Chemical Thinning of Satsuma Mandarin by NAA (α-Naphthalene acetic acid)

By KAZUYOSHI HIROSE

Chief, 2nd Laboratory of Fruit Tree,
Okitsu Branch, Horticultural Research Station

The Horticultural Research Station has been actively engaged in studying chemical thinners of citrus fruits since 1962 for it has held the keen interest of researchers and growers for several reasons.

Cold weather, typhoon and drought lasting for a long time sometimes alternately affect Satsuma mandarin. The cyclic bearing habit, therefore, can be broken by fruit thinning which increases flowering and yield in the following year.

Thinning results in an increased yield and quality of the remaining fruit by lowering crop load when compared with fruit from crop stressed trees.

By thinning, the young trees grow vigorously and the entire trees prolong the bearing life themselves by lowering of crop load.

Hand thinning has resulted in manual labor taking 8 to 10 days per 10 are on the basis of an eight-hour working day. In thinning season after blossom, hand thinning does not show a good result such as mowing weed, and spraying of fungicide and insecticide which require a large labor force for the growers.

In the preliminary screening of compounds for thinning of citrus fruit, growth regulators and chemicals such as 2, 4, 5-trichloro-phenoxypropionic acid (2, 4, 5-TP), Maleic hydrazide (MH-30) and Naphthalene acetic acid (NAA) have induced a sufficient thinning of Satsuma mandarin.

In the present study, NAA application is most suitable for thinning of Satsuma mandarin and gradually became popular in the mandarin growing area since 1969.

When Satsuma mandarin trees were treated with the 200 to 300 ppm of NAA solutions, adequate thinning occurred in 20 days as shown in Fig. 1.

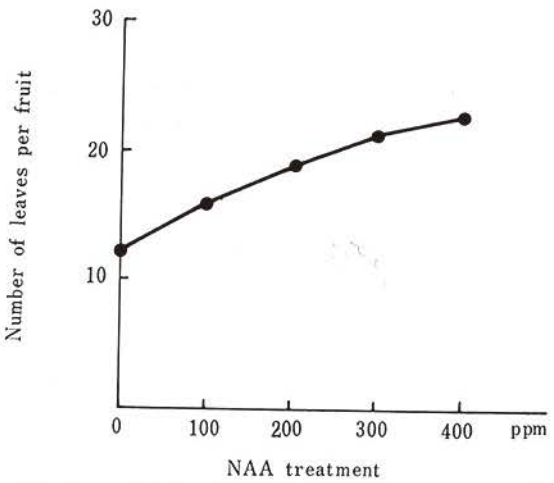

Fig. 1. Effect of NAA concentration applied during 30 days after full bloom.

At the concentration of 1,000 ppm and above, foliage chlorosis occurred but the twigs were not dieback and killed.

There is some further evidence that NAA application may under certain conditions give fruit thinning over flowers.

In the course of investigating application time, spray treatments were applied to the entire Satsuma mandarin trees at fixed day

intervals throughout the bloom and June drop period.

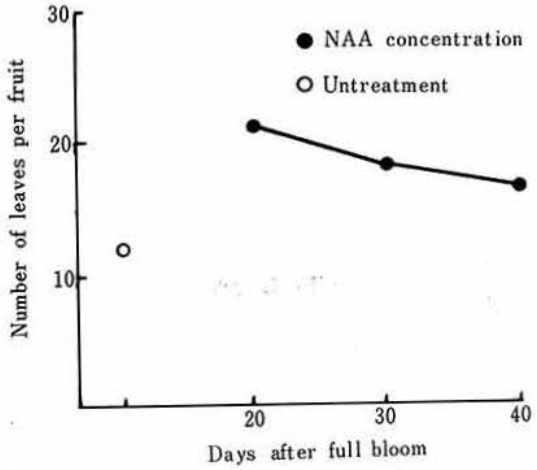

Fig. 2. Effect of NAA (200 ppm) spray days.

NAA sprays ranging from 200 to 300 ppm during 20 to 30 days after full blossom (at the onset of June drop) caused moderate fruit thinning. Fruit drop might be stimulated by NAA applications at the beginning of June drop.

Investigations were conducted to determine the solution volume per 10 are and concentration of NAA induced moderate fruit thinning. When all the trees were treated with 400 liters of the 200 to 300 ppm NAA solutions, sufficient thinning occurred.

Data presented in Fig. 3 show the relation between the degree of thinning obtained and the number of leaves per fruit.

It was suggested that fruit thinning depended on the absorption of the NAA by the leaves.

Moreover, it was discovered that the 200 to 300 ppm NAA application to the 5 to 10 leaves per fruit caused a sufficient fruit drop; a fruit on the branches had about 20 leaves in 28 days after the application.

With the resulting increase in fruit size, it is possible to greatly decrease the number of fruits without altering the volume produced by the tree. Furthermore, as shown in Fig. 4, NAA thinning, by lowering the crop load, results in increasing the size of the remaining fruit.

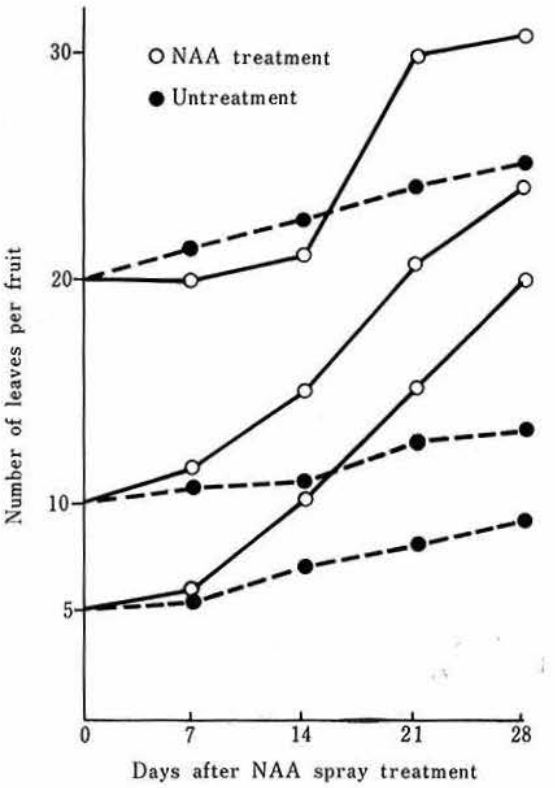

Fig. 3. Effect of NAA (300 ppm) treatment under different number of leaves per fruit.

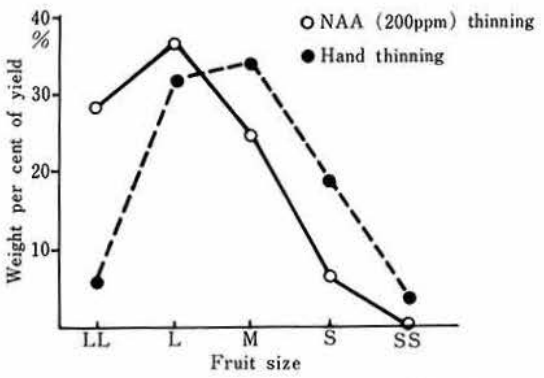

Fig. 4. Effect of NAA (200 ppm) thinning on fruit size of Satsuma mandarin.

Hand removal of fruit has almost resulted in producing a medium-size (6.1 to 6.7 cm in diameter) a fruit, while fruit treated with NAA nearly attained a large size (6.7 to 7.3 cm) where volume yield was reduced. Trees after NAA treatment did not produce the smallest size of the fruit (unmarketable fruit).

It was thought that NAA hastened the growth of fruit and earlier NAA treatments further increased the size of the fruit.

The fruit from trees after NAA treatment are superior in size and appearance to those from trees by hand thinning.

Adequate NAA concentration applied to Satsuma mandarin trees at the start of June drop significantly and expedited fruit maturity.

NAA actually appeared to keep a smooth rind without strain, water spotting and puffy rind, characteristically and physiologically.

Juice quality also was not affected by NAA application. Fruits treated with NAA had been stored till mid-March of the following year, and maintained a healthy stem button and smooth rind. NAA also did not alter the juice quality during the period.

NAA application sometimes caused defoliation, leaf, burn, leaf curring and growth retardation of twigs or shoots. But these injurious effects were negligible for the trees grown in the following seasons.

NAA treatments inhibited the growth of autumn flushes in the year they were sprayed, but did not affect the bloom and flushes or shoots in the following year.

Indol acetic acid was contained at a rate of 6.5 mg per 10 kg of the small fruit at the 7th day after the blossom, but almost disappeared during the 60 days.

Indol acetoic amide, however, was found at a rate of 12 mg per 10 kg of the small fruit at same time.

There was no sufficient evidence for observation of the physiological effects of endogenous indol aceto amide on the citrus trees.

Khalifah et al also has first identified "the citrus auxin" without an indol radical from citrus trees.

The author has, however, found that Satsuma mandarin trees will not have "the citrus auxin".

The chemical compositions consisted of an indol radical effective in biological activity for auxin test of the young fruits of Satsuma mandarin.

The concentration of gibberellin-like substances in the fruits of Satsuma mandarin started to increase in 7 days, but to decrease during 14 days after blossom.

Increases in concentration rate of the abscisic acid-like substances were noted during the 15 days after blossom.

There is now considerable interest in the studies of plant regulators and chemical thinning of citrus fruit.

Reference

1) Khalifah, R. A., Lewis, L. N., Coggins, C. W., Jr., and Radlick, P. C.: Fluorometric, chromatographic, and spectronic evidence for the non-indolic nature of citrus auxin. *Jour. Exper. Bot.*, **16**(48), 511–517 (1965).