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Diversity of the known phytoplasmas in Israel

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Abstract

Phytoplasma-caused diseases have been identified in Israel in numerous species of various botanical families, primarily from crop plants. Northern Israel has the most diversity of phytoplasma groups followed by the northern Negev desert and Arava valley, with the center of the country having the least. There are proportionally more infected flowers than orchards (including vineyards) or than vegetable crops. Of the 15 known 16S rDNA phytoplasma groups, seven are represented in Israel. It is very likely that at least one group was imported into Israel from another area of the world.

Key words: Taxonomic groups, geographical distribution, phytoplasmas.

Introduction

Yellows diseases have been known in Israel since the mid 1970s. It is only recently, with the advent of improved biochemical analysis and DNA sequencing that ribosomal groups of phytoplasma could be defined and readily identified. We did not actively survey plants for phytoplasmas; virtually all phytoplasmas presented herein are a result of commercial agricultural problems.

Materials and methods

Total DNA was extracted from plant tissues. The purified DNA was passed through two cycles of PCR – the first in the presence of universal primer P1/P7 (Deng and Hiruki, 1991), followed by the universal primers fU5/rU3 (Lorenz *et al*., 1995) for a nested reaction. Amplified PCR products were analyzed by gel electrophoresis followed by staining with ethidium bromide and visualization of DNA bands using a UV transilluminator. DNA extracted from asymptomatic plants of the same species served as a negative control. The 860 bp PCR product was cloned into the pGEM-T Easy Vector (Promega, Madison, Wi, USA). The nucleotide sequence of the insert was determined using an ABI Prism 3700 DNA analyzer (Hy Laboratories, Rehovot, Israel). Sequence homology analysis with other phytoplasmas in the GenBank Database was done using BLAST.

Results

To date, more ornamental species have been identified with phytoplasma infections than orchards, including vineyards for wine production, or vegetable crops (table 1). The geographical distribution of the various phytoplasma groups in Israel is shown in figure 1. The greatest diversity of phytoplasma ribosomal groups was found in northern Israel and the least in the center of the country.

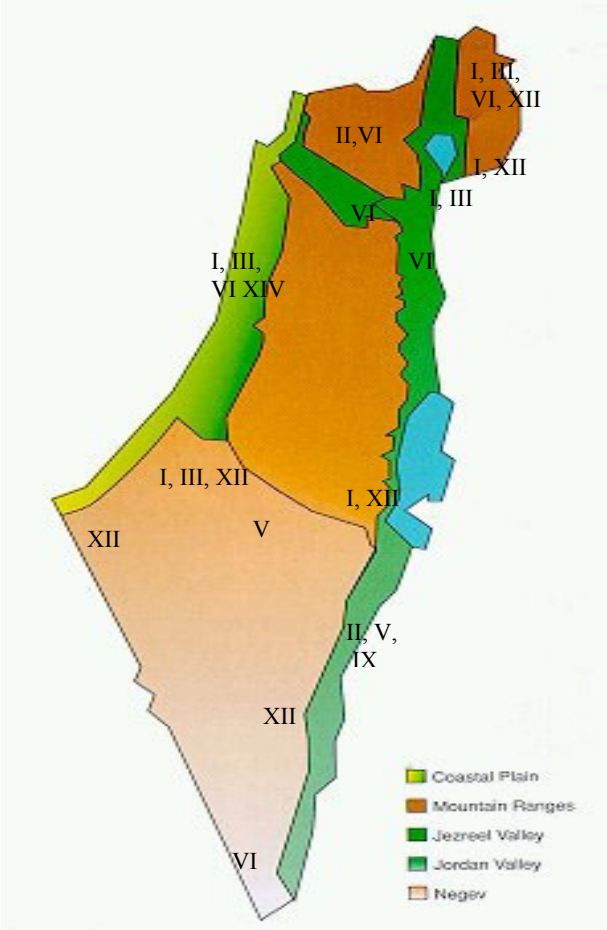

Figure 1. Distribution of 16S rDNA phytoplasma groups in Israel.

Discussion

The abundance of identified phytoplasmas in flowers may be due to the very large export market, and direct impact that phytoplasma infections have on flowers, necessitating constant monitoring of these crops.

Table 1. Identified phytoplasmas, host plants and locations (N – north, S – south, C – center) in Israel.

Host Plant	Phytoplasma group(s)	16Sr group	Area	Year observed
Flowers				
Anemone sp	Clover proliferation	16SrVI	Galilee (N)	1998
Catharanthus roseus	Clover proliferation	16SrVI	Eilat (S)	2005
Celosia sp.	Aster yellows; X-disease	16SrI; 16SrIII	Sharon (C)	1998
Cosmos sp.	Clover proliferation	16SrVI	Sharon (C)	1999
Cyclamen sp.	Stolbur	16SrXII-A	Besor (S)	2002
Gypsophila sp.	Peanut witches' broom	16SrII	Arava (S)	2002
Lavandula sp.	Clover proliferation	16SrVI	Afula (N)	2006
Lisianthus sp.	Stolbur	16SrXII-A	Besor (S)	2003
Limonium hybrids	Peanut witches' broom; Elm yellows; Pigeon pea witches' broom	16SrII; 16SrV; 16SrIX	Arava (S)	2000
Mirabilis jalapa	Peanut witches' broom	16SrII	Galilee (N)	2007
Verbesina encelioides	Clover proliferation	16SrVI	Sharon (C)	2000
Orchards				
Apricot	Stolbur	16SrXII-A	Neot Smadar (S)	2005
Grapevine	Aster yellows; X-disease; Stolbur	16SrI; 16SrIII; 16SrXII-A	North, central Golan (N)	1980's
Grapevine	Aster yellows; Stolbur	16SrI; 16SrXII-A	South Golan (N)	1980's
Grapevine	Aster yellows; Stolbur	16SrI;16SrXII-A	Arad (S)	2002
Papaya	Stolbur	16SrXII-A	Kfar Maimon (S)	2005
Sweet cherry	Clover proliferation	16SrVI	Golan (N)	2006
Vegetables				
Carrot	Aster yellows; X-disease	16SrI; 16SrIII	Beit She'an (N)	1995
Carrot	Aster yellows	16SrI	Sharon (C)	1996
Carrot	Aster yellows; X-disease	16SrI;16SrIII	Sa'ad (S)	1996
Carrot	Elm yellows	16SrV	Gilat (S)	2003
Pepper	Stolbur	16SrXII-A	Besor (S)	2003
Strawberry	Green Petal	Not determined	Sharon (C)	1970's
Grass				
Bermuda grass	Bermuda grass white leaf	not detemined	Sharon (C)	1970's

The aster yellows (16SrI), X-disease (16SrIII) and stolbur (16SrXII-A) ribosomal groups were the most abundant in Israel. There are no representatives of coconut lethal yellowing, ash yellows, loofah witches' broom, apple proliferation, rice yellow dwarf, Mexican periwinkle virescence or *Hibiscus* witches' broom in Israel. The greatest economic losses have occurred in carrots, strawberry, Chardonnay grapevines, *Limonium* hybrids and *Gypsophila* sp.

We have evidence that at least one ribosomal group of phytoplasmas (16SrIX) entered Israel in flowers propagated by tissue culture and grown under low concentration of antibiotics which masked symptoms (Gera *et al*., 2004). It is unknown how many other times this occurred.

There are six confirmed leafhopper vectors throughout the country, and only one suspected planthopper vector which has been found only in northern Israel.

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