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Effect of Daminozide on Total Nonstructural Carbohydrates, Total Nitrogen Contents in Leaves and Stem Apexes in Relation to Flowering Ability of Tangerine (*Citrus reticulata* Blanco cv. Khiew-Waan)

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ABSTRACT

The effect of daminozide on flowering, total nonstructural carbohydrates, total nitrogen contents in leaves and stem apexes of tangerine (*Citrus reticulata* Blanco cv. Khiew-Waan) was studied during January 1985 to Apil 1985. The results showed that daminozide at 2,000, 4,000 and 6,000 ppm applied under the normal irrigation condition tended to increase flowering. The rate of 6,000 ppm gave the highest percentage of flowering (38.8%) while the untreated trees produced the lowest percentage of flowering (13.1%). Daminozide at all concentrations showed no effect on the total nonstructural carbohydrate contents in leaves and stem apexes compared to the untreated trees.

Daminozide had no effect on the total nitrogen contents after the application until flushing but after that flushing stage the trees having daminozide at 6,000 ppm tended to contain the highest total nitrogen contents in leaves and stem apexes.

INTRODUCTION

Tangerine (*Citrus reticulata* Blanco cv. Khiew-Waan) is one of the important economic crops in Thailand. They are grown at almost all over the country, but the big plantation is in the Central Plain. The common practice in producing tangerine in this area is to stress the trees by withdrawal of water in the ditches surrounding the growing beds. This method seems to be cumbersome and makes high cost of production and the trees died occasionally as a result of this practice. Therefore other alternative methods are searched and one possibility is to use plant growth regulators. Daminozide, a growth retarding chemical, was therefore brought to the experiment to see if it can induce flowering instead of stressing the tree. Daminozide had been shown to induce flowering in apples, pears, cherries (Batjer *et al.*, 1964), lemons (Monselise et. al., 1966) and mangoes (Das and Panda, 1976).

The relation of carbohydrate and nitrogen contents on flowering of plants had been mentioned (Goss, 1973). Kar and Randhawa (1968) found the carbohydrate in citrus leaves and twigs to increase before flushing and flowering. Daminozide was found to cause an increase on carbohydrate, RNA and protein in leaves and stem apexes during flowering of mango (Das and Panda, 1976). This experiment was designed to evaluate daminozide influencing on total nonstructural carbohydrates, total nitrogen contents in leaves and stem apexes of tangerine in relation to its flowering ability.

MATERIALS AND METHODS

Sixteen of ten years old tangerine trees, uniform in growth and productivity were selected in the orchard at Tumbol Bung Ba, Amphur Nong Sua, Patum Thani Province. Forty stem apexes were tagged from each tree. The percentage of flowering from these tagged apexes was recorded. There were four treaments in the experiment with four trees per treatment. The

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treatments were 0, 2,000 4,000 and 6,000 ppm of daminozide. In each treatment the trees were sprayed with daminozide to run-off on 13/1/85. Twenty stem apexes per tree were randomly sampled around the tree every week after spraying. These samples were analysed for total nonstructural carbohydrate and total nitrogen contents in leaves and stem apexes, by washing the samples in tap water, rinsed in distilled water, and dried in hot air oven at about 65°C for 72 hours. After drying, the materials were ground in a Wiley Mill and then stored in desiccator.

Total nonstuctural carbohydrates were extracted with 0.2 nH_2SO_4 (Smith, 1969) and determined by Nelson reducing sugar procedure method (Hodge and Hofreiter, 1962). Total nitrogen in tissues was extracted by digestion mixture and determined by using Analyzer II.

RESULTS

In all treatments, the tangerine trees were found to start flushing and flowering at about seven weeks after treating with daminozide. However not all the terminal apexes were flushing and hence flowering. This irregular flowering was found in both the treated and untreated trees which indicated that daminozide at all concentrations had no effect on the time of flushing and flowering of tangerine.

Flowering and Fruiting

Daminozide at 0, 2,000 4,000 and 6,000 ppm had no significant effect on the amount of flowers produced in the trees but the treated trees tended to show earliness in flowering. The trees treated with daminozide at 6,000 ppm tended to produce the highest percentage of flowering while the untreated trees had the lowest percentage of flowering (Table 1). Daminozide had no effect on fruiting but at 6,000 ppm the trees tended to produce the highest fruiting percentage while the untreated trees produced the lowest (Table 1).

Table 1 Effect of daminozide on flowering and fruiting of tangerine

Concentration of daminozide (ppm)	flowering (%)	fruit setting (%)
0	13.1	14.3
2,000	20.0	19.8
4,000	20.8	14.8
6,000	38.8	21.8

Total nonstructural carbohydrate (TNC) contents in leaves and stem apexes

Daminozide at all concentrations had no significant effect on TNC level in leaves of tangerine, TNC tended to increase at 3 and 4 weeks after the application there-after the level decreased to the lowest in the seventh week, time that trees started to flush (Fig. 1). Daminozide at 0, 2,000 4,000 and 6,000 ppm had no effect on TNC level in the stem apexes. The rapid rise of TNC level in stem apexes was at the fourth week after the application then the level decreased and the lowest amount was also found at the seventh week. Daminozide treated trees tended to produce higher TNC level in the stem apexes than the untreated trees. (Fig. 2)

Total nitrogen (TN) contents in leaves and stem apexes

Daminozide at 0, 2,000 4,000 and 6,000 ppm showed no significant different on the amount of TN in leaves, however after the second week of application, leaves receiving daminozide at 6,000 ppm showed the highest TN content of 31.3 mg/g. The TN content in leaves tended to decrease thereafter and the content increased again in the seventh week which was the period of flushing (Fig. 3). Daminozide had no significant effect on the TN content in stem apexes except at the rate of 6,000 ppm of daminozide which showed the highest TN contents in the stem apexes at the fourth and seventh weeks after the application (Fig. 4), however the differences in TN contents at various time after the application of daminozide were not significant among the treatments.

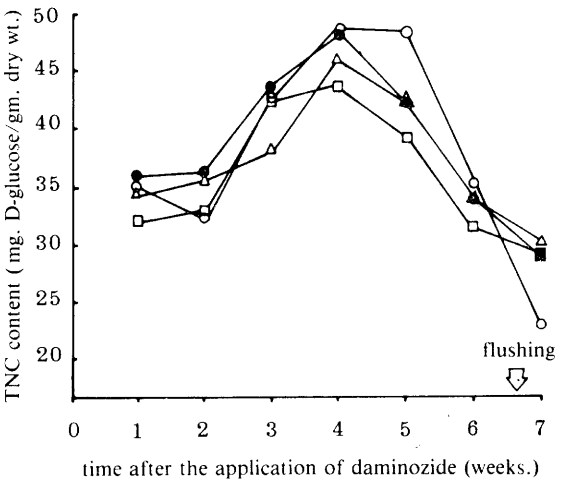


Figure 1 TNC levels in leaves of tangerine trees at different time intervals after receiving various concentrations of daminozide

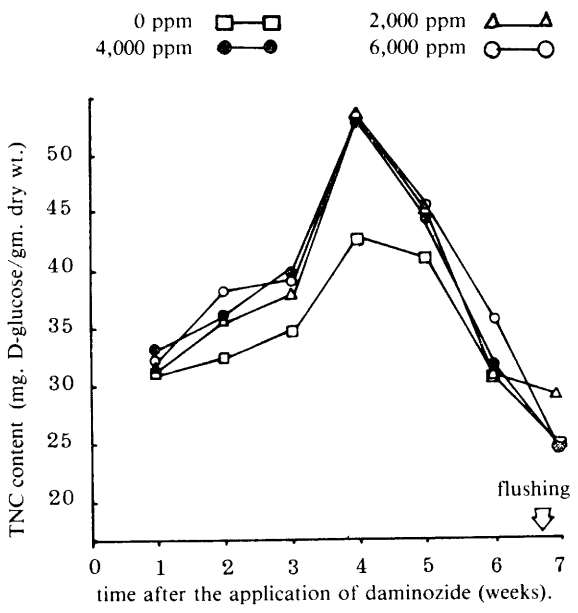


Figure 2 TNC levels in shoot apexes of tangerine trees at different time intervals after receiving various concentrations of daminozide.

DISCUSSION

Under the normal irrigation condition, daminozide tended to increase the percentage of flowering in tangerine while the untreated trees were not flowering (Table 1). This may be due to the low night temperature and low humidity during the time when the experiment was conducted. This growing condition was in itself can create the tree with slight stress. Beneficial effect of daminozide on flowering percentage increment was also reported in lemon (Monselise and Halevy, 1964).

In this experiment, daminozide tended to cause an increase in the flowering of tangerine in the same way as those reported in other citrus and lemon (Monselise *et al.* 1966 ; Monselise and Goren, 1978). One possible action of daminozide may be due to the inhibitory action of gibberellin (GA) synthesis in plants. Hoad and Monselise (1976) found the levels of GA in apples to reduce after the application of daminozide. The decrease of GA level may be due to the inhibitory action on enzyme activity responsible for GA synthesis in plants. (Krishnamoorthy, 1981). The inhibition of flower bud formation caused by GA was also reported in many plants (Monselise and Halevy, 1964 ; Goldschmidt and Monselise, 1972 ; Goldschmidt, 1976). When the levels of GA were reduced, the vegetative buds were changed to flower buds (Guardiola *et al.*, 1982), which were reported in plums, pears and apples, (Bradley and Crane, 1960 : Griggs and Iwakiri, 1961 ; Landsberg and Thrope, 1975)

The total nonstructural carbohydrate (TNC) contents in leaves and stem apexes tended to show marked increase in the second to fourth weeks of daminozide application (Fig. 1,2) this may be due to the increase in photosynthesis and the decrease in respiration of leaves (Rhoads and Wedding, 1953) resulted in the accumulation of carbohydrates in leaves and stem apexes. The amount of TNC tended to decrease at the fifth, sixth and seventh weeks which coincided to the flushing time of the trees when carbohydrates were used up during flushing. The amount of TNC in stem apexes of the treated tangerine trees was higher than the untreated trees (Fig. 1,2) as reported in mango (Suryanarayana and Rao, 1978).

With daminozide treatment, the amount of TN in leaves tended to decrease (Fig. 3).

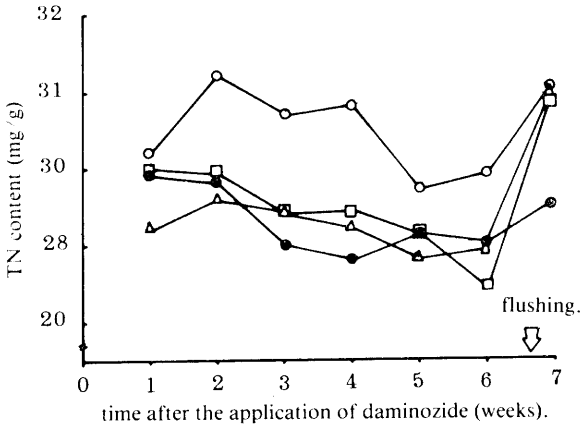
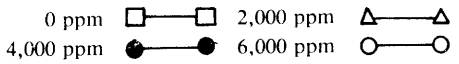


Figure 3. TN levels in leaves of tangerine trees at different time intervals after receiving various concentrations of daminozide.



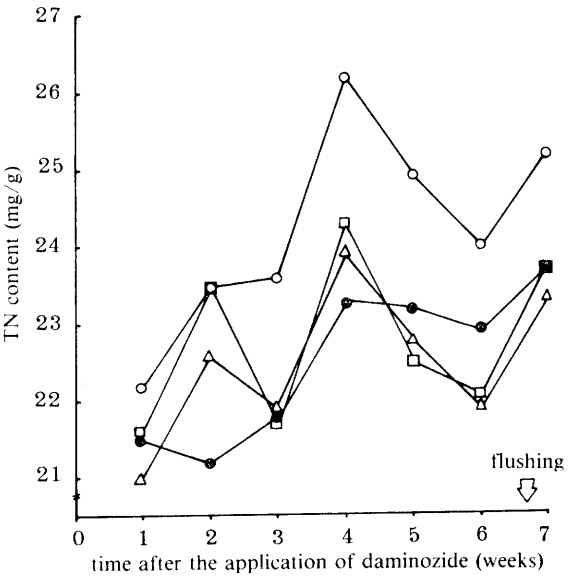


Figure 4. TN levels in shoot apexes of tangerine trees at different time intervals after receiving various concentrations of daminozide.

This was seen in all concentration except at 6,000 ppm where the TN levels fluctuated, and the level reached the highest at the time when the trees flushed. This fluctuation in TN levels may be contributed to the increase in the synthesis of nitrogenous compounds in leaves and quickly translocated to other parts of the tree (O'Kennedy *et al.*, 1975).

Daminozide at 6,000 ppm tended to produce the highest TN content in leaves and stem apexes which was found at every week after applications (Fig. 3,4). The effectiveness of daminozide at 6,000 ppm in increasing chlorophyll contents (Weaver 1972) as well as in delaying the degradation of chlorophyll contents in leaves of many plants were reported (Krisnamoorthy, 1981). Furthermore daminozide can also increase the RNA and protein in leaves and shoots of mango plants (Suryanarayana and Rao, 1978).

SUMMARY

The study on the effect of daminozide on the physiological change in the tangerine plants in relation to flowering can be concluded as follows :

1. Daminozide tended to increase flowering in tangerine under the normal irrigation condition. Daminozide at 6,000 ppm tended to cause the highest flowering while the untreated trees had the lowest flowering.

2. Daminozide had no effect on fruit set, except at 6,000 ppm which seem to have some influence on fruit setting percentage.

3. Daminozide showed no effect on the total nonstructural carbohydrate contents in leaves and stem apexes.

4. Daminozide did not have any influence on total nitrogen contents in leaves and stem apexes, except at the second and fourth weeks after application. Daminozide at 6,000 ppm tended to produce the highest total nitrogen contents.

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