

Weekly Publication of



**Cotton
Association
of India**

COTTON STATISTICS & NEWS

Edited & Published by Amar Singh

2015-16 • No. 23 • 8th September, 2015 Published every Tuesday

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WHITEFLY –THE BLACK STORY

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Three years in a row, the whitefly has been on a song in north India. Two weeks ago, I went to Punjab, Haryana and Rajasthan. Clearly the whitefly was on a high. There was hardly any cotton hybrid that was unaffected with the whitefly and the cotton leaf curl virus disease that it transmits. Some hybrids were more susceptible. A few hybrids were tolerant to whiteflies and the leaf curl virus disease as well. August is generally not the peak month for the whitefly. Late September and October are expected to have the highest peaks of the insect. Are we to expect a menace of the whitefly in north India by this month-end? If proper timely steps are not initiated, this insect will grab the national headlines in the next 4-5 weeks time.

WHITEFLY: The whitefly was first reported in Greece 125 years ago. It became a major pest on cotton in India only after 1984. Whitefly is a small white insect of 1.0 mm length. It feeds on more than 500 plant species and transmits a range of viral diseases in plants. Whiteflies suck sap from under surface of leaves causes yellowing and upward curling of the leaves. Though, the ideal conditions for growth are 27°C and 71% relative humidity, hot and humid conditions favour the insect. The insect excretes sticky honeydew which promotes a fungal sooty mould formation on leaves and cotton bolls. The black mould interferes with photosynthesis in leaves and reduces quality of the cotton fibre. Sticky cotton is not accepted by

ginners and the textile industry. Cotton losses were estimated to be in the range of 15-20% and sometimes up to 30%.

The scientific name of the whitefly is *Bemisia tabaci*. But in 1994, a new aggressive biotype 'B biotype' was debatably categorized as a new species *Bemisia argentifolii*.

The presence of a wide range of hosts such as vegetables, pulses, citrus all through the year helps the whiteflies to survive and proliferate. But clearly, it is human interventions that aggravate the crisis.

COTTON LEAF CURL VIRUS (CLCuD): The whitefly transmits the dreaded cotton leaf curl virus disease in Pakistan and north India. There are no control measures for the leaf curl virus. Disease affected plants are stunted with fewer number of bolls and reduced yields. Infected plants serve as source of inoculum and infestation for the remaining healthy fields. Almost all the Bt-cotton hybrids in north India were found to be affected by the disease. However a few hybrids were found to be tolerant to whiteflies and the virus. Interestingly, early sown crop was found to be less affected.

EXPERT'S Column



Dr K.R. Kranthi

INSECTICIDE INDUCED WHITEFLY OUTBREAKS: Why is the whitefly having fun in north India? It is interesting that this small insect emerged as a major menace on cotton in India only after 1984. There were severe outbreaks in 1987-88 in Andhra Pradesh and later in Maharashtra, Gujarat and Punjab. Clearly the trigger was a group of insecticides called 'synthetic pyrethroids' that were introduced into the country in 1981. There was clear evidence that indiscriminate use of the pyrethroids was aggravating the problem. A small experiment

conducted in Arizona almost two decades ago by Peter Asimwe showed that when acephate was sprayed four times at biweekly intervals, the treated plots sustained heavy damage from whiteflies leading to plant death. Imagine a tank-mix of pyrethroid + acephate being sprayed repeatedly. This leads to a quick surge in whiteflies resulting in outbreaks. This is what happens more frequently in north India. There have been many such cases with many insecticides that aggravate whitefly infestation in crops, especially in cotton. DDT was known to have caused it in several parts of the world. Fipronil is a recent insecticide that was found to cause whitefly resurgence in north India. Thus it is clear that broad spectrum insecticides and insecticide mixtures cause high levels of whitefly resurgence.

WHAT CAUSES OUTBREAKS: Whitefly is an invited guest and an induced pest. Human interventions are responsible for the insect to survive, reproduce, spread and proliferate. A combination of factors such as a) susceptible hybrids, b) hairy or bushy genotypes, c) late sowing, d) high nitrogenous fertilizers, e) inadequate phosphorus and Potassium in the soil, f) indiscriminate use of pyrethroids, acephate, fipronil and mixtures, g) whitefly resistance to insecticides, i) scant regard for proper choice of control measures, j) improper spray application methods and k) favourable weather.

HOW CAN INSECTICIDES INDUCE PEST OUTBREAKS?: Of course they do. At CICR we found that synthetic pyrethroids and acephate induce bollworms and whiteflies and; spinosad induces mealybugs. Insect pests, including whiteflies are naturally controlled by predators and parasites called 'natural enemies' in the field. The natural enemies are generally more susceptible to insecticides than the insect pests. For example, the whiteflies have a waxy coating over the body which protects against insecticides; but its natural enemies are not protected. The whiteflies feed from under surface of the leaf where insecticides do not easily reach. The natural enemy predators and parasites are generally present all over the plant and get exposed to insecticides. Insect pests become resistant quickly to insecticides whereas natural enemies take a longer time for resistance development. Additionally there is a phenomenon reported with whiteflies and American bollworms, called 'hormoligosis' which causes insects to rapidly reproduce and multiply when the surviving insects perceive chemical stress, especially at sub-lethal doses. An insecticide mixtures such as cypermethrin+profenophos was found to induce strong hormoligosis in bollworms in our laboratory. Some reports also describe insecticide-induced physiological changes in the plant which become more favourable to insect pests. Thus more the insecticide sprays -more the problem.

CURRENT STATUS: During the cotton season

2015-16 an epidemic of whitefly incidence was noticed during August in the cotton growing areas of Haryana, Punjab and Rajasthan. The white fly populations were above economic thresholds in almost all the regions surveyed in Punjab, Haryana and Rajasthan. Whitefly infestation and the CLCuV disease were first noticed in early June. The menace increased in July-August. The insect infestation and whitefly incidence were higher than the previous three years. The virus caused leaf curl symptoms during August in >90% of the hybrids surveyed in the three states, except in early sown crop. Whitefly incidence ranged from 1.6 to 90 adults /3 leaves during July-August in Sirsa. Thus far, high levels of whitefly infestation were noticed in the second week of August in all the three states.

Fields sprayed with repeated insecticide sprays, insecticide mixtures, fipronil and pyrethroids had the highest levels of whitefly infestation. In Rajasthan, the initiation of whitefly infestation started in the last week of June. The white population ranged between 20- 140 whiteflies/3 leaves. In Punjab, whitefly incidence was very severe in Abohar, Faridkot, Fazilka, Muktsar and Mansa districts, to an extent of about 60 -90 insects per leaf in some fields. Infestation was also severe in Hansi and Hisar region of Haryana mainly due to planting of susceptible Bt cotton hybrids.

SOME BITTER FACTS: Global experimental data affirms that majority of recommended insecticides disrupt naturally occurring biological control thereby leading to whitefly outbreaks in cotton across the world. This season insecticides such as fipronil and synthetic pyrethroids were used frequently also as mixtures with organophosphate insecticides (monocrotophos, acephate and triazophos) in north India right through July-August. These insecticides severely aggravate pest populations leading to resurgence and outbreaks.

Majority of the Bt-cotton hybrids grown in north India are susceptible to whiteflies and the CLCuV. This year, in many parts of the north, there was delay in sowing by 15-20 days, which helped the whitefly. High levels of urea (nitrogenous fertilizer) were used mostly in Haryana and Punjab. Insecticide mixtures mostly with pyrethroids plus acephate were sprayed indiscriminately. Spray application methods were bad. Deficient rainfall of less than 100 mm up to July coupled with cloudy conditions and high humidity created favourable weather for the insect pest. Everything is working out well for the whitefly.

Bt cotton hybrids cultivated in north India were released directly without subjecting them to rigorous screening for tolerance to whitefly and the leaf curl virus. More than 90% of the Bt-cotton hybrids under cultivation are highly susceptible to the whiteflies and the cotton leaf curl virus.

The weather during July 2015 was ideally suited for whiteflies. Prolonged cloudy conditions and intermittent scanty rains caused high humidity and hot weather leading to whitefly outbreaks.

Late sowing after second week of May caused high levels of CLCuV infestation coupled with whitefly outbreaks. This year sowing was delayed due to late harvesting of wheat and late release of canal water. Therefore the CLCuV disease is high. As per the CICR survey conducted during the third week of August 2015, crop sown before the first fortnight of May is relatively healthy and crop sown subsequently was stunted and more vulnerable to whitefly and the CLCuV disease. Late sown crop has tender foliage in June-July which coincides with whitefly peaks thus leading to higher pest infestation. Whitefly incidence at high levels early in the season caused sooty mould in some hybrids due to the honey dew excreted which resulted in poor growth of plants.

Whiteflies are present continuously in north India due the availability of wide range of crops all through the year. Crops such as rice, guar (cluster bean), and moong, groundnut and kharif vegetables are predominantly grown during the season. Both guar and moong crop are a good alternate host of whitefly. The insect is continuously subjected to selection pressure by insecticides used for its control. Several weeds serve as hosts for the whitefly and the CLCuV disease. Severity of the disease depends on the level of weed infestation in the vicinity of fields.

INSECTICIDE RESISTANCE: Studies conducted by CICR showed that whiteflies in north India have developed resistance to all the commonly used insecticides. 'Neonicotinoid' group insecticides are most commonly used in north India. Whitefly resistance to the neonicotinoid insecticides is high in north. There are very few insecticides that are effective. This has resulted in excessive indiscriminate insecticide sprays that disrupted ecosystems, which led to the severe whitefly outbreaks and further development of resistance.

CICR is monitoring for insecticide resistance development against 12 insecticides in whiteflies and jassids collected from 24 locations across the country. Insecticide resistance monitoring carried out by CICR showed high level of insecticide resistance to acetamiprid, thiomethoxam, imidacloprid, monocrotophos, clorpyrifos, triazophos and acephate. The institute is also monitoring for resistance development in bollworms to Bollgard-II. Based on the results, IRM strategies will be developed and disseminated across the country.

HYBRID SUSCEPTIBILITY: CICR is conducting a multi-location experiment with 143 Bt-cotton hybrids this year at five locations (Hisar, Sirsa,

Sriganganagar, Bhatinda and Faridkot) in the three north India states of Haryana, Rajasthan and Punjab to evaluate for tolerance/susceptibility to CLCuV and whiteflies. Recommendations of tolerant Bt-cotton hybrids to be preferred for 2016, will be finalized from the trial data.

RECOMMENDATIONS FOR MANAGEMENT: For effective management of the pest, crop ecosystems must be least disturbed. Never use Fipronil, synthetic pyrethroids or any insecticide mixtures. Avoid excessive urea application. Use NPK mixed fertilizers as split doses. Plant yellow sticky traps at 5 traps per 100 sq metre. For best long term results, neem-oil and castor oil based insecticides, soap sprays and insect growth regulators are recommended. Initially use vacuum suction traps followed by a sequential use of water sprays, soap sprays and neem-oil based neem seed kernel extracts. If needed insect growth regulators such as difenthiuron, buprofezin, spiromesifen, and pyriproxifen can be used after mid-August. These insecticides are effective on whiteflies and are relatively safer to its natural enemies.

NEED FOR A ROBUST POLICY: If cotton has to survive in north India, it is important that some policies are formulated. 1. Never allow CLCuV susceptible varieties/hybrids to be permitted for cultivation. 2. Create facilities for early sowing before the end of April by providing irrigation and enforcing a ban on sowing after 7th May. 3. Insect pest management must be based on sticky traps, reflective sheets, suction traps, soap emulsions of neem oil, castor oil, fish oil rosin soap and insect and insect growth regulators. 4. Appropriate spray methods must be used to ensure that the spray fluid covers the under-surface of leaves. 5. Fields and vicinity must be kept weed free

I must mention here that during my visit to north India in August, I was delighted to see that all the varieties of the Desi cotton species *Gossypium arboreum* were immune to the virus and were absolutely unaffected by the whitefly. In fact there were hardly any whiteflies on the Desi varieties. But the area under Hybrid cotton is about 1.46 million hectares in north India, while the Desi cotton species is now cultivated in just about 0.04 million hectares. My respect for Desi cotton jumped a few notches above than the current high levels. Desi cotton species *Gossypium arboreum* is immune to CLCuV. Desi cotton species *Gossypium arboreum* is highly resistant to the whiteflies. Therefore, for next year, farmers should be advised to choose either Desi cotton varieties or whitefly tolerant and CLCuV tolerant varieties / hybrids in the American cotton species, *Gossypium hirsutum* and sow early.

(The views expressed in this column are of the author and not that of Cotton Association of India)