



**Small
Planet
Foods™**

General Mills, Inc.

One General Mills Blvd.
Minneapolis, MN 55426

October 11, 2007

Robert Pooler
Agricultural Marketing Specialist
National Organic Program
USDA-AMS-TMP-NOP
Room 4008-So, Ag Stop 0268
1400 Independence Ave. SW
Washington DC 20250-0020

Petition for the addition of Okra to USDA-NOP 205.606

Dear Mr. Pooler

Attached is a petition from Small Planet Foods for okra, individually quick frozen. Small Planet Foods is submitting this petition to the National Organic Standards Board (NOSB) to request the addition of okra to section 205.606 of the National Organic Program's National List as an agricultural product that is currently not available in an organic form.

Please contact me if you require any additional information.

Sincerely,

David Bailey
Quality and Regulatory Operations
Small Planet Foods

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U.S. DEPARTMENT OF AGRICULTURE

PETITION FOR THE ADDITION OF OKRA TO 7 CFR 205.606

ITEM A

Category for which substance is being petitioned:

7 CFR 205.606 Nonorganically produced agricultural products allowed as ingredients in or on processed products labeled as "organic" or "made with organic (specified ingredients or food groups(s))"

ITEM B

1. The substance's common name:

Okra – Individually Quick Frozen

2. The producer or manufacturer's name, address, telephone number.

Non-specific; agricultural commodity grown by farmers and quick frozen.

3. A list of the types of product(s) (e.g., cereals, salad dressings) for which the substance will be used and a description of the substance's function in the product(s) (e.g., ingredient, flavoring agent, emulsifier, processing aid).

Okra is typically used in soups and stews as a food ingredient and thickening agent.

4. A list of the crop, livestock or handling activities for which the substance will be used. If used for handling (including processing), the substance's mode of action must be described.

Used for handling (processing) as a food ingredient.

5. The source of the substance and a detailed description of its manufacturing or processing procedures from the basic component(s) to the final product. Petitioners with concerns for confidential business information can follow the guidelines in the Instructions for Submitting Confidential Business Information (CBI) listed in #6.

IQF cut okra is made from the pods of the okra plant by first trimming it, followed by washing, sorting, cutting, blanching, draining, and passing it through a quick-freeze tunnel before packaging it.

Links to the USDA's United States Standards for Grades of Okra and United States Standards for Grades of Okra for Processing are given here. Printed copies are also attached to this petition.

- [United States Standards for Grades of Okra \(USDA-AMS\) \[pdf\]](#)
- [United States Standards for Grades of Okra for Processing \(USDA-AMS\) \[pdf\]](#)

6. A summary of any available previous reviews by State or private certification programs or other organizations of the petitioned substance.

None known to exist.

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7. Information regarding EPA, FDA and State regulatory authority registrations, including registration numbers.

N/A

8. The Chemical Abstract Service (CAS) number or other product numbers of substance and labels of product that contain the petitioned substance.

N/A

9. The substance's physical properties and chemical mode of action, including:

(a) **chemical interactions with other substances, especially substances used in organic production;** N/A - Okra is an agricultural food ingredient.

(b) **toxicity and environmental persistence;** N/A

(c) **environmental impacts from its use or manufacture;** N/A

(d) **effects on human health;** N/A

(e) **effects on soil organisms, crops, or livestock;** N/A

10. Safety information about Okra – Instant Quick Frozen: N/A

11. Research information about the substance which includes comprehensive substance research reviews and research bibliographies, including reviews and bibliographies which present contrasting positions to those presented by the petitioner in supporting the substance's inclusion on or removal from the National List.

Informational internet links about okra. Printed copies are also attached to this petition.

- http://www.cals.ncsu.edu/sustainable/peet/profiles/har_okr.html
- <http://www.ces.ncsu.edu/depts/hort/hil/hil-19.html>
- <http://vric.ucdavis.edu/selectnewtopic.fruitveg.htm>

12. Petition Justification Statement

We submit this petition to have okra, instant quick frozen, added to the National List based on its current state of noncommercial availability. While we acknowledge that organic okra is being grown, its availability is curtailed in regard to our intended use by intertwining issues of form and quantity, which are addressed below.

We are actively working with growers and processors to develop a consistent organic source; it is our hope that adding IQF okra to the National List will motivate growers and processors to fill the existing gap and make an organic version available for purchase. Per the NOP, we are committed to buying using an organic version once a reliable source emerges.

Statement of need for the non-organic form of the ingredient for use in organic handling:

Information concerning how or why the Ingredient/substance cannot be obtained organically in the appropriate form to fulfill an essential function in a system of organic handling:

Information concerning how or why the ingredient/substance cannot be obtained organically in the appropriate quality to fulfill an essential function in a system of organic handling:

Information concerning how or why the ingredient /substance cannot be obtained organically in the appropriate quantity to fulfill an essential function in a system of organic handling:

Information on ingredient/substance non-availability or organic sources:

While we acknowledge that some fresh organic okra is grown, its availability as a direct substitute for frozen okra is severely curtailed by its perishability. It is grown and harvested in limited geographic growing regions during limited growing seasons, and typically requires some cooling to last just 7 to 10 days before deteriorating in quality. Quick-freezing okra enables it to overcome concerns of perishability during shipping and storage.

Quick-freezing okra requires a capable processor in proximity to an okra-growing region. Within the last three months we have surveyed possible suppliers of organic okra in the USA (Texas, California), Guatemala, Mexico, Turkey, and China. Some of these suppliers are certified organic for other crops; some are not. The companies listed below represent either the primary companies that produce frozen okra or they are the primary freezing companies in areas that could potentially process – freeze - fresh organic okra. None have ever grown or seen produced organic frozen okra.

- RIO VALLEY FROZEN FOODS (Texas)
- SEABROOK FROZEN FOODS (New Jersey)
- HANOVER FROZEN FOODS (USA, Guatemala)
- MARBRAN (Mexico, Guatemala)
- GIGANTE VERDE (Mexico)
- COASTAL GREEN FROZEN FOODS (California)
- CEBRO FROZEN FOODS (California)
- PATERSON FROZEN FOODS (California)
- SUPERIOR FOODS (Guatemala)
- ASIA FROZEN FOODS (China, Taiwan)
- MAVIDENIZ (Turkey)
- NIMEKS (Turkey)
- SANEX (Turkey)

Even if enough organic fresh okra was available in proximity to a freezing company, an availability issue would remain. Processing (freezing) operations normally require a minimum volume of raw material to run a frozen, blanched product through their systems. Most plants operate at 5,000 – 15,000 lbs. per hour through a standard freezing tunnel. Typically a plant requires a full shift of organic production to consider the time practical. For an organic production, a two hour shift may be a more reasonable request. At this time the amounts of IQF okra we wish to harvest and use in processing do not come near to meeting minimum run-time standards by freezers. It is our hope that the organic market's desire for organic okra develops to point where this hurdle is eliminated.

Attachments:

1. United States Standards for Grades of Okra (USDA)
2. United States Standards for Grades of Okra for Processing (USDA)
3. Excerpt from "Sustainable Practices for Vegetable Production in the South (Dr. Mary Peet, North Carolina State University)
4. "Okra Production" (Douglas C. Sanders, North Carolina State University)
5. "Postharvest Handling Systems: fruit vegetables" (University of California Cooperative Extension, Vegetable Research & Information Center, reprinted from *Postharvest Technology*, UC DANR Publication 3311)

The following chart may be used by the NOSB as Evaluation Criteria for Substances to be added to the National List Section 205.606.

Is the Substance Essential for Organic Production? Substance:

Question	Yes	No	N/A	Documentation Source
1. Is the substance an agricultural product?				
2. Is the substance formulated or manufactured by a process that chemically changes a substance extracted from a nonorganic agricultural substance?				
3. Is the substance created by naturally occurring biological processes?				
4. Is there an organic source of the substance? 1				
5. Is the substance essential for handling of organically produced agricultural products? 2				
6. Are there any commercially available alternative organic substances? 3				
7. Is there another practice that would make the substance unnecessary?				

1 Documentation should specify details of efforts made to obtain an organic source and the outcome of that effort

2 Documentation should specify the essential qualities required for the product to be suitable, e.g., liquid vs. powder, viscosity, color, flavor profile, etc.

3 Documentation should specify organic alternatives that have been evaluated and reasons for unacceptability.

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United States Standards for Grades of Okra

Effective December 18, 1928
(Reprinted - January 1997)

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United States Standards for Grades of Okra¹

Grade

51.3945 U.S. No. 1.

Unclassified

51.3946 Unclassified.

Definitions

51.3947 Damage.

51.3948 Serious damage.

Grade

§51.3945 U.S. No. 1.

"U.S. No. 1" consists of pods of okra of similar varietal characteristics which are fresh, tender, not badly misshapen, free from decay, and from damage caused by dirt or other foreign matter, disease, insects, mechanical or other means.

(a) In order to allow for variations incident to proper grading and handling, the following tolerances, by weight, are provided as specified:

(1) Ten percent for pods in any lot which fail to meet the requirements of this grade, including therein not more than 5 percent for defects causing serious damage, and including in this latter amount not more than 1 percent for pods affected by decay.

Unclassified

§51.3946 Unclassified.

"Unclassified" consists of pods of okra which have not been classified in accordance with the foregoing grade. The term "unclassified" is not a grade within the meaning of these standards but is provided as a designation to show that no grade has been applied to the lot.

Definitions

§51.3947 Damage.

"Damage" means any defect, or any combination of defects, which materially detracts from the appearance, or the edible or marketing quality of the individual pod or of the lot as a whole.

§51.3948 Serious damage.

"Serious damage" means any defect, or any combination of defects, which seriously detracts from the appearance, or the edible or marketing quality of the individual pod or of the lot as a whole.

¹Packing of the product in conformity with the requirements of these standards shall not excuse failure to comply with the provisions of the Federal Food, Drug, and Cosmetic Act or with applicable State laws and regulations.



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United States Standards for Grades of Okra for Processing

Effective December 15, 1965
(Reprinted - January 1997)

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United States Standards for Grades of Okra for Processing ¹

General

51.3635 Application.

Grades

51.3636 U.S. No. 1.

51.3637 U.S. No. 2.

Culls

51.3638 Culls.

Size Classifications

51.3639 Size classifications.

Definitions

51.3640 Similar varietal characteristics.

51.3641 Fresh.

51.3642 Tender.

51.3643 Fairly well colored.

51.3644 Fairly well formed.

51.3645 Worm hole.

51.3646 Damage.

51.3647 Fairly well trimmed.

51.3648 Well trimmed.

51.3649 Pale green.

51.3650 Moderately misshapen.

51.3651 Poorly trimmed.

51.3652 Length.

General

§51.3635 Application.

These standards are intended to apply only to seed pods of the okra plant (*Hibiscus esculentus*) delivered to a freezing or canning plant for processing purposes. They may be used as a basis for grading the quality of lots of okra for the purpose of more equitable pricing. It is assumed that a schedule of prices will be established to be paid by the pound for each quality and size of okra to be purchased by the processor. The percentage of each quality and size okra in the lot may be approximately determined by analyzing a representative sample or samples drawn from the lot. The price of the load can be calculated from the number of pounds and the established price of each quality and size.

Grades

§51.3636 U.S. No. 1.

¹Compliance with the provisions of these standards shall not excuse failure to comply with the provisions of the Federal Food, Drug and Cosmetic Act, or with applicable State laws and regulations.

"U.S. No. 1" consists of pods of okra of similar varietal characteristics which are fresh, tender, fairly well colored, fairly well formed, free from decay and worm holes, and free from damage caused by scars, bruises, cuts, punctures, insects, discoloration, dirt or other foreign material or other means. Pods in this grade are at least fairly well trimmed, unless specified as well trimmed or poorly trimmed. (See Size, §51.3639.)

§51.3637 U.S. No. 2.

"U.S. No. 2" consists of pods of okra which meet the requirements of U.S. No. 1 grade except those for color, shape and trim. Okra in this grade may be pale green in color, moderately misshapen and poorly trimmed. (See Size, §51.3639.)

Culls

§51.3638 Culls.

"Culls" consists of pods of okra which fail to meet the requirements of either of the foregoing grades, and any extraneous material in the lot.

Size Classifications

§51.3639 Size classifications.

Okra may be classified as to size in connection with the grade into two or more groups on the basis of specified lengths in inches, or on the basis of the following size classifications:

- (a) "Very small" includes pods of okra less than 1-3/4 inches in length.
- (b) "Small" ("baby") includes pods of okra not less than 1-3/4 inches or more than 3-1/2 inches in length.
- (c) "Medium" includes pods of okra more than 3-1/2 inches in length and, unless otherwise specified, not more than 5 inches in length.
- (d) "Large," unless otherwise specified, includes pods of okra more than 5 inches in length.

Definitions

§51.3640 Similar varietal characteristics.

"Similar varietal characteristics" means that the pod is of the same type and closely similar in appearance to the rest of the pods in the lot.

§51.3641 Fresh.

"Fresh" means that the pod is not appreciably wilted or flabby.

§51.3642 Tender.

"Tender" means that the pod is succulent and reasonably free from fiber. The tip will break fairly easily and cleanly when bent back, and flesh of the central portion of the pod can be cut crosswise with a sharp knife using very little pressure.

§51.3643 Fairly well colored.

"Fairly well colored" means that the pod of a green variety has a good green color or is at least light green with no yellowish cast.

§51.3644 Fairly well formed.

"Fairly well formed" means that the pod is not more than slightly curved, crooked or otherwise not more than slightly deformed.

§51.3645 Worm hole.

"Worm hole" means a hole caused by an insect penetrating the wall of the pod.

§51.3646 Damage.

"Damage" means any specific defect described in this section; or an equally objectionable variation

of any one of these defects, or any other defect, or any combination of defects which materially detracts from the edible or processing quality of the pod. The following specific defects shall be considered as damage:

- (a) Scars or bruises which will materially detract from the appearance of the pod after processing;
- (b) Cuts or punctures which penetrate the wall of the pod.
- (c) Insects when the insect is present inside the pod, or when the action of insects has distinctly affected the appearance of the pod;
- (d) Discoloration which will materially detract from the appearance of the pod after processing; and,
- (e) Dirt or other foreign material which is so firmly attached to the pod that it cannot be removed by the usual processing plant washing.

§51.3647 Fairly well trimmed.

"Fairly well trimmed" means that the stem has been broken or cut off at a point not more than three-fourths inch below the cap scar at the base of the pod, and that the open seed cavities have not been exposed by excessively high trimming.

§51.3648 Well trimmed.

"Well trimmed" means that the stem has been neatly cut off at a point not more than one-fourth inch below the cap scar at the base of the pod, and that the open seed cavities have not been exposed by excessively high trimming.

§51.3649 Pale green.

"Pale green" means that the pod of a green variety has a tinge of green predominating over most or all of its surface, and not more than one-tenth of its surface shows a yellowish cast.

§51.3650 Moderately misshapen.

"Moderately misshapen" means that the pod is not badly curved, crooked or otherwise badly misshapen.

§51.3651 Poorly trimmed.

"Poorly trimmed" means that the stem has been broken or cut off at a point more than three-fourths inch below the cap scar at the base of the pod, or that the open seed cavities have been exposed by excessively high trimming.

§51.3652 Length.

"Length" means the dimension of the pod measured from the cap scar at the base to the tip end of the pod.

Sustainable Practices for Vegetable Production in the South
Dr. Mary Peet, NCSU
[Home](#)

Okra

HARVEST

Okra flowers about 60 days after seed germination. Once flowering starts, pods must be harvested frequently. Within 10 to 12 days of flower opening, the pods of most cultivars become woody and inedible. 'Annie Oakley II' and 'Prelude' retain tender pods beyond this period. Pod quality of most cultivars peaks at 3 to 4 days when pods are 2.5 to 3.5 inches long. Some cultivars such as 'Emerald' were developed for the processing market and may reach 8 to 9 inches long and still be tender.

With every 18 degree F rise in temperature, pods develop twice as fast, so harvesting every other day is important in hot weather. Maturing pods suppress the development of new fruit and should not be left on the plant. Once the seeds harden in the pods, subsequent flowers are aborted. Average yields are 4 tons or 250 bushels per acre. In long-season areas, okra plants can be cut back to 6 to 8 inches above the ground to produce a second crop. This is usually done when pod quality starts to deteriorate (about August 1 in Louisiana). If plants are fertilized with nitrogen and kept picked, fruit of acceptable quality can be harvested up to frost. Almost all harvesting is done by hand because pods are tender and bruise or discolor easily.

Shipping

containers should be packed tightly enough to prevent shifting of pods during transit. Like other immature fruits, okra pods must be cooled soon after harvest to preserve quality. At 45 to 50 degrees F and 90 to 95 percent relative humidity, okra can be stored for 7 to 10 days. Pods are subject to chilling injury at lower temperatures.

NC STATE UNIVERSITY

Horticulture Information Leaflets

Okra Production

Revised 1/01 -- Author Reviewed 1/01 HIL-19

Douglas C. Sanders
Extension Horticultural Specialist
Department of Horticultural Science
College of Agriculture & Life Sciences
North Carolina State University

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Okra is grown throughout North Carolina in home gardens and for commercial markets. It is a warm season crop that belongs to the cotton (Mallow) family and should not be planted until the soil has thoroughly warmed in the spring. Okra is referred to as 'Gumbo' in some areas.

Soil -- Well drained sandy loams high in organic matter are the most desirable. It is difficult to get good stands on heavy clays. Poorly drained soils may result in drowning of the plants. Okra is susceptible to several soil borne disease pests (nematodes, Southern stem blight and wilts) thus crop rotation should be so planned to avoid these where possible.

Varieties

Clemson Spineless is a uniform spineless variety with medium dark green, angular pods. It requires 55 to 58 days from seeding to maturity.

Emerald is a spineless variety with dark green, smooth, round pods. It requires 58 to 60 days from seeding to maturity.

Lee is a spineless variety with deep bright green, very straight angular pods. The plant is a semi-dwarf type.

Annie Oakley is a hybrid, spineless variety with bright green, angular pods. It requires 53 to 55 days from seeding to maturity.

Prelude (PVP) is a new open pol-linated, spineless variety with very dark glossy green fluted pods. It can be harvested when pods are ½ to ¾ inches longer and still remain tender. It requires 50 to 55 days from seed and generally yields better than Clemson Spineless.

Fertilization -- Before planting, have the soil tested and follow recommendations. If no soil test was made a general recommendation would be to apply 25 to 30 lb of nitrogen, 50 to 70 lb of P₂O₅ and 50 to 70 lb of K₂O per acre and make two sidedressings of 20 pounds nitrogen each, beginning when plants are 6 to 8 inches tall and again 2 to 3 weeks later. Additional sidedressing may be needed if heavy rains occur. **Do not over use nitrogen**, since it can cause excessive vigor and poor yield.

Spacing and Seeding -- Space rows 36 to 42 inches apart with 12 to 15 inches between plants. Seed should be chemically treated to reduce "damping-off" (seedling rot) and planted about one inch deep. To establish good stands plant 3 to 4 seeds per ft and thin. Six to 7 lb of seed are required to plant one acre. Soaking seeds overnight will hasten germination.

Cultivation and Weed Control* -- Okra is harvested over a long period of time and full season weed control is important. Where mechanical cultivation is necessary it should be shallow and only as often as necessary to control weeds.

Insect Control -- The insects found on okra vary from year to year, but generally various beetles (flea, Japanese, blister and cucumber beetles) and worms (mostly corn earworm) are most common.

Disease Control -- The more serious disease pests are rootknot nematode, Southern stem blight and wilt. A combination of crop rotation and soil fumigation is important for control of these diseases. Foliage blights may occur, but generally they do not reach epidemic proportions. Blossom blight can be serious in persistent rainy periods.

Harvesting -- The plant continues to produce so long as pods are removed. Mature pods left on the plant will reduce flowering and fruit set. Generally pods are harvested when 2½ to 3½ inches long. When plants are healthy and actively growing 5-inch pods are usually tender and acceptable. To achieve maximum yields the pods must be harvested every other day. Most pods are ready for harvesting 4 to 6 days after the bloom opens. Pods may be cut with a knife or snapped off by hand. Cutting is slower, but produces a nicer product. Most people are sensitive to the small spines on okra and often get a rash or itch. When harvesting, pickers should be provided with gloves and wear long sleeves and long pants for protection.

Yields -- Average yields are about 250 bushels (4 tons) per acre. Some experimental plantings have yielded as high as 10 tons. A bushel basket of okra weighs 30 to 35 pounds net.

Cutback -- After the market price drops in the late spring, cutting back okra will allow the plant to rejuvenate and produce a fall crop. Cut plants with a weedeater or mower to 8 to 10 nodes, 6 to 8 inches above the ground. Refertilize with 15-0-14, 8-0-24 or 13-0-44 to encourage regrowth and side branches. Fall yields of cutback crops will often exceed spring crops or yield of noncutback crops.

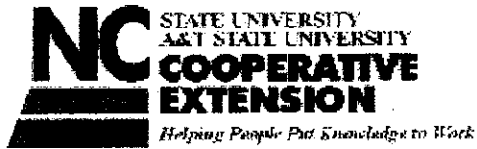
Mulching -- Plastic mulching has increased yields and earlier production. Transplanting part of a crop will also result in earlier production. Okra should be transplanted at 3- to 4-leaf stage in double rows 15 to 18 inches apart and 12 inches between plants. If drip irrigation is used in conjunction with plastic mulch, the tube should be centered between the rows and buried approximately 2 to 3 inches deep. Transplants and mulch allow earlier harvest and increased profit due to higher early prices.

Storage -- Harvested okra deteriorates rapidly, and normally it is stored only for short periods. If the pods are in good condition, they can be stored 7 to 10 days at 45 to 50 °F and 90 to 95% humidity. Upon removal from storage the pods must be sold relatively quickly. At temperatures below 45 °F okra is subject to chilling injury which results in surface discoloration, pitting and decay.

* Consult the current *N.C. Agricultural Chemicals Manual* or your county extension agent for chemical weed control recommendations.

Recommendations for the use of chemicals are included in this publication as a convenience to the

reader. The use of brand names and any mention or listing of commercial products or services in this publication does not imply endorsement by the North Carolina Cooperative Extension Service nor discrimination against similar products or services not mentioned. Individuals who use chemicals are responsible for ensuring that the intended use complies with current regulations and conforms to the product label. Be sure to obtain current information about usage and examine a current product label before applying any chemical. For assistance, contact an agent of the North Carolina Cooperative Extension Service in your county.



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About
VRIC

Veg
Info

Issues
News
Events

Virtual
Tour

History
Humor
Science
Projects

Useful
Links

Postharvest Handling Systems: fruit vegetables

With the exceptions of peas and broad beans, fruit vegetables are warm-season crops, and with the exception of sweet corn and peas, all are subject to chilling injury. Fruit vegetables are not generally adaptable to long-term storage. Exceptions are the hard rind (winter) squashes and pumpkin. A useful classification for postharvest discussion of the fruit vegetables is based on the stage of maturity at harvest. This presents an overview of the general postharvest requirements and handling systems for this group of commodities.

Immature fruit vegetables

Legumes: snap, lima, and other beans, snow pea, sugar snap and garden peas

Cucurbits: cucumber, soft rind squashes, chayote, bitter melon, luffa

Solanaceous vegetables: eggplant, peppers, tomatillo

Others such as okra and sweet corn

Mature fruit vegetables

Cucurbits: cantaloupe, honeydew, and other muskmelons; watermelon, pumpkin, hard-rind squashes

Solanaceous vegetables: mature green and vine-ripe tomatoes, ripe peppers

Field Operations

Harvesting

The harvest index for most immature fruit vegetables is based principally on size and color. Immature soft-rind squashes, for example, may be harvested at several sizes or stages of development, depending upon market needs. Fruit that are too developed are of inferior internal quality and show undesirable color change after harvest. This also applies to other immature fruit vegetables such as cucumber and bell peppers.

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on Tuesday, June 11
2002*

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The harvest index for mature fruit vegetables depends on several characteristics, and proper harvest maturity is the key to adequate shelf life and good quality of the ripened fruit. For cantaloupe, the principal harvest indices are surface color and the development of the abscission zone.

Most fruit vegetables are harvested by hand. Some harvest aids may be used, including pickup machines and conveyors for melons. Cantaloupe is also harvested with "sack" crews who empty the melons into bulk trailers. Crenshaw and other specialty melons are easily damaged and require special care in handling and transport to the packing area. Mature green tomatoes are usually hand harvested into buckets and emptied into field bins or gondolas. Almost all fresh market tomatoes grown in California are bush type, and the plants are typically harvested only once or twice. At the time of harvest, 5 to 10 percent of the tomatoes have pink and yellow color and are separated out later on the packing line as vine-ripest

Immature fruit vegetables generally have very tender skins that are easily damaged in harvest and handling. Special care must be taken in all handling operations to prevent product damage and subsequent decay. Sweet corn, snap beans, and peas may be harvested mechanically or by hand.

Many of the mature fruit vegetables are hauled to packinghouses, storage, or loading facilities in bulk bins (hard rind squashes, peppers, pink tomatoes), gondolas (mature green tomatoes and peppers), or bulk field trailers or trucks (muskmelons, hard rind squashes).

Harvesting at night, when products are the coolest, is common for sweet corn and is gaining in use for cantaloupe. Products reach their lowest temperature near daybreak. Night harvest may reduce the time and costs of cooling products, may result in better and more uniform cooling, and helps maintain product quality. Fluorescent lights attached to mobile packing units have permitted successful night harvesting of cantaloupe in California.

Field packing

The trend is increasing toward field packing of fruit vegetables. Grading, sorting, sizing, packing, and palletizing are carried out in the field. The products are then transported to a central cooling facility. Mobile packing facilities are commonly towed through the fields for cantaloupe, honeydew melon, eggplant, cucumber, summer squashes, and peppers. Field-pack operations entail much less handling of products than in packinghouses. This reduces product damage and, therefore, increases packout yield of products. In melons, for example, field packing means less rolling, dumping, and dropping and thus helps reduce the "shaker" problem, in which the seed cavity loosens from the pericarp wall. It also reduces scuffing of the net which reduces subsequent water loss. Handling costs are also reduced in field pack operations. One difficulty with field packing, however, is the need for increased supervision to maintain consistent quality in the packed product. Field packing is not used for commodities that require classification for both color and size, such as tomato.

Packinghouse Operations

Receiving

Loaded field vehicles should be parked in shade to prevent product warming and sunburning. Products may be unloaded by hand (soft rind squashes, eggplant, some muskmelons, cucumber, watermelon), dry-dumped onto sloping, padded ramps (cantaloupe, honeydew melon, sweet peppers) or onto moving conveyor belts (tomatoes), or wet-dumped into tanks of moving water to reduce physical injury (honeydew melon, tomatoes, and peppers). Considerable mechanical damage occurs in dry-dumping operations; bruising, scratching, abrading and splitting are common examples. The water temperature in wet-dump tanks for tomatoes should be slightly warmer than the product temperature to prevent uptake of water and decay-causing organisms into the fruits. The dump tank water needs to be chlorinated. An operation may have two tanks separated by a clean water spray to improve overall handling sanitation.

Preliminary operations

Presizing. For many commodities, fruit below a certain size are eliminated manually or mechanically by a presizing belt or chain. Undersize fruit are diverted to a cull conveyor or used for processing.

Sorting or selection. The sorting process eliminates cull, overripe, misshapen, and otherwise defective fruit and separates products by color, maturity, and ripeness classes (e.g. tomato and muskmelons). Electronic color sorters are used in some tomato operations.

Grading. Fruit are sorted by quality into two or more grades according to U.S. standards, California grade standards, or a shipper's own Trade standards.

Waxing. Food grade waxes are commonly applied to cucumber, eggplant, sweet peppers, cantaloupe, and tomato, and occasionally to some summer squashes. The purpose is to replace some of the natural waxes removed in the washing and cleaning operations, to reduce water loss, and to improve appearance. Waxing may be done before or after sizing, and fungicides may be added to the wax. Application of wax and postharvest fungicides must be indicated on each shipping container. Waxing and fungicides are used only in packinghouse handling of fruit vegetables. European cucumbers are frequently shrink-wrapped rather than waxed.

Sizing. After sorting for defects and color differences, the fruit vegetables are segregated into several size categories. Sizing is done manually for many of the fruit vegetables, including the legumes, soft and hard rind squashes, cucumber, eggplant, chili peppers, okra, pumpkin, muskmelons, and watermelon. Cantaloupes may be sized by volumetric weights, or diverging roll sizers, sweet peppers are sized commonly by diverging bar sizers, and tomatoes are sized by diameter with belt sizers or by weight.

Packing. Mature green and pink tomatoes, sweet and chili peppers, okra, cucumber, and legumes are commonly weight- or volume-filled into shipping containers. All other fruit type vegetables and many of the above are place-packed into shipping containers by count, bulk bins (hard rind squashes, pumpkin, muskmelons, and watermelon) or bulk trucks (watermelon). Fruit type vegetables that are place-packed are often sized during the same operation.

Palletizing. Packed shipping containers of most fruit vegetables in large-volume operations are palletized for shipment. This is a common practice with

cantaloupe, muskmelons, sweet peppers, and tomato. Except for sweet corn, the immature fruit vegetables are often handled in low volume operations, where palletizing is not common because of lack of forklifts. In these cases, the products are palletized at a centralized cooling facility or as they are loaded for transport. Palletizing is usually done after hydrocooling or package-ice cooling, but before forced-air cooling. In field-pack operations, palletizing is generally done in the field.

Cooling

Various methods are used for cooling fruit vegetables. The most common methods are discussed here.

Forced-air cooling is used for beans, cantaloupe, cucumbers, muskmelons, peas, peppers, soft rind squashes, and tomato. Forced-air evaporative cooling is used to a limited extent on chilling-sensitive commodities such as squashes, peppers, eggplant, and cherry tomato.

Hydrocooling is used before grading, sizing, and packing of beans, cantaloupe, sweet corn, and okra. Sorting of defective products is done both before and after cooling. Hydrocooling cycles are rarely long enough during hot weather. The need to maintain a continuous, adequate supply of cantaloupes to the packers often results in the melons being incompletely cooled. This can be remedied if, after packing and palletizing, enough time is allowed in the cold room to cool the product to recommended temperatures before loading for transport to markets.

Package icing and liquid-icing are used to a limited extent for cooling cantaloupe and routinely as a supplement to hydrocooling for sweet corn.

Temporary cold storage. In large-volume operations, most fruit vegetables are placed in cold storage rooms after cooling and before shipment. Cold rooms are less used in small farm operations; the products are often transported to central cooperatively owned or distributor-owned facilities for cooling and short-term storage.

Loading for transport. Some tomatoes, cantaloupe, and other muskmelons are shipped in refrigerated railcars, but most fruit vegetables are shipped in refrigerated trucks or container vans. Except for the major volume products such as cantaloupe and tomato, most are shipped in mixed loads, sometimes with ethylene-sensitive commodities. Among the immature fruit type vegetables, products such as cucumber, legumes, bitter melon, and eggplant are sensitive to ethylene exposure. Among the mature fruit types, watermelon is detrimentally affected by ethylene, resulting in softening of the whole fruit, flesh mealiness, and rind separation.

Special Treatments

Ripening

For uniform and controlled ripening, ethylene is often applied to mature green tomatoes and sometimes to honeydew, casaba, and Crenshaw melons. Ethylene treatments may be done at the shipping point or the destination, although final

fruit quality is generally considered best if the treatment is applied at the shipping point soon after harvest. Satisfactory ripening occurs at 12.5° to 25°C (55° to 77°F), the higher the temperature, the faster the ripening (table 29.3). Above 30°C (86°F), red color development of tomato is inhibited. An ethylene concentration of about 100 ppm is commonly used. Honeydew melons (usually class 12 melons) are sometimes held in ethylene up to 24 hours; tomatoes are usually held at 20°C (68°F) and treated for up to 3 days.

Tomatoes may be ethylene-treated before or after packing, but most are treated after packing. An advantage of treating before packing is that the warmer conditions favor development of any decay-causing pathogens on the fruit, so infected fruit can be eliminated before final packout. Packing after ethylene treatment also permits a more uniform packout. Because most of the mature green tomatoes produced in California are packed and then treated with ethylene, "checkerboarding" may still occur and make a repack operation necessary.

Modified atmospheres

Modified atmospheres are seldom used commercially for these commodities, although shipments of melons and tomato under modified atmospheres are being tested for long-distance markets. Consumer packaging of vine-ripe tomatoes may also involve the use of modified atmospheres. For tomatoes held at recommended temperatures, oxygen levels of 3 to 5 percent slow ripening, with carbon dioxide levels held below 5 percent to avoid injury. Muskmelons have been less studied, but recommended atmospheres under normal storage conditions are 3 to 5 percent oxygen and 10 to 20 percent carbon dioxide.

Recommended storage/transit conditions

For mature fruit type vegetables temperature can effectively control the rate of ripening. Most mature-harvested fruit vegetables are sensitive to chilling injury when held below the recommended storage temperature. Chilling injury is cumulative, and its severity depends on the temperature and the duration of exposure. In the case of tomato, exposure to chilling temperatures below 10°C (50° F) results in lack of color development decreased flavor, and increased decay

The optimum temperatures for short-term storage and transport are:

Mature green tomatoes, pumpkin, and hard rind squashes: 12.5° to 15° C (55° to 60° F)

Partially to fully ripe tomatoes, muskmelons (except cantaloupe): 10° to 12.5° C (50° to 55° F).

Honeydew melons that are ripening naturally or have been induced with ethylene are best held at 5° to 7.5° C (41° to 45° F).

Watermelon: 7° to 10° C (45° to 50° F)

Cantaloupe: 2.5° to 5° C (36° to 41° F)

The optimum relative humidity range is 85 to 90 percent for tomato and muskmelons (except cantaloupe), 90 to 95 percent for cantaloupe, and 60 to 70 percent for pumpkin and hard rind squashes.

Immature fruit vegetables

All fruit vegetables harvested immature are sensitive to chilling injury. Exceptions are the peas and sweet corn, which are stored best at 0° C (32° F) and 95 percent RH.

The optimum product temperatures with RH at 90 to 95 percent for short-term storage and transport are as follows:

Eggplant, cucumber, soft rind squashes, okra: 10° to 12.5° C (50° to 55° F)

Peppers: 5° to 7° C (41° to 45° F)

Lima beans, snap beans: 5° to 8° C (41° to 46° F)

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