CHAPTER 8

Physiological and Biochemical Aspects of Citrus Virus Diseases

The Relation of Fertilization to Stem Pitting and Yield of Calamonding Trees in the Philippines

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CALAMONDING (*Citrus mitis* Blanco)* is the most important acid citrus fruit in the Philippines, and commercial orchards of it near large population centers are very profitable. Most calamonding orchards are planted with seedling trees, and because of this practice they are relatively free of bud-transmitted virus diseases. However, calamonding is susceptible to tristeza virus, and recent indexing of field trees indicates that tristeza is present in almost all calamonding trees throughout the Philippine archipelago (1).

Young calamonding orchards are normally very productive, but as the trees grow older, yields decline, trees become stunted, fruits are smaller, and stems are badly pitted. This stem pitting is attributed to tristeza virus because indexing on Key lime seedlings gives a positive test for tristeza virus.

Materials and Methods

Calamonding trees budded on calamandarin (*C. reticulata* Blanco hyb.) rootstock were used in this experiment. The trees were planted in

*Ed. Note. This variety of citrus is native to the Philippines, according to the authors, and they prefer the name *calamonding* as used there to *calamondin* as used elsewhere.

September, 1965, on level, well-drained Lipa clay loam at the Central Experiment Station at Los Banos, Laguna, Philippines.

Fertilizer treatments (Table 1), arranged in a randomized complete block design and replicated 4 times, were started in 1957. Each plot consisted of 4 trees.

Beginning in 1959, yield records were collected. In the period 1959-60, all fertilizer treatments yielded better than did the control. Treatment 9 (N_2, P_1, K_2) yielded best in both years, and was significantly better than treatment 1 (control) (2). However, all yields decreased in 1961, at which time treatment 4 (N_1, P_1, K_1) yielded the highest, but was not

TABLE 1. PROPORTIONS AND AMOUNTS OF NITROGEN, PHOSPHORUS, AND POTASSIUM APPLIED PER TREE, 1957 THROUGH 1961

Treatment	Proportions of N	P	K	Treatment	Proportions of N	P	K
1 (control)	0	0	0	6	2	0	1
2	1	0	1	7	2	0	2
3	1	0	2	8	2	1	1
4	1	1	1	9	2	1	2
5	1	1	2				

N-1-$(NH_4)_4SO_4$, 20 per cent N—applied 125 g/tree in 1957, doubled each succeeding year through 1961, 5 = year total, 3,875 g.

N-2-$(NH_4)_4SO_4$, 20 per cent N—applied 250 g/tree in 1957, doubled each year, 5 = year total, 7,750 g.

P-1-Superphosphate, 20 per cent P_2O_5—applied 125 g/tree in 1957, doubled each year through 1961, 5 = year total, 3,875 g.

K-1-KCl, 60 per cent K_2O—applied 42 g/tree in 1957, doubled each year through 1961, 5 = year total, 1,294 g.

K-2-KCl, 60 per cent K_2O—applied 83 g/tree in 1957, doubled each year through 1961, 5 = year total, 2,588 g.

significantly better than the control. Reduction in yield appears to result occasionally from the reduction in fruit size on tristeza-infected trees (3, 4, 5, 6).

Continued omission of phosphorus was believed to depress yield. Consequently, beginning in 1962, all treatments that previously received no phosphorus (treatments 2, 3, 6, and 7) were given 1,000 g of superphosphate per tree per year. The rates for N, P, and K, were maintained. In spite of the fertilizer applications, yields continued to drop in the years that followed, and the experiment was discontinued in 1965. The decline in production was accompanied by slow dying back of twigs. Dieback started with chlorosis, and leaf mottling and defoliation followed. The trees became stunted, fruit size was severely reduced, and declining trees showed severe stem pitting.

This study was undertaken to investigate the influence of fertilization on the severity of stem pitting in these tristeza-infected calamonding trees and its relation to growth and yield of infected trees. Ten branches of the previous season's growth were collected at random from each tree. After removal of the bark, the severity of wood pitting was rated on a scale of 1 (pitting barely discernible) to 5 (severely pitted).

Results and Discussion

The figures obtained by rating 10 branches from each of the 143 trees (1 tree died) were analyzed statistically. There was no evidence that the severity of stem pitting was influenced by the fertilization treatments.

Yields over a 4-year-period, 1962-65, were also examined statistically. Up to the present time, there has been no significant relation between fertilization treatments and the weight of fruit per tree, or the number of fruits per tree.

In April, 1966, the height of each tree was measured and the data were examined statistically. The average height of trees subjected to treatment 4 (N_1, P_1, K_1) was significantly better at the 1 per cent level than the average of the control trees. The heights of trees subjected to treatment 3 (N_1, P_0, K_2) were significantly better at the 5 per cent level than the control trees. The heights of trees in the other treatments were not significantly better than the controls.

Conclusions

The results presented above indicate that different levels of nitrogen, phosphorus, and potassium applied to tristeza-infected calamonding trees on calamandarin rootstock had no significant effect on the severity of stem pitting, on the total yield of fruit per tree, or on the number of fruits per tree. However, there was evidence of a relation between fertilization and tree height, in spite of tristeza, because trees in treatments 3 (N_1, P_0, K_2) and 4 (N_1, P_1, K_1) were significantly taller than the control trees at the 5 per cent and 1 per cent levels, respectively.

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