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## PROCEEDINGS

### OF THE

### 38<sup>th</sup> ANNUAL MEETING

June 30<sup>th</sup> – July 5<sup>th</sup> 2002  
Hôtel Méridien, Trois-Ilets, Martinique

**“Quel devenir pour l’agriculture caribéenne ?  
Qualité, économie, progrès social, environnement”**

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CHAMBRE  
D'AGRICULTURE  
MARTINIQUE

### Published by:

AMADEPA  
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97 232 Lamentin, Martinique  
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## **CULTIVAR EVALUATION FOR EGGPLANT PRODUCTION UNDER ORGANIC CROP MANAGEMENT SYSTEM IN THE U.S. VIRGIN ISLANDS**

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### **RESUME**

Des essais à la ferme ont été menés sur deux saisons afin d'évaluer le niveau de rendement des cultivars d'aubergines (*Solanum melongena* L.) conduits sur substrat organique. En 1998, les cultivars comprenaient 7 hybrides avec des fruits ovales ou ovoïdes et quatre types Orientaux, fécondés naturellement avec des fruits de forme allongée. En 2001, l'essai consistait en 5 hybrides et 3 cultivars de type Oriental. Les plants étaient espacés de 61 cm sur la ligne et 1.22 m entre les lignes. Les deux essais étaient établis en utilisant un schéma en bloc complet au hasard avec trois répétitions. Un système de culture substrat organique était adopté pour l'alimentation et l'ancrage des cultures. On utilisa un insecticide organique en pulvérisation, du fumier de vache et de l'herbe séchée. Des données étaient collectées sur le nombre de récoltes, la taille du fruit et le rendement commercialisable. Des différences considérables ( $P < 0,05$ ) étaient observées dans le rendement commercialisable parmi les cultivars compris dans les hybrides et les plants fécondés naturellement durant les deux saisons. En 1998, les cultivars hybrides à haut rendement étaient "Black Nite" (32.4 tonnes à l'hectare), le "Black Bell" (29,5 tonnes à l'hectare) et "Black Beauty" (28,8 tonnes à l'hectare). Parmi les cultivars de type Oriental fécondés naturellement "Trinidad Long" a produit le plus haut rendement. Les cultivars hybrides "Black Nite", "Black Bell" et "Black Beauty" ont obtenu le plus haut rendement en 2001 alors que le cultivar "Megal" a produit le plus haut rendement (18 tonnes à l'hectare) parmi le type Oriental. Les ravageurs communs étaient les cochenilles, les pucerons, les altises et les acariens. Les traitements organiques n'étaient pas très efficaces, mais réduisaient la population des ravageurs entraînant des dommages minimes. Les rendements commercialisables étaient comparables avec ou plus élevés que ceux rapportés dans l'évaluation d'essais précédents qui font état que les cultivars d'aubergines améliorés peuvent être conduits avec succès sous un système de substrat organique sans l'utilisation d'engrais chimiques et de pesticides.

### **ABSTRACT**

On-farm trials were conducted over two seasons to evaluate yield performance of eggplant (*Solanum melongena* L.) cultivars under organic crop management system. In 1998, cultivars included 7 hybrids with oval or egg-shaped fruit and 4 open-pollinated Oriental type, elongated fruit shape. Trial in 2001 consisted of 5 hybrids and 3 Oriental type cultivars. Plants were spaced 61 cm within rows 1.22 m apart. Both trials were established using a randomized complete block design with three replications. An organic crop management system was adopted in growing and maintaining the crops. These consisted of organic insect sprays, cow manure and grass straw mulch. Data were collected on number of harvests, fruit size and marketable yield. Significant differences ( $P < 0.05$ ) were observed in marketable yield among cultivars within hybrids and open-pollinated in both seasons. In 1998, top yielding hybrid cultivars were 'Black Nite' (32.4 t ha<sup>-1</sup>),

'Black Bell' (29.5 t ha<sup>-1</sup>) and 'Black Beauty' (28.8 t ha<sup>-1</sup>). Cultivar 'Trinidad Long' produced the highest yield among the open-pollinated type. Hybrid cultivars 'Black Nite', 'Black Bell' and 'Black Beauty' maintained top yields in 2001 whereas cultivar 'Megal' produced the highest yield (18.0 t ha<sup>-1</sup>) among the Oriental type. Common insect pests were mealy bugs, aphids, flea beetles and mites. Organic sprays were not very effective, but reduced pest population resulting in minimal damage. Marketable yields were comparable with or higher than those reported in previous evaluation trials which suggests that improved eggplant cultivars can be grown successfully under organic management system without the use of chemical fertilizers and pesticides.

## INTRODUCTION

Eggplant (*Solanum melongena* L.) ranks fifth as important vegetable crop in the Virgin Islands. The 1998 Census of Agriculture (U.S. Dept. of Commerce, 2000) reported a total production of 3,442 kg (7,572 lbs) from 50 farms with total area of 2.43 ha (6 acres). This production level is not sufficient to meet demands such that the Virgin Islands import most the eggplant from other islands and the mainland U.S. (Pearrow, 1992). Eggplant is a popular vegetable in the Virgin Islands and mainly used in local dishes. Common recipes include fried eggplant, stuffed eggplant, eggplant filling with rice and eggplant croquettes (Henry, 1994).

Eggplant can be grown year-round in the Virgin Islands, however, there are major constraints limiting increased production. These constraints are associated with crop management practices such as high cost of production, limited water resources and inefficient marketing system. The cost of production inputs (chemical pesticides, fertilizers, irrigation water, etc.) is a major expenditure that discourages vegetable growers to expand their operation. Production cost can be reduced by using alternative management system. Growing eggplant using organic and cultural methods encourages efficient use of local resources, thereby reliance to external and imported inputs. Adapting crop management strategies including use of cultivars adapted to low production and management inputs with high tolerance to pest and diseases would lead to a sustainable vegetable production.

There is little information on sustainable crop management practices and cultivars that can be adapted by vegetable growers in the Virgin Islands. Research is needed for screening new vegetable cultivars and evaluate yield performance under organic management systems since most of these cultivars are grown under high management inputs. The Agricultural Experiment Station has been conducting cultivar evaluation trials since 1980 and five of these trials were conducted for eggplant. Results of these evaluation trials are summarized in several report (Navarro, 1982; Ramcharan, 1981; Petersen, 1987; Palada, *et al.*, 1993). This study was conducted to: 1) evaluate the performance and adaptability of eggplant cultivars under low-input/sustainable production systems; and 2) select superior cultivars in terms of yield stability, pest and disease tolerance and quality for commercial production and home gardening.

## MATERIALS AND METHODS

The trial was located on farmer's field in Estate Glynn, St. Croix, Virgin Islands (Lat. 17°42'N, Long. 64°48'W). The soil is a Glynn gravelly loam (clayey, skeletal, mixed, superactive, isohyperthermic, typic argiustoll) as described by Lugo-Lopez, *et al* (1998). Average rainfall is 1015 mm per year. The first trial was planted on March 5, 1998 and harvested seven times on May 29, June 2, 10, 17, July 2 and August 6. The eleven cultivars evaluated and their fruit characteristics are shown in Table 1. Seven cultivars were hybrid and the other five were open-pollinated. Most cultivars have oval fruit with dark purple color. The second trial was established at the Agricultural Experiment Station on April 5, 2001 and harvested five times on June 5, 11, 18, 25 and July 5. Due to lack of seeds some cultivars in the 1998 trial were not planted in the second trial. Five cultivars were hybrid with oval-shaped fruit and three cultivars were long-fruited Oriental type eggplant (Table 1).

The cultivars were planted in plots consisting of three rows 7.3 m long and spaced 1.2 m apart. Each plot measured 3.6 m x 7.3 m or 26.3 m<sup>2</sup>. Plants were spaced 0.61 m withing rows. All plots were drip irrigated to maintain soil moisture tension at -30 kPa. The experiment was established using a randomized complete block design with three replications. The organic management system consisted of application of dehydrated cow manure (2-1-2), spraying of insecticidal soap (M-Pede), pepper sprays (Red Arrow), Azatin, and bacterial spray (Dipel). Cow manure was applied at the rate of 26 kg/plot (10 t.ha<sup>-1</sup>). All plots were applied with dry guinea grass (*Panicum maximum*) straw mulch at 15 cm thick. The straw mulch was spread over the whole plot area one week after planting.

Visual field observations were performed on the incidence of pests and disease during the early plant establishment, active vegetative growth and bloom stage. Plant height was measured during the first harvest. Data on number of fruits, fruit size, and fruit yield were taken at each harvest. All data were taken from a harvest sample of 5 plants in the middle row. Data were analyzed for statistical significance using the SAS program.

**Table 1. Eggplant cultivars evaluated under organic management system on St. Croix, U.S. Virgin Islands, 1998-2001.**

Cultivars	Type <sup>1</sup>	Fruit Shape	Fruit Color	1998	2001
Beauty	H	Oval	Dark Purple	Yes	No
Black Beauty	H	Oval	Dark Purple	Yes	Yes
Black Bell	H	Oval	Dark Purple	Yes	Yes
Black Nite	H	Oval	Dark Purple	Yes	Yes
Dumaguete Long Purple	OP	Oblong	Light Purple	Yes	No
Early Bird	H	Oval	Dark Purple	Yes	No
Italian Pink Bicolor	H	Oval	Pink	Yes	No
Philippine Long Purple	OP	Oblong	Light Purple	Yes	No
Pingtung Long	OP	Elongated	Light Purple	Yes	No
Trinidad Long Purple	OP	Oblong	Dark Purple	Yes	No
Viserba	H	Oval	Dark Purple	Yes	No
Epic	H	Oval	Purple	No	Yes
Rosita	H	Oblong	Rose Pink	No	Yes
Ichiban	H	Elongated	Purple	No	Yes
Megal	H	Elongated	Dark Purple	No	Yes
Orient Express	H	Elongated	Purple	No	Yes

<sup>1</sup>H=Hybrid; OP=Open pollinated

## RESULTS AND DISCUSSION

### *Plant height*

The average plant height of cultivars is shown in Figs. 1-4. In the 1998 trial, plant height of hybrid cultivars ranged from 33.7 cm for Early Bird to 80.9 cm for Italian Pink Bicolor and differences were significant (Fig. 1). Early Bird is the shortest cultivar and the first to produce fruits. It matured in 74 days after planting. All other cultivars matured in 85 days after planting. Trinidad Long Purple was the tallest among the open-pollinated cultivars (Fig. 2). Most of the open-pollinated cultivars are shorter than the hybrid types except for Trinidad Long Purple which has similar plant height with a hybrid cultivar Black Nite. It was also observed that taller cultivars have vigorous plants with many side branches than shorter cultivars. When it comes to manual harvesting, taller cultivars are much easier to harvest than shorter cultivars. Significant differences in plant height was also observed among the hybrid cultivars in 2001 (Fig. 3). Plant height ranged from 54 cm for Black Beauty to 71 cm for Rosita. Among the Oriental eggplant cultivars, tallest plants were measured in cultivar Megal (67 cm) while Orient Express produced the shortest plants (59 cm). It appears that cultivars Italian Pink Bicolor, Black Nite, Trinidad Long Purple, Black Bell, Beauty and Rosita have the plant height advantage over the other cultivars.

### *Number of Fruits, Fruit Weight and Total Fruit Yield.*

In 1998, there were no significant differences in total number of fruits for any of the two groups. However, significant differences ( $P < 0.05$ ) were observed in the average fruit size (Table 2). The largest hybrid fruits were harvested from cultivars Black Beauty (298 g) which were significantly larger than fruits from all of the other hybrid cultivars except Italian Pink Bicolor (Table 2). Cultivar Pingtung Long produced fruits with the least weight (94 g) of the open pollinated group. Trinidad Long Purple was superior to all other cultivars of this group (Table 3). Number of fruits differed significantly among cultivars in 2001. Rosita produced the greatest number of fruits followed by Black Bell and Black Nite (Table 4). No significant differences were observed in the number of fruits for the three Oriental eggplant cultivars (Table 5). However, Ichiban and Megal produced the greatest number of fruits which was twice that of Orient Express. Of the hybrid cultivars, fruit size was largest in cultivars Black Bell and Black Beauty (Table 4), however, differences were not significant.

Fruits of the Oriental eggplant cultivars are generally smaller and lighter than the hybrid cultivars. Orient Express produced fruits that are larger than Ichiban and Megal but differences were not significant (Table 5).

In 1998, the hybrid cultivars differed significantly ( $P < 0.05$ ) in total fruit yield (Table 2). The five highest yielding cultivars were Black Nite (32.4 t.ha<sup>-1</sup>), Black Bell (29.5 t.ha<sup>-1</sup>), Black Beauty (28.8 t.ha<sup>-1</sup>), Italian Pink Bicolor (26.1 t.ha<sup>-1</sup>) and Beauty (26.0 t.ha<sup>-1</sup>). These cultivars consistently produced higher yields in all harvests compared to the other cultivars (Table 2). Although cultivar Italian Pink Bicolor produced smaller number of fruits per plot, higher total fruit yield was attributed to its larger fruit size. Conversely, although cultivar Early Bird produced higher number of fruits per plot, low fruit yield was the result of smaller fruit size. Yields from the open-pollinated group ranged from 9 to 16.6 t.ha<sup>-1</sup> and there were no significant differences observed (Table 3). Total fruit yield in the 2001 trial was generally lower than those obtained in 1998 for both hybrid and Oriental cultivars (Table 4-5). Lower yield was attributed to

damage by Russet mites, pinworms and hornworms which resulted in fewer harvests. For hybrid cultivars fruit yield ranged from 17.0 t ha<sup>-1</sup> for Black Bell to 8.1 t ha<sup>-1</sup> for Epic. Differences in fruit yield among cultivars were significant ( $P<0.05$ ) for hybrids but not for Oriental cultivars (Tables 4-5). The three Oriental eggplant cultivars produced similar fruit yield.

The high yield of cultivars Black Bell and Black Beauty are consistent with those reported earlier by Ramcharan (1981), Petersen (1987) and Palada *et al.* (1993). Therefore, these cultivars are more likely to be stable in performance and adapted in the Virgin Islands under sustainable crop management practices. Their yield performance are consistently outstanding. Other promising cultivars are Black Nite, Beauty and Italian Pink Bicolor. These cultivars produced yields which are higher than Trinidad Long Purple, a common local eggplant grown by farmers. All open-pollinated and Oriental (elongated) egg plant cultivars are adapted to Virgin Islands with yield potential of over 10 t ha<sup>-1</sup>.

### ***Cultivar Response to Insect Pests and Diseases***

Visual observations throughout the growing season indicated that some cultivars were susceptible to damage by insect pests and virus infection. Incidence mosaic virus was evident in open-pollinated cultivars such as Dumaguete Long Purple, Philippine Long Purple, Trinidad Long Purple and Pingtung Long. Hybrid cultivars Viserba and Beauty also showed signs of mosaic virus. There were no symptoms of other fungal or bacterial diseases in all cultivars. Insect damage due to mealy bugs and aphids was common in cultivars Philippine Long Purple, Black Nite, Black Beauty, Dumaguete Long Purple, Beauty and Trinidad Long Purple. Insect damage in 1998 was minimal and did not seriously affect fruit yield. However, in 2001 infestation by Russet mites, pinworms and hornworms was significant in reducing total yield. It appears that most cultivars are sensitive to insect damage regardless of whether cultivars are hybrid or open-pollinated. Although organic sprays were not effective in bringing down pest population, marketable yields were within the range obtained from previous trials using conventional management practices.

### **SUMMARY AND CONCLUSIONS**

This study has shown that eggplant cultivars differed in their yield performance when grown under sustainable crop management practices. Five of the hybrid cultivars produced high yields while the open-pollinated cultivars were generally low yielding. In terms of total fruit production, the outstanding cultivars were hybrids Black Nite, Black Bell, Black Beauty, Italian Pink Bicolor and Beauty all with a total fruit yield of over 25 t.ha<sup>-1</sup>. These cultivars appear to be most adapted to production in the Virgin Islands under low-input sustainable crop management practices. Vegetable growers should select and plant these cultivars with minimum production inputs. The study also showed that eggplant can be grown successfully in the Virgin Islands without the use of chemical fertilizers and pesticides.

### **ACKNOWLEDGMENTS**

This research was supported by Hatch grant from the U.S. Department of Agriculture. The authors are grateful to Paulino Perez, Research Assistant, Nelson Benitez, Agricultural Aide, Renee Boston, Research Assistant, Laurel Royer and Esterlyn Matura student assistants for their



assistance in establishing the field trial, maintaining the trial plots and collecting samples and other data. Special appreciation is extended to Kirk Ajamu Benoit, Vegetable Grower who provided a portion of his farm for conducting the field trial.

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**Table 2. Total number of fruits, fruit size and total fruit yield of hybrid eggplant cultivars grown under organic management practices. St. Croix, .S. Virgin Islands, 1998.**

Cultivars	No. of fruits/ha (x1000)	Fruit size (g)	Total fruit yield (t.ha <sup>-1</sup> )
Black Nite	133	245 bc	32.4 a
Black Bell	131	231 c	29.5 a
Black Beauty	100	298 a	28.8 a
Beauty	111	235 c	26.0 ab
Early Bird	122	113 de	13.9 c
Italian Pink Bicolor	93	285 ab	26.1 ab
Viserba	122	145 d	15.9 bc

Mean separation in columns by Duncan's Multiple Range Test, P=0.05.

**Table 3. Total number of fruits, fruit size and total fruit yield of open-pollinated eggplant cultivars grown under organic management practices. St. Croix, U.S. Virgin Islands, 1998.**

Cultivars	No. of fruits/ha (x1000)	Fruit size (g)	Total fruit yield (t.ha <sup>-1</sup> )
Pingtung Long	124	94	11.5
Philippine Long Purple	117	144	16.4
Trinidad Long Purple	79	212	16.6
Dumaguete Long Purple	74	117	8.96

**Table 4. Total number of fruits, fruit size and total fruit yield of hybrid eggplant cultivars grown under organic management practices. St. Croix, U.S. Virgin Islands, 2001.**

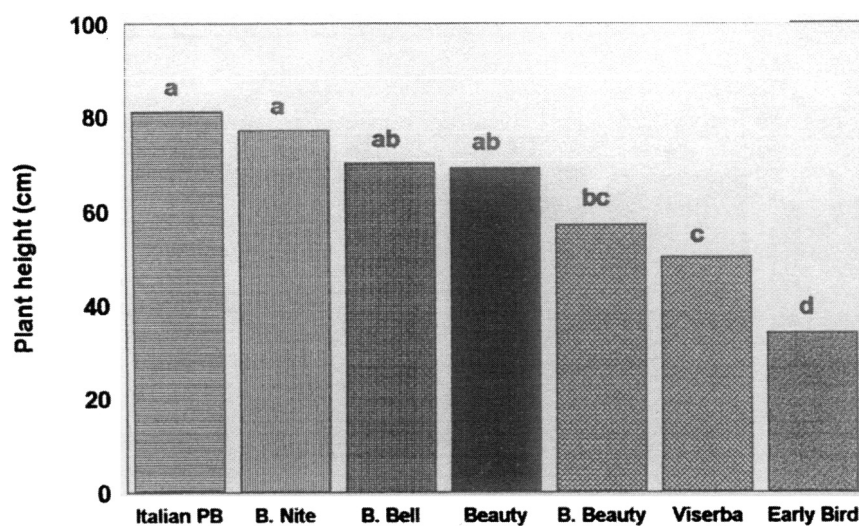
Cultivars	No. of fruits/ha (x1000)	Fruit size (g)	Total fruit yield (t.ha <sup>-1</sup> )
Black Bell	55 ab	305	17.0 a
Rosita	61 a	245	14.5 ab
Black Nite	54 ab	232	12.1 abc
Black Beauty	37 bc	304	11.2 bc
Epic	31 bc	262	8.1 c

Mean separation in columns by Duncan's Multiple Range Test, P=0.05.

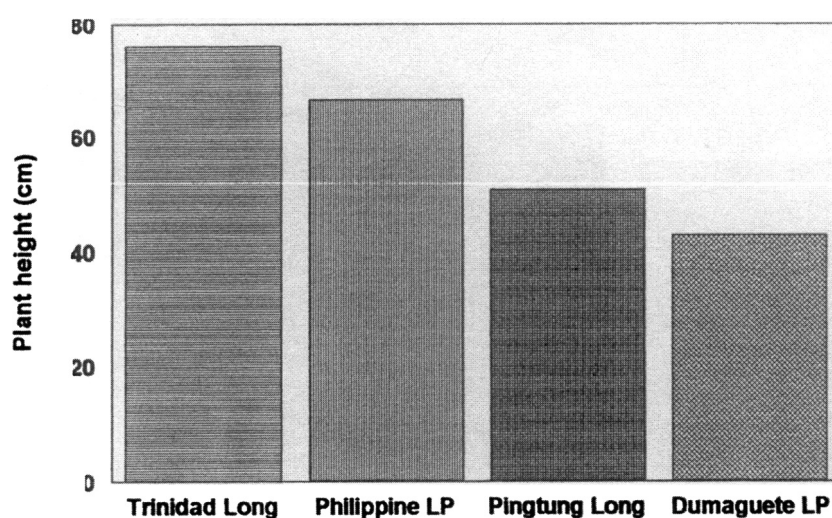
**Table 5. Total number of fruits, fruit size and total fruit yield of Oriental eggplant cultivars grown under organic management practices. St. Croix, U.S. Virgin Islands, 2001.**

Cultivars	No. of fruits/ha (x1000)	Fruit size (g)	Total fruit yield (t.ha <sup>-1</sup> )
Ichiban	80	126	10.1
Megal	79	149	11.9
Orient Express	42	182	10.2

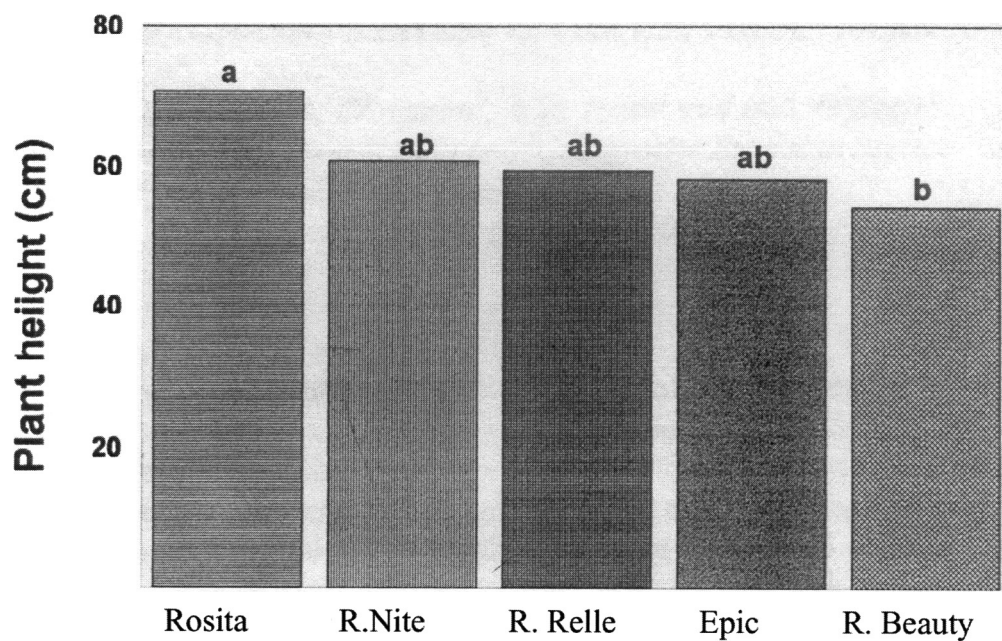
**Figure 1 : Plant height of hybrid eggplant cultivars, 1998**



**Figure 2 : Plant height to open-pollinated eggplant cultivars, 1998**



**Figure 3 : Plant height of hybrid eggplant cultivars, 2001**



**Figure 4 : Plant height of Oriental eggplant cultivars, 2001**

