POPULATION DENSITY STUDY ON COOKING BANANA CV CARDABA (MUSA BALBISIANA)

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ABSTRACT

There were four plant spacing tested fro the cooking cultivar Cardaba. It was conducted from 1990 to 1993 at Panabo, Davao Norte. The results showed that the vegetative and reproductive plant characters were influenced by plant spacing. Plants at 3 x 3 and 4 x 4 were observed to be taller, have smaller pseudostem diameter compared to those planted at either 5 x 5 or 6 x 6 m. Bunch weight yield likewise showed similar response where the lighter bunches came from the closer spacings and heavier bunches from the wider spacings. In like manner, heavier mean weight of hands are obtained from the 5 x 5 or 6 x 6 m distancing. Other observations revealed that no pest was noted to infest the plants during the course of the study. However, incidences of bunchy-top, bugtok, black cross and bract mosaic was noted. Infection of bugtok occurred at the 3 x 3 and 4 x 4 m distancing with the bunchy-top infecting plants from all treatments. Bract mosaic confined to the 3 x 3 m distancing.

The profitability of the treatments were evaluated using the marginal rate of return (MRR) expressed in percentage, indicated that the 4 x 4 m spacing was the most profitable. The MRR obtained was 113.20 per cent.

INTRODUCTION

In the Philippines, banana is the prime fruit crop. It occupies and contributes to half the area and quantity of fruits produced in the country (Hassan and Pantastico, 1990). The Bureau of Agricultural Statistics (1986) reports that there was 330,060 hectares planted to bananas. The popular and major type planted are the cooking cultivars aggregating 129,620 ha producing 1,520,795 t.

The Saba or Cardaba banana belong to the BBB gerome and scientifically known as Musa balbisiana (Valmayor et al., 1991). These

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are found growing under a wide range of soil and climatic conditions. Thus, the ubiquitous Saba/Cardaba could be found in all regions of the country. The popularity of the Saba/Cardaba cultivar stems from the fact that it is used as a staple food whenever there is scarcity of rice and corn among the rural populace. It is consumed either boiled, broiled, ingredient of popular Filipino cuisines and is the cultivar used in processing (PCARRD, 1988).

The cooking cultivars has suffered from neglect and inattention that very little is known in its culture and management. Generally they are grown in backyards, small fields, along boundaries of farms, intercropped with coffee, cacao, coconuts and other plantation crops. In short, they are found in countless places where bananas thrive.

One important factor that contributes to the good performance and yield of bananas is its plant spacing or population density. The choice of the distance of planting depends on the variety to be used, soil fertility and the cultural management to be followed (Simmonds, 1959).

In the local banana industry, where the cultivars used are the Dwarf Cavendish; Umalag, Grand Naine, Latundan, Lakatan and Amas; their population density is well studied here and in other banana growing and exporting countries.

On the contrary, for both Saba or Cardaba, no study or recommendations is available on plant spacing or population density in order that optimum yield may be obtained. It is because of this situation that this study was conceived with the aim of being able to help our small cooking banana growers improve their production.

REVIEW OF LITERATURE

The choice of spacing or density of planting in banana depends on several factors, with the choice of clone or variety being the more important consideration. Large plants in general are allowed more space

than small one, as in the case of Dwarf Cavendish where it is planted more closely than Gros Michel (Simmonds, 1959). He also pointed out that soil fertility and fertilization regimes influences spacing. The more fertile the soil and the heavier the fertilization, the denser the population.

On vegetative growth, Simmonds noted that at high densities plants are slender and taller and their rate of maturity delayed. This observation conforms with the results obtained by Robinson, Daniells and Israeli (1989) working independently elsewhere that cycle length or duration is increased at high densities of planting. Likewise, Cull (1988) noted increase interval at high densities. Furthermore Cull avers that shading reduces soil temperature which produces a cool environment that reduce sucker development.

According to Simmonds, at wider spacing/planting, bananas tend to produce poor yields of bunches having a high average grade. In contrast, those at close spacing produces higher yields of bunches of poorer grades. Similarly Robinson observed that average weight of bunch, decreased from 55.9 to 40.7 kg of high density of planting using the cv Williams. Results of the study Shaikh et al.(1991) conforms with Robinson's findings.

Other workers like Cull (1988) states that at commercial densities, as spacing decreases s does bunch and finger size.

Yields obtained in the study by Espino et Al.(1991), comparing the performance of sucker and in-vitro derived planting materials spaced at 5 x 5 m was 28.99 and 27.77 kg bunch weights, respectively.

OBJECTIVES

1. To be able to determine the best population density for the cultivar Cardaba;

2. To be able to determine the economic benefit for the best population density.

METHODOLOGY

The study was laid out in Randomized Complete Block Design using four (4).density planting which serves as treatments and replicated five (5) times. The four densities of planting were as follows : T1- 1,111 plants per hectare planted at 3 x 3 m; T2 - 625 plants per hectare planted at 4 x 4 m; T3 - 400 plants per hectare planted at 5 x 5 m and T4 - 277 plants per hectare planted at 6 x 6 m.

The plot size per treatment varied as follows: 3 x 3m = 144 m^2; 4 x 4m = 256 m^2; 5 x 5m = 400 m^2; and 6 x 6m = 576 m^2. The number of plants in a plot remained constant at 16 mats per treatment. Each mat was maintained at one mother plant plus 2 followers or a ration of 1:2. Judicious sucker control was employed to maintain the ratio. Corms from healthy parent plants were used as source of planting materials. Each corm weighed from 300-500 grams. The soil fertility status of the site was also taken.

The plant were fertilized with complete fertilizer (14-14-14) at the rate of 200 g per plant at quarterly intervals.

For the economic analysis, the marginal rate of return (MRR) was used as a measure of profitability.

The study was first established in Catalunan Grande, Davao City in 1988. It was transferred and re-established in 1990 in Carmen, Davao Norte due to the high incidence of bugtok and banana bunchy-top diseases. Furthermore, yield data has been adversely affected due to bunch pilferages. As shown in Table 1, only the vegetative and reproductive characters of the plant crop could be presented from the former site.

Table 1. Vegetative and reproductive characters of plant crop of Cardaba at different spacing in Catalunan Grande, Davao City, 1988-1990.

TREATMENT	PARAMETERS								
	PLANT HEIGHT (cm)	GIRTH (cm)	AVE. NO. OF SUCKERS	AVE. NO. OF LEAVES AT HARVEST	DAYS TO SHOOTING	BUNCH WEIGHT (kg)	NO. OF HANDS/ BUNCH	AVERAGE WEIGHT OF HANDS	CYCLE OF HARVEST (days)
Catalunan Grande, Davao City (Plant Crop)									
T1 (3 x 3 m)	478.34^{a}	24.48^{c}	4.20^{b}	4.34^{b}	305.11^{a}	15.48^{c}	7.46^{b}	1.84^{c}	120^{a}
T2 (4 X 4 m)	430.45^{ab}	25.36^{bc}	3.15^{b}	5.01^{b}	299.53^{b}	15.82^{c}	3.82^{b}	1.89^{c}	96^{b}
T3 (5 x 5 m)	384.00^{b}	28.20^{ab}	8.33^{a}	5.33^{b}	298.85^{b}	24.33^{b}	10.09^{b}	2.20^{b}	96^{b}
T4 (6 x 6 m)	348.00^{b}	30.34^{a}	9.46^{a}	6.41^{a}	295.00^{b}	30.32^{a}	10.34^{a}	2.33^{a}	95^{b}
C.V (%)	11.26	12.08	18.05	8.01	5.48	11.36	10.11	5.32	15.42

Means followed by a common letter are not significantly different at 5% level (DMRT).

The parameters taken in the study are as follows:

1. Plant height in cm
2. Pseudostem diameter in cm = measured 50 cm from the ground level.
3. Average number of suckers
4. Average number of leaves
5. Days to shooting
6. Bunch weight in kg
7. Average number of hands/bunch
8. Average weight of hand
9. Cycle/interval of harvest
10. Pest and disease observation
11. Man-days required/activity/treatment
12. Material inputs used and cost

RESULTS AND DISCUSSIONS

Description of the Site- The site at Panabo, Davao Norte is relatively level land. It was amply provided with drainage canals and has a clay loam soil texture. It was previously planted to ramie. As shown in Appendix 1, the pH is 7.2 with an organic matter content of 2.0 per cent. The dominant weed species found in the area was para grass.

Vegetative Plant Characters

Plant Height- The results obtained revealed that at closer planting taller plants were observed. At 3 x 3 m either coming from the plant crop, first or second ratoon, were significantly the tallest plants compared to the rest of the treatments. This is in conformity with Simmonds' observation that at denser planting, plants tend to be taller (Table 2).

Table 2. Vegetative characters of plant crop (PC) and the first (R1) and second (R2) ratoons of cy Cardaba at different spacing at Carmen, Davao Norte, CY 1990-93.

TREATMENT	Plant Height (cm)			Pseudostem Diameter (cm)			Number of Leaves at shooting			Number of Leaves at harvest			Mean Number of Suckers		
	PC	R1	R2	PC	R1	R2	PC	R1	R2	PC	R1	R2	PC	R1	R2
T1 (3 x 3 m)	520.00^{a}	490.86^{a}	490.30^{a}	28.40^{b}	26.14^{b}	26.00^{b}	13	12	10	3.30^{c}	3.02^{b}	3.00^{b}	3.30^{c}	-	-
T2 (4 x 4 m)	480.00^{b}	485.00^{b}	484.12^{a}	29.15^{b}	27.15^{b}	26.32^{b}	14	14	14	4.33^{b}	4.15^{b}	4.00^{a}	4.30^{c}	-	-
T3 (5 x 5 m)	420.35^{b}	423.16^{b}	422.14^{b}	31.53^{b}	30.00^{a}	29.40^{a}	14	14	14	4.33^{b}	4.10^{b}	4.00^{a}	9.33^{ab}	-	-
T4 (6 x 6 m)	420.32^{b}	419.36^{b}	420.16^{b}	34.40^{a}	30.12^{a}	29.86^{a}	14	14	14	5.34^{a}	4.25^{a}	4.00^{a}	10.34^{a}	-	-
CV (%)	9.50	9.82	10.12	9.32	9.86	10.34	6.50	8.41	9.82	10.36	9.32	8.46	9.34	-	-

Means followed by a common letter (s) are not significantly different at 5% level (DMRT).

Pseudostem Diameter- A similar trend was also noted on pseudostem diameter, that at denser planting or closer spacing, the diameter is smaller. As shown in Table 2, 3 x 3 and 4 x 4 m distancing, measurements of 28.40 and 29.15 cm diameter from the plant crop was recorded. Both measurements are significantly smaller from those obtained from either 5 x 5 or 6 x 6 m distancing. A similar trend was noted from the two succeeding ratoon plants.

Number of Leaves at Shooting- In terms of the number produce at shooting no significant differences was observed among treatments. The number produced by the plant crop at this stage is from 13 t 14, the first ratoon 12-14 and the second, 10-14 (Table 2). It could, however, be noted that the lesser number came from the denser planting (3 x 3 m).

Number of Leaves at Harvest- At this stage of development, it was revealed that significant differences in the number occurred among treatments. This is in contrast to what was observed at shooting time. At 3 x 3m leaf counts of 3.30, 3.02, and 3.00, from the plant crop, first and second ratoon, respectively were obtained. On the other hand, the widest spacing (6 x 6 m) retained 5.34, 4.25 and 4.00 leaves, respectively, for the plant and ratoon crops. It is probable that the lesser leaf counts from the 3 x 3m spacing was influenced by th fewer leaf count at shooting time as well as the high incidence of black cross leaf disease at that density (Table 4).

Mean Number of Suckers- The result obtained revealed that the highest mean number of suckers came from the widest spacing (Table 2). The 6 x 6 m treatment, significantly our performed the rest by obtaining a mean of 10.34 suckers per plant. It may be inferred that due to the shading effect at denser planting sucker development with what Cull (1988) also observed that shading slows down sucker development. He further stated that shading reduces soil temperature. The cool environment reduces sucker development.

Reproductive Plant Characters

Days to Shooting- Table 3 shows the number of days required to reach shooting or flowering stage. It was noted that the wider spacings required

lesser number of days to shoot when compared to those from the closer spacings. This response was noted both in the plant and ratoon crops. The results obtained concurs with what Simmonds (1959) stated that maturity is delayed at high densities of planting.

Table 3. Reproductive characters of plant crop (PC) and the first (R1) and the second (R2) rattoons of cv Cardava at different spacings at Carmen, Davao Del Norte, CY 1990-1993.

TREATMENT	PARAMETERS														
	Days to Shooting			Bunch Weight (kg)			No. Hands per Bunch			Mean Weight of Hands (kg)			Cycle of Harvest (Days)		
	PC	R1	R2	PC	R1	R2	PC	R1	R2	PC	R1	R2	PC	R1	R2
T1 (3 x 3 m)	315.00[a]	318.60[a]	320.32[a]	24.32[c]	20.08[b]	18.42[c]	9.32[c]	7.46[b]	9.32[c]	2.13[b]	1.84[c]	2.13[b]	115[a]	120[a]	115[a]
T2 (4 x 4 m)	315.33[a]	310.32[a]	312.61[a]	26.30[b]	21.55[b]	19.50[c]	10.15[b]	8.32[b]	10.15[b]	2.25[b]	1.89[c]	2.25[b]	98[b]	96[b]	98[b]
T3 (5 x 5 m)	285.00[b]	282.40[b]	284.36[b]	27.40[b]	27.35[b]	27.20[b]	10.33[b]	10.09[b]	10.33[b]	2.30[b]	2.20[b]	2.30[b]	96[b]	96[b]	96[b]
T4 (6 x 6 m)	285.00[b]	285.45[b]	283.10[b]	35.46[a]	36.35[a]	34.59[a]	12.05[a]	10.34[a]	12.05[a]	2.80[a]	2.33[a]	2.80[a]	96[b]	95[b]	96[b]
CV (%)	7.42	8.47	8.50	10.32	9.46	10.36	10.11	10.36	10.11	6.80	5.32	6.30	14.38	15.42	14.38

Means followed by a common letter(s) are not significantly different at 5% level (DMRT).

Cycle of Harvest- As shown also in Table 3, the 3 x 3 m distance of planting required 115, 120, and 115 days circle, respectively, for the plant crop and two ratoon crops. These are significantly longer periods compared to the rest of the treatments. Similar results were noted by Robinson, Daniells and Israeli (1989) in their studies, that cycle length or duration increased at high density planting.

Bunch Weight- The results are presented in Table 3 and Fig. 1. Yield response in terms of bunch weight indicated that as far as density is concerned, significantly heavier bunch were harvested from 6 x 6 and 5 x 5 m distancing. This observation is similar to what Robinson (1989) and Shaikh (1991) obtained that bunch weight decreased at high density of planting. On the other hand, the results agree with what Simmonds observed, that poor bunch yield come from wider spacings. Results of the study also indicated poor bunch yield are coming from wide spacings of either 5 x 5 or 6 x 6 m.

Results of the simple regression analysis on the influence of the pseudostem diameter on bunch weight indicated r values of 0.955, 0.872 and 0.949 for the plant crop, first and second ratoons, respectively. This is in conformity with what has been established that bunch weight is related in part to plant mass (Simmonds, 1959 and Cull, 1988). The plant mass measurement is taken from the pseudostem diameter. The bigger the pseudostem diameter, the heavier the bunch.

In the study of Espino et al. (1991) using a 5 x 5m spacing for sucker derived plant material, the bunch weight obtained was 28.99 kg. Using the same distance (5 x 5 m) results from this study shows (Table 3) that it closely approach the yield they obtained.

Number of Hands per Bunch - Results indicated that significant differences was observed among treatments, both on the plant and ratoon crops. At wider spacing more hands were produced per bunch compared to those coming from the closer spacing (Table 3).

Mean Weight of Hands - Since the widest treatment (6 x 6 m) produced

Table 3. Reproductive characters of plant crop (PC) and the first (R1) and the second (R2) rattoons of cv Cardava at different spacings at Carmen, Davao Del Norte, CY 1990-1993.

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	Days to Shooting			Bunch Weight (kg)			No. Hands per Bunch			Mean Weight of Hands (kg)			Cycle of Harvest (Days)		
	PC	R1	R2	PC	R1	R2	PC	R1	R2	PC	R1	R2	PC	R1	R2
T1 (3 x 3 m)	315.00^a	318.60^a	320.32^a	24.32^c	20.08^b	18.42^c	9.32^c	7.46^b	9.32^c	2.13^b	1.84^c	2.13^b	115^a	120^a	115^a
T2 (4 x 4 m)	315.33^a	310.32^a	312.61^a	26.30^b	21.55^b	19.50^c	10.15^b	8.32^b	10.15^b	2.25^b	1.89^c	2.25^b	98^b	96^b	98^b
T3 (5 x 5 m)	285.00^b	282.40^b	284.36^b	27.40^b	27.35^b	27.20^b	10.33^b	10.09^b	10.33^b	2.30^b	2.20^b	2.30^b	96^b	96^b	96^b
T4 (6 x 6 m)	285.00^b	285.45^b	283.10^b	35.46^a	36.35^a	34.59^a	12.05^a	10.34^a	12.05^a	2.80^a	2.33^a	2.80^a	96^b	95^b	96^b
CV (%)	7.42	8.47	8.50	10.32	9.46	10.36	10.11	10.36	10.11	6.80	5.32	6.30	14.38	15.42	14.38

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Number of Hands per Bunch - Results indicated that significant differences was observed among treatments, both on the plant and ratoon crops. At wider spacing more hands were produced per bunch compared to those coming from the closer spacing (Table 3).

Mean Weight of Hands - Since the widest treatment (6 x 6 m) produced

the heaviest bunch, it likewise yielded the heaviest hands. The mean weight of the hand from the plant and ratoon crops ranged from 2.33 to 2.80 kg.

Disease Incidence - Fortunately no serious pest was observed during the conduct of the study. However, the bugtok, bunchy top, bract mosaic and black cross diseases were encountered. The results presented in Table 4 indicated that the bunchy-top infection in the study could have been introduced by the vector that have acquired the inoculum from infected plants from farmers field adjacent to the experimental site. Immediate roguing of the infected plants was instituted to contain the disease.

Table 4. Disease incidence observed in Cardaba planted at different distances at Carmen, Davao del Norte, 1993.

TREATMENTS	DISEASES Bugtok (%) Plt. Crop	Bugtok (%) 1st Fol.	Bugtok (%) 2nd Fol.	Bunchy-top (%) Plt. Crop	Bunchy-top (%) 1st Fol.	Bunchy-top (%) 2nd Fol.	Bract Mosaic (%)	Black Cross */
3 x 3 m	0	12.50	18.75	0	0	18.75	12.50	High
4 x 4 m	0	12.50	12.50	0	0	25.00	0	Moderate
5 x 5 m	0	0	0	0	0	12.50	0	Low
6 x 6 m	0	0	0	0	0	12.50	0	Low

*/
0-10 streaks - low
10-20 - moderate
20-above - high

It was also observed that bugtok infection was confined to treatments with closer spacing. No incidence was seen from plants planted at the wide spacings. A similar pattern of incidence was noted for black cross disease. At 3 x 3 and 4 x 4 m spacings, a high and moderate rating was observed. It contrast, the 5 x 5 m and 6 x 6 m treatments rated only low infection.

For bract mosaic, incidence was only observed in the 3 x 3 m spacing.

It may be inferred that considering the number of diseases observed infecting the Cardaba plants a rigid monitoring and eradication of diseased plants especially bunchy-top infected ones be followed. Cultural management practices that will help reduce infection or incidence should be strongly considered.

Man - days Spent per Major Activity - It may be noted that activities were either done singly, or in combination with other activities like lay-outing and staking. In some instances, there are two or more operations in combination with one another that are done in a day. As show in Table 5, these are de-leafing, desuckering, roguing, de-belling and stem sanitation. The planting and harvesting operations were all done in contract basis.

Table 5. Man-days spent on establishment and maintenance per plot of Cardaba planted at different densities of planting at Carmen, Davao del Norte, CY 1990-1993.

ACTIVITIES	DISTANCE OF PLANTING (m)			
	3 x 3	4 x 4	5 x 5	6 x 6
General Weeding	8.72	15.51	24.24	34.91
Layouting/staking	4.00	3.00	2.00	1.00
Holing	8.00	6.00	4.00	2.00
Planting	7.00	7.00	7.00	7.00
Weeding	6.00	9.00	12.00	18.00
Fertilization	5.00	6.00	7.00	8.00
De-leafing, de belling, de-suckering, roguing & stem sanitation	18.00	27.00	36.00	54.00
Harvesting	12.00	12.00	12.00	12.00

Economic analysis - To measure the profitability of the different treatment used, the marginal rate of return (MRR) expressed in per cent was utilized. To calculate, the formula used is:

$$MRR + \frac{\text{increment in net benefit (NB)}}{\text{increment in total variable cost (TVC)}} \times 100$$

As presented in Table 6, treatment 2 (T2) appeared to be the profitable spacing with a corresponding MRR of 113.20 per cent. The MRR of T2 is far better than that obtained by T1, which is 13.54 per cent.

In treatment 2 also, the breakeven yield was 2,126.73 kg, whereas treatment 1, required a greater breakeven yield of 3,824.32 kg.

Table 6. Bunch yield and economic analysis of banana as affected by different population density per hectare, Carmen, Davao del Norte, 1993.

Planting Distance (m)	Yield/ Hectare (kg/ha)	Gross Benefit (P/ha)	Total Variable Cost (P/ha)	Net Benefit (P/ha)	MRR (%)
6 x 6 (T4)	7,196.10	17,990.25	4,006.62	13,983.63	
5 x 5 (T3)	7,243.02	18,107.55	4,228.00	13,879.55 D 1/	
4 x 4 (T2)	8,313.46	20,783.65	5,316.83	15,466.82	113.20 a/
3 x 3 (T1)	9,560.80	23,902.00	8,063.16	15,838.84	13.54 b/

1/ D = Dominated Treatment

a/ Break even Yield = 2,126.73 kg/ha

b/ Break even Yield = 3,824.32 kg/ha

CONCLUSIONS

1. The study revealed that vegetable plant characters such as plant height, pseudostem diameter, number of leaves at harvest and mean number of suckers produced were influenced by density of planting or spacing.

2. At closer spacings such as 3 x 3 m and 4 x 4 m apart taller and slender plant and reduce number of suckers were produced. Similarly, there was also lesser number of leaves left at harvest.

3. The plants at higher density (3 x 3 m and 4 x 4 m) required longer period to shoot compared to those coming from 5 x 5 m and 6 x 6 m.

4. The cycle or interval of harvest took longer period at closer spacing than at wider distance.

5. The yield in terms of bunch weight were significantly different, with the closer planting having lighter bunches than the wider planting.

6. No pest infestation was observed in all treatments.

7. Bugtok disease was confined to treatments of closer spacing.

8. Bunchy-top infection was noted to have come from an outside inoculum source or infected adjacent fields.

9. The break even yield and Marginal Rate of Return was best at 4 x 4 m spacing.

RECOMMENDATIONS

The results of the study shows that among the different treatments used, the spacing 4 x 4 m is the most profitable treatment. It obtained a marginal rate of return of 113.20 per cent and required a lesser break even yield of 2,126.73 kg. At this density, optimum plant growth and production is attained.

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Appendix 1. Soil characteristics of the site where Cardaba was planted at varying distance, 1990-1993.

CHEMICAL PROPERTIES	CARMEN, PANABO, DAVAO DEL NORTE
pH	7.2
Organic Matter (OM) %	2.0
Nitrogen (%)	0.14
Phosphorous (P_2O_5) %	0.10
Potassium (K_2O) %	0.10
Soil Texture	clay loam

DEVELOPMENT OF PUREE FROM ACIDIC FRUITS (GUAVA, SANTOL AND MANGO) AND DETERMINATION OF THEIR PHYSICO-CHEMICAL PROPERTIES

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ABSTRACT

Puree was prepared from acidic fruits (santol, native guava, green 'Carabao' mango, and green 'pico' mango) which are used as condiments in cookery.

Pulp recovery from santol was an average of 48.14% while puree recovery was 80.76% after addition of water and passing through a blender. Pulp recovery from green carabao mango was 71.62% and 71.63% from green 'pico' mango. After addition of water and passing through a blender puree recovery was 107.61% for carabao and 110.81% from pico.

High percentage of recovery was obtained from unpeeled white guavas (88%) compared with the hand-peeled guavas (56.5%). Both the lye-peeled and unpeeled guavas had the same percentage of pulp recovery (50%).

There was no change in the color and appearance of the processed products during storage at root temperature.

Mango and guava puree were utilized as souring ingredients in "pork sinigang" and " bangus sinigang" and subjected to sensory evaluation using the Multiple Comparison Test. Results showed that the bottled guava and mango puree received higher scores than the control and found to be more acceptable. Statistical analysis of the results using ANOVA showed that there was no significant difference among the samples.

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