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GEOGRAPHIC DISTRIBUTION OF BEMISIA TABACI BIOTYPES COLLECTED FROM AUTUMN-CULTURED POTATO FIELDS IN SYRIA

Azusa Fujiie[1], Abdul Mohsen Said Omar[2], Ahmed Bahij Sawas[2], Abbas Abbas[2], Mohammad Abdul Hadi[2], Emad Alden Sawas[2], Ayman Barakat[2], Shigenori Ueda[3] and Keiko T. Natsuaki [4]

[1] Former Japan International Cooperation Agency (JICA)
Syria Office and Attachment to General Organization for Seed Multiplication (GOSM) in Syria, E-mail: fwgh1797@mb.infoweb.ne.jp
[2] General Organization for Seed Multiplication in Syria
[3] National Agricultural Research Center for Kyushu, Okinawa Region in Japan
[4] Department of International Agricultural Development, Tokyo University of Agriculture, Japan

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ABSTRACT

Potatoes are one of the most essential crops in irrigated fields of Syria. In 2007 we investigated whiteflies in autumn-cultured potato fields in six Syrian prefectures, Al-Hasakeh, Aleppo, Idleb, Hama, Homs and Damascus. Whiteflies were always observed in each investigation, and the density was 0.030-0.695 individuals per compound potato leaf. Moreover, in 2007, 14 samples of adult whiteflies were collected from 12 autumn-cultured potato fields, one tomato field and one yellow water pan in seven prefectures, Al-Hasakeh, Aleppo, Idleb, Latakia, Hama, Homs and Damascus. The samples were identified using whitefly mitochondrial cytochrome oxidase I (mtCOI) sequence analysis, and confirmed that they were the Q, B and non-B (B2) biotypes of *Bemisia tabaci*. The six samples from Aleppo and Hama were the Q biotype, the four samples from Latakia, Homs and Damascus the B biotype and the four samples from Al-Hasakeh, Aleppo and Idleb the non-B (B2) biotype. This paper is the first report of the geographic distribution of *B. tabaci* biotypes collected from autumn-cultured potato fields in Syria.

Key words: whitefly, B biotype, Q biotype, mtCOI

INTRODUCTION

Potatoes (*Solanum tuberosum*) are one of the most prosperous crops in well-established irrigation systems in Syria. Potatoes are cultivated in fields of about 29,500 ha and the yields are above 600,000 t per year (CBS, 2006). In Syria, there are two cropping types, spring-cultured and autumn-cultured potatoes. The General Organization for Seed Multiplication (GOSM), a national organization in Syria, exclusively imports, produces and distributes the main crop seeds including seed potatoes (GOSM, 2006). GOSM, in cooperation with the Japan International Cooperation Agency (JICA), is propagating healthy and virus-free seed potatoes to switch from the importation of seed potatoes to domestic production.

Seed potatoes produced under supervision by GOSM are, however, severely infested with insect pests such as aphids (*Myzus persicae*, *Aphis gossypii* and *A. fabae*),

wireworms (*Agriotes* spp.), and the potato tuber moth (*Phthorimaea operculella*) (Netherlands Potato Consultative Institute, 1996; GOSM, 2005; Fujiie *et al*., 2008). The damage caused by diseases such as late blight, early blight, skin spot, *Rhizoctonia* canker, black scurf, silver scurf, common scab, and bacterial tuber soft rot (Netherlands Potato Consultative Institute, 1996; GOSM, 2005), as well as virus disease (Chikh Ali *et al*., 2006, 2007ab; Sankari, *et al.,* 2007) is devastating. Farmers have suffered serious yield losses from these insect pests and diseases in potato cultivations of commercial fields. Moreover, the attack by many whiteflies occurs in autumn-cultured potatoes in GOSM and commercial fields.

Using the samples collected on potatoes in Syria in 2006, we reported that autumn-cultured potatoes were usually infested with whiteflies, and this whitefly was shown to be the Q biotype populations of *Bemisia tabaci* (Fujiie *et al*., 2007). This biotype has recently occurred in many countries, and has become a serious threat for crops and ornamental plants, such as tomato, melon, pumpkin, cotton and poinsettia. Moreover, this biotype has a stronger resistance to chemical pesticides compared with other biotypes.

However, there is scanty scientific knowledge of this biotype in Syria, because it is not yet recognized as a dangerous insect pest on potatoes. Therefore, we investigated densities, biotypes and geographic distribution of biotypes of whiteflies from autumn-cultured potato fields.

MATERIALS AND METHODS

The survey was conducted in the main potato growing areas in nine prefectures of Syria, Al-Hasakeh (the eastern part), Aleppo (the northern part), Idleb (the midland part), Latakia (the Mediterranean side), Hama (the midland part), Tartus (the Mediterranean side), Homs (the midland part), Damascus (the midland part), and Dara'a (the southern part), in October and November, 2007. There were, however, no potato fields in Latakia, Tartus nor Dara'a in this season.

We investigated whiteflies in 14 autumn-cultured potato fields in six prefectures, four times in Al-Hasakeh, six times in Aleppo, once in Idleb, twice in Hama, twice in Homs and once in Damascus, between October 17 and November 13, 2007. The numbers of adult whiteflies were counted on 200 random compound leaves in each field, and the average number of whiteflies per leaf was estimated.

Moreover, 14 samples of adult whiteflies were collected from 12 autumn-cultured potato fields, one plastic house-cultured tomato field and one yellow water pan in seven prefectures, Aleppo (five from potato fields and one from one yellow water pan), Hama (one from a potato field), Damascus (one from a potato field), Homs (two from potato fields), Idleb (one from a potato field), Latakia (one from a tomato field) and Al-Hasakeh (two samples from potato fields), from October 17 to November 13, 2007 (Table 1).

Two individuals per sample were identified using the whitefly mitochondrial cytochrome oxidase I (mtCOI) sequence analysis (Frohlich *et al*., 1999; Brown, 2000; Ueda and Brown, 2006). Phylogenetic analysis was run by the maximum likelihood method of TREE-PUZZLE version 5.2 (Strimmer and von Haeseler, 1996; Strimmer *et al*., 1997). One thousand puzzling steps were calculated using the Hasegawa-Kishino-Yano (HKY) method of substitution (Hasegawa *et al*., 1985).

Table 1. Whiteflies collected in Syria in 2007.

Sample abbreviation	Date	Prefectures	Note
WF-17	October 17	Aleppo	Potatoes (Field)
WF-18	October 17	Aleppo	Potatoes (Field)
WF-19	October 17	Aleppo	Potatoes (Field)
WF-20	October 23	Hama	Potatoes (Field)
WF-21	October 24	Damascus	Potatoes (Field)
WF-22	October 24	Homs	Potatoes (Field)
WF-23	October 24	Homs	Potatoes (Field)
WF-24	October 25	Aleppo	Yellow water pan
WF-25	October 25	Aleppo	Potatoes (Field)
WF-26	October 31	Idleb	Potatoes (Field)
WF-28	October 31	Latakia	Tomatoes (Plastic house)
WF-29	November 11	Aleppo	Potatoes (Field)
WF-30	November 13	Al-Hasakeh	Potatoes (Field)
WF-32	November 13	Al-Hasakeh	Potatoes (Field)

RESULTS AND DISCUSSION

Investigations of whiteflies in autumn-cultured potato fields

The assessments of whitefly populations were carried out in autumn-cultured potato fields in Syria. Whitefly individuals were confirmed in every field, Aleppo 1-4, Hama 1-2, Damascus 1, Homs 1-2, Idleb 1, Al-Hasakeh 1-4, in six prefectures (Table 2). Whiteflies, which were counted in the fields, consisted mostly of *B. tabaci*, although not at all the individuals were identified to species.

The population density ranged from 0.030 individuals per compound leaf in a field in Aleppo, to 0.695 in a field in Al-Hasakeh, and the densities were higher in Al-Hasakeh. In Aleppo and Hama the densities in 2007 were four times higher than those in 2006 (Fujiie *et al.*, 2007). Even though few whiteflies were observed on spring-cultured potatoes (data not shown), autumn-cultured potatoes were infested with whiteflies. This phenomenon might be explained by whiteflies emerging in spring and not only infecting potatoes, but also many other plants that have fresh new leaves during this season.

Maximum likelihood tree for *Bemisia tabaci*

Figure 1 shows the maximum likelihood phylogenetic tree for *B. tabaci* reconstructed using the whitefly mitochondrial cytochrome oxidase I (mtCOI) sequence as a molecular marker. The Q, B and non-B (B2) biotypes were identified from 14 collected samples.

Table 2. Average whitefly numbers per leaf from autumn-cultured potato fields in six prefectures of Syria in 2007.

Field in each prefecture [1]	Date	Whitefly counts (No. / leaf) [2]
Aleppo 1	Oct. 17	0.075
Aleppo 2	Oct. 17	0.040
Aleppo 3	Oct. 17	0.030
Hama 1	Oct. 23	0.130
Hama 2	Oct. 23	0.255
Damascus 1	Oct. 24	0.220
Homs 1	Oct. 24	0.085
Homs 2	Oct. 24	0.060
Aleppo 4-1	Oct. 29	0.150
Idleb 1	Oct. 31	0.050
Aleppo 4-2	Nov. 6	0.100
Aleppo 4-3	Nov. 7	0.170
Al-Hasakeh 1	Nov. 13	0.180
Al-Hasakeh 2	Nov. 13	0.695
Al-Hasakeh 3	Nov. 13	0.635
Al-Hasakeh 4	Nov. 13	0.595
Average		**0.217**

[1] "Aleppo 4-1", "Aleppo 4-2" and "Aleppo 4-3" are from the same field at the GOSM laboratory site, and the others at fields of farmers.
[2] Adult whiteflies on 200 compound leaves of potatoes were investigated each time.

The populations from Syria are shown as "WF17-WF26, WF28-WF30 and WF32" in the tree; all other populations are sources of reference sequences used in the analysis. Information from Fujiie *et al*. (2007) was added as "SyWF2, SyWF3 and SyWF7". The numbers placed at each node indicate the percentage of supporting puzzling steps (only values >50 are shown). The two sequences have been submitted to the DDBJ/EMBL/GeneBank databases under the following accession numbers: Damascus WF21 (AB473558) , Al-Hasakeh WF30 (AB473559).

The Q biotype was confirmed from five samples (WF-18, WF-19, WF-20, WF-25, WF-29) collected on potatoes, and one sample (WF-24) trapped in one yellow water pan. On the other hand, the B biotype was confirmed from three samples (WF-21, WF-22, WF-23) on potatoes and one sample (WF-28) on tomatoes, and the non-B (B2) biotype from four samples (WF-17, WF-26, WF-30, WF-32) on potatoes. A part of the B and non-B (B2) biotypes from Syria probably belongs to the Mediterranean/Asia Minor/Africa invasive genetic group (Boykin *et al*., 2007). The samples of WF17, WF26, WF30 and WF32, which were classified as the non-B (B2), and the biotype of *B. tabaci* from Yemen in the Arabian Peninsula belonged to the same group (Fig. 1). The

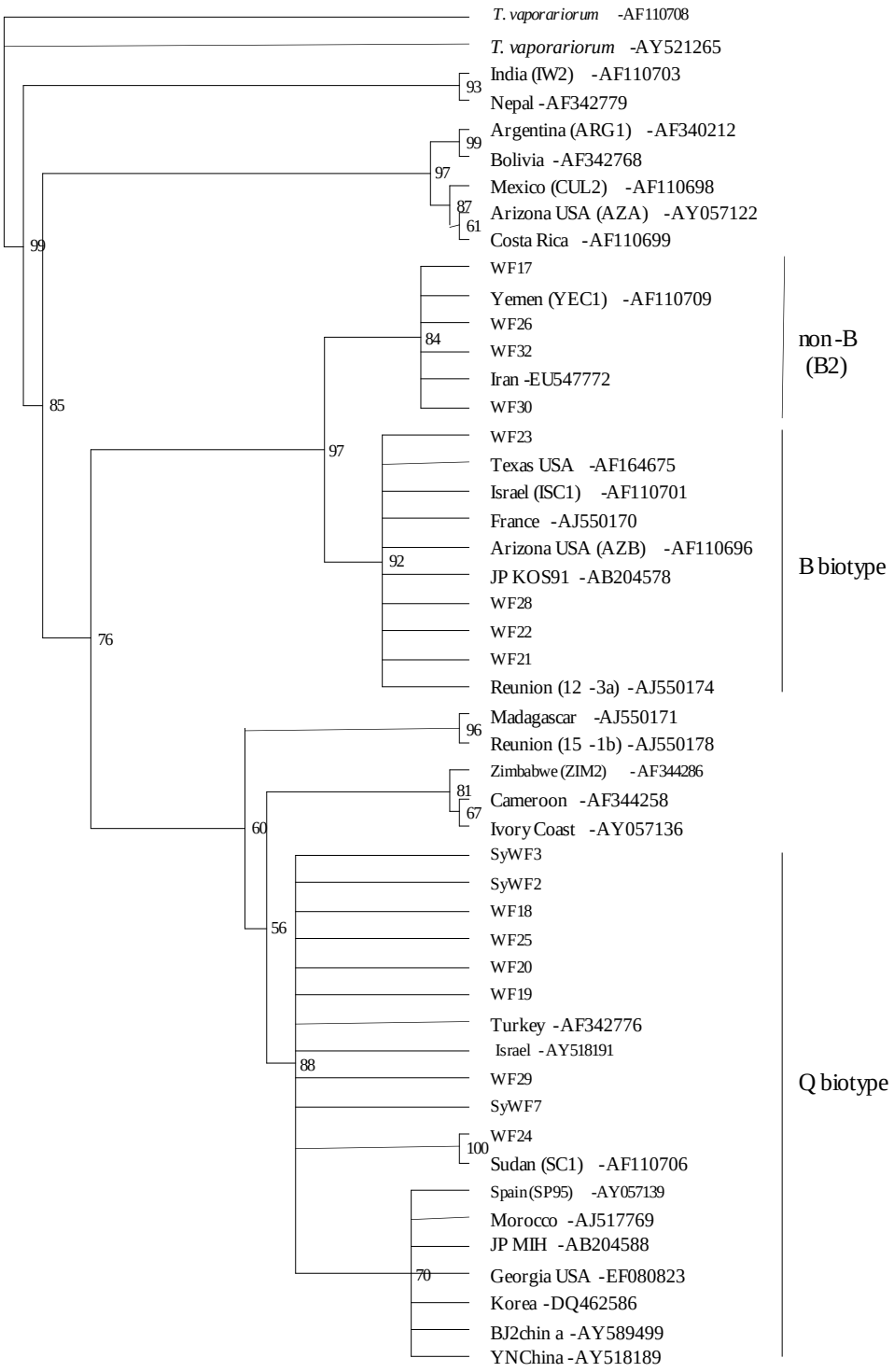

Fig. 1. Maximum likelihood phylogenetic tree for *Bemisia tabaci* reconstructed using the whitefly mitochondrial cytochrome oxidase I (mtCOI) sequence.

data from Yemen, Yemen (YEC1)-AF110709, was most closely related to B-like variants (Frohlich *et al*., 1999). Delatte (2005) also reported that the biotype of *B. tabaci* in Yemen was the B and B2. These facts are essential for further classification of WF17, WF26, WF30 and WF32.

Geographic distribution of *Bemisia tabaci*

This insect is distributed in potato fields of six prefectures in which potatoes are grown, Al-Hasakh, Aleppo, Idleb, Hama, Homs and Damascus, and in one tomato field in Latakia. The distributions of the Q, B and non-B (B) biotypes were in Aleppo and Hama Prefectures, in Latakia, Homs and Damascus Prefectures and in Al-Hasakeh, Aleppo and Idleb Prefectures, respectively. The Q biotype was also identified from the samples collected on potatoes in Aleppo and Hama in 2006. (Fujiie *et al*., 2007).

The Q biotype was first reported to be locally distributed in the Iberian Peninsula (Guirao *et al.*, 1997). In recent years, this biotype has been reported from China (Zhang *et al*., 2005; Chu *et al*., 2006), Japan (Ueda and Brown, 2006), New Zealand (Scott *et al*., 2007) and Syria (Fujiie *et al*., 2007). The biotypes of *B. tabaci* could be only identified using molecular sequence methods (Brown, 2000), because morphological identification is impossible. In this study we also applied this method and showed the geographical distribution of *B. tabaci* in Syria with the information of its biotype for the first time.

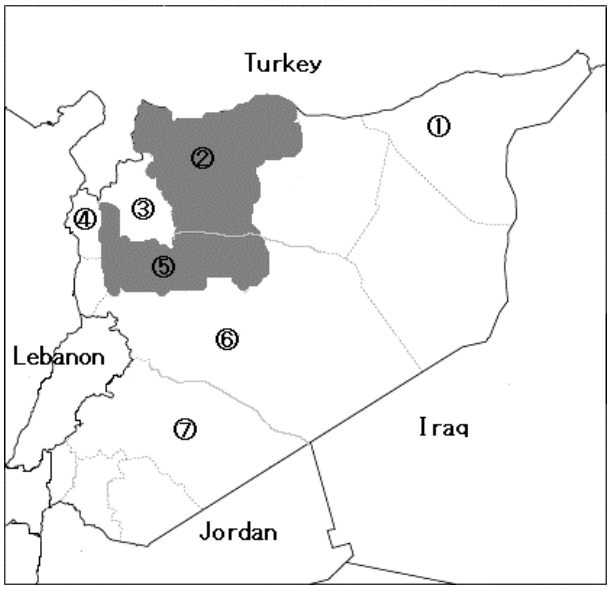

Fig. 2. Map showing the geographic distribution of *Bemisia tabaci* in Syria in 2007. The Q biotype was found in 2 (Aleppo) and 5 (Hama) Prefectures. On the other hand, the B biotype was in 4 (Latakia), 6 (Homs) and 7 (Damascus) Prefectures and the non-B (B2) biotype in 1 (Al-Hasakeh), 2 (Aleppo) and 3 (Idleb) Prefectures.

B. tabaci is the vector of viruses in genus *Begomovirus*, such as *Tomato yellow leaf curl virus*, Tobacco leaf curl Japan virus, *Honeysuckle yellow vein mosaic virus* and *Eupatorium yellow vein virus*, therefore either of the biotypes is harmful in potato protection. However, the Q biotype is a bigger pest, because the resistance to chemical pesticides is

pesticides is stronger than the B (Nauen *et al*., 2002; Horowitz *et al*., 2005). Thus the Q is one of the most dangerous pests.

In this report, we showed the geographic distribution of *B. tabaci*, particularly the distribution of the Q biotype in Aleppo and Hama (Fig. 2). Latakia and the adjacent southern prefecture, Tartus, are near Hama, and these prefectures are a major source of tomatoes which are severely damaged with this biotype. Strong management measures are required to protect the expansion of the Q biotype to tomato fields in Latakia and Tartus.

CONCLUSION

Whiteflies were investigated and collected in autumn-cultured potato fields in Syria. The density was 0.030-0.695 individuals per compound potato leaf. The samples were identified using whitefly mitochondrial cytochrome oxidase I (mtCOI) sequence analysis. They were the Q, B and non-B (B2) biotypes of *Bemisia tabaci*. This paper is the first report of the geographic distribution of *B. tabaci* biotypes in Syria.

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