JULIE MANGO
IN THE EASTERN CARIBBEAN

A comprehensive manual

Caribbean Agricultural Research and Development Institute (CARDI)

The Technical Centre for Agricultural and Rural Cooperation (CTA)

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Annex 1 Principal findings of CARDI's research programme on Julie mango

Pathology

- Anthracnose disease inoculum is present throughout the crop cycle i.e. from leaf flushing to bearing.
- Inoculum is found on dead twigs.
- High relative humidity (over 95%) was shown to be highly correlated with disease intensity and incidence.
- Isolates on fruits, leaves and flowers showed different sensitivity to fungicides.
- Pathotypes of Collectotrichum isolates were found to be insensitive to copper and only sensitive to benomyl at high concentrations. These factors eliminate two commonly recommended fungicides.
- *In vitro* studies indicated that prochloraz (Sportak ®) at low concentrations is effective in controlling the disease, this needs to be tried in the field.
- Data over five seasons collected on three farms, show consistently lower anthracnose disease severity in Roger, Melville Hall and Grand Savanne which are relatively dry areas of Dominica, when compared with higher severity in Stowe, Salisbury Heights and the North Eastern parts of the Island. These data will allow more accurate determination of appropriate zones for mango production in the region.
- An anthracnose disease severity score procedure was defined as a tool to be used by extension agents to predict accurately potential damage in any season for planning harvest and postharvest activities in mango. This procedure is being validated.

Entomology

- Caribbean fruit fly, *Anastrepha obliqua* causes losses ranging from 20–100% in Julie mango in Dominica.
- An integrated pest management strategy comprising field sanitation, spraying with malathion, and use of baited McPhail ® traps reduces losses to fruit fly from 60% to 10%.
- This technology is more suited to orchard systems with yields of 200 fruits per tree; fruit losses of 20% justify the use of traps.
- For high yielding single trees, the technology is justified only when the fruit losses are 60%.
- Plastic Liquibator ® traps which are cheaper and more durable, proved to be as effective as glass McPhail ® traps and can therefore result in reduced cost of this technology.
- Gall midge *Erosomyia mangiferae* attacked 23–68% of the inflorescence on Julie mango depending on the state of development of the inflorescences. Higher infestations occurred in wet humid areas.
- Some 55–69% of the gall midge larvae were parasitised by *Platygaster* spp. Parasitism varied with location.
- Inflorescence death was caused primarily by invasion of saprophytic bacterial *Botrydiplodia theobromae* and *Phomopsis mangiferae.*

Postharvest technology

- The United States Department of Agriculture's requirement of 'probit 9' larval mortality (99.996% mortality) for fruit flies can be achieved through treatments with hot water at 48°C for 35 minutes, during which a pulp temperature of 46°C is achieved.
- Probit 9 is achieved within 24 hours using the above treatment.
- An economic analysis was completed for the hot water treatment facility designed for Dominica Export Import Agency (DEXIA). The income statement gives a deficit of EC$39,962 in the first year with 70 tonnes of fruit marketed. Income rises to EC$296,803 in year 5 with 1100 tonnes of fruit marketed. The facility breaks even in Year 2 at 193 tonnes of fruit marketed. Sensitivity analyes show that if 30% of the fruit are culled, or price of fruit delivered to the facility rises to EC$1.85/kg, or the wholesale price in London falls to EC$4.56/kg, there are no profits before tax. Profitability is affected most by the London prices.
- When mature Julie mango fruits were treated with a solution of benomyl (1.0g/L a.i.) at 46°C and assessed after seven days, fruit flies and anthracnose incidence were reduced significantly.
- The incidence of shrivelling on ripe fruits increased significantly whether mangoes were stored either in ambient conditions or simulated shipping conditions, though there was no evidence of deterioration of fruit internally.
- Exporters traditional postharvest treatment with sea water and lime juice neither improved pericarp colour nor reduced anthracnose. The incidence of soft rots increased from 20 to 50% and 70 to 80% respectively.
- The most effective time/temperature combination for anthracnose control was treatment with hot water for 5 minutes at 53°C and 15 minutes at 50°C for Julie and Long mango respectively.

Agronomy

- Potassium nitrate had no significant effect on flower induction in Julie mango. Neither brix percentage, nor acid concentration nor brix/acid ratio were influenced by the treatment.
- A study of the biological cycle of Julie mango at five locations in Dominica provided data on flushing, flowering and intensity of flowering, fruit set and fruit retention. These data are being used to delimit the most appropriate areas for Julie mango production.

Annex 2 Project staff

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Annex 3 Concerning the marketing and commercial quality control of mangoes moving in international trade between and to UN/ECE member countries

I. DEFINITION OF PRODUCE

This standard applies to mangoes of varieties (cultivars) grown from *Mangifera indica L.* to be supplied fresh to the consumer, mangoes for industrial processing being excluded.

II. PROVISIONS CONCERNING QUALITY

The purpose of the standard is to define quality requirements for mangoes at the export control stage, after preparation and packaging.

A. Minimum requirements

In all classes, subject to the special provisions of each class and the tolerances allowed, the mangoes must be:

- intact
- firm
- fresh in appearance
- sound; produce affected by rotting or deterioration such as to make it unfit for consumption is excluded
- clean, practically free from any visible foreign matter
- practically free from pests
- practically free from damage caused by pests
- free from black stains or trails which extend under the skin
- free from marked bruising
- free from damage caused by low temperature
- free of abnormal external moisture
- free of any foreign smell and/or taste

Mangoes must be sufficiently developed and display satisfactory ripeness.

Mangoes must be carefully picked at the stage of physiological development so as to enable them:

- to ensure a continuation of the ripening process until they reach the appropriate degree of ripeness corresponding to the varietal characteristics,
- to withstand transport and handling, and
- to arrive in satisfactory condition at the place of destination.

In relation to the evolution of maturing, the colour may vary according to variety.

B. Classification

Mangoes are classified in three classes defined below:

(i) Extra Class

Mangoes in this class must be of superior quality. Shape and colouring must be characteristic of the variety.

They must be free of defects, with the exception of very slight superficial defects provided these do not affect the general appearance of the produce, the quality, the keeping quality and presentation in the package.

(ii) Class I

Mangoes in this class must be of good quality. They must be characteristic of the variety.

However, the following slight defects may be allowed provided these do not affect the general appearance of the produce, the quality, the keeping quality and presentation in the package:

- slight defects in shape

- slight defects of the skin due to rubbing or sunburn, suberized stains due to resin exudation (elongated trails included) and healed bruises not exceeding 3, 4, 5 cm^2 for size groups A, B, C respectively.

(iii) Class II

This class includes mangoes which do not qualify for inclusion in the higher classes but satisfy the minimum requirements specified above.

The following defects may be allowed provided the mangoes retain their essential characteristics as regards the quality, the keeping quality and presentation:

- defects in shape
- defects of skin due to rubbing or sunburn, suberized stains due to resin exudation (elongated trails included) and healed bruises not exceeding 5, 6, 7 cm^2 for size groups A, B, C respectively.

In classes I and II it is also allowed:

- scattered rusty lenticels
- a yellowing of green varieties due to exposure to direct sunlight, not exceeding 40% of the surface of the fruit, excluding necrotic stains.

III. PROVISIONS CONCERNING SIZING

Size is determined by the weight of the fruit[1]. The minimum weight of mangoes must not be less than 200 g. Mangoes are sized according to the following size groups:

Size Code	Weight (g)	Maximum permissable difference between fruit within the package (g)
A	200 — 350	75
B	351 — 550	100
C	551 — 800	125

IV. PROVISIONS CONCERNING TOLERANCES

Tolerances in respect of quality and size shall be allowed in each package for produce not satisfying the requirements of the class indicated.

A. Quality tolerances

(i) "Extra Class"

Five percent by number or weight of mangoes not satisfying the requirements of the class but meeting those of Class I or, exceptionally, coming within the tolerances of that class.

(ii) Class I

Ten percent by number or weight of mangoes not satisfying the requirements of the class but meeting those of Class II or, exceptionally, coming within the tolerances of that class.

(iii) Class II

Ten percent by number or weight of mangoes satisfying neither the requirements of the class nor the minimum requirements, with the exception of fruit affected by rotting, marked bruising or any other deterioration, rendering it unfit for consumption.

B. Size tolerances

For all classes: Ten per cent by number or weight of mangoes conforming to half of the permissible difference of the related size group above or below the range specified on the package, with a minimum of 180 g for those packed in the smallest size range and a maximum of 925 g for those in the largest size range.

V. PROVISIONS CONCERNING PRESENTATION

A. Uniformity

The contents of each package must be uniform and contain only mangoes of the same origin, variety, quality and size.
The visible part of the contents of the package must be representative of the entire contents.

B. Packaging

Mangoes must be packed in such a way as to protect the produce properly.
The materials used inside the package must be new, clean and of a quality such as to avoid causing any external or internal damage to the produce. The use of material and particularly paper or stamps bearing trade specifications is allowed, provided the printing or labelling has been done with non-toxic ink or glue.
Package must be free of all foreign matter.

VI. PROVISIONS CONCERNING MARKING

Each package[2] must bear the following particulars, in letters grouped on the same side, legibly and indelibly marked, and visible from the outside.

A. Identification

Packer	Name and address or
And/or	officially issued or
Dispatcher	accepted code mark.[3]

B. Nature of the produce

"Mangoes" if the contents are not visible from the outside
Name of the variety

C. Origin of the produce

Country of origin and, optionally, district where grown or national, regional or local place name.

D. Commercial specifications

Class
Size expressed as minimum and maximum weight
Size code (optional)
Number of fruit

E. Official control mark (optional)

Notes:

[1] Australia at present determines size of mangoes on the basis of diameter and has placed its reservation on this point ad referendum.

[2] Package units of produce, pre-packed for direct sale to the consumer, shall not be subject to these marking provisions, but shall conform to national requirements. However, the markings referred to shall in any event be shown on the transport packaging containing such package units.

[3] The national legislation of a number of countries require the explicit declaration of the name and address. However, in the case where a code mark is used, the reference "packer and/or dispatcher (or equivalent abbreviations)" has to be indicated in close connection with the code mark.

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Annex 4 Draft OECS Standards for Mango

1. Scope and Objectives

These grade standards apply to mangoes (*Mangifera indica* L.), grown in OECS countries to be supplied fresh as ripe fruit to the consumer market and excludes products for industrial processing. They are aimed at providing clear and common specifications or descriptions of the main acceptable quality levels (grades) so as to:

(a) Avoid misunderstanding and confusion among those involved in the marketing chain.
(b) Provide an objective basis for relating price to quality.
(c) Encourage better selection, packaging, and presentation of produce as a means of obtaining greater income overall.
(d) Assist exporters and their countries in meeting export market requirements and thereby enhancing their reputation and market position.

The grade standards are voluntary, unless products are stated as being of a particular grade or if governments have established legal minimum requirements.

2. Application of the Standards

The grade standards refer to the condition the produce should be in at the point of dispatch by the seller.

3. Definition of the Terms

(a) Similar Varietal Characteristics: means that mangoes shall be of the same variety, showing similar shape, skin and flesh colour, flavour, and odour.
(b) Mature: means that the mangoes have reached a state of development that will ensure that they arrive on the market in an acceptable condition subject to the expected type of transportation and handling conditions, and that they will ripen with the colour, flavour, and texture, acceptable to the consumer. This is normally 3/4 mature, as shown by rounded shoulders and cheeks and by loss of sheen.
(c) Clean: means that the mangoes are free from dirt, foreign material, and odours.
(d) Desired Size: means the sizes requested by the customer.
(e) Size Difference: means the difference in weight between the largest and the smallest mango in any package, expressed as a percentage of the larger.
(f) Damage: means physical or physiological injury to the fruit, such as decay, chilling injury, insect damage, sunscald, bruises, cracks, wounds or punctures which could lead to the abnormally quick deterioration of the fruit, and cause rejection by most consumers.
(g) Blemish: means any physical injury affecting the surface of the fruit, such as scars or scratches, which detracts from its natural appearance, but will not significantly affect its shelf life.
(h) Disease: means any signs of the growth of mold, fungus, or development of dry or soft rots such as anthracnose.
(i) Insect Free: means no signs of live or dead insects at any stage of development shall be present on or in the fruit or in the package.
(j) Firm: means not soft.

Grade 1	Grade 2	Grade 3
Individual Fruit		
1. Blemish free	1. Blemishes shall not exceed more than 5% of the surface area	1. Blemishes shall not exceed more than 10% of the surface area
Tolerance		
1. Not more than 10% size difference. 2. Not more than 5% shall fail to meet the specifications, of which not more than 2% shall be due to damage and disease on receipt by the buyer.	1. Not more than 20% size difference. 2. Not more than 10% shall fail to meet the specifications of which not more than 2% shall be due to damage and disease on receipt by the buyer.	1. Not more than 35% size difference. 2. Not more than 15% shall fail to meet the specifications of which not more than 2% shall be due to damage and disease on receipt by the buyer.
Packaging		
New clean adequately ventilated boxes preferably fully protecting the fruit, with the fruit packed in single layers and containing no more than 5kg (11 lb).	New clean adequately ventilated boxes fully protecting the fruit, and containing no more than 10 kg (22 lb).	Clean boxes adequately ventilated fully protecting the fruit, and containing no more than 18 kg (40 lb).

(k) Properly Trimmed: means the stalk is intact and not more than 6 mm (1/4 inch) long.

(l) Similar Maturity: means that there should be no very distinct visual difference in harvest maturity between mangoes in the same box.

(m) Lot: two or more mangoes whether or not packaged, but sold as one distinct and separate group.

(n) Properly Labelled: meets the requirements of the importer and importing country legislation; each box for export shall be legibly and indelibly marked on at least two sides. Labelling may include:

- Name and address of exporter
- Name and address of consignee
- Name of produce/variety
- Country of origin
- Grade of produce
- Net weight of package as Kgs (Lbs)
- Postharvest treatments eg. Waxing or fungicide use
- Number of pieces per package (count)
- Storage and ripening temperature requirements

(o) Correct Packed Weight/Count: means that the weight placed in the package shall take account of the expected natural weight loss and ensure that the buyer gets the net weight/count stated on the package.

4. Quality Requirements

4.1 Minimum Requirements

Mangoes shall be:

- The same variety
- Clean
- Mature
- Of similar maturity stages
- Free from damage
- Free from insects
- Free from diseases
- Properly trimmed
- Firm
- Of the desired size
- In properly labelled packages
- Of correct packed weight

4.2 Grade Requirements

The degree or tolerance for the individual grade are meant to account for normal human error in sorting and packing, and for the deterioration in quality that may occur between the point of dispatch and receipt and should not be deliberately exploited by the packer.

All grades shall meet the minimum requirements as well as the following additional requirements. In addition, grades 1 and 2 shall consist of only grafted varieties.

5. Minimum Extraregional Export Requirement

Grade 2 shall be the minimum grade exported to extra-regional markets.