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Postharvest Handling
Technical Bulletin

BORA (YARD LONG BEAN)

Postharvest Care and Market Preparation

Technical Bulletin No. 20

April 2004

POSTHARVEST HANDLING TECHNICAL SERIES

BORA (YARD LONG BEAN)

Postharvest Care and Market Preparation

Ministry of Fisheries, Crops and Livestock
New Guyana Marketing Corporation
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Preface

This publication is part of a series of technical bulletins that seek to provide specific recommendations for improvements in postharvest care and market preparation for selected non-traditional agricultural products. The intended audience for this series is primarily extension agents.

Initial market assessments in current export markets and visits with producers and exporters in Guyana have shown the quality of fresh produce currently exported is uneven and in some instances very poor. Stages all along the export chain from harvest and pre-harvest to transportation and final export are all in need of improvement. Pre-harvest practices, sanitation at the packinghouse, packaging, bacterial and fungal problems, and transportation were all identified as areas where improvement could benefit the quality and increase the shelf life of Guyana's fresh produce exports. The technical bulletins address these issues specific to each product. Harvesting techniques and crop maturity indices are provided. Preparation for market, including cleaning, sorting, packing and transportation are covered. The bulletins address and recommend specific storage conditions, covering temperature and humidity controls. Finally the bulletins address postharvest diseases and insect damage.

The undertaking of these technical bulletins is a joint effort of the Ministry of Fisheries, Crops and Livestock; the New Guyana Marketing Corporation (NGMC) and the National Agricultural Research Institute (NARI) to improve quality, increase production and promote exports. As a team, the three agencies are working on the problems, limitations, and constraints identified in the initial reconnaissance surveys, from production and post harvest handling problems, to packaging and transportation, to final market.

Introduction

Bora (*Vigna sesquipedalis*), also known as long bean or yard long bean, is one of the most perishable vegetable crops grown in Guyana. It is a high respiring elongated edible bean pod harvested at an immature stage of development. Bora quality depends on the maturity stage of the pods at harvest and the postharvest care. Cooling of the pods right after harvest combined with low temperature storage are the principal methods to maintain bora quality and extend market life. The vast majority of the bora produced in Guyana is marketed domestically. Small volumes are exported by air to Barbados, Canada, and the U.S. Postharvest handling practices must be improved before increased export market share will be realized.

Harvest Maturity Indices

Bora is harvested at an immature stage, prior to full development of the seeds and pod. The initial harvest maturity can be estimated by counting the number of weeks after planting. Bora requires about 7 weeks from seeding until the start of harvest, depending on cultivar and environmental conditions. The harvest period typically continues over a period of about 6 to 8 weeks. Pod length and pod diameter are the two principal indices of harvest maturity. Pod diameter is more closely related to edible quality than length.

Bora is typically harvested when the pods have reached a minimum length of 38 cm (15 inches). However, some markets prefer longer pods of up to 76 cm (30 inches). Pod length is significantly influenced by vigor of the plant and cultivar. Highly vigorous plants may produce pods of 90 cm (35 inches) in length. Highest quality pods are straight, crisp, and uniform in colour (Figure 1). The most popular cultivars have a green colour, although specialty markets may prefer cultivars which produce a reddish-coloured pod (Figure 2).

Figure 1. Long, straight dark green bora ready for harvest.

Figure 2. Purple coloured bora pods for specialty markets.

Pod diameter enlarges with maturity and bora should be harvested when the pods have reached about 1 cm (0.4 inches) in diameter. At this diameter the immature seeds will be slightly protruding or bulging outward (Figure 3). Bora should be harvested before the seeds fill out the pods. Pod diameter should not exceed 1.25 cm (0.5 inches). Over-mature pods are tough and unsuitable for eating.

Harvest Methods

Bora should be harvested by pinching the stem with the thumbnail pressed against the index finger. A short section of the stem should remain attached to the pod. If done carefully, twisting of the pod off the plant can be done provided the stem remains attached to the pod. Pickers should be careful not to tear or pull the pods off the plant. The pod should never be severed below the stem, as this creates an open wound in the pod which would be a likely site for decay establishment. Rough handling of the pods during harvest should be avoided as this will result in tissue damage and subsequent decay. In addition, harvested pods should never be packed tightly into the harvest container or allowed to remain in the sun for extended periods. Do not put damaged, diseased, or culled pods in the same harvest container as the marketable pods.

Figure 3. Slightly bulged pods with acceptable diameter for harvest.

Harvesting should be done during the coolest time of the day, which typically is in the early morning. However, picking should not begin until the moisture on the plants has evaporated. Harvesting after the pods have dried will help prevent the spread of postharvest diseases and will result in less contamination by dirt and debris. Avoid harvesting in the afternoon, as the pods will be the least swollen at this time. Harvest frequency should be every other day or every third day, depending on growth rate of the pod. The harvest container should be well-ventilated and not contain more than about 10 kg (22 lbs) of pods in order to avoid over-heating. Once harvested, bora should be protected from direct sunlight. Heat increases pod respiration rate, which is already relatively high after harvest.

Preparation for Market

Bora is highly perishable and must be prepared for market within several hours after picking, particularly if there is no cool storage facility available to temporarily hold the pods. Delayed postharvest cooling and exposure to the sun will soon result in pod shriveling and quality deterioration. Limiting the time between harvesting and cooling to no more than 1 or 2 hours will help maximize potential shelf life (Figure 4). Bora held at ambient temperature for 1 hour before cooling will lose about 2% of its original weight. If the delay in cooling is 5 hours,

Figure 4. Bora should be transported to the packing facility immediately after harvest.

bora may lose up to 10% of its original weight. The steps in market preparation involve cleaning, sorting, and packing. The packing area should be shaded, clean, and well ventilated.

Figure 5. Harvested bora spread on a flat table for easy inspection and cleaning.

Cleaning

The initial step in market preparation involves cleaning of the harvested product. This is typically done by spreading the pods out in a shallow layer on top of a clean, flat surface (Figure 5). Spreading bora pods out on a flat surface helps to dissipate field heat before packing. Any pod found with a stem longer than 1 cm should be re-trimmed to a shorter length. Bora should be cleaned by removing any leaves, stems, broken pods, blossom remains, insect-damaged, or partially decayed pods.

Generally, bora should not be washed because of the likelihood of spreading decay organisms. However, the Barbados export market requires a postharvest wash treatment for phytosanitary reasons (Figure 6). In this case, bora should be submerged in clean water adjusted to a pH of 6.5 and sanitized with 150 ppm hypochlorous acid. Household bleach is the most convenient source of hypochlorous acid and is widely available in a 5.25% solution. Following the washing treatment, the bora pods should be air dried on a clean, flat surface before sorting and grading (Figure 7).

Figure 6. Cleaning of bora in properly sanitized wash water for the Barbados market.

Figure 7. Fan used to speed up air drying of bora prior to grading and packing.

Sorting/Grading

There are no established grade standards for bora, but the pods should be sorted according to length, maturity, and external appearance. The length and thickness of the harvested bora pods is often quite variable. Uniform length and diameter of the bora pods in each bundle and carton is critical for market acceptance. Pod colour should be bright and typical of the cultivar. Each pod should be free of blemishes. Pods displaying rusty brown spots or other blemishes indicate disease, injury, or the possibility of deterioration and should be discarded.

The pods should be well-formed and straight, uniform in colour with a fresh appearance, and tender but firm (Figure 8). They should snap easily when bent. Freshness is indicated by a distinct, audible snap when the pod is broken. Buyers prefer bora with no bulge or only a slight bulge, which indicates the pods are tender with immature seeds. Over-mature bora with bulging pods are tough and fibrous. On the other hand, too immature pods are highly susceptible to wilting.

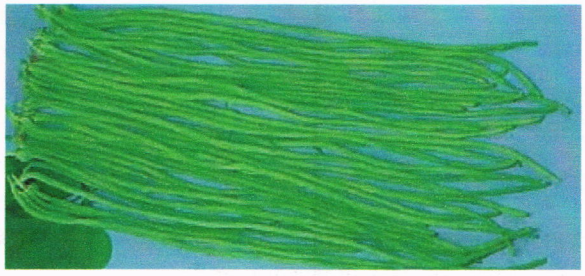

Figure 8. High quality pods are long and straight with a uniform green colour.

Packing

Bora is typically wrapped in bunches for marketing (Figure 9). Exporters prefer to purchase bora in larger bunches of 350 individual pods, while domestic markets prefer smaller bunches.

Figure 9. Bora wrapped in small bunches (foreground) for domestic marketing.

Several different container types are used for packing bora. Large sacks are often used in the domestic market. However, canvas or polypropylene sacks should not be used because the pods will rapidly heat and wilt due to restricted ventilation. Reed baskets are often used as packaging materials for exporting bora to Canada (Figure 10). However, they do not have an attractive appearance and are not desirable for display on wholesale markets.

Figure 10. Reed baskets used as export packages do not have an attractive visual appeal.

Figure 11. Bunches of bora should be loosely packed inside fiberboard cartons for export.

Well-ventilated fiberboard cartons provide more protection and are recommended, especially for export. Bora should be loosely packed within the carton to allow for adequate heat dissipation (Figure 11).

Temperature Management

Bora has a very high respiration rate and generates large amounts of heat at ambient temperatures. The pods will rapidly lose moisture and crispness and become limp if not cooled immediately after harvest. Bora should be cooled to 5°C (42°F) as soon as possible after harvest to maintain its edible quality and crisp texture. Pods that are not cooled will quickly wilt, lose crispness, and have only a 1 or 2 day market life. Postharvest decay will also quickly begin at ambient temperatures.

The most practical way of cooling bora is to loosely stack the pods on a clean surface inside a cold room with high humidity and good air flow. To speed up the rate of cooling, fans should be used to increase the rate of air circulation.

Hydrocooling, the process of bringing chilled water into contact with the pods, is the quickest method of cooling bora. Water is a better heat transfer agent than air. However, if hydrocooling is used, the water must be very clean and properly sanitized to prevent contamination of the bora with postharvest pathogens. Any open wound, cut, or tear in the pod will provide an entry point for bacteria and fungi. It is very important to maintain a 150 ppm chlorine concentration and keep the water pH at 6.5 for optimal sanitation. Severe postharvest decay will occur if the water is not properly chlorinated or if the pods are allowed to re-warm after hydrocooling. Therefore, although hydrocooling is the most effective method of cooling, it should be used only if adequate sanitation methods are followed and refrigeration facilities are available to maintain a continuous product cool chain during distribution to market.

After cooling, bora should be held at its optimum storage temperature of 5°C (41°F). At this temperature, bora will have a 7 day market life. It is important to maintain the cool

chain during transport and distribution to market. Pods allowed to re-warm will have moisture condensation on their surface, which is a favorable environment for the development of postharvest decay.

When refrigeration is not available and the intended market is local, practices such as harvesting during the coolest part of the day, soaking the bora in clean cool water, and keeping the harvested pods in shade will help to extend the market life.

Relative Humidity

Harvested bora is highly susceptible to water loss and wilting. Pod shriveling and loss of crispness will soon occur if the postharvest relative humidity (RH) is low. About 5% weight loss is needed before shriveling and limpiness are observed. After 10% to 12% weight loss, the bora is no longer marketable. The rate of water loss from immature pods is higher than from more mature pods. In order to minimize wilting and quality loss, bora should be held at 95% RH. This may be obtained by the use of a supplemental humidifier or water vaporizer in the cooling and storage area. Packaging materials that allow for the establishment of a high RH microenvironment should also be used.

Principal Postharvest Diseases

Bora is a highly perishable vegetable crop subject to various fungal and bacterial decays. The principal postharvest fungal diseases of bora include cottony leak, rhizopus rot, gray mould, watery soft rot, and anthracnose. The principal postharvest bacterial disease is soft rot.

Cottony Leak

Cottony leak, caused by the soil-borne fungus *Pythium*, is a common postharvest decay of bora. Infection begins in the field and the decay progresses after harvest. The incidence of cottony leak is higher during the rainy season. The first symptoms of cottony leak are dark lesions of irregular shape, which enlarge rapidly at ambient temperatures. Under humid conditions, a white cottony mould may cover the pod and liquid may leak from the rotting tissue (Figure 12). Mould from infected pods will spread to adjacent healthy pods, forming nests of decay in packed cartons. In order to minimize cottonly leak, bora should always be harvested when dry and handled with care to avoid wounding of the pod surface. In addition, the pods should be cooled to 5°C (41°F) immediately after harvest.

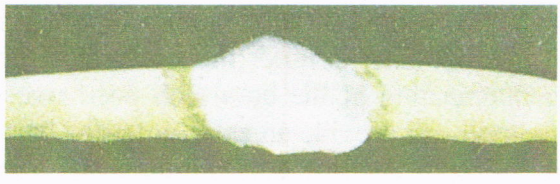

Figure 12. White mould associated with cottony leak.

Rhizopus Rot

Rhizopus rot, caused by the fungus *Rhizopus*, is another common postharvest disease of bora. Injury predisposes the pods to infection, which occurs under warm, moist conditions. Initially, small water-soaked spots form on the pod surface. The decayed tissue becomes soft and watery, with considerable leakage of fluid. Grayish-white masses of mould develop over the infected area (Figure 13). In contrast to cottony leak, Rhizopus rot is characterized by the formation of coarse strands of white mould and round black spore heads. A distinctive sour odour may accompany the decay. Nests of mould and decaying pods form within a carton of packed bora. The main ways to control Rhizopus rot are to harvest when the pods are completely dry, avoid injury to the pods during harvest and handling, and cool the pods to 5°C (41°F) immediately after harvest. Moisture condensation on the pod surface should also be avoided during transport to market.

Gray Mould

Gray mould, caused by the common soil-borne fungus *Botrytis cinerea*, causes dark spotting on the surface of the bora pod (Figure 14). An obvious growth of gray-coloured mould will eventually cover the infected areas of the pod. Control of this disease is obtained by a combination of pre-harvest fungicide sprays, removal of infected crop debris, careful handling practices to avoid damage to the pod surface, and prompt cooling to 5°C (41°F).

Figure 13. Severe infestation of Rhizopus rot forming a nest of mould growth.

Figure 14. Dark spots on pod surface characteristic of gray mould.

Watery Soft Rot

Watery soft rot, caused by the soil-borne fungus *Sclerotinia*, is a common pod disease of bora, especially during periods of prolonged wet weather. This disease is also referred to as white mould. Symptoms begin as water-soaked lesions that soon turn brown and become covered with a dense white mould (Figure 15). Pods appearing healthy at harvest may rot during transit or storage. Nests of decay develop most rapidly at around 25°C (77°F). Good aeration of the plant in the field is important in minimizing this disease.

Pre-harvest sprays of systemic fungicides can also be effective in retarding watery soft rot. Holding of the pods at 5°C (41°F) will significantly slow disease development.

Anthracnose

Anthracnose, caused by the fungus *Colletotrichum,* may be severe on bora grown under poor field sanitation or when infected seed is used in planting the field. The disease is more severe during the rainy season and pods may appear healthy at harvest but undergo rotting during transit and marketing. Initial disease symptoms appear as dark specks or blotches on the pod surface. Individual lesions may become sunken and are typically gray or black in the center (Figure 16). They may coalesce and discolour much of the pod. Wounds and skin damage predispose the pod to infection. The optimal temperature for anthracnose development is 25°C (77°F). Cooling the pods to 5°C (41°F) as soon as possible after harvest will arrest the growth of this disease.

Figure 15. Watery soft rot (right) with typical white mould growth.

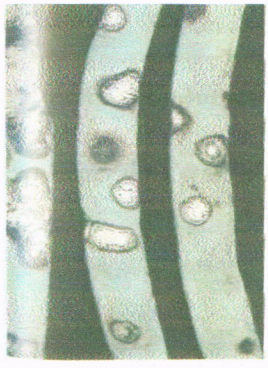

Figure 16. Anthracnose lesions on pod surface.

Bacterial Soft Rot

Bacterial soft rot, caused by *Erwinia carotovora*, is the main postharvest bacterial disease of bora. The bacteria is a secondary decay organism and attacks tissue weakened by injury, sunscald, chilling injury, or fungal attack. Soft rot rapidly develops in warm, moist storage environments. Pods become soft, slimy, and foul smelling (Figure 17). Control of this disease is obtained by careful harvesting and handling practices to prevent wounding of the tissue, avoiding postharvest fungal growth, and maintenance of the pods at 5°C during transport and distribution to market.

Figure 17. Slimy rot symptoms of bacterial soft rot.

Halo Blight

Halo blight, caused by *Pseudomonas syringae*, is another bacterial disease that may infect bora. The disease is most commonly observed on pods harvested during the rainy season. Symptoms first appear as tiny, water-soaked pinpricks on the surface. These gradually enlarge and appear as small greasy spots scattered on the pod (Figure 18). The spots eventually darken, appear sunken, and sometimes a whitish ooze is emitted from the center. Development of halo blight is rapid under ambient temperatures. Control of this disease is obtained by planting disease-free seed, avoiding harvest when the pods are wet, and holding the bora at 5°C(41°F).

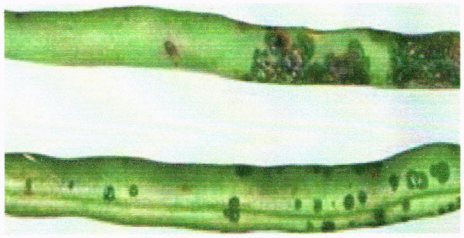

Figure 18. Severe infection of halo blight.

Postharvest Disorders

Chilling Injury

Storage of bora at temperatures less than 4°C (42°F) will result in chilling injury (CI) to the pod. Symptoms appear as surface pitting, brown streaks, a general dullness of the pod colour, and increased susceptibility to decay. Injury may be induced within several days, although cultivars differ in sensitivity. Furthermore, symptoms may not become apparent until the pods have been returned to ambient temperature for a few days. The presence of free moisture on the surface of the pod aggravates the effects of CI.

ANNEX I

PUBLICATIONS IN THE POSTHARVEST HANDLING TECHNICAL BULLETIN SERIES

PH Bulletin No. 1	Pineapple: Postharvest Care and Market Preparation, November 2002.
PH Bulletin No. 2	Plantain: Postharvest Care and Market Preparation, June 2003.
PH Bulletin No. 3	Mango: Postharvest Care and Market Preparation, June 2003.
PH Bulletin No. 4	Bunch Covers for Improving Plantain and Banana Peel Quality, June 2003.
PH Bulletin No. 5	Papaya: Postharvest Care and Market Preparation, June 2003.
PH Bulletin No. 6	Watermelon: Postharvest Care and Market Preparation, October 2003.
PH Bulletin No. 7	Peppers: Postharvest Care and Market Preparation, October 2003.
PH Bulletin No. 8	Oranges: Postharvest Care and Market Preparation, October 2003.
PH Bulletin No. 9	Tomato: Postharvest Care and Market Preparation, October 2003.
PH Bulletin No. 10	Okra: Postharvest Care and Market Preparation, October 2003.
PH Bulletin No. 11	Pumpkin: Postharvest Care and Market Preparation, January 2004.
PH Bulletin No. 12	Lime: Postharvest Care and Market Preparation, January 2004.
PH Bulletin No. 13	Grapefruit: Postharvest Care and Market Preparation, January 2004.
PH Bulletin No. 14	Passion Fruit: Postharvest Care and Market Preparation, January 2004.
PH Bulletin No. 15	Green Onions: Postharvest Care and Market Preparation, January 2004.
PH Bulletin No. 16	Sweet Potato: Postharvest Care and Market Preparation, January 2004.
PH Bulletin No. 17	Eggplant (Boulanger): Postharvest Care and Market Preparation, January 2004.
PH Bulletin No. 18	Avocado (Pear): Postharvest Care and Market Preparation, January 2004.
PH Bulletin No. 19	Bitter Melon: Postharvest Care and Market Preparation, January 2004.
PH Bulletin No. 20	Bora: Postharvest Care and Market Preparation, April 2004.

PH Bulletin No. 21 Cassava: Postharvest Care and Market Preparation, April 2004.

PH Bulletin No. 22 Eddoes: Postharvest Care and Market Preparation, April 2004.

PH Bulletin No. 23 Ginger: Postharvest Care and Market Preparation, May 2004.

OTHER PLANNED PUBLICATIONS

Breadfruit: Postharvest Care and Market Preparation.

Cabbage: Postharvest Care and Market Preparation.

Calaloo: Postharvest Care and Market Preparation.

Coconut: Postharvest Care and Market Preparation.

Cucumber: Postharvest Care and Market Preparation.

Lemon: Postharvest Care and Market Preparation.

Starfruit: Postharvest Care and Market Preparation.

Tangerine: Postharvest Care and Market Preparation.

Yam: Postharvest Care and Market Preparation.