *Encarsia opulenta*) were released in the tri-county infested area of Florida (Thompson et al., 1987). IFAS and ARS conducted several joint studies to determine the effectiveness of the parasites in Florida where weather and cultural practices of citrus production were different than in Texas, the last area where these bio-control agents had been successful in controlling CBF. These particular wasps were chosen because the first named had proven effective against large population levels while the second was more effective against low levels of CBF.

Some of the regulatory and industry representatives believed that all agencies should make a strong commitment to the eradication program. However, APHIS took the position that it would not commit itself to an eradication program until ARS could assure that technological methods were available for a successful eradication program¹.

Faculty from the two research agencies served on the CBF Technical Committee and conducted important research to support the eradication effort. In 1976 the introduced parasites had not demonstrated their effectiveness in Florida and the chemical spray program appeared to be effective in the containment effort and raised hopes for eradication.

An administrator with APHIS presented his agency's position on the CBF at the 16 June 1977 joint meeting of the CBF Council, the Technical Committee and the Administrative Committee. He stated the national policy, "... is to prevent the spread of CBF in Florida, Texas and Mexico to other citrus producing areas in the U.S. and to retard the spread of existing infestations through suppression and containment efforts".

Unfortunately, this did not satisfy everyone as one industry representative responded that he could paraphrase his citrus organization's position, "We don't give a damn whether the research people tell us it can be done or not. We're saying, get busy and if you don't know how, use the best tools you've got and go try". The 16 June 1977 meeting was concluded by the DPI Director saying, "the Technical Committee is following the eradication concept/course and alleged that the CBF Advisory Council already has voted to pursue eradication".

Although two parasites were introduced into the quarantine area in April 1976, a strategic plan for developing full potential of bio-control through the use of these parasites was never incorporated into the total council plan during the first three years. Instead, bio-control was only viewed and actually used as a supplemental activity that might reduce the pest popula-

¹ Citrus Blackfly Technical Committee and Citrus Blackfly Administrative Committee, 16 June 1977, Minutes of meeting.

tion in the infested area and hence increase the likelihood of successful eradication. If the bio-control (by use of two parasites) approach had been considered seriously as an alternative to chemical eradication, the issue of the wisdom of killing the last CBF in Florida would likely have been raised and debated. In other words, a successful eradication effort would have eliminated the two parasites and Florida would be more vulnerable to a third invasion of CBF in the future without the benefit of the parasites that had already been proven effective in controlling the pest.

By the latter part of 1978 the comprehensive eradication program directed by DPI had reached its peak. Approximately 25 million boxes of citrus had been fumigated. Over 200 000 residential properties had been sprayed. It was estimated that by the end of the fiscal year a total of \$15 million would have been spent on the eradication program. Despite the large eradication effort with increasing helpful knowledge gained from research programs on spraying methods, the eradication program had some serious problems:

(1) The eradication effort had become more complex as research results showed that over 20 host plant species, including several Florida native plants, would support the complete life cycle of CBF.

(2) The CBF was found to be breaking out of the quarantine area into surrounding counties. On 2 January 1978 the CBF was at Ft. Pierce approximately 50 miles north of the initial quarantined area. Also, there were increasing incidences of reinfestation of previously sprayed areas.

(3) There was resistance by some homeowners (nine cases of legal action) to spraying their properties as the length of the eradication period increased ².

During this time the research program conducted by IFAS and ARS had become more comprehensive and had produced some very useful results. The program had accumulated a large amount of information about the biology, behavior and development of the CBF and the two introduced parasites. This knowledge was most helpful in answering questions which led to strengthening DPI's spray program. The researchers had screened many pesticides and one named Acephate was determined to be effective in killing CBF and compatible with all species of CBF predators and parasites. Several studies were conducted to improve the methods of spraying.

Although less visible, some extremely productive research was being conducted regarding the adaptability of the parasites to Florida conditions. Furthermore, for the first time sufficient knowledge about the biology and behavior of the parasites had been gained to make a statement about the potential of bio-control as a permanent solution to the problem. Although

² C. Poucher, 15 January 1979. Citrus blackfly eradication program review. Presented to Citrus Research Council, Lakeland, FL.

ARS had found through research in Texas that the CBF bio-control program was successful in 1974, it was considered essential to fully research how the two parasites would perform under Florida environmental conditions and Florida citrus cultural practices before making a statement about bio-control as a permanent solution. Specifically the research studies found:

(1) Spray schedules and chemicals used by Florida citrus producers were compatible with the two parasites.

(2) A wide range of temperatures would not adversely affect the parasites from following the CBF throughout the citrus belt.

(3) Prior to the introduction of the parasites in April 1976 the CBF averaged 40–60 live larvae per plant leaf. Over an 8-month period after the introduction of the parasites the CBF decreased per leaf by 98% and had established an equilibrium between the CBF and the parasites that remained stable at non-economic levels for several months (Dowell et al., 1979).

Based on the research program it was determined that CBF was under bio-control in south Florida. This was first reported to the IFAS Dean for Research in a research report by Dr. William Ennis, Director of the Agricultural Research and Education Center (AREC) at Ft. Lauderdale on 31 October 1978. After reviewing the report, research administration immediately called a meeting on 6 and 7 November 1978 in Ft. Lauderdale to review the CBF research program. As a result of this review a meeting was scheduled with the DPI Director on 11 December 1978 to discuss these research findings and their implications for the eradication program. As the regulatory agencies became informed that the CBF was under bio-control in south Florida, they were aware of the broad implications this would have for the eradication program. The Florida Commissioner of Agriculture in a 5 January 1979 news release announced a review of the CBF problem would be held in Lakeland at the Citrus Research Council meeting on 15 January 1979. He stated that the meeting “will include an updating of current chemical spraying efforts and reports of new research findings on the use of biological parasites as an effective control method”.

DECISION MAKING ENVIRONMENT

In order to fully appreciate the difficulty IFAS faced in announcing to the public that CBF was under bio-control, it is necessary to understand the setting in Florida and some of the attitudes of people at that time. IFAS had recently completed a state-wide planning effort entitled *Agricultural growth in an urban age* (Pierce, 1975). A major conclusion was that Florida's agriculture must adjust agricultural practices to not only stay efficient but to remain compatible with the state's fragile natural resources. The research programs of IFAS and ARS were focusing on bio-control as one approach

to keeping an efficient agriculture that is also compatible with Florida's fragile natural resource base. Although relatively few pests in Florida had been brought under bio-control, researchers saw this as a promising approach to improve Florida's agriculture. Hence, when the CBF invaded Florida in 1976, researchers already were looking for opportunities to expand the bio-control approach to pest problems. This case showed real promise since the CBF had been completely under bio-control in Texas since 1974.

Although Florida had more pests under bio-control in citrus than any other commodity, the concept of eradicating pests with chemicals was firmly entrenched in the minds of most agricultural people as the only sure, permanent solution to a serious pest problem.

Even though there was increased awareness by the public of the environmental impact of spraying chemicals, the issue, in the case of CBF, was the effectiveness of chemicals as a method of eradication. A part of the setting also was that the bio-control of CBF was viewed from the beginning (April 1976) as strictly a supplement to the eradication spray program. Although the effectiveness of the two parasites on CBF in Florida was being studied by researchers (and viewed with great promise), bio-control was not perceived by most people as being an alternative to eradication.

The history of DPI and APHIS joint efforts showed a record of success that had eradicated ten major pests from Florida (Collins, 1977). It was only natural to consider that the CBF would be the 11th successful eradication of a foreign pest that had invaded Florida. An example of the view that eradication was the only alternative for a solution to the CBF problem and that it would be successful was expressed by the State Commissioner of Agriculture in a joint meeting of the CBF committees on 16 June 1977. He stated, "I have advocated all along, in a number of these situations, even though initial cost may be greater, ultimately the public pays less when various diseases and pests are eradicated. The United States has capability that is unexcelled anywhere in the world, and the CBF program is another instance where we can think big. I am hopeful that we are at the point now where we know enough about the fly and about control measures that we can approach eradication. I think it is possible. I have a good feeling about the CBF program, and it is my feeling we can announce at sometime down the road that the agricultural technicians in this country have once again accomplished eradication of a pest that could very well threaten the most important agricultural industry here in the state of Florida".

The 15 January 1979 meeting of the Citrus Research Council was considered by IFAS to be the right setting to have a major discussion of the issue – eradication or bio-control? However, instead of a critical analysis of the strengths and weaknesses of the eradication program including the implica-

tion of recent research findings on bio-control, it was begun by a DPI representative presenting the status of the eradication program. His views are highlighted by quoting his opening and closing comments. "On 28 January, 1976, citrus blackfly was discovered in Ft. Lauderdale. Today, almost 3 years later, I'm happy to report excellent progress is being made in containing and eradicating the pest". "In closing, we feel that the eradication program is proceeding on schedule. Certainly, we are a little disappointed when we find reinfestations, but as have indicated before, this has happened on all eradication programs. We estimate it will cost an additional \$23 million in state and federal funds and 6 more years to carry the eradication concept to completion ³.

IFAS had expected the DPI report to set the stage for a major discussion of bio-control as a substitute for eradication as a permanent solution to the CBF program. Dr. Vernon Perry, IFAS research administrator for the CBF research program, made the bio-control presentation. He made two strong points about the implications of the research findings. "The citrus blackfly is now under bio-control in Florida and we anticipate that the two parasites will continue to be effective in all citrus-producing areas in Florida. These factors indicate to us that the citrus blackfly is no longer the threat to Florida citrus production that it was considered to be when citrus blackfly was detected early in 1976" ⁴.

Although Dr. Perry made a strong statement of the research findings and implications for the CBF problem, it was not received by the audience as a substitute for eradication. With the glowing presentation by DPI of the successful eradication program and the closely held opinion of people for the past 3 years that bio-control was only an aid to the eradication effort, many people did not grasp that IFAS was presenting a permanent solution to the problem and that the eradication program could be terminated. Members of the Florida Citrus Research Advisory Council listened to the presentation and then before concluding their meeting voted unanimously for complete eradication of the CBF as the least expensive solution to the CBF problem ⁵.

It was very clear that the CBF program review on 15 January 1979 was not effective in either gaining acceptance of bio-control accepted as a permanent solution for the CBF problem or advancing the idea that eradica-

³ C. Poucher, 15 January 1979. Citrus blackfly eradication program review. Presented to Citrus Research Council, Lakeland, FL.

⁴ V.G. Perry, 15 January 1979. Research on the citrus black fly. Presented to Citrus Research Council, Lakeland, FL.

⁵ Citrus Research Council, 15 January 1979, Minutes of meeting.

tion was neither needed nor possible. Research results were available that would benefit the citrus industry and many residences in the quarantine area and could potentially save millions of dollars of state funds. The IFAS administration decided to publicly announce the implications of the results the following Monday using slightly different language than had been used on 15 January. Three days after the council meeting, Dr. K.R. Tefertiller, the Vice President for Agricultural Affairs, IFAS, University of Florida stated in a 18 January news release, "On the basis of our bio-control research we're convinced the citrus blackfly is no longer a serious threat to the citrus industry".

Although a rigid application of decision-making rules was not used, the general principles were considered informally in making the decision to announce that CBF was under bio-control and no longer a threat to the citrus industry. It was clear from the beginning that to withhold research results where the implications were so important to an industry and the general public was unacceptable. But, it was also realized that a wrong decision about the performance of the bio-control agent in the control of CBF would have serious economic consequences for the citrus industry and the public and could damage the reputation of IFAS as a leading research organization. IFAS administration was mainly concerned about the cost of being wrong. Also, IFAS officials were very aware that they could receive criticism for using a news release as a means of communicating such important research findings.

The news release was based upon a careful review of all pertinent inputs as follows:

When the CBF research report from Ft. Lauderdale was received late in October 1978, the Dean of Research, Dr. F.A. Wood (now deceased), immediately called a two-day comprehensive review of the CBF research program at the research and education center in Ft. Lauderdale.

After reviewing the accuracy of the research findings, the IFAS research administration met in December 1978 with the DPI administrator to explain the findings to him and discuss the implications for the eradication program.

As a result of the December meeting with research and regulatory agencies, the state Commissioner of Agriculture publicly announced a meeting on 15 January for the purpose of review before the Citrus Research Council to evaluate the program and the new research for bio-control for the CBF.

Since this formal meeting with the Citrus Research Council did not serve to communicate the story, it was decided to make an announcement based upon IFAS research that the CBF was under bio-control in south Florida and it was no longer a threat to the Florida commercial citrus industry.

Assuming IFAS scientists were correct that bio-control was the best

permanent solution to the problem, IFAS administrators realized that making such an announcement would create several other problems:

- (1) The news release procedure would surely be criticized.
- (2) The homeowners would be less willing to allow spraying after the announcement – hence it would make it more difficult to continue the chemical eradication program.
- (3) During the upcoming legislative session research and eradication funds would likely be reduced.
- (4) It might cause some strain between the research and regulatory agencies which had a good working relationship.

TABLE 1

Transect data summary for citrus blackfly (CBF) and parasites, November 1976 to January 1979

Month	CBF infestation index ^a
November, 1976	16.55
December	17.30
January 1977	15.95
February	14.90
March	14.95
April	13.60
May	13.30
June	10.45
July	8.25
August	4.30
September	1.50
October	1.00
November	0.60
December	0.35
January 1978	0.40
February	0.30
March	0.10
April	0.43
May	0.15
June	0.05
July	0.05
August	0.30
September	0.35
October	0.34
November	0.36
December	0.30
January 1979	0.12

^a Computed by multiplying the percent of trees infested CBF times the percent of leaves infested per infested tree (Cherry and Pastor, 1980).

(5) The most serious barrier to the acceptance of the research findings would likely be the mind-set of many people from the beginning of the project that eradication was the only acceptable permanent solution. It had not been possible to educate the industry to bio-control as a serious permanent alternative because such an effort would have been interpreted by some people in industry, regulatory agencies and the general public that IFAS was not committed to the eradication program.

Of course, IFAS people were deeply involved indirectly in the eradication effort through a large research program in support of the improved spray methods and related problems. In addition, some of the key members of the CBF administration and technical committees were IFAS faculty. After IFAS had reviewed the accuracy of the bio-control results again with ARS, the IFAS Vice President and Deans decided to make the news release on 18 January 1979. The decision to make such a strong statement that CBF is under bio-control and no longer a threat to the citrus industry was based upon the confidence the IFAS Vice President and Deans had in their faculty. The results in Table 1 showing significant declines in CBF infestation were available for their review and were important in their final decision.

OUTCOME OF THE DECISION

There were various reactions to the IFAS 18 January 1979 announcement that the CBF in south Florida was under bio-control and no longer a threat to the Florida citrus industry. Although IFAS was aware and interested in the reaction to the announcement, their major concern continued to be to do all they could for a permanent solution to the problem. They had committed themselves by the announcement to guaranteeing bio-control as the answer to the problem. There were generally three types of reactions to the CBF announcement:

(1) The press and general public were positive toward an early solution to the problem and pleased that it was a non-chemical method of control. Also, they were genuinely surprised as they (like others) believed that the only permanent solution would be chemical eradication of the pest and that it would be several years before the pest could be completely eradicated from Florida. Many were surprised by a favorable editorial in the *Lakeland Ledger* of 14 February 1979 entitled "Bye-Bye Citrus Blackfly" that even supported agricultural research as a wise investment.

(2) There was another group of people that agreed with the research findings but felt a need to defend eradication as long as the Citrus Research Advisory Council voted for eradication. The Director of DPI stated in a letter to the CBF Advisory Council members dated 8 February 1979, "We

can't disagree with the researcher's opinion but we were staying with the eradication concept because the Citrus Research Council expressed the desire for total eradication at the 15 January meeting".

(3) Some industry representatives and staff felt that it was irresponsible to not go for total chemical eradication. One of the members of the CBF Advisory Council strongly believed that the citrus industry was too important to turn it over to two tiny wasps.

The CBF Advisory Council voted on 19 February to continue the eradication program. However, the IFAS announcement and some continuing problems with the eradication program resulted in the representative of DPI stating on 19 February, "It is my opinion that the success of achieving eradication now is less than 20%". He gave urban resistance to the spray program after the announcement as a major reason for the reduced chance for eradication. "The effectiveness of the parasites far exceeded anyone's expectations". In relation to the Ft. Lauderdale area he stated, "I feel certain that you will not find a single tree being damaged by CBF; in fact, unless you look real close, you will not even be able to find CBF" ⁶.

In the same meeting on 19 February a member of the Florida Senate Appropriations and Agriculture committees asked the agricultural agencies involved to make a decision soon on whether or not to continue the CBF eradication program as legislative appropriations hearings were scheduled for the 5th of March. This challenge stimulated the agencies to schedule another meeting on 1 March to develop a recommendation ⁷.

The CBF Advisory Council met jointly with the Technical Committee on 1 March, and then held their own meeting immediately afterward. The recommendation of the Technical Committee to move away from eradication to a containment concept was rejected in the CBF Advisory Council meeting and by a vote of four to three they acted to continue the eradication program ⁸. As a side note it seems worth mentioning that Mr. Bob Brooks, the only member of the Advisory Council who had CBF in his grove, voted with the minority to discontinue the eradication program.

On 8 March 1979 the Commissioner of Agriculture and Consumer Services announced that DPI would move from an eradication program to containment using a spray program with assistance of the two parasites ⁹. On 27 September 1979 the Commissioner of Agriculture announced termination of all spraying operations (DACS News Release 1979). Although there was

⁶ C. Poucher, 19 February 1979. Citrus blackfly eradication program. Presented to Citrus Blackfly Research Council, Lakeland, FL.

⁷ Citrus Blackfly Advisory Council, 19 February 1979, Minutes of meeting.

⁸ Citrus Blackfly Advisory Council, 1 March 1979, Minutes of meeting.

⁹ C. Poucher, 8 August 1979. Letter to Citrus Blackfly Advisory Council.

strong initial reaction to the IFAS announcement of 18 January, it undoubtedly hastened the date in which the eradication program was terminated, reducing the DPI request for public funds from \$5,000,000 to \$500,000 and significantly reducing the expenditure for research.

Most importantly the 18 January announcement was the correct decision because in the months that followed it became clear to even those who were most critical of IFAS that CBF in all of Florida was successfully under bio-control. One of the most vocal industry supporters of eradication in 1979 stated in a letter of 7 March 1980 to the Director of DPI regarding the CBF, "We made a mistake in delaying termination of a program (eradication), maybe we ought not to make another mistake in terms of delaying or stopping most all research activity".

The CBF case is now often quoted in Florida as a major success story saving millions of public dollars but few people are aware that it was an important decision made in the midst of controversy. An unexpected benefit of the decision-making that led to the successful bio-control of the CBF in Florida is the increased status that bio-control and other non-chemical methods have attained in Florida agriculture during the 1980's.

Florida was indeed fortunate to have had the late Dr. Reece I. Sailer as a member of the IFAS faculty when the CBF was discovered in 1976. He had an international reputation in classical bio-control. His experience and expertise was invaluable in bringing to bear the appropriate knowledge of the relationship between CBF and parasites that made it possible to bring the pest under bio-control.

The CBF has remained under bio-control in Florida continuously for over 10 years. The two parasites followed the CBF throughout the Florida citrus industry without regard to the varying environmental conditions. The CBF and the two parasites continue to exist at very low levels in Florida. The successful control of CBF for over a decade has been of great economic importance to the Florida citrus growers and to the general public of Florida. It has been estimated that the successful control of CBF has saved several million dollars annually.

The bio-control of CBF resulted in everyone being a winner:

- (1) The citrus grower had a low-cost solution to the problem.
- (2) The general public was saved millions of dollars and the control methods used were environmentally sound. And finally,
- (3) The growers and the public can be assured that Florida will not be required to have a massive chemical spray program to combat the next invasion of the CBF.

The CBF bio-control success story is a classical case of a non-chemical method being used to control a serious pest. Unfortunately, a relatively

small number of foreign pests that have invaded Florida or that are likely candidates for invading Florida can be successfully controlled biologically. As a result of new breakthroughs in bio-technology research improvement can be expected in the traditional bio-control approach to pest management, and it may be possible that more foreign pests can be brought under control through the use of bio-control methods. However, as many foreign pests in the foreseeable future will not be susceptible to control by biological methods, it will be essential for Florida and the United States to continue to invest in the development of improved chemical and other non-chemical methods to deal with future invasions of foreign pests.

Perhaps the most important lesson that can be gained from this effort to control CBF in Florida is that when faced with an invasion of a serious foreign pest, all feasible methods of control should be given serious consideration as a possible permanent solution to the problem. If it is determined that bio-control methods are possible, then there should be a high priority given to funding that approach. Of course, in the CBF case in Florida the bio-control approach was considered by the leading scientists to be a possible solution, but officially it was viewed and used as a supplement to the chemical spray program for accompanying eradication of the pest.

The four agencies have benefited from the CBF experience and have been successful in other pest problems during the past decade. Considering the seriousness of the CBF problem there was general agreement with Dr. Reitz, Director, Citrus Research and Education Center who served as Chairman of the CBF Technical Committee, when he wrote a CBF project report on 20 February 1979, "I personally feel that our four agencies have done a very commendable job of sorting out the realities and discarding the hopes".

Any measure of benefit-cost analysis applied to the CBF problem would show that the decision to announce that the CBF was under bio-control benefited Floridians far more than it cost them. The total cost of CBF research in Florida by IFAS and ARS was approximately \$2.2 million. Assuming that the pest could have been eradicated it was estimated that it would have required an additional \$23 million and six more years of time. Furthermore, if the pest had been eradicated it is impossible to actually estimate the cost of the threat of another invasion of CBF into Florida.

By early 1979 the total cost of eradication had reached almost \$16 million. The spray program had been effective in the early years (1976-77) in the containment of the CBF to the quarantine area and bought time which was urgently needed to test the adaptability of the bio-control agents to the Florida environment. Hence, the past cost of the spray program was not relevant in deciding whether to terminate the eradication effort and to accept the bio-control approach. It was only important to have the estab-

lished future cost and length of time required for a successful eradication of the CBF.

It is probably more realistic to assume that eradication would have failed. In such case the spray program probably would have been terminated before the estimated 6-year period of time. It is most likely that the industry would have accepted the bio-control approach to the problem when it became clear that eradication was not possible.

With the mind-set people had in 1979 it is not possible to predict how much longer the regulatory agencies and some industry people would have insisted on eradication if the IFAS news release had never been issued. However, using DPI's estimated total costs of eradication for the 6-year period as a basis, the monthly cost for the eradication is approximately \$720,000.

One approach to placing a value on the CBF research would be to compute the additional cost of each additional month of eradication in relation to the total cost of CBF research (\$2.2 million). Using this approach to estimate the value of research, every three additional months of spraying would have paid for the total cost of the research. The spray program that had already cost \$16 million was at best a temporary fix that would have been continued for years, wrecking on-going biological control programs, adding to environmental pollution and may have lost whatever effectiveness it had due to acquired resistance build up in CBF to the chemicals.

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