Whiteflies: *Bemisia tabaci* (Gennadius, 1889)

Identity

Preferred Scientific Name: *Bemisia tabaci* (Gennadius, 1889)
Preferred Common Name: tobacco whitefly
International Common Names: cassava whitefly; cotton whitefly; silver leaf whitefly; sweet potato whitefly


Bemisia tabaci

Description

B. tabaci adults are about 1mm long and similar to the glasshouse whitefly *Trialeurodes vaporariorum*). The two species are difficult to distinguish in the field, but differ slightly: The wings of *B. tabaci* are held tent-like above the body and slightly apart, so that the yellowtinged body is more apparent. Adult females tend to lay eggs randomly, either singly or in scattered groups, usually on the under-surface of leaves, whereas the glasshouse whitefly usually lays its eggs in a semi-circle. However, on smoother leaved plants, such as *Ficus*, *B. tabaci* generally lays eggs in semi-circles.

Bemisia tabaci has been reported from all continents except Antarctica. *B. tabaci* and its biotypes are polyphagous and now attack many crops. Over 900 host plants have been recorded for *B. tabaci* and it reportedly transmits 111 virus species. The genus *Bemisia* contains 37 species and is thought to have originated from Asia (Mound and Halsey, 1978). *B. tabaci*, being possibly of Indian origin (Fishpool and Burban, 1994), was described under numerous names before its morphological variability was recognised. Three distinct groups of *B. tabaci* have now been identified using molecular techniques (Frohlich and Brown, 1994).


Fig.2: Adult greenhouse white fly (*Trialeurodes vaporariorum)*

Bemisia tabaci is believed to be a species complex, with a number of recognised biotypes and two described extant cryptic species. Nineteen biotypes have been identified based on non-specific esterase banding patterns (biotypes A-T), and the two described species are *Bemisia tabaci* and *Bemisia argentifolii* Bellows and Perring (Bellows *et al.* 1994). *B. argentifolii* carries the common name of silverleaf whitefly or poinsettia strain. The B biotype is highly

polyphagous and almost twice as fecund as previously recorded strains, and has been documented as being a separate species, *B. argentifolii* (Bellows et al., 1994).

Hosts/species affected

B. tabaci is highly polyphagous attacking over 900 host plants. Until recently, *B. tabaci* was mainly known as a pest of field crops in tropical and sub-tropical countries, on cassava, cotton, sweet potatoes, tobacco and tomatoes. However, currently *B. tabaci* is a pest of an extremely wide range of host plants, and the number of recorded hosts is increasing. They include crops such as cotton, soyabean, cassava, cucumber, aubergine, peppers, tomatoes; cut flowers especially *Solidago*, herbs such as thyme and rosemary and ornamental plants (e.g. *Pelargonium* sp., *Impatiens* sp., *Gerbera* sp. *Hibiscus* sp., and *Begonia* sp., *Arum* spp., *Begonia* sp., *Coleus* sp., *Fuschia* sp., *Pelargonium* sp., *Primula* sp., *Verbena* sp. and *Euphorbia* spp. (e.g. poinsettias).

Growth stages affected

Flowering stage, Seedling stage and Vegetative growing stage

Biology and Ecology

Whiteflies have an interesting biology (called arrhenotoky) in which females can lay eggs that have not been fertilised and these eggs will result in male offspring. Fertilised eggs will result in female offspring. Each female can produce as many as 200 eggs in her lifetime. It takes 30-40 days to develop from egg to adult, depending on the temperature (CABI, 2016).

Eggs, deposited on the underside of leaves, (Note: circular egg deposition for *Bemisia* is rare) are tiny, oval-shaped, about 0.25mm in diameter and stand vertically on the leaf surface. Newly laid eggs are white then turn brownish. On hatching, the first instar or crawler is flat, oval and scale-like, and is the only mobile larval stage. It moves to a suitable feeding location on the lower leaf surface where it moults and becomes sessile throughout the remaining nymphal stages. The first three nymphal stages last 2-4 days each (depending on temperature). The fourth nymphal stage is termed the puparium, and is approximately 0.7 mm long.
True pupation within the whitefly life-cycle is debatable as it does not occur in other Homopterous families, although the last stage of the fourth nymphal instar after apolysis has been completed is typically referred to as a pupa. Pupation lasts for about 6 days and within the latter period, the metamorphosis to adult occurs. Adult whitefly is about 1mm long with two pairs of white wings and light yellow bodies.

While whitefly adults can be seen on all plant surfaces, they spend most of their time feeding, mating and ovipositing on the under surfaces of leaves. Males and females are present, typically in even ratios, and mating takes place after an elaborate courtship period.

Adult females insert their eggs into the foliage of host plants and the newly-hatched nymphs settle for larval life with little movement on the plant chosen by the parent. Winged adults fly about, however, and move between crops (Byrne *et al.*. 1996).

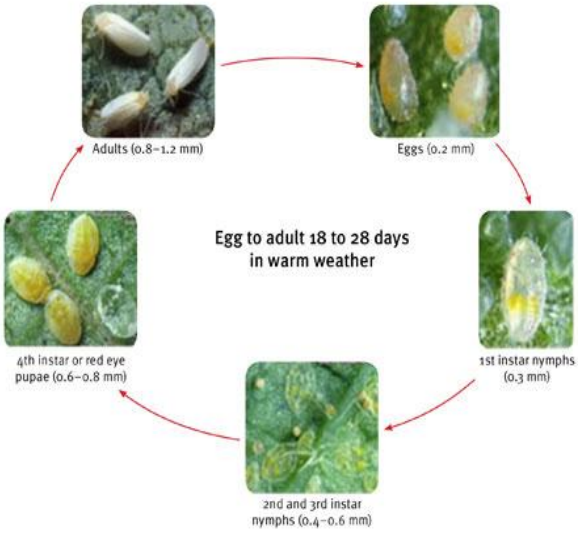

Fig. 3: *Bemisia sp* Life cycle

Symptoms

Infested plants may exhibit a range of symptoms due to direct feeding damage, contamination with honeydew and associated sooty moulds (e.g., *Cladosporium* and *Alternaria* spp.), whitefly-transmitted viruses and phytotoxic responses. There may be one, or a combination of the following symptoms: chlorotic spotting, vein yellowing, intervein yellowing, leaf yellowing, yellow blotching of leaves, yellow mosaic of leaves, leaf curling, leaf crumpling, leaf vein thickening, leaf enations, leaf cupping, stem twisting, plant stunting, wilting and leaf loss. Phytotoxic responses such as a severe silvering of courgette and melon leaves usually indicate the presence of a *Bemisia argentifolii* infestation (CABI, 2016).

Means of movement and dispersal

Adults of *B. tabaci* do not fly very efficiently but, once airborne, can be transported quite long distances by the wind.

Movement in trade

All stages of the pest are liable to be carried on planting material and cut flowers of host species. For instance, the international trade in poinsettia is considered to have been a major means of dissemination of the B biotype of *B. tabaci* within the EPPO region. Ornamental plants are the main source of introduction of *Bemisia tabaci* to the UK (CABI, 2016).

Bemisia tabaci was first intercepted in the UK in 1987 on poinsettia cuttings and since then outbreaks have occurred annually, again mainly on poinsettia. It has also been intercepted on a wide range of other plant material including bedding plants such as lantana and verbena and on pot plants such as Ficus species, ornamental citrus and also on herb cuttings.

It is believed that *B. tabaci* has been spread throughout the world through the transport of plant products that were infested with whiteflies. Once established, *B. tabaci* quickly spreads and through its feeding habits and the transmission of diseases, it causes destruction to crops around the world.

Impact

Most biotypes of *B. tabaci* can vector of over 100 plant viruses in the genera *Begomovirus* (Geminiviridae), *Crinivirus* (Closteroviridae) and *Carlavirus* or *Ipomovirus* (Potyviridae) (Jones, 2003) and a rod-shaped DNA virus (Markham et al., 1994; Alegbejo, 2000). Damage is caused not only by direct feeding, but also through transmission of viruses. *Begomoviruses* are the most numerous of the *B. tabaci* transmitted viruses and can cause crop yield losses of between 20% and 100% (Brown & Bird, 1992).

The feeding of *B. tabaci* adults and nymphs causes chlorotic spots to appear on the surface of the leaves. Depending on the level of infestation, these spots may coalesce until the whole of the leaf is yellow, apart from the area immediately around the veins. Such leaves are later shed. Heavy infestations of *B. tabaci* and *B. argentifolii* may reduce host vigour and growth, cause chlorosis and uneven ripening, and induce physiological disorders. The honeydew produced by the feeding of the nymphs covers the surface of the leaves on which sooty moulds grow, reducing the photosynthetic capabilities of the plant, resulting in defoliation and stunting. Honeydew can also disfigure flowers and, in the case of cotton, can cause problems in processing the lint. *B. tabaci* is known to be a potentially damaging pest of crops such as cotton, brassicas, cucurbits, okra, solanums in the tropics and subtropics (CABI, 2016).

The damage potential of this pest as a direct plant stressor, virus vector, and quality reducer (e.g., by contamination with excreta) is substantial.

Phytosanitary significance

B. tabaci (implicitly including its B biotype) is regulated by the European Union (EU, 2000) and by other EPPO countries. Some areas in the EU (British Isles, Nordic countries, parts of Portugal) are maintained as 'protected zones'. *B. tabaci* also presents a risk to countries in Central America, the Caribbean, Africa and South America.

The risk is primarily to the glasshouse industry in northern countries (Bedford et al., 1994b), and mainly concerns the B biotype. Since its recent introduction to several of these countries, the pest has proved particularly difficult to combat because of its polyphagy, its resistance to many insecticides and its disruption of biological control programmes (Della Giustina et al., 1989).

Because *B. tabaci* is the vector of a number of mainly tropical begomoviruses, temperate areas face the risk that these viruses, of which certain ones are listed for example in EU regulations (EU, 2000), will enter with their vector. The EU requires special measures to deal with this additional risk.

Detection and inspection

While whitefly adults can be seen on all plant surfaces, they spend most of their time feeding, mating and ovipositing on the under surfaces of leaves. In the field or greenhouse situations,

infestations of whiteflies can be easily spotted by the presence of: plant damage (chlorosis, stippling, etc.); whitefly immatures located on the underside of foliage and the presence of adults which will readily fly when the plant material is disturbed.

Figure 4. White flies found on the under side of bean leaves (Picture by KEPHIS)

Bemisia tabaci are usually detected by close examination of the undersides of leaves, which will reveal adults and/or nymphs. Shaking the plant may disturb the small white adults, which flutter out and quickly resettle. Adults may also be found on sticky traps placed above infested plants.

Management

Cultural Control: Intercropping practices using non-hosts have been used in many countries aiming to reduce numbers of whiteflies on specific crops. Weed species play an important role in harbouring whiteflies between crop plantings and attention should be paid to removing these in advance of planting susceptible crops. Weeds also often harbour whitefly-transmitted viruses (Bedford et al., 1998) and may be a major source of crop virus epidemics.

Biological Control: Conservation of natural enemies is important in field crops where feeding damage is the cause of losses, rather than virus transmission. Attempts have been made in Israel to enhance natural enemy action on cotton by introduction of additional, hopefully more efficient parasitoids (Rivany and Gerling, 1987). This has resulted in the establishment of two species from the USA, *Encarsia luteola* and a species of *Eretmocerus*.

Beneficial insects are used alongside chemicals that offer a high level of selectivity such as insect growth regulators. However, the use of biological control agents alone, such as *Encarsia formosa* and *Verticillium lecanii*, although moderately successful (Nedstam, 1992), can never bring infestation levels down to a level that stops virus transmission, as *B. tabaci* is such an efficient virus vector.

Chemical Control: *B. tabaci* appears to develop resistance to all groups of pesticides that have been developed for its control. A rotation of insecticides that offer no cross-resistance must therefore be used to control *B. tabaci* infestations. Active ingredients that have already been reported to have an effect in controlling *B. tabaci* worldwide include bifenthrin, buprofezin, imidacloprid, fenpropathrin, amitraz, fenoxycarb, deltamethrin, azidirachtin and pymetrozine.

Phytosanitary Control: In countries where *B. tabaci* is not already present, the enforcement of strict phytosanitary regulations help reduce the risk of this whitefly becoming established. Because of the difficulty of detecting low levels of infestation in consignments, it is best to ensure that either the area or the place of production is free from the pest (EPPO, 2016). If this cannot be achieved, a detailed treatment and inspection regime can be used to ensure that traded plants are free from the pest.

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