Madras Agric. J. 90 (10-12) : 756-759 October-December 2003

Research Notes

Studies on hot water treatment as a quarantine measure for export of mango

NEHRU CHEVANAN
Indian Institute of Horticultural Research, Hessraghatta, Bangalore - 560 089, Karnataka

The annual production of mango during 2000-2001 in India was 10.5 million tonnes. India exports large quantities of fresh and processed mango to U.A.E., Saudi Arabia, Bangladesh, U.K., Kuwait, Sri Lanka, Bahrain, U.S.A, Netherlands, Qatar, Malaysia, Belgium, Spain and Canada. The total export of fresh mangoes alone during 1999-2000 was 34631.2 MT valued at Rs. 7154.9 lakhs which was 4% of the total horticulture produce exported during 1999-2000 (Anonymous 2001). The export of fresh mangoes to foreign countries requires strict quarantine measures. While exporting mangoes, due to the continuous rise in quarantine charges at different entry ports and to avoid the rejection of fruits due to insect pest problems, utmost care should be taken before the fruits are loaded into the containers. For export of mango, the quarantine inspection includes the fruit should be free from fruit fly and anthracnose contamination. Different methods are recommended for post harvest disinfestation of fruitfly and anthracnose. Fumigation with methyl bromide, heat treatment with hot water or vapour, insecticidal dipping and irradiation will disinfest the fruits for fruitfly (Ian and Marlene, 1992). United States Department of Agriculture recommends hot water treatment of mango for post harvest disinfestation of fruit fly(Anonymous 2001). Verghese *et.al.* (2002) reported a double walled steel tank of one cubic meter capacity fitted with thermostat and treated the mangoes at 48°C for one hour gave satisfactory results for disinfestation of fruit fly. Mandhar *et al.* (2000), have found the mangoes treated at 46°C for 65 min. could disinfest both fruitfly and anthracnose and 52°C for 5 min. could disinfest anthracnose only. Based on these results the following study was undertaken at the section of Agricultural Engineering, Indian Institute of Horticultural Research and reported in this paper.

A rectangular hot water treatment plant having the size of 2400 mm length, 1200 mm width and 500mm height was used for testing. The hot water treatment plant was fabricated using AISI 403 grade stainless steel sheet of 2 mm thickness. Five electric coils of 3 kW capacity were fitted at an height of 60 mm from the bottom. A stand was fixed inside the water tank to prevent the direct contact of the mango or the plastic crates with the heating coil. A fractional hp pump set was fitted at the one end of the tank. The wat from the pump set was left at the other en of the tank for continuous stirring of the wate

Experiments were conducted in the h water treatment plant with the followin combinations of temperature and treatment tim

T_1 - 46°C temperature for 65 minutes
T_2 - 46°C temperature for 75 minutes
T_3 - 46°C temperature for 90 minutes
T_4 - 48°C temperature for 40 minutes
T_5 - 48°C temperature for 60 minutes
T_6 - 48°C temperature for 80 minutes
T_7 - 50°C temperature for 10 minutes
T_8 - 50°C temperature for 20 minutes
T_9 - 50°C temperature for 30 minutes
T_{10} - 52°C temperature for 5 minutes
T_{11} - 52°C temperature for 10 minutes
T_{12} - 52°C temperature for 15 minutes
T_{13} - Control.

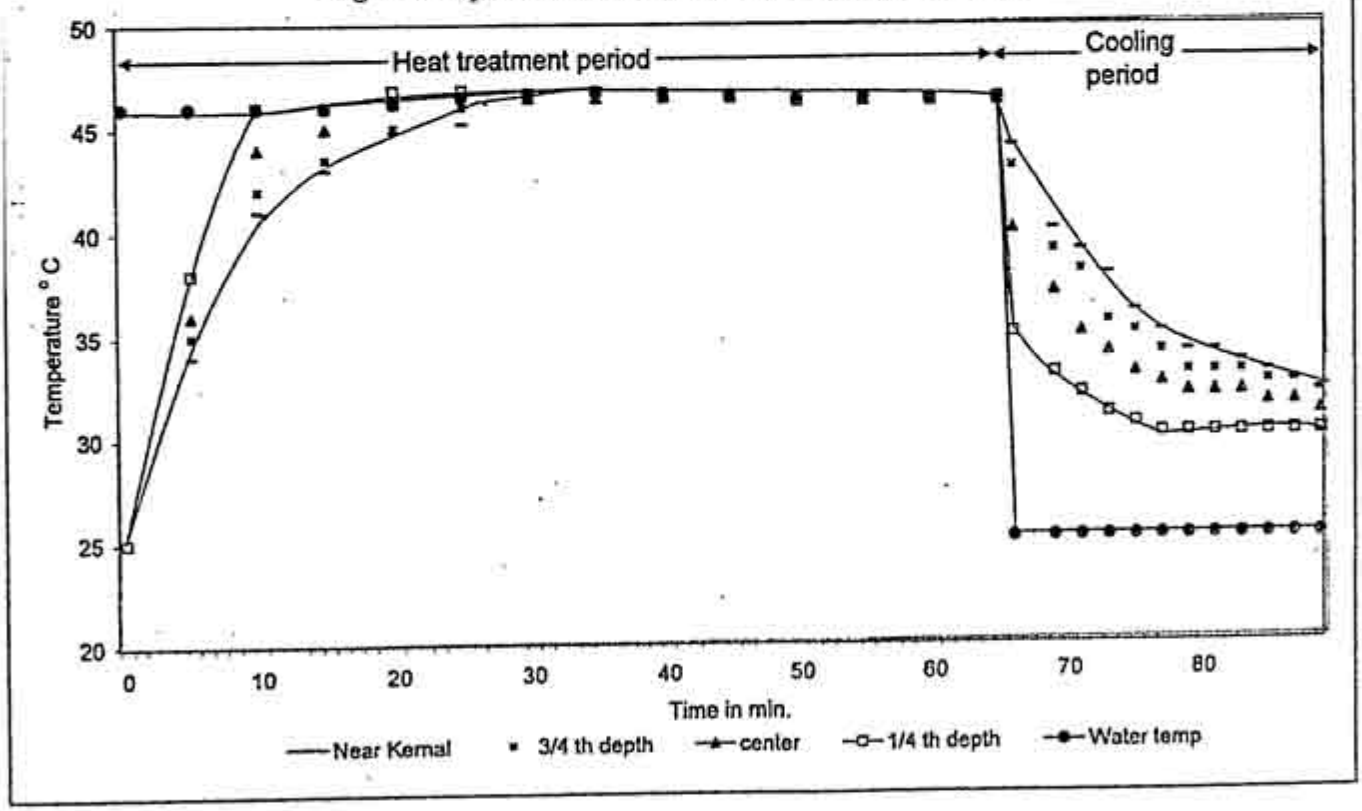
Initially the water was heated to 2°C temperature above the proposed treatmen temperature so that on immersion of the fruits the water temperature has reached the preset temperature. To avoid the sudden fall in temperature during the initial dipping of the fruits the water to fruit ratio was kept at 5:1 on weight basis. Fungicide was mixed with the water at 0.1 per cent concentration to destroy the spores of anthracnose on the fruit surface.

The fruits were placed in commercially available plastic crates of size 600 mm x 300mm x 280mm and immersed in the hot water treatment plant. The water with the fruits were stirred continuously using the water pressure from the

Table 1. Physiological loss in weight of two varieties mango subjected to hot water treatment

Treatment	PLW of Alphonson variety			PLW of Totapuri variety		
	Initial weight (g)	Final weight (g)	PLW (%)	Initial weight (g)	Final weight (g)	PLW (%)
46°C for 65 min.	1390.9	1132.5	17.4	1411.3	1239.6	12.2
46°C for 75 min.	1438.4	1158.7	19.45	1192.9	1013.7	15.0
46°C for 90 min.	1391.9	1133.7	18.6	1324.0	1159.1	12.5
48°C for 40 min.	1282.8	1051.2	18.0	1447.0	1270.6	12.2
48°C for 60 min.	1321.0	1064.3	19.4	1379.4	1184.8	14.1
48°C for 80 min.	1481.7	1201.4	18.9	1582.0	1376.4	13.0
50°C for 10 min.	998.2	905.4	9.3	1524.0	1379.3	9.5
50°C for 20 min.	1177.9	1055.1	10.4	1598.5	1432.8	10.4
50°C for 30 min.	1017.8	926.8	8.9	1604.2	1439.1	10.3
52°C for 5 min.	1063.3	921.5	13.3	1408.3	1266.8	10.0
52°C for 10 min.	1081.1	996.4	7.8	1458.0	1307.0	10.4
52°C for 15 min.	1246.7	1089.7	12.6	1688.0	1518.8	10.0
Control	1124.2	921.5	18.0	1791.7	1571.9	12.3

Fig. 1. Temperature inside the fruit during treatment time



pumpset. The stirring action helps in prevention of accumulation of heat around the heating coils and helps in the rotation of the fruits so that all the sides of the fruit were subjected to uniform temperature conditions.

After the treatment of fruits, the qualities of the fruits like the physiological loss of weight, heat injury and storage qualities of the fruits were studied to understand the effect of hot water treatment on qualities of mango.

Movement of temperature inside the fruit

The hot water treatment process involves immersion of the mangoes at a constant temperature bath for a known period of time and then cooling the mangoes in running water for 30 min. to remove the heat from the treated fruits.

The movement of heat inside the fruit was studied using a needle type sensor. Four sensors were inserted at 1/4th of flesh thickness, centre of flesh thickness, 3/4 of the flesh thickness and just above the kernel. The sensors were of needle type and could be inserted into the fruit and the depth of insertion could be maintained easily. The inside temperature was recorded for every 2 min. till the end of the experiment. The thermocouples were calibrated and used in the experiments.

Physiological loss of weight

The physiological loss of weight of the fruits treated at different temperature and time were studied. The initial weight of the fruits immediately after treatment was recorded. The weight of the fruits was recorded daily till the fruits reached the fully ripened condition. The PLW was calculated using the equation

$$PLW = \frac{\text{Initial weight of the fruits} - \text{final weight of the fully ripened fruits}}{\text{Initial weight of the fruits}} \times 100$$

Heat injury

The heat injury on the fruits treated at different temperature and duration were studied. The heat injury was observed on fruits by indications such as shriveling of the skin near the pedicle end, darkening of the skin etc. Few injured fruits spoiled very quickly during storage and the number were recorded and were discarded to avoid the contamination to the other fruits.

$$\text{Heat injury} = \frac{\text{Number of fruits lost due to heat injury}}{\text{Total number of fruits}} \times 100$$

Storage studies

After the treatment the fruits were stored under atmospheric conditions in aluminum trays. The treated fruits were observed for ripening rate and anthracnose spoilage by visual inspection. The fruit fly damage was inspected from the holes made by the fruit fly during escape. On completion of ripening the fruits were cut in to pieces and inspected for the presence of any fruit fly damage in the fruit.

The experiments were conducted during the months of May-June,2002. The fruits were harvested from the fields of Indian Institute of Horticultural Research and used for testing. Utmost care was taken while harvesting the fruits to avoid the injury to the fruit. Fruits weighing lesser than 250 grams and above 550 grams were not having export potential and discarded before taking up the experiments.

Temperature movement inside the mango fruit

The temperature movement inside the fruit was recorded at a treatment temperature of 46°C for 65 min. treatment time. Alphonso variety of mango having 380 grams weight was used for testing. The temperature was recorded on a single fruit at points adjacent to the stone, 3/4th of flesh thickness, centre of flesh thickness and 1/4 h of the flesh thickness are depicted in the Fig. 1. During the treatment, the outer layer of the fruit reached 46°C within the first 10 min. where as the it requires 30 min. to reach the desired temperature to the innermost layer. So a fruit subjected to treatment time of 65 min., the innermost layer of the fruit was subjected to the treatment temperature for 35 min. During cooling with the running water at 25°C, the outer most layer reached the temperature of 300°C within 6 min., whereas it took more than 25 min. for the inner most layer to reach the desired temperature. The rate of heat removal was faster in the beginning when the difference of temperature between the fruit and the water was more. As the time increased the rate of heat removal reduced. Hence the time taken for the fruit to reach the room temperature was very high.

Physiological loss in weight (PLW)

The physiological loss in weight for alphonso and totapuri varieties of mango subjected to hot water treatment was observed and depicted in the table 1. For alphonso variety of mango the PLW for control fruits was 18%. It was observed that the fruits subjected to longer duration at temperatures of 46°C and 48°C, the PLW was almost equal to the control fruits. But the PLW for alphonso variety of fruits treated for shorter duration was in the range of 7.8 to 12.6 per cent. The PLW for totapuri

variety of mango for control fruits was 12.3%. The PLW of totapuri variety fruits treated for a longer duration at 46°C and 48°C, the PLW was almost equal to the control fruits where as the PLW for fruits treated for a shorter duration was in the range of 9.5 to 10.4 per cent.

Heat injury

Heat injury to the fruits was observed when the fruits were subjected to longer duration. There was loss up to 10% when the fruits were subjected to 46°C for 90 min. and 48°C for 60 min. and 48°C 80 min. The heat injury was observed when the size of the fruits was very small. The quality of the fruit before treatment also plays a very important role in spoilage of fruit due to heat injury. However no damage to the fruit was observed when the fruits were subjected to shorter duration of treatment at 50°C and 52°C.

Storage behaviour of hot water treated mangoes

Hot water treatment helped in the uniform ripening of mango fruits. Nearly 90 per cent of the fruits treated at 52°C for 10 min and 20 min ripened between 10h and 11h day during storage. More than 80 percent of the fruits treated at temperature of 48°C for 40 min, 50 min and 80 min ripened between 12th and 13th day. The same trend was observed when the fruits were treated at 46°C for 75 min and 90 min. In the fruits treated at 46°C for 65 min., ripening was very slow and the fruits ripened between 16th and 17th day. The control fruits ripened over a period of 17 days and the ripening was not uniform.

References

Anonymous (2001). Indian Horticultural Database-2001, published by National Horticulture Board, Ministry of Agriculture, Government of India.

Anonymous (2001). USDA-APHIS plant protection and quarantine treatment manual.

Ian M. White and Marlene M. Elson-Harris. (1992). Fruit flies of economic importance: Their identification and bionomics, CAB International in association with The Australian centre for International Agricultural Research. pp.22,23.

Mandhar, S.C., Senthil Kumaran, G., Mohan, B. and Carolin Rathinakumari. (2000). Development of a commercial hot water treatment plant, 14 h Indian convention of Food scientists and Technologists 2000, 22-24 November 2000 held at Central Food Technological Research Institute, Mysore.

Verghese, A., Madhura, H.S., Kamala Jayanthi, P.D. and Stonehouse, J.M. (2002). Fruit flies of economic significance in India with special reference to Bactrocera dorsalis (Hendel), 6th International Symposium on Fruit flies of Economic importance 6-10 May 2002, Stellenbosch, South Africa.

(Received: January 2003; Revised: June 2003)

Madras Agric. J. 90 (10-12) : 759-762 October-December 2003

Research Notes

Economics and quality assessment of organically grown tomato

C. PRABAKARAN
Department of Environ. Sciences, Tamil Nadu Agrl. University, Coimbatore - 641 003, Tamil Nadu

Organic vegetable cultivation offers one of the most sustainable farming system with long term recurring benefits such as soil health maintenance, stability in production etc. by imparting a better resistance against biotic and abiotic stresses. Renewed efforts are in vogue during the last 10 years in the pursuit of growing organically since tomato is one major vegetable commonly grown in India. So, the present study was undertaken with an objective of exploring the economics and quality of tomato under organic farming besides improving the yield.

A field experiment was conducted with different organic N sources during Dec.1999-Mar. 2000 in red sandy loamy soil of Agricultural College and Research Institute, Killikulam in