

PERFORMANCES AND ECONOMIC RETURNS OF LEAF ORIENTED BANANA CULTIVATION IN TWO AGRO ECOLOGICAL REGIONS

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ABSTRACT

Banana is mainly grown for fruits despite its potential uses for different purposes. However, inadequacy of leaf production limits its usage. Therefore, an investigation was carried out with the objectives of developing a planting system for leaf production and estimating the economic feasibility of the system, with an introduction of a new leaf based product - a banana leaf plate. This study was conducted in the wet zone and the dry zone following a double row system (2m x 1m x 1m) having 6000 plants ha⁻¹ and standard annual planting system (3m x 1m) having 3000 plants ha⁻¹. Alternate leaves were trimmed after 4 months from crop establishment up to the time of bearing in both the cultivations. All the leaves were used for leaf plate production. Plant height, stem girth, number of trimmed and remaining leaves, leaf length and width, bunch weight, number of hands, fruit weight and cost - returns were estimated. Although the crop and yield performances in the dry zone were better than that of the wet zone, the parameters of the two planting systems were comparable. Leaf plates produced could be stored for 21 days. Trimming of the leaves reduced the bunch weight by 28% without affecting the quality of the product. A net profit of Rs. 620,000 could be obtained from one hectare of leaf oriented banana cultivation.

KEYWORDS: Banana annual planting, Banana leaf plate, Leaf oriented cultivation, Leaf trimming,

INTRODUCTION

Banana is interwoven into the Asian culture by virtue of its multiple uses and all parts of the plant including leaves, flower bud, pseudostem, and corm are used for different purposes. Among them, banana leaf is popularly used for serving of food in addition to wrapping and storing food items.

Banana is mainly grown for dietary purposes in Sri Lanka despite its potential of being used for many different purposes. Presently there is a growing demand for leaves as a substitute for polyethylene cling films and the production of bio food wrappers from leaves has been shown to be a profitable agro based industry for banana growers. In annual planting system of banana, production of leaf wrappers would generate an additional income of Rs. 336,000 ha⁻¹ (Weerasinghe *et al.*, 2007). However, production of wrappers from leaves has a major problem in banana growing areas of the dry zone where wind damage frequently results in greater percentage of torn leaves.

Therefore, a technique of using torn leaves would be an advantageous especially for banana cultivations in the dry zone.

Anon. (1997) showed the feasibility of producing plates from leaves of *Napoleona imperials* in Netheralands. Therefore, fabrication of a plate using banana leaves is an improvement to the currently available options of using banana leaves in Sri Lanka (Weerasinghe *et al.*, 2007). Since commercial banana growers are reluctant for leaf trimming, there is an immediate need of developing a crop management package for banana leaf production. Therefore, it is important to investigate the feasibility of cultivating banana for leaf harvesting purpose, as such, a practice would otherwise contradict with the fruit harvesting. Hence, the present study was carried out with the objectives of evaluating performance of cultivating banana for leaf production, to identify the feasibility of fabricating a banana leaf plate and to investigate the economic feasibility of the leaf harvesting cultivation.

MATERIALS AND METHODS

Experimental sites

Experiment was conducted at the Agriculture Research Station, Telijjawila (WL1b) in the wet zone and in a farmer field at Morakatiya, Embilipitiya (DL1) in the dry zone.

Crop management

Variety Nadee of embul cultivar (*Musa spp*) was grown in a double row system (2 m x 1 m x 1 m) population at the plant density of 6000 plants ha⁻¹ for leaf harvesting which is a six fold increase in plant as compared to conventional cultivation (1000 plants ha⁻¹). Leaf harvesting oriented system was compared with the annual planting system (3000 plants ha⁻¹) and the later has been recommended for both leaf and fruit production (Weerasinghe *et al.*, 2007). Each system had an experimental plot consisting of 100 plants at both locations. Banana suckers of 5-7 kg in weight were used for planting and they were dipped in boiling water for 30 seconds to eradicate the banana corm weevil (Weerasinghe, 2007). All suckers in both growing systems were cut back at 45 cm height to achieve a uniform cultivation at 30 days after planting. Only mother plants were maintained removing all emerging followers throughout the experimental period. All recommended cultural practices were adopted for both types of cultivations. Leaf trimming was started at 4 months after planting and each alternate leaf was trimmed up to the emergence of the last leaf before the flag leaf.

Randomly selected 25 plants from each planting system were used to record the plant performances during growing period. Plant age at

bearing (days), stem girth (cm) at 30 cm above the ground level, remaining number of leaves at bunch filling, plant height (m) at shooting, number of trimmable leaves, length and width of leaves (m), number of hands per bunch, fruit weight (g) and bunch weight (kg) were recorded and the data were analysed using students 't' test in the wet zone cultivation. In the dry zone location, data were obtained from different number of datum trees due to practical difficulties and number of datum trees varied (between 18-25) between different parameters. Economic performances of the two cultivations were estimated using the farm records and mean values of crop performances for both regions.

Leaf plate production

Leaf blades of all the trimmed leaves were used to produce leaf plates. In this procedure, leaves were cut into appropriate shape and dipped in boiling water for curing (Weerasinghe *et al.*, 2007). Three to four layers of cured leaves were affixed together using sago. These sets were molded into a plate using a device prepared for the purpose. Molded plates were dipped in a water bath for one and half seconds and immediately transferred to a cold water bath. Thirty seconds later, dipped molded plates were taken out from the cold water bath to fabrication of the banana leaf plates. Plates were stored in a refrigerator and the colour changes were monitored using the colour chart developed for banana by International Network for Improvement of Banana and Plantain (INIBAP, 1996).

RESULTS AND DISCUSSION

Crop and yield performance

Growth and yield performance of banana variety 'Nadee' at both locations under standard cultivation and leaf oriented cultivation are given in Table 1a and 1b. No significant difference in plant performances could be observed between both cultivation systems in wet zone. Although differences are not significant, standard cultivation matured early in both agro-ecological regions (Table 1a and 1b). However, in the dry zone, the standard cultivation produced plants with greater stem girth and also with more number of hands and fruit weight showed a slightly higher bunch weight.

In general, it was observed that both types of cultivations in the dry zone showed better performances compared to that of the wet zone. This behaviour could be attributed to the favourable climatic conditions that prevailed. Cultivation in the dry zone was well irrigated and subjected to greater interception of solar radiation. Whereas in the wet zone, only rain-fed cultivations were maintained and they were grown under coconut where solar

radiation interception was restricted. Hence, the better performance in dry zone was mainly due to the superior growing conditions.

Table 1a. Crop and yield performance of variety Nadee under two cultivation systems in the wet zone.

<i>Parameter</i>	<i>Leaf oriented</i>	<i>Standard</i>
Age at flowering (days)	312 a	304 a
Plant height at flowering (m)	3.1 b	3.0 b
Stem girth (cm)	57 c	59 c
Trimmable leaves plant ⁻¹	9.4 d	10 d
Length of leaves (m)	2.0 e	2.2 e
Width of leaves (m)	0.73 f	0.75 f
Remaining leaves at bunch filling	6.2 g	6.7 g
Weight of bunch (kg)	9.6 h	9.8 h
Number of hands per bunch	7.2 i	7.4 i
Fruit weight (g)	83.6 j	86.5 j
No. of fruits per hand	16.0 k	16.8 k

Means followed by the same letter in each row are not significantly different at $P = 0.05$ according to students 't' test.

Table 1b. Crop and yield performance of variety Nadee under two cultivation systems in the dry zone.

<i>Parameter</i>	<i>Leaf oriented</i>	<i>Standard</i>
Age at flowering (days)	300 (± 2.1)	295 (± 2.4)
Plant height at flowering (m)	2.6 (± 0.1)	2.7 (± 0.1)
Stem girth at flowering (cm)	59.7 (± 1.0)	64.9 (± 1.1)
Trimmable leaves plant ⁻¹	10 (± 0.3)	10 (± 0.2)
Remaning leaves at bunch filling	7.1 (± 0.3)	7.3 (± 0.3)
Bunch weight (kg)	10.2 (± 0.4)	10.7 (± 0.3)
No. of hands per bunch	9 (± 0.2)	10 (± 0.3)
Fruit weight (g)	92.5 (± 1.2)	98.6 (± 1.1)

Values in parenthesis are the standard errors of the estimates.

Irrespective of the agro ecological region, both cultivating systems produced comparable number of leaves i.e. trimmable leaves and the number of leaves remained at bunch filling (Table 1a 1b). Hence, per plant source capacity and loading of assimilates to bunches would have remained nearly same between the two cultivation systems though the plant populations were different. Further, as all the individual plants in both cultivation systems were separately fertilized with recommended dose of fertilizer, and hence higher density in leaf harvesting cultivation did not affect the plant growth and yield formation. It is well documented that active root zone of banana is confined to 30-40 cm depth and 1-2 m radius (Robinson, 1999). Hence, the space provided in leaf oriented banana cultivation system might not have restricted the plant growth and their subsequent performances.

The comparable bunch weight between the two cultivation systems in both agro-ecological regions could be the result of leaf trimming.

Leaf trimming might have avoided the mutual shading of leaves at higher plant density and created a uniform microclimate around plants. In addition, at the bearing stage there were about minimum of six leaves remaining in the plant to help bunch filling. Generally, the number of functional leaves remaining at bunch filling should be equal to the number of hands for a well developed bunch to be formed (Daniells and Foster, 2001). In both these systems, number of remaining leaves were comparable with the number of hands which existed in bunches.

It has been reported that under standard planting system with no leaf trimming, an average of 14 kg of bunch weight could be obtained in the dry zone (Weerasinghe, 2000). Whereas in this study, leaf trimming reduced the bunch weight by 28% as the recorded weights were around 10 kg. This is in agreement with Daniel and Foster (1991) as they reported a 12 % reduction in bunch weight when leaf number was reduced from 10-4 at bunching stage. Daniells and Bryde (1995) developed guidelines for removing leaves without affecting the bunch yield and the fruit quality. However, bunch weights obtained from both systems do agree with the present national average bunch weight of 8 kg.

Plates from leaves and their characteristics

Leaves having length from 2-2.6 m and 0.73 to 0.80 m width were produced in the wet zone (Table 1a) and it was observed that the leaf size was slightly higher in the dry zone. Sing (1996) reported that a well managed banana plant could produce leaves of 2-2.5 m of length and 60-70 cm width at base in Mysore banana. It was observed that a leaf of this size can be used to produce an average of three plates each having an area of 366 cm². Leaf plates produced were stored in a refrigerator up to a period of three weeks without affecting the quality of the plate. However, slight change in the colour was observed during the period of storage (Fig. 1).

At seven days after storage, plates remained dark green in colour and after 14 days they showed a medium green colour. Twenty one days later plates turned into green yellow colour. Although the plates were in useable form even after 21 days, three weeks were considered the optimum storage period under refrigerated conditions.

Cost and return of the leaf oriented banana cultivation

In this analysis it was assumed that all the trimmed leaves were converted into leaf plates which have a higher demand and an identity. Costs and returns of banana cultivation for leaf production (Table 2) show that cultivation of banana following standard cultivation procedure is not that

profitable when obtaining both leaves and bunches compared to the leaf oriented cultivation system.

Table 2. Comparison of the costs and returns of the two cultivating systems with leaf trimming.

<i>Item</i>	<i>Leaf oriented</i>	<i>Standard</i>
Cost (Rs.)		
Establishment and maintenance	100,000	90,000
Suckers	120,000	60,000
Fertilizer	720,000	360,000
Leaf trimming	180,000	90,000
Production of plates	360,000	180,000
Total	1,480,000	780,000
Income (Rs.)		
From bunches at (10 kg per bunch, Rs. 20 per kg)	1200,000	600,000
Income from plates	900,000	450,000
Total	2,100,000	1,050,000
Net Profit	620,000	270,000

Assumptions made in calculation: Mean values of two locations were considered. All the trimmed green leaves were used for the production of plates, Cost for initial sucker – Rs 20.00 per sucker, Cost of fertilizer for 2 kg per plant per year as Rs 120.00. Cost of production for one plate as Rs 2.00. Selling price for one plate as Rs 5.00.

The leaf oriented system generates 2.3 times more profit than that of the standard cultivation system when both leaf and fruit production was considered. Profit would further increase when the returns from the newly emerging followers are also considered. Hence, leaf oriented system is much profitable for the growers. However, leaf production system demands almost nearly twice the expenditure that is needed for the standard cultivation (Table 2).

There are some other added advantages of leaf oriented banana cultivation. Firstly, the lands which are marshy or not suitable for commercial banana cultivation may be used for leaf oriented cultivations aiming for leaves but not for the fruits. Secondly, the lands which are infected with *Fusarium* wilt can be used for leaf oriented banana cultivation using the variety Nadee which shows tolerance for *Fusarium* infection. Usage of leaves either for making plates or wrappers helps the farmers to minimize their profit losses during the periods of marketing gluts for fruits as the leaf based products could compensate the cost involvements.

Also the unproductive somoclonal variant plantations of tissue cultured plants can be used to produce leaf based products as these plantations often do not yield marketable bunches. The main advantage of fabricating the leaf plate is the ability of using all the leaves of the plant including torn, mechanically damaged, dried, spotted and ripened leaves (Fig. 2). Therefore, no leaves are wasted as even the portions can be utilized for making plates as described.

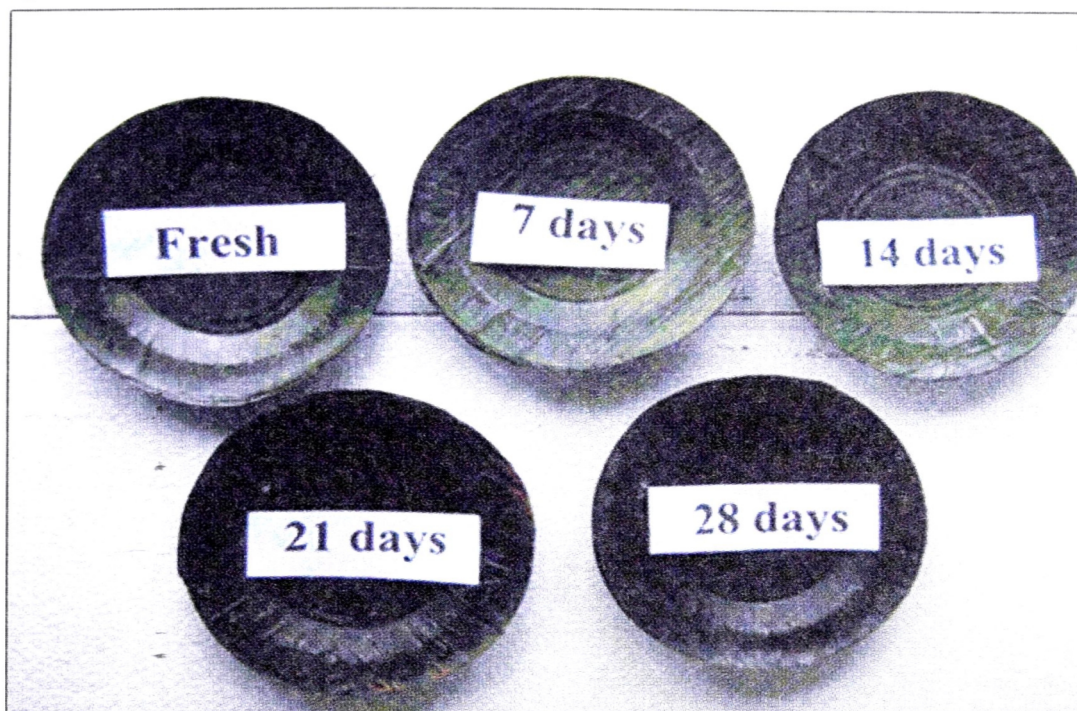


Figure 1. Changes in the colour of banana leaf plates during storage under refrigerated conditions.



Figure 2. Leaf plates produced with different types of banana leaves.

CONCLUSIONS

Banana can be successfully grown at the plant density of 6000 plants ha⁻¹ to obtain leaves. Leaf trimming practice favours the development of a bunch with reasonable weight at the plant density of 6000 plants ha⁻¹ when compared with the leaf trimming of standard cultivation. However, leaf trimming reduced the bunch weight by 28% but leaf oriented cultivation could provide a 2.3 times higher profit than that of the standard cultivation. All types of leaves can be used for the fabrication of leaf plates which could be stored under refrigerated conditions for a period of three weeks without affecting their quality.

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