PHILIPPINE SCIENCE HIGH SCHOOL WESTERN VISAYAS
Doña Lawaan H. Lopez Campus
Iloilo City

THE EFFECT OF HOT WATER TREATMENT ON THE SHELF LIFE AND SUSCEPTIBILITY TO ANTHRACNOSE OF NEWLY HARVESTED MANGOES

A Research Paper Presented to the
Faculty of Philippine Science High School Western Visayas
Iloilo City

In Partial Fulfillment
Of the Requirements in
Technology Research II

by

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Francis Ace P. Sonalan
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APPROVAL SHEET

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Abstract

This study aimed to determine the effect of hot water treatment on the shelf life and susceptibility to Anthracnose of newly harvested mangoes. It was hypothesized that there exists no significant difference in the shelf life and susceptibility to anthracnose of the test organisms when treated at different time intervals. Results of the study were subjected to descriptive statistical tests, namely mean and standard deviation. An inferential statistical test, the One-Way Analysis of Variance (ANOVA), set at 0.05 alpha level of significance, was employed to test the hypothesis. The Scheffe test, also set at .05 alpha level, was used as post hoc multiple comparison test. Based on the findings of the study, it was concluded that the shelf life and susceptibility to anthracnose of newly harvested mangoes was increased when the hot water treatment time was increased, which means that increasing the length of exposure time to hot water

also prolongs the shelf life and decreases susceptibility to anthracnose of newly harvested mangoes. There were also significant differences in the shelf life and susceptibility to anthracnose of newly harvested mangoes when the exposure time to hot water treatment was increased. The effective hot water treatment times were 10 minutes and 15 minutes. Since a significant difference also occurred between 10 and 15 minutes hot water treatment time, the more effective hot water treatment time is 15 minutes.

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THE EFFECT OF HOT WATER TREATMENT ON THE SHELF LIFE AND SUSCEPTIBILITY TO ANTHRACNOSE OF NEWLY HARVESTED MANGOES

Chapter 1

Introduction to the Study

Background of the Study

People have come up with different ideas on how to preserve food. They have been successful so far but most preservation processes require harmful chemicals to be added to the food.

Mango is one of the most popular and important fruit crops in the Philippines. There are few plantations devoted solely to mangoes with most trees scattered over the entire archipelago as a result of limited plantings along property limits, highways, river banks, more popularly, as household plantings in villages. Although mango is grown all over the country, the principal producing areas are those with continuous dry periods for at least four months (Jimenez, Sta. Singh, Torres, 1997).

In the Philippines, the mango season starts in late November, gradually increases to peak availability in April and May, and ends in June due to the onset of the rainy season.

The Philippines is one of the leading exporters of fresh mangoes almost exclusively to Hong Kong or Japan. Advances in the technology of mango production, particularly fruit fly control and flower induction, have contributed considerably in increasing yields to levels that permitted increased exportation not only to the said places but also to other countries (Golez and Bignayan, 1993).

Western Visayas has a large number of hectarage planted to mango and in fact, it is considered as one of the major mango producing regions in the country. On yield, it has the highest quantities of fruits produced as compared to other regions (Golez et. al, 1993).

Anthracnose occurs in all mango-producing areas of the country. Considered the most serious fungal disease of mango, it attacks the different parts of the tree, but major damage occurs during flowering up to settings, and then again after harvest. The disease is most serious during wet season.

Hot water treatment is a process not so expensive compared with other processes. Another is it does not need harmful chemicals to be added to the fruit.

The independent variable for this study would be the duration hot water treatment on the newly harvested mangoes, and the dependent variable for this study would be the shelf life and susceptibility to anthracnose of mangoes.

The relationship between the independent and dependent variables in the study is presented in Figure 1.

Statement of the Problem and Hypothesis

This study aimed to determine the effect of hot water treatment on the shelf life and susceptibility to anthracnose of newly harvested mangoes. Specifically, it answered the following questions:

1. What is the effect of hot water treatment on the (a) shelf life, and (b) susceptibility to anthracnose of newly harvested mangoes?

2. Is there a significant difference as to (a) shelf life, and (b) susceptibility to anthracnose of newly harvested mangoes

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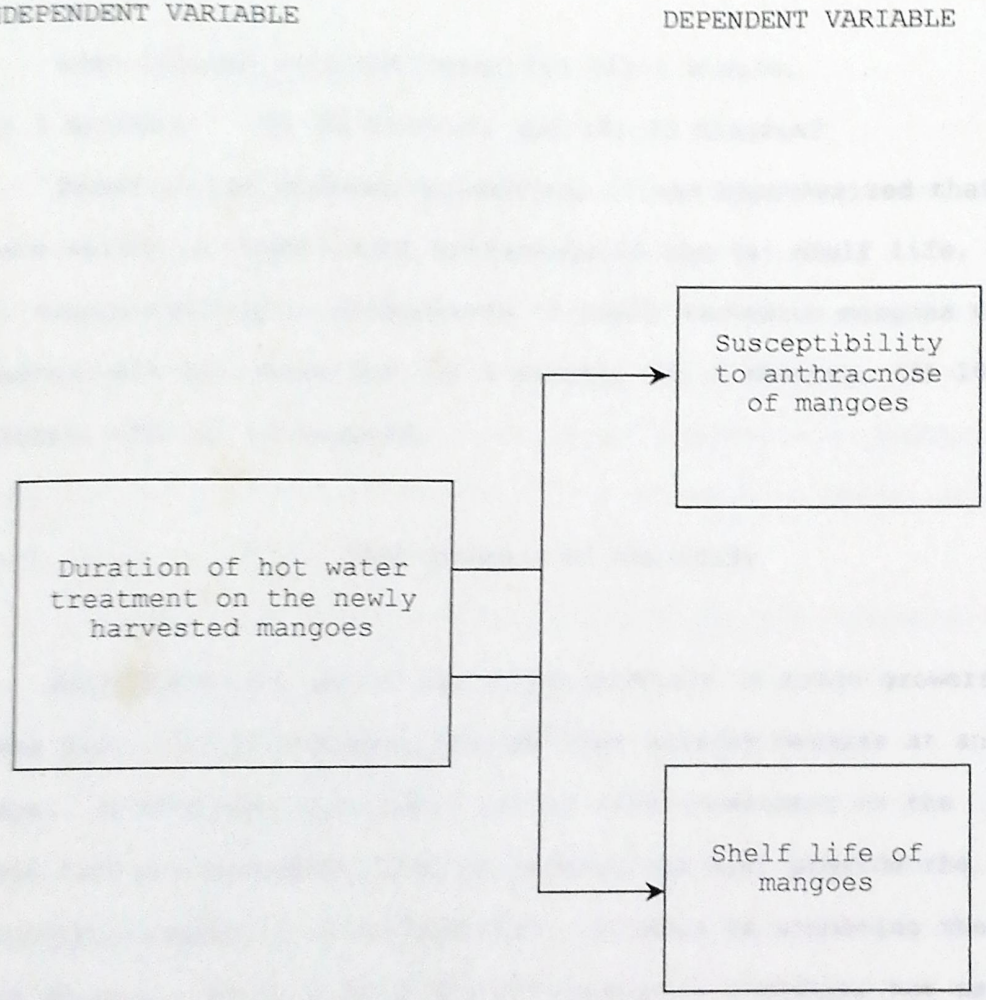

Figure 1. Shelf life and susceptibility to anthracnose of newly harvested mangoes as affected by the duration of hot water treatment.

when treated with hot water for (1) 1 minute, (2) 5 minutes, (3) 10 minutes, and (4) 15 minutes?

Based on the problems presented, it was hypothesized that there exists no significant difference in the (a) shelf life, and (b) susceptibility to anthracnose of newly harvested mangoes when treated with hot water for (1) 1 minute, (2) 5 minutes, (3) 10 minutes, and (4) 15 minutes.

Significance of the Study

Anthracnose is one of the major problems of mango growers these days. It is a fungal disease that attacks mangoes at any stage. Determining the effect of hot water treatment on the shelf life and susceptibility to anthracnose will provide the scientific community with additional insights on combating the said disease. Since fungicides are expensive nowadays, hot water treatment is the best alternative for controlling this disease. Not only does it help control anthracnose, it also extends the shelf life of the fruit. The result of this research will also serve as a basis for future studies where hot water treatment will be applicable.

Definition of Terms

For clarity and single-mindedness, the following terms used in the study are defined conceptually and operationally:

Mango (*Mangifera indica*)- is a member of the cashew family (Anacardiaceae), one of the most important and widely cultivated fruits of the tropical world, considered indigenous to Eastern Asia, Myanmar (Burma) and Eastern State of India (Jimenez, Sta. Singh, Torres, 1997).

In this study, the term "mango" meant the test subjects.

Hot water treatment- the process of treating materials in hot water (Webster Comprehensive Dictionary, 1995).

In this study, "hot water treatment" meant the process by which mangoes remained in hot water at different time intervals.

Anthracnose- is a plant disease of warm, humid areas that infects a variety of plants from trees to grass (Jimenez et al., 1997).

In this study, the term "anthracnose" meant a destructive disease of plants manifested by sharply defined discolored spots.

Shelf life- is the time span in which fruits are still consumable after harvesting from the tree. In this stage, the fruits are free from disease (Jimenez et al.).

In this study, the term "shelf life" meant the time interval in which the mangoes lasted without showing symptoms of anthracnose or rotting. This included the weight loss of the mangoes.

[Weight] loss- is the act or state of losing; failure to keep weight (Webster Comprehensive Dictionary, 1995).

In this study, the term "weight loss" was determined by subtracting the present day weight with the last day's weight. It determined the shelf life of the mangoes.

Effect - is a result or product of some causes (Webster Comprehensive Dictionary).

In this study, the term "effect" meant the reaction of mangoes to hot water treatment in terms of shelf life {weight loss} and susceptibility to anthracnose.

Susceptibility - is the capability of being influenced, acted on, or determined (Webster Comprehensive Dictionary, 1995). In this study, the term "susceptibility" meant the ability of hot water treatment to prevent anthracnose and early rotting on the test organisms.

Scope and Limitations

The study was limited only in using newly harvested mangoes as test objects. Another is that the study used only the temperature (55°C). The experiment took place at the Philippine Science High School Western-Visayas Campus (PSHSWVC).

Chapter 2

Review of Related Literature

Mango

Mango is prone to attacks of insect pests and diseases in all stages of its development. Hardly any plant part (roots, trunks, branches, leaves) is immune and yield is considerably reduced when damage is done during flowering and fruiting stages (Philippine Council for Agriculture, Forestry and Natural Resources Research and Development {PCARRD}, 1994).

In the Philippines, knowledge of the flowering habits of mango is inadequate and is largely based upon general observations. Rainy weather in November, December, and January doesn't favor the production of a heavy flower flush in February and March. On the other hand, if these months are dry, the mangoes generally produce heavy florescence.

Anthracnose

According to Ocfemia and Agati, anthracnose of mango is caused by *Glomerella cingular*. The organism remains on the

different parts of the host-on fallen flowers, stems, leaves, dried-up fruits and other hosts, leaving over the next season in a more or less active form. Warm water with intermittent showers during the blooming period favors the disease. Dissemination of the fungus spores is by means of insects, rain, wind, and other factors coincident with injudicious cultural practices. The disease has been the cause of occasional decline in mango production during certain seasons. The popular belief attributes the casual factors to showery weather when mango trees are in bloom. Although shedding of flowers may be partly occasioned by physiological disturbances, the real cause of the trouble is the fungus.

Anthracnose is caused by the organism *Colletotrichum gloeosporiodes*. It occurs in all mango-growing areas and is considered as the most serious fungal disease of mango in the Philippines. It attacks the different parts of the tree but major damage occurs during flowering up to fruit setting, and after harvesting. The disease is most serious during the wet season (Golez and Bignayan, 1993; Mendoza and Wills, 1984).

Anthracnose is the most important fungus disease of the mango. Its epidemic outbreak is largely influenced by high humidity so that in certain years, it causes serious loss; in

other years, it is practically of little economic significance. It is caused by Gloeosporium stage of *Glomerella cingulata* (Stenium) of which are several strains.

Symptoms on the leaves start as tiny necrotic spots that later enlarge into discrete, round or angular spots. Under wet conditions, however, these spots coalesce to form larger, irregular-shaped patches with light brown to grayish centers, and dark-brown margins. Oftentimes, the center spots fall off, thus producing a shothole appearance. Disease on the flower moreover starts as tiny black necrotic spots. They are formed on the buds, blouts, pedicels, and on the main secondary stalks of the panicle. These spots coalesce, resulting in the blighting of flower clusters or entire inflorscence. The flowers later blacken and eventually fall.

Black spots due to Anthracnose fungus are serious on ripe mangoes. The disease also occurs on young leaves, fruits, and flowers during rainy and humid weathers.

Anthracnose is a serious disease of avocado and mango in the Philippines. It may cause destruction of as high as 30% in immature fruits of avocado and mango. It causes considerable damages to the mango fruits after windy days, and 10% of the picked fruits may suffer from storage roots.

The fungus grows readily on ordinary media and on sterile plant tissues producing abundant mycelium, conidia, and black sclerotia-like bodies. Under filled conditions, the fungus produces the perfect stage on the dead infected portion of the host, but it may be induced to form perithecia on the artificial media.

A cool, moist and shady place is favorable for the disease development. Young, tender, succulent growths are readily infected. Under Philippine conditions, insects, rain, and to one extent, wind, are believed to be responsible for the wide spore dissemination.

Anthracnose causes about 39% of the storage decay on mangoes. The disease development on the seedlings is favored by rains, alternating with drizzles of a period of 7 days. Occurrence of the anthracnose is a fearful one because it may serve as the source of a severe outbreak when conditions for its development become favorable.

Control of Anthracnose

To minimize damage caused by anthracnose disease, only healthy seedlings should be planted and even if the least sign of

the disease is noticed, removal of the infected part is advisable. Fruits showing disease symptoms should be separated from sound fruit baskets since they will serve as sources of infection for others.

The disease may be controlled by careful sanitary measures such as control of insects that disseminate the spores, protection of delicate tissues with fungicides, and the use of resistant varieties.

Hot water treatment

In the Bureau of Plant Industry ([BPI] in Bergonia and Diloy, 1974), experiment showed that the water treatment could free ripe fruits without impairing their quality. Soaking freshly harvested fruits into heated water at 55°C for 5 to 10 minutes does this. Ten minutes heating is especially recommended for more serious infections.

After treatment, the heated fruits should be exposed in a well-ventilated room or immersed in tap water for 2 hours to cool them down to normal temperature before keeping them in closed container to avoid heat injury.

Chapter 3

Research Design and Methodology

This study aimed at determining the effect of hot water treatment on the shelf life and susceptibility to anthracnose of newly harvested mangoes. It specifically determined the effect of hot water treatment at different time intervals in terms of shelf life, which includes the weight loss, and the susceptibility to anthracnose.

It was hypothesized that there exists no significant difference in the shelf life and susceptibility to anthracnose of newly harvested mangoes when treated with hot water at different time intervals.

The Research Design

The pre-test post-test control group was employed in achieving the aim of this study.

Fifteen test organisms were randomly selected. They were newly harvested, and were treated right after harvest.

Materials and Equipment

The subjects of the study were fifteen newly harvested carabao mangoes.

They were placed in trays and covered with plastic to prevent them from injury and insects. Each treatment had separate trays.

A large cauldron was used to prepare the hot water with the help of a hot plate. A mercury thermometer was used to measure the water temperature.

The weight of the mangoes was determined by the digital weighing scale.

Methodology

Preparation of test organisms

Mangoes were gathered from Sta. Barbara. They were placed in plastic bags and were transported from Sta. Barbara to Philippine Science High School Science Research Laboratory. Utmost care was taken to prevent injury on the test organisms.

Fifteen mangoes were randomly picked from the newly harvested mangoes. They were divided into five groups; each

group had three mangoes. The five groups became the five different treatments.

The first group was labeled as Treatment 1, and the three mangoes in this group were labeled as 1.1, 1.2, and 1.3. The second group was labeled as Treatment 2, and the mangoes were labeled as 2.1, 2.2, and 2.3. The third group was labeled as Treatment 3, and the mangoes were labeled as 3.1, 3.2, and 3.3. The fourth group was labeled as Treatment 4, and the mangoes were labeled as 4.1, 4.2, and 4.3. The last group was labeled as Control, and the mangoes were labeled as C1, C2, and C3.

The initial weights of the mangoes were determined using the digital weighing scale and were recorded.

Hot water treatment

A large cauldron was filled with a sufficient amount of water. The cauldron was placed on top of the hot plate and heated until the water temperature reached 55° Celsius. Then the mangoes in different treatments, except the Control, were immersed in the hot water.

Treatment 1 remained in the water for one minute only. Treatment 2 remained in the water for five minutes. Treatment 3

remained in the water for 10 minutes. Treatment 4 remained in the water for 15 minutes.

Mangoes in each treatment were placed in their respective trays and were covered with plastic to protect them against insects.

Gathering of data

The treatments were observed for 12 days. Everyday, the individual weights of each fruit was determined and recorded. The researchers also inspected the fruits for possible symptoms of anthracsnose and/or rotting and recorded their observations.

Statistical Testing

Certain statistical tools were used in testing the data for analysis of this study.

The mean and standard deviation were used as descriptive statistical tools. The One-way Analysis of Variance (ANOVA), set at 0.05 alpha level of significance, was used as an inferential statistical tools. The Scheffe test, also set at .05 alpha level of significance, was used as post hoc multiple comparison test.

Mean

The mean was used to determine the shelf life and susceptibility to anthracnose of the mangoes in different treatments.

Standard deviation

The standard deviation measured the variability of any set of numerical values about their arithmetic mean.

One-Way Anova

The One-Way ANOVA, set at 0.05 alpha level of significance, determined the significance of the difference in shelf life and susceptibility to anthracnose among the experimental treatments.

Scheffe Test

The Scheffe test, set at .05 alpha level of significance, was used as post hoc multiple comparison test.

Chapter 4

Results

This study aimed at determining the effect of hot water treatment on the shelf life and susceptibility to anthracnose of newly harvested mangoes. It specifically determined the effect of hot water treatment at different time intervals in terms of shelf life and susceptibility to anthracnose of newly harvested mangoes.

It was hypothesized that there were no significant differences in the shelf life and susceptibility to anthracnose of newly harvested mangoes when treated with hot water at different time intervals.

Effects of Hot Water Treatment on the Shelf Life of Newly Harvested Mangoes

The length of time that the newly harvested mangoes were treated with hot water proved to increase the shelf life of newly harvested mangoes when the time of exposure was also increased.

The mean shelf life of mangoes treated with hot water for 1 minute was 5.00 days. The mean shelf life of mangoes treated with hot water for 5 minutes was 5.67 days. The mean shelf life

of mangoes treated with hot water for 10 minutes was 9.00 days. The mean shelf life of mangoes treated with hot water for 15 minutes was 12.00 days. In the control group, the mean shelf life of mangoes was only 5.00 days.

Table 1 shows the data.

Effects of Hot Water Treatment on the Susceptibility to Anthracnose of Newly Harvested Mangoes

The length of time that the newly harvested mangoes were treated with hot water proved to decrease the susceptibility to anthracnose of newly harvested mangoes when the time of exposure was increased.

The mean susceptibility to anthracnose of mangoes treated with hot water for 1 minute was 5.00 days. The mean susceptibility to anthracnose of mangoes treated with hot water for 5 minutes was 5.67 days. The mean susceptibility to anthracnose of mangoes treated with hot water for 10 minutes was 9.00 days. The mean susceptibility to anthracnose of mangoes treated with hot water for 15 minutes was 12.00 days. In the control group, the mean susceptibility to anthracnose of mangoes was only 5.00 days.

Table 1 shows the data.

Table 1.

Mean Shelf Life And Susceptibility to Anthracnose of Newly Harvested Mangoes.

Hot water Treatments		Shelf life (days)	Susceptibility (days)
1 minute	Mean	5.00	5.00
	N	3	3
	Std. Deviation	.00	.00
5 minutes	Mean	5.67	5.67
	N	3	3
	Std. Deviation	.58	.58
10 minutes	Mean	9.00	9.00
	N	3	3
	Std. Deviation	1.73	1.73
15 minutes	Mean	12.00	12.00
	N	3	3
	Std. Deviation	.00	.00
Control	Mean	7.33	7.33
	N	3	3
	Std. Deviation	2.94	2.94

Difference in the Shelf Life of Newly Harvested Mangoes Treated with Hot Water for Different Lengths of Time

The One-Way ANOVA showed that there was a significant difference in the shelf life of newly harvested mangoes when treated with hot water for different lengths of time, as reflected by $F(10) = .000$, $p < .05$.

Table 2 shows the data.

The Scheffe test showed that there were no significant differences in the shelf lives of newly harvested mangoes between those treated with hot water for 1 minute and 5 minutes and between those treated for 1 minute and the control, which was not treated with hot water at all.

There was also no significant differences observed in the shelf life of newly harvested mangoes treated with hot water for 5 minutes and the control.

However, significant differences in the shelf lives of newly harvested mangoes were observed between those treated with hot water for 1 minute and 10 minutes, 1 minute and 15 minutes, 10 minutes and 15 minutes, 10 minutes and control, and 15 minutes and control.

Table 3 shows the data.

Table 2.

One way ANOVA of the Difference in Shelf Life and Susceptibility to Anthracnose of Newly Harvested Mangoes Treated with Hot Water in Different Lengths of Time.

		Sum of Squares	df	Mean Sqaure	F	Sig.
Shelf Life (days)	Between Groups	114.667	4	28.667	43.000	.000
	Within Groups	6.667	10	.667		
	Total	121.333	14			
Susceptibility (days)	Between Groups	114.667	4	28.667	43.000	.000
	Within Groups	6.667	10	.667		
	Total	121.333	14			

Table 3.
Scheffe Test of the Significant Differences in One Way ANOVA in Table 2.

Dependent Variable	(I) Hot Water Treatments	(J) Hot Water Treatments	Mean Diff. (I-J)	Std. Error	Sig.
Shelf Life (days)	1 minute	5 minutes	-.67	.667	.903
		10 minutes	-4.00*	.667	.002
		15 minutes	-7.00*	.667	.000
		control	.00	.667	1.000
	5 minutes	10 minutes	-3.33*	.667	.009
		15 minutes	-6.33*	.667	.000
		control	.67	.667	.903
	10 minutes	15 minutes	13.00*	.667	.017
		control	7.00*	.667	.002
	15 minutes	control	-7.00*	.667	.000
Susceptibility (days)	1 minute	5 minutes	-.67	.667	.903
		10 minutes	-4.00*	.667	.002
		15 minutes	-7.00*	.667	.000
		control	.00	.667	1.000
	5 minutes	10 minutes	3.33*	.667	.009
		15 minutes	-6.33*	.667	.000
		control	.67	.667	.903
	10 minutes	15 minutes	13.00*	.667	.017
		control	7.00*	.667	.002
	15 minutes	control	-7.00*	.667	.000

Difference in the Susceptibility to Anthracnose of Newly Harvested Mangoes Treated with Hot Water in Different Lengths of Time

The One-Way ANOVA showed that there was a significant difference in the susceptibility to anthracnose of newly harvested mangoes when treated with hot water for different lengths of time, as reflected by $F(10) = .000$, $p < .05$.

Table 2 shows the data.

The Scheffe test showed that there were no significant differences in the susceptibility to anthracnose of newly harvested mangoes between those treated with hot water for 1 minute and 5 minutes and between those treated for 1 minute and the control, which was not treated with hot water at all.

There was also no significant difference observed in the susceptibility to anthracnose between those treated with hot water for 5 minutes and the control.

However, significant differences in the susceptibility to anthracnose of newly harvested mangoes were observed between those treated with hot water for 1 minute and 10 minutes, 1 minute and 15 minutes, 10 minutes and 15 minutes, 10 minutes and control, and 15 minutes and control.

Table 3 shows the data.

Chapter 5

Summary and Conclusions

This study aimed to determine the effect of hot water treatment on the shelf life and susceptibility to anthracnose of newly harvested mangoes. Specifically, it answered the following questions:

1. What is the effect of hot water treatment on the (a) shelf life, and (b) susceptibility to anthracnose of newly harvested mangoes?

2. Is there a significant difference as to (a) shelf life and (b) susceptibility to anthracnose of newly harvested mangoes when treated with hot water for (1) 1 minute, (2) 5 minutes, (3) 10 minutes, and (4) 15 minutes?

Based on the problems presented, it was hypothesized that there exists no significant difference in the (a) shelf life and (b) susceptibility to anthracnose of newly harvested mangoes when treated with hot water, and when treated with hot water for (1) 1 minute, (2) 5 minutes, (3) 10 minutes, and (4) 15 minutes.

Findings

Based on the data gathered from the study, the following were the findings:

1. The shelf life of newly harvested mangoes increased when the hot water treatment time was increased which means that increasing the exposure time increases the shelf life of the newly harvested mangoes.

2. The susceptibility to anthracnose of newly harvested mangoes decreased when the hot water treatment time was increased which means that prolonging the exposure time to hot water treatment decreases the susceptibility to anthracnose of newly harvested mangoes.

3. There were significant differences in the shelf life of newly harvested mangoes when the exposure time to hot water treatment was increased.

The effective hot water treatment times were 10 and 15 minutes. Since a significant difference also occurred between 10 and 15 minutes hot water treatment time, the more effective hot water treatment time was 15 minutes.

4. There were significant differences in the susceptibility to anthracnose of newly harvested mangoes when the exposure time to hot water treatment was increased.

The effective hot water treatment times were 10 and 15 minutes. Since a significant difference occurred between 10 and 15 minutes hot water treatment time, the more effective hot water treatment time is 15 minutes.

Recommendations

In view of the results and limitations of this study, it is recommended that the duration of hot water on the newly harvested mangoes be lengthened. It is also suggested that other water temperature be used.

Furthermore, other fruits are also recommended as test subjects. Also recommended is finding other ways of lengthening the shelf life and susceptibility to Anthracnose of newly harvested mangoes as well as other fruits.

Lastly, it is recommended that the test subject be subjected to taste test after treatment.

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