



PROYECTO DE APOYO A LA EXPORTACION DE PRODUCTOS AGRICOLAS NO-TRADICIONALES DE CENTRO AMERICA Y PANAMA

RECOMENDACIONES PARA LA COSECHA Y
EMPAQUE DE PINA FRESCA PARA EXPORTACION

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PROCEDURES FOR FRESH PINEAPPLE HARVESTING AND PACKING

1. Pre-Harvest Inspection

One to two weeks prior to the expected date of the first harvest and one day before each subsequent harvest round a survey should be conducted in each block or lot of pineapple, collecting 8 random fruits each of shell colors 0, 1, 2, 3, 4, and 5 (See Annex No. 1). Each fruit will be inspected for external defects and crown size (See Annex No. 4). The fruits will be weighed and the percent size distribution and average fruit weight recorded (See Annex No. 2). After recording the fruit weight, the fruit will be sliced into ten (10) horizontal slices and inspected for the degree of translucence (flesh color varying from white to dark yellow, with yellow preferred), porosity, brix, and presence of disease. There usually exists a relationship between fruit size and shell color to fruit diseases, therefore those sizes and colors demonstrating problems should be avoided or picked at lower shell color.

The ideal fruit will be one that weighs around 4 to 5 pounds, with 25-50 percent of its shell of a yellow color (shell color between 2 and 4). It should be firm, free of internal and external decay or blemishes, and possess a green, single, upright crown with a length between 1/2 to 1 1/2 times the length of the fruit. The flavor and aroma should be those of a completely ripe fruit, but not over-ripe. The sugar content (brix) should be a minimum of 12 degrees and no higher than 16. The titratable acidity (pH) of the fruit should be in the range of 0.5 to 0.8.

Based on the results of the pre-harvest survey, harvesting instructions will be issued for the correct size and color of fruit to be harvested, not allowing green fruit to be picked nor fruit to become over-ripe between harvests. A good rule of thumb to follow is that a ripening pineapple will change one complete color every two days under normal tropical weather conditions. Remember that once picked the pineapple does not ripen any further and the eating quality of the fruit will be determined by its ripeness at harvest.

2. Harvesting (Manual)

Fresh pineapple should be harvested in the early morning hours when fruit pulp temperature is lower than 85 degrees Fahrenheit (29 C) to reduce chances of fruit bruising and to reduce the amount of field heat in the fruit at packing time. However, it is not uncommon to harvest fruit throughout the day if care is taken and fruit cooling facilities are available after packing.

The harvester selects the recommended size, color, and quality of fruit according to the harvesting instructions. Gently grasping the fruit at its base, it is snapped from the peduncle with a quick, firm twist of the fruit. The harvested pineapple should be gently placed in a harvesting apron with a capacity of 8-12 fruits.

When the harvester has filled his/her apron, he/she leaves the field and carries the fruit to the block road or alleyway. The fruit is carefully unloaded into a basket or onto the side of the road for loading into a container for hauling to the packing site. Try to avoid contact of the freshly picked fruit peduncle area with any soil. If loading of the fruit is not done immediately (within 2 hours), then a wet burlap bag or similar type material should be placed over the fruit to protect it from the sun.

3. Loading and Hauling

Pineapple loaded into a box or basket or directly to a trailer should be stacked vertically with the crown down to cushion the fruit. No more than three layers of fruit should be stacked in a container, always using the crown to cushion the layers of fruits. The containers should be carefully stacked and hauled to the packing site, avoiding any method of hauling which could damage or bruise the fruit. In small operations, the use of padded plastic or wooden boxes or baskets is recommended instead of bulk loading directly into trailers. This will increase the efficiency of loading and unloading and reduce fruit handling and bruising. During hauling, the speed of the truck or tractor/trailer should be regulated and rough roads avoided enroute to the packing station.

4. Fruit Receiving

Harvested fresh pineapple should be placed in a shaded area upon arriving at the packing station. Trained people should unload the containers of fruit, doing a preliminary selection for size, color, and quality. Any fruit outside the recommended standards should be rejected at this point.

Selected fruit should be placed into clean, cool water with 100 ppm chlorine for washing and removal of foreign matter such as mud, dirt, straw, etc. The washwater should be adjusted to pH 6.0 by using hydrochloric acid or vinegar to increase the efficacy of the chlorine, and reinforced with additional chlorine throughout the packing day to maintain the chlorine solution at 100 ppm.

It is not necessary to remove the basal leaves of each pineapple nor to individually brush each fruit. As the fruit is washed, inspection should be done for the presence of any insects, mealybugs, scale, and mites on the fruit body or crown. They can be gently removed with a hand brush or water pressure.

5. Packing

Selected, washed, and clean fruit can be passed to tables with a wire screen (mesh) top for drying and grading by size and color. Another visual inspection for fruit defects is done at this time. Graded fruit will then be conveyed to a dip tank containing an approved fungicide and fruit coating. Although withdrawn for use within the United States, a common pineapple post-harvest fungicide is Benomyl, applied at 4.8 grams of 50% active ingredient product per liter of water. Benomyl has an EPA residue tolerance level of 35 ppm for fresh pineapple, which will not be exceeded by the above rate of application. Always check with the regulatory agencies of the destined market for approved fungicides and residue tolerances for post-harvest applications, as regulations frequently change.

Shelf life can be extended by applying a fruit coating to reduce transpiration during shipment. A recommended product is FMC Sta-Fresh 705-1 applied at 1 gallon of commercial product in 9 gallons of water. The above mixture of 10 gallons of fruit coating and fungicide combination is sufficient to treat 3 tons of fruit or approximately 30 cc per fruit. The correct amount of mixture to prepare can be estimated by determining the amount of fruit to be treated on a daily basis. Only the fruit body is dipped in the fungicide/wax mixture. After dipping, the fruit is allowed to dry on tables with a wire screen top and then passed to the packing table lines.

The packing table lines consist of a slanted, padded packing table, a place for storing packing material and cartons, and scales. After drying, the fruit is once again inspected for defects, size, and shell color and acceptable fruit is packed horizontally in the box with uniform size and color in each box. The box is usually made of corrugated paper with a water resistant coating, but not waxed. A paper pad is placed in the bottom of the box for additional cushioning and a paper liner placed between the two layers of fruit to minimize bruising during transport. Both of these pads should be perforated to allow air movement throughout the fruit layers.

The normal box size for the North American market is a 40 Lb. net weight box with two horizontal (lay flat) layers of fruit. For European markets, the fruit is commonly packed in 20 Lb. boxes with one layer of fruit, either vertical or horizontal, but the latter is now preferred (See Annex No. 3). Both boxes must be designed with ventilation holes for air movement to allow for fruit cooling during transport. When packing the fruit, a final inspection is done by the packer to assure good quality. Particular attention is given to packing fruit of the same size and shell color in each box. Each fruit should be placed so that the crown is next to the body of the adjacent fruit. This will prevent bruising during shipment.

After packing, each box is marked with the proper size and the net weight checked on the scale. Normally, a 5% shrink factor is allowed for each box.

After weighing, the carton top is put on or closed and the pineapple boxes placed on pallets according to size. If possible, it is preferable to palletize the fruit and strap the boxes on the pallets using cornerposts, plastic strapping, and hand strap tighteners. With practice, palletizing can be done inside the container without the use of hydraulic aids.

If palletizing is not possible, the fruit should be separated by size and an accurate count made of the number of boxes of fruit according to sizes. They should be loaded into the shipping container by size, placing the larger fruit in the front and working to the rear with smaller size fruit or in a manner as prescribed by the client. It is useful to keep a record of the loading pattern for future reference.

6. Quality Inspection

During and after packing the pineapple, a quality inspection should be done to check for net box weight, shell color and fruit size uniformity per box, fruit and crown defects, and the correct sizes and shell colors according to the harvesting instructions. Incorrectly packed pineapple should be returned for repacking. A minimum of four (4) boxes per size of pineapple should be inspected per hour.

7. Shipping

Refrigerated containers are recommended for shipping fresh pineapple, and if possible should be stationed at the packing site during the harvesting and packing operation. Refrigeration of the fruit immediately after packing is preferable and almost mandatory, and can be aided by pre-cooling the containers to 45 degrees F. before loading. This will help in removing field heat, reduce possible bruising, slow down ripening, and extend the shelf life of the fruit. Recommended cold storage and shipping temperature of fresh pineapple is 45 - 50 degrees Fahrenheit (7.2 - 10 C). In shipments of short duration (less than 7 days) it is possible to ship pineapples at banana shipping temperature (55 degrees F.) if necessary. Pineapple is a low generator of ethylene gas and can safely be shipped with other products such as melons, mangoes, and papaya. It should never be shipped with avocados as their odor will be absorbed by the pineapple.

If fruit is not palletized during shipment, then the correct stacking pattern should be used to both keep the boxes from shifting and to allow proper air flow and cooling during shipment.

A record should be made of the number and description of boxes packed, and the number of the shipping container recorded. Such information as loading date(s), time, fruit temperature, shell color at packing, and container temperature will be valuable for further follow-up on any possible claims. The container should be cleaned and inspected for any insects or objects that can cause problems during Customs and Agriculture inspections at the port of arrival.

It is always a good idea to include a returnable temperature recording device such as a Ryan or Cox recorder to monitor the container temperature during shipment. The device should be placed inside a box of fruit and the box clearly identified for its removal upon arrival. At least two recorders in different locations in the container are recommended.

PINEAPPLE SHELL COLOR STANDARDS

Shell Color	<u>Description</u>
0	Pineapple fruit eyes flat and smooth. No yellow color in the middle of any eyes. Fruit color bright green, beginning to de-green at base of pineapple.
1	1 - 12 percent gold color in the middle of the eyes at the base of the fruit.
2	13 - 25 percent gold color in the middle of the eyes, measuring from the base up.
3	26 - 49 percent gold color in the eyes.
4	50 - 74 percent gold color in the eyes.
5	75 - 99 percent gold color in the eyes.
6	100 percent ripe, fruit turning brown, shell pressure softening (over-ripe).

PINEAPPLE FRUIT SIZES

40 Lb. Net Weight Box

<u>Size</u>	<u>Weight Range (Lbs.)</u>	<u>Average</u>
Jumbo (7)	6.1 - 7.0	6.5
8	5.1 - 6.0	5.5
10	4.1 - 5.0	4.5
12	3.6 - 4.0	3.75
14	3.1 - 3.5	3.25
16	2.5 - 3.0	2.75
18 (Europe)	2.2 - 2.5	2.35

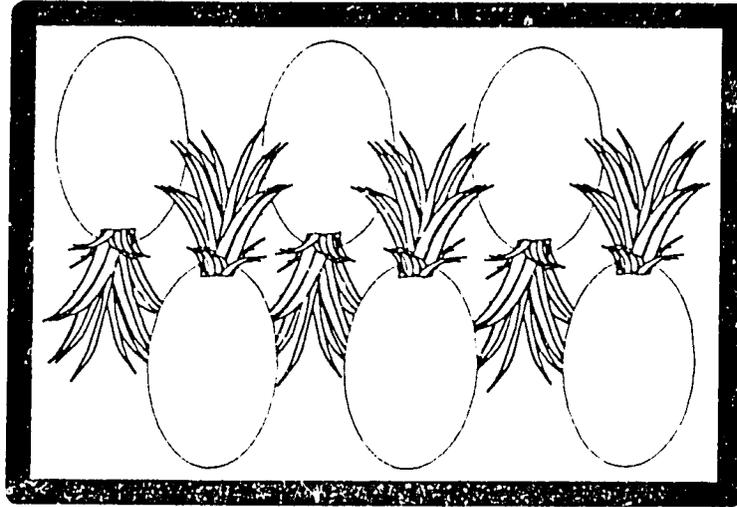
20 Lb. Net Weight Box

4	5.1 - 6.0	5.50
5	4.1 - 5.0	4.50
6	3.6 - 4.0	3.75
7	3.1 - 3.5	3.25
8	2.5 - 3.0	2.75
9 (Europe)	2.2 - 2.5	2.35

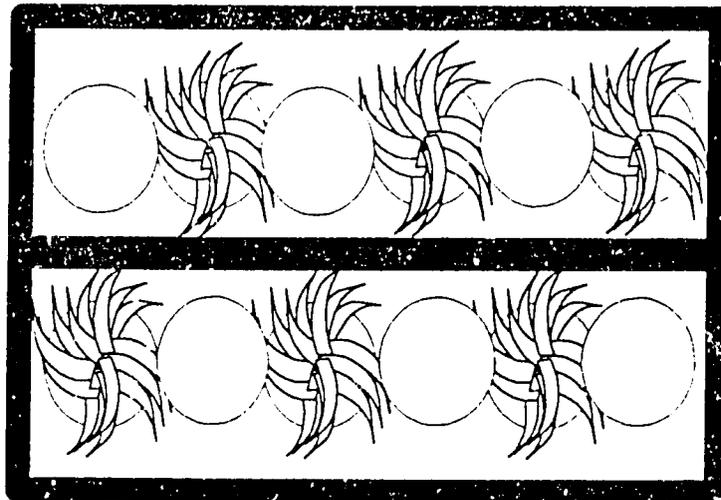
PINEAPPLE PACKING PATTERN

40 Lb. Box

TOP VIEW



SIDE VIEW



Note: 20 Lb. box is one layer only, packed as shown above in top view or in side view bottom layer.

REASONS FOR FRUIT REJECTS

1. **Small Fruit:** Fruit less than 2.2 Lbs.
2. **Large Fruit:** Fruit weighing more than 7.0 Lbs.
3. **Over-ripe Fruit:** Generally, fruit with a shell color higher than 4, except for high shell color jet fresh shipments.
4. **Bruised:** Damage to the fruit covering more than one eye, caused during any stage of the harvesting, hauling, and packing process.
5. **"Picudo" Damage:** Damage caused by the pineapple weevil Metamusius spp., usually holes or scars on plant parts distinguished by a fibrous lesion left at the point of attack by the insect.
6. **Thecla Damage:** Damage caused by the larva of a lepidopterous insect called Thecla. These larvae penetrate the fruit mainly in its flowering stages and feed on the flesh. The results of the attacks are seen as indents and holes in the fruit shell, usually surrounded by a brown, gelatinous secretion.
7. **Rodent Damage:** Damage caused by rats or rodents chewing on the crown and fruit, leaving them unusable.
8. **Knobby:** Large knobs at the base of the fruit around the area of the peduncle, caused by unformed slips.
9. **Cripple:** Genetic damage caused by lack of growth of the eyes, generally in a vertical line and as a result causing a crack or indent on the shell of the fruit.
10. **Deformed:** Fruit that does not have the characteristic cylinder shape of a pineapple. Generally they are elongated, tapered, or indented on one side.
11. **Sunburn:** Damage produced on the shell of the fruit when it is exposed to the rays of the sun for long periods of time. It is worse in fruit that has lodged. The damage occurs in one spot and is yellow to brown depending on the severity of damage.

12. **Erwinia Rot:** Damage caused by the bacteria of the *Erwinia* genus. It produces a soft rot in the core of the pineapple, usually beginning at the base of the fruit and spreading to the whole fruit. It releases a putrid odor with gas production and a complete lack of fluids.
13. **Deformed Crown:** Any crown that did not develop normally and does not look like a typical crown. Examples are:
 - a) **Rosette:** A small, short crown made up of many small growing points.
 - b) **Fasciated:** Multiple crowns shaped like a fan.
 - c) **Multiple:** More than one crown present.
 - d) **Crooked:** A crown more than 45 degrees off the vertical, commonly found in lodged fruit.
14. **Small Crown:** A crown less than one-half of the length of the fruit.
15. **Inter-Fruitlet Corking:** IFC is the formation of corky tissue between the eyes of the fruit. Causes are believed to be deficiencies of boron, iron, or nitrogen or by a fungus of the *Penicillium* genus.
16. **Crownless:** Fruit without a crown due to genetic, mechanical, or human damage.
17. **Dark Peduncle:** A condition in which the peduncle of the fruit turns dark from oxidation, usually indicating that the fruit is old or was broken from the peduncle in the field before or during harvesting passes.
18. **Gummosis:** A crystalline, brown gelatinous secretion found on the fruit shell, usually caused by insect or mechanical damage.
19. **Sinker:** A highly translucent fruit that sinks when placed in water.
20. **Crown Damage:** Damage caused by chemical, mechanical, rodent, or insect means which ruins the appearance of the crown.
21. **Immature fruit:** Green fruit low in brix, white flesh, and high porosity which does not possess acceptable pineapple flavor.

COMMON PINEAPPLE DISEASES

Listed below are some of the most common diseases of fresh pineapple. Parasitic diseases are caused by fungus, bacteria, and yeasts. Non-parasitic diseases are caused by physiological, climatic, or genetic disorders. Many of these diseases are not important individually, but together can cause great losses. It is helpful to know the identification and terminology of pineapple diseases when exporting pineapples.

1. Fruitlet Core Rot (FCR)

FCR is caused by a fungi of the *Penicillium* and *Fusarium* genera, and on occasion by yeasts and bacteria. The symptoms of the disease are generally confined to the heart of the individual fruitlets; nevertheless they can develop in adjacent fruitlets.

The disease is characterized by a discoloration of the heart of the fruitlet from gray to dark brown. Frequently a cottony growth can be observed in the cavities of the seeds of the fruitlet. Generally the infected eyes are few.

2. Leathery Pocket

Leathery Pocket is caused by a species of *Penicillium*. It is characterized by a hardening of the walls of the seed cavity. The fungus penetrates the stylar canal or the nectary ducts and grows over the surface of the seed cavity which stimulates the corky formation.

3. Marbling

Marbling is a bacterial disease characterized by speckled browning and abnormal hardening of the flesh. There are several unrelated species of bacteria that cause typical marbling. This disease makes the tissues abnormally firm and crispy or almost woody. The flavor is insipid but there is no characteristic aroma.

4. Inter - Fruitlet Corking (IFC)

IFC is characterized by a cork formation between the eyes of the pineapple accompanied by small cracks, varying from mild cases to very severe extremes when it covers all the eyes, causing malformation to the fruit.

Penicillium funiculosum and/or mite infestations can be the causal agent of this disease. Similar symptoms are caused by boron and iron deficiencies.

5. Yeasty Fermentation

Yeasty Fermentation is caused by organisms of the yeast genera. It affects fruit with high ripeness. It is characterized by formation of suds and loss of juice. The internal tissue is watery, spongy, and has the typical odor of fermentation.

6. Brown Rot

Brown Rot is caused by a fungus, Thielaviopsis spp. It originates in the developing fruit in the field and appears as an external discoloration in the shell in one or two eyes as a bright yellow discoloration not to be confused with sunburn. Internally it is indicated by a severe necrosis of a brown color and dry appearance in the whole fruitlet or adjacent fruitlets. Mycelial growth of Penicillium spp. may also be found in the walls of the fruitlets, associated with the same damage.

7. Thielaviopsis Rot (Butt Rot or T.V. Rot)

T.V. Rot is caused by the fungus Thielaviopsis paradoxa. The external symptom of the disease is a localized light to dark brown appearance which is soft and watery when pressure is applied.

Internally, affected portions of the fruit are yellow to gray or black in color and the flesh is very watery and soft. Frequently it starts at the base of the fruit in a conical shape and advances rapidly upwards through and around the fruit core. Wounds, insects, and rodent damage or bruises are the cause of the penetration of the pathogen. T.V. Rot occurs very rapidly at room temperature of 70 degrees Fahrenheit or more, with the entire fruit rotting in 5 to 7 days. This is one of the most common post harvest diseases in pineapple. It is prevented by harvesting and hauling pineapple very carefully to avoid bruising, packing the pineapple within 16 hours of harvest, and dipping the fruit in an approved post-harvest fungicide immediately after harvesting.

8. Internal Browning or Internal Brown Spot (IB or IBS)

IBS, also known as Endogenous Brown Spot (EBS), is a non-parasitic, physiological disorder that occurs initially as a series of separate, water-soaked brown spots at the base of the fruitlet core, beginning near the core of the fruit. In more severe form, the spots enlarge and coalesce, involving large masses of flesh and core. Affected tissues vary from light brown to dark brown or black; hence the term "black heart".

Generally I.B.'s development is associated with fruit low in brix and ascorbic acid (titratable acidity) which matures during periods of cloudy cool weather, although development may also occur under other circumstances. It rises fast after the period of refrigeration of the fruit, and is worsened by changes in temperature during and after shipment. Green fruit is more prone to the disorder than riper fruit. This disorder is very common in the Monte Lirio, Montufar, Pan de Azucar, Perolera and other pineapple cultivars low in ascorbic acid.

IBS and T.V. Rot, which are often confused, are two of the most common pineapple disorders/diseases found in fresh pineapple shipments and account for the majority of quality complaints from importers and consumers.