activities in three varieties of mango (*Mangifera indica*). *Indian J Plant Physiol*, 1995, 38(1), 73～76

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摘　要　用10 mmol·L^{-1}硼酸处理Sensation芒果果实，目的在于了解硼酸对延缓成熟过程，尤其对延缓那些与成熟有关的生理变化是否有一定的作用。8 d的成熟过程所观测的结果表明：①硼酸处理的鲜果质量下降不如对照明显，果皮中叶绿素含量的变化也类似；②硼酸处理的果实中，果胶甲酯酶及多聚半乳糖醛酸酶的活性高于对照，且果胶甲酯酶的活性比多聚半乳糖醛酸酶的活性早2 d达到峰值；③与对照相比较，硼酸能降低果实的呼吸作用，而对果肉的总糖含量没有影响。

关键词　芒果；硼酸；成熟；果胶甲酯酶；多聚半乳糖醛酸酶；呼吸作用
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Effect of Boric Acid Treatment on the Ripening of Mango (*Mangifera indica*) cv. Sensation

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Abstract: An attempt has been made to treat Sensation mango fruits with 10 mmol·L^{-1} boric acid with the aim to see whether boric acid has some effect on delaying ripening process, especially those ripening associated changes. Results obtained during a 8-day ripening period have shown that ① in boric acid treatment fruits didn't lose fresh weight so drastically as in control, so did the chlorophyll content in the skin, ② boric acid treated fruits were higher in activity of pectin methyl esterase (PME) and polygalacturonase (PG) than control with PME peak coming 2 days earlier than that of PG and ③ boric acid lowered respiratory activity of the fruit as compared to control with no effect on total sugar content in the pulp.

Key words: mango; boric acid; ripeness; pectin methyl esterase; polygalacturonase; respiration

Mango (*Mangifera indica*) is one of the fruits that have a short shelf life. How to delay the process of ripening is of interest to plant physiologists and horticulturists. Efforts have been mabe to delay ripening associated changes of the fruit by means of chemicals so that the shelf life could be extended in Kinnow mandarin fruits[1], banana[2], mango[3,4] and apple[5]. But till now no report on the effect of boric acid on ripening mango fruit has been read. Boric acid was reported to improve fruit quality in guava[6,7], mandarin[8], apple[9], ber[10] and mango[11,12] when applied to fruit trees singly or in combination with other che-

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micals/fertilizers. Therefore, its effect on the ripening fruit of mango cv. Sensation, particularly in ripening associated physiological and biochemical changes, was studied.

1 Materials and Methods

Mature, unripe Sensation mango fruits were obtained from the Division of Horticulture, IARI and treated with 10 mmol·L^{-1} boric acid and water by vacuum infiltration for 1 min followed by a 10-min soak. After treatment, the fruit were dried and kept in open trays in a room at a day/night temperature of 26±1)℃, three of which were used for recording loss in fresh weight and measurement of respiration every day during ripening. At the same time, chlorophyll content in the skin, total sugar content, free amino acid (FAA) content and the activity of enzymes viz. pectin methyl esteraes (PME) and polygalacturonase (PG) in the pulp were estimated every other day in three replications.

An Infra Red Gas Analyser (ADC-225-MK 3/WA 161, England) with a specially designed chamber was used for the measurement of respiration, which was expressed as μmole of CO_2 released per gram of fresh weight per hour. Chlorophyll content was done by means of Arnon's method[13] and expressed as mg of chlorophylls 'a' and 'b' per gram of fresh weight. The method described by Lee and Takahashi[14] was adopted in the determination of FAA expressed as μmole of glycine equivalent per gram of fresh weight. In the estimation of total sugar content, which was expressed as mg of sucrose equivalent to total carbohydrate per gram of fresh weight, the method suggested by Upmeyer *et al.*[15] was followed. PME activity was estimated according to Rouse and Atkins[16] and expressed as enzyme activity unit per gram of fresh weight per miniute. PG expressed as mg of glucose equivalent released per gram of fresh weight per hour was assayed by the modified method of Hobson[17] and the method described by Hodge and Hofreiter[18].

2 Results and Discussions

Results obtained during a 8-day ripening process on the parameters mentionep above were shown in Figs. 1~7.

Generally speaking, there was a continuous loss in fresh weight and chlorophyll content as ripening advanced in Sensation in both control and two treatments. But the fruit treated with boric acid didn't lose weight (5.27%) so much as that in water treatment (7.38%). Control lost weight almost twice (9.83%) as much as boric acid treatment. Chlorophyll content in the treatment of boric acid decreased less than control and more than water treatment. That means the fruit

treated with boric acid became yellow faster than water treatment but slower than control (Figs 1～2).

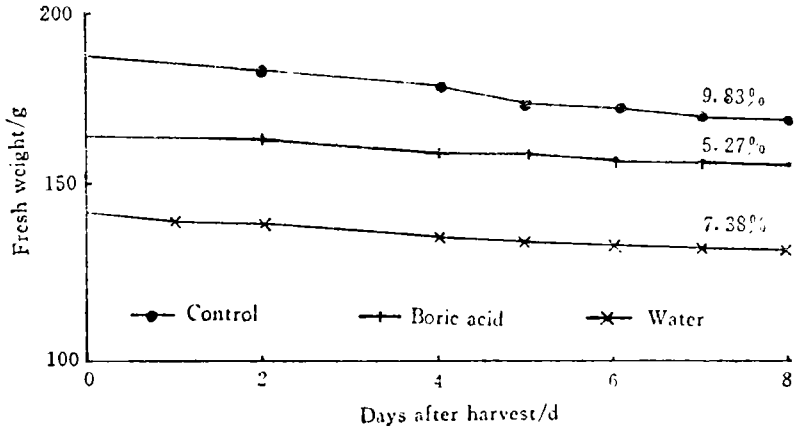

Fig. 1　Loss in fresh weight in Sensation mango

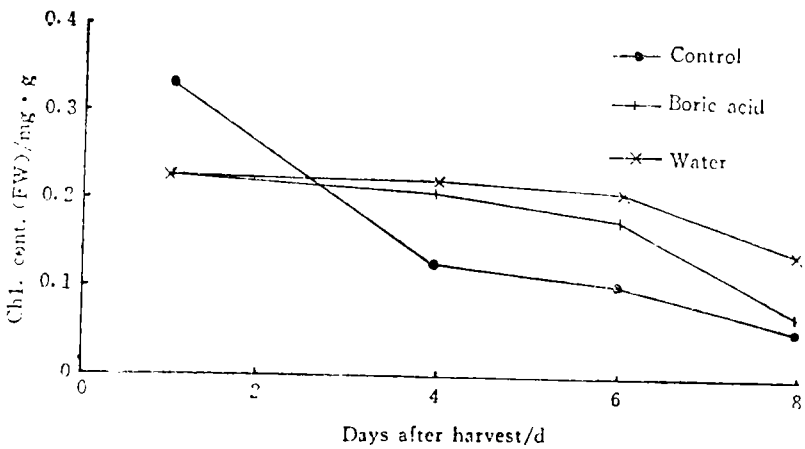

Fig. 2　Chlorophyll content in the skin of Sensation mango

Changes in FAA seemed to be a little bit unusual. After harvest FAA decr eased for 4～6 days followed by an increase. Boric acid treatment didn't increase as drastically as water treatment, which indicates that increase in cell water content to some extent helps the conversion (hydrolysis) of protein to free amino acids (Fig. 3).

Total sugar content in the pulp increased with ripening followed by a fall when the fruit was over ripe. The fruit treated with boric acid seemed to have a high sugar content compared to control and water treatment with control being lowest (Fig. 4).

Respiratory activity of the fruit increased with ripening. Boric acid treatment was more effective in lowering respiration of the ripening fruit than water treat-

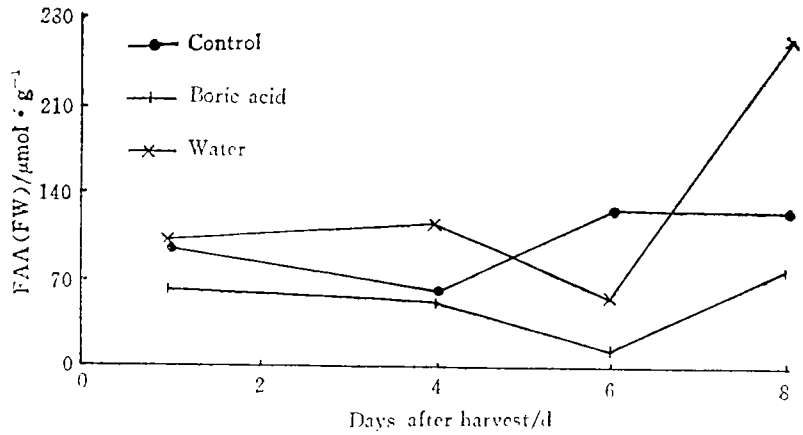

Fig. 3 Free amino acid content in the pulp of Sensation mango

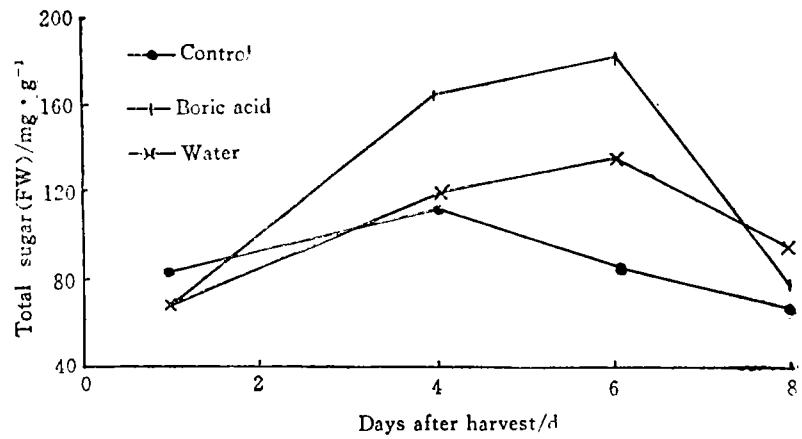

Fig. 4 Total sugar content in the pulp of Sensation mango

ment, both of which had some effect in comparison to control (Fig. 5).

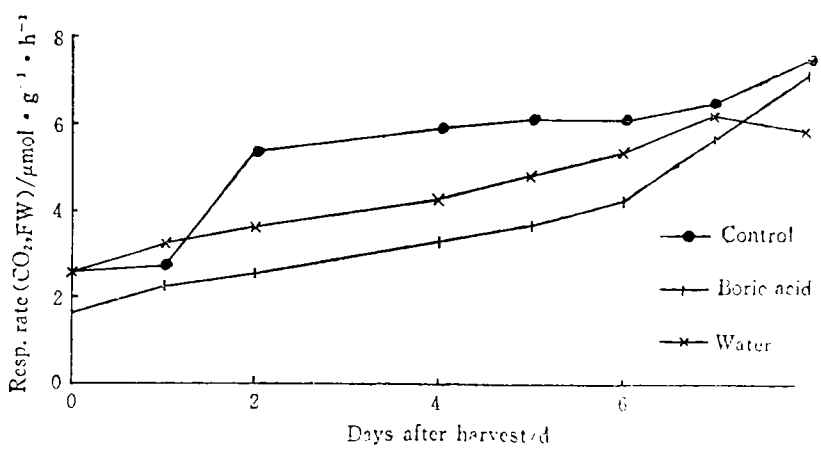

Fig. 5 Respiratory activity in Sensation mango

PME is responsible for the deesterification of pectin required before PG starts the depolymerization of pectins associated with fruit softening[19]. The peak of PME activity occurred on 6th day after little change in the first 4 days. The fruit in the treatment of boric acid had a higher PME activity peak than control. Water treatment lowered the activity of this enzyme during the ripening. It appears that the peak of PME coincided with that of total sugar, whereas, when FAA had a relatively low value. It's quite possible that around the 6th day much protein was involved in the synthesis of this enzyme. In lowering the activity of PG, boric acid treatment and water treatment had no effect. PG activity had little change in the first 6 days in both treatment and control. Thereafter there was a sharp increase, which seemed to coincide with the climacteric rise in respiration. The peak of PME activity was observed at least 2 days in advance of that of PG activity, which is similar to the result obtained in other 3 varieties of mango fruits[20] (Figs. 6～7).

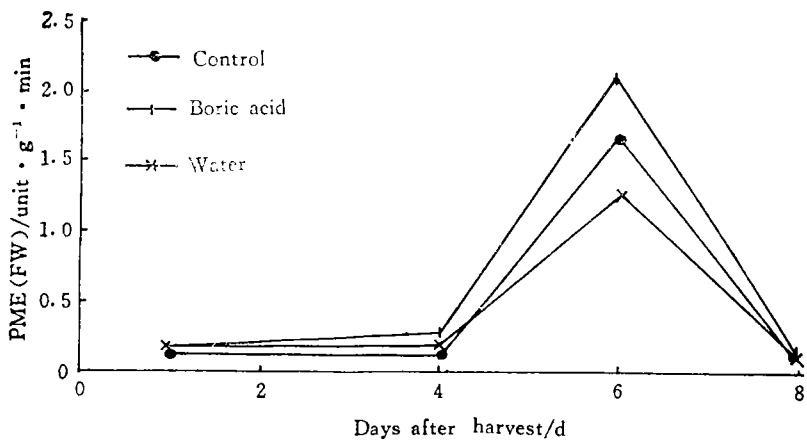

Fig. 6　Pectinmethylesterase activity in the pulp of Sensation mango

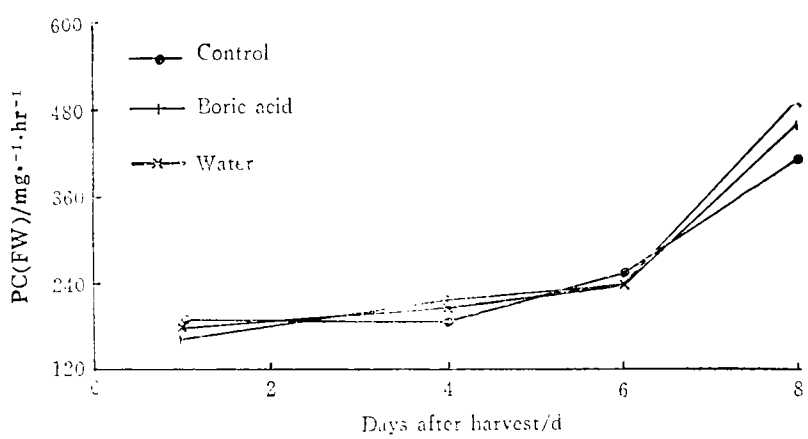

Fig. 7　Polygalacturonase activity in the pulp of Sensation mango

In conclusion, boric acid treatment of mango fruit has some effect on loss in fresh wight and chlorophyll content in the skin and on lowering respiratory activity in terms of delaying ripening. Water treatment is also a method feasible.

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