

OCCURRENCE OF *BEMISIA ARGENTIFOLII* ON CHRYSANTHEMUMS IN NORTHERN TANZANIA

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Abstract: Samples of whiteflies were collected from *Dendranthema* spp. in major growing areas of Tanzania. The insects were transferred onto test plants to confirm host specificity. Infested with insects, test plants were then protected with polyethylene bags. Samples of whiteflies from infested plants were taken at 10 day intervals post-infestation (dpi), 28 dpi and 35 dpi, for behavioural studies. At 10 dpi eggs were seen as oval bodies while at 28 dpi crawling bodies and newly emerged adults were observed, leaving behind characteristic shiny hollow cases. At 35 dpi, all the stages of development were seen. The features observed are typical of *Bemisia argentifolii* and the area is endangered by the occurrence and spread of viruses transmitted by this species. This identification, which is an integral part of pest surveillance, initiates a study of the viruses and will lead to pest records for regulatory purposes. The international scientific and trading community is assured that the report reflects the real situation. The pest is thought to be present in the reported areas only and the pest status is actionable and under surveillance.

Key words: Pest surveillance, *Bemisia argentifolii*, *Dendranthema*, Tanzania

INTRODUCTION

Horticultural industry in Tanzania contributes significantly to the country economy. The industry creates jobs to the growing urban dwellers and contributes to country's foreign exchange earnings. For flowers, the most important crops in the country are roses (*Rosaceae*) and chrysanthemums (*Asteraceae*). Whiteflies (*Homoptera: Aleyrodidae*) infest greenhouse grown and outdoor horticultural crops. The sucking of phloem sap by both adults and larvae stunts plants. The honeydew they secrete also fouls shoots, making the produce unmarketable. There are three whitefly species likely to be encountered in greenhouse grown flowers: greenhouse whitefly *Trial-*

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eurodes vaporariorum Westwood, banded-wing whitefly *T. abutilonea* Haldeman, and sweet potato whitefly *Bemisia tabaci* Gennadius.

B. tabaci has a number of strains which differ in their host plant range, ability to produce plant disorders and to transmit viruses (Martin 1999). Strain B, which causes silver leaf symptoms in pumpkin and squash, is considered to be a separate species *B. argentifolii* (Perring *et al.* 1993; Bellows *et al.* 1994; Greer 2000; OEPP/EPPO 2004). Those earlier studies considered that the physiological change (silverleafing) was induced only through the feeding of juvenile whiteflies. Of late, De Barro and Khan (2007) observed that adult males alone were able to induce silverleafing after 11 days of feeding on the same host. *B. argentifolii* has become a major pest of world agriculture. Recent findings (Schuster 2003) show that tomato and squash are most preferred by whitefly adults, suggesting that the later is a better choice as trap crop. It has an expanded host range, increased intercrop mobility and enhanced ability to develop insecticide resistance. At least *B. argentifolii* and *T. vaporariorum* can be distinguished in some life stages using morphological features (OEPP/EPPO 2004).

Wintermantel (2004) asserts that majority of the known whitefly-transmitted viruses are transmitted by *B. tabaci* biotypes. Some of the transmitted viruses known to exist in Tanzania is *sweet potato chlorotic stunt virus* (SPCSV) isolated from sweet potato and *African cassava mosaic virus* (ACMV) isolated from cassava. Crops grown in the studied area and that are at risk include tomato, strawberry, squash, field bean and chrysanthemums grown for aesthetic value, dessert red fruits and seed extraction for export. Quite often, whiteflies have been reported to occur on the farms in Northern Tanzania. However, no investigation has been carried out what species of whiteflies are present. As a result, knowledge about potential threat as virus vectors transmitters in the area is so far unclear. This study reports the occurrence of *B. argentifolii* on chrysanthemums grown in Northern Tanzania.

MATERIALS AND METHODS

Samples of whiteflies were collected from chrysanthemum (*Dendranthema: Astera-ceae*) farms in the major growing areas of Nduruma (03°24.078'S 36°45.740'E, 1261m) and Njiro (03°24.174'S 36°42.444'E, 1327 m) in Arusha Northern Tanzania between November and December 2006. The samples were carried on infested twigs of *Dendranthema* spp., *Duranta* spp. (*Verbenaceae*) and *Datura* spp. (*Solanaceae*), the later two plants being wild hosts found to grow in the vicinity to the chrysanthemums farms. The whiteflies were transferred onto test plants comprising tomato (*Lycopersicon esculentum: Solanaceae*) cv Maglobe and *Dendranthema* plants raised on BVB peat substrate (Maasmat B.V., Holland), maintained in a screen house at Post Entry Plant Quarantine Station in Arusha (03°19.764'S 36°37.160'E, 1464.5 m) to confirm host specificity. While tomato was raised from seeds purchased locally (Kibo Seed Ltd., Arusha), *Dendranthema* plants were obtained as seedlings from Arusha Cuttings Ltd in Arusha. The technique of infestation agrees with some previously adopted approaches (Gelman and Gerling 2003). The screen house plants were first placed within a perforated bag made from thin transparent polyethylene sheet (Morogoro Plastics Ltd., Morogoro). The infested twigs were put into the bags and the entry closed against the stem using rubber bands, thereby holding the whiteflies in captivity. Whiteflies were held in the captivity for 46 days allowing them to reproduce and give a sufficient mix of immature stages

for laboratory investigation. Survival of whiteflies in the captivity was monitored as the carrier twigs wilted out and died and flying whiteflies were shaken over test plants. Samples of whiteflies from the captivity were collected at the 10th day post infestation (dpi), and then 28 dpi and 35 dpi, by plucking part of the test plants and taken to the laboratory for investigation. The various stages were observed with the help of Illuminated Swinging-arm Bench Magnifier (Luxo UK Ltd., London); a dissecting microscope (WILD Heerbrugg, Germany) and HM-Lux 3 compound microscope (Leitz, Portugal).

RESULTS

Insects collected in the field were successfully established on the test plants. On all the three test plants, gradually the few surviving individuals were seen feeding on the underside of leaves on the new hosts. New forms of life were first observed 7 dpi. On the first sample (at 10 dpi), eggs were observed through illuminated swinging-arm bench magnifier and a dissecting microscope at $\times 50$ magnification, as minute oval bodies, some were white and others brown.

At 28 dpi, a mixture of stages was observed. Through a dissecting microscope at $\times 50$ eggs were observed, as expected, some white and others brown. At the same magnification, something oval with two dark spots on the rear supposedly to be the abdomen was seen "walking". Also, at 28 dpi and through the dissecting microscope at $\times 50$ magnification was observed a slender crawling life form with segmented body and short antenna, resembling body lice *Pediculus* spp. (*Phthiraptera: Pediculidae*). A newly emerged adult whitefly was seen, first through the magnifier and then through a dissecting microscope at $\times 50$ magnification. This was whitish in colour and its wings were without wax deposition. The compound eyes resembled a "strawberry" when viewed through a compound microscope at $\times 40$ magnification. Characteristic transparent and shiny hollow cases were seen embedded on the affected leaves.

At 35 dpi, all the above forms of whitefly's development were observed. In addition, fully developed wax-dusted adults were observed. At $\times 10$ magnification of the compound microscope, the body was yellowish and the forewings were not overlapping. At $\times 50$ magnification of a dissecting microscope, a clear gap was observed between the forewings and a pair of black compound eyes was also seen. The forewings were virtually parallel to the body. Using the compound microscope at $\times 40$ magnification, it was found that the forewing vein, though curved at about two thirds of its length, had no fork. *B. argentifolii* adults as they emerged from their nymphal exuvia were soft, whitish yellow. However, within a few hours, the two pairs of wings became white possibly due to deposition of wax. At rest, the wings would be held in an inverted V position.

DISCUSSION

The present work that has led to the identification of the pest was based on previous routine phytosanitary inspection reports in the area of production. The insects were collected from the actual hosts, which involved the crop as well as weed hosts surrounding the commercial crop. In principle, the whitefly transfer process has to simulate the normal niche conditions. Any change in position eg of leaves, gives a stress to the insects and is likely to cause death *en route*. The colonization of the insects on the new hosts (the test plants) was a clear success. Whiteflies in all the three

screen house test plants survived and reproduced, indicating that they were probably the right hosts. So, one can suspect that *B. tabaci* biotypes could be present because they are reported to attack these plants. The pest resurgence meant that the insects were initially encountering a difficulty in probing and adjusting to the new host conditions, causing the decrease in numbers. The numbers then rose as the insects fully acclimatized.

At 7 and 10 dpi, mostly eggs were seen on the plants. It is possible that the eggs change in colour as they mature and approach hatching. At 28 dpi, the oval moving objects were likely to be the newly emerged immature whiteflies. This is because at some stage of development, whiteflies are reported to have a life form that closely resembles soft scales (*Coccoidea*) and that could be the one. This stage then perhaps metamorphoses into a slender crawling stage before finally transforming into the second instar. The newly emerged adult is a typical whitefly although no wax was deposited as yet. Based on observations done and available literature, the pupal cases were typical of *B. argentifolii*. No pupa had filamentous rays around the top of its rim in any of the whitefly samples submitted to the laboratory. The empty cases remained embedded on the underneath of the leaves as transparent scales and this was most prominent in tomato. *B. argentifolii* was most probably the biotype present on the silver leaf symptoms observed in *Duranta* spp, a decorative plant grown on the sides of greenhouses in some of the farms.

The set up of the forewings of the insect at rest was typical of *B. argentifolii*, especially by the appearance of the conspicuous gap between them. According to available literature, the occurrence of the non-branching wing vein is perhaps the most convincing evidence that the whitefly was *B. argentifolii*. As *B. argentifolii* is now present in the industry, the area is endangered by the occurrence and spread of the viruses it vectors. This includes *Cucurbit yellow stunting disorder virus* (CYSDV), *Lettuce chlorosis virus* (LCV), *Sweet potato sunken vein virus* (SPSVV), *Tomato infectious chlorosis virus* (TICV), *Tomato chlorosis virus* (ToCV), *Cucumber yellow virus* (CuYV), *Sweet potato chlorotic stunt virus* (SPCSV), *Tomato yellow leaf curl begomovirus* and *Squash leaf curl begomovirus* (SLCV) (Gibson *et al.* 2002; Aguilar *et al.* 2003).

Some of the commercial crops available in the industry and which are suitable hosts for the viruses are tomato, cape gooseberry, roses, chrysanthemums, cucumber, melons, fresh beans, baby corn, strawberry and raspberry. These are likely to be infected and others are probably already infected. These are commercial produce exported to the EU and the USA. *B. argentifolii* and some of the viruses it vectors such as ToCV are regulated quarantine pests into these areas (EPPO/CABI 1997). Thus the present identification opens a door to the study of occurrence of these viruses and is headway to pest records for phytosanitary regulatory activities.

CONCLUSION

The Post Entry Plant Quarantine Station in Arusha, Tanzania undertakes routine official visual examination of plants and plant products to determine if pests are present and to assess compliance with phytosanitary regulations. To achieve these purposes, surveys need to be carried out. Pest identification is an integral part of pest surveillance as required by the International Plant Protection Convention (FAO 1997). The international scientific and trading community is assured that the report

reflects the reality of the situation. *B. argentifolii* is considered to be present in the reported areas only and the pest status is therefore actionable and under surveillance (FAO 1998). The report is based on the use of all pertinent facilities available for identification at Tropical Pesticides Research Institute. The collector and the identifier is a professional specialist; the identification process used description based on available information; the observation was based on detection survey and precise location and known dates. Furthermore, the record is submitted in a technical journal for publication. The survey sites were selected based on previously reported presence and distribution of the pest as well as distribution of the host plants and their areas of commercial production. Indeed, in order to improve reliability of these pest records, surveillance for pests in the endangered area should be a routine activity. This is because new plant materials constantly enter the endangered area in the realm of trade, either as rootstocks or seeds and they also leave the area as produce for export. Where facilities are available, molecular techniques such as RAPD-PCR (Perring *et al.* 1993, OEPP/EPP 2004) should be the future focus in surveillance work for the most reliable records. It is also advised that in carrying such surveys, farms growing squash such as Q-SEM Ltd and ENZA Africa Ltd should be included for best results in fortifying the identity of *B. argentifolii*. Of late, the author of this report has acquired a digital camera and a GPS receiver for improved future work.

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POLISH SUMMARY

WYSTĘPOWANIE *BEMISIA ARGENTIFOLII* NA CHRYZANTEMACH W PÓŁNOCNEJ TANZANII

Próby mączlika zebrano z gatunków *Dendranthema* rosnących w głównych rejonach ich uprawy w Tanzanii. Aby potwierdzić specyficzną patogeniczność znalezionego mączlika, owady przeniesiono na żywicielskie rośliny testowe umieszczone w woreczkach foliowych. Z roślin tych pobierano okresowo próby mączlika w celu przestudiowania jego zachowania się oraz rozwoju. Próby były pobierane po 10, 28 i 35 dniach od momentu zakażenia roślin testowych. Po 10 dniach zaobserwowano jaja o owalnym kształcie, a po 2 dniach stwierdzono obecność czołgających się tworów i wylęgające się osobniki dorosłe. Po 35 dniach stwierdzono obecność wszystkich stadiów rozwojowych szkodnika. Zaobserwowane cechy są typowe dla *Bemisia argentifolii*, co wskazuje na zagrożenie tym szkodnikiem rejonu objętego obserwacjami, jak również na zagrożenie wirusami przenoszonymi przez ten gatunek. Zidentyfikowanie szkodnika zapoczątkuje badania nad występowaniem wiroz oraz dostarczy materiałów dotyczących jego występowania i zwalczania. Autorzy zapewniają międzynarodową naukową i przemysłową społeczność, że wykonana praca odzwierciedla aktualną sytuację. Przyjęto, że szkodnik występuje obecnie tylko w rejonie, w którym go znaleziono, lecz niezależnie od tego kontynuuje się prowadzenie lustracji w rejonach uprawy roślin żywicielskich.