

A basic outline of the insect-related stickiness problem and its management in cotton

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Summary: The honeydew-producing insects in cotton are whiteflies, aphids and mealybugs. Fiber stickiness is caused by the swarming of these insects at the end of the cotton growing cycle, when bolls are open. They have been increasing in number over the last few years because of changes in climate and cropping practices, pesticide resistance and probably also because of the appearance of new biotypes. Direct chemical control is often ineffective at the end of the cotton cycle. It is preferable to adopt an integrated approach involving cultural practices and an accurate varietal choice, seeking to increase natural control and to eliminate or at least reduce the support provided by the leaves that persist at the end of the cycle.

Introduction

Drops of honeydew deposited onto cotton fiber are the excretory products of sucking insects belonging to the insect Order Homoptera: whiteflies, aphids and mealybugs. Once these insects have ingested the elaborate sap that circulates in the phloem vessels, they excrete the excess carbohydrates after having modified their chemical structure. This physiological particularity can be used to confirm the entomological origin of the honeydew on the fiber because of the presence of trehalulose and melezitose which are not sugars naturally present in the plant. The problems posed by sticky cottons increased in the course of the 1980's and today constitute a major hazard in most cotton-producing countries.

The insects responsible

Three species or groups of species are encountered frequently on cotton plant at the end of the season: the aphid *Aphis gossypii* Glover, the whiteflies - mainly *Bemisia tabaci* Gennadius, but also *B. afer* and *Trialeurodes* spp. - and the mealybugs *Ferrisia virgata* and *Pseudococcus filamentosus*. However, only the first two have a major economic impact. These insects present common biological characteristics: high multiplication capacity (a generation every 15 days for whiteflies, but every seven to nine days for aphids) and localization under the leaves. In addition to producing honeydew, they also cause trophic damage because of their substantial consumption of sap which normally nourishes the plant. They are also vectors of viral diseases that affect cotton plants ("Blue disease" carried by aphid, Mosaic and "Leaf curl" by whitefly).

Assumed origins of the current situation

Fiber stickiness has been known for many years. Honeydew contamination was often attributed to the whitefly *B. tabaci*.

It was suggested that repeated applications of DDT-based formulations, widely used on cotton from the 50', were responsible, because DDT and its metabolites were considered as enhancing whitefly egg-laying. Meanwhile organophosphates, more specifically directed against sucking insects, progressively lost their effectiveness because of the development of resistance.

More recently (in the 80'), whiteflies and aphid populations have been seen to increase in almost all cotton producing countries. According to cultivation practices, reasons for this may be:

- the introduction and use of pyrethroids to control bollworm and which, while being ineffective against sucking insects, destroy beneficials;
- recourse to low volume spraying techniques (through aerial or ground ULV equipment) that are unable to coat the inner surface of the foliage;
- increased dosages of nitrogen which favor the vegetative growth of the cotton plant; while increasing sap-sucking by the insects;
- the apparition of new biotypes.

The problem in Africa also includes the increased production since this has created a labor shortage and led to late harvesting.

Improving honeydew-producing insect management

Three approaches are possible in an attempt to reduce the incidence of honeydew on cotton fiber:

- remove the fiber from contamination roots;
- reduce the insect population;
- remove the vegetal support on which the insect population is likely to develop.

Removing the fiber from possible contamination in fact means harvesting the bolls as soon as they open. Obviously, this measure requires labor availability that is not always easy to organize for small-scale producers, as well as financial incitement to pick early.

Reducing the number of insects that produce honeydew is possible through a set of cultural practices and varietal choices and by respecting natural enemies before implementing direct control methods:

- as far as cropping practices concerned, the farmer has to choose sowing date the less favorable for the sucking insect populations, and plant the rows further apart, reduce the dosage of nitrogen and use growth regulators to restrict the exuberance of the vegetation;
- as far as varietal measures are concerned, attention has to be focused on selecting morphological or physiological traits of the cotton cultivar capable of slowing population growth as well as developing a plant growth pattern at the end of which the plant dries out very rapidly and loses its leaves;
- as far as the encouragement of natural factors is concerned, practices could be conducted to enhance the action of beneficials (predators and parasites) which decimate aphid and

whitefly populations. Insect pathogens efficacy will be enhanced by indirect measures (modifying crop microclimate);

- finally, direct control measures consist of the judicious choice of chemicals (specific products, with systemic effects), combined with effective spraying methods (sufficient volume to coat the entire canopy), possibly in combination with varietal traits controlling leaf morphology ("okra" leaf).

The most promising measures today seem to be those removing the leaf as a support where the insect populations grow and multiply. Three research routes are proposed:

- breeding of varieties of determined growth that lose their leaves at maturity,
- use of defoliant,
- manual topping of the cotton plants at the end of the cycle.

We have also to take into account that the honeydew-producing insect management has to be planned not only inside the cotton plot, but also at the agrosystem level, where other crops are refugia for cotton pests, when adults escape pesticide applications or host-plants for populations during the dry season.

Conclusion

The struggle against honeydew-producing insects draws on various techniques but all enter into the concept of Integrated Crop Management. Mastering the situation will only be achieved at the agrosystem level, and by combined efforts in cropping methods, varietal selection and a rational use of chemicals in the cotton plot.

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