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WHITEFLY RESURGENCE ON COTTON FROM THE YAQUI VALLEY SONORA MEXICO

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Introduction

The silverleaf whitefly *Bemisia argentifolii* Bellows and Perring, became a key cotton pest in Mexico and in different regions of the world early in the 1990´s. This pest has damaged cotton seriously in northwestern Mexico and has contributed to the increase in production costs of this crop. The area planted to cotton in Mexico has fluctuated through time due to different causes among others low fiber price at the international market, high production costs -greatly influenced by the use of insecticides- and fiber importation. In 1996, a new era in cotton pest control was iniciated due to the introduction of varieties modified to express some toxins of *Bacillus thuiringiensis* bacteria. The Bollgard® materials which contain the CryIAc toxin have been used extensively in Mexico, to reduce problems with the pink bollworm *Pectinophora gossypiella*, tobacco budworm *Heliothis virescens* and cotton bollworm *Helicoverpa zea*. The area planted to these materials reached 60.6% in 2004 (Martinez-Carrillo and Diaz-Lopez 2005) and maintained the same proportion in 2005. However, these biotech materials are not effective to control sucking insect pests such as the Silverleaf whitefly *Bemisia argentifolii*, Lygus bugs *Lygus* spp., Green stink bugs *Nezara viridula*, Brown stink bugs *Euschistus servus* and other plant suckers, which are serious cotton pests in different regions of Mexico.

The whitefly present in the Yaqui valley up to 1992 was *Bemisia tabaci*, this insect sporadically became a problen in cotton. However, since 1993, the *Bemisia tabaci* biotype "B", later known as the silverleaf whitefly, *Bemisia argentifollii* Bellows and Perring was detected. This insect increased rapidly, damaging several crops mainly soybeans, cotton, sesame, tomato, pepper, and various cucurbits such as watermelon, cantaloupe and cucumbers. Soybeans disappeared as an option for growers in Sonora and Sinaloa, due, among other factors to the silverleaf whitefly damage, draught and low soybean seed grain price in the market.

Hugh populations observed in 1994 forced the implementation of pest management actions at the regional level. The actions were supported by data generated through a regional whitefly research project, also through experiences obtained with national and international experts, and implemented in whitefly management groups. Contributions of the research project were published in eight scientific memories (Mosquita Blanca en el Noroeste de Mexico), which contain information to implement pest management strategies in any agricultural region of Mexico adapting the recommendations to the sociological and agroecological conditions of the region.

Results of the actions implemented in 1994, to reduce silverleaf whitefly populations were satisfactory and by 1997, the problem was reduced considerably (Ellsworth and Martinez-Carrillo, 2001). Unfortunately, after this year relaxation in planting dates and residue destruction, including weed proliferation, propitiated an excellent environment for whitefly reproduction. In the summer of 2004, at the end of the cotton season, high silverleaf whitefly populations were detected (Figure 1). However, since they increased at the time when cotton was ready to be harvested; damage to this crop was not appreciable. This same year a boll weevil eradication program was initiated in the Yaqui Valley, Malathion ULV was sprayed to cotton fields in order to reduce hibernating boll weevil populations. During the fall-winter crop season, crops such as common beans, green tomato, and watermelon were severely damaged by whiteflies; some plantations of common beans were destroyed before harvest due to the excessive whitefly damage.

Monitoring through yellow sticky traps indicated that since January 2005, high populations were detected (Figure 1); this influenced the application of insecticides against this pest earlier than other years. Besides whiteflies, cotton was affected by aphids, thrips, mites, and a variety of plant sucking insect pests. Up to five insecticide applications were sprayed only for whiteflies and control was not achieved in most of the cotton fields. The impact of this pest was tremendous, the area planted to this crop was 27, 692 ha, average yield was estimated to be 1,620 kg/ha cotton seed. Considering that average yield in the area is 3.5 to 4.0 ton/ha, yield reduction was between 54% and 60%. Factors involved and the actions taken to reduce this problem in the Yaqui, Valley will be discussed in this paper.

Analysis of the Production System

In any IPM management strategy, it is important to take into consideration the different crops established in the production system, they are the first trophic level of the alimentary chain and definitively have influence in the presence of specific insect pests which prefer those crops grown in the region. Thus, depending on the crops and area planted, the insect pests and the densities expected can be determined. If the insects are polyphagous, they will move among the crops and weeds and other vegetation present in the agricultural system. Because of this, the IPM strategies should take into consideration not only the crop in which the insect pest is present but also the complete production system, in order to implement the actions relative to each of the elements of the system.

In the Yaqui, Valley, main crops are wheat, corn, and safflower, which are not affected by whiteflies. Cotton, tomato, pepper, potato, watermelon, and other vegetables, that are preferred by whiteflies. This pest, moves through the production system according to the available food and prevalent environmental conditions. Population densities fluctuate depending on the food quality and biotic and abiotic factors present through the year. Also the cultural practices applied by the growers influence the population densities of the insect pests.

The whitefly IPM strategy implemented in 1984, through active participation of growers, agricultural authorities, researchers, pest control advisors, chemical companies and in general all people involved in agricultural production, achieve its goal in two years, reducing the massive whitefly populations to levels below damaging thresholds. The most important actions were adjust of planting dates, residue destruction as soon as the crops were harvested, weed control, rational use of insecticides, trying to use those with low impact on beneficial insects, host free periods, frequent meetings to train pest control advisors on sampling techniques, and decision making plans, diffusion through press, TV, radio and pamphlets to inform people of the situation of the pest at the regional level, and overall, a weekly follow up of the activities implemented and results obtained, which were analyzed in the technical whitefly working group (Ellsworth and Martinez-Carrillo, 2001)..

Successful results were observed so that by the growing season of 1996 whiteflies were not an agricultural problem in the Yaqui, Valley of Sonora. However, when not follow up is maintained people in general forget what it was achieved and by 1997, actions were relaxed and again planting dates were not controlled, crop residues left for some time in the field, not host free periods and in general a lack of plant protection discipline. The whitefly IPM strategic program did not eradicate the pest, since it has become endemic to the region, finally ten years later by the end of the 2004 crop season it resurged in an explosive way damaging mainly fall planted crops as common beans. In the 2005 crop season cotton was severely damaged.

Whitefly impact on cotton during the cotton growing season of 2005

Whitefly populations, have been monitored through time by the yellow sticky trap methodology, in 2005 weekly 24 h captures indicated since early February up to 22.73 adults per trap as compared to 0.93 and 0.27 obtained in 2003 and 2004 respectively (Martinez and Pacheco, 2005). This situation was informed to producers and agricultural authorities, but since there were not experiences in handling early season whiteflies on cotton, it was not considered as a potential problem. As the season progressed it was evident that whitefly populations continued increasing and insecticides were not reducing the problem, it was clear that a strategy should be implemented. However, since in 2004 it was initiated the boll weevil eradication program in this valley, the focus was on this pest, but through time the whitefly became more problematic, changes in objectives were established and again the whitefly working group was reintegrated.

INIFAP has a comprehensive organizational scheme on the way each of the participants in the whitefly management program should work in order to avoid an overlap of functions. This scheme was presented to agricultural authorities, as a proposal to obtain order and direction on the actions to be taken to control the pest, and to understand the responsibility each of the participants have in the strategic and operational plan.

There are three main groups official, technical and operational. The first one is formed by the agricultural authorities, whose main duty is to inform the community on the actual situation of the problem; also to encourage growers to participate in the regional plan.

The technical group designed the strategic plan to manage whiteflies in south of Sonora. The main objective was to consolidate the whitefly working group, which will analyze the monitoring data, suggest the actions to be implemented and inform on the whitefly situation to the authorities, establish the planting and residue destruction

dates, to eliminate food sources and have host free periods. Also promote protection of beneficial insects and massive releases of these organisms to augment biological control in the area.

The strategic plan is based on system analysis and insect pest management. Modification of the agricultural system through time and space is achieved by changing the planting dates and total areas planted of the different crops in the region given priority to those less preferred by whiteflies. This modification will reduce insect pressure in the area. Data obtained on yellow sticky trap monitoring, allows having information of the whitefly migration through the valley and population densities in each crop are evaluated by the binomial sampling methodology. When some hot spots are observed, notifications are made to the growers in order to reduce the population as soon as possible. Vegetable growers have to obtain a permit to establish their crops and must have a technical support of a pest control advisor as to the actions that have been planned to reduce whitefly populations in their crop land. The technical support has to be signed by both the producer and the advisor. The grower authorizes the plant protection agency in the area to destroy the crop in case it becomes risky for the agricultural system. Weeds have to be destroyed around cultivation area and authorities are responsible of weed control at the regional level. In the area of biological control the aim is to protect natural beneficial insects by using narrow action or specific insecticides, and the massive release of Chrysopa. Chemical control involves the rational use of insecticides, considering rotation and alternation of products according to the mode of action in order to reduce selection pressure. When possible the use of biorational insecticides such as soaps, vegetable oils, and botanical extracts are encouraged. Pyrethroids are delayed to middle or late season. Sampling and use of thresholds is recommended before taking chemical control actions. Besides, courses and pest management training are suggested. Also it was considered in this plan support to research projects in order to generate information to sustain the actions implemented in a campaign against the whitefly in south Sonora.

The operative group is responsible for getting the data needed to design the control actions. They sample the crops and organize the yellow sticky traps data, notify growers of the actions that have to be taken and go behind the recommendations generated in the technical group.

The plan is working well up to now, every Tuesday the technical group gets together and evaluates the impact of the actions suggested the week before. Whitefly populations by the end of 2005 have been reduced considerably as compared to last year (Figure 1). However, the impact on cotton producer was serious and will be in the records and memories of this region for years.

Conclusions

Silverleaf whitefly continues to be a serious insect pest of several crops in south Sonora and other agricultural regions of Mexico. Outbreaks of this and other pests are usually related to unbalance of the systems due to the intensive agricultural exploitation and lack of order, discipline, opportunity and efficiency of the actions taken to manage crops. The silverleaf whitefly has increased in south Sonora because it has found the requirements needed for its reproduction an survivorship, among others preferred food, favorable environmental conditions, few natural enemies, ineffective insecticides, applications out of time, and not efficient, all have contributed for the whitefly to become again an explosive pest. On order to reduce this problem it is a priority to retake the management activities designed ten years ago and now established in the regional whitefly management plan. Overall it is important the participation of all people involved in agricultural production at the regional level, such as growers, pest control advisors, authorities, and researchers.

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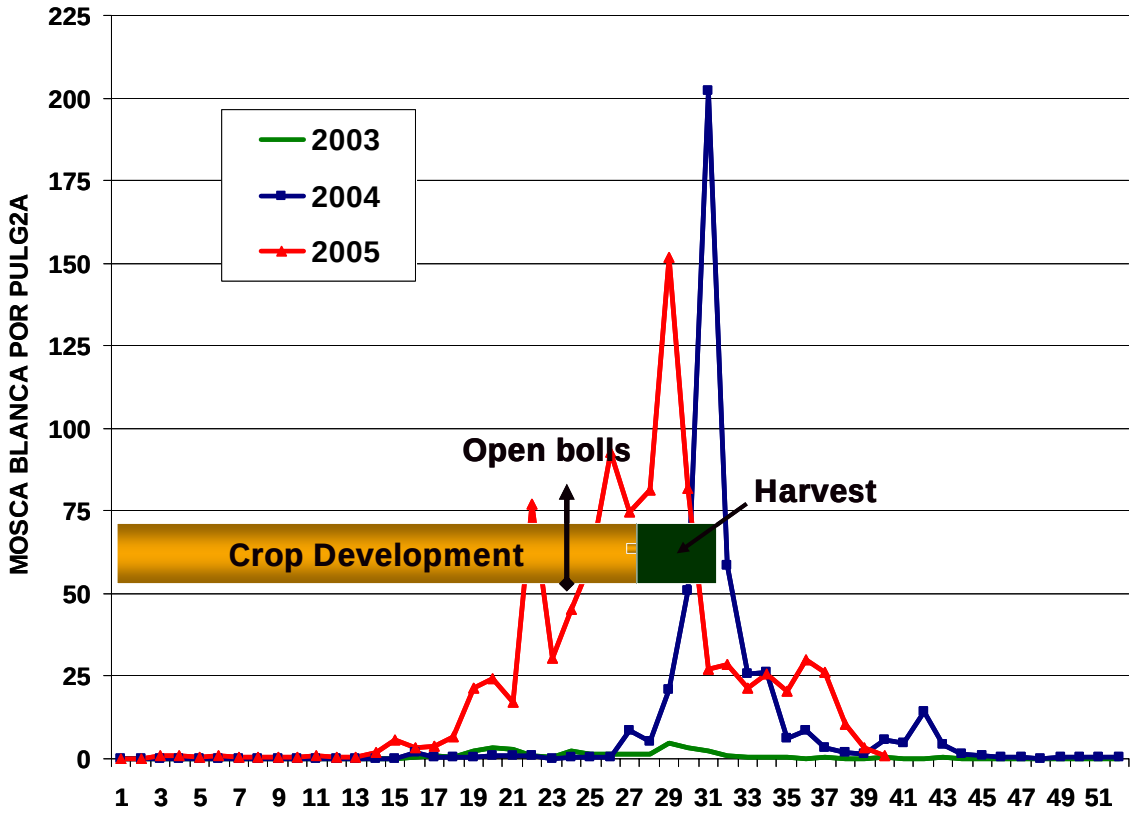

Figure 1. Population densities of *Bemisia tabaci* biotype "B" in the Yaqui Valley, Sonora, measured through yellow sticky traps. 2003-2005.