Severe Tristeza Stem Pitting Decline of Young Grapefruit in South Africa

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ABSTRACT. Since 1979 several cases of very severe tristeza stem pitting in 2-4-year-old grapefruit trees have appeared in Natal and the Western Cape, South Africa. The affected trees were severely pitted, stunted and produce very small fruit. Sister trees, produced from the same budwood batches, but growing in the Transvaal and the Eastern Cape, have not developed such severe symptoms. This observation together with experimental evidence indicates an influence of environment on strain dominance.

A decline of grapefruit in South Africa, which was associated with stem pitting symptoms, was first reported in 1949 (9), and shown soon afterwards to be caused by tristeza (5). As a result of this decline, most grapefruit trees become unproductive before they are 20 years old and are therefore removed. Consequently, there are very few old grapefruit trees in the country.

Recently there has been a sudden and potentially disastrous development. In 1979 very severe tristeza symptoms were observed on 4-year-old Redblush grapefruit in the Nkwalini Valley in the province of Natal (3). In 1980, a similar phenomenon was observed in 2-year-old Marsh grapefruit trees at Hluhluwe, also in Natal. In both cases the parent trees displayed no obvious tristeza symptoms, and were registered parent trees in the interim Citrus Improvement Programme (CIP) (14).

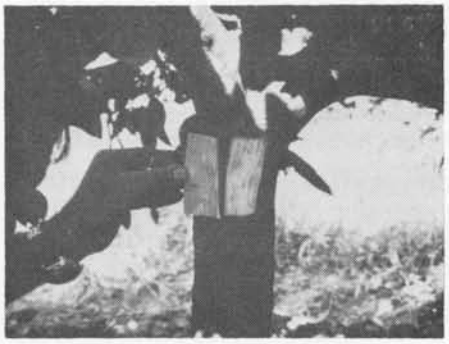

Fig. 1. Severe stem pitting on a young Redblush grapefruit tree at Nkwalini.

Fig. 2. Normal sized grapefruit being held next to the small fruit on a tristeza-affected grapefruit tree at Nkwalini.

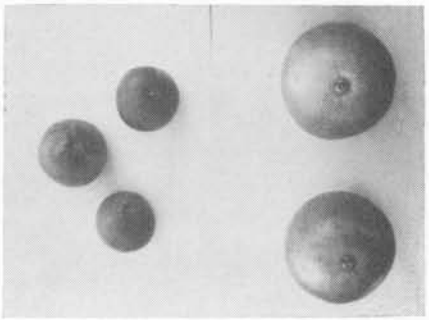

Fig. 3. Fruit from a young grapefruit tree with severe tristeza symptoms (left) and normal fruit (right).

OBSERVATIONS

The symptoms of tristeza on these young trees include stunting, severe stem pitting (fig. 1), small fruit (figs. 2 and 3) and several small leaves with deficiency symptoms. A survey of the affected orchard showed that virtually all the 500 trees had developed these symptoms, while only 2.5% of the sister trees (i.e. propagated from the same parent tree) planted at

the same time at Kaapmuiden in the Eastern Transvaal had small fruit and severe pitting, and 10% had severe pitting only.

Similarly, all of the 2000 Marsh grapefruit trees at Hluhluwe displayed severe symptoms, while sister trees planted in other areas show varying degrees of disease development. Those in the Eastern Cape, near the parent tree, show no symptoms, some of those in the Western Cape have developed severe pitting, while those at Nkwalini in Natal have mild to moderate pitting.

The severe strain in the Redblush grapefruit has become known as the Bolton strain, after the farm on which the trees were planted, and the Marsh strain has been named the 7/K6 strain after the parent tree's CIP tree number.

EXPERIMENTS

Buds were collected from the various Redblush and Marsh sources and grafted onto West Indian lime and sour orange seedlings, and sweet on sour orange plants in a glasshouse. In a separate experiment nine selections of Marsh grapefruit seedlings were inoculated with buds from the Redblush source (Bolton) in Natal and from two Marsh grapefruits infected with mild tristeza.

In field experiments the same Redblush source and seven apparently mild isolates were inoculated into grapefruit seedlings (ten replicates) and planted out at two locations, one in the Eastern Transvaal and the other in Hluhluwe in Natal.

RESULTS AND DISCUSSION

The results of the indexing on West Indian lime (table 1) showed a fairly uniform, severe reaction, even when the inoculum was from a tree with very mild symptoms. This lack of correlation between symptoms on grapefruit in the field and lime seedlings in the glasshouse has been demonstrated previously (4).

None of the sources induced a seedling yellows (SY) reaction in the sour orange seedlings, but the severe Bolton strain induced SY in six of the nine Marsh grapefruit seedling selections (table 2). Only one of the mild isolates caused SY in one of the selections. In general the severe strain stunted the grapefruit seedlings more than the mild.

Although grapefruit was not

TABLE 1
GLASSHOUSE INDEXING OF TRISTEZA FROM VARIOUS GRAPEFRUIT SOURCES

Tristeza strain*	Indicators	
	West Indian lime†	Sour orange
1. Severe (Redblush-Nkwalini)‡	+++++	—
2. Severe (Redblush-Kaapmuiden)	++++	—
3. Mild (Redblush-Kaapmuiden)	++++	—
4. Severe (Marsh-E. Cape parent)§	+++++	—
5. Severe (Marsh-E. Cape)	+++++	not tested
6. Severe (Marsh-W. Cape)	+++++	not tested
7. Severe (Marsh-Nkwalini)	++++	—
8. Severe (Marsh-Hluhluwe)	+++++	not tested
9. Mild (Marsh-Nkwalini)	+++	—

*1-3 from the same parent; 5-8 are daughter trees of 4.
†rated on visual appearance of stunting, vein flecking, vein corking and stem pitting. +++++ indicates very severe symptoms.
‡Bolton strain.
§7/K6 strain.

TABLE 2
REACTION OF GRAPEFRUIT SEEDLING SELECTIONS TO DIFFERENT TRISTEZA STRAINS FROM GRAPEFRUIT

Grapefruit selection	Mean height (cm) Tristeza strain			
	Mild	Mild	Severe	Control
4	—	78.0	71.8 SY*	112.0
9	80.3	101.0	73.6 SY	115.0
13	88.6	94.8	83.1 SY	87.8
18	40.7	—	67.8	118.0
19	—	110.0	69.0 SY	115.6
21	73.8	90.5	83.0	103.0
25	110.0	64.0 SY	77.8	77.5
27	85.5	98.0	82.8 SY	108.0
28	—	112.5	69.5 SY	108.5

*SY = seedling yellows reaction.

considered a carrier of SY by McClean and van der Plank (7), Roistacher (12) suggested that its presence in South African grapefruit may have some connection with tristeza decline in South Africa. The above results indicate that more research in this area is needed. McClean (6) found evidence for the retention of a mild form of SY in grapefruit which is detectable using sweet orange on sour orange indicators. The tristeza strains in the affected young grapefruit trees have been inoculated into such indicators but results are not yet available.

Results from the field trials (table 3) 16 months after inoculation indicate that the severe Bolton strain from Natal, retains its severity when transferred back to the Transvaal where it originated, but the growth retardation in the seedlings at Hluhluwe is more pronounced.

TABLE 3
EFFECT OF GEOGRAPHIC LOCATION ON VARIOUS GRAPEFRUIT TRISTEZA STRAINS

Tristeza strain	Height (cm) of grapefruit seedlings	
	E. Transvaal	Natal
Severe (Bolton)	135	93
Mild 1	144	116
Mild 2	141	110
Mild 3	147	134
Mild 4	146	103
Mild 5	172	117
Mild 6	174	139
Mild 7	146	133
Control	162	152

The observations and preliminary experimental results all point to the presence of severe strains in the parent trees and to environmental effect on tristeza symptom expression. This supports Marais's suggestion (8) that this is a more likely cause of the problem than the introduction of new strains by aphids. Different strains of tristeza can co-exist in one host plant (10). Under one set of conditions one strain may dominate, but if the conditions are changed another strain may become dominant (1). If there is a subdominant severe strain in a parent tree, this may become dominant in its daughter trees under different climatic conditions. The citrus areas in Natal are warmer than the Eastern Cape, and have higher humidities than the Transvaal (13). These two factors may favour a change in the balance of strains. Van Vuuren (13) recently showed that the severe Marsh grapefruit strain caused more severe symptoms in lime seedlings at 24-28 C than at

either higher or lower temperatures. There is also evidence from Australia (2) and Brazil (11) for increased tristeza symptom severity in warm, humid climates.

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