



WATERMELON CULTIVATION AND POST HARVEST HANDLING

W A T E R M E L O N

INTRODUCTION

Watermelon (*Citrullus lantatus*) belongs to the family Cucurbitaceae which includes squash, pumpkin and cucumber. It is a popular dessert vegetable, with year round availability.

Watermelons vary in shape; from globular to oblong. External rind colour varies from light to dark green and may be solid, striped or marbled. The pulp colour of most commercial varieties is red.

The fruit is generally eaten raw. Watermelon has a very high water content (93 ml/ 100g edible portion). It contains carbohydrates (5mg), calcium (8mg), phosphorous (9 mg), ascorbic acid (8 mg) and vitamins (0.64 g) per 100 g of edible portion.

Varieties

The leading variety (cultivar) grown in Guyana is the MickyLee, which has a round shape, solid, light green skin colour, and typically weighs between 2.3 and 3.6 kg (5 – 8 lbs). Lesser amounts of the large, elongated light green skinned – Charleston Grey, are grown. Another cultivar produced on a smaller scale is the Sugar Baby.

Environmental Requirements

Climate

Watermelons grow and produce fruits ideally during dry, sunny periods. Excessive rainfall and high humidity reduce productivity by affecting flowering and encouraging the development of leaf diseases. Elevations up to 1000 m normally provide suitable conditions for growth although excessively high temperatures of more than 30^oC may be harmful, reducing the degree of fertilization. Stable day – night temperatures promote a rapid growth rate.

Soil

Watermelons are well adapted to soils that are well drained, high in organic matter, with a good moisture retaining capacity. Crops are also frequently grown in low rainfall areas on soils which are relatively low in fertility. Well drained sandy loams are considered ideal for watermelon.

Watermelons can tolerate some degree of soil acidity. However, the pH of the soil should not be below 5.5 for good yields to be obtained. Liming at the recommended rate, should be done in the planting holes or mounds, if the soil pH is below 5.5.

Cultivation

Propagation and planting

Seeds in groups of 1-3 are sown 2 -4 cm deep in trenches, on mounds or prepared planting holes at 1 .2-2.0 in each way; seedlings are later thinned to 1 per station. Seedlings may be raised in containers and transplanted when 10-14 cm high. Seed required per hectare is 2.5-4 kg for a density of 5000-10000 plants/ha.

Irrigation

This should be regular throughout the growing period.

Fertilizer Application

A dressing of NPK should be applied to mounds or planting, followed by applications of a nitrogenous fertilizer at intervals up to flowering time. Alternatively liquid manure may be applied up to fruit set.

Insect/ Pest Management

The pests of watermelons are similar to those of pumpkins. An exhaustive description of these pests is provided in the manual ‘A Guide to Pumpkin Cultivation and Post Harvest Handling’. Table 1 provides a summary of pest that attack watermelons, damage caused and control methods.

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Table 1: Insect pests of watermelon

Scientific Name	Common Name	Damage	Control
<i>Aphis gossypii</i>	Melon or Cotton aphid	Sucks sap and weakens plant. Leaves curl, shrivel and may turn brown and die. Secretion of 'honey dew' causes sooty mould to develop.	Biological – use of ladybird beetle Chemical – Fastac, Decis, karate (1.5 ml/ L water) or Sevin 85 wp (1.5g/ L)
<i>Diaphania hyalinata</i>	Pickleworm or melon worm	Caterpillars feed on leaves and flowers. Sometimes they bore into the developing.	Use of appropriate contact insecticide such as malathion (2 ml/l of water)
<i>Diabrotica separata</i>	Leaf cutting beetle	Developing seedlings are affected by adults. Leaves become skeletonized.	Use of appropriate contact insecticide such as malathion (2 ml/l of water)
<i>Thrips palni</i>	Thrips	Sucks sap of leaves which become scorched. Infestation most severe during sunny weather.	1. Crop rotation 2. Chemical – Regent (10- 30 ml/L water), Vydate L (2.5 ml/ L water) or Admire
<i>Bemisia tabaci</i>	White fly	Sucks plant sap, leaves become chlorotic and are shedded prematurely	Cultural – keep farm free of weeds Chemical – Use soap based products or other chemicals such as Pegasus or Vydate l at the recommended rates
<i>Liriomyza sp.</i>	Leaf miner	Larva feeds between leaf surfaces resulting in 'chinese writing'	Chemical control – using Trigaul, Admire, Pilarking, Vertimex, Abamectin and Newmectin at the recommended rates.

Disease Management

Diseases that affect watermelons are similar to those of pumpkins. Farmers have reported recently a specific problem that they are encountering with watermelons. It was determined that the problem is known as Bacterial Blotch

The symptom of bacterial fruit blotch of watermelon is a dark olive green stain or blotch on the upper surface of the fruit (Figure 1). The blotch is first noticeable as a small water-soaked area, less than 1 cm in diameter, but it rapidly expands to cover much of the fruit surface in 7–10 days. As the blotch increases in size, the area around the initial infection site becomes necrotic. In advanced stages of lesion development, the epidermis of the rind ruptures, and frequently a transparent or amber-colored substance is exuded (Figure 2). Fruit lesions rarely extend into the flesh of watermelon, but when this occurs, the bacteria contaminate the seeds. Secondary rotting organisms are responsible for the ultimate decay and collapse of the fruit. Rapid expansion of fruit lesions usually occurs during the few weeks prior to harvest. Bacterial fruit blotch also affects melon, often resulting in water-soaked pits on the fruit surface, but the disease is best characterized in watermelon.

The fruit blotch bacterium also infects leaves, although foliage surrounding infected fruit may appear healthy to the untrained eye. Leaf lesions are small, dark brown, somewhat angular, and often inconspicuous. During periods of high humidity, the margins of leaf lesions often appear water-soaked. The initial symptom on seedlings is a water-soaked area on the undersides of the cotyledons (Figure 3). As the cotyledons expand, the lesion becomes necrotic and often extends along the length of the midrib. Lesions on young true leaves are small and dark brown and may have chlorotic halos. Seedlings infected with fruit blotch often do not collapse and die in the greenhouse, but the incidence of foliar symptoms will increase slowly in a warm, moist environment.

Causal Organism

The taxonomy of the causal agent of bacterial fruit blotch remains uncertain. The pathogen is a gram-negative, rod-shaped, motile bacterium with single polar flagellum. It was described as being very similar but not identical to *Pseudomonas pseudoalcaligenes* Stanier subsp. *citrulli*.

Fig 1. Symptoms of bacterial fruit blotch



Fig 2. Advanced stage of lesion development



Fig 3. Leaf symptoms of bacterial fruit blotch

Disease Cycle

The bacterial fruit blotch pathogen is seedborne. Internal and external contamination of the seed coat may occur; however, there is no evidence of infection within the seed. Contaminated seed results in infected seedlings, which serve as important sources of secondary inoculum, especially in transplant production facilities, where warm, humid conditions, overhead irrigation, and a canopy of susceptible plant tissue favor pathogen dispersal and disease increase. Secondary infections occur after bacteria gain entrance into plant tissues via natural openings, such as stomates. In the field, the bacteria produced on lesion surfaces are rain-splashed onto newly developed leaves and neighboring plants.

Although a very high proportion of leaves on a plant may exhibit symptoms of bacterial fruit blotch, the severity of symptom expression on individual leaves is very slight. Infection does not result in wilt, defoliation, vine blight, or vine collapse. There is no evidence of systemic infection; attempts to isolate the bacterium from surface-sterilized vines or peduncles of infected fruit have been unsuccessful. Leaf lesions are most important as a primary source of bacteria for fruit infection. Lesions on mature fruit are an additional source of secondary inoculum in the field. Bacteria associated with fruit infections filter down through the flesh of the watermelon, where they become associated with the seed.

In addition to overwintering contaminated seed, the pathogen may overwinter in infested rind. Infested crop residue, volunteer watermelon plants from contaminated seed, and infected wild cucurbits, especially wild citron, are important potential sources of primary inoculum in a subsequent crop season. Seed transmission has also been demonstrated in citron.

Harvest Maturity Indices

Several different maturity indicators can be used to determine when to harvest watermelon fruit. Watermelons should be harvested at full maturity to ensure that good quality fruit are delivered to the market. The fruit do not develop internal color or increase in sugar content after being removed from the vine. Commonly used non-destructive maturity indicators include fruit size, skin color, the amount of surface shine or waxiness, the color of the ground spot, the sound of the fruit when tapped, and the condition of the tendril at the first node above the fruit. Each of these individual indicators by themselves is not a foolproof determinant of fruit ripeness.

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It is advisable to use at least 3 or more of the above indicators to have more confidence in the harvest maturity state. Growers should also become familiar with the changes in external appearance of the fruit of the particular cultivar grown as it nears maturity in order to develop more confidence in the best stage for harvesting. Each cultivar has a known average fruit size, controlled by the genetic make-up of the cultivar and influenced by environmental conditions. Based on this previously established average fruit size, the timing of harvest can be approximated. As the fruit approaches harvest maturity the surface may become a bit irregular and dull rather than glossy. The ground spot (the portion of the melon resting on the soil) changes from pale white to a creamy yellow at the proper harvest maturity. The ground spot color is easily revealed by gently rolling the fruit over to one side while still attached to the vine. Very experienced workers can determine ripeness stage based on the sound produced when the fruit is thumped or rapped with the knuckles.

Immature fruit will give off a metallic ringing sound whereas mature fruit will sound dull or hollow. Another reliable indicator of fruit ripeness is the condition of the tendril (small curly appendage attached to the fruit stem slightly above the fruit). As the fruit become mature, the tendril will wilt and change from a healthy green color to a partially desiccated brown color. Several destructive indices can be used on randomly selected fruit to predict harvest maturity of the remaining fruit in the field of similar size. When the fruit is cut in half longitudinally, the entire flesh should be well-colored and uniform red (unless it is a yellow-flesh type). Immature melons have pink flesh, mature melons have red to dark red flesh, and over-mature fruit have reddish-orange flesh. For seeded cultivars, maturity is reached when the gelatinous covering around the seed is no longer apparent and the seed coat is hard and either black or brown in color. Melon fruit that have an abundance of white seeds are not mature. The soluble solids content of the juice is another commonly used index of harvest maturity. Soluble solids in watermelon consist mostly of sugars. A soluble solids content in the center of the fruit of at least 10% is an indicator of proper maturity. Soluble solids is determined by squeezing a few drops of juice on a hand-held refractometer (Figure 4). In addition, the flesh of mature fruit should be firm, crisp, and free of hollow heart.



Fig 4. Hand-held refractometer for determining watermelon soluble solids content.

Principal Postharvest Diseases

Postharvest diseases are important sources of postharvest loss of watermelons in Guyana. The amount of disease pressure depends on cultural practices used during production and the local climatic conditions at harvest. Disease pressure is greater in areas with high rainfall and humidity during production and harvest.

A number of pathogens may cause postharvest decay of watermelon. The primary defense against the occurrence of decay is the exclusion of diseased fruit from the marketing chain through careful selection at harvest and appropriate grading before shipment. Also, holding the fruit at 10°C (50°F) will slow the rate of disease development, compared to ambient temperature storage. There are no postharvest fungicide treatments for watermelon.

Common fungal diseases that cause rind decay after harvest include black rot, anthracnose, Phytophthora fruit rot, Fusarium, and stem-end rot. The most common postharvest bacterial disease is soft rot.

Black Rot

Black rot, also known as gummy stem blight, is caused by the fungus *Didymella bryoniae*. Fruit lesions appear as small water-soaked areas and are nearly circular in shape. They rapidly enlarge to an indefinite size, up to 10 cm to 15 cm (4-6 inches) in diameter. Mature lesions are sunken, may show a pattern of concentric rings, and turn black. Lesions in stems and fruit may ooze or bleed an amber plant fluid, hence the name gummy stem blight. A brown streak may also appear at the blossom end of the fruit.

The pathogen is transmitted from contaminated seed and is spread from plant to plant by splashing rain or wind. Inoculum is also found on old plant debris. The disease is controlled by planting clean seed in soils free of watermelon crop debris.

Anthracnose

Anthracnose, caused by the fungus *Colletotrichum orbiculare*, is a common postharvest watermelon disease. Dormant infections may exist at the time of harvest, with no external evidence of the disease. During storage, the latent infections may become active at high temperatures or after exposure to chilling injury inducing conditions. Disease development is rapid at temperatures between 20°C to 30°C (68°F to 86°F). The fungus can penetrate the fruit surface and wounding is not necessary for infection. Symptoms of anthracnose include sunken spots on the rind, which eventually become black (Figure 5). Red or orange colored spores may appear in the decayed areas.

Anthracnose spores are spread by water, insects, or pickers' hands. Infection is particularly severe after prolonged wet periods. A combination of seed treatment, crop rotation, removal of infected debris, and fungicide applications are necessary for controlling this disease. Protective spray applications of the fungicide chlorothalonil

should be made when vines start to run and should be continued at 7 to 10 day intervals during periods of humid or rainy weather. Also, storage of the fruit at 10°C (50°F) will retard the growth of this fungus.

Phytophthora Fruit Rot

Phytophthora fruit rot is caused by the soilborne fungus, *Phytophthora capsici*. The fruit rot will appear as greasy blotches on the outer rind. A whitish mold is likely to be present on the greasy tissue (Figure 6). This disease is most likely to occur during or after periods of excessive rains where water remained in the field. Control of Phytophthora may be obtained by avoiding planting in low areas. In addition, foliar sprays of the systemic fungicide Ridomil provide some protection against this disease.



Fig 5. Anthracnose decay of watermelon fruit.



Fig 6. Greasy spot and associated whitish mold growth of Phytophthora infected fruit.

Fusarium

Fusarium is a soil-borne fungus that attacks the roots, stems, and fruit of watermelons. The fungus can attack both sound and wounded tissue. Fruit

symptoms first appear as spots on the underside of the fruit, and eventually spread to the upper surface. Infected tissue is usually spongy or corky. Under humid conditions, the fruit may become covered with a white or pinkish mold (Figure 7). Decay may be shallow or it may extend deep into the flesh of the fruit. There is usually a sharp separation between healthy and rotted tissue. The temperature range that favors Fusarium growth is 22° to 29°C (72°F to 84°F). Use of resistant varieties can minimize the risk of Fusarium. Rotating the planting site and removing and destroying all plant debris at the end of each growing season will also reduce the incidence of the disease. For watermelon, a minimum eight-year planting site rotation is recommended to avoid Fusarium. This disease may also be spread by planting previously saved seed that came from contaminated fruit.

Stem-end Rot

Stem end rot is caused by the fungus *Lasiodiplodia theobromae*. The disease is first seen as a shriveling and drying of the stem followed by browning of the area around the stem, which progressively enlarges as the disease develops (Figure 8). The cut flesh is noticeably softened and lightly browned. If the cut melon is exposed to the air for a few hours, the diseased areas become black. The disease develops rapidly in the fruit at temperatures greater than or equal to 25°C (77°F) but slowly or not at all at 10°C (50°F). In order to minimize the incidence of this disease, at least 2.5 cm of stem should remain attached to the fruit at harvest.



Fig 7. Fusarium rot on 'Sugar Baby' watermelon.



Fig 8. Symptoms of stem-end rot.