

# Evaluation of Luffa (*Luffa acutangula* (L.) Roxb) Varieties under Low Country Intermediate Zone of Sri Lanka

R.M.S.S. RAJAPAKSHA<sup>1</sup>, K.P.D. SIRIWARDHANE<sup>2</sup> and R.H.M.K. RATHNAYAKE<sup>1</sup>

<sup>1</sup> Department of Horticulture and Landscape Gardening, Faculty of Agriculture and Plantation Management, Wayamba University of Sri Lanka, Makandura, Gonawila (NWP), Sri Lanka.

<sup>2</sup> Regional Agricultural Research and Development Center (RARDC), Makandura, Gonawila (NWP), Sri Lanka.

## ABSTRACT

The existing Luffa (*Luffa acutangula*) varieties in Sri Lanka, recommended by the Department of Agriculture and the introduced hybrids are vulnerable to pests and diseases in cucurbitaceous crops and the cost for pest and disease control mainly accounts for the higher production cost of Luffa. Makandura Selection (MK) is a Luffa variety selected from farmer fields and it shows tolerance to fruit fly (*Bactrocera cucurbitae* (Coquillett)) which is the most serious pest causing high level of economic losses in cucurbitaceous crops. An experiment was laid out in a Randomized Complete Block Design (RCBD) with four replicates to evaluate the performance of Makandura Selection with the two Department of Agriculture recommended Luffa varieties, Asiri and LA 33. Evaluation was done based on reproductive, yield and fruit quality parameters. Though the variety LA 33 recorded the significantly highest yield (9.08 t/ha), highest fruit length (35.2 cm), highest fruit weight (280.5 g) and high fruit firmness (4.38 kg) were not desirable in the context of consumer preference. The variety Asiri recorded significantly a lower yield (7.05 t/ha) and lowest fruit firmness (3.89 kg) which are not preferred by the farmers. It performed intermediate fruit characteristics for fruit length (25.1 cm) and fruit weight (217.5 g) which are desirable for consumer preference. The variety Makandura Selection was comparable with the two recommended varieties and showed moderate yields (8.98 t/ha) and better performance in fruit quality attributes such as lower fruit length (21.7 cm), lower fruit weight (207.2 g) and moderate fruit firmness (4.25 kg). Therefore, the fruit fly tolerant ability, along with these positive fruit characteristics makes Makandura Selection a suitable variety to introduce to the Luffa growers in Sri Lanka after further testing.

**KEYWORDS:** Luffa (*Luffa acutangula*), Makandura Selection, Performance, Variety.

## INTRODUCTION

The genus Luffa which belongs to the family Cucurbitaceae is essentially an old world genus consisting of two cultivated and two wild species beside only one new world species. Two cultivated species are *Luffa acutangula* (Ridge or Ribbed gourd) and *L. cylindrica* (Sponge gourd) (Bose *et al.*, 2002). *Luffa acutangula* has been originated in India (Purseglove, 1968) and also has a long history of Asia and Africa (Bose *et al.*, 2002). It is now well popular in Malaysia, Indonesia, Philippine, Caribbean Islands, Brazil, Australia and China while mostly grown commercially in Korea, China and Colombia (Ariyaratna, 2005).

Luffa is mainly grown for its tender fruit, which is used as a vegetable in soups and curries. The leaves are also edible (Tindall, 1983). Tender fruits have higher medicinal value and it acts against diabetes. Mature fruits are bitter and inedible. The fibrous portion of mature fruit is used as heat resistance in some countries. Further, it is used for cleaning purposes and decorations. The seed oil extraction can be used for cooking, lighting and candle and soap making. Luffa juice mixed with Nidikumba (*Mimosa pudica*) juice is a good repellent for mites in agricultural fields (Ariyaratna, 2005).

In Sri Lanka, Luffa is grown throughout the year in Wet Zone and during *maha* season mainly in Dry Zone. During *yala* it can be grown successfully in Low Country Dry Zone, Intermediate Zone, and Mid Country Wet Zone as a cash crop up to an elevation

of 500 m from mean sea level. Major Luffa growing districts in Sri Lanka are Moneragala, Anuradhapura, Ampara, Rathnapura and Kurunegala. (Anon, 2005/2006). There are two Luffa varieties, LA 33 and Asiri, recommended by the Department of Agriculture (DOA), Sri Lanka. Asiri is an early variety having shorter fruits. It gives early yield and continues for a shorter period of time than LA 33 which has longer fruits. Further, some of the hybrids *viz.* Hercules (F1 from Thailand), Naga (F1 from Malaysia), Kaew 501 F1 and Cow Boy, have been introduced to the farmers (Gunasekara, 2006). Even though there are recommended varieties and F1 hybrids, both are not adequately tolerant to the major pests and diseases of cucurbitaceae family. Some hybrids such as Naga F1 are not suitable for *yala* cultivations since it is more prone to insect attacks during that season. As a result, yield losses occur and spending more on pest and disease control increases the crop production cost (Kalugamage, 2005). The cost of production is more important for growers to increase their income level. Cost for pest and disease control contributes to a significant proportion of the total production cost.

According to the Ministry of Agriculture and Land, the production cost of Luffa could be reduced by the effective use of high yielding varieties, selection of varieties with appropriate characters *viz.* low firmness, low fiber content, high flesh weight, accepted flavour and also through introduction of new technology for crop management, soil and water

management and crop protection (Anon, 1998). Hence, it is a must to introduce high yielding varieties with better fruit quality and tolerance to major pests and diseases.

“Makandura Selection” (MK) is a farmer field selection of Luffa which is mostly cultivated in Daduru Oya catchment area and has smaller fruits resembling fruits of Asiri when compared to LA 33. Studies conducted at Regional Agricultural Research and Development Center, Makandura (Anon 2004/2005), Adaptive Research Center, Walpita, and Horticultural Crop Research and Development Institute (HORDI), Gannoruwa (Anon 2004) revealed that Makandura Selection possesses a tolerance to fruit fly (*Bactrocera cucurbitae* (Coquillett) ) damage which is wide spread and a serious pest of cucurbit fruits causing economical damages (Kudagamage *et al.*, 2000). Introduction of a fruit fly tolerant Luffa variety will be a successful remedy to reduce the cost of pest control, if the particular variety possesses other desirable characters for commercial cultivation. Therefore, a study was conducted to evaluate the field performance of “Makandura Selection” in comparison to other two DOA recommended varieties, LA 33 and Asiri.

## MATERIALS AND METHODS

### Experimental Site

The study was carried out at the Regional Agricultural Research and Development Centre (RARDC), Makandura, Gonawila (NWP), Sri Lanka where the soil type is Red Yellow Podosolic with hard and soft laterite soil group (Panabokke, 1967), in the Low Country Intermediate Zone. The experimental period was from November 2005 to March 2006 (during *maha* 2005/2006).

The mean monthly weather data in Makandura area during the experimental period are shown in the Table 1.

Table 1 - The Mean monthly weather data in Makandura area during the experimental Period:

Month	Temperature (C°)		Rain Fall (mm)	RH (%)
	Max	Min		
Nov	31.0	23.2	327.5	87.2
Des	30.8	22.5	85.9	86.3
Jan	31.7	21.6	141.0	88.0
Feb	33.6	22.6	25.0	86.7
Mar	32.4	22.3	153.7	87.0

Source: RARDC, Makandura

### Treatments

Makandura Selection - MK (T1), the Luffa variety selected from farmer fields and the two DOA recommended Luffa varieties *viz.* Asiri (T2) and LA 33 (T3) were used as the treatments.

### Field Layout

The experiment was laid out in a Randomized Complete Block Design (RCBD) with four replications, each treatment having four plots. The raised beds (3 m x 2.5 m) were prepared providing drains of 60 cm width to overcome the water logging. Planting holes were prepared (30 cm x 30 cm x 30 cm) providing 1.5 m x 1.5 m spacing in each bed. Initially, three to four seeds were planted in one hole and only two vines were maintained per hole. A trellis system for each plot was established.

The crop establishment and maintenance were carried out according to the DOA recommendations (Anon, 2003).

### Data Recording

#### 1. Reproductive Parameters

Reproductive parameters including days to 50% flowering of staminate and pistillate flowers and days to first harvest were recorded according to the descriptors of the Department of Agriculture (Anon, 1995).

#### 2. Fruit Quality Parameters

Fruit quality parameters were recorded at the green mature stage based on the descriptors of the Department of Agriculture (Anon, 1995). Fruit lengths (cm) (from stem end to blossom end of the fruit), fruit weight (g) using Trade Sprang Balance (model 226s to weight 10 kg x 50 g), fruit diameter (cm) along the axis of maximum diameter of the fruit, and fruit wall (pericarp) thickness (mm) in between two ridges after cutting the fruit along the diameter were recorded. Fruit firmness (kg) was determined with two measurements obtained for each fruit at opposite sides of the middle point, using a fruit pressure tester (Model FT 011).

#### 3. Yield Parameters

Fruits were harvested at four days interval in all the vines of each plot. Average yield (t/ha) was obtained by harvesting in green mature stage. Yield per vine (kg) and the number of fruits per vine were calculated by using the total yield and the number of fruits, respectively.

#### 4. Pest and Disease Occurrence

Pest and disease incidences were observed throughout the experimental period.

## RESULTS AND DISCUSSION

### 1. Reproductive Parameters

#### 1.1. Days to 50% Flowering

According to the statistical analysis, variety Asiri required a significantly lesser number of days for flowering of both staminate/male (26) and pistillate/female (36) flowers. Staminate flowers opened 8 to 9 days prior to the opening of pistillate flowers in all varieties. Early flowering of both staminate and pistillate flowers results early

pollination thus giving early fruit development and lower vegetative phase. As a result, Variety Asiri showed shorter vegetative phase and both the varieties, LA 33 and Makandura Selection showed a longer vegetative phase (Figure 1).

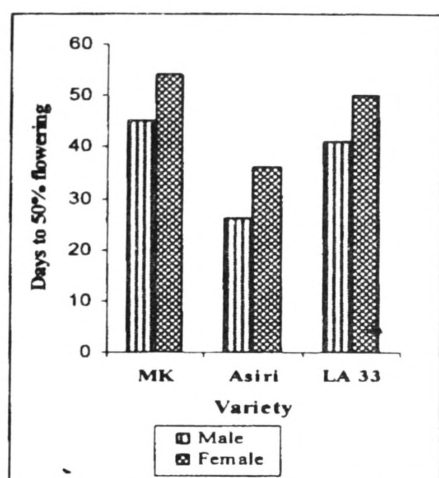


Figure 1 - Days to 50% flowering in three Luffa varieties:

### 1.2. Days to First Harvest

As a consequence of early flowering, the variety Asiri recorded a significant lesser number of days to first harvest compared to Makandura Selection which recorded a significantly longer time to yield the first harvest. The variety LA 33 recorded the intermediate time duration for the first harvest when compared to the variety Asiri and Makandura Selection. Early first harvest will result early income generation for growers. Further, ability to remove fruits early from the field will reduce pest and disease incidences (Figure 2).

## 2. Fruit Quality Parameters

### 2.1. Fruit Length (cm)

The results indicated that, there is a significant difference in fruit length among Luffa varieties (Table 2). LA 33 showed the highest fruit length (35.2 cm) which is significantly different from other two varieties. Fruit lengths of Makandura Selection and Asiri were not significantly different from each other. However, the lowest fruit length (21.72 cm) was recorded from the Makandura Selection. According to the Dekker and Messing (2001), small fruit varieties can be harvested with less infestation of fruit flies than that of larger fruit varieties. As a result, LA 33 could be more prone to fruit fly damage than other two varieties.

### 2.2. Average Fruit Weight (g)

Variety LA 33 recorded the highest average fruit weight (280.5 g) which is significantly different from that of other two varieties (Table 2). The average fruit weights of Makandura Selection and Asiri were not significantly different while Makandura Selection recorded the lowest fruit weight (207.25 g). As a result, the number of fruits required for one kilogram

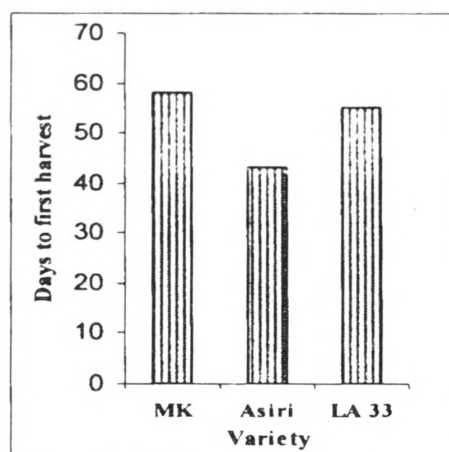


Figure 2 - Days to first harvest in three Luffa Varieties:

is higher in Makandura Selection. It gains more consumer preference to these two varieties than for LA 33, because of the easiness in handling.

Makandura Selection recorded the lowest fruit weight (207.25 g). As a result, the number of fruits required for one kilogram is higher in Makandura Selection. It gains more consumer preference to these two varieties than for LA 33, because of the easiness in handling.

### 2.3. Fruit Diameter (cm)

No significant differences were observed in fruit diameter among the three varieties. The fruit diameter ranged from 6.04 cm (Makandura Selection) to 6.2 cm (Asiri) (Table 2).

### 2.4. Pericarp Thickness (mm)

There were no significant differences in pericarp thickness among the three varieties. However, the highest pericarp thickness (6.75 mm) was recorded in LA 33 while the lowest (6.12 mm) was given by Asiri. The Makandura Selection showed a moderate pericarp thickness (6.45 mm) (Table 2).

### 2.5. Fruit Firmness (kg)

There were no significant differences in fruit firmness among the tested varieties. However, the highest fruit firmness was recorded in LA 33 (4.38 kg) while Asiri showed the lowest firmness (3.89 kg). The Makandura Selection showed an intermediate fruit firmness (4.25 kg) (Table 2). Higher fruit Firmness is not preferred in Luffa because it reduces the consumer preference (Anon, 1998) whereas lower fruit firmness is associated with higher incidence of pest attacks such as fruit fly due to the succulent nature.

## 3. Yield Parameters

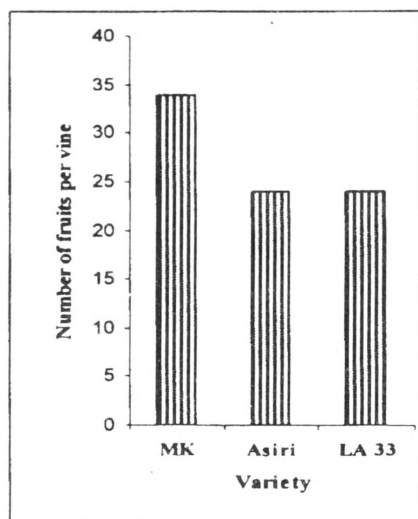
### 3.1. Number of Fruits per Vine

Significant differences were observed in the number of fruits per vine. Makandura Selection showed the highest number of fruits per vine (34) which was significant while the other two varieties (24) had no significant difference (Figure 3).

**Table 2 - Fruit quality parameters of three Luffa varieties:**

Variety	Fruit Length (cm)	Average Fruit Weight (g)	Fruit Diameter (cm)	Pericarp Thickness (mm)	Fruit Firmness (kg)
MK	21.7 <sup>B</sup>	207.2 <sup>B</sup>	6.0 <sup>A</sup>	6.45 <sup>A</sup>	4.25 <sup>A</sup>
Asiri	25.1 <sup>B</sup>	217.5 <sup>B</sup>	6.2 <sup>A</sup>	6.12 <sup>A</sup>	3.89 <sup>A</sup>
LA33	35.2 <sup>A</sup>	280.5 <sup>A</sup>	6.0 <sup>A</sup>	6.75 <sup>A</sup>	4.38 <sup>A</sup>
LSD	5.51	58.23	0.35	1.38	0.62
CV	11.64	14.32	3.33	12.37	8.58
R <sup>2</sup>	0.88	0.69	0.66	0.45	0.56

Values in a column followed by the same letter are not significantly different at 0.05 probability level



**Figure 3 - Number of fruits per vine in three Luffa varieties:**

**3.2. Average Yield (t/ha)**

Variety LA 33 showed the highest significant yield (9.08 t/ha) compared to other two varieties, whereas the variety Asiri showed a significantly lower yield (7.05 t/ha). Makandura Selection gave moderate yields which are not significantly different from other two varieties (Table 3). Yield parameter is of more importance for Luffa growers to get a higher income per unit area. In this context, high yielding varieties are always preferred.

**3.3. Yield per Vine (kg)**

There was no significant difference in yield per vine among the three varieties. However, the highest yield per vine was recorded in LA 33 and Makandura Selection (Table 3).

**Table 3 -Yield parameters of three Luffa varieties:**

Variety	Average Yield (t/ha)	Yield/Vine (kg)
MK	8.98 <sup>AB</sup>	0.84 <sup>A</sup>
Asiri	7.05 <sup>B</sup>	0.66 <sup>A</sup>
LA33	9.08 <sup>A</sup>	0.85 <sup>A</sup>
LSD	2.02	0.19
CV	13.94	14.12
R <sup>2</sup>	0.80	0.80

Values in a column followed by the same letter are not significantly different at 0.05 probability level

**4. Pest and Disease Occurrence**

Punched hole leaf damage of *Aulacophora foveicollis* (Red pumpkin beetle) and the damage of *Liriomyza sativae* (Leaf miner) were equally observed in all three varieties.

Downy mildew (*Psuedoperonospora cubensis*) was also observed in all varieties with same severity. The high rain fall intensity in the area during *maha* season facilitates the rapid spread of fungal diseases. Downy mildew favours the high humidity and low temperature conditions which prevails during *maha* season. Hence, continuous cultivation of cucurbitaceae crops in the same field should be prevented by practicing crop rotation.

**CONCLUSIONS**

The study reveals that the DOA recommended variety; LA 33 performs better in attributes such as the average yield and average fruit weight. Being a longer and larger fruit it is more vulnerable to post-harvest losses during transport and other post-harvest practices and more prone to fruit fly damage. Even though Asiri is an early variety, shorter crop duration results lower yields for growers. The yield parameters and the desirable fruit quality parameters (less fruit length, fruit weight and moderate firmness) of Asiri variety are similar to those of variety Makandura selection. However, owing to the fruit fly tolerance, which is not characteristic to variety LA 33 and Asiri (Anon, 2004). Makandura Selection would be a better variety to reduce the cost of pest control, thus, minimizing the production cost of Luffa. Therefore, the variety Asiri could be replaced by the new variety Makandura Selection for commercial level cultivations in Low Country Intermediate Zone of Sri Lanka. Further, the Makandura Selection could be used in future breeding programs of Luffa. Further studies are needed to confirm the adaptability of Makandura Selection in other agro-ecological regions of Sri Lanka and to test the preference of farmers and consumers.

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