

# GRAFTABILITY OF 'CARABAO' MANGO (MANGIFERA INDICA LINN.) SCION AS AFFECTED BY MODES OF PACKAGING AND STORAGE DURATIONS

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## ABSTRACT

The effect and interaction of modes of packaging and different storage durations on graftability of 'Carabao' mango scions were studied from March to May, 2003 at BPI-NMRDC, Jordan, Guimaras. The association between the function of storage durations and modes of packaging on the survival of grafted mango scions was measured. Furthermore, the study also described temperature and relative humidity on storage boxes at different modes of packaging as well as agro-climatic data that could affect success in grafting of scions.

Graftability of 'Carabao' mango scions was influenced by different storage durations and modes packaging as observed on the percentage viability, mortality, bud emergence and growth parameters. A significant interaction effect between the two factors was noted on most of the data collected except on percentage mortality of grafted scions at 25 to 50 DAG and percentage bud emergence at 5 to 20 DAG.

Shorter durations of storage resulted in higher percentage viability and bud emergence of grafted scions. Longer storage resulted in a lower percentage but when packed at 50 to 100 pieces an increase in survival rate was observed.

Almost 93.0 percent of the variations in bud emergence can be explained by the linear function involving storage durations and modes of packaging.

More vigorous seedlings were achieved when grafting of stored scions was done at 1 to 5 days after collection, regardless of the modes of packaging used. Vigorous grafted seedlings can still be achieved when scions were packed at 50 to 100 pcs and stored up to 7 days.

Temperature and relative humidity in storage boxes had minimal variations which ranged from 28.20 to 28.37°C and 84.03 to 84.75 percent, respectively. Agro-climatic data gathered indicated ample amounts of sunshine, moderate temperature, high relative humidity and less rainfall.

## INTRODUCTION

Mango (*Mangifera indica* Linn.) is the third most important crop in the Philippines next to banana and pineapple in terms of economic potential. The genus *Mangifera* with 850 species is one of the 73 genera belonging to the family Anacardiaceae in the order Sapindales (Bombard and Schnell, 1997). It is mainly a tropical species but some cultivars can grow in temperate regions. There are over 500 different indigenous and introduced mango cultivars in the ASEAN regions (Kusumo, et al., 1984). The two most important varieties grown commercially in the Philippines are 'Carabao' and 'Pico' which occupy 61 and 21 percent, of the total area planted in the country, respectively. The Philippine 'Carabao' mango with the trade name "Manila Super Mango" in the international market is acclaimed as one of the world's best variety, having delicate and sweet flavor, aromatic and fiber free flesh. Other varieties such as 'Pahutan', 'Katchamita', 'Dudul', 'Binoboy' and 'Señoria' are also planted in the country with lesser commercial value (National Research Council of the Philippines, 1984; Mango Sub-Network Planning Team, 1999). As a commodity with great commercial value, 'Carabao' mango is extensively planted in different regions of the country especially in areas with distinct wet and dry seasons. With the expansion of plantings, it is projected that the demand for quality planting materials will also increase.

Propagation of 'Carabao' mango could either be sexual or asexual. Sexual propagation is the growing of plants through seeds while the later is through its clone or vegetative parts. Methods of asexual propagation in mango include nucellar seedlings from polyembryonic seeds, attached and detached graftage, rootage and microporopagation (Ram, 1997). In the Philippines, cleft grafting is the most common, since it is easy to perform and the percentage of success is high.

In establishing an orchard, grafted seedlings are usually preferred because of their precocity. Under proper management, grafted trees bear fruits in a shorter time. However, it is recommended that four year's growth should be maintained for proper establishment of trees in the field. Likewise, trees are generally small in size and several numbers can be planted to a hectare. In addition, many of the cultural practices, i.e., spraying, cultivation, bagging and harvesting can be implemented without much difficulty. Fruits of grafted trees are "true to type", which when planted in the field, the expected characters of the parents are carried to the next generation. Because of this, it is important that scions to be used in asexual propagation should come from mother trees that are prolific bearer of good quality fruits.

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Mango (*Mangifera indica* Linn.) is the third most important crop in the Philippines next. At present, there are 6 strains of 'Carabao' mango in the Philippines that were approved and recommended by the National Seed Industry Council (NSIC). These are the Lambo Strain, Sweet Elena and MMSU Gold in Luzon and GES No. 73, 77, 84, 85, Talaban Strain, Sweet Elena and MMSU Gold in Mindanao (Phil. Seed Board, 1989; Fruit Crops Technical Working Group, 2008; Dizon, 2001). These trees are heavy yielders, regular bearers and have large fruits with thin seed, delicate and sweet taste, fiber free flesh and have high edible portion. Mass propagation of these strains is being advocated to assure high quality fruits. As a result, increasing demands of grafted seedling and scions for plant propagators is not a problem. However, bulk and cargo handling of seedlings and the time duration on collection, handling and transport of scions limits the distribution of these strains to other places. Most plant propagators prefer to buy scions because these are cheap, large number can be requested and the ease of transfer. However, longer storage duration was observed to decrease scion viability leading to lower survival rate after grafting. This is one reason why plant propagators order a maximum number of these elite strains that can be grafted immediately.

In order to prolong the viability of scions, proper packaging and storage should be employed. This should be done in a way to prevent or lessen the evapotranspiration rate of the bud sticks and maintain optimum moisture, oxygen and temperature to assure the viability of nodes and terminal buds. The manner by which the scions are packed and number of scions per pack could prolong its viability and increase its survival rate when grafted within a certain period of time. Hence this study was conducted.

## Objectives

This study was conducted with the following objectives:

1. to determine the effect of modes of packaging on graftability of 'Carabao' mango scions.
2. to determine the effect of different storage durations on graftability of 'Carabao' mango scions.
3. to determine the interaction effect of modes of packaging and storage durations on graftability of 'Carabao' mango scion.
4. to measure the association between survival as manifested by bud emergence of grafted mango scions and storage durations and modes of packaging.
5. to describe storage temperature and relative humidity on storage boxes where scions were packed at different modes.
6. to describe agro-climatic data after grafting of scions that could affect success in grafting.

**Definition of Terms.** The following terms used in this study are herewith defined:

**Graftability** is the ability of scion to be viable and to survive when connected or fixed to a stock in such a way that they will unite and subsequently behave as one plant. The term graftability was used by Soto and Oporto (1985) and Tanny (1985).

**Grafting** is a method of asexual propagation in which a scion is united to the stock for them to become one plant e.g. cleft grafting.

**Scion** is the short piece of detached shoot containing several dormant buds, which when united with the stock, comprises the upper portion of the grafted plant and from which will grow the shoots and branches.

**Stock** is the lower portion of the graft, which develops into the root system of the grafted plant.

**Viability** is the capacity of tissues and cells to be alive so that the physiological functions of the cells are not affected.

**Survival** is a state of the clone when growth commences actively or when the bud emerges and grows.

**Precocity** is the tendency for some plants to become reproductive sooner than others of the same kind.

**Clone** is a group of plants originating from a single individual and reproduced solely by vegetative means, such as by cuttings, layers, or grafts.

**Cultivar** is a contraction of the phrase "cultivated variety" and should be distinguished from the analogous, naturally occurring category, "botanical variety". This refers to selected varieties of plants that suit a particular purpose with distinct characteristics.

**Variety** is synonymous with cultivar, which refers to a group of plants within a species with similar characteristics.



## REVIEW OF LITERATURE

Alvarez (1983) reported that a successful association of Plant Nursery Operators (BAPNO) could graft or bud the Lamiao strain scions with a survival rate of 90 to 98 percent. Higher success was obtained at the end of the rainy season. Prolific buds should be obtained from matured shoots or at the start of the rainy season. Prolific buds should be obtained from matured shoots or when mother trees were about to flush or during pre-flowering stage.

One week storage of mango scions packed with sphagnum moss and saw dust at different temperatures showed that scions stored at 20 °C gave the best results in terms of survival of the grafted plants for both packing materials (Soto and Ojeda, 1983). On the other hand, Petrola *et al.* (2002), reported that scions stored for 4 to 5 days and treated with 150 to 200 ppm alpha naphthalene acetic acid (ANAA) emerge earlier compared to ANAA treated scions stored from one to three days. Results further showed that untreated scions stored at 1 to 3 days emerge faster than treated ones.

Delimited sections have higher sprouting and survival rate of 73.33 and 68.33 percent, respectively. As the length of scion increased (2.5 to 10.0 cm), percentage of success also increased from 6.66 to 58.33 percent. The length of 7.5 and 10 cm gave the highest success of 58.33 percent. Defoliated and undelimited sections have no variations. The jackfruit scion slips can be stored in moist sphagnum moss, polybags, moist gunny cloth or newspaper up to 3 days (Devi and D., 2010).

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## METHODOLOGY

**Application of starter solution.** Starter solution was applied to each seedling to revigorate growth. This was prepared by dissolving 20 g Triple 14 fertilizer in 4 gallons of water. Each pot was applied with 20 ml of the solution.

**Experimental treatments and design.** This study utilized the split plot experimental design with four replications. Storage durations of collected scions served as main plots and modes of packaging were assigned as sub plots. Experimental treatments used are presented in Table 1.

**Table 1. Experimental Treatments Used in this Study.**

Storage Duration (Days)	Mode of Packaging (pcs)	Number of Packs	Total Number of Scions Used
1	25	10	250
3	50	5	250
5	75	5	375
7	100	5	500
9	Loose at 200	none	1000
TOTAL			2,375



Collected scions were thoroughly wetted to the point of drip using an ordinary hand sprayer. Scions were wrapped using an old newspaper by 25, 50, 75, and 100 pieces per pack. The wrapping newspaper was also wetted to maintain proper moisture of scions. Modes of packaging were done by packs of 10 at 25 scions each and packs of 5 at 50, 75 and 100 scions. Scions in different modes of packaging were placed separately in the same sized carton boxes lined with newspaper and sealed for storage except for 25 pieces scions per pack treatment. This treatment contained 2 packs per carton box to have sufficient scions for the sampled rootstocks used at the time of grafting. On the other hand, another 200 scions were layered in another carton box lined with old newspaper and sealed that served as loose package. Scions were stored at 1, 3, 5, 7 and 9 days in a laboratory room with temperature that ranged from 23 to 27°C.

At the prescribed day of storage, 10 randomly selected viable scions kept in different modes of packaging were grafted to 10 'Carabao' mango seedling rootstocks. Cleft grafting was the method used. A single plant propagator did the cleft grafting in each replication to minimize variation. A total of 1,000 rootstocks were utilized for grafting. One row of potted mango seedlings was lined around the grafted seedlings in each treatment to serve as border plants.

**Care and maintenance.** The experimental set-up was monitored daily. Weeds that grow in the plastic bags were uprooted. Weekly spraying of recommended insecticides and fungicides was employed to eliminate damage of insect pests and diseases. Watering was done using an inverted micro-sprinkler pressurized irrigation system when necessary.

**Data collected.** The effects of the different treatments used were evaluated based on the following:

1. **Temperature and relative humidity in storage.** Daily temperature and relative humidity in storage container were monitored and recorded in °C using an Advanced Digital Large-Display Hygro-Thermometer. These data were gathered prior to grafting to help explain the survival of the scions.
2. **Percent viable scions.** At the time of grafting, percent viable scions in each prescribed storage duration and mode of packaging were recorded. A scion was considered viable when buds and shoot tip are still green and active with no browning and discoloration and at the same time was still firm and show no sign of dehydration and blackening of tissues. Viability was monitored on the grafted scions every five days after grafting up to the time they emerged.
3. **Days from grafting to bud emergence.** Number of days from grafting to bud emergence was recorded. A bud was considered emerged when the shoot tip sprouts into a beak-like formation with whitish-to-whitish green color. During this time, the polyethylene sheet covering the tip of the scion was removed.

4. **Days from bud emergence to flushing.** This was recorded when all the leaves opened, the surface of the leaves is flat and colored tan brown to yellowish green.
5. **Percent of graft bud emergence.** Scions that emerged were considered to have survived. This was observed at 5 days after grafting and was monitored at 5-day intervals. Percent bud emergence was computed as the total number of scions that survived over the total number of grafted plants per treatment then multiplied by 100.
6. **Percent mortality.** Blackened or discolored scions after grafting were considered dead or unsuccessful grafts. This was observed at 5 days after grafting and was monitored at 5-day intervals. Percent mortality was computed as the total number of dead scions over the total number of grafted plants per treatment then multiplied by 100.
7. **Average number of leaves developed per plant.** The number of leaves developed in all sample plants was counted at flushing stage. This was recorded as average number of leaves developed per plant.
8. **Agro-climatological data.** Agro-climatic conditions in the area were monitored throughout the duration of the study. Data were taken from the nearby weather station of the National Mango Research and Development Center. Data taken were atmospheric temperature, relative humidity, rainfall and total minutes of bright sunshine. Data taken were presented as mean observation throughout the duration of the study that could affect grafting success of 'Carabao' mango scions.
9. **Seedling vigor.** A rating scale listed below was used to describe seedling vigor as affected by the different treatments used. Observation was done 30, 40 and 50 days after grafting.

Rating Scale	Description
1	Dead. Unsuccessful graft or the grafted scions died.
3	Less vigorous. Grafted scion was viable but did not emerge. This also included emerged scions that developed less than 4 functional leaves.
5	Moderately vigorous. Seedlings developed 8 to 10 functional leaves.
7	Vigorous. Seedlings developed 4 to 7 functional leaves.
9	Very vigorous. Seedlings developed more than 10 functional leaves.



**Statistical analysis.** Mean observations were used to describe variations of temperature and relative humidity in storage boxes as well as in agro-climatic data that could influence grafting success. The rest of the data collected were analyzed using the analysis of variance (ANOVA) for a split plot design using the Statistical Analysis for Sciences (SAS) software program. Significant differences among treatment means were determined using the Duncan's multiple range test (DMRT) using IRRISTAT software program. The association between modes of packaging and storage durations on survival or bud emergence of grafted scions at 50 DAG was determined using the regression and correlation analysis using IRRISTAT software program.

## RESULTS AND DISCUSSIONS

### Viability of Stored Scions

Initial viability of stored scions at different durations and modes of packaging is presented in Table 2. Average data showed that at 1 to 3 days of storage, scions packed at different modes had 100 percent viability. As the storage duration is extended, viability of stored scions decreases. Loosely packed scions were observed to have lesser viability when stored up to 7 and 9 days. This could be due to faster transpiration rate and moisture loss of scions since in this treatment scions were not wrapped in newspapers. These were just placed inside a carton box. Analysis of variance was not done since data gathered were not replicated and reflected as mean data on percent viability of all the scions packed at different modes and stored at various durations.

### Viability of Grafted Scions

Viability of scions stored at different durations and packed at various modes was evaluated and monitored at different day intervals after grafting. Interaction between storage duration and mode of packaging was observed to be highly significant from 5 to 50 days after grafting (DAG) as presented in Table 2. At 5 DAG, all scions stored from 1 to 5 days and packed at different modes have 100 percent viability. As the storage duration was extended, viability of scions decreased, such that, at 7 and 9 days of storage, viability of scions decreased significantly compared to shorter duration of storage. Further observation showed that scions packed at 25 and 50 pieces and loose which were:

**Table 2. Viability of 'Carabao' Mango Scions as Affected by Storage Durations and Modes of Packaging.<sup>1</sup>**

		Mode of Packaging				Mean
Storage Duration (Days)		25/pack	50/pack	75/pack	100/pack	Loose
Initial Viability of Packed Scions at the Time of Grafting						
1	100.00	100.00	100.00	100.00	100.00	100.00
3	100.00	100.00	100.00	100.00	100.00	100.00
5	96.00	96.00	97.33	96.00	83.50	93.77
7	94.00	94.00	93.33	91.00	72.00	88.87
9	86.00	84.00	73.33	78.00	46.00	73.47
Mean	95.20	94.80	92.80	93.00	80.30	

5.DAG						
1	100.00 <sup>a</sup>	100.00 <sup>a</sup>	100.00 <sup>a</sup>	100.00 <sup>a</sup>	100.00 <sup>a</sup>	100.00 <sup>a</sup>
3	100.00 <sup>a</sup>	100.00 <sup>a</sup>	100.00 <sup>a</sup>	100.00 <sup>a</sup>	100.00 <sup>a</sup>	100.00 <sup>a</sup>
5	100.00 <sup>a</sup>	100.00 <sup>a</sup>	100.00 <sup>a</sup>	100.00 <sup>a</sup>	100.00 <sup>a</sup>	100.00 <sup>a</sup>
7	60.00 <sup>b</sup>	77.50 <sup>a</sup>	87.50 <sup>a</sup>	90.00 <sup>a</sup>	80.00 <sup>a</sup>	79.00
9	7.50 <sup>c</sup>	15.00 <sup>b</sup>	20.00 <sup>a</sup>	22.50 <sup>a</sup>	17.50 <sup>a+b</sup>	16.50
Mean	73.50	78.50	81.50	82.50	79.50	

**Continuation Table 2...**

Communities

Storage Duration (Days)	Mode of Packaging				Mean
	25/pack	50/pack	75/pack	100/pack	
10 DAG					
1	100.00 <sup>a</sup>	100.00 <sup>a</sup>	100.00 <sup>a</sup>	100.00 <sup>a</sup>	100.00 <sup>a</sup>
3	100.00 <sup>a</sup>	100.00 <sup>a</sup>	100.00 <sup>a</sup>	100.00 <sup>a</sup>	100.00 <sup>a</sup>
5	82.50 <sup>a</sup>	67.50 <sup>b</sup>	87.50 <sup>a</sup>	70.00 <sup>b</sup>	76.00 <sup>b</sup>
7	5.00 <sup>b</sup>	47.50 <sup>b</sup>	52.50 <sup>b</sup>	52.50 <sup>b</sup>	15.00 <sup>c</sup>
9	0.00 <sup>b</sup>	0.00 <sup>c</sup>	2.50 <sup>c</sup>	0.00 <sup>c</sup>	0.00 <sup>d</sup>
Mean	57.50	63.00	68.50	64.50	57.50
15 DAG					
1	100.00 <sup>a</sup>	100.00 <sup>a</sup>	100.00 <sup>a</sup>	100.00 <sup>a</sup>	100.00 <sup>a</sup>
3	100.00 <sup>a</sup>	87.50 <sup>ab</sup>	95.00 <sup>a</sup>	97.50 <sup>a</sup>	96.00 <sup>a</sup>
5	80.00 <sup>a</sup>	65.00 <sup>b</sup>	85.00 <sup>a</sup>	67.50 <sup>b</sup>	70.00 <sup>b</sup>
7	2.50 <sup>b</sup>	40.00 <sup>c</sup>	50.00 <sup>b</sup>	50.00 <sup>b</sup>	15.00 <sup>c</sup>
9	0.00 <sup>b</sup>	0.00 <sup>d</sup>	2.50 <sup>c</sup>	0.00 <sup>c</sup>	0.00 <sup>d</sup>
Mean	56.50	58.50	66.50	63.00	57.00
20 DAG					
1	100.00 <sup>a</sup>	100.00 <sup>a</sup>	97.50 <sup>a</sup>	100.00 <sup>a</sup>	99.50 <sup>a</sup>
3	87.50 <sup>a</sup>	80.00 <sup>ab</sup>	92.50 <sup>a</sup>	97.50 <sup>a</sup>	95.00 <sup>a</sup>
5	77.50 <sup>a</sup>	65.00 <sup>b</sup>	85.00 <sup>a</sup>	65.00 <sup>b</sup>	67.50 <sup>b</sup>
7	0.00 <sup>b</sup>	40.00 <sup>c</sup>	47.50 <sup>b</sup>	50.00 <sup>b</sup>	10.00 <sup>c</sup>
9	0.00 <sup>b</sup>	0.00 <sup>d</sup>	2.50 <sup>c</sup>	0.00 <sup>c</sup>	0.00 <sup>d</sup>
Mean	53.00	57.00	65.00	62.50	54.50

GG - days after infection

DAG - days after grafting

<sup>1</sup> Average of four replications. Data were transformed using Square root of (X+0.5).

<sup>ab</sup> Treatment means in a column followed by the same letter superscript are not significantly different at the 5% level of probability by DMRT.

<sup>bc</sup> Treatment means in a row followed by the same letter superscript are not significantly different at the 5% level of probability by DMRT. Stored more than 5 days had lower viability as compared to scions that were packed at 75 and 100 pieces.



25 DAG		30 DAG		35 DAG		40 DAG		45 DAG		50 DAG	
1	100.00 <sup>a</sup> x 97.50 <sup>a</sup> x 97.50 <sup>a</sup> x 100.00 <sup>a</sup> x 100.00 <sup>a</sup> x 99.00 <sup>a</sup>	1	100.00 <sup>a</sup> x 97.50 <sup>a</sup> x 97.50 <sup>a</sup> x 100.00 <sup>a</sup> x 100.00 <sup>a</sup> x 99.00 <sup>a</sup>	1	100.00 <sup>a</sup> x 95.00 <sup>a</sup> x 95.00 <sup>a</sup> x 100.00 <sup>a</sup> x 97.50 <sup>a</sup> x 97.50 <sup>a</sup>	1	100.00 <sup>a</sup> x 95.00 <sup>a</sup> x 95.00 <sup>a</sup> x 100.00 <sup>a</sup> x 97.50 <sup>a</sup> x 97.50 <sup>a</sup>	1	100.00 <sup>a</sup> x 95.00 <sup>a</sup> x 95.00 <sup>a</sup> x 100.00 <sup>a</sup> x 97.50 <sup>a</sup> x 97.50 <sup>a</sup>	1	100.00 <sup>a</sup> x 95.00 <sup>a</sup> x 95.00 <sup>a</sup> x 100.00 <sup>a</sup> x 97.50 <sup>a</sup> x 97.50 <sup>a</sup>
3	85.00 <sup>ab</sup> x 80.00 <sup>b</sup> x 92.50 <sup>a</sup> x 95.00 <sup>a</sup> x 95.00 <sup>a</sup> x 89.00 <sup>a</sup>	3	85.00 <sup>ab</sup> x 75.00 <sup>b</sup> x 92.50 <sup>a</sup> x 95.00 <sup>a</sup> x 95.00 <sup>a</sup> x 87.50 <sup>a</sup>	3	85.00 <sup>ab</sup> x 75.00 <sup>b</sup> x 92.50 <sup>a</sup> x 95.00 <sup>a</sup> x 95.00 <sup>a</sup> x 87.50 <sup>a</sup>	3	80.00 <sup>ab</sup> x 75.00 <sup>b</sup> x 92.50 <sup>a</sup> x 95.00 <sup>a</sup> x 95.00 <sup>a</sup> x 86.00 <sup>a</sup>	3	80.00 <sup>ab</sup> x 75.00 <sup>b</sup> x 92.50 <sup>a</sup> x 95.00 <sup>a</sup> x 95.00 <sup>a</sup> x 84.50 <sup>a</sup>	3	80.00 <sup>ab</sup> x 75.00 <sup>b</sup> x 92.50 <sup>a</sup> x 95.00 <sup>a</sup> x 95.00 <sup>a</sup> x 84.50 <sup>a</sup>
5	72.50 <sup>b</sup> x 65.00 <sup>b</sup> x 85.00 <sup>a</sup> x 95.00 <sup>a</sup> x 95.00 <sup>a</sup> x 70.50 <sup>a</sup>	5	70.00 <sup>b</sup> x 65.00 <sup>b</sup> x 85.00 <sup>a</sup> x 95.00 <sup>a</sup> x 95.00 <sup>a</sup> x 69.50 <sup>a</sup>	5	70.00 <sup>b</sup> x 65.00 <sup>b</sup> x 82.50 <sup>b</sup> x 95.00 <sup>a</sup> x 95.00 <sup>a</sup> x 68.50 <sup>a</sup>	5	65.00 <sup>b</sup> x 65.00 <sup>b</sup> x 82.50 <sup>b</sup> x 95.00 <sup>a</sup> x 95.00 <sup>a</sup> x 67.50 <sup>a</sup>	5	65.00 <sup>b</sup> x 65.00 <sup>b</sup> x 82.50 <sup>b</sup> x 95.00 <sup>a</sup> x 95.00 <sup>a</sup> x 67.50 <sup>a</sup>	5	62.50 <sup>b</sup> x 62.50 <sup>b</sup> x 82.50 <sup>b</sup> x 95.00 <sup>a</sup> x 95.00 <sup>a</sup> x 66.50 <sup>a</sup>
7	0.00 <sup>c</sup> x 40.00 <sup>c</sup> x 45.00 <sup>c</sup> x 47.50 <sup>b</sup> x 10.00 <sup>c</sup> x 28.50 <sup>a</sup>	7	0.00 <sup>c</sup> x 40.00 <sup>c</sup> x 45.00 <sup>c</sup> x 47.50 <sup>b</sup> x 10.00 <sup>c</sup> x 28.50 <sup>a</sup>	7	0.00 <sup>c</sup> x 40.00 <sup>c</sup> x 42.50 <sup>b</sup> x 47.50 <sup>b</sup> x 10.00 <sup>c</sup> x 28.00 <sup>a</sup>	7	0.00 <sup>c</sup> x 40.00 <sup>c</sup> x 35.00 <sup>b</sup> x 47.50 <sup>b</sup> x 10.00 <sup>c</sup> x 26.50 <sup>a</sup>	7	0.00 <sup>c</sup> x 37.50 <sup>c</sup> x 35.00 <sup>b</sup> x 47.50 <sup>b</sup> x 10.00 <sup>c</sup> x 26.00 <sup>a</sup>	7	0.00 <sup>c</sup> x 37.50 <sup>c</sup> x 35.00 <sup>b</sup> x 47.50 <sup>b</sup> x 10.00 <sup>c</sup> x 26.00 <sup>a</sup>
9	0.00 <sup>c</sup> x 0.00 <sup>d</sup> x 2.50 <sup>c</sup> x 0.00 <sup>c</sup> x 0.00 <sup>d</sup> x 0.50 <sup>a</sup>	9	0.00 <sup>c</sup> x 0.00 <sup>d</sup> x 2.50 <sup>c</sup> x 0.00 <sup>c</sup> x 0.00 <sup>d</sup> x 0.50 <sup>a</sup>	9	0.00 <sup>c</sup> x 0.00 <sup>d</sup> x 2.50 <sup>c</sup> x 0.00 <sup>c</sup> x 0.00 <sup>d</sup> x 0.50 <sup>a</sup>	9	0.00 <sup>c</sup> x 0.00 <sup>d</sup> x 2.50 <sup>c</sup> x 0.00 <sup>c</sup> x 0.00 <sup>d</sup> x 0.50 <sup>a</sup>	9	0.00 <sup>c</sup> x 0.00 <sup>d</sup> x 2.50 <sup>c</sup> x 0.00 <sup>c</sup> x 0.00 <sup>d</sup> x 0.50 <sup>a</sup>	9	0.00 <sup>c</sup> x 0.00 <sup>d</sup> x 2.50 <sup>c</sup> x 0.00 <sup>c</sup> x 0.00 <sup>d</sup> x 0.50 <sup>a</sup>
Mean	51.50	Mean	51.50	Mean	51.50	Mean	51.50	Mean	51.50	Mean	51.50

Continuation Table 2...

Storage Duration (Days)	Mode of Packaging				Mean
	25/pack	50/pack	75/pack	100/pack	

35 DAG	1	100.00 <sup>a</sup> x 95.00 <sup>a</sup> x 95.00 <sup>a</sup> x 100.00 <sup>a</sup> x 97.50 <sup>a</sup> x 97.50 <sup>a</sup>	3	85.00 <sup>ab</sup> x 75.00 <sup>b</sup> x 92.50 <sup>a</sup> x 95.00 <sup>a</sup> x 95.00 <sup>a</sup> x 87.50 <sup>a</sup>	5	70.00 <sup>b</sup> x 65.00 <sup>b</sup> x 82.50 <sup>b</sup> x 95.00 <sup>a</sup> x 95.00 <sup>a</sup> x 68.50 <sup>a</sup>	7	0.00 <sup>c</sup> x 40.00 <sup>c</sup> x 42.50 <sup>b</sup> x 47.50 <sup>b</sup> x 10.00 <sup>c</sup> x 28.00 <sup>a</sup>	9	0.00 <sup>c</sup> x 0.00 <sup>d</sup> x 2.50 <sup>c</sup> x 0.00 <sup>c</sup> x 0.00 <sup>d</sup> x 0.50 <sup>a</sup>	Mean	51.00
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40 DAG	1	100.00 <sup>a</sup> x 95.00 <sup>a</sup> x 95.00 <sup>a</sup> x 100.00 <sup>a</sup> x 97.50 <sup>a</sup> x 97.50 <sup>a</sup>	3	80.00 <sup>ab</sup> x 75.00 <sup>b</sup> x 92.50 <sup>a</sup> x 95.00 <sup>a</sup> x 95.00 <sup>a</sup> x 86.00 <sup>a</sup>	5	65.00 <sup>b</sup> x 65.00 <sup>b</sup> x 82.50 <sup>b</sup> x 95.00 <sup>a</sup> x 95.00 <sup>a</sup> x 67.50 <sup>a</sup>	7	0.00 <sup>c</sup> x 40.00 <sup>c</sup> x 35.00 <sup>b</sup> x 47.50 <sup>b</sup> x 10.00 <sup>c</sup> x 26.50 <sup>a</sup>	9	0.00 <sup>c</sup> x 0.00 <sup>d</sup> x 2.50 <sup>c</sup> x 0.00 <sup>c</sup> x 0.00 <sup>d</sup> x 0.50 <sup>a</sup>	Mean	49.00
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45 DAG	1	100.00 <sup>a</sup> x 95.00 <sup>a</sup> x 95.00 <sup>a</sup> x 100.00 <sup>a</sup> x 97.50 <sup>a</sup> x 97.50 <sup>a</sup>	3	80.00 <sup>ab</sup> x 75.00 <sup>b</sup> x 92.50 <sup>a</sup> x 95.00 <sup>a</sup> x 95.00 <sup>a</sup> x 84.50 <sup>a</sup>	5	62.50 <sup>b</sup> x 62.50 <sup>b</sup> x 82.50 <sup>b</sup> x 95.00 <sup>a</sup> x 95.00 <sup>a</sup> x 66.50 <sup>a</sup>	7	0.00 <sup>c</sup> x 37.50 <sup>c</sup> x 35.00 <sup>b</sup> x 47.50 <sup>b</sup> x 10.00 <sup>c</sup> x 26.00 <sup>a</sup>	9	0.00 <sup>c</sup> x 0.00 <sup>d</sup> x 2.50 <sup>c</sup> x 0.00 <sup>c</sup> x 0.00 <sup>d</sup> x 0.50 <sup>a</sup>	Mean	48.50
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50 DAG	1	100.00 <sup>a</sup> x 95.00 <sup>a</sup> x 95.00 <sup>a</sup> x 100.00 <sup>a</sup> x 97.50 <sup>a</sup> x 97.50 <sup>a</sup>	3	80.00 <sup>ab</sup> x 75.00 <sup>b</sup> x 92.50 <sup>a</sup> x 95.00 <sup>a</sup> x 95.00 <sup>a</sup> x 84.00 <sup>a</sup>	5	62.50 <sup>b</sup> x 62.50 <sup>b</sup> x 80.00 <sup>a</sup> x 95.00 <sup>a</sup> x 95.00 <sup>a</sup> x 66.00 <sup>a</sup>	7	0.00 <sup>c</sup> x 37.50 <sup>c</sup> x 35.00 <sup>b</sup> x 47.50 <sup>b</sup> x 10.00 <sup>c</sup> x 26.00 <sup>a</sup>	9	0.00 <sup>c</sup> x 0.00 <sup>d</sup> x 2.50 <sup>c</sup> x 0.00 <sup>c</sup> x 0.00 <sup>d</sup> x 0.50 <sup>a</sup>	Mean	48.50
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DAG - days after grafting

Average of four replications. Data were transformed using Square root of (X+0.5).

Treatment means in a column followed by the same letter superscript are not significantly different at the 5% level of probability by DMRT.

Treatment means in a row followed by the same letter superscript are not significantly different at the 5% level of probability by DMRT. Stored more than 5 days had lower viability as compared to scions that were packed at 75 and 100 pieces.

The trend was almost the same, as observed at 5-day intervals up to 50 DAG. Regardless of the modes of packaging, viability of scions stored for 1 to 5 days ranged from 62.50 to 100 percent. Higher viability was observed on scions stored for 7 days when these were packed at 50, 75 and 100 pieces. On the other hand, almost none of the scions stored for 9 days were viable at 50 DAG.

In terms of storage duration means compared at the same mode of packaging used, scions that were packed at 25 pieces and stored for 1 and 3 days had higher viability at 50 DAG that ranged from 80 to 100 percent. Five days storage duration resulted in 62.50 percent viability but was comparable to percent viability of scions in 3 days storage duration. At 7 to 9 days of storage, no more scions maintained its viability when grafted.

Comparison done on percent viability of grafted scions packed at 50 pieces showed a similar trend up to 5 days of scion storage at 50 DAG. There were 37.50 percent viable scions observed on the 7 days of storage duration which was statistically lesser compared to those of scions stored in shorter duration. However, this was much better than that of scions stored for 9 days duration.

Scions packed at 75 pieces and stored for 1 to 5 days had comparable percentage of viability (80 to 95 %) at 50 DAG but were statistically higher than those of scions stored for 7 and 9 days duration.

A different trend was observed when scions were packed at 100 pieces. Scions stored for one and 3 days had no significant ( $P>0.05$ ) difference in terms of viability (100.00 to 87.50 %), but had higher viability compared to those of scions stored at other durations. At 5 and 7 day durations, only 62.50 and 47.50 percent viable scions were obtained, respectively. All grafted scions were dead when stored up to 9 days. A similar trend was observed on viability of scions that were loosely packed.



### Mortality of Grafted Scions

A high significant interaction between storage duration and mode of packaging on mortality of grafted scions was observed at 5 to 20 DAG. Higher mortality was observed at longer storage duration, loose storage and at lesser number of scions per package.

At 5 DAG, modes of packaging treatments were statistically insignificant at the same storage durations used except for 7 days duration. Scions packed at 50, 75, 100 pieces and loose package had lower percentage mortalities compared to those scions packed at 25 pieces per pack.

Observations done at 10, 15, and 20 DAG revealed that the trend on percentage of mortality in each mode of packaging was increasing. More scions per pack had lesser mortality compared to those scions packed at 25 pieces and those, which were loosely stored, notably when these were stored within 7 days.

More mortality of grafted scions was observed when the duration of storage was longer.

No interaction was observed on the percentage mortality of grafted scions from 25 to 50 DAG. At 25 DAG, mortality on different modes of packaging was not significant at 5 percent level of probability. However, 99.5 percent of the grafted scion died when stored for 9 days. Only one percent mortality was noted when scions were stored for 1 day.

Succeeding observations on mortality showed similar trend. At 50 DAG, where all grafts were already stable, only 25 percent mortality was observed on scions that were stored for one day. Percentage of mortality increased as the number of storage duration was extended. Average mortality on packaging modes was not significant at 5 percent level of probability except at 40 DAG. Scions at 100 pieces per pack had lesser mortality of 39.00 percent but were comparable to those scions with loose packaging and those packed at 75 pieces (Table 3).

### Bud Emergence of Grafted Scions

Scions stored at different durations and packed using different modes started to emerge at 10 DAG. Modes of packaging were insignificant at 5 percent level of probability. Emergence of the grafted scions ranged from 11.00 to 15.50 percent. Scions in one-day storage had higher percentage emergence as compared to those stored for longer durations. The trend was almost the same up to the 20th day after grafting, where interaction between the two factors used was not observed.

At 25th to 50th DAG, interaction effect between the two factors was highly significant. Percent bud emergence of grafted scions at 25 DAG revealed that different modes of packaging had no significant variations at the same storage durations used, except at 7 days duration. Scions packed at 50, 75 and 100 pieces had higher percentage of bud emergence compared to scions loosely packed and those at 25 pieces per pack. Further observations showed that scions stored in shorter durations had higher percentage of bud emergence compared to those stored in longer durations. Consecutive observations on bud emergence up to 50 DAG have somewhat similar trends. Analysis of data done at 50 DAG.

Table 3. Mortality of 'Carabao' Mango scions as affected by storage durations and modes of packaging<sup>1</sup>

Storage Duration (Days)	Mode of Packaging				Mean
	25/pack	50/pack	75/pack	100/pack	Loose
5 DAG					
1	0.00 <sup>c</sup> x	0.00 <sup>c</sup> x	0.00 <sup>c</sup> x	0.00 <sup>c</sup> x	0.00 <sup>c</sup> x
3	0.00 <sup>c</sup> x	0.00 <sup>c</sup> x	0.00 <sup>c</sup> x	0.00 <sup>c</sup> x	0.00 <sup>c</sup> x
5	0.00 <sup>c</sup> x	0.00 <sup>c</sup> x	0.00 <sup>c</sup> x	0.00 <sup>c</sup> x	0.00 <sup>c</sup> x
7	40.00 <sup>b</sup> x	22.50 <sup>b</sup> x	12.50 <sup>b</sup> x	10.00 <sup>b</sup> x	20.00 <sup>b</sup> y
9	92.50 <sup>a</sup> x	85.00 <sup>a</sup> x	80.00 <sup>a</sup> x	77.50 <sup>a</sup> x	82.50 <sup>a</sup> x
Mean	26.50	21.50	18.50	17.50	20.50



Continuation Table 3...

Continuation Table 3....

Mode of Packaging

Mean

Storage Duration

25/pack

50/pack

75/pack

100/pack

Loose

(Days)

10 DAG

1	0.00 <sup>c</sup> x	0.00 <sup>c</sup> x	0.00 <sup>d</sup> x	0.00 <sup>d</sup> x	0.00 <sup>c</sup> x	0.00
3	0.00 <sup>c</sup> x	0.00 <sup>c</sup> x	0.00 <sup>d</sup> x	0.00 <sup>d</sup> x	0.00 <sup>c</sup> x	0.00
5	17.50 <sup>b</sup> yz	32.50 <sup>b</sup> yz	12.50 <sup>c</sup> z	30.00 <sup>c</sup> xy	27.50 <sup>b</sup> xy	24.00
7	95.00 <sup>a</sup> x	52.50 <sup>b</sup> y	47.50 <sup>b</sup> y	47.50 <sup>b</sup> y	85.00 <sup>a</sup> x	65.50
9	100.00 <sup>a</sup> x	100.00 <sup>a</sup> x	97.50 <sup>a</sup> x	100.00 <sup>a</sup> x	100.00 <sup>a</sup> x	99.50
Mean	42.50	37.00	31.50	35.50		42.50

15 DAG

1	0.00 <sup>c</sup> x	0.00 <sup>c</sup> x	0.00 <sup>d</sup> x	0.00 <sup>c</sup> x	0.00 <sup>c</sup> x	0.00
3	0.00 <sup>c</sup> y	12.50 <sup>d</sup> x	5.00 <sup>cd</sup> y	2.50 <sup>c</sup> y	0.00 <sup>c</sup> y	4.00
5	20.00 <sup>b</sup> xy	35.00 <sup>c</sup> x	15.00 <sup>c</sup> y	32.50 <sup>b</sup> x	30.00 <sup>b</sup> xy	26.50
7	97.50 <sup>a</sup> x	60.00 <sup>b</sup> yz	50.00 <sup>b</sup> z	50.00 <sup>b</sup> z	85.00 <sup>a</sup> xy	68.50
9	100.00 <sup>a</sup> x	100.00 <sup>a</sup> x	97.50 <sup>a</sup> x	100.00 <sup>a</sup> x	100.00 <sup>a</sup> x	99.50
Mean	43.50	41.50	33.50	37.00		43.00

20 DAG

1	0.00 <sup>c</sup> x	0.00 <sup>d</sup> x	2.50 <sup>d</sup> x	0.00 <sup>c</sup> x	0.00 <sup>c</sup> x	0.50
3	12.50 <sup>b</sup> xy	20.00 <sup>c</sup> x	7.50 <sup>cd</sup> y	2.50 <sup>c</sup> y	5.00 <sup>c</sup> y	9.50
5	22.50 <sup>b</sup> xy	35.00 <sup>bc</sup> x	15.00 <sup>c</sup> y	35.00 <sup>b</sup> x	32.50 <sup>b</sup> xy	28.00
7	100.00 <sup>a</sup> x	60.00 <sup>b</sup> yz	52.50 <sup>b</sup> z	50.00 <sup>b</sup> z	90.00 <sup>a</sup> xy	79.50
9	100.00 <sup>a</sup> x	100.00 <sup>a</sup> x	97.50 <sup>a</sup> x	100.00 <sup>a</sup> x	100.00 <sup>a</sup> x	99.50
Mean	47.00	43.00	35.00	37.50		45.50

25 DAG

1	0.00	2.50	2.50	0.00	0.00	1.00 <sup>e</sup>
3	15.00	20.00	7.50	5.00	7.50	11.00 <sup>d</sup>
5	27.50	35.00	15.00	35.00	35.00	29.50 <sup>c</sup>
7	100.00	60.00	55.00	52.50	90.00	71.50 <sup>b</sup>
9	100.00	100.00	97.50	100.00	100.00	99.50 <sup>a</sup>
Mean	48.50 <sup>ns</sup>	43.50	35.50	38.50		46.50

30 DAG

1	0.00	2.50	2.50	0.00	0.00	1.00 <sup>e</sup>
3	15.00	25.00	7.50	5.00	10.00	12.50 <sup>d</sup>
5	30.00	35.00	15.00	35.00	37.50	30.50 <sup>c</sup>
7	100.00	60.00	55.00	52.50	90.00	74.50 <sup>b</sup>
9	100.00	100.00	97.50	100.00	100.00	99.50 <sup>a</sup>
Mean	49.00 <sup>a</sup>	44.50 <sup>a</sup>	35.50 <sup>b</sup>	38.50 <sup>ab</sup>	47.50 <sup>ab</sup>	

\* Data before analysis.

DAG - days after grafting

Average of four replications. Data were transformed using square root of (X+0.5).

ns - not significant

xy - treatment means in a column followed by the same letter superscript are not significantly different at the 5% level of probability by DMRT.

xy - treatment means in a row followed by the same letter superscript are not significantly different at the 5% level of probability by DMRT. DAG showed that bud emergence of grafted scions at 25 pieces per pack and stored for 1 day was significantly higher with 97.50 percent as compared to those scions stored in longer durations. Scions stored for 3 and 5 day had comparable results with 67.50 and 57.50 percent emergence, respectively. On the other hand, storage for 7 days or longer resulted in zero bud emergence.

Continuation Table 3...

Storage Duration (Days)		Mode of Packaging				Mean
		25/pack	50/pack	75/pack	100/pack	Loose
<b>35 DAG</b>						
1	0.00	5.00	5.00	0.00	2.50	2.50 <sup>e</sup>
3	15.00	25.00	7.50	5.00	10.00	12.50 <sup>d</sup>
5	30.00	35.00	17.50	37.50	37.50	31.50 <sup>c</sup>
7	100.00	60.00	57.50	52.50	90.00	72.00 <sup>b</sup>
9	100.00	100.00	97.50	100.00	100.00	99.50 <sup>a</sup>
Mean	49.00 <sup>ns</sup>	45.00	37.00	39.00	48.00	
<b>40 DAG</b>						
1	0.00	5.00	5.00	0.00	2.50	2.50 <sup>e</sup>
3	20.00	25.00	7.50	5.00	12.50	14.00 <sup>d</sup>
5	35.00	35.00	17.50	37.50	37.50	32.50 <sup>c</sup>
7	100.00	60.00	65.00	52.50	90.00	73.50 <sup>b</sup>
9	100.00	100.00	97.50	100.00	100.00	99.50 <sup>a</sup>
Mean	51.00 <sup>a</sup>	45.00 <sup>a</sup>	38.50 <sup>ab</sup>	39.00 <sup>b</sup>	48.50 <sup>ab</sup>	
<b>45 DAG</b>						
1	0.00	5.00	5.00	0.00	2.50	2.50 <sup>e</sup>
3	20.00	25.00	10.00	10.00	12.50	15.50 <sup>d</sup>
5	37.50	37.50	17.50	37.50	37.50	33.50 <sup>c</sup>
7	100.00	62.50	65.00	52.50	90.00	74.00 <sup>b</sup>
9	100.00	100.00	97.50	100.00	100.00	99.50 <sup>a</sup>
Mean	51.50 <sup>ns</sup>	46.00	39.00	40.00	48.50	
<b>50 DAG</b>						
1	0.00	5.00	5.00	0.00	2.50	2.50 <sup>e</sup>
3	20.00	25.00	10.00	12.50	12.50	16.00 <sup>d</sup>
5	37.50	37.50	20.00	37.50	37.50	34.00 <sup>c</sup>
7	100.00	62.50	65.00	52.50	90.00	74.00 <sup>b</sup>
9	100.00	100.00	97.50	100.00	100.00	99.50 <sup>a</sup>
Mean	51.50 <sup>ns</sup>	46.00	39.50	40.50	48.50	

DAG - days after grafting

Average of four replications. Data were transformed using square root of (X+0.5).

ns - not significant

xy - treatment means in a column followed by the same letter superscript are not significantly different at the 5% level of probability by DMRT.

xy - treatment means in a row followed by the same letter superscript are not significantly different at the 5% level of probability by DMRT. DAG showed that bud emergence of grafted scions at 25 pieces per pack and stored for 1 day was significantly higher with 97.50 percent as compared to those scions stored in longer durations. Scions stored for 3 and 5 day had comparable results with 67.50 and 57.50 percent emergence, respectively. On the other hand, storage for 7 days or longer resulted in zero bud emergence.



Scions packed at 50 pieces and stored for one day have significantly ( $P < 0.05$ ) higher percentage bud emergence than in other treatments except for those scions stored for 3 days. Bud emergence was only observed up to 7 days of storage. The same trend was observed on grafted scions at 100 pieces per pack.

Percentage bud emergence did not vary significantly at 1 to 5 days of storage when scions were packed at 75 pieces. Scions stored for 9 days had the lowest percent emergence of 2.5 followed by scions stored for 7 days with 32.50 percent.

For loose package, scions stored 1 and 3 days had comparable percentages of 97.50 and 85.00 bud emergence, respectively. This was significantly higher compared to longer storage durations (Table 4).

Multiple regression analysis showed that 93 percent of the total variations in bud emergence of grafted mango scions can be accounted for by the linear function, involving mode of packaging and storage duration. The estimated multiple linear regression  $\hat{Y} = 111.418 - 12.3X_1 + 0.01X_2$  was significant at 1 percent level of probability. Thus, the combined linear effects of modes of packaging and storage durations contributed significantly to the variations in bud emergence (Figure 1).

Table 4. Bud Emergence of 'Carabao' Mango Scions as Affected by Storage Durations and Modes of Packaging.<sup>1</sup>

Storage Duration		Mode of Packaging					Mean
(Days)	25/pack 50/pack 75/pack 100/pack Loose						
5 DAG							
1	0.00	0.00	0.00	0.00	0.00	0.00	ns
3	0.00	0.00	0.00	0.00	2.50	2.50	1.00
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mean	0.00	ns	0.00	0.00	0.50	0.50	
10 DAG							
1	45.00	42.50	52.50	47.50	30.00	43.50	a
3	7.50	7.50	22.50	17.50	20.00	15.00	b
5	10.00	0.00	2.50	2.50	0.00	3.00	c
7	0.00	0.00	0.00	0.00	0.00	0.00	c
9	0.00	0.00	0.00	0.00	0.00	0.00	c
Mean	12.50	ns	10.00	15.50	13.50	10.00	

DAG - days after grafting

DAG - days after grafting

<sup>1</sup>Average of four replications. Data were transformed using square root of ( $X+0.5$ ).

<sup>ns</sup> - not significant

<sup>a</sup>Treatment means in a column followed by the same letter superscripts are not significantly different at the 5% level of probability by DMRT.

<sup>b</sup>Treatment means in a row followed by the same letter superscripts are not significantly different at the 5% level of probability by DMRT.

Continuation Table 4...

Storage Duration (Days)	Mode of Packaging				Mean
	25/pack	50/pack	75/pack	100/pack	
15 DAG					
1	62.50	62.50	70.00	65.00	62.50 <sup>a</sup>
3	47.50	30.00	57.50	52.50	57.50 <sup>a</sup>
5	32.50	17.50	30.00	30.00	10.00 <sup>b</sup>
7	0.00	0.00	0.00	0.00	0.00 <sup>c</sup>
9	0.00	0.00	0.00	0.00	0.00 <sup>c</sup>
Mean	28.50 <sup>ns</sup>	22.00	31.50	29.50	26.00
20 DAG					
1	82.50	75.00	82.50	92.50	80.00
3	50.00	47.50	65.00	67.50	65.00
5	40.00	35.00	42.50	50.00	35.00
7	0.00	15.00	12.50	17.50	5.00
9	0.00	0.00	0.00	0.00	0.00
Mean	34.50 <sup>ns</sup>	34.50	40.50	45.50	37.00
25 DAG					
1	85.00 <sup>a</sup>	80.00 <sup>a</sup>	82.50 <sup>a</sup>	95.00 <sup>a</sup>	87.50 <sup>a</sup>
3	55.00 <sup>b</sup>	57.50 <sup>ab</sup>	70.00 <sup>ab</sup>	77.50 <sup>ab</sup>	75.00 <sup>a</sup>
5	47.50 <sup>b</sup>	42.50 <sup>b</sup>	52.50 <sup>b</sup>	50.00 <sup>b</sup>	47.50 <sup>b</sup>
7	0.00 <sup>c</sup>	20.00 <sup>c</sup>	25.00 <sup>c</sup>	17.50 <sup>c</sup>	5.00 <sup>c</sup>
9	0.00 <sup>c</sup>	0.00 <sup>d</sup>	2.50 <sup>d</sup>	0.00 <sup>d</sup>	0.00 <sup>c</sup>
Mean	37.50	40.00	46.50	48.00	43.00
30 DAG					
1	90.00 <sup>a</sup>	80.00 <sup>a</sup>	90.00 <sup>a</sup>	100.00 <sup>a</sup>	90.00 <sup>a</sup>
3	60.00 <sup>b</sup>	60.00 <sup>ab</sup>	77.50 <sup>ab</sup>	82.50 <sup>a</sup>	80.00 <sup>a</sup>
5	50.00 <sup>b</sup>	47.50 <sup>b</sup>	55.00 <sup>b</sup>	50.00 <sup>b</sup>	47.50 <sup>b</sup>
7	0.00 <sup>c</sup>	27.50 <sup>c</sup>	30.00 <sup>c</sup>	27.50 <sup>c</sup>	7.50 <sup>c</sup>
9	0.00 <sup>c</sup>	0.00 <sup>d</sup>	2.50 <sup>d</sup>	0.00 <sup>d</sup>	0.00 <sup>d</sup>
Mean	40.00	43.00	51.00	52.00	45.00
35 DAG					
1	95.00 <sup>a</sup>	85.00 <sup>a</sup>	92.50 <sup>a</sup>	100.00 <sup>a</sup>	92.50 <sup>a</sup>
3	62.50 <sup>b</sup>	70.00 <sup>ab</sup>	80.00 <sup>a</sup>	82.50 <sup>a</sup>	85.50 <sup>a</sup>
5	52.50 <sup>b</sup>	50.00 <sup>bc</sup>	65.00 <sup>a</sup>	52.50 <sup>b</sup>	52.50 <sup>b</sup>
7	0.00 <sup>c</sup>	32.50 <sup>c</sup>	30.00 <sup>b</sup>	30.00 <sup>c</sup>	7.50 <sup>c</sup>
9	0.00 <sup>c</sup>	0.00 <sup>d</sup>	2.50 <sup>c</sup>	0.00 <sup>d</sup>	0.00 <sup>d</sup>
Mean	42.00	47.50	54.00	53.00	47.00

DAG - days after grafting

<sup>1</sup>Average of four replications. Data were transformed using square root of ( $X+0.5$ ).

<sup>ns</sup> - not significant

<sup>a</sup>Treatment means in a column followed by the same letter superscripts are not significantly different at the 5% level of probability by DMRT.

<sup>b</sup>Treatment means in a row followed by the same letter superscripts are not significantly different at the 5% level of probability by DMRT.



Continuation Table 4...

Storage Duration (Days)	Mode of Packaging				Mean
	25/pack	50/pack	75/pack	100/pack	
<b>40 DAG</b>					
1	95.00 <sup>a</sup> x 90.00 <sup>a</sup> x 92.50 <sup>a</sup> x 100.00 <sup>a</sup> x 95.00 <sup>a</sup> x 94.50				
3	67.50 <sup>ab</sup> x 70.00 <sup>ab</sup> x 82.50 <sup>a</sup> x 82.50 <sup>a</sup> x 82.50 <sup>a</sup> x 77.00				
5	55.00 <sup>b</sup> x 55.00 <sup>b</sup> x 67.50 <sup>a</sup> x 55.00 <sup>a</sup> x 52.50 <sup>b</sup> x 57.00				
7	0.00 <sup>c</sup> x 32.50 <sup>c</sup> x 32.50 <sup>b</sup> x 35.00 <sup>b</sup> x 10.00 <sup>c</sup> x 22.00				
9	0.00 <sup>c</sup> x 0.00 <sup>d</sup> x 2.50 <sup>c</sup> x 0.00 <sup>c</sup> x 0.00 <sup>d</sup> x 0.50				
Mean	43.50	49.50	55.50	54.50	48.00
<b>45 DAG</b>					
1	97.50 <sup>a</sup> x 90.00 <sup>a</sup> x 92.50 <sup>a</sup> x 100.00 <sup>a</sup> x 97.50 <sup>a</sup> x 95.50				
3	67.50 <sup>b</sup> x 70.00 <sup>ab</sup> x 82.50 <sup>a</sup> x 82.50 <sup>ab</sup> x 85.00 <sup>a</sup> x 77.50				
5	55.00 <sup>b</sup> x 57.50 <sup>b</sup> x 67.50 <sup>a</sup> x 60.00 <sup>b</sup> x 52.50 <sup>b</sup> x 58.50				
7	0.00 <sup>c</sup> x 32.50 <sup>c</sup> x 32.50 <sup>b</sup> x 35.00 <sup>c</sup> x 10.00 <sup>c</sup> x 22.00				
9	0.00 <sup>c</sup> x 0.00 <sup>d</sup> x 2.50 <sup>c</sup> x 0.00 <sup>d</sup> x 0.00 <sup>d</sup> x 0.50				
Mean	44.00	50.00	55.50	55.50	49.00
<b>50 DAG</b>					
1	97.50 <sup>a</sup> x 90.00 <sup>a</sup> x 92.50 <sup>a</sup> x 100.00 <sup>a</sup> x 97.50 <sup>a</sup> x 95.50				
3	67.50 <sup>b</sup> x 70.00 <sup>ab</sup> x 85.00 <sup>a</sup> x 82.50 <sup>ab</sup> x 85.00 <sup>a</sup> x 78.00				
5	57.50 <sup>b</sup> x 57.50 <sup>b</sup> x 70.00 <sup>a</sup> x 60.00 <sup>b</sup> x 55.00 <sup>b</sup> x 60.00				
7	0.00 <sup>c</sup> x 32.50 <sup>c</sup> x 32.50 <sup>b</sup> x 35.00 <sup>c</sup> x 10.00 <sup>c</sup> x 22.00				
9	0.00 <sup>c</sup> x 0.00 <sup>d</sup> x 2.50 <sup>c</sup> x 0.00 <sup>d</sup> x 0.00 <sup>d</sup> x 0.50				
Mean	44.50	50.00	56.50	55.50	49.50

DAG - days after grafting

Average of four replications. Data were transformed using square root of (X+0.5).

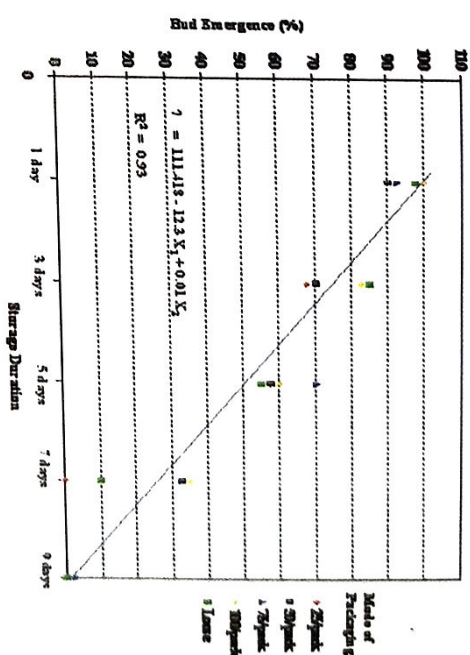
\* - not significant

\* - Treatment means in a column followed by the same letter superscripts are not significantly different at the 5% level of probability by DMRT

\* - Treatment means in a row followed by the same letter superscripts are not significantly different at the 5% level of probability by DMRT

(irrigability of Mango... Yonder &amp; Paricio...

Figure 1. Regression Equation for Bud Emergence (Y) of Mango Scions at 50 Days After Grafting as a Function of Modes of Packaging (X1) and Storage Duration (X2).



### Growth Parameters

The data on growth parameters are presented in Table 5. These include the number of days from grafting to bud emergence, the number of days from bud emergence to flushing and the number of leaves developed per grafted seedlings as affected by storage durations and modes of packaging.

**Days from Grafting to Bud Emergence.** The number of days from grafting to bud emergence of grafted scions stored at various duration and modes of packaging is presented in Table 5. It was observed that scions emerged between 12 to 22 days after grafting. Interaction between the two factors used was highly significant. The number of days from grafting to bud emergence as affected by modes of packaging at the same level of storage duration was observed to be comparable with other treatments except at 7 and 9 days storage durations. Grafted scions at all modes of packaging and stored for 7 days emerged at 16.88 to 22.46 days. This was statistically higher from emergence of scions packed at 25 pieces, which gave no emergence at all. At 9 days storage, only the grafted scions packed at 75 pieces, had an observed bud emergence (5.50 days). The result was quite low since only 1 plant emerged out of 40 sample plants used in 4 replications.

On the other hand, storage duration treatment means at 25 pieces per pack revealed that 1 to 5 days storage had insignificant differences that ranged from 14.53 to 18.06 days. Seven and 9 days storage resulted in non-emergence of scions when grafted.



At 50 pieces per pack, 1 to 7 days storage had a comparable number of days to bud emergence that ranged from 14.72 to 21.14 days. No bud emergence was observed at 9 days storage duration. The same trend was observed on grafted scions with loose packaging.

Table 5. Growth Parameters of 'Carabao' Mango Scions as Affected by Storage Durations and Modes of Packaging.<sup>1</sup>

Storage Duration		Mode of Packaging				Mean
(Days)	25/pack	50/pack	75/pack	100/pack	Loose	
Days from Grafting to Bud Emergence						
1	14.53 <sup>a</sup> y	14.72 <sup>a</sup> y	12.54 <sup>b</sup> y	12.52 <sup>b</sup> y	14.52 <sup>a</sup> y	13.77 <sup>a</sup> y
3	16.64 <sup>a</sup> y	18.12 <sup>a</sup> y	16.44 <sup>ab</sup> y	14.64 <sup>ab</sup> y	15.87 <sup>a</sup> y	16.34 <sup>a</sup> y
5	18.06 <sup>a</sup> y	20.74 <sup>a</sup> y	21.92 <sup>a</sup> y	17.70 <sup>ab</sup> y	19.84 <sup>a</sup> y	19.65 <sup>a</sup> y
7	0.00 <sup>b</sup> z	21.14 <sup>a</sup> y	20.04 <sup>ab</sup> y	22.46 <sup>a</sup> y	16.88 <sup>a</sup> y	16.10 <sup>a</sup> y
9	0.00 <sup>b</sup> z	0.00 <sup>b</sup> z	5.50 <sup>c</sup> y	0.00 <sup>c</sup> z	0.00 <sup>b</sup> z	1.10 <sup>b</sup> z
Mean	9.85	14.94	15.29	13.46		13.42
Days from Bud Emergence to Flushing						
1	5.50 <sup>a</sup> y	5.98 <sup>a</sup> y	5.86 <sup>a</sup> y	6.32 <sup>a</sup> y	5.27 <sup>ab</sup> y	5.79 <sup>a</sup> y
3	5.29 <sup>a</sup> y	5.49 <sup>a</sup> y	5.61 <sup>a</sup> y	5.14 <sup>ab</sup> y	6.68 <sup>a</sup> y	5.64 <sup>a</sup> y
5	4.78 <sup>a</sup> y	4.53 <sup>a</sup> y	4.64 <sup>a</sup> y	4.15 <sup>b</sup> y	4.75 <sup>ab</sup> y	4.57 <sup>a</sup> y
7	0.00 <sup>b</sup> z	4.50 <sup>a</sup> y	4.79 <sup>a</sup> y	3.96 <sup>b</sup> y	4.12 <sup>b</sup> y	3.47 <sup>b</sup> y
9	0.00 <sup>b</sup> z	0.00 <sup>b</sup> y	1.00 <sup>b</sup> y	0.00 <sup>c</sup> y	0.00 <sup>c</sup> y	0.20 <sup>c</sup> z
Mean	3.11	4.10	4.38	3.91		4.16
Number of Leaves Developed						
1	9.90 <sup>a</sup> x	9.10 <sup>a</sup> x	9.32 <sup>a</sup> x	9.82 <sup>a</sup> x	11.97 <sup>a</sup> x	10.02 <sup>a</sup> x
3	11.22 <sup>a</sup> x	9.84 <sup>a</sup> x	9.15 <sup>a</sup> x	11.27 <sup>a</sup> x	10.18 <sup>a</sup> x	10.33 <sup>a</sup> x
5	11.31 <sup>a</sup> x	10.25 <sup>a</sup> x	10.99 <sup>a</sup> x	10.80 <sup>a</sup> x	11.31 <sup>a</sup> x	10.93 <sup>a</sup> x
7	0.00 <sup>b</sup> z	8.40 <sup>ax</sup> y	10.42 <sup>a</sup> x	10.76 <sup>a</sup> x	7.00 <sup>b</sup> y	7.32 <sup>b</sup> y
9	0.00 <sup>b</sup> y	0.00 <sup>b</sup> y	3.50 <sup>b</sup> x	0.00 <sup>b</sup> y	0.00 <sup>c</sup> y	0.70 <sup>c</sup> z
Mean	6.49	7.52	8.68	8.53		8.09

DAE - days after grafting

DAG - days after grafting

<sup>1</sup>Average of four replications. Data were transformed using square root of (X+0.5).

<sup>a</sup> - not significant

<sup>ab</sup> Treatment means in a column followed by the same letter superscripts are not significantly different at the 5% level of probability by DMRT.

<sup>xy</sup> Treatment means in a row followed by the same letter superscripts are not significantly different at the 5% level of probability by DMRT.

Scions packed at 75 pieces and stored at 1 day had earlier bud emergence (12.54 days) but the difference was not significant at 5 percent level of probability compared to scions stored at 3 and 7 days duration. Data obtained at 9 days storage was non conclusive since only 1 sample plant emerged out of the 40 scions grafted.

Data taken on scions packed at 100 pieces and stored for 1 day treatment showed that grafted scions emerged faster as compared to scions in other storage durations. However, results were comparable among scion stored for 3 and 5 days. Scions stored for 9 days had no emergence.

**Days from Bud Emergence to Flushing.** It took almost 4 to 6 days for the buds to open. At this stage, young leaves were flat and tan-brown to yellowish green in color. The interaction effect between the two factors used was highly significant. The difference on the number of days from bud emergence to flushing on the various modes of packaging used at the same storage duration treatments was almost the same except at 7-day duration. Grafted scions stored at 7 days and packed at 25 pieces had no flushing and was statistically different compared to scions in other modes of packaging.

Comparison made between storage duration means under the same level of packaging modes showed that grafted scions packed at 25 pieces and stored at 1 to 5 days had no variations at 5 percent level of probability. No flushing was observed from scions packed at 25 pieces and stored for 7 and 9 since these did not emerge.

At 50 pieces per pack, scions stored at 1 to 7 days and grafted to 'Carabao' mango seedlings had flushed at 4.50 to 5.98 days from bud emergence. All scions stored at 9 days were dead. The trend on the number of days from bud emergence to flushing was similar when scions were packed at 75 pieces.

Flushing took longer for scions packed at 100 pieces and stored for one day (6.32) as compared to scions which were stored for 5, 7, and 9 days. Scions stored at 7 days had earlier flushing at 3.96 days but did not differ statistically from scions stored at 3 to 5 days durations.

Flushing of scions, which were loosely packed and stored for 3 days, took longer time (6.68 days) than scions stored for 7 and 9 days but not to scions stored for 1 and 5 days. Scions stored for 9 days did not flush in all instances since all the grafted scions were dead.

**Number of Leaves Developed.** An interaction effect was observed between modes of packaging and storage durations used. Comparison made between different modes of packaging over the same storage duration revealed that the number of leaves developed per plant was statistically the same, except on 7 days storage. Scions packed at 100 pieces produced more leaves (10.76 pcs) which were statistically higher compared to the number of leaves of scions packed at 25 pieces and those scions loosely packed but not on scions that were packed at 75 and 50 pieces.

Comparison of storage duration means over the same modes of packaging showed that regardless of the modes used, scions stored for 1 to 5 days produced comparable number of leaves ranging from 9.10 to 11.31 leaves. Similar results were observed when scions were stored for 7 days and packed at 50, 75 and 100 pieces. Scions that were packed loosely and stored for 7 days had developed 7 leaves only.



In all instances, scions stored for 9 days died but only one plant survived out of the ten samples in replication 3.

### Seedling Vigor

Table 6 presents the vigor of grafted 'Carabao' mango seedlings. At 30 DAG, grafted scions stored for 1 to 3 days and packed at any mode showed vigorous growth. Grafted scions stored for 5 days were moderately vigorous, while scions stored for more than 7 days had less vigorous to dead rating. At 9 days storage, grafted scions lost their viability and were considered dead.

Further observations at 40 and 50 DAG showed a similar trend, but the rating on seedling vigor increase. This was due to the emergence or refushing of some sample plants in a treatment. Generally, regardless of the modes of packaging, early grafting (1 to 5 days) of collected scions resulted in vigorous seedlings. When extended up to 7 days, more scions per pack should be considered (50 to 100 scions per pack), to achieve a moderately vigorous seedling.

Table 6. Seedling Vigor of Grafted 'Carabao' Mango Where Scions are Stored at Different Durations and Modes of Packaging.

Storage Duration (Days)	Mode of Packaging					Mean
	25/pack	50/pack	75/pack	100/pack	Loose	
<u>30 DAG</u>						
1	6.55	5.75	6.55	6.45	7.40	6.54
3	5.35	5.32	5.92	6.85	5.95	5.88
5	4.65	4.38	5.35	4.80	4.45	4.73
7	1.00	2.95	3.40	3.15	1.60	2.42
9	1.00	1.00	1.20	1.00	1.00	1.04
Mean	3.71	3.88	4.48	4.45	4.08	
<u>40 DAG</u>						
1	7.00	6.00	6.55	6.80	7.55	6.78
3	5.90	5.35	6.25	7.00	6.30	6.16
5	4.65	4.60	5.60	4.85	4.80	4.90
7	1.00	3.10	3.20	3.35	1.50	2.43
9	1.00	1.00	1.20	1.00	1.00	1.04
Mean	3.91	4.01	4.56	4.60	4.23	

Continuation Table 6...

Storage Duration (Days)	Mode of Packaging				Mean
	25/pack	50/pack	75/pack	100/pack	
50 DAG					
1	7.35	6.30	6.65	7.10	8.00
3	5.90	5.45	6.20	6.85	6.35
5	4.80	4.60	5.80	5.20	5.05
7	1.00	3.05	3.20	3.45	1.60
9	1.00	1.00	1.20	1.00	1.04
Mean	4.01	4.08	4.61	4.72	4.40

DAG - days after grafting

RATING SCALE	DESCRIPTION
1	Dead. Unsuccessful grafts or the grafted scions died.
3	Less vigorous. Grafted scions were viable but did not emerge. These also included all emerged scions that developed less than 4 functional leaves.
5	Moderately vigorous. Seedlings developed 4 to 7 functional leaves.
7	Vigorous. Seedlings developed 8 to 10 functional leaves.
9	Very vigorous. Seedlings developed more than 10 functional leaves.

### Temperature and Relative Humidity in Storage Boxes

To prevent deterioration and bud development as well as extend viability and period of seed dormancy, Hartman, Kester and Davies (1990) recommended that scions should be stored in an optimum temperature and in moist condition. As shown in Figure 2, average temperatures in storage boxes were almost the same that ranged from 28.20 to 28.37°C regardless of the storage duration and modes of packaging. On the other hand, relative humidity inside the storage boxes as affected by modes of packaging ranged from 84.03 to 84.75 percent, where the differences were very minimal. It was noted, that relative humidity was higher in boxes for scions stored at shorter period since scions and newspaper wrappers were still wet. Supporting data is shown in Appendix Table 1.

### Climatic Observations

In this study, climatic observation from 1 to 50 days after grafting of stored scions is presented in Table 7. Averages of all the climatic data are within the requirements stated by Ram (1997). This present study which was conducted in summer months (March to May) when there were ample amounts of sunshine, moderate temperature, high relative humidity and less rainfall agrees with the observations of Ram (1997). He reported that in areas with dry, hot weather and with low precipitation, success in softwood grafting is effective and high. This could be augmented with moderate temperature and high relative humidity.



Figure 2. Mean Temperature and Mean Relative Humidity in Storage Boxes of 'Carabao' Mango Scions as Affected by Storage Durations and Modes of Packaging

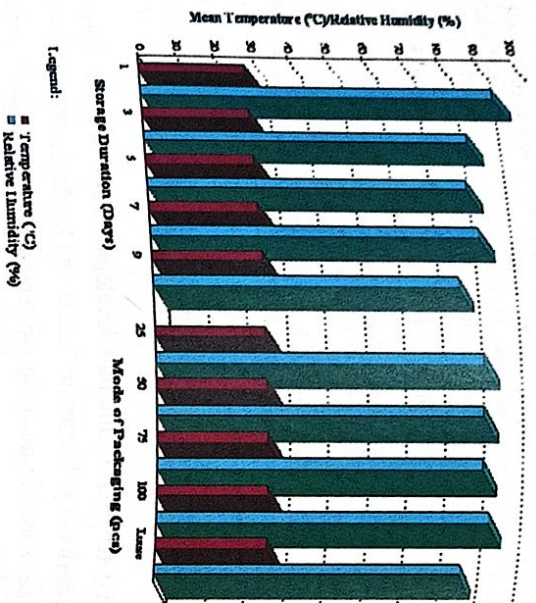


Table 7. Average Climatic Observations from Day 1 to 50 Days After Grafting of Stored Scions.

Storage Duration (days)	Climatic Observation							
	Air Temperature (°C)				Relative Humidity (%)		Rainfall (mm/day)	Total Bright Sunshine (min)
	Minimum		Maximum					
	8:00 AM	2:00 PM	8:00 AM	2:00 PM	8:00 AM	2:00 PM		
1 (March 29-May 17, 2003)	23.95	26.91	34.83	34.74	82.54	55.26	2.47	552.86
3 (March 31-May 19, 2003)	24.42	27.41	35.37	35.34	84.78	57.68	4.14	543.62
5 (April 2-May 22, 2003)	24.45	27.31	35.12	35.06	85.06	59.58	5.20	521.00
7 (April 4-May 24, 2003)	24.54	27.28	34.98	34.85	85.32	60.96	5.60	502.82
9 (April 6-May 26, 2003)	24.50	27.17	34.71	34.53	85.94	62.98	8.23	480.00

## CONCLUSIONS AND RECOMMENDATIONS

### Summary of the Methodology

The study was conducted at the nursery of the Bureau of Plant Industry - National Mango Research and Development Center, San Miguel, Jordan, Guimaras from March to May 2003. The study was conducted with the following objectives:

1. to determine the effect of modes of packaging on graftability of 'Carabao' mango scions.
2. to determine the effect of different storage durations on graftability of 'Carabao' mango scions.
3. to determine the interaction effect of modes of packaging and storage durations on graftability of 'Carabao' mango scions
4. to measure the association between survival as manifested by bud emergence of grafted mango scions and function of storage durations and modes of packaging.
5. to describe storage temperature and relative humidity on storage boxes where scions were packed at different modes of packaging.
6. to describe agro-climatic data after grafting of scions that could affect success in grafting.

The experimental treatments were laid out in a split plot design, replicated four times. The main plot was composed of five storage durations of scions, which were 1, 3, 5, 7 and 9 days. The sub-plots were composed of five modes of packaging, which were 25, 50, 75 and 100 scions per package and scions that were unpacked or loosely stored at 200 pieces.

Eight-month old scions were collected from a single mother tree. These were packed and stored according to the treatments used. At certain storage duration, scions at different modes of packaging were grafted to 10 rootstocks of 'Carabao' mango seedlings per sub-plot treatment. Grafted seedlings were cared for and maintained properly at the nursery.

Mean observations were used to describe variations of temperature and relative humidity in storage boxes as well as in agro-climatic data that could influence grafting success. The rest of the data collected (percent viable scions, days from grafting to bud emergence, days from bud emergence to flushing, percent of graft bud emergence, percent mortality, and average number of leaves developed per plant) were analyzed using the analysis of variance (ANOVA) program. Significant differences among treatment means were determined using the Duncan's multiple range test (DMRT) using IRRISTAT software program. The association between modes of packaging and storage durations on survival of bud emergence of grafted scions at 50 DAG was determined using the regression and correlation analysis using IRRISTAT software program.



### Summary of Findings

Results of the study showed that graftability of 'Carabao' mango scions as observed on the percentage of their viability, mortality, bud emergence and growth parameters was greatly affected by different storage durations and modes of packaging used. Analysis of variance showed that almost all data had highly significant interaction effect between the two factors used except on percentage of mortality of grafted scions observed at 25 to 50 DAG and percentage of bud emergence gathered at 5 to 20 DAG.

General trend revealed that shorter durations of storage resulted in higher percentage of viability and earlier bud emergence of grafted scions. Storage of more than 5 days resulted in lower percentage but when scions were packed at 50 to 100 pieces, they tend to increase their survival rate. Scions stored for 9 days to 100 pieces regardless of packaging modes died and only one plant survived out of the ten samples in replication 3.

Almost 93 percent of the total variation in bud emergence can be accounted for by a linear function, involving mode of packaging and storage duration. The equation on the percentage of bud emergence as a function of storage duration and mode of packaging is  $\hat{Y} = 111.418 - 12.3X_1 + 0.01X_2$  which is significant at 1 percent level of confidence.

Vigorous grafted seedlings were produced when grafting of stored scions was done at 1 to 5 days after collection, regardless of the modes of packaging used. When storage of scions was extended up to 7 days, more scions should be packed at 50 to 100 pieces to achieve moderately vigorous grafted seedlings.

Temperature and relative humidity in storage boxes had minimal variations that ranged from 28.20 to 28.37 °C and 84.03 to 84.75 percent, respectively. Boxes where scions were stored for shorter duration had higher relative humidity, because evaporation of moisture was still minimal.

Combined effect of agro-climatic factors contributed on the success of grafted scions regardless of the different treatments used.

### CONCLUSIONS

Several conclusions can be made based on the results of the study. These are as follows:

1. Best result could be obtained when grafting is done at 5 days or earlier after scion collection (higher percentage of viability and survival as manifested by more bud emergence and better growth parameters).
2. Grafting could be extended up to 7 days as long as the number of scions per pack ranged from 50 to 100 pieces
3. The regression equation that can best describe the combined linear effects of the modes of packaging ( $X_1$ ) and storage durations ( $X_2$ ) that contribute significantly to the variation of bud emergence is:  $\hat{Y} = 111.418 - 12.3X_1 + 0.01X_2$ .
4. Temperature and relative humidity in storage boxes had minimal variation among treatments.
5. Combined effect of agro-climatic data observed contributed to success in grafting but did not vary among treatments.

### RECOMMENDATIONS

Based on the conclusions of the study, the following recommendations were made:

1. Collected scions of 'Carabao' mango should be grafted within 5 days after collection, regardless of the modes of packaging used.
2. Should grafting activities be extended up to 7 days, the number of scions should be increased from 50 to 100 pieces per pack to trap more moisture and delay drying up of scions.
3. Regardless of the modes of packaging used, scions can be stored up to 5 days and achieved vigorous grafted seedlings.
4. More scions per pack (50 to 100 pcs) should be done when storage of scions is extended up to 7 days to achieve moderately vigorous grafted seedlings.
5. Wrapping materials should be properly moistened to allow exchange of gases within the scions and in the storage boxes.



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## APPENDIX TABLE 1

*Temperature and Relative Humidity in Storage Boxes of 'Carabao' Mango Scions as Affected by Storage Durations and Modes of Packaging.*

Storage Duration (Days)	Mode of Packaging					Mean
	25/pack	50/pack	75/pack	100/pack	Loose	
Temperature						
1	28.30	28.30	28.30	28.30	28.30	28.30
3	28.10	28.17	28.27	28.27	28.27	28.20
5	28.20	28.22	28.28	28.34	28.34	28.26
7	28.16	28.24	28.33	28.30	28.30	28.25
9	28.41	28.41	28.38	28.38	28.38	28.37
Mean	28.23	28.27	28.31	28.32	28.32	
Relative Humidity						
1	93.00	93.00	94.00	95.00	95.00	94.00
3	85.67	84.00	84.00	83.00	83.00	85.40
5	83.00	82.80	83.80	80.60	80.60	83.40
7	83.71	82.71	82.57	83.43	83.43	85.28
9	75.89	76.22	77.22	78.11	78.11	78.62
Mean	84.25	83.75	84.32	84.03	84.03	

## APPENDIX TABLE 2

## Summary of Findings

OBJECTIVE	HYPOTHESIS	DATA GATHERED AND STATISTICAL TOOL USED	FINDINGS	CONCLUSIONS	RECOMMEN-DATIONS	OTHER FINDINGS
1. Determine the effect of modes of packaging on graftability of 'Carabao' mango scions.	• Modes of packaging have no effect on graftability of 'Carabao' mango scions	• Percent viability, mortality, survival as manifested by bud emergence, and growth parameters • ANOVA and DMRT	• Graftability of 'Carabao' mango scions as observed on the percentage of its viability, mortality, survival as manifested by bud emergence and growth parameters was influenced by different storage durations and modes packaging	• Best result could be obtained when grafting is done at 5 days or earlier after scion collection (higher percentage of viability and survival as manifested by more bud emergence and better growth parameters) • Grafting could be extended up to 7 days as long as the number of scions per pack ranged from 50 to 100 pieces	• Collected scions of 'Carabao' mango should be grafted at least 5 days after collection, regardless of the modes of packaging used. • Should grafting activities be extended up to 7 days, the number of scions should be increased from 50 to 100 pieces per pack to trap more moisture and delay drying up of scions • Regardless of the modes of packaging used, scions can be stored up to 5 days and achieved moderately vigorous grafted seedlings	• One (1) week storage of mango scions packed with sphagnum moss and saw dust gave the best result in terms of survival (Soto and Operio, 1983; Pasayan 1980 and Tanay 1985 as cited by Bondad, 1987) • Shorter duration of storage (1 to 3 days) emerged faster compared to longer storage of scions (Petrola, et al 2002)
2. Determine the effect of storage durations on graftability of 'Carabao' mango scions	• Storage durations have no effect on graftability of 'Carabao' mango scions					
3. Determine the interaction effect of modes of packaging and storage durations on graftability of 'Carabao' mango scions	• Modes of packaging and storage durations have no interaction effect on graftability of 'Carabao' mango scions		• A significant interaction effect between the two factors was noted on most of the data collected except on percentage of mortality of grafted scions at 25 to 50 DAG and percentage of bud emergence at 5 to 20 DAG • Shorter durations of storage resulted in higher percentage of viability and bud emergence of grafted scions			



Continuation of Appendix Table 2...

OBJECTIVE	HYPOTHESIS	DATA GATHERED AND STATISTICAL TOOL USED	FINDINGS	CONCLUSIONS	RECOMMENDATIONS	OTHER FINDINGS
4. Measure the association between survival as manifested by bud emergence of grafted mango scions as a function of storage duration and modes of packaging.	There is no association between survival as manifested by bud emergence of grafted mango scions as a function of storage durations and modes of packaging.	<ul style="list-style-type: none"> <li>Percent bud emergence</li> <li>Multiple correlation and regression analysis.</li> </ul>	<ul style="list-style-type: none"> <li>Longer storage resulted in a lower percentage but when packed at 50 to 100 pieces tends to increase its survival rate</li> <li>Almost 93.0 percent of the variations in bud emergence can be explained by the linear function involving storage durations and modes of packaging.</li> <li>More vigorous seedlings were achieved when grafting of stored scions was done at 1 to 5 days after collection, regardless of the modes of packaging used</li> <li>Vigorous grafted seedlings can still be achieved when scions are packed at 50 to 100 pcs and stored up to 7 days</li> </ul>	<ul style="list-style-type: none"> <li>The regression equation that can best describe the combined linear effects of the modes of packaging (<math>X_1</math>) and storage durations (<math>X_2</math>) that contribute significantly to the variation of bud emergence is: <math>Y = 111.418 - 12.3 X_1 + 0.01 X_2</math></li> </ul>	<ul style="list-style-type: none"> <li>More scions per pack (50 to 100 pcs) should be done when storage of scions be extended up to 7 days to achieve a vigorous grafted seedlings.</li> <li>Wrapping materials should be properly moistened to allow exchange of gases within the scions and in the storage boxes</li> </ul>	

Continuation of Appendix Table 2...

OBJECTIVE	HYPOTHESIS	DATA GATHERED AND STATISTICAL TOOL USED	FINDINGS	CONCLUSIONS	RECOMMENDATIONS	OTHER FINDINGS
5. Determine storage temperatures and relative humidity on storage boxes where scions were packed at different modes.	<ul style="list-style-type: none"> <li>There are no differences on storage temperatures and relative humidity on storage boxes where scions were packed at different modes.</li> </ul>	<ul style="list-style-type: none"> <li>Storage temperature and relative humidity</li> <li>Mean</li> </ul>	<ul style="list-style-type: none"> <li>Temperature and relative humidity in storage boxes had minimal variations that ranged from 28.20 to 28.37°C and 84.03 to 84.75 percent, respectively.</li> </ul>	<ul style="list-style-type: none"> <li>Temperature and relative humidity in storage boxes had minimal variation among treatments.</li> </ul>		<ul style="list-style-type: none"> <li>Scions packed with sphagnum moss and covered with polyethylene and stored for 8 days at 25 to 35°C ambient temperature can still be grafted with 50 percent success (Ram, 1997).</li> </ul>
6. To monitor agro-climatic data after grafting of scions as support to either success or failure in grafting.	<ul style="list-style-type: none"> <li>Climatic data monitored has no effect on grafting success of scions</li> </ul>	<ul style="list-style-type: none"> <li>Agro-climatic data</li> <li>Mean</li> </ul>	<ul style="list-style-type: none"> <li>Agro-climatic data gathered indicated ample amounts of sunshine, moderate temperature, high relative humidity and less rainfall.</li> </ul>	<ul style="list-style-type: none"> <li>Combined effect of these factors contributed to success in grafting but did not vary among treatments.</li> </ul>		<ul style="list-style-type: none"> <li>In areas with dry, hot weather and with low precipitation, softwood grafting is effective and success in grafting is high. This could be augmented with moderate temperature and high relative humidity (Ram, 1997)</li> </ul>