MAURITIUS RESEARCH COUNCIL
INNOVATION FOR TECHNOLOGY

SUSTAINABLE PRODUCTION OF PALMS ON MARGINAL LANDS: OPTIMUM SUCKER POPULATION DENSITY OF BEJIBAYE

Final Report

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MAURITIUS SUGAR INDUSTRY RESEARCH INSTITUTE

Food Crop Agronomy Department

Project Title: Sustainable production of palm on marginal lands: optimum sucker population density in pejibaye

Final Report

1. Introduction

In 2004, the pejibaye palm *(Bactris gasipaes)* was recommended for cultivation in the humid and superhumid zones of Mauritius. This palm re-grows from basal suckers: however, the optimum number of suckers to be kept has not yet been established. A research project of 5-year duration was initiated in March 2005. The objective of the project was to establish the optimum sucker population density of pejibaye palm in order to sustain production on marginal lands.

2. Materials and methods

There were six treatments in a factorial combination of three plant population densities and two sucker management treatments giving 6 suckers population densities, as follows:

Treatment No.	Density (plant /hectare)	Sucker (no/plant)	Sucker population density per hectare
1	1667	1	1667
2		2	3333
3	2083	1	2083
4		2	4167
5	2500	1	2500
6		2	5000

Trials have been planted at 5 sites: Britannia, Bois Cheri (St Aubin l.tee), Combo (Union SE), Eau Bleue (Rose Belle SE) and Deep River (Deep River-Beau Champ SE).

Plots consisted of four rows 24m long. Interrow spacing was fixed at 2m, and intrarow spacing was at 2m, 2.4m and 3 m to give the three desired plant densities

Leaf counts were carried out at three-month intervals and at harvest. Also at harvest, girth diameter was measured and samples of shoots were taken and the edible heart portions were extracted and weighed. The edible heart weight was then regressed on the girth diameter at the base. A simple linear regression equation was derived and was used to estimate heart weight. The average yield per plot was then calculated and subjected to an analysis of variance.

After harvest, all small undesirable suckers were removed so as to leave only one or two per plant as required by the treatments. In the rare case where a plant had no sucker, or only one, instead of two, more suckers were left on the neighbouring plants to compensate and, hence ensure that the requisite number of suckers be present at the plot level. Leaf counts and harvest of suckers were carried out as for the mother plant.

Planting date and plant establishment

The trial at Britannia was planted late April 2005. Plant establishment has been excellent, with less than 5% mortality. At Union, the trial was planted in mid July 2006, and plant establishment has been excellent also. At Rose Belle, the trial was planted in February 2006 and plant development was good. At Beau Champ, the trial was planted on 2006 but because of hare damage, it had to be replanted in January 2007. At Bois Cheri, the trial was planted end-April 2005. Establishment was very poor because (1) the seedlings used were too small, (2) too cool temperatures during the winter of 2005, and (3) repeated hare attacks on the seedlings. The trial was replanted in 2006. However, the plants did not develop well.

3. Results and discussion

3.1 Britannia

3.1.1. Mother plant

At Britannia, growth has been excellent during the first 2 years of the trial. During that period, the rate of leaf emergence has been biphasic. In the first phase (establishment) from planting to about 44 weeks, one leaf emerged every 82 days. In the second phase, from the 44th to the 92"d week (grand period of growth), leaf emergence has accelerated, one leaf emerging every 27 days. By the first harvest the total number of leaves had reached 23. The number of green leaves per plant at any given time has increased from 6 at 44 weeks to about 9 at 92 weeks.

Table 1: Average weight of palm heart per plant and yield per hectare at Britannia, first harvest

Treatment	Density	Average heart weight (g)	Yield (kg/ha)
01 (2500)	a	388	937
	b	366	846
Mean		377	892
02 (2083)	a	361	689
	b	361	704
Mean		361	696
03 (1667)	a	384	598
	b	409	671
Mean		396	634

The harvest of the mother plant (first harvest) was carried out in April 2007, two years after plantation. At harvest time, the total number of leaves which has emerged was 24, i.e. it took 30 days for each leaf to emerge. The number of green leaves still on the plant at harvest was 10.

At harvest, edible heart weight was regressed on the girth diameter at the base and the following simple linear regression equation was derived:

$$y = 6.47\ x + 68.9\ (r^2 = 0.67;\ n = 41)$$

where y = heart weight in gram
x = girth at base of crown in centimetre

Average edible heart weight was 378 g, and average yield was 704 kg/ha (Table 1). There was no significant difference in average heart weight due to planting density. The very high significant difference in plot yield is attributed entirely to the difference in plant number.

3.1.2. Suckers

The harvest of suckers obtained from the mother plants (second harvest) at Britannia was carried out in October 2008, i.e. one and a half year after the first harvest and three and a half years after planting. As before regression analysis was done and gave the following equation:

$$y = 8.2\ x - 142\ (r^2 = 0.35;\ n = 25)$$

Table 2: Average weight of palm heart per plant and yield per hectare at Britannia, second harvest

Treatment	Density	Average heart weight (g)	Yield (kg/ha)
01 (2500)	a	203	508
	b	251	1255
Mean		**227**	**882**
021 (2083)	a	227	473
	b	227	944
Mean		**227**	**709**
03 (1667)	a	255	425
	b	230	767
Mean		**243**	**586**

An average, edible heart weight was 316 g compared to 378 g from the first harvest (Table 2).

There was also a decrease in the number of green leaves per plant (7) while the number of days for leaf emergence increased from 30 on the mother plants to 36 for the suckers.

3.2 Union

3.2.1. Mother plant

At Union at 20 months, growth and development have progressed satisfactorily. From 34th to 82"d week, 12 leaves have emerged, i.e. at the almost-constant rate of one leaf every 28 days, as at Britannia.

At harvest time, about 27 leaves had emerged, slightly more than at Britannia. The number of green leaves at harvest was 1O, similar to that at Britannia.

Harvest was carried out as from August 2007, two years after planting. The same method as used at Britannia for sampling, extracting and weighing palm hearts, measuring shoot girth at base and regressing heart weight on shoot girth was adopted to estimate yield. The fit of the equation was not as good, indicating that there is still much variation due to other factors beside the regression, as shown below:

$$y = 7.73\ x + 49.9\ (r^2 = 0.45;\ n = 30)$$

The average edible heart weight amounted to 401 g, and the average yield was 775 kg/ha (Table 3). There was no significant difference due to planting density. Consequently, and as at Britannia, the large difference in yield per plat can be attributed to plant density.

Table 3: Average weight of palm heart per plant and yield per hectare at Union, first harvest

Treatment	Density	Average heart weight (g)	Yield (kg/ha)
01 (2500)	a	398	933
	b	389	884
Mean		393	909
021 (2083)	a	412	804
	b	393	761
Mean		402	782
03 (1667)	a	412	635
	b	406	635
Mean		409	635

3.2.2. Suckers

The second harvest at Union was carried out in April 2009, three and a half years after planting.

At harvest, the following simple linear regression equation was derived:

$$y = 3.9\ x + 96.8\ (r^2 = 0.26;\ n = 27)$$

An average edible heart weight of 263 g was obtained, compared to 401 g for the first harvest on the mother plants (Table 4).

The average number of green leaf per plant was 8.

Table 4: Average weight of palm heart per plant and yield per hectare at Union, second harvest

Treatment	Density	Average heart weight (g)	Yield (kg/ha)
01 (2500)	a	261	651
	b	256	1280
Mean		**258**	**966**
021 (2083)	a	275	572
	b	256	1068
Mean		**265**	**820**
03 (1667)	a	268	447
	b	262	875
Mean		**265**	**661**

3.3 Rose Belle

At Rose Belle, the trial was planted in February 2006 and plant development was good. At 72 weeks, the number of leaves emerged was 19, which was more than at Britannia and Union at the same age.

The trial at Rose Belle was ready for harvest at 24 months after planting. At harvest time, the total number of leaves which has emerged was 25, similar to that at Britannia. The number of green leaves per plant was about 9.

The equation from simple linear regression for Rose Belle was:

$$y = 5.147x - 10.499 \ (r^2 = 0.59;\ n = 31)$$

Average edible heart weight was 206 g and the average yield was only 495 kg/ha, compared to an average of 770 kg/ha at Britannia and Union (Table 5). Again there was no significant difference due to plant density.

Table 5: Average weight of palm heart per plant and yield per hectare at Rose Belle, first harvest

Treatment	Density	Average heart weight (g)	Yield (kg/ha)
01 (2500)	a	253	486
	b	256	500
Mean		**255**	**493**
021 (2083)	a	254	494
	b	261	506
Mean		**258**	**500**
03 (1667)	a	259	491
	b	261	498
Mean		**260**	**495**

The sucker treatment could not be implemented at Rose Belle. The trial was not harvested due to a lack of market.

3.4 Deep River-Beau Champ

The trial was planted on 2006 but because of hare damage, it was replanted in January 2007. At 150 weeks after planting, the total number of leaves produced has reached about 22, but the number of green leaves per plant has fallen to about 4. Hare attack was a continual problem all throughout the trial, severely affecting plant growth.

Table 6: Average weight of palm heart per plant and yield per hectare at Deep River Beau Champ

Treatment	Density	Average heart weight (g)	Yield (kg/ha)
D1 (2500)	a	190	475
	b	207	1033
Mean		**198**	**754**
021 (2083)	a	228	474
	b	238	992
Mean		**233**	**733**
03 (1667)	a	274	456
	b	197	657
Mean		**235**	**557**

The trial at Beau Champ was harvested 36 months after planting. At harvest time, the total number of leaves which has emerged was 22 and the number of green leaves at harvest was about 4.

The following simple linear regression analysis was obtained for D.R.B.C:

$$y = 0.312\ x + 255.6\ (r^2 = 0.01;\ n = 32)$$

Average edible heart weight was 268 g and the average yield was 681 kg/ha (Table 6). There was no significant difference due to plant density.

The sucker treatments could not be implemented at Deep River. The trial was not harvested due to a lack of market.

3.5 Bois Cheri

At Bois Cheri, the trail was planted end April 2005. As mentioned earlier, establishment was very poor for various reasons. The trial was replanted in 2006. However, the plantation did not develop well. Plant establishment was erratic. The plants were emitting leaves regularly, albeit at a lower rate than at the other sites, but the leaf mortality rate was as high and, consequently, the number of green leaves was not increasing. The problem may be more with the soil than with the weather. Root development seemed to be

restricted to the planting hole with little movement laterally and downwards. Soil samples were analysed to check the hypothesis of toxic effects of iron, aluminium and manganese oxides and compared with those of Rose Belle and Britannia. Soil analysis revealed that the soil at Bois Cheri was not more acid than that of Rose Belle. In fact it had more P and K. The levels of iron were comparable to Rose Belle, but similar to Britannia. The level of manganese was low and that of aluminium was high; but was within the acceptable levels.

At 120 weeks, a total of 14 leaves had emerged, but the number of green leaves was still low, indicating high leaf mortality. At 200 weeks after planting, the total number of leaves had reached about 26, but the number of green leaves per plant averaged only 6 per plant.

Due to erratic plant stand and growth, the trial at Bois Cheri was not harvested.

2. Project Monitoring

Seven Project Monitoring Committee meetings have been held to review progress of work and to validate the Progress reports to be submitted to MRC. Seven Progress report were submitted to MRC: March 2006, September 2006, March 2007, September 2007, April 2008, October 2008 and May 2009.

Two field visits have been organized for the benefit of the PMC members: the first one to the trial at Britannia in September 2006 and the second one, in December 2007 to the trials at Rose Belle and Britannia.

3. Output

It was found that there was no difference in edible heart weight between plant densities. Therefore pejibaye can be grown at the highest density of 2500 plants per hectare. Since there was no difference in heart weight when either one or two suckers were kept per plant, it was confirmed that two suckers may be left per plant to reach maturity.

To date, no major risk to production has been identified; pejibaye does not have any pest or disease of importance. Cyclones may be a setback, but not so important as to

breakage of the stem at ground level, but not of uprooting. In most instances where the main stem snapped, the suckers remained intact and resumed growth.

4. Financial viability

The production potential of 2500 palm hearts per hectare of pejibaye after 2 years of plantation and then 5000 palm hearts per hectare every two years is now proven. Assuming a farmgate price of MUR 150 per unit, this amounts to revenues of about MUR 375,000 after 2 years, then MUR 750 000 every other year. Besides the initial investment required to establish the crop, maintenance and other costs are minimal; the cultivation of pejibaye is therefore profitable provided that the marketing aspect is also worked out.

5. Value-addition

Improvements further down the chain, such as packing for supermarkets should open new markets as well as adding value to the product. Studies carried out on the processing of pejibaye palm hearts have shown that they may be processed into different ways such as spicy pickles and palm heart in brine. Undersized palm hearts which comprise of a true heart consisting of undeveloped leaves and a solid stem base can be used for processing.

6. Conclusion

It was found that two suckers may be kept per plant to reach maturity after the harvest of the mother plant. Thus it would be possible to produce 5000 palm hearts per hectare every two years. There is no major risk to production as pejibaye has no known major pest and disease in Mauritius. The plant is also very tolerant to cyclones. Profitability is ensured if the marketing issue is worked out. There exists the possibility of further processing so as to add value and to extend the shelf life of the product.

The cultivation of pejibaye palm on marginal lands is feasible, despite some problems. Where sugar cane cultivation is abandoned, the land is often left fallow until it is devoted to an agricultural or non-agricultural use. Since pejibaye does not have to be replanted, it will occupy the land permanently and shelter the soil from soil erosion.