Greening Spread in Two Locations of Uttar Pradesh (India)

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ABSTRACT. In 1986 two citrus variety demonstration blocks were established at Dakrani (Dehradun district) and Jeolikote (Nainital district) of Uttar Pradesh with six sweet orange, one grapefruit and three mandarin varieties, all virus-free, grafted on sour orange and Troyer citrange rootstocks introduced from Italy. Surveys carried out in 1990 and 1991 revealed an increasing incidence of greening in all varieties at Jeolikote with 67.2% of the trees infected by late 1991. Only a few trees showed symptoms at Dakrani, which experiences different environmental conditions. Electron microscopy of symptomatic tissues confirmed the presence of the greening organism. ELISA tests for citrus tristeza virus were negative.

Citrus greening disease is a serious threat to Indian citriculture (7), and its presence and distribution in Uttar Pradesh has been known since 1968 (4), where it has been disseminated by infected budwood and psyllid vector, *Diaphorina citri* (3).

In 1986 two variety demonstration blocks, composed of virus-free trees brought in from Italy as part of the Indo-Italian Fruit Development Project, were established at Dakrani (Dehradun district) and Jeolikote (Nainital district), two areas with differing elevation and climate (Table 1). Mandarin and grapefruit varieties were grafted onto sour orange rootstock, while sweet orange were grafted onto sour orange and Troyer citrange. The Dakrani block consists of 320 trees, while the Jeolikote block consists of 128 trees, both planted in randomized blocks at a spacing of 5 × 5 m.

TABLE 1
METEROROLOGICAL DATA AND ELEVATION, OF THE TWO DEMONSTRATION CITRUS BLOCKS IN UTTAR PRADESH

	Dakrani	Jeolikote
Elevation (m)	500	1,220
Av. min. monthly temp. (C)	6	6
Av. max. monthly temp. (C)	39	35
Annual rainfall (mm)	1,400	2,000

Annual surveys for greening symptoms began in 1990. In November 1991 the incidence at Dakrani was only 1.9%, while at Jeolikote it was 67.2% with all varieties there being affected (Table 2). To assist identification, 2-5 mm pieces of columella and leaf veins from selected

TABLE 2
INCIDENCE OF GREENING DISEASE SYMPTOMS IN THE TWO DEMONSTRATION CITRUS BLOCKS IN UTTAR PRADESH (NOVEMBER 1991)

Citrus cultivar	Dakrani Symptomatic plants/ total plants	Jeolikote Symptomatic plants/ total plants
Sweet orange		
Belladonna	1/40	9/16
Moro	0/40	12/16
Sanguinello Moscato	1/40	10/16
Tarocco	2/40	13/16
Valencia Campbell	1/40	13/16
Washington Navel	0/40	12/16
Mandarin		
Monreal clementine	0/20	5/8
Nules clementine	1/20	6/8
Mapo tangelo	0/20	2/8
Grapefruit		
Star Ruby	0/20	4/8
	6/320 (1.9%)	86/128 (67.2%)

symptomatic trees were immediately fixed in 3% glutaraldehyde in 0.1 M phosphate buffer (pH 6.8), transported to University of Catania, Italy, and processed further for electron microscopy (5). Greening organisms were observed in high concentrations in Jeolikote samples (Fig. 1), but sparingly present in Dakrani samples.

No trees on sour orange rootstocks displayed tristeza decline symptoms, and ELISA tests performed using standard procedure (2) on samples from 10% of the trees were all negative.

Both citrus blocks were established in citrus areas adjacent to local plantings where greening seems to be endemic. Some wild citrus, ornamental hedges of citrus and *Murraya paniculata* exist in both areas, and populations of the vector, *D. citri* were noted to peak in April-May. Although the vector generally prefers the lower elevations with lower humidity (1), it can adapt to cooler areas (6).

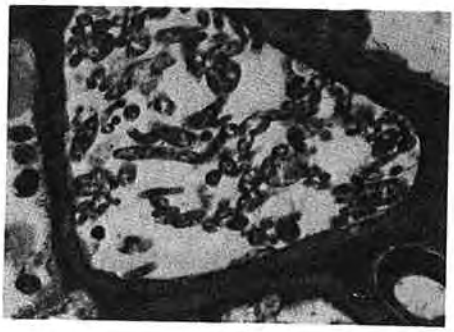

Fig. 1. Greening organisms in the sieve elements of a citrus leaf midrib from a symptomatic tree at Jeolikote.

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