Evaluation of Cucumber (*Cucumis sativus* L.) Varieties in the Low Country Intermediate Zone of Sri Lanka

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ABSRACT

Cucumber (*Cucumis sativus* L.) is one of the most important market vegetables in the tropics. However, the available recommended varieties in Sri Lanka are having undesirable attributes, such as extended time taken to initiate male and female flowers, bitter taste in flesh, low yield and poor marketability. An experiment was conducted to evaluate two varieties of Vietnam origin (MK-1 and MK-2) with two locally recommended varieties (LY-58 and Kalpitiya White) on their vegetative, reproductive and fruit quality parameters, quality assessments and yield parameters. Significant differences in all attributes were observed among the cucumber varieties. Increased internode length (5.92cm), higher size of leaf laminar (leaf length 13.6cm, leaf width 17.1cm), and early harvesting (44.5 days) were recorded in MK-1. It further possessed desired fruit length (18.3cm) for slicing, and recorded a similar flesh thickness (16.8 mm) as in recommended variety LY-58. It also showed higher fruit firmness (3.84 kg), comparatively less bitterness and less number of seeds/fruit (251) than the two recommended varieties. Further, MK-1 yielded maximum number of fruits per vine (12.7), and recorded tolerance to Fusarium wilt and downy mildew diseases. The variety MK-2 showed better performances such as higher internode length (6.18cm), early female flowering (33 days), and early harvesting (46 days), lesser number of seeds/fruit (96), bitterless in flesh than recommended varieties. Therefore, variety MK-1 which showed superior characters over recommended varieties could be successfully cultivated in the Low Country Intermediate Zone of Sri Lanka. MK-2 too can be introduced for home gardens with an alteration of agronomic practices.

KEY WORDS: Cucumber, *Cucumis sativus* L. Varietal evaluation.

INTRODUCTION

Cucumber (*Cucumis sativus* L.) is a popular market vegetable in the tropics grown throughout the year for slicing, cooking and pickling purposes. It is assumed to be a native of north India (Purseglove, 1982). Generally, in the international market cucumbers are of two types, slicing and pickling.

Pickling cucumbers have shorter fruits with more prominent warts than slicing cultivars. The length to width ratio, usually about three to one, is important for pickling cucumbers.

Most slicing cultivars have white-spined fruits while pickling cultivars may have either white or black spines. Pickling cultivars with white spines are becoming more popular because their fruits retain green colour longer (Robinsón and Decker - Walters, 1997). In Sri Lanka, cucumber is best eaten sliced immature fruits as a salad or as an appetizer with other vegetables because of its distinct flavour and texture. The matured fruits are also cooked and eaten as a curry with rice.

Cucumber belongs to the family Cucurbitaceae, and it is an annual with a prostrate vining type of growth, which results from the branching of the main stem in to several trailing laterals. Three distinct types of vine growth can occur in the plant: Indeterminate, determinate, and compact. Poor pollination is one of the main causes of fruit abortion, misshapen fruits, or poor fruit set in cucumbers (Mc Collum *et al.*, 1994). The fruits are picked at various stages of development.

This crop can be grown throughout the year in the wet zone and during *maha* season in the dry zone to an elevation of about 1000 m. The optimum temperature for successful cucumber cultivation is about 30^{0}C and well-drained soil, rich in organic matter with a pH range of 5.5 – 7.5 is more suitable. The identified districts for cucumber production in Sri Lanka are Kurunegala, Matale and Hambantota. The potential districts for cucumber production are Puttalam, Matara, Badulla, Moneragala, Polonnaruwa and Anuradhapura (Anon, 2004a).

The Cultivation extent and the production over *Maha* and *Yala* seasons during the period of 1999-2004 are given in Table 1.1.

Table 1.1. Cucumber cultivation extent and production during the 1999-2004

Year	Area(ha)			Production(t)		
	Maha	Yala	Total	Maha	Yala	Total
1999	1,371	1,030	2,401	11,550	7,865	19,415
2000	1,416	1,085	2,501	11,555	8,570	20,125
2001	1,414	966	2,380	11,139	7,656	18,795
2002	1,459	1,184	2,643	11,322	9,672	20,994
2003	1,995	1,157	3,152	14,408	8,981	23,389
2004	1,540	1,134	2,674	14,036	8,855	22,891

Source: Department of Census and Statistics

The cultivation extent and production during *maha* season were higher than that of yala season, probably due to the prevalence of favourable weather conditions during *maha*.

The export of fresh cucumber and gherkin is shown in Table 1.2.

Table 1.2 depicts that there has been an increasing trend in the value derived during 1999 to 2002 period indicating that crop has substantial export market. Cucumber is exported especially to cater to the needs of the Asian expatriates living in the Middle East.

Table 1.2. Export of fresh Cucumber and Gherkin from 1999 to 2003.

Year	Crop	Quantity (Mt)	Value ('000Rs)	FOB price(Rs/ Kg)
1999	Cucumber	0.20	41	19.84
2000	Cucumber	0.50	86	152.96
2001	Cucumber	6.81	738	108.29
2002	Cucumber and Gherkin	11.28	609	53.99
2003	Cucumber	2.15	308	143.26

Source: Agstat 2002, 2004.

There are three recommended cucumber varieties available in the country for cultivation. However, their attributes are not acceptable for farmers as well as for consumers. This is mainly due to longer time taken for initiation of male and female flowers, low yield, poor marketability, bitterness in flesh and poor flesh and rind colour which cause poor grower and consumer acceptance. Hence, these varieties are need to be replaced with varieties having high yielding ability, better fruit quality, wide adaptability and, tolerance to pests and diseases. It should meet the requirements of both growers and consumers. Therefore, this study was conducted to evaluate two cucumber varieties, introduced from Vietnam (MK-1, MK-2), with two varieties (LY-58, Kalpitiya White) recommended by the Department of Agriculture (DOA) and to prepare a varietal description for each variety tested.

MATERIALS AND METHODS

Experimental Site

The study was carried out at the Regional Agricultural Research and Development Center (RARDC), Makandura, situated in the Low Country Intermediate Zone, at an elevation of 25 m above mean sea level. The major soil group is Red Yellow Podsolic with hard and soft laterite (Panabokke, 1967). The soil can vary from sandy loam to sandy clay loam with moderately well drained. The experiment was conducted during the period from November 2004 to February 2005.

The mean monthly weather data were shown in Table 2.1.

Table 2.1. Mean monthly weather data recorded during the experimental period.

Season	Temperature ^{0}C		Relative Humidity (%)	Rain fall (mm)
	Maximum	Minimum		
Maha 2004/2005				
November 2004	31.88	24.20	77.15	285.8
December 2004	31.24	22.82	75.10	141.1
January 2005	32.03	23.56	74.56	104.3
February 2005	33.70	22.33	67.69	57.6

Source: RARDC, Makandura.

Treatments

Four open-pollinated cucumber varieties were used as experimental treatments. The treatments are detailed in Table 2.2.

Table 2.2. Treatments used in the experiment.

Treatment	Variety
*T_1	Kalpitiya White -Recommended by the DOA
*T2	LY-58 - Recommended by the DOA
T3	MK-1 - Introduction from Vietnam
T4	MK-2 - Introduction from Vietnam

**Check varieties.*

Field Layout

Each treatment was planted in a raised bed (4m x 4m). The raised beds were prepared providing drains with 50cm width to overcome the water logging conditions. Planting holes (30cm x 30cm x 30cm) were prepared providing 1mx1m spacing in each bed. The treatments were arranged in a Randomized Complete Block Design, and replicated four times.

Table 2.3. The DOA fertilizer recommendation for Cucumber.

Time of application		Fertilizer (kg/ha) Urea	TSP	MOP	N	P_2O_5	K_2O
Basal	At planting	75	200	60	35	90	35
Top	2 weeks after planting	75	-	60	35	-	35
	5 weeks after planting	75	-	60	35	-	35

Crop Establishment and Maintenance

Basal concentrated inorganic fertilizer (Table 2.3) and organic fertilizer (cow dung 3 kg per hill) were applied to each planting hole. Top of the each hole was raised up to 10cm from the ground level. Pre soaked seeds of four cucumber varieties were sown two days after preparation of planting hole at the rate of four seeds per hill and dibbled to a depth of 2-3cm.

The seedlings were thinned-out two weeks after emergence leaving two healthy vigorous seedlings per hill. Over head irrigation was done by a hand–held hose. Irrigation intervals were adjusted according to prevailed weather condition and the growth stages of the crop. Manual weeding was done until vines covered the ground.

Statistical Analysis

Data were recorded from the net plot (3m x 3m) and avoided the boarder plants of each treatment of four blocks. But the whole plot was considered to record days to fifty percent flowering of staminate and pistillate flowers and yield parameters due to practical reasons. The data generated from the experiment were statistically analyzed using Statistical Analysis System (SAS) package.

Data Recording

a. Morphological Characters

The cultivars were characterized and grouped based on data collected from morphological characters.

Growth habit, flowering habit were determined. Furthermore fruit shapes, presence of stripes and fruit size variability were determined at the table use maturity stage. Above characters were determined according to the descriptors published by the DOA (Anon, 1995).

Fruit skin colour at the table use maturity and seed harvest maturity stages were determined. Further fruit spine colour was determined at the table use maturity stage. These characters were determined using the Royal Horticultural Society Colour Chart.

b. Vegetative Parameters

Randomly selected five vines from each treatment were taken to record the measurements of internode length, leaf width and leaf length.

i. Internode Length

The length between third and fourth internodes was taken at four weeks after sowing.

ii. Leaf Width and Leaf Length (cm)

The maximum width of the leaf at the third internode and the length from the point where leaf petiole attaches to the leaf lamina to the tip of the middle lobe at four weeks after sowing.

c. Reproductive Parameters

i. Days to Fifty percent Flowering of Staminate and Pistillate Flowers

The numbers of days taken from the date of sowing to fifty percent of vines had staminate and pistillate flowers (50% of the plants with at least one flower).

Randomly selected five vines from each treatment were taken to record following data

ii. Days to First Harvest

The number of days taken from the date of sowing to first harvest at the table use maturity stage was recorded.

d. Fruit quality Parameters

Five fruits from randomly selected five vines from each treatment were taken to record the measurements of fruit weight, fruit width, fruit length, flesh thickness and number of seeds per fruit.

i. Fruit Weight (grams)

Fruits at the table use maturity stage were weighed using the triple beam balance (700series 2610g) and the trade sprang balance (model 226S to weight 10kg x 50g).

ii. Fruit Width and Length (cm)

Fruit width was measured at the maximum fruit diameter and the length from stem-end to blossom-end of each fruit at the table use maturity stage.

iii. Flesh Thickness (mm)

The flesh thickness at the maximum fruit diameter except the pericarp thickness was measured using the Veernier caliper (15-100-500 Manosat).

iv. Number of Seeds per Fruit

Mean number of seeds of five fruits at the seed harvest maturity stage.

e. Fruit quality Assessments

Five fruits from randomly selected five vines from each treatment were taken to record the measurements of total soluble solids and fruit firmness.

i. Total Soluble Solids (Brix value)

This was taken at the table use maturity stage using the hand refractometer [ATAGO, N-1_E (Brix 0-32%)].

ii. Fruit Firmness (kg)

Two measures using fruit pressure tester [model FT 011 (0 -11Lbs)] were taken on each fruit, at the middle point of each side after removing1/2-3/4 inch diameter disc of peel with a fruit peeler.

iii. Sensory Evaluation

Sensory evaluation was conducted to evaluate the bitterness in flesh of each variety at the table use maturity stage. Fruit pericarp was peeled off and the endocarps were removed. The mesocarp was sliced and distributed to 30 panellists for sensory evaluation. They were asked to rank each sample on bitterness of flesh (bitter less, low, intermediate, high). Data were analyzed using SAS (Kruskal –Wallis) statistical package.

f. Pests and Diseases

Pests and diseases were observed and identified which were prevailed during the experimental period. The pest and disease management practices were carried out as per DOA recommendation.

g. Yield Parameters

Harvesting of fruits which were at table use maturity stage was carried out weekly starting from 40 days after sowing.

i. Number of Fruits per Vine
ii. Yield per Vine (kg)
iii. Total Yield (t/ha)
iv. Crop Duration

Number of days taken from the date of sowing to final harvest was recorded.

RESULTS AND DISCUSSION

a. Morphological Characters.

i. Vine

Growth Habit: Kalpitiya White, LY-58 and MK-1 showed prostrate growth habit, while MK-2 exhibited intermediate growth habit. The prostrate types grew horizontally along the ground and the intermediate type had a character between bushy and prostrate (Table 3.1). Robinson and Decker-Walters, (1997) reported that the most cucumber plants were indeterminate, producing a small trailing vine 1-3m long. But determinate cultivars with a compact plant habit had been developed for home growers and mechanical harvesting. Vines of MK-2 did not grow up to the length of vines as Kalpitiya White, LY-58 and MK-1.

Table 3.1. Morphological characters of four cucumber varieties tested at Makandura during *maha* 2004/2005.

Characters	Kalpitiya White	LY-58	MK-1	MK-2	Remarks
i.Vine Growth habit	P	P	P	I	P = Prostrate I = Intermediate
ii. Flowers Flowering habit	M	M	M	M	M = Monoecious
iii. Fruits Fruit shape	O.E	O.E	O.E	E	E = Ellipsoid O.E = Oblong ellipsoid
Presence of stripes	A	A	M	M	A = Absent M = More than 2/3rd of fruit Length
Fruit size variability	L	I	L	H	L = Low I = Intermediate H = High
iv. Fruit skin colour Table use maturity stage	Yellow-Green 150 D	Yellow-Green 150 B	Green 137 A	Green 137 A	
Seed harvest maturity stage	Greyed-Orange 163 A	Greyed -Orange N172A	Greyed-Orange N 167 A	Greyed-Orange N163 D	
Fruit spine colour	White 155 A (White)	Black 202 A (Black)	White 155A (White)	Black 202 A (Black)	

ii. Flowers

Flowering Habit: The four treatments showed monoecious flowering habit, producing both male and female flowers separately on the same vine (Table 3.1). Mc Collum *et al.*, (1994) reported that monoecious cucumbers generally go through three phases of sex expression: i) an initial period when only male flowers were produced, ii) a long period when equal number of male and female flowers were borne, and iii) a final relatively short phase when female flowers largely predominate.

iii. Fruits

Fruit Shape: Kalpitiya White, LY-58 and MK-1 exhibited oblong ellipsoid fruit shape and the MK-2 exhibited ellipsoid fruit shape (Table 3.1). Anon. (1995) classified the different fruit shapes of cucumber cultivars as ellipsoid, oblong ellipsoid, globular, stem-end tapered and blossom-end tapered.

Presence of Stripes: Variety Kalpitiya White and LY-58 didn't have distinguishable stripes on blossom-end of fruit. But variety MK-1 and MK-2 showed stripes on blossom-end which were more than 2/3rd of fruit length (Table 3.1). Anon. (1995) classified stripes on cucumber fruit rind according to the presence of that character and length of the stripes as absent, less than 1/3rd of length, approximately 1/2 of fruit length and more than 2/3rd of fruit length.

Fruit size Variability: Variety Kalpitiya White and MK-1 showed less fruit size variability due to lesser fruit length, width variation. Variety MK-2 showed higher fruit size variability caused by high variation in fruit length and width. Variety LY-58 had intermediate variability (Table 3.1). Fruit size variability is an important character in fruit grading and less variability is preferred.

iv. Fruit skin Colour

Table use and Seed harvest maturity Stages: Fruit skin colour changes could be observed among the four varieties at table use maturity and seed harvest maturity stages respectively. Fruit skin colour of Kalpitiya White and LY-58 at the table use maturity showed the same colour group (yellow-green).While the varieties MK-1 and MK-2 showed green colour group. Even though Kalpitiya White and LY-58 belonged to the same colour group, a little variation could be seen (Table 3.1). Fruits of MK-1 retained green colour longer than MK-2. Fruit skin colours of four varieties at the seed harvest maturity stage were similar (Greyed-orange). However, a variation could be observed among the four varieties within same colour group (Table 3.1). It was reported by Sarananda (2005) that fruits having greenish yellow colour rind have an export demand, hence varieties MK-1 and MK-2 are suitable for export than the other two varieties.

Fruit spine Colour: Colour changes in spine could be seen among the four varieties. Spine of LY-58 and MK-2 were black in colour. While Kalpitiya White and MK-1 were white (Table 3.1). Robinson and Decker - Walters, (1997) reported that spine colour was associated with mature fruit colour and netting. Fruits of white-spined cultivars were light green to yellow at maturity and not netted. Blacked-spined Fruit become orange or brown when matured.

b. Vegetative Parameters

Results of the vegetative parameters of cucumber varieties are given in Table 3.2.

i. Internode Length

Significant differences were observed in internode length among the varieties. It varied from 3.75 to 6.18cm. The highest value (6.18cm) was recorded in T4, while the lowest value (3.75cm) was in

T1. There were no significant differences observed in internode length between T3 and T4. Varieties T1 and T2 were significantly different from each other as well as from the values of T3 and T4 (Table 3.2).

Table 3.2. Internode length, leaf width and leaf length of cucumber varieties tested at Makandura during maha 2004/2005.

Varieties		Internode length(cm)	Leaf width(cm)	Leaf length(cm)
Kalpitiya White	(T1)	3.75 [c]	16.1 [b]	12.8 [a]
LY-58	(T2)	5.12 [b]	17.4 [a]	11.5 [b]
MK-1	(T3)	5.92 [a]	17.1 [a]	13.6 [a]
MK-2	(T4)	6.18 [a]	12.6 [c]	9.95 [c]
LSD		0.60	0.60	6.10
CV		7.15	2.39	6.10

Means followed by the same letter in each column are not significantly different at p=0.05

ii. Leaf Width

There were significant differences in leaf width among the varieties. It varied from 12.6 to 17.4 cm. The highest value of 17.4 cm was recorded in T2, while the lowest value of 12.6cm was recorded in T4.There were no significant differences observed in leaf width between T2 and T3. But T1 was significantly different from the treatments T2, T3 and T4 (Table 3.2).

iii. Leaf Length

Significant differences were observed in leaf length among the varieties. The values varied from 9.95 to 13.6cm. The highest value (13.6cm) was recorded in T3, while the lowest (9.95 cm) was recorded in T4. There were no significant differences observed in leaf length between T1 and T3. The treatments T2 and T4 were significantly different in leaf length from each other as well as from T1 and T3 (Table 3.2).

The results revealed that the internode length has determined the distance between two leaves. Variety MK-1 (T3) and MK-2 (T4) had higher internode length values which resulted in higher distance between two leaves. Variety Kalpitiya White (T1) which had lowest internode length was compact in appearance. The Kalpitiya White (T1) and LY-58 (T2) had overlapping leaves and leaves covered the flowers. This enabled the pollinators, principally the bees, for better access to the flowers, and facilitated harvesting later on than T3 and T4.

In addition, T1and T2 covered the ground earlier than T3and T4 and weed management was easier. Generally, the amount of captured solar radiation is determined by the size of the leaf laminar. Higher the size of the leaf laminar, the dry matter production will be high (Brimble, 1957). The variety T3 had higher leaf length and width resulting larger size of leaf laminar than other varieties. Variety T4 had the smallest leaf laminar due to its smaller length and width of leaves. Furthermore, characters such as internode length, leaf width and leaf length showed their status as distinct cultivars.

c. Reproductive Parameters

Results of the reproductive parameters of cucumber varieties are given in Table 3.3

i. Days to 50% Flowering (Staminate)

Significant differences were observed among the varieties in number of days taken to 50% flowering of staminate flowers. It varied from 29.2 to 41.5 days. T1 took the maximum number of days (41.5 days), while the T4 was earlier (29.2 days). There were no significant differences between T2 and T3 as well as between T3 and T4 for 50% flowering (Table 3.3).

ii. Days to 50% Flowering (Pistillate)

Significant differences were observed in time taken to 50% flowering of pistillate flowers among the varieties. The number of days varied from 33.0 to 45.0 days. The maximum time (45.0 days) was taken by T1, while the minimum time (33.0 days) was taken by T4. There were no significant differences between T1 and T2. The T3 was distinctly different fromT1, T2 and T4 (Table 3.3).

iii. Days to First Harvest

Significant differences were observed in number of days taken to first harvest among the varieties. The maximum number of days (55.5 days) was recorded by T1, while the minimum number of days (44.5 days) was recorded by T3.There was no significant difference between T1 and T2. Significant difference was not observed in between T3 and T4 either (Table 3.3).

It was clear that the early harvesting has been influenced by the early production of the female flowers. The MK-2 (T4) produced female flowers earlier than other varieties. Though the variety MK-1 (T3) took higher number of days for fifty percent flowering than the T4, there was no difference in harvesting period. Hence, early harvesting was possible in both T3 and T4. The varieties Kalpitiya White (T1) and LY-58 (T2) which showed late female flower production, took a longer time for fruiting, thus delaying the harvest. Mc Collum *et al.*, (1994) reported that the high temperature and long days favor male blooms, while short days and low temperature promote female flower development. The variety T4 had the lesser vegetative phase indicated in early production of staminate flowers than others. The variety T2 and T3 also had considerably lower vegetative phases. Reproductive growth varies due to genetic differences among varieties and environmental factors.

Table 3.3.Days to 50% flowering of staminate and pistillate flowers and days to first harvesting of cucumber varieties tested at Makandura during *maha* 2004/2005.

Varieties		Days to50% flowering (Staminate)	Days to 50% flowering (Pistillate)	Days to first harvest
Kalpitiya White	(T1)	41.5 [a]	45.0 [a]	55.5 [a]
LY- 58	(T2)	35.7 [b]	43.7 [a]	53.2 [a]
MK-1	(T3)	33.0 [bc]	38.5 [b]	44.5 [b]
MK-2	(T4)	29.2 [c]	33.0 [c]	46.0 [b]
LSD		4.45	4.35	4.43
CV		7.98	6.78	5.56

Means followed by the same letter in each column are not significantly different at p=0.05

d. Fruit quality Parameters

Results of the fruit quality parameters of cucumber varieties are given in Table 3.4.

i. Fruit Weight

Significant differences were observed in fruit weight among the varieties. The fruit weight varied from 129 to 1498g. The maximum fruit weight (1498g) was recorded in T1, while the minimum (129g) was recorded in T4. The fruit weights of four varieties were significant differently from each other (Table 3.4).

ii. Fruit Width

Significant differences were also observed in fruit width among the varieties. The fruit width varied from 4.81 to 10.4cm. The highest fruit width (10.4 cm) was recorded in T1, while the lowest fruit width (4.18 cm) was recorded in T4. There was no significant difference between T2 and T3 (Table 3.4).

iii. Fruit Length

Significant differences were observed in fruit length among the varieties. The fruit length varied from 10.8 to 22.6cm. The highest fruit length (22.6 cm) was recorded in T1, while the lowest (10.8 cm) was recorded in T4. There was no significant difference in fruit length between T2 and T3 (Table3.4).

iv. Flesh Thickness

Significant differences in Flesh thickness were observed among the varieties. The flesh thickness varied from 10.8 to 23.6mm. The maximum flesh thickness (23.6mm) was recorded in T1, while the minimum (10.8mm) was in T4. There was no significant difference in flesh thickness between T2 and T3 (Table 3.4).

v. Number of Seeds per fruit

Significant differences were observed in number of seeds per fruit among the varieties. The number of seeds per fruit varied from 96 to 481. The highest number of seeds (481) was recorded in T1, while the lowest (96) was in T4 (Table 3.4).

It was noted that the fruit weight has been influenced by the size of fruit. Variety T1 had highest values for fruit length and width which gave maximum fruit weight than other varieties. However LY-58 (T2) and MK-1 (T3) which had similar fruit length and width gave fruits with different weight. If fruits are under weight or overweight, it will result in poor consumer demand for slicing purpose than the fruits for cooking. Mc Collum *et al.*, (1994) reported that the slicing cucumbers were graded by fruit diameter, length, shape, and colour. The desired length was 6.0 - 8.5 inches, with a diameter of 1.5 - 2.5 inches. The T2 and T3 had fruit lengths, which come under desired fruit length for slicing cucumber. However, Kalpitiya White (T1) and MK-2 (T4) had over and under fruit length values respectively in relation to desired fruit length. The longer fruit character is advantageous for slicing cucumber type because more slices could be obtained. Furthermore, T1, T2 and T3 had higher fruit width compared to desired fruit width, while the T4 had a desired width value for slicing cucumber. The edible portion of the fruit depends on the flesh thickness and is important for a salad cucumber. Variety T1 had the highest flesh thickness over other varieties, having maximum edible portion. The variety T2 and T3 also had considerable amount of flesh thickness. Reduction of number of seeds per fruit is an important character for cucumber in commercial production. Variety T4 had minimum number of seeds per fruit than other varieties. Considering the length, width and size of the fruit, T3 had lesser number of seeds than T2 although the two varieties had similar values for fruit length and width.

Table 3.4.Fruit weight, width, length, flesh thickness and number of seeds per fruit of cucumber varieties tested at Makandura during *maha* 2004/2005.

Varieties	Fruit weight (g)	Fruit Width (cm)	Fruit length (cm)	Flesh thickness (mm)	No.of seeds per fruit
Kalpitiya White (T1)	1498[a]	10.40[a]	22.6[a]	23.6[a]	481[a]
LY-58 (T2)	702[b]	7.65[b]	18.3[b]	18.8[b]	340[b]
MK-1 (T3)	483[c]	6.95[b]	18.3[b]	16.8[b]	251[c]
MK-2 (T4)	129[d]	4.81[c]	10.8[c]	10.8[c]	96[d]
LSD	186.6	0.83	1.49	2.57	87.68
CV	16.57	7.00	5.34	9.18	18.68

Means followed by the same letter in each column are not significantly different at p=0.05

e. Fruit quality Assessments

Results of sensory evaluation of cucumber varieties are given in Table3.5a.

i. Sensory Evaluation

Statistical analysis of probability value and mean scores for sensory evaluation of cucumber have shown that there were significant differences for bitterness in flesh among the cultivars ($p<0.05$). Variety MK-2 (T4) was bitterless, obtaining the highest mean value (8.66) compared to the other three treatments. Variety LY-58 (T2) gave a low mean value (6.40) reflecting the highest bitterness in flesh. Kalpitiya White (T1) and MK-1 (T3) scored the mean values of 8.26 and 7.60 respectively, which showed high bitterness than the T4 and less bitterness than the T2. But T1 showed less bitterness than T3 (Table 3.5a).

The cause of bitterness in cucumber was more often related to production of cucurbitacins. Production of cucurbitacins is not a varietal character of cucumber. It was mainly due to production of ethylene. The ethylene production was caused by certain stress factors such as high environmental temperature, pest and disease incidents, fertilizer and moisture stress and any stress conditions (Wahundeniya, 2005). According to panellists' comments, the variety MK-2 has delicious flavour in flesh than other three varieties. Furthermore, the

varieties of MK-1, Kalpitiya White and LY-58 had good crispiness than variety MK-2.

Results of total soluble solids and fruit firmness of cucumber varieties are given in Table 3.5b.

ii. Total Soluble Solids (Brix value)

Significant differences were observed in Brix values among the varieties. It varied from 3.34% to 4.87%. The highest brix value (4.87%) was recorded in T4, while the lowest value (3.34%) was recorded in T3. There were no significant difference in brix values between T1 and T3. Brix value of treatment 2 was significantly different from T1, T3, and T4 (Table3.5b).

iii. Fruit Firmness

Significant differences were observed in fruit firmness among the varieties. It varied from 2.33 to 4.21kg. The highest value (4.21kg) was recorded in T1, while the lowest value (2.33kg) was recorded in T4. There were no significant differences in fruit firmness among T1, T2 and T3 while variety T4 was significantly different from others (Table3.5b).

The Brix value indicates the total soluble solids. Variety MK-2 (T4) had delicious flavour that denoted by highest brix value. So that MK-2 is not suitable for slicing cucumber than others due to its delicious flavour. Generally, cucumber had high amount of water and fewer amounts of soluble solids. The brix value of cucumber varied from 2% to 4% (Sarananda, 2005).

It is a known factor that fruits need to be firm, to resist the external forces that could damage the fruit. The Kalpitiya White (T1), LY-58 (T2) and MK-1 (T3) had firmed fruits which indicated better resistance against externally applied forces and is important feature in postharvest handling.

Table 3.5a. Probability (P) value and mean scores of sensory evaluation of cucumber varieties tested at Makandura during *maha* 2004/2005.

Attribute	P value	Kalpitiya White (T1)	LY-58 (T2)	MK-1 (T3)	MK-2 (T4)
Bitterness in flesh	0.0001	8.26	6.40	7.60	8.66

Probability value ($p<0.05$) significant different

Table 3.5b Total soluble solids and fruit firmness of cucumber varieties tested at Makandura during *maha* 2004/2005.

Varieties	Total soluble solids(Brix value)	Fruit firmness(kg)
Kalpitiya White (T1)	3.49%^{c}	4.21^{a}
LY-58 (T2)	3.95%^{b}	4.02^{a}
MK-1 (T3)	3.34%^{c}	3.84^{a}
MK-2 (T4)	4.87%^{a}	2.33^{b}
LSD	0.41	0.39
CV	6.63	6.86

Means followed by the same letter in each column are not significantly different at p=0.05

f. Pests and Diseases

Damages from *Aulacophora foveicollis* (Red pumpkin beetle), *Bactrocera cucurbitae* (Fruit fly) and *Liriomyza sativae* (Leaf miner) were observed. Damages of Fruit fly were minimized by pheromone trap (methyl eugenol) at on set of fruiting. Less infestation of leaf miner was observed in MK-1 and MK-2 than recommended variety Kalpitiya White.

Commonly observed diseases were Fusarium wilt (*Fusarium spp*), Downy mildew (*Pseudoperonospora cubensis*) and Cucumber mosaic virus (CMV) were observed. Higher infestation of downy mildew disease was observed in Kalpitiya White and LY-58.But variety MK-1 and MK-2 showed less susceptible to downy mildew. Higher number of dead vines were observed in MK-2 due to fusarium wilt at early vegetative stage during November and December months. Preliminary studies conducted at Makandura revealed that variety MK-1 possess tolerance to fusarium wilt and downy mildew diseases (Anon, 2004b).

g. Yield Parameters

Results of yield parameters of cucumber varieties are given in Table 3.6.

i. Number of Fruits per Vine

Significant differences were observed in number of fruits per vine among the varieties. It varied from 7.5 to 12.7 fruits per vine. The highest number (12.7) was recorded in T3, while the lowest number (7.5) was recorded in T2. There were no significant differences in number of fruits between T3 and T4 as well as between T1 and T2 (Table3.6).

ii. Yield per Vine

Significant differences were observed in yield per vine among the varieties. The values of yield per vine varied from 1.02 to 6.31kg. The highest value (6.31kg) was recorded in T1, while the lowest (1.02kg) was in T4. There were no significant differences in values betweenT2 and T3 (Table3.6).

iii. Total Yield

Significant differences were observed in total yield among the varieties. The total yield varied from 2.25 t/ha to 24.4 t/ha. The highest value (24.4 t/ha) was recorded in T1, while the lowest (2.25t /ha) was recorded in T4. There were no significant differences in total yield betweenT2 and T3 as well as between T1 and T2 (Table 3.6).

iv. Crop Duration

A significant difference was observed in duration of the crop among the varieties. The duration of crop varied from 64.0 to77.0 days. The maximum duration (77.0 days) was recorded in T1 and T2, while the minimum (64.0 days) was recorded in T4. There was no significant difference in crop duration between T3 and T4 (Table 3.6).

It was clear that total yield has been influenced by the yield per vine. Variety Kalpitiya White (T1) which had the highest yield per vine gave the highest total yield than other varieties. Though MK-1 (T3) had highest number of fruits per vine it was unable to give highest total yield per vine. It was mainly due to

its lower fruit weight, size and lower crop duration than T1. However, T3 gave highest number of fruits per vine than other varieties. The results also revealed that the prolonged crop duration has contributed to higher total yield .Variety T1 had the highest crop duration and total yield. The yield was lower in MK-2 (T4) because of the incidence of fusarium wilt disease that resulted in death of large number of vines. Further T4 also showed poor seed germination ability. It was noted that the spoilt fruits were resulted because of fruit rotting as secondary infection due to damages caused by larval stage of *Aulacophora foveicollis*

It must be noted that, the variety MK-2 is an intermediate type and there is a possibility of increasing the plant density per unit area by reducing the plant spacing. In situation like that the total yield per unit area can be increased by increasing the plant density. However, further studies are needed in future to work out a suitable spacing for intermediate types of cucumber.

Table 3.6. Number of fruits per vine, yield per vine, total yield and crop duration of cucumber varieties tested at Makandura during *maha* 2004/2005.

Varieties	No. fruits per vine	Yield per vine (kg)	Total yield (t/ha)	Crop duration (days)
Kalpitiya White (T1)	8.3 [b]	6.31[a]	24.4 [a]	77.0 [a]
LY-58 (T2)	7.5 [b]	3.66[b]	15.9 [ab]	74.7 [a]
MK-1 (T3)	12.7 [a]	3.66[b]	13.5 [b]	68.7 [b]
MK-2 (T4)	10.2 [ab]	1.02[c]	2.25 [c]	64.0 [b]
LSD	3.04	1.68	10.74	5.36
CV	19.63	28.66	47.96	4.71

Means followed by the same letter in each column are not significantly different at p=0.05

CONCLUSIONS

The two introduced cucumber varieties (MK-1, MK-2) showed better performances than the two check varieties. The variety MK-1 showed better performance in all attributes including vegetative, reproductive, fruit quality parameters, fruit quality assessment and yield parameters. However, MK-2 showed better performances in a few attributes including higher internode length under vegetative parameters, all the reproductive parameters, and bitterless in taste under fruit quality assessment. Furthermore, MK-1 was tolerance to fusarium wilt and downy mildew diseases than the recommended varieties Kalpitiya White and LY-58. Therefore, MK-1 has shown superior characters and it could be successfully cultivated in the low country intermediate zone cultivation in the North Western Province of Sri Lanka. Variety MK-2 too, could be introduced for home gardens with an alteration of agronomic practices. It is recommended that these new varieties be tested in farmer fields for the adaptability and acceptance by the farmers.

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