

PUMPKIN CULTIVATION AND POST HARVEST HANDLING



INTRODUCTION

Cucurbita maxima (pumpkin) is believed to have originated in South America, while the other species became differentiated in the southern U.S.A, Mexico and Central America. Pumpkins are now grown all over the world with the exception of Antarctica.

Pumpkin belongs to the Cucurbitaceae family, which includes cucumber, melon and squash. Within this family is the genus *Cucurbita* which includes all varieties of pumpkin.

Pumpkin plants are hardy creepers or soil surface runners, but able to climb where there are supports. The fruits vary in shape, colour and sizes. They are monoecious and can be bred from pure lines.

Pumpkins are cultivated for their ripe fruit with the seeds in the central cavity and the yellow or orange flesh being eaten. Pumpkin contains an important antioxidant, beta-carotene, which is converted to vitamin A in the body. In the conversion to vitamin A, beta-carotene performs many important functions in overall health. Research suggests that pumpkin seeds have unique nutritional and health benefits.

Varieties

There are numerous pumpkin varieties. The basic types of pumpkins are

(1) American pumpkins - very long, soft and rounded. Some have trailing stems of 3m long while some are non-runners.

Three types of fruits are produced within this category:

(1) Two layered or turban type (mainly red, with green, yellow or orange markings). These pumpkins weigh up to 5 kg: (ii) a yellow, white or red colour and weighs up to 40 kg and (iii) hubbard green, squash-dark green and pear shaped.

(2) Butternut squash is called “butternut pumpkin” and neck pumpkin. These are annuals with soft leaves and stems 3-5 m with branched tendrils. Fruits are orangish, ovoid or rounded. Fruits weigh about 1 kg. The flesh is white without yellow or red. It is best suited for the tropics. It is hardy and disease resistant. Some are non-runner types and late maturing, > 100 days.

(3) Marrows- these are variable species both in vegetative growth and fruit structure. Stems are elongated, thin and trailing or sometimes short and thick (non-runner type). Fruits are very large, green mottled, ovoid and non ribbed. They may also be pear shaped and rounded.

Environmental Requirements

Cultivated *Cucurbita* species are photoperiod neutral, with differing thermal optima. The area where pumpkin is cultivated should receive maximum sunshine to maximize the photosynthetic process, and therefore, produce the largest plant and fruit. The crop grows best with altitude up to 2000m and temperature of 22-25°C, though some are well adapted to high temperatures. Low humidity reduces the incidence of diseases such as mildew. Heavy rain adversely affects flowering and delays development. Pumpkins grow well on soil that is high in organic matter, has good moisture retention capability and is easily drained. Soil pH ranges between 5.5 – 6.8 are ideal for cultivation.

Productive Area

Pumpkin is grown commercially in Guyana for local consumption and also for export. The main Regions of production are Regions 3 and 4. Other Regions producing pumpkin are Regions 1,2,5 and 6.

CULTIVATION

Land Preparation:

Soil preparation of the bed where pumpkin is to be planted and where the main root exist is very important. Preparation of the soil around the whole area where the pumpkin vines will spread is equally important, and may be the difference between a large pumpkin and a prize winner. Start land preparation by digging out a one meter pit, about one meter deep. Fill the pit with manure and compost. By using a lot of rich materials, a nutrient rich and soft composition for the pumpkin roots to be grown in will result. Be careful not to compact the soil which make it difficult for the roots to spread. The material should be well composted, otherwise, it can be harmful to the plant, burning the roots or robbing the soil of nitrogen. Manures and compost should be added to the soil in generous portions. These amendments should be thoroughly mixed into the soil.

Sowing

Pumpkin seeds may be sown on mounds (creating a hill or raised area) or on the level bed. Mounding allows for better drainage. Excessive moisture can promote bacterial growth, damping off disease or “drowning” of the roots by depriving the root of oxygen. Plant seeds three centimetres (one inch) deep (four or five seeds per hill). Allow two metres (six feet) between hills, spaced in rows three metres (ten feet) to four metres (fifteen feet) apart. When the young plants are established, thin each hill to the best two or three plants.

Semi-bush varieties – one meter between hills and 2.5 metres between rows. Miniature varieties – 0.75 metres in a row and three to four metres between rows. Bush varieties – one single plant every meter and one to two metres between rows

Fertilizer Application

Pumpkins are very heavy feeders. They thrive in rich soil with a lot of manure and compost. They grow even larger when fertilizer is added to the soil. The three basic plant nutrients are required at higher or lower levels depending upon the growth stage of the pumpkins. These basic nutrients are Nitrogen, Phosphorus and Potassium.

Apply higher concentrations of Nitrogen at the early growth stage. It provides for leaf, root and vine growth. Avoid direct contact to leaves and vines. Excessive nitrogen can burn the plants and reduce or delay the emergence and number of flowers and fruits.

As the crop moves towards fruit set stage, higher phosphorus levels should be used (5-10-5 or 5-15-5 are good ratios). Phosphorus will promote fruit set and development.

Potassium will promote fruit growth. After fruit set, a high potassium fertilizer should be used. Over application can cause your pumpkin to grow so quickly that it outgrows its skin and splits or explodes. Over application should be avoided and the other essentials of good soil management and plenty of water should not be overlooked. Micro nutrients contribute to and are essential to plant growth. These can be applied in the form of liquid fertilizer. Liquid fertilizer can be applied to secondary roots, and included in the water supply.

Insect Pest Management

Vegetable production occurs within a relatively short time frame and as such yield losses due to pests may be substantial if the problem is not identified early, and remedial action not implemented in a timely manner. **Correct identification of the pest and an understanding of its behaviour, including its most vulnerable stages, would provide insights into its management.**

The early maturity of vegetables and short intervals between harvests during the cropping season impose constraints on the pest control strategy option. Care must be then taken if pesticide application is contemplated, since there is the likelihood of high residual levels remaining in the product after harvest if an inappropriate formulation is used.

Pumpkin is subjected to, attack from many insect pests and diseases. The following is a detailed description the major pests and the appropriate management strategies that may be employed for control.

1. Cricket

Gryllotalpa spp. (Orthoptera: Gryllotalpidae)

Acheta spp. (Orthoptera: Gryllidae)

Sumptoms

Cricket attacks seedlings of all vegetables. Fully grown crickets are brown in colour and are about 2.5 – 3.5 cm long. The various species of these insects usually live either in the soil, bushes and under decaying crop residues and vegetation.

Mole crickets, which have heavily sclerotised front legs that are adapted for digging, are usually common in sandy soils (Figure 1). All crickets are nocturnal, feeding at night and secluded by day, under the soil. They feed at or slightly below the soil surface and can cause considerable damage before being discovered. Seedlings may be denuded of leaves or cut below the soil surface without any trace of insect on them. Crickets spend their entire life cycle below the soil, which may be for a period of approximately 28 -35 days. They are termed soil insects.

Control

- **Good field sanitation-** rid the field of weeds and plant residues from previous crops.

Cultural control:

- The areas where vegetables are grown should receive full sunlight, kept clean of weeds and all crop residues should be removed and burnt.
- Proper land preparation serves to control weeds, diseases, and soil insects, and also helps in the destruction of large soil clods, which act as hiding places for cricket.



Fig 1. Mole crickets

Chemical control:

- Any approved soil insecticide at the recommended rate may be applied, such as Basudin 60% E.C (Diazinon) or Vydate L 40%E.C at the rate of 10 mls to 4500 mls water, to seed beds and cultivated cropping areas.

2. Cut worm

Agrotis spp. (Lepidoptera: Noctuidae)

Symptoms

These are the caterpillars of various species of moth. They have a greasy appearance, are grey to brown in colour with faint lighter-colored strips, and when fully grown are usually the colour of the soil in which they live.

They can be found on the soil surface, beneath leaves and under large soil clods.

Cutworms are surface feeders and cut seedlings at or slightly above the soil surface. Evidence of cutworm presence will be greenish-black excreta pellets below the seedling. Most of its lifecycle is spent below the soil which is for a period of approximately. 21-28 days.

Control

- **Good field sanitation-** rid the field of weeds and plant residues from previous crops.

Cultural control:

- The areas where vegetables are grown should receive full sunlight, kept clean of weeds and all crop residues should be removed and burnt.
- Proper land preparation serves to control weeds, diseases, and soil insects and also helps in the destruction of large soil clods, which acts as hiding places for cutworms.



(a) Larva



(b) Adult

Fig. 2. Larva & adult cutworm

Chemical control:

- Any approved soil insecticide at the recommended rate may be applied, such as Basudin 60% E.C (Diazinon) or Vydate L 40% E.C at the rate of 10 mls to 4500 mls water, to seed beds and cultivated cropping areas.

3. Aphids

Aphis gossypii (Homoptera: Aphididae)

Symptoms

This pest attacks all vegetables. They are commonly known as “plant lice” or “nit” and are small, yellow, green or black pinhead-size insects (Figure 3). They are soft bodied, slow, moving and multiply rapidly within a short time span. These insects attack plants at all stages of growth and are usually found in dense clusters on the under surface of the young leaves and also on young tender stems and growing points. They suck plant sap and make the plant weak. Some also act as vectors of plant diseases. Seedlings are weakened and killed when the infestation is high and growth of older infested plants is retarded. Infested leaves curl, shrivel and may turn brown and die.

Aphids secrete a sweet substance known as “honey dew” while they feed. This substance attracts ants and serves as a substrate for sooty mould (black fungus) thus impairing photosynthesis. The lifecycle ranges between 21-28 days.

**P
U
M
P
K
I
N**

5. Mites

Tetranychus spp. (Acarina: Tetranychidae)

Symptoms

Mites are arachnids and are not insects (adults have four pairs of legs and two pairs of eyes). They are extremely tiny and appear as dust-like particles on the underside of leaves (Figure 5). Their colour ranges from red, translucent fawn to green. Eggs are laid on the underside of leaves and hatch beneath a web, which is spun by the adults. Both immature and mature stages suck plant sap, resulting in leaves becoming yellow and eventually turning reddish. Fruits may also be affected; especially by the rust mite.

Control:

- **Good field sanitation-** rid the field of weeds and plant residues from previous crops.

Chemical control:

- During severe infestations chemical control may become necessary. Any miticide may be used for their control, such as Abamectin, Newmectin or, Vertimec at 5mls to 4500mls water.

6. Thrips

Frankliniella sp. (Thysanoptera: Thripidae)

Symptoms

Thrips are yellow, tiny, elongated insects about 1mm in length and can be found on the upper and lower surfaces of leaves (Figure 6). Infestations are more severe in the dry season.

Both young and adult suck the sap from leaves and cause them to lose their colour (Figure 6). If attack occurs early, the young leaves become distorted. Older tissues become blotched and appear silvery or leathery in affected areas, thus hindering photosynthesis. Flowers and fruits are also affected, thus yields are reduced. Infected fruits are discoloured, distorted and hardened. Thrips are also vectors of major viral diseases. The lifecycle may be completed in about 14-21 days.

Control:

- **Good field sanitation-** rid the field of weeds and residues of all previous crops.

Cultural control:

- **Crop rotation-** cultivation of crops (vegetables) which are not host to the pest.
- Overhead irrigation will help in reducing the population of infestation during the dry season.
- An integrated approach is recommended for the management of thrips

Chemical control:

Among the insecticides which may be used are Regent (Fipronil), Admire, Abamectin and Vydate L at 5 mls to 4500 mls water, to both surfaces of leaves for effective control

N.B. Spray should be directed to both surfaces of leaves for effective control.



Fig. 5: Adult mite



(a) Adult thrip



(b) Damage

Fig. 6: Adult thrips and damage caused

7. Fruit sucking bugs

Nezara viridula: (Hemiptera: Pentatomidae)

Phthia picta: (Hemiptera: Coreidae)

These are various species of plants bugs (Figure 7). They actually do the same type of damage, by puncturing and sucking the sap from leaves, flowers and fruits. Affected fruits become discoloured, hardened and deformed, thus the market value of the fruits is reduced. *Nezara* commonly known as “stink bugs” is green in colour and about 1.5 – 2 cm and is recognized by its shield shape body, and awful protective odors emitted when molested. The *Phthia* are brownish – black bugs with a red band across the back of the thorax, and are about 2-2.5 cm in length. Both the adult and nymphs of this pest incur economic losses. The Life cycle ranges from 35-70 days.



(a) Nymphs



(b) Adult

Fig. 7: Nymphs & adults fruit sucking bugs

Control:

- **Good field sanitation**- rid the field of weeds and plant residues from previous crops.

Chemical control:

- Among the insecticides which may be used are Fastac, Decis, Karate and Ambush at 6 mls to 4500 mls water or Sevin at 10 gms to 4500 mls water.

8. Striped Cucurbit Beetle

Acalymma vittata

Symptoms

Striped cucurbit beetle (Figure 8) feeds on wild hosts until cucurbits are planted. Once cucurbits are present, adults can appear in a matter of hours in a field. They move from fence rows and wooded areas into the first few rows.

Once in the field, beetles congregate on a few plants in large numbers.

Beetles are most active in the morning and the late afternoon as they first begin to move into cucurbit fields. After a few days of massing and mating, beetles disperse throughout the field where they continue to feed (Figure 9).

After dispersing, females begin to lay eggs in the soil near the base of cucurbit plants.

Eggs hatch in 6-9 days into larvae that begin to feed on the roots and stems of plants. The lifecycle ranges between 28-35 days.



Fig. 8: Striped cucurbit beetle

Chemical Control

- When the insect population is very high, chemical control may be required. An appropriate contact insecticide may be used such as Malathion, Sevin, Fastac, Decis, and Karate at 6ml to 4500ml water. Spraying should start as soon as plants are in the field and at intervals once every two weeks up to harvest.



Fig. 9: Damage to pumpkin leaves from striped cucurbit beetle

9. Pickle Worm

(Diaphania hyalinata)

Symptoms

Pickleworm moths are nocturnal fliers, and mating does not begin until the onset of scotophase. Mating in this species is mediated by a female-produced sex pheromone.

Moths typically mate within three days after emergence.

Pickleworms have several generations each season, and generations overlap to form continuous pest populations in some locations.

The caterpillar (Figure 10) feeds on leaves and flowers of the cucurbit cultivars and often bores into the developing fruits, usually the side touching the ground.

Adults are strong, swift fliers and live up to 35-40 days.

Chemical Control

When the insect population is very high, chemical control may be required; an appropriate contact insecticide may be used such as Malathion, Seven, Fastac, Decis, and Karate at 6ml to 4500ml water. Spraying starts as soon as plants are in the field and once every two weeks up to harvest.



Fig. 10: Caterpillar of pickle worm

Major Diseases of Pumpkin (*Cucurbita moschata*) And Management Strategies

1. Sclerotinia Stem Rot

(Sclerotium rolfsii)

Symptoms

The Sclerotinia fungus affects a wide variety of crop plants. Many vegetables including tomatoes, beans, and carrots, as well as cucurbits, are susceptible. The pathogen produces resilient structures, called sclerotia that survive in our soils indefinitely (Figure 11).

Cultural control:

- Rotations with non-host crops will limit the potential for damage to subsequent vegetable crops.

Chemical control:

- Fungicides may be effective if applied to young plants.



Fig. 11: Symptom of sclerotinia stem rot

Phytophthora Blight

(*Phytophthora infestans*)

Plants infected with this fungus express several symptoms depending on the plant part affected and the stage of disease development. The following are some common symptom types:

1. Damping off of seedlings
2. Leaf spots that are dark brown and large (up to 5cm) and in some cases with a yellow halo.
3. Water-soaked, oily, sticky decay and collapse of stem and petiole.
4. Root rot and crown rot causing the entire plant to collapse and then die.
5. A white downy fungal growth may first appear on the surface of the fruit (Figure 12). This will quickly expand and cover the entire surface of the fruit, especially in moist humid conditions and may consist of fungal mycelia and numerous sporangia mixed with saprophytic bacteria (Figure 13)
6. Fruit symptoms first appear as a small water-soaked spot, usually on the under side in contact with the soil. These spots are soft and easily punctured when handle. These water--soaked spots increase in size rapidly and the entire fruit collapses in a short time (Figure 13).
7. Stem end infection can be seen as decay with dark exudates around the affected area.
8. Affected fruits are soft, mushy and watery when opened (Figure 14).



Fig 13. Fruit completely covered with fungal mycelia



Fig 12: White mycelia of *P. capsici* on infected pumpkin fruit.



Fig 14: Destruction of pumpkin fruit tissues by *P. capsici*.

Control

Since no single procedure will effectively control phytophthora blight, an integrated management programme is essential.

1. Prevention is the first step in managing this disease since this disease is difficult to suppress once it gets started in the fields.
 - Decontaminate all equipment when moving from infested areas to non--infested areas
 - Workers should disinfect hands and boots after handling infected plants or visits to an infested field.
 - Use only pathogen free seeds and transplants. Seeds from affected fields should never be used for planting.
2. Fungicides should be used preventively. Two fungicides, Ridomil and Aliette have shown to be effective in managing this disease. Soil infested with *P. capsici* can be treated with Ridomil or Aliette. Fields should be routinely scouted and plants should be treated with Ridomil or Aliette at first sign of the disease. These two fungicides should be used in rotation since the *P capsici* can develop resistance to these fungicide over time.
3. Crop rotation should be the practice, especially in areas with a history of phytophthora blight. Do not rotate with crops such as tomatoes, peppers or boulangers since these crops are also susceptible to *P capsici*.
4. Provide proper drainage in fields in order to prevent water logging following heavy rainfall or irrigation.
5. When available, plant pumpkin varieties with a hard rind. Mature fruits of these varieties are less susceptible than varieties with softer rinds.

Contact your local agricultural officers as soon as an outbreak of this disease is observed.

3. Powdery Mildew

(*Erysiphe cichoracearum*)

Symtoms

Powdery mildew can result in serious losses on pumpkin. The pathogen produces airborne spores that enable new infections to increase rapidly throughout an unprotected field.

The white, powdery mold first appears on lower stems and petioles (Figure 15). As the disease continues to develop, the white moldy spots occur on the underside of leaves. Symptoms on the upper leaf surfaces usually signal a severe outbreak.



Fig. 15: Symptoms of powdery mildew

Cultural control:

- Normal rotations with non-cucurbit crops will help prevent serious epidemics.

Chemical control:

- Several fungicides are effective against powdery mildew. Systemic fungicides can be effective if applied at appropriate times during the season, even if symptoms are not obvious.

4. Downy Mildew

(*Peronospora cubensis*)

Symptoms

Downy mildew is a fungal disease often identified on pumpkin crops. Yield loss associated with downy mildew is most likely related to soft rots that occur after plant canopies collapse and sunburn occurs on fruit. Initial symptoms include large, angular or blocky yellow areas visible on the upper surface (Figure 16). As lesions mature, they expand rapidly and turn brown. The under surface of infected leaves appears water soaked.



Fig. 16: Symptoms of downy mildew

Cultural options:

- Planting early season may further reduce the already minor threat posed by downy mildew.

Chemical control:

- Broad spectrum protectant fungicides such as Mancozeb are at least somewhat effective in protecting against downy mildew infection.

5. Black Rot

(*Xanthomonas campestris*)

Symptoms

Black rot is caused by a fungus that attacks pumpkins. It causes the disease known as “gummy stem blight” on cucumbers and melons. Yield loss due to black rot occurs as a result of rapid defoliation of vines and fruit infection and subsequent decay. Black rot affects leaves, stems, and fruit of pumpkins. Stem infections result in irregular, tan lesions that have a corky texture and often exude an orangered- brown gummy substance (Figure 17). The key diagnostic feature of black rot is the presence of small black fungal structures called pycnidia embedded in the diseased tissue.



Fig. 17: Symptoms of black rot

Cultural control:

- Implementing cultural control options alone will not result in satisfactory control of black rot. However, employing options such as rotating fields with non-susceptible crops for at least two years is recommended.

Chemical control:

- Apply protectant fungicides at 10- to 14-day intervals beginning when vines form a complete canopy within rows. A fungicide recommended for use on pumpkins is Mancozeb.

6. Fusarium Crown & Fruit Rots

(*Fusarium oxysporum*)

Symptoms

Fusarium crown rot is caused by different Fusarium pathogens than those that cause Fusarium wilt diseases, even though wilting is part of the disease syndrome. Some crown rot fungi also are responsible for a characteristic fruit rot that occurs on pumpkins. Initial symptoms on pumpkins include a general yellowing of the entire plant; over the subsequent 2-4 weeks, the entire plant will wilt, collapse, and decay. Fruit symptoms vary dependent upon the specific Fusarium pathogen involved. Lesions may be small, dry, and pitted, or larger sunken areas covered with gray or white mold.

Cultural control:

- Rotations of non-cucurbit crops will help to reduce Fusarium populations in soil.

Chemical control:

- None.

7. Bacterial Wilt

(*Erwinia tracheiphila*)

Symptoms

Bacterial wilt is one of the most important diseases of pumpkins. The bacterial pathogen responsible for this disease is spread from plant to plant by the feeding activities of striped and spotted cucumber beetles. Wilting of one or a few leaves is the first symptom of this disease (Figure 18).

In the early stages of the disease, plants with wilt symptoms may recover during the night, and wilt again in the heat of the day. After several days, the wilt becomes permanent, and the plant turns yellow and dies.

Cultural control:

- Avoid planting pumpkins next to other cucurbits, which may increase disease pressure.

Chemical control:

- Insecticides aimed at reducing cucumber beetle populations are recommended.



Fig 18. Symptoms of bacterial wilt

7. Viral Diseases

Viral diseases of pumpkins may be caused by any of several different pathogens: cucumber mosaic virus (CMV), squash mosaic virus (SqMV) and watermelon mosaic virus (WMV).

WMV is the most common virus diseases of pumpkins. Leaves of virus-infected plants often appear mottled and distorted (Figure 19). The extent of crop loss due to virus disease is highly correlated with the crop growth stage at which the virus becomes established in the field.

Cultural control:

- Control weeds within and around fields.

Chemical control:

- Attempts to control insects for virus disease control may be futile, because insects may transmit the virus before insecticides are effective.



Fig 19. Leaves of virus infested plants

Harvest Maturity Indices

Pumpkins should be harvested when the fruit are completely mature. Several different indices can be used to determine harvest maturity, including time after planting, external appearance, hardness of the rind, stem texture, die-back of the tendril nearest the fruit, and internal colour. The number of days after planting can be used as a guide to predict the beginning of harvest. Pumpkin fruit are usually fully mature and ready for harvest about 3 months after sowing, or approximately 45 days after flowering.

External appearance of the fruit changes with maturity. Immature fruit typically have a bright surface sheen. As the fruit matures, the amount of shine diminishes. The rind of mature pumpkins has a dull waxy appearance that has lost much of its gloss. The fruit surface should have a good colour, characteristic of the cultivar.

Also, there will usually be a noticeable lighter coloured ground spot on the fruit underside (Figure 20).



Fig. 20: Mature pumpkin

Hardness of the rind is a good indicator of harvest maturity. As pumpkins mature, the rind tissue becomes noticeably tougher and harder. When the rind is sufficiently hard to resist puncture from the thumbnail or from fingernail scratches, the fruit is mature enough for harvest. At this stage of development the seeds are also mature. Stem texture can be used to determine when to harvest pumpkins. As the fruit matures, the area of the stem attached to the fruit will change from a uniform green colour and fairly succulent texture to a brownish colour and hard dry texture. Die-back of the tendril nearest to the fruit can also be used to determine harvest maturity. The tendril is a small curly appendage which grows on the vine in the node (joint) nearest the fruit. A green actively growing tendril indicates the fruit is immature. When the tendril starts to dry from natural senescence, the fruit is nearly mature. When the tendril completely dries, the pumpkin fruit nearest that node is mature and ready for harvest.



Fig. 21: Immature fruit

Internal flesh colour is also an indicator of fruit maturity. Immature fruit have a cream or light orange-coloured flesh (Figure 21). As the fruit matures, the content of carotenoid pigments increases and the flesh becomes a deep orange colour. An orange flesh colour is required for successful domestic and export marketing of pumpkins (Figure 22). Dead vines are not an indication of fruit maturity. When vines die prematurely from disease, stress, or lack of water, the fruit is usually immature and of low quality. Immature fruit will not store as successfully as fully matured fruit produced on a healthy vine. The rind colour of immature pumpkins will not be as well-developed as matured fruit. Pumpkins do not all mature at the same time on the plant, but will continue to colour up over a period of three to four weeks if diseases and insects are held in check. Do not harvest fruit that are immature, injured, seriously blemished, or beginning to decay.

Harvest Methods

Pumpkins are manually harvested when they have reached maturity. Pumpkins should be picked only when the fruit surface is completely dry. The fruit should be carefully clipped off the vine, leaving about a 2.5 cm (1 inch) stem attached to the fruit (Figure 23).

A pair of sharp pruning shears is needed to sever the stem and create an attractive, smooth, clean cut. Do not pick up the pumpkin by the stem, as it may separate from the fruit and provide an easy access for decay organisms. A short length of stem should always remain attached to the fruit. Once removed from the vine, the pumpkins should be put in wooden or strong plastic field crates for transport to the collection site or packinghouse. Out-grading is required in the field to remove pumpkins affected by disease, insects, or physical damage. During harvesting, handling, and field transport, every effort should be made to avoid bruising or puncturing the rind. Also, harvested pumpkins should not be exposed to direct sunlight or rainfall. Ideally, pumpkins should not be stacked on top of each other. Stacking is a sure way to create bruises. Padding material, such as grain straw, should be used liberally if fruits have to be stacked during harvest. Spread out a layer of dry straw on the ground and set the pumpkins on this. Keep the fruit dry at all times and never store pumpkins on moist bare ground. If the pumpkins must be stacked for transport, the pile should not be more than 1 meter (3 ft) deep.



Fig. 22: Mature fruit



Fig. 23: Method of harvesting pumpkin

Sorting/Grading

Pumpkin fruit are quite variable in size, shape, and colour; therefore it is difficult to obtain consistent uniformity of product from a single harvest. However, grading for uniformity of appearance is important to meet market requirements. There are 3 established size categories (small, medium, and large) for domestic marketing of pumpkins, based on fruit weight. Small sized pumpkins weigh between 1.4 to 3.2 kg (3 to 7 lbs), medium sized pumpkins weigh between 3.3 to 5.5 kg (7 to 12 lbs) and large sized pumpkins weigh 5.6 kg (12 lbs) or more. Export markets accept a range in fruit size, although large sized fruit weighing between 5.6 to 8 kg (12 to 18 lbs) are preferred. Fruit shape may vary from round, to oval, to slightly flat (Figure 24). Similarly, rind colour ranges from green, to blue-green, to tan. The striping pattern or mottling of the rind also varies, although the striations are typically white or cream coloured. The rind may be smooth or sutured. Domestic consumers and importers prefer uniformly regular shaped fruit that have a smooth, tough rind (Figure 25).



Fig. 24: Various types of pumpkin

All fruit should be examined for external maturity characteristics, and only mature pumpkins should be packed. The fruit should be free of noticeable skin blemishes. The rind should not be discoloured or have any surface mould growth. Fruit should be free of insect or mechanical damage and any partially decayed fruit should be discarded. The fruit must have a closed blossom end and be free of cracking in order to avoid serious decay problems. The flesh should be thick and dark orange, since many pumpkins are sold as cut fruit in the market (Figure 26). Randomly selected fruit should occasionally be cut open for assessment of internal colour.



Fig. 25: Uniformly shaped fruit

Packing

Packages used to market pumpkins vary depending on market destination. Fruit sold in the domestic market and nearby Caribbean export destinations is usually packed in mesh sacks (Figure 27). The sacks typically contain from 3 to 7 fruit and weigh around 23 kg (50 lbs). However, mesh sacks provide little or no protection against bruising and physical injury. Variability in fruit size will also cause bulging problems of the mesh sack. Smaller sized pumpkins intended for more distant export markets should be packed in strong, wellventilated fiberboard cartons containing 19 kg (42 lbs) of fruit. The cartons should have a minimal bursting strength of 275 psi and internal dividers should be used to separate and protect the fruit. Large wooden bulk bins holding from 360 to 410 kg (800 to 900 lbs) of fruit may be used for marine transport to export market destinations. Pumpkins packed in cartons and transported by marine container should include an additional 5% weight to account for moisture and respiratory weight loss that will occur during transport.



Fig. 26: Pumpkin sold as cut fruit



Fig. 27: Pumpkin packed in mesh socks

Preparation for Market

Cleaning

Any adhering soil in the ground spot area or other surface stains should be removed at the time of harvest with a soft cloth or cotton gloves. Washing is usually not desirable. However, if washing is required to remove excess soil or to enhance the appearance for a particular market, the wash water should be clean and properly sanitized to reduce the potential for spread of disease. Sodium hypochlorite (household bleach) is commonly

used since it is an inexpensive and readily available wash water sanitizing agent. It is effective against decay organisms when added to the wash water at a concentration of 150 ppm and the water is maintained at a pH of 6.5. 150 ppm is equal to 2 oz of household bleach (such as Marvex) per 5 gallons of water, or .3 liters of bleach per 100 liters of water. As the wash water becomes contaminated with soil and organic matter, the

sanitizing ability of the hypochlorous acid is diminished. Therefore, the wash water tank should be changed when the hypochlorous acid concentration cannot be maintained. The washed fruit should be placed on a flat surface or table to air dry prior to grading.

Temperature Management

Pumpkins not intended for immediate sale should be held in a cool, dry, well-ventilated area. The optimum temperature for pumpkin storage is 12°C (54°F). Sound fruit can be stored for up to 3 months at this temperature without a significant loss in quality. Storage at ambient temperature will result in excessive weight loss, loss of surface colour intensity, and a decline in culinary quality. Green-skinned cultivars will gradually turn yellow at high temperature and the flesh will become dry and stringy. Storage life of pumpkins at ambient temperatures is limited to several weeks. On the other hand, the fruit should not be stored at cold temperatures. Pumpkins are susceptible to chilling injury (CI) and should never be stored below 10°C (50°F).