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Ripening and Quality of Selected High Value Fruits in Response to Varying Levels of Ethephon Applications and Packaging Materials

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Abstract- Mangoes, papayas and bananas are among the high value fruits where ethephon and storage conditions play a great role on their ripening quality. The study was conducted at Barangay 2, Balingasag, Misamis Oriental from December 6, 2011 to January 21, 2012 to determine the quality and ripening of selected high value fruits in response to varying levels of ethephon applications and packaging materials. It was laid-out in 5x3 factorial in Completely Randomized Design (CRD) and replicated four times. Results revealed that dipping papaya, mango and banana fruits to 10 ml ethephon/liter of water induced their earlier ripening; color index, physical appearance, resistance to pests and diseases, organoliptic test and weight loss. For the TSS, dipping papayas in 7.5 ml ethephon solution and the untreated mangoes gave the sweetest fruits. Dipping bananas with ethephon showed resistance to pests and diseases. For Factor B, the ambient/polyethylene bags ripened banana fruits at earlier time; wrapping in newspapers fastly developed colors, TSS, least weight loss, while at ambient condition showed better pests resistance. Wrapping mangoes and bananas in newspapers showed very firm fruits, pest and diseases resistance, good taste, TSS and least weight loss. On interaction effects, dipping fruits in 10 ml ethephon solution in newspapers gave better results for earlier, quality and uniform ripening and least weight losses of fruits, thus recommended. Although the ambient condition gave sweeter fruits especially among mangoes. Obtaining fruits of equal age of physiological maturity is also recommended to avoid biases in the study.

Index Terms- ethephon, storage condition, organoliptic test, brix, ripening

I. Introduction

High Value Commercial Crops (HVCC) is a priority program of the Department of Agriculture, created to address the priority concerns of the government on food security and poverty alleviation. The current activities of the program are in support to the development of the new agribusiness land and generation of new jobs and reduction of cost of wage goods through productivity enhancement and improved retailing linkages.

The good of the program is to empower the private sectors, particularly small farmers or small stockholders and entrepreneurs in order to increase their contribution to economic growth as well as to augment producers' income and enhance consumers' health and welfare. High Value Commercial Crops program aims to help ensure food security by producing available, safe, nutritious and affordable income opportunities for producers and entrepreneurs and also to improve access to local and foreign market and develop niche market (HVCC, 2010).

According to the data of the Bureau of Agricultural Statistics of Misamis Oriental, the total of 9,937.93 metric tons for mango fruits produced, 25,076.01 metric tons of papaya and 164, 387.57 metric tons of bananas as well. The data was updated last June 30, 2011 (Manabat, 2011).

Most of our small high value fruits farmers in Misamis Oriental have less knowledge and skills on how to do value adding of their products. The farmers sell the product directly to the buyers specifically on mango, papaya and banana because farmers don't have so much know-how to ripen their produce with the technology using of ethephon. By doing this technology, this will help and empower them to become entrepreneur and earn higher income rather than selling their goods outright to the middlemen.

Ethephon is a name for 2-chloroethylphosphonic acid, a compound that slowly releases ethylene gas. Ethylene gas is a naturally occurring plant hormone that is associated with fruit ripening, among many other normal plant functions. Ethephon is the most widely used plant growth regulator. It affects the growth, development, ripening, and senescence (aging) of all plants. It is normally produced in small quantities by most fruits and vegetables. Many fruits produce larger quantities of ethylene and respond with uniform ripening when exposed to an external source of ethylene (Sergent et al., 2009).

Ethephon also is widely used by pineapple growers to initiate reproductive development of pineapple. Ethephon is also sprayed on mature-green pineapple fruits to degreen them to meet produce marketing requirements. However, there can be some detrimental effects on fruit quality (Rhone, 2011).

Ethephon has many uses such as hastening the production of flowering in fruit trees and hastening ripening. When applied to plants, it is absorbed and broken into ethylene which is a natural non-toxic substance. Ethephon is commonly used in India (Baramati, 2009). A minimal amount of ethephon is diluted in water, and containers are placed around the room. The fruits are then stacked in the room, and sodium hydroxide is added to the mixture. All ventilation to the room is then blocked off, and the fruits will ripen in three to five days in the gas that is released. The gas that is released is ethylene, the natural ripening agent found in fruits. This substance ensures that there is a uniform ripening of the fruits, in addition the fruits retaining their flavour (Baramati, 2009).

Storage conditions to where the fruits are exposed to likewise contribute to the early or delayed ripening of the fruits. Temperature, for one, is essential as well. Higher temperature could enhance ripening as metabolism increases (Bautista, 1994), but too high could lead to plasmolysis on the cells of the commodities

The use of ethephon as well as the storage conditions is at stake in this study, trying to find out which combination will give an earlier and more quality ripening on papaya, mango and banana fruits for recommendation purposes.

Thus, this study was conducted to assess the ripening and quality of selected high value fruits in response to varying levels of ethephon applications and packaging materials.

II. Materials and Methods

This study was conducted at Barangay 2, Balingasag, Misamis Oriental from December 6, 2011 to January 21, 2012.

The study used ethephon to selected high value fruits namely: mango, banana, and papaya obtained from the local farmer producers. Plastic trays/crates for hauling and transportation of fruits, tables where fruits were placed, hand gloves used for protection during dipping of fruits with ethephon solution, newspapers where fruits were wrapped, polyethelene bag (black) where fruits were placed inside, refractometer used for reading of total soluble solid (^{o}Brix), knife, digital weighing scale were used in monitoring weight loss from fresh fruits up to fruits ripening, measuring instruments for ethephon and water solution were used.

This study was laid-out following a 5 x 3 factorial in Completely Randomized Design (CRD) with four (4) replications with ten (10) sample fruits each replication (Appendix Fig. 1). The different treatments are as follows: Factor a (varying levels of ethephon) **-** A_1 – Control (untreated), A_2 – 2.5ml/Liter water, A_3 –5.0 mL/Liter of water, A_4 – 7.5mL/Liter of water and A_5 – 10.0 mL/liter of water; Factor B (Packaging materials) **-** B_1 – Ambient, B_2 – Wrapped with newspapers and B_3 – Polyethylene bags. Each treatment combination contained ten (10) sample fruits in a tray with a distance of 0.15 meter apart per tray. All the set-ups were placed in the table.

All the materials needed were purchased for the study on ripening induction of selected high fruits such as ethephon, plastic trays, newspapers, polyethelene (PE) bags, hand gloves, table, pail, and measuring instruments and thermometer. Selected high value fruits such as papaya (solo) mango (carabao) and banana (lacatan) varieties were purchased. The numbers of fruits were limited to ten (10) pieces per treatment per replication.

For papaya, mango and banana fruits, the researcher was identified one farmer grower. Fruits were harvested at the same time. Matured green fruits were selected and sorted with no color sign of ripening. Fruits with color signed, deformed and physical damaged were not accepted for this study.

Cleaning and preparation of the area of the study was conducted. All materials used were prepared for ripening induction such as ethephon, plastic trays, hand gloves, tables, pail, newspapers, polyethelene (PE) bags, and measuring instruments. Thermometer was used to monitor the daily room temperature. Tables were arranged according to the lay-out of the study.

Washing of fruits with plain water in a washing bin was done thoroughly in order to prevent the presence of pests and other foreign materials like dust. The varying levels of applications of ethephon with water was prepared and calibrated. The fruits were set according to their treatments and dipped into the solution of ethephon (Appendix Fig. 2). All the studied fruits were placed in the plastic trays and placed it on the tables according to the experimental lay-out. All of the treatments were observed at the room temperature. Fruit by its kind was applied with ethephon in order to maximize gathering of data. Data gathered were done daily until the end of the study (Appendix Fig. 3 and 4).

Among the data gathered included the number of days to ripening, color index per day, physical appearance, total soluble solids, pest and diseases resistance rating, organoleptic test, daily temperature and fruit weight loss.

The analysis of variance (ANOVA) using 5 x 3 factorial in Completely Randomized Design (CRD) was used to solve for the level of significance. The Tukey Test was, then, used to compare significant differences among treatment means.

III. Results and Discussion

Papaya

Number of days to ripening.The mean number of days to ripening of papaya fruit at varying levels of ethephon applications (Factor A) and storage conditions (Factor B) is shown in Table 1. Highly significant differences were observed among treatment means on papayas dipped at varying levels of ethephon, while, no significant differences were revealed among treatment means on papaya subjected to different storage conditions. There were likewise interaction effects between the two factors.

In Factor A, papaya dipped at 10.0 ml ethephon/liter of water of ethephon application ripened the earliest time at 5.42 number of days. It was not, however, significantly different from those dipped in 5.0ml and 7.5ml with both 5.83 day and 2.5ml/liter of water at 6.25days from which were not treated with ethephon ripened lately after 6.5 days. The result likewise showed that the higher the level of ethephon applied as ripening hormone to papayas, the faster is their ripening responses. According to Bautista (1994), ethephon is a hormone which contains ethylene responsible for ripening of fruits.

However in Factor B, even though there were no significant differences observed among treatment means, papayas wrapped with newspapers ripened earlier at 5.80 days, while the subjected to ambient condition and placed inside polyethylene bags ripened both after 6.05 days.

On the interaction effects between the two factors, result showed highly significant differences among treatment means. Among the best combination contributory to the early ripening of papaya revealed on treatment with the fruits dipped in 10.0ml ethephon/liter of water and wrapped with newspapers (5.25 days), followed by those dipped in 10.0ml subjected to the ambient condition and placed inside polyethylene bags and dipped in 2.5ml/liter of water wrapped with newspapers and

7.5ml/liter of water and placed inside polyethylene bags with 5.5 days. However, the combinations which had a little bit delay in ripening were observed in those fruits which were treated with 2.5ml ethephon/liter of water and allowed to ripen inside polyethylene bags with 7.5 days, followed closely by those which were untreated and placed in an ambient condition with 7.5 days. For those wrapped in newspapers, papaya fruits which were untreated and dipped in 7.5ml/liter of water were among those delayed in ripening at 6.25 days. As being observed papayas treated with 10.0ml/liter of water of ethephon regardless of storage conditions appeared to ripen the earlier time. According to Bauer (2006), ethephon is also used to accelerate post-harvest ripening in fruits.

Table 1. Mean number of days to ripening of papaya as affected by varying levels of ethephon applications and packaging materials

FACTOR A	FACTOR B (Packaging Materials), ***AxB*			
(Levels of Ethephon)	Ambient	Newspapers	Polyethylene bags	(**A)
Control (untreated)	7.25^{b}	6.25^{b}	6.00^{ab}	6.50^{b}
2.5ml/Liter of water	5.75^{ab}	5.50^{a}	7.50^{b}	6.25^{ab}
5.0ml/Liter of water	6.00^{ab}	5.75^{ab}	5.75^{ab}	5.83^{ab}
7.5ml/Liter of water	5.75^{ab}	6.25^{b}	5.50^{a}	5.83^{ab}
10.0ml/Liter of water	5.50^{a}	5.25^{a}	5.50^{a}	5.42^{a}
(^{ns}B)	6.05	5.80	6.05	

Means of same column followed by common letters are not significantly different at 5% using Tukey Test.
** *(A), ^{ns} (B), ** (A x B), CV 11.68%*
Rating Scales: 1 - Strongly fast (30% change in color per day), 2 - Moderately fast (20% change in color per day),3 - Slightly fast (10% change in color per day)

Mango

Number of days to ripening. Table 2 presents the mean number of days to ripening of mangoes which was significantly affected by the different levels of ethephon applications regardless of packaging materials used. Interaction effects were observed to be highly significant between the two factors.

Ripening response on mango fruits being dipped at ethephon with 10.0ml/liter of water was the fastest at 4.75 days. This level was not significantly different from those dipped at 5.0ml/liter of water with 4.92 days. However, significant differences were observed the rest of the treatment means. The control (untreated) treatment ripened late at 5.75 days and was not significantly different at 2.5ml/liter of water of ethephon. Based on the result, it showed that mango fruits ripened earlier than those not being dipped with ethephon, just like papayas, mangoes responded well to ripening. According to Adel (1998), ethephon contains ethylene which can be used to promote faster and more uniform ripening of fruits picked at the matured-green stage.

Ripening response to mango under different packaging materials showed no significant differences among treatment means. Those mangoes placed inside polyethylene bag ripened earlier at 5.10 days, followed by those in ambient condition and wrapped with newspapers which had 5.25 mean number of days. According to Morton (1987), ethylene treatment causes green mangoes to develop full color in 7 to 10 days depending on the degree of maturity.

On the interaction effects between the two factors, it showed highly significantly differences among treatment means. Among the best contributory to early ripening of mango revealed on treatment with the fruits dipped in 10.0ml ethephon/liter of water and polyethylene bags (4.25 days), followed by those fruits dipped in 2.5ml and 7.5ml/liter of water in ambient condition; 2.5ml, 5.0ml and 10.0ml/liter of water and wrapped with newspapers and 5.0ml inside polyethylene bags with both 4.75 days. Yet, the combination which had a little bit delay in ripening were observed in those fruits untreated in ambient condition and untreated and at 7.5ml/liter of water in wrapped with newspapers as well as at 2.5ml/liter of water placed inside polyethylene bag condition with 6.0 days.

Table 2. Mean number of days to ripening of mango as affected by varying levels of ethephon applications and packaging materials

FACTOR A	FACTOR B (Packaging Materials), ***AxB*			
(Levels of Ethephon)	Ambient	Newspapers	Polyethylene bags	(**A)
Control (untreated)	6.00^{c}	6.00^{c}	5.25^{a}	5.75^{c}
2.5ml/Liter of water	4.75^{a}	4.75^{a}	6.00^{b}	5.17^{bc}
5.0ml/Liter of water	5.25^{ab}	4.75^{a}	4.75^{a}	4.92^{ab}
7.5ml/Liter of water	4.75^{a}	6.00^{b}	5.25^{ab}	5.33^{bc}
10.0ml/Liter of water	5.25^{ab}	4.75^{a}	4.25^{a}	4.75^{a}
(^{ns}B)	5.20	5.25	5.10	

Means of same column followed by common letters are not significantly different at 5% using Tukey Test.
** *(A), ns (B, ** (A x B), CV 8.38%*

Banana

Number of days to ripening . Statistical analysis showed highly significant differences on the number of days to ripening of banana dipped at varying levels of ethephon as well as significant differences were observed on the packaging materials. There were likewise interaction effects between the two factors (Table 3).

In Factor A, banana fruits dipped at 5.0 and 10.0ml ethephon/liter of water was earliest to ripen at 6 days than those dipped in 2.5ml/liter of water of ethephon which ripened latel at 8.83 days.

Factor B, likewise, showed significant differences among treatment means. Banana fruits wrapped with newspapers showed the earliest to ripen at 7.12 days, followed by those in ambient condition which ripened at 7.15 days. Fruits placed inside the polyethylene bag were the last to ripen at 7.70 days.

Differences on the interaction effects between two the factors revealed highly significant among treatment means. Fruits wrapped with newspapers and dipped in 2.5ml ethephon were late to ripen at 11.50 days, followed closely by those subjected to ambient condition showing the untreated fruits which had a mean of 11.75 days to ripen. In polyethylene bags, fruits dipped in 2.5ml/liter of water of ethephon which ripened late at 14.50 days because fruits might harvested not in less number of days to maturity compared to other treatments which had earliest to ripen in 6 days.

Table 3. Mean number of days to ripening of banana as affected by varying levels of ethephon applications and packaging materials.

FACTOR A	FACTOR B (Packaging Materials), ***AxB*			
(Levels of Ethephon)	Ambient	Newspapers	Polyethylene bags	(**A)
Control (untreated)	11.75[b]	6.12[a]	6.00[a]	7.96[ab]
2.5ml/Liter of water	6.00[a]	6.00[a]	14.50[b]	8.83[a]
5.0ml/Liter of water	6.00[a]	6.00[a]	6.00[a]	6.00[c]
7.5ml/Liter of water	6.00[a]	11.50[b]	6.00[a]	7.83[b]
10.0ml/Liter of water	6.00[a]	6.00[a]	6.00[a]	6.00[c]
(*B)	7.15[a]	7.12[a]	7.70[b]	

Means of same column followed by common letters are not significantly different at 5%using Tukey Test.
** *(A), * (B), ** (A x B), CV 10.66%*

Papaya

Color index per day. The mean color index per day of papaya dipped at varying levels of ethephon and storage conditions is shown in Table 4. Papaya fruits dipped at varying levels of ethephon revealed highly significant differences among treatment means, while no statistical significance was found on different packaging materials. No interaction effect was found between the two factors.

Factor A, papaya fruits dipped in 10.0 ml ethephon/liter of water had 1.25 color index per day described as strongly fast change in color, while the control (untreated) had a mean of 2.0 color index per day (moderately fast). According to Siddiqui (2010), unsaturated hydrocarbons, particularly acetylene, ethylene, etc. can promote ripening and induce colour changes effectively.

Yet, in Factor B, the mean storage conditions of papaya showed no significant differences among treatment means. However, statistical analysis showed that those fruits wrapped with newspapers and placed in polyethylene bags obtained a color index per day of 1.70 (strongly fast changed in color per day) compared to those in the ambient condition which had 1.75.

Table 4. Mean color index per day of papaya as affected by varying levels of ethephon applications and packaging materials

FACTORS		COLOR INDEX PER DAY
Varying Levels of Ethephon (A)	Control (untreated)	2.00[b]
	2.5ml/Liter water	1.83[ab]
	5.0ml/Liter of water	1.83[ab]
	7.5ml/Liter of water	1.67[ab]
	10.0ml/Liter of water	1.25[a]
Packaging Materials (B)	Ambient	1.75
	Newspapers	1.70
	Polyethylene bags	1.70
F-test	(A)	**
	(B)	n.s.

(AXB)	n.s.
CV (%)	22.38

Means of same column followed by common letters are not significantly different at 5% using Tukey Test.
Rating Scales: *1 - Strongly fast (30% change in color per day), 2 - Moderately fast (20% change in color per day) and 3 - Slightly fast (10% change in color per day)*

Mango

Color index per day. Table 5 presents the mean color index per day of mango fruits as affected by varying levels of ethephon applications and packaging materials. Mango fruits dipped at varying levels of ethephon revealed highly significant differences on their treatment means were observed, while no significant differences were observed to those subjected to different storage conditions. There were likewise highly significant differences in the interaction effects between the two factors.

Mango fruits dipped in 2.5 ml ethephon/liter of water developed color fast with a color index of 1.67 (strongly fast change in color per day), while the control (untreated) and those dipped in 5 and 7.5 ml ethephon/liter water, regardless of storage conditions obtained a mean of 2.00 described as moderately fast. One of the contributing factors that led to this irregularity of ripening responses of such fruits is the stage of physiological maturity of the fruits at the time of harvesting. However, it was observed that fruits which were untreated with ethephon could still be a little bit delayed in color development of the ripening of the fruits.

On packaging material, it showed no significant differences among treatment means. However, ambient condition had the lowest mean of 1.85 changed in color per day. Fruits wrapped with newspapers and placed inside polyethylene bags had the same mean of 1.95 color index per day.

Ethephon applied to fruits had influenced the interaction effects between the two factors. Result indicated highly significant differences. At ambient condition, statistical analysis showed that mango fruits dipped in 2.5ml/liter of water of ethephon obtained the mean of 1.25 was (strongly fast change in color per day), followed closely by the fruits wrapped with newspapers and placed inside polyethylene bags dipped in 2.5, 10 ml ethephon/liter water with a color index of 1.75 (described as moderately fast).

Table 5. Mean color index per day of mango as affected by varying levels of ethephon applications and packaging materials

FACTOR A	FACTOR B (Packaging Materials),** *AXB*			
(Levels of Ethephon)	Ambient	Newspapers	Polyethylene bags	(**A)
Control (untreated)	2.00^{b}	2.00b	2.00^{b}	2.00^{b}
2.5ml/Liter of water	1.25^{a}	1.75^{ab}	2.00^{b}	1.67^{a}
5.0ml/Liter of water	2.00^{b}	2.00^{b}	2.00^{b}	2.00^{b}
7.5ml/Liter of water	2.00^{b}	2.00^{b}	2.00^{b}	2.00^{b}
10.0ml/Liter of water	2.00^{b}	2.00^{b}	1.75^{ab}	1.92^{ab}
(^{ns}B)	1.85	1.95	1.95	

Means of same column followed by common letters are not significantly different at 5% using Tukey Test.
** *(A),^{ns} (B),** (A x B), CV 8.38%*
Rating Scales: *1 - Strongly fast (30% change in color per day), 2 - Moderately fast (20% change in color per day) and3 - Slightly fast (10% change in color per day)*

Banana

Color index per day. Mean color index per day of banana fruits dipped at varying levels of ethephon applications and packaging material shown in Table 6. Color development of bananas were highly influenced by the levels of ethephon applications and likewise affected by the storage conditions. Interaction effects between the two factors were found positive.

It was observed in Factor A that banana dipped in 5 ml and 10 ml ethephon/liter of water obtained a color index of 1.00 (described as strongly fast changed in color per day). Fruits dipped in 2.5ml/liter of water of ethephon had a mean aindex of 1.42 observed as moderately fast changed in color per day. According to Palmer (1971), since banana peel is rich of phenolic compounds, it is rapidly oxidized by polyphenoloxidase. Further, ethephon which contains ethylene, a ripening hormone, has multiplier effects on ripening response where it is located. At ambient condition where fruits were exposed to had the fastest to ripen or develop yellow colors with an index of 1.10 (strongly fast), followed by those fruits wrapped in newspapers with a rating of 1.15. The fruits placed inside the polyethylene bag were the latest to develop colors with 1.30 index, respectively.

The finding on the interaction effects between the two factors was observed to be highly significant. Among the best combinations where color development of fruits was strongly fast at 1.0 color index rating were obtained by all combinations, except for fruits dipped in 2.5 ml ethephon/liter water and wrapped in polyethylene bags with 2.25 index (moderately to slightly fast) and 7.5 ml ethephon/liter water wrapped in newspapers. Delayed in color development might be due stage of physiological maturity of fruit upon harvesting.

Table 6. Mean color index per day of banana as affected by varying levels of ethephon applications and packaging materials

FACTOR A	FACTOR B (Packaging Materials), ***AxB*			
(Levels of Ethephon)	Ambient	Newspapers	Polyethylene bags	(**A)
Control (untreated)	1.50^{b}	1.00^{a}	1.00^{a}	1.17^{ab}
2.5ml/Liter of water	1.00^{a}	1.00^{a}	2.25^{b}	1.42^{b}
5.0ml/Liter of water	1.00^{a}	1.00^{a}	1.00^{a}	1.00^{a}
7.5ml/Liter of water	1.00^{a}	1.75^{b}	1.25^{a}	1.33^{b}
10.0ml/Liter of water	1.00^{a}	1.00^{a}	1.00^{a}	1.00^{a}
(*B)	1.10^{a}	1.15^{a}	1.30^{b}	

Means of same column followed by common letters are not significantly different at 5% using Tukey Test.
** *(A), * (B), ** (A x B), CV 22.23%*
Rating Scales: *1 - Strongly fast (30% change in color per day, 2 - Moderately fast (20% change in color per day) and 3 - Slightly fast (10% change in color per day)*

Papaya

Physical appearance. The mean physical appearance of papaya fruits at varying levels (Factor A) of ethephon applications and packaging materials (Factor B) is revealed in Table 7. No significant differences were observed among treatment means on Factor A and B. However, significant differences were observed among treatment means of various combinations.

On Factor A, fruits in the control treatment (untreated) and dipped in 10.0 ml ethephon/liter of water showed very firm (scale of 1.08), whereas the papaya fruits dipped in 5.0 ml and 7.5ml/liter of water of ethephon had both obtained a mean of 1.25 scale rating (still described as very firm).

Likewise, no significant differences were revealed among treatment means on papayas subjected to various packaging materials. It showed that papaya fruits placed inside polyethylene bag obtained a rating scale of 1.10 (very firm) followed by those wrapped with newspapers conditions with 1.15 rating. Those placed in ambient condition garnered a rating of 1.25 scale (still very firm as well).

However, interaction effect was found positive between the two factors. Fruits which were untreated at ambient condition/wrapped with newspapers, dipped with 2.5, 5, 7.5 ml ethephon/liter water all placed in polyethylene bags, and dipped in 10 ml ethephon/liter water showed very firm appearance of papaya with 1.0 rating scale. However, fruits dipped in 7.5 ml ethephon/liter of water in an ambient condition obtained only a rating scale of 1.75 (moderately firm). The concentration level of ethephon did not affect the physical appearance of the fruits. Even though fruits were already ripe, however, they were still hard. This means that full ripening of papayas had not yet been attained by them especially those placed inside the polyethylene bags.

Table 7. Mean physical appearance of papaya as affected by varying levels of ethephon applications and packaging materials

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FACTOR A	FACTOR B (Packaging Materials), **AxB*			
(Levels of Ethephon)	Ambient	Newspapers	Polyethylene bags	(^{ns}A)
Control (untreated) :	1.00^{a}	1.00^{a}	1.25^{ab}	1.08
2.5ml/Liter of water	1.25^{ab}	1.25^{ab}	1.00^{a}	1.17
5.0ml/Liter of water :	1.25^{ab}	1.50^{ab}	1.00^{a}	1.25
7.5ml/Liter of water :	1.75^{ab}	1.00^{a}	1.00^{a}	1.25
10.0ml/Liter of water :	1.00^{a}	1.00^{a}	1.25^{ab}	1.08
(^{ns}B)	1.25	1.15	1.10	

Means of same column followed by common letters are not significantly different at 5% using Tukey Test.
*^{ns}(A), ^{ns} (B), * (A x B), CV 28.47%*
Rating scales: 1 - very firm, 2 - moderately firm, 3 - weakling/brittle

Mango

Physical appearance. Table 8 presents the mean physical appearance of mango fruits dipped at varying levels of ethephon and packaging materials.

Statistical analysis on Factor A showed highly significant differences observed among treatment means, while non-significant result was revealed on fruits subjected to different packaging materials (Factor B). However, positive interaction effects were found on the interaction effects between the two factors.

The control (untreated) and fruits dipped with 7.5ml ethephon/liter of water produced a physical appearance rating scale of 1.42 rating scale (very firm). Mango fruits dipped in 5 ml ethephon/liter of water were observed to be moderately firm with 2.00 rating scale, which means that ripened fruits were soft which is associated by the conversion or disintegration of carbohydrates to sugar (Bautista, 1995).

However in Factor B, it showed no statistical significance found on fruits subjected to various storage conditions. Though, fruits at ambient condition and wrapped with newspapers showed the same mean physical appearances of 1.70 rating scale (described a moderately firm) compared to fruits placed inside polyethylene bags which obtained the mean rating scale of 1.75, more or less the same. Besides, Siddiqui (2010) cited that the quantity of ripening agent is required to induce ripening for better cosmetic quality, including physical appearance.

Combining the levels of ethephon and packaging maetrials where fruits were subjected to found to be significant among their treatment means. Fruits which were untreated and placed in an ambient condition and those dipped in 7.5 ml ethephon/liter of water and wrapped in newspapers were observed to very firm with rating scale of 1. Those fruits dipped in 5 ml ethephon/liter of water regardless of storage conditions obtained a rating scale of 2 (moderately firm), and as well as those dipped in 10 ml and wrapped in newspapers and placed in polyethylene bags. Softening of fruits is associated with the conversion of carbohydrates to sugar wherein cells are disintegrated to transform hard to softer tissues (Bautista, 1995).

Table 8. Mean physical appearance of mango as affected by varying levels of ethephon applications and packaging materials

FACTOR A	FACTOR B (Packaging Materials), (**AxB)			
(Levels of Ethephon)	Ambient	Newspapers	Polyethylene bags	(**A)
Control (untreated)	1.00[a]	1.50[a]	1.75[b]	1.42[a]
2.5ml/Liter of water	2.00[b]	2.00[b]	1.50[a]	1.83[b]
5.0ml/Liter of water	2.00[b]	2.00[b]	2.00[b]	2.00[b]
7.5ml/Liter of water	1.75[b]	1.00[a]	1.50[a]	1.42[a]
10.0ml/Liter of water	1.75[b]	2.00[b]	2.00[b]	1.92[b]
([ns]B)	1.70	1.70	1.75	

Means of same column followed by common letters are not significantly different at 1% using Tukey Test.
** *(A),[ns] (B),** (A x B), CV 19.69%*
Rating scales: 1 - very firm, 2 - moderately firm, 3 - weakling/brittle

Banana

Physical appearance. The varying concentration levels of ethephon per liter of water significantly affected the ripening physical appearances of fruits. Packaging materials where the fruits were subjected to were observed to be non-significant among treatment means, and as well as their respective interaction effects (Table 9).

Like any other fruits, banana likewise showed positive responses when induced by a ripening hormone. Fruits which were dipped with 10 ml ethephon/liter of water were described a moderately firm (1.75 rating scale). It showed that fruits which were untreated with ethephon were observed to be very firm at the close of the study with a physical appearance rating scale of 1.25 and as well as those dipped in 5 ml ethephon/liter of water with a rating of 1.17. Softening of fruits is associated with the conversion of carbohydrates to sugar wherein cells are disintegrated to transform hard to softer tissues (Bautista, 1995). Softening of fruits is related to a change in cell wall component and starch degradation (Seymour, 1993).

Factor B, though no significant differences were observed among treatment means, fruits wrapped with newspapers showed the lowest mean of 1.25 in physical appearance compared to those placed in polyethylene bags which had a mean of 1.45 rating in physical appearance. Sometimes once physiological maturity is not fully attained by fruits upon harvesting; ripening physical appearance is highly affected even if induced by a ripening hormone (Seymour, 1993).

Table 9. Mean physical appearance of banana ripening and quality in response to varying levels of ethephon applications and packaging materials

FACTORS		PHYSICAL APPEARANCE
Varying Levels of Ethephon (A)	Control (untreated)	1.25[a]
	2.5ml/Liter of water	1.25[a]
	5.0ml/Liter of water	1.17[a]
	7.5ml/Liter of water	1.42[ab]
	10.0ml/Liter of water	1.75[b]
Packaging Materials (B)	Ambient	1.40
	Newspapers	1.25
	Polyethylene bags	1.45
F-test	(A)	*
	(B)	n.s.
	(AXB)	n.s.

CV (%)	31.26

Means of same column followed by common letters are not significantly different at 5% using Tukey
Rating scales: 1 - very firm, 2 - moderately firm, 3 - weakling/brittle

Papaya

Pests and diseases resistance. Statistical analysis showed that there were no significant differences observed among treatment means regardless of the varying levels of ethephon applications and packaging materials. Likewise, no significant differences in the interactions were observed between the two factors (Table 10).

Nevertheless, in Factor A, papaya fruits dipped in 5 ml ethephon/liter of water obtained a resistance rating of 1.0 described as strongly resistant. This was followed by those fruits which were untreated, dipped in 2.5 and 10 ml ethephon/liter water with a resistance rating of 1.08 (strongly resistant). Anthracnose was also observed especially those fruits dipped in 7.5 ml ethephon/liter of water with resistance rating of 1.17, though described as strongly resistant. According to Nelson (2010), anthracnose (*Colletotrichum gloeaporides*,) attacks the petioles and fruits. Symptoms mainly appear on the mature fruit and thus shorten its shelf life. They are apparent when acids in the stem end of the fruits were not properly removed.

Papaya fruits subjected to different packaging materials did not significantly affect their resistance to pests and diseases. Fruits subjected to ambient condition and as well as those placed in polyethylene bags obtained a resistance rating of 1.05 (strongly resistant), while those wrapped in newspapers garnered a resistance rating of 1.15 (strongly resistant).

Table10. Mean resistance to pests & diseases of papaya, mango and banana as affected by varying levels of ethephon applications and packaging materials

FACTORS		RESISTANCE TO PESTS AND DISEASES		
		PAPAYA	MANGO	BANANA
Varying Levels of Ethephon (A)	Control (untreated)	1.08	1.08	1.17
	2.5ml/Liter of water	1.08	1.17	1.08
	5.0 ml/Liter of water	1.00	1.17	1.08
	7.5ml/Liter of water	1.17	1.08	1.08
	10.0ml/Liter of water	1.08	1.25	1.08
Packaging Materials (B)	Ambient	1.05	1.20	1.20
	Newspapers	1.15	1.10	1.05
	Polyethylene bags	1.05	1.15	1.05
F-test	(A)	n.s.	n.s.	n.s.
	(B)	n.s.	n.s.	n.s.
	(AXB)	n.s.	n.s.	n.s.
CV (%)		26.90	31.28	28.63

Rating scales: *1 - Strongly Resistant (1-10% Symptoms of damage), 2 - Moderately Resistant (11-20% symptoms of damage) and 3 - Slightly Resistant (21-30% symptoms of damage)*

Mango

Pests and diseases resistance. Statistical analysis showed that there were no significant differences observed among the treatment means on the mean resistance to pests and diseases of mango fruits regardless of the varying levels of ethephon applications and packaging materials. Likewise, no significant interaction effects were found between the two factors (Table 10).

However, fruits not treated with ethephon and as well as those dipped in 7.5 ml were observed to be strongly resistant with a rating of 1.08. This was followed by those dipped in 2.5 and 5.0 ml ethephon/liter of water with both 1.17 (still described as strongly resistant), and the last was those dipped with 10 ml ethephon/liter for water with 1.25 resistance rating. Anthracnose was also observed among manog fruits. According to Chia (1992), anthracnose *(Colletotrichum* state of *Glomerella cingulata* Ston, Spaull and Schrenk) causes serious losses to fruits under favorable climatic conditions of high humidity. It is also affects fruits during storage.

On the other hand, it showed no significant differences among treatment means on mango subjected to different packaging materials. Mango fruits at different packaging materials showed strongly resistant to damage when wrapped with newspapers with the mean resistance rating of 1.10 (strongly resistant), while those in ambient condition obtained a mean resistance rating of 1.20 (strongly resistant to pests and diseases).

Banana

Pests and diseases resistance. Resistance to pests and diseases of banana fruits was not significantly affected by the varying levels of ethephon applications and packaging materials. There was no interaction effects observed among the treatments means of the two factors (Table 10).

On the varying leverls of ethephon applied, it showed that there were no significant differences in the treatment means on the resistance to pests and diseases of mango fruits. Fruit dipped in 2.5ml, 5.0ml, 7.5ml and 10.0 ml ethephon/liter of water all obtained the resistance rating scale of 1.08 scale rating (strongly resistant), but did not vary statistically with the control (untreated) which had the rating scale of 1.17 (strongly resistant) to pests and diseases.

On the packaging materials, banana fruits wrapped in newspapers and placed in polyethylene bags obtained the same resistance rating of 1.05 (strongly resistant). While those subjected to ambient condition garnered 1.2 resistance rating (strongly resistant).

Papaya

Organoliptic test (taste test). The mean organoliptic test of papaya subjected to varying levels of ethephon applications and packaging materials statistically showed no significant differences among treatment means. There were likewise no significant differences in the interaction effects between the two factors (Table 11).

Dipping banana fruits at 10 ml ethephon/liter of water showed an organoliptic test rating of 3.65 (described as very good-sweet). This was followed by those untreated with 3.60 rating, while the lowest rating was obtained by those dipped in 5 ml ethephon/liter of water with 3.43 rating. Ethephon applications did not influence the organoliptic test to improve taste of fruits to be very sweet.

The mean average organoliptic test at ambient condition showed 3.46 rating which was the lowest, followed by those fruits wrapped with newspapers with 3.55 scale rating. Those placed inside polyethylene bags showed 3.63 rating (very good-sweet) which was the highest rating which means good (moderate) in taste test. Lacatan bananas contains moderate sweetness as compared with mangoes (Seymour, 1993).

Table11. Mean organoliptic test (taste test) of papaya, mango and banana as affected by varying levels of ethephon applications and packaging materials

FACTORS		ORGANOLIPTIC TEST (TASTE TEST)		
		PAPAYA	MANGO	BANANA
Varying Levels of Ethephon (A)	Control (untreated)	3.60	4.22[a]	4.30
	2.5ml/Liter of water	3.50	3.92[ab]	4.00
	5.0 ml/Liter of water	3.43	4.12[ab]	4.42
	7.5ml/Liter of water	3.55	4.20[a]	4.12
	10.0ml/Liter of water	3.65	3.73[b]	4.42
Packaging Materials (B)	Ambient	3.46	3.97	4.28
	Newspapers	3.55	4.07	4.30
	Polyethylene bags	3.63	4.07	4.20
F-test	(A)	n.s.	**	n.s.
	(B)	n.s.	n.s.	n.s.
	(AXB)	n.s.	n.s.	n.s.
CV (%)		11.68	8.87	11.68

Rating scales: 5 – Excellent (very sweet), 4 – Very Good (sweet), 3 – Good (moderate) and 2 – Not Palatable (bland)]

Mango

Organoliptic test (taste test). Table 15 presents the mean organoliptic test of mango at varying levels of ethephon applications and packaging materials. Statistical analysis showed highly significant differences among treatment means on the concentration levels of ethephon, while non-significant effects were found on storage conditions and as well as their interaction effects (Table 11).

The organoliptic test was significantly affected by the levels of ethephon applications on mango fruits. Fruits which were untreated with ethephon revealed the sweetest of them all with a rating of 4.22 and are not significantly different from those dipped at 7.5, 5 and 2.5 ml ethephon/liter water with 4.2, 4.12 and 3.92 rating scales (described as very good-sweet), respectively. This means that fruits applied at higher level had lesser taste test against to the untreated fruits which ripen naturally. According to Bautista (1995) that ethylene (with ethephon) as a ripening hormone induces fruit to ripening at the earliest time; however, the sweetness is affected as normal physiological functioning of ripening is abruptly induced. According to Siddiqui (2010) that the cosmetic quality of such artificially ripened fruits was found to improve, the organoliptic quality was impaired especially when harvested fruits were subjected to treatment without considering their maturity status.

On packaging materials, it showed no significant differences among treatment means. However, the mean organoliptic test at ambient condition which showed 3.97 (very good-sweet) was the lowest rating scale. Fruits wrapped with newspapers and placed inside polyethylene bags had relatively obtained the same mean of 4.07 rating with still very good or sweet in taste.

Banana

Organoliptic test (taste test). The evident result of the mean organoliptic test of banana at varying levels of ethephon applications (Factor A) and packaging materials (Factor B) had revealed no significant differences among treatment means.

There were likewise no significant differences in the interaction effects between two factors (Table 11).

Organoliptic test of bananas was not significantly affected by the varying levels of ethephon applications. However, fruits dipped in 5 and 10 ml ethephon/liter of water obtained the highest rating with 4.42, the untreated with 4.30, while the lowest with those applied with 2.5 ml ethephon/liter of water with 4.0 rating (very good-sweet). According to Siddiqui (2010) that the cosmetic quality of such artificially ripened fruits was found to improve, the organoleptic quality was impaired especially when harvested fruits were subjected to treatment without considering their maturity status. IIn Factor B, it showed no significant differences among treatment means. The organoliptic test of fruits placed inside polyethylene bags showed a mean rating of 4.20 (very good-sweet) which was the lowest in contrast to fruits wrapped with newspapers had 4.30 rating as the highest rating.

Papaya

Total soluble solids (°brix). The total soluble solids (TSS) of papaya fruits was not significantly affected by the varying levels of ethephon applications, packaging materials and as well as their corresponding interaction effects (Table 12).

However, fruits which were dipped in 7.5 ml ethephon/liter of water proved to have the highest TSS than the rest with 8.12 °brix and followed closely by those dipped in 10 ml ethephon with 8.11. The lowest was obtained by those dipped in 5 ml ethephon with 7.63 °brix. All the treatments are under the normal °brix values of 6-13. Those fruits wrapped with newspapers and placed in polyethylene bags revealed the higher TSS with both 8.02 °brix, while those in the ambient condition showed a 7.78 °brix, still way above the normal reference values of 6-13 brix. According to Siddiqui (2010) that the cosmetic quality of such artificially ripened fruits was found to improve, the organoleptic quality with total soluble solids was impaired especially when harvested fruits were subjected to treatment without considering their maturity status.

Table12. Mean total soluble solids (°brix) of papaya, mango and banana as affected by varying levels of ethephon applications and packaging materials

FACTORS		TOTAL SOLUBLE SOLIDS (°BRIX)		
		PAPAYA	MANGO	BANANA
Varying Levels of Ethephon (A)	Control (untreated)	7.98	14.07[a]	26.27
	2.5ml/Liter of water	7.87	13.20[a]	26.65
	5.0 ml/Liter of water	7.63	13.10[ab]	27.00
	7.5ml/Liter of water	8.12	13.22[a]	26.67
	10.0ml/Liter of water	8.11	11.93[b]	27.08
Packaging Materials (B)	Ambient	7.78	13.08	26.71
	Newspapers	8.02	13.14	26.55
	Polyethylene bags	8.02	13.09	26.94
F-test	(A)	n.s.	**	n.s.
	(B)	n.s.	n.s.	n.s.
	(AXB)	n.s.	n.s.	n.s.
CV (%)		7.29	8.27	4.81

Means of same column followed by common letters are not significantly different at 5% using Tukey *Reference values: 6-13 ⁰ brix* (Abu-Bakr A, 2010)

Mango

Total soluble solids (°brix). The mean result of total soluble solid (°brix) of mango at varying levels of ethephon applications (Factor A) and packaging materials (Factor B) is shown in Table 12. Highly significant results were observed among treatment means on mango fruits dipped at varying levels of ethephon, while no significant differences were revealed among treatment means on mango subjected to different storage conditions. There were no significant differences in the interaction effects between the two factors.

In Factor A, mango fruits dipped at 10.0ml ethephon/Liter of water obtained the lowest with 11.93 °brix rating. The highest rating was revealed on the control treatment (untreated) with 14.07 brix rating. According to Paull (1993) as mangos ripen, there is an increase in total soluble solids from 8.5 to 19 percent in natural physiological ripening, mostly a result of starch conversion to sucrose.

However, no significant differences were observed among treatment means on mangoes subjected to different packaging materials. Those in the ambient condition, fruits obtained a °brix rating of 13.08 followed by fruits placed inside polyethylene bags with 13.09 brix rating and as well as those wrapped with newspapers with °brix rating of 13.14.With normal reference values of 8-19 °brix, the °brix of all those under studied is within the reference values. Such values are way above its lowest reference value of only 8.

Banana

Total soluble solids (°brix). Table 19 presents the mean total soluble solid (°brix) banana dipped at varying levels of ethephon applications and packaging materials. No significant differences were observed among treatment means of those dipped at varying levels of ethephon, storage conditions and as well as their respective interaction effects (Table 12).

At varying levels of ethephon applied, result showed no significant differences at control (untreated) which was a little bit lower with a °brix rating of 26.27 compared to fruits dipped in 10.0ml ethephon/liter of water with the highest brix rating of

27.08. According to Siriboon (2008), banana total soluble solid will range from 5 to 30 ^{o}brix or percent sweetness. This means that their respective TSS values are way above the normal range of 5-30 ^{o}brix.

On packaging materials, fruits wrapped with newspaper condition obtained a ^{o}brix rating of 26.55 as the lowest, followed by ambient condition with brix rating of 26.71, and the fruits placed inside polyethylene bag condition had the brix rating of 26.94 as the highest among treatment means. However, their differences were not that statistically far from each other.

Papaya

Weight loss. The mean weight loss (grams) of papaya fruits at varying levels of ethephon applications and packaging materials is shown in Table 13. Highly significant differences were observed among treatment means on papayas dipped at varying levels of ethephon, while, no significant differences were revealed among treatment means on papaya fruits subjected to different packaging materials. There were likewise highly significant differences in the interaction effects between the two factors.

In Factor A, papaya fruits dipped in 10.0ml/liter of water of ethephon had the smallest weight loss of only 0.15 gram, while fruits which were untreated with ethephon obtained the biggest weight loss of 0.33 grams. It is not however significantly different from those dipped in 2.5 and 5 ml ethephon with 0.30 and 0.31 g, respectively. According to Shattir (2010), respiration rate is inversely proportional to shelf-life of the product, thus the lower rate the longer is the shelf life of fruits.

In Factor B, fruits wrapped with newspapers had the smallest weight loss with 0.24g, while those in the ambient condition obtained the biggest loss with 0.30g. Fruits covered and wrapped with newspapers and polyethylene bags had lesser respiration and transpiration as well compared with those laid-out in an ambient condition.

The interaction between two factors showed highly significant differences among treatment means. Among the best combination contributory to the weight loss of papaya revealed on the treatments with the fruits dipped in 10ml/liter of water which had 0.11 grams weight loss and wrapped with newspapers. This was followed by fruits dipped in 10.0ml/liter of water in an ambient condition with 0.12 gram weight loss. However, the combinations which had contributed a higher weight loss during ripening were observed in those fruits treated with 7.5ml ethephon/liter of water in an ambient condition and fruits placed inside polyethylene bags with both having a weight loss of 0.39g.

Table 13. Mean weight loss (g) of papaya as affected by varying levels of ethephon applications and packaging materials

FACTOR A (Levels of Ethephon)	FACTOR B (Packaging Materials), ***A x B*			
	Ambient	Newspapers	Polyethylene bags	(**A)
Control (untreated)	0.38^{ab}	0.29^{ab}	0.32^{ab}	0.33^{a}
2.5 ml/Liter of water	0.25^{bc}	0.25^{abc}	0.39^{a}	0.30^{ab}
5.0 ml/Liter of water	0.32^{ab}	0.36^{a}	0.26^{abc}	0.31^{ab}
7.5ml/Liter of water	0.39^{a}	0.20^{bc}	0.14^{c}	0.24^{b}
10.0 ml/Liter of water	0.12^{c}	0.11^{c}	0.21^{bc}	0.15^{c}
(^{ns}B)	0.30	0.24	0.27	

*Means of same column followed by common letters are not significantly different at 5% using Tukey Test. **(A), ^{ns} (B), ** (A x B), CV 26.07%*

Mango

Weight loss. Table 14 result exhibited the mean weight loss (grams) of mango at varying levels of ethephon applications and packaging materials with highly significant differences on both factors. However, there were no significant differences observed on the interaction effects between the two factors.

On the response to varying levels of ethephon applied, it showed highly significant differences among treatment means. Fruits dipped in 10.0ml/liter of water had a smallest weight loss of 153.08 grams, while those fruits which were untreated obtained the biggest loss with 191.70 grams, followed by those dipped in 2.5, 7.5 and 5 ml ethephon/liter of water with 180.33, 170.42 and 162.75 grams. According to Banlusilp (2008), percent of the weight loss increased continuously during ripening due to a high storage temperature at 30°C. Transpiration and respiration played a great role on the weight losses of fruits after harvest (Seymour, 1993).

On packaging materials, fruits wrapped with newspaper had the lowest weight loss with 167.85 grams, followed by fruits placed inside polyethylene bags with a weight loss of 169.60 grams and the ambient condition as the highest weight loss of 177.20 grams. The high losses of weights for those fruits subjected to ambient condition could be attributed to the escape of water from the fruits as higher temperatures of 25-30 deg. centigrade during the conduct of the study.

Table 14. Mean weight loss (g) of mango as affected by varying levels of ethephon applications and packaging materials

FACTORS		WEIGHT LOSS (g)
Varying Levels of Ethephon (A)	Control (untreated)	191.70[a]
	2.5ml/Liter of water	180.33[ab]
	5.0 ml/Liter of water	162.75[cd]
	7.5ml/Liter of water	170.42[c]
	10.0 ml/Liter of water	153.08[d]
Packaging Materials (B)	Ambient	177.20[a]
	Newspapers	167.75[b]
	Polyethylene bags	169.60[b]
F-test	(A)	**
	(B)	**
	(AXB)	n.s.
CV (%)		4.91

Means of same column followed by common letters are not significantly different at 5% using Tukey

Banana

Weight loss. Table 15 shows the mean weight losses (grams) of banana at varying levels of ethephon applications (Factor A) and packaging materials (Factor B). Highly significant differences were observed in Factor A and as well as significant effects were evidently observed on Factor B. Interaction effects were likewise found positive on the interaction effects between the two factors.

Fruits dipped in 10.0ml/liter of water of ethephon obtained the smallest weight loss of 35.08 grams. However, the largest weight loss was observed on fruits which were dipped in 2.5 ml ethephon/liter of water with 87.08 and is not significantly far from those which were untreated with ethephon with a weight loss of 86.67 grams.

On Factor B, fruits wrapped with newspaper had the lowest weight loss with 53.70 grams followed by fruits placed inside polyethylene bags 64.20 grams. Fruits which were subjected to ambient condition obtained the highest weight loss of 73.50 grams. According to Banlusilp (2008), the excess energy produced from the respiration process is released from the tissue by the vaporization of water, which will subsequently be transpired from the fruit, causing a weight loss.

Among the best combinations contributory to the weight loss of banana revealed on treatment with the fruits dipped in 7.5ml ethephon/liter of water and placed inside polyethylene bags with the weight loss of 26.00 grams, followed closely by fruits dipped in 10.0ml/liter of water at fruits wrapped with newspapers with the weight loss of 30.50 grams. However, the combinations which had the higher weight loss were observed in those fruits which were untreated and subjected to ambient condition with the weight loss of 116.75 grams. It was followed closely by fruits dipped in 2.5ml/liter of water of ethephon with fruits placed inside polyethylene bag with weight loss of 116.50 grams respectively.

Table 15. Mean weight (g) loss of banana ripening and quality in response to varying levels of ethephon appplications and packaging materials

FACTOR A	FACTOR B (Packaging Materials), [ns]*A x B*			
(Levels of Ethephon)	Ambient	Newspapers	Polyethylene bags	(**A)
Control (untreated)	116.75[a]	57.50[ab]	85.75[b]	86.67[a]
2.5ml/Liter of water	79.00[b]	65.75[a]	116.50[a]	87.08[a]
5.0ml/Liter of water	65.75[bc]	59.50[a]	60.50[b]	61.92[b]
7.5ml/Liter of water	63.50[bc]	55.25[ab]	26.00[c]	48.25[bc]
10.0ml/Liter of water	42.50[c]	30.50[b]	32.25[c]	35.08[c]
(*B)	73.50[a]	53.70[b]	64.20[ab]	

Means of same column followed by common letters are not significantly different at 5% using Tukey Test.
** *(A), **(B), ** (A x B), CV 21.62%*

IV. CONCLUSION

A concentration of 10 ml ethephon/liter of water can induce earlier ripening on papaya, mango and banana; color development, physical appearance, resistance to pests and diseases, organoliptic test and least weight loss; color index and least weight loss for mangoes; and resistance to pests and diseases, organoliptic test and least weight losses for bananas. For the TSS, dipping papayas in 7.5 ml ethephon solution and untreated mangoes gave the sweetest fruits, while for organoliptic test on mangoes the untreated treatments showed the best. Among papayas, the ambient/polyethylene bags ripened fruits at earlier time; wrapping in newspapers developed colors, TSS, least weight loss, while at ambient condition, papayas showed better in pests and diseases resistance. For mangoes, wrapping in newspapers showed very firm ripened fruits in physical appearance, pest and diseases resistance, organoliptic test, TSS and least weight loss. For bananas, wrapping in newspapers performed better in almost all parameters. For the respective interaction effects, dipping fruits to 10 ml ethephon solution and wrapped in newspapers gave better results to their ripening indices.

APPENDICES

Appendix Fig. 1. Experimental lay-out of banana

Appendix Fig. 2. Banana fruits dipped with ethephon solution

Appendix Fig. 3. Brix reading using refractometer

Appendix Fig. 4. Weighing of fruits

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