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EXPERIENCE WITH Bemisia tabaci IN THE PRODUCTION OF TOMATO FOR INDUSTRIAL PURPOSES IN THE DOMINICAN REPUBLIC

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Let us start this paper with a piece of advice - you are not going to spray the whitefly problem away with chemicals. If you think you can, two things are going to happen: 1) you will probably lose your crop, and 2) you are going to create a super whitefly. Once you depend only on chemical control, you have lost the battle. We know because we tried it and lost.

We are positive that the intensive culture of melons, tomatoes, and beans in addition to the varied planting of eggplant, okra, etc., in conjunction with overuse of pesticides, especially piretheroids, and climatic conditions, led to the outbreak of Bemisia tabaci.

November 1988 marked a new date in Dominican agriculture. This was when Bemisia tabaci became a major pest problem causing excessive economic damage. It exploded in Azua in the south-western part of the country where four industrial tomato producers and two major canteloupe producers are located and devastated tomatoes, melons, eggplant, cucumbers, beans and sweet potatoes. It is now in the process of rapidly becoming a problem all over the country. In our case both the factor of blotchy ripening or no ripening at all contributed to the disastrous tomato and melon crop of 1988/89/90. Some varieties, for example "Napoli", go from the green or color break stage to white. The damage caused has been reported to be 1200 ha of industrial tomato and melon for a value of no less than RD$32,000,000; these figures do not include poor fruit quality. If you add the losses in the rest of the Caribbean and Florida, we have a major problem on hand. Bemisia tabaci is found all over the world and reported in 98 countries and states. It may have 11-15 generations per year under our tropical conditions and has been reported to attack at least 506 plants species representing 74 families.

The whitefly goes from eggs to four nymphal states, pupae, and adult, completing the cycle in 16-21 days. Dispersal of the whitefly is from plant to plant, normally at low levels, various areas on the same plants and the wind. The latter generates a massive explosion and then the sequence of dispersal-dispersal-colonization-population growth-outbreak occurs.

At least 19 viruses are known to be transmitted by the whitefly and almost all are members of the geminivirus group as

recognized by the International Committee for the Taxonomy of Viruses. At least three occur in tomato: tomato golden mosaic, tomato leaf curl and tomato yellow leaf curl. But Dr. Eugene Scheiber confirmed the presence of bean goldmn mosaic in 1970.

It seems there are different races of Bemisia tabaci. Our Dominican one colonizes heavily and completes its life cycle in 16 to 21 days.

Bemisia in Central America does not colonize tomato,according to Dr. Joe Saunders, CATIE; the one in Mexico prefers hot weather, according to FMC Representative, Mr. Octavio Flores, while the Dominican type prefers cooler weather.

Various decisions were made and implemented to try to diminish the Bemisia population. Foremost was to prohibit planting various crops such as tomato, melon, cucumber, watermelon, eggplant, okra, beans, cundeamor, potato, pepper, squash, cowpea and sweet potato between March 1 and September 1, agreed to between the private sector and the government.

We also tried a crop rotation based on corn and sorghum. Innocently, we stumbled into a massive natural control with an enormous production of Chrysopa sp. In conjunction with virtually no host crops, change of climate and Chrysopa, the population diminished considerably. Chrysopa were imported from California so as to boost our local population and to start our IPM program. Trichogramma for Heliothis control are being produced locally.

Plans were made as to what chemical products to use, how and when to use them. Technicians were brought in to teach us about the whitefly and develop an Integrated Pest Management Program. Seminars were held. A National Board for Integrated Pest Management was established with the private sector and the Secretary of State of Agriculture, with the assistance of the U.S. Agency for International Development.

Train your people so that they can assist and explain to the farmer. The concept of IPM is not easy to grasp. This is especially true after using Dipel. The farmer has difficulty believing the worm is dead because he can see it alive. Most farmers want to see a dead insect one minute after spreading. There is also the belief that the only good bug is a dead bug. Teach them and show them the beneficial ones.

The first decision taken for the 1989-1990 crop was to delay our first spray. Normally we spray for ants and crickets immediately upon plant emergence. This time, our first spray began 14-21 days after emergence. Thus, we eliminated two sprays of the eleven planned during the tomato crop cycle. No significant damage was done by the ants or crickets.

Our experience has shown us that Bemisia definitely prefers other crops rather than tomatoes. Eggplant, okra and melon appear to be are very delectable dishes, hence their possible use as traps. We plan on using these crops around and in our next tomato planting and, of course, corn and sorghum as refuge crops for our predators. There is a preference for some tomato varieties.

We came up with three surprises this past crop. First, that cultural practices can influence whitefly control, particularly irrigation practices. By observing what was taking place in our field, we noticed that we had a higher incidence of whitefly adults that coincided with the need to irrigate. We began to irrigate to saturation and at shorter intervals. The result was a decrease in whitefly levels. We speculate that a parasite, maybe a fungus, is working on the Bemisia and needs higher humidity. A fungus has been found but this is speculation.

Our second surprise and far greater threat to the industry was the appearance of a new insect in tomatoes, a member of the Miridae family tentatively identified as Cyrtopeltis tenuis. This insect was observed to be a predator on the whitefly nymph and contributed to high expectations that we had an additional element for biological control to assist us in our efforts to control the Bemisia. Our celebration was quickly dispelled when further observations confirmed that Cyrtopeltis girds the flower peduncle, causing partial or total flower drop, depending on where it feeds. If and when the level of whitefly numbers drops below the requirement of the Cyrtopeltis, it then starts feeding on the flower peduncle and new tender growth, which then fall off with the movement of the wind. The population increased directly in proportion to the Bemisia. Cyrtopeltis particularly concerns us because it means we will have to break our IPM program by using other chemicals. This use will lower our adult population of whitefly, but worse, it will lower our Encarsia and Chrysopa, and lead to a possible new outbreak, worsening the problem.

One third surprise began innocently enough. At our largest producer's farm, 130 ha, we had a major invasion of whitefly that was brought in on the wind. The farm is isolated and is surrounded on three sides by typical semi-desert vegetation of cacti and mesquite. Strangely enough, the whitefly eventually disappeared. Due to our heavy dews during the winter months and a longer time between sprays, we began to observe that the field was glistening with dew on spider webs. Upon closer scrutiny we found thousands of whiteflies in the webs. We held off our sprays altogether and let nature take its course. We found at least three different spiders. On one leaf we found a tiny spider and 23 adult whitefly skeletons. Dipel was used for Heliothis control over a period of 105 days. This farm was sprayed only five times. The last spray to harvest was 42 days.

It became our "University" and much experience was obtained to further our IPM/Biological Control Program.

Through the cooperation of Barceló Industrial, the Dominican Agricultural Foundation and Dr. Modesto Reyes, several experiments were developed. These experiments are to be published at a later date, so, we do not want to go into them, but they deserve mentioning.

1) DYNAMICS OF POPULATION. This trial was set up to observe all insect activity with no chemical control.

2) BIOLOGICAL CONTROL. Releasing Chrysopa and Trichogramma to boost the local populations.

3) TOMATO WITH TRAP CROPS. These included eggplant, okra, corn and sorghum. Since the first three are preferred over tomato, the idea was that Bemisia would stay on these crops and leave the tomato alone, or use chemical control to try to eliminate Bemisia, or after being heavily populated and colonized, simply eliminate and burn it. Corn and sorghum were planted as a refuge crop for predators, especially Chrysopa. Since Chrysopa seem to have a natural affinity for aphids/sorghum, they can be found there during the day. At night they go into the tomatoes (and in the sorghum too) and lay their eggs. Chrysopa lay their eggs anywhere and everywhere, from one to fifteen or more. Other predators we are taking advantage of are: Encarsia sp., Cyrtopeltis sp., Coccinella sp. and Arancida sp.

4) IPM. This trial was set up using chemicals "JMS stylette" Oil, "Trichlorfon" and "SAFER'S Natural Insecticide". Also included were biological controls and cultural practices.

5) IPM - Neem. In conjunction with the German group, GTZ, a trial was planted using Neem, a natural insecticide. Neem deserves serious consideration as a part of any IPM program. Dr. D.E. Meyerdirk et al report that it results in a reduction of whitefly. It is further reported to work on various other insects. Efforts are being made by the GTZ group and the private sector for large plantings of Neem and individual farmer plantings of one or two trees to be used as a natural insecticide or as a source for firewood. Plant some trees. The worse you can do is contribute to the reforestation of your country.

You are going to find that when you get a "whitefly mentality", you tend to forget or overlook the other insects--our old problems of leaf miner (Liriomyza), hornworm (Heliothis) and Keiferia sp. appeared again. We lost tomato fields this past

crop because of Keiferia sp. We have seen plantings of eggplant abandoned because of the severe attack of rejuvenated whitefly, sooty mold and thrip. This came about because once they were abandoned, natural biological control took over and eliminated the whitefly and thrips. Maybe we should learn something from this example.

After deliberations between the Secretary of Agriculture, the Dominican Foundation for Agriculture, JACC, the Private Sector, the U.S. Agency for International Development and various consultants, it was decided to establish a National Board for Integrated Pest Management. The National Board for IPM is being funded by the Agency for International Development through the Secretary of Agriculture (RD$2.75 million), the private sector (RD$2.3 million) and the Dominican Agriculture Foundation (RD$3.5 million). Through all of these efforts we have not eliminated the whitefly, but we have managed to diminish its population and continue to learn to live with it. Since we are on an island, we have nowhere else to go. Thus, we must confront the problem head on. We would propose that a Joint Caribbean effort be made in conjunction with Florida for exchange of information and technicians.

RESUMEN

Por más de dos años, la mosca blanca (Bemisia tabaci) ha causado serios problemas económicos en el sector del tomate industrial en República Dominicana, con pérdidas que exceden los RD$32,000,000. Para encarar el problema se está instituyendo un Programa de Manejo Integrado de Plagas entre la industria, el sector privado, la Secretaría de Agricultura, la Fundación Dominicana de Agricultura, la Junta Agroempresarial de Consultoría y Coinversión y la nueva Comisión Para el Manejo Integrado de Plagas. Con la implementación de este Programa esperamos controlar el ataque de la mosca blanca, Bemisia tabaci, y de ser posible, erradicarla.

SOME RECOMMENDATIONS FOR WHITEFLY CONTROL

1) Walk your field and observe what is going on.
2) Get rid of the piretheroids!
3) Use the softer insecticides whenever possible and rotate them.
4) Keep down the number of sprays. Do not try to spray away the problem.
5) Bring in predators and/or give the natural occurring ones a chance to build up to control levels.
6) Rotate crops - plant crops that can assist in preserving and maintaining beneficial insects.

7) Plant trap crops with your principal crop - spray carefully and choose the time of day when there is less predator activity.
8) Eliminate host plants in your crop as soon as possible.
9) Train your technicians so they can teach the farmer.
10) Start an integrated pest management program.
11) Walk your fields and observe.
12) Do not give up! You can learn to live with the whitefly.

List of most effective products for whitefly control*

Insecticide	Dosage/ha	Control/stage
Endosulfan EC	1600 ml	Adult
Orthene WP	880 ml	adult
Visect WP	400 ml	Adult
Safer EC	8 lt	Adult, nymphs some eggs
Endosulfan EC + Vydate L EC	800 ml 1200 ml	Adult, some nymphs
Endosulfan EC + Orthene WP	800 ml 640 ml	Adult
Endosulfan EC + Lannate WP	800 ml 240 gr	Adult
Endosulfan EC + Methamidophos EC	800 ml 560 ml	Adult
Endosulfan EC + Selecron EC	800 ml 400 ml	Adult
Endosulfan EC + Oil EC	1200 ml 1600 ml	Adult, some nymphs, some pupa
Rthene WP + Oil EC	540 gr 1500 ml	Adult, some nymphs, some pupa
Methamidophos + Oil	565 ml 1600 ml	

* In 110 gal. of water per ha.

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