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POSTHARVEST TECHNOLOGY:  
METHODS OF HARVESTING, DRYING AND STORAGE  
OF ONIONS IN JAMAICA

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ABSTRACT

Inadequate water supply caused by drought, poor quality seeds, wrong variety, the high cost of planting materials, fertilizer, chemicals and labour are some of the problems which the farmers have to face in their effort to produce onion. Owing to the high incidence of praedial larceny, as well as the attractive prices when onion is in short supply, many farmers are reluctant to leave their onion in the field until the bulbs have matured. Consequently, immature green onions are often harvested some two to three weeks prematurely, which results in a poor quality produce and shortened shelf-life.

Little consideration has been given by farmers to proper harvesting, field drying, curing and storage of onions. Many farmers have not had the need to field dry, cure or store for long periods, hence they have never developed any techniques or structures. Efforts were made by the Ministry of Agriculture to reduce the postharvest losses and to improve the quality of onion by introducing simple techniques and low input storage and drying structures. The paper deals with postharvest techniques and basic information to farmers on preharvesting and field conditioning, maturity, harvesting, curing and storage of onion. It also describes the simple low cost drying and storage structures developed by the Ministry of Agriculture.

INTRODUCTION

The use of onion as a seasoning ingredient is well established in Jamaica and for many years this item was imported as there was no tradition of growing onions locally. The crop was introduced into the island in 1963 and the farmers are still experimenting. In the meantime, the production trend for onion has been far less than desirable. In 1978, an estimated 2,237 acres were planted and 9,073 short tons produced. By 1982, the acreage fell to 372 and production declined to 1,575 tons. The 1987 figures were 2,241 short tons from 550 acres at an average yield of 4.07 tons/acre. In recent years much attention has been paid to growing onions locally, and the interest is spreading among Jamaican farmers.

Inadequate water caused by drought, poor quality seeds, inappropriate varieties, the high cost of planting materials, fertilizer, chemicals and labour are some of the problems which the farmer has to face in his effort to produce. One of the major problems which often confronts him however, is that of praedial larceny. Owing to the high incidence of praedial larceny, many farmers are reluctant to leave their onion in the field until the bulbs have matured. Consequently, immature green onions are often harvested some 2-3 weeks prematurely, which results in a poor quality produce and shortened shelf life.

Premature reaping is sometimes motivated by a high demand and attractive farmgate prices. A large percentage of the onion produced is purchased by higglers, who are sometimes willing to do the harvesting themselves, and to a large extent have encouraged the practice of premature harvesting.

Little consideration has been given by farmers to proper harvesting, field drying, curing and storing of onions. Many farmers have not had the need to field dry, cure or store for very long periods, hence they have never developed any techniques or structures. The common practice is to randomly pull out the onion by hand even before it is ready for reaping, cut off the tops and roots with a knife in the field, and send it straight to the market.

This paper is limited to the presentation of basic information on the technical aspects of handling onion after harvest. It is instructive especially for small farmers, keeping in mind their socio-economic problems in growing onions. Very simple methods and structures are suggested for field drying and storing. For large scale operation and extended period of storage, other methods should be followed.

#### CAUSES OF SPOILAGE

- A. **Microbiological**: Onion bulbs are storage organs and contain about 90-95% water, therefore they provide excellent media for the growth and development of various micro-organisms. Storage diseases such as Neck rot/Grey mould rot, Black mould rot, Basal bulb rot are caused by various species of fungi namely Botrytis allii, Aspergillus niger and Fusarium oxysporum, respectively. Decay due to bacteria is quite common.
- B. **Chemical**: Wrong application of fertilizers and pesticides during the growth period in the field and during storage may lead to certain biochemical changes within the bulbs resulting in spoilage.
- C. **Mechanical**: Onion is a soft tissue which can bruise by a drop of 15 inches. Therefore, care must be taken not to damage the bulbs during harvesting, drying and handling. Rot organisms will enter through the injured tissues.
- D. **Physical condition**: Exposing onions to extremes of physical conditions such as temperature and humidity will lead to losses. Usually bulbs freeze below  $-3^{\circ}\text{C}$ , ( $27^{\circ}\text{F}$ ) and high temperatures lead to sprouting during storage.
- E. **Physiological**: Since onion bulbs are part of the living plant, they undergo all the vital functions of a living organism. Depending on the physical conditions to which they are exposed, they perform the following functions:
  - a) Respiration
  - 2) Transpiration
  - 3) Senescence
  - 4) Ripening
  - 5) Sprouting.

F. Secondary causes: The following factors cause considerable losses in onions during storage:

- 1) Harvesting
- 2) Packing
- 3) Packaging materials
- 4) Rough handling
- 5) Drying
- 6) Transportation
- 7) Storage facilities
- 8) Bumper crops

#### METHODS FOR REDUCING LOSSES

- A. Pre-Harvesting and Field Conditioning: It is a known fact that post-harvest problems begin even before harvesting. Certain precautions must be followed while the onions are still growing. Good cultural practices are very essential. High nitrogen in the soil delays maturity of the bulbs and decreases the storage life; therefore, nitrogen fertilizers should not be applied less than 30 days before harvesting.
- B. Irrigation: If irrigation water is used, stop irrigating the field two weeks before harvest. The size of the onions will still increase. Drying the field before harvest will hasten maturity and lead to even maturity throughout the field. Too much water in the soil will allow the rot organisms to enter the onions and cause rotting. If one wants to apply sprout inhibitor, it should be applied before 40% of the tops have fallen. Use maleic hydrazide. It may be applied at the rate of 5.4 litres (9.5 pints) of 36% active ingredients in 600 litres (132 gallons) of water per hectare (2.5 acres).
- C. Maturity: Proper harvesting practices must be followed to avoid losses and to have good quality onions. Harvesting at the correct time is very critical and important. Leaving the matured onions too long in the field leads to loss of the outer protective wrapper scale leaves. Harvesting before time will lead to poor quality, immature onions with chick necks which will reduce the storage life through increased susceptibility to various kinds of rots.

It is important to know when the field is ready for harvest. A field is ready to harvest when 60% of the onion tops (upper leaves) have fallen over. This falling over happens in a matured onion because the junction between bulbs and the green leaves becomes soft and the tops bend over. A matured onion will have the following qualities:

- 1) Firm
- 2) Dry
- 3) Closed neck
- 4) Thin, dry and papery scale leaves
- 5) No new roots
- 6) Stopped growing.

- D. Harvesting: Once the onions are fully matured in the field, it can be harvested by simple hand pulling or by mechanical means. The pulled onions should be left in the field to dry. The leaves of one row of onions should cover the bulbs of the next (Windrowing). In some countries, bulbs are stacked in the field in shallow trays, or bulbs

Figure 1-3. HANGING SYSTEMS FOR FIELD DRYING OF ONION

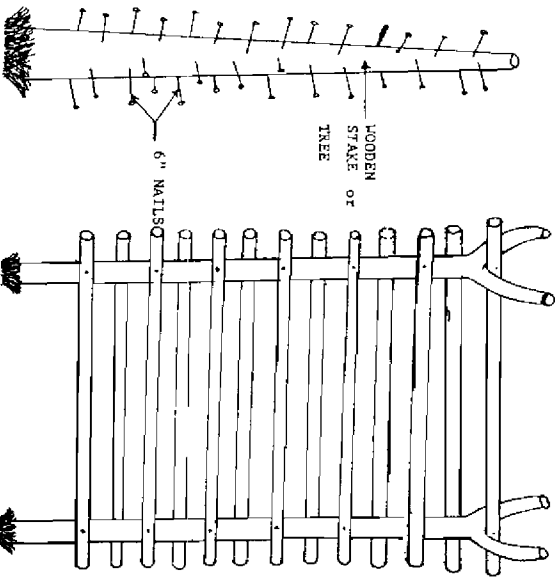


Figure 1. STAKE & NAILS

Figure 2. WOODEN HANGING FRAME

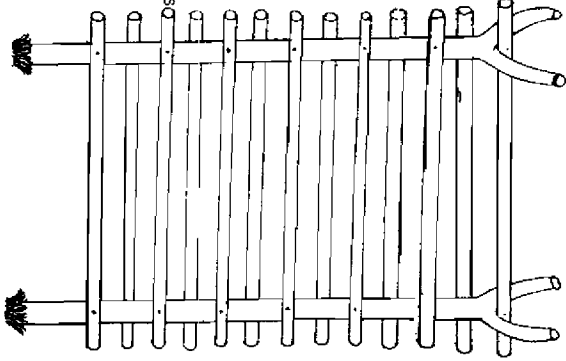


Figure 3. WOODEN HANGING FRAME

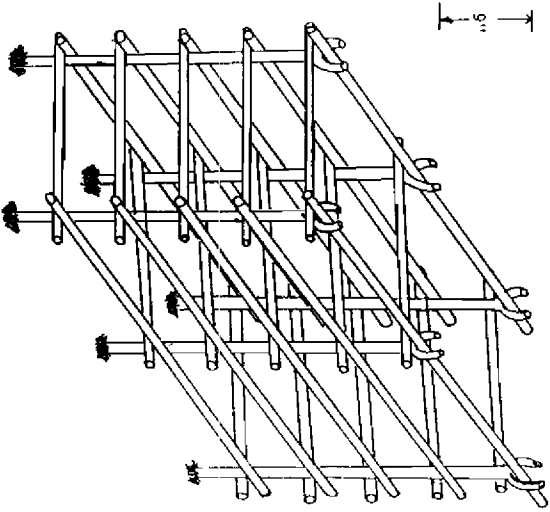


Figure 4. PORTABLE WOODEN TRAY FOR OUTDOOR DRYING OF ONION

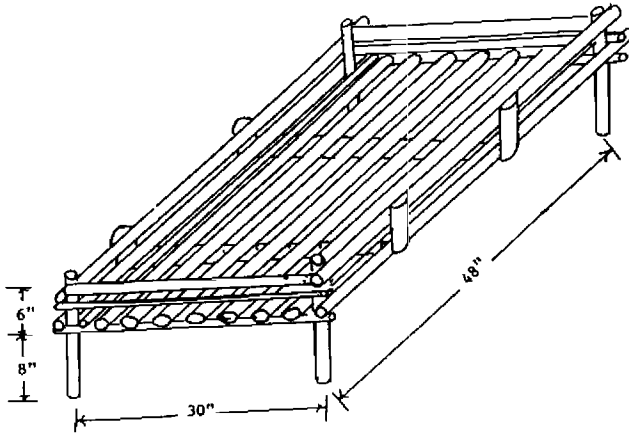


Figure 5. PORTABLE MESH TRAY FOR OUTDOOR DRYING OF ONION

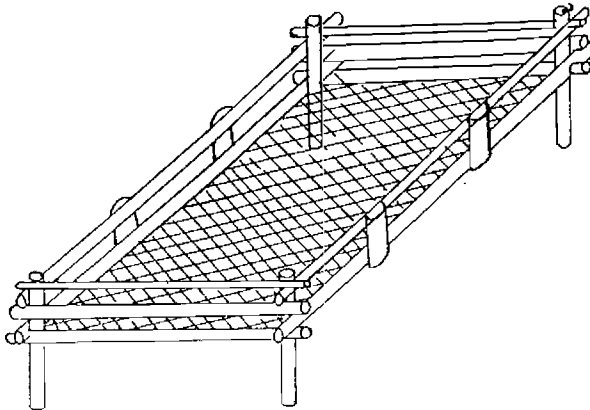
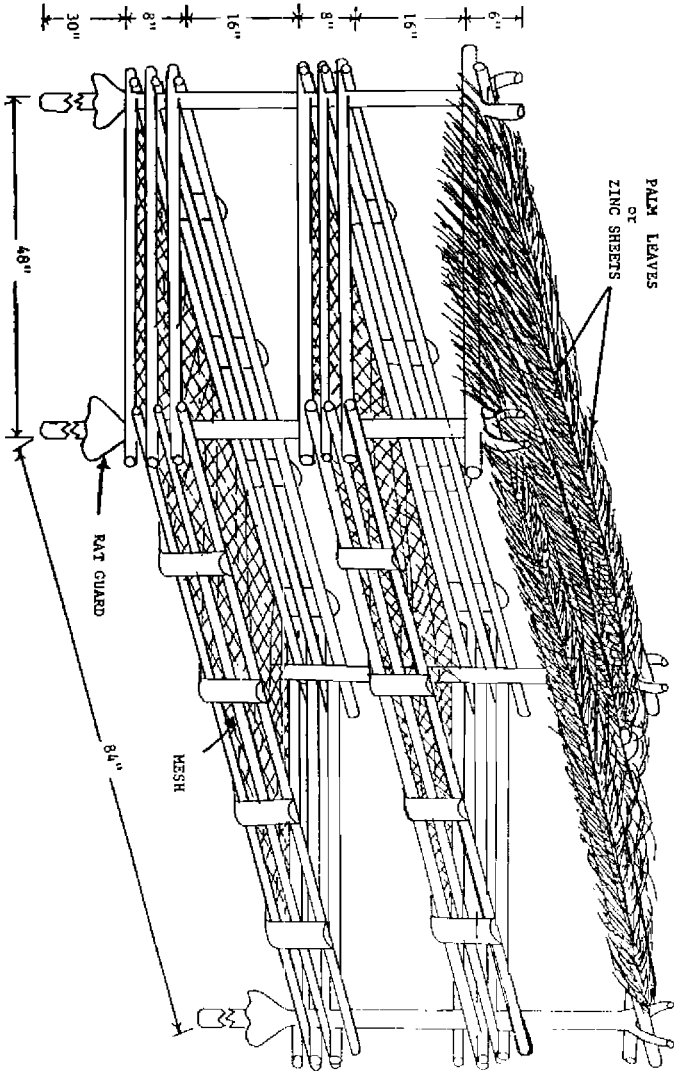


Figure 6. PERMANENT SHED FOR OUTDOOR DRYING OF ONION





are tied together in bunches and these are hung over poles either in the field or near the house. We are suggesting to our onion farmers to try these methods to avoid praedial larceny. After a period of two days of windrowing/field drying, the bulbs are separated by cutting at the neck (Topping). If onions are topped before being properly dried, neck rot will result because, the plant juice will ooze out of the neck region of the bulb providing the necessary environment for the decay organisms.

- E. Simple Methods of Field Drying: Field drying as described above is practised in some countries. The harvested onions are left in the field for 1-2 days before topping. If it is not possible to leave the onions in the field to dry they can be taken home and tied together in bunches with their leaves intact. The bunches can be hung on simple structures built in front of the house. Examples of such poles and wooden hanging structures are shown in Figs. 1-3. They are easy to construct using available sticks, bamboo, nails etc. The sizes and shapes will depend on the quantity of onions and the number of bunches the farmer has. It will require extra time and work to build these structures, but in the end it will be worth it. Farmers will have reduced postharvest losses and will be able to sell better quality onions at better prices. The consumer will be pleased and will be willing to purchase larger quantities of local onions. The local onion industry as a whole will benefit from a better reputation, since onions that are reaped at proper maturity and are properly dried will store much longer.
- F. Curing: Onions contain 90-95% water. For good quality and long shelf-life, onions must be cured or dried. The purposes of drying is to remove excess moisture from the outer skin and neck. This is achieved with a weight loss of 3-5%. Drying helps to reduce infection by disease organisms and minimises shrinkages caused by removing moisture from the interior of the bulbs. Most tropical countries have enough sunlight to dry their onions. The Ministry of Agriculture has developed several simple low-cost drying structures as shown in Figs. 4-6. Artificial drying can be done by special driers. It is usually done at 30-35°C (86-95°F) and about 75% R.H. with an air flow of 7m<sup>3</sup>/ton per minute or at 46°C, (115°F) 70-80% R.H. for 16 hours.
- G. Simple Methods of Curing: Immediately after field drying (1-2 days) the onion bulbs are separated from the leaves by cutting at the neck at the point where the stem has fallen over. For enhanced storage life the bulbs should be exposed to a further period of drying. Small quantities of onions can be cured in sunlight in three to four days. To dry onions effectively, it must be spread over a tray (not more than 6" in depth) and air must circulate through the product on all sides. Two portable trays are shown in Figs. 4-5 which can hold about 200-250 lbs. of onions. These trays are easy to construct and cost very little. Onions can be left in the trays to dry in front of the house, and during the night these can be moved inside, thus avoiding the problem of praedial larceny. Fig. 6 shows a structure designed for permanent outdoor drying. All these structures can be used to dry other crops as well.

Figure 6. CONCRETE (OR ZINC) SHEED FOR SEMI-COMMERCIAL DRYING AND STORAGE OF ONION

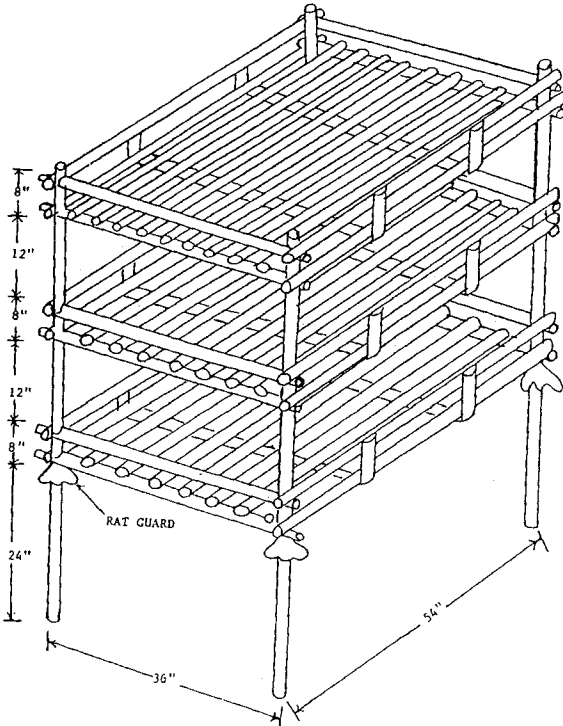
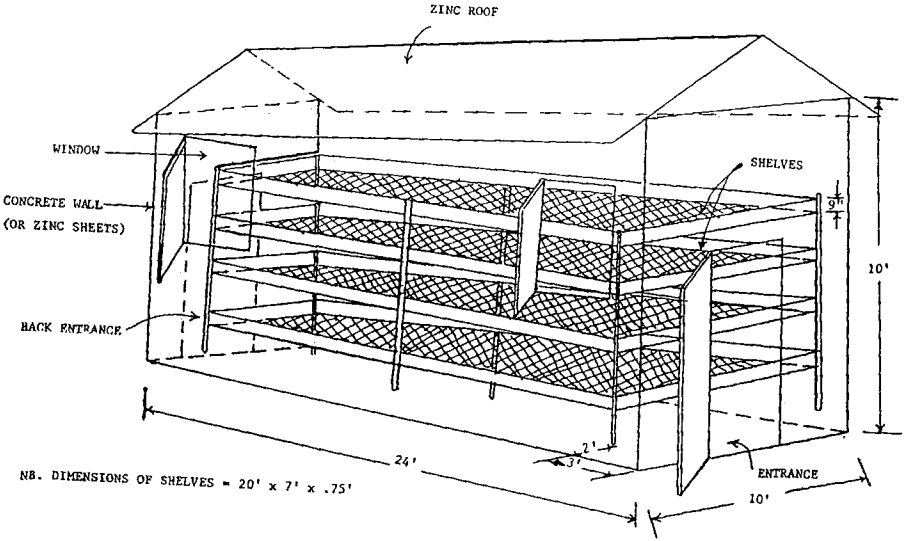


Figure 7. WOODEN STALL FOR INDOOR STORAGE OF ONION

- H. **Storage:** Matured onions that are properly dried can be stored very easily for up to 6-9 months depending on the variety. The basic principle in storing onion is good ventilation; air must freely pass through the product. Immature or diseased onions should not be stored, nor should onions be stored with most other products. There are different storage structures that can be used, ranging from simple shallow mesh wire trays to cold storage facilities. Farmers should be made aware that onions can be easily stored for several months without much effort, and by doing so they will be in a better position to sell the product whenever it suits them and demand better prices. The current practice of selling onions at the farmgate leads to all kinds of problems and in the long run, it is the farmer who loses. The Ministry of Agriculture encourages the farmers to produce good quality onions, store them and release them as the market demands. For long term cold storage, the recommended temperature is 0°C (32°F) at 70-75 R.H. If onions are stored in closed containers or closed rooms, the respiration of the bulbs increases the temperature and creates a humid environment resulting in decay and sprouting.
- I. **Simple Method of Storage:** Figure 7 shows a simple and easily constructed wooden stall on which onions can be stored indoors for several months after curing. The trays are shallow enough to allow for easy ventilation. The size of the stall can be adjusted to suit the farmer's storage facility, and the number of trays may be increased as necessary. The use of a stall such as this is a much better postharvest practice than storing the onions on the floor as many farmers sometimes do. The onions will store better due to the increased ventilation. Figure 8 is another method of drying as well as storing onions for up to three months. This method is very popular among Jamaican farmers
- J. **Packing:** Net bags are widely used in Jamaica for packing onions. Usually, farmers use 50 lb. capacity bags and most supermarkets use smaller net bags to retail their product. Usually a draw string is incorporated at the mouth of the 50 lb. bag to facilitate closure. A printed label may be attached around the middle of the bag for identification purpose. Onions should never be packed in closed, airtight containers.

## DISEASES

- A. **Bacterial Soft Rot:** This rot often occurs following periods of excessive rain before harvest, resulting in accumulation of moisture under the outer scales and in the necks where the decay generally starts. It is characterised by a yellowish appearance of the affected tissues and is frequently found affecting one or more inner scales of an onion which may appear entirely sound externally. In advanced stages Bacterial Soft Rot produces a foul repulsive odour.
- B. **Black Mould Rot:** This disease may develop when onions are infected with Black Mould spores. It develops most rapidly at temperatures above 55°F; especially if the humidity is high. In the initial stages it starts as a wet slick area on the fleshy outer scale and develops into a semi-watery decay. It usually starts in or just below the neck, but sometimes on wounded or bruised tissue in any location.

- C. Neck Rot/Grey Mould: This disease may develop at any point on the bulb, but it is most common on the damaged neck tissues. It produces a watery translucent appearance of the affected flesh; as the decay advances, a greyish white mould develops. In the advanced stages part or all of the affected surface becomes covered with grey, granular areas which consist of the spore masses of the fungus. This decay, like Bacterial Soft Rot, often enters at the neck and often follows rainy weather before harvest or during the curing period. There is no distinctive odour associated with this decay.

This storage disease is widespread wherever onions are grown. In certain areas of St. Elizabeth, which is the largest onion producing area in Jamaica, this disease has been noticed and the farmers have been advised as follows:

1. The infection is seed-borne. For future planting, all onion seeds must be treated with a systemic fungicide before planting (Benomyl at a rate of 1 g active material per kg of seed).
  2. No onions should be planted the following year in the fields in which rotting is being experienced. Instead, crop rotation should be practised (Watermelon suggested).
  3. In those infested fields, the entire onion crop should be pulled up and the good onions saved. The rest of the crop must be burned, including the mulch used to cover the fields. This will prevent the spread of fungal spores.
- D. Basal Bulb Rot/Fusarium Bulb Rot: Usually it starts at the onion base and works upwards progressing along the scales. High temperatures tend to produce a mealy or semi-watery rot, while low temperatures and low humidity produce a dry decay. In storage it can be distinguished by the dense growth of white to purplish mould at the base. This is a soil-borne disease which can affect onions at any stage of development.

#### ACKNOWLEDGEMENTS

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