PRODUCTION GUIDELINES

for

Muskmelons

agriculture, forestry & fisheries

Department: Agriculture, Forestry and Fisheries

REPUBLIC OF SOUTH AFRICA
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PART 1: GENERAL ASPECTS

Classification

Scientific name: *Cucumis melo* L.
Common names: Muskmelon or cantaloupe (English), spanspek (Afrikaans)
Family name: Cucurbitaceae

Muskmelons, often called cantaloupes in the United States, are not commonly grown here in South Africa, although their cultivation is slowly increasing in many areas of the country because of their export grade. True cantaloupes have deeply grooved fruit with a hard, warty, or scaly rind and orange or green flesh. Muskmelons (*Cucumis melo* L. Reticulatus Group), on the other hand, possess a fruit rind that is netted. The muskmelon is a member of the Cucurbitaceae (cucumber) family, which also includes cucumbers, watermelons and honeydew, Persian, casaba, and crenshaw melons.

Origin and distribution

Cantaloupes were first cultivated in the Near East and were found growing in areas from Turkey to China, including northwest India, Afghanistan, and Uzbekistan. Several cantaloupe varieties were reportedly grown in the West Indies as early as 1494. Cantaloupes were also cultivated by Native Americans near the present city of Montreal in 1535 and in the vicinity of Philadelphia prior to 1748.

Major production areas in South Africa

*South Africa*

Wild populations of muskmelons occur in desert and savannah regions of Africa, Arabia, southwestern Asia and Australia. Within southern Africa, it occurs in the South African provinces of Limpopo, Gauteng and Mpumalanga.

Description of the plant

*Botany*

Cantaloupe or muskmelons (*Cucumis melo* L.) are annual plants with a trailing vine growth.

*ROOTS*

Muskmelons and watermelons have strong taproots that can be deep on non-irrigated melons but generally are shallow but horizontally extensive when the crops are adequately irrigated.
STEM

Usually the main stem produces three to four major branches of equal or longer length than the main stem. Additional laterals (branches) later arise from both the main stem and branches and can produce additional flushes of fruit if the vines remain healthy.

LEAVES

Melons have modified, threadlike leaves called tendrils, which the vine uses for anchoring or climbing. Tendrils can be branched (watermelon) or simple (muskmelon).

FLOWER

Cucurbit flowers are diverse in colour, shape and size. Cucurbits have a monoecious flowering pattern, which means male and female flowers are borne separately on each plant. Melons have male (staminate) flowers and a mix of female (pistillate) and perfect (both male and female organs) flowers.

Muskmelons contain two blossom types: perfect (having both male and female parts) and male (staminate) flowers.

FRUIT

The fruit typically sets in cycles in which several muskmelons are set per plant in the first cycle, and additional fruit can be set in subsequent cycles. Fruit is typically harvested from the first cycle of fruit set (crown fruit) because this produces the highest quality fruit (high in sugars and large size).

Cultivars

Varieties that are grown frequently in South Africa are Imperial 45, Honeydew, Hale’s Best cantaloupe, and Edisto cantaloupe.

Climatic requirements

Temperature

Muskmelons are warm-season crops that grow best at average air temperatures between 18 and 24°C. It is best to plant when the soil temperature is at least 15 to 18°C. Temperatures above 35°C or below 10°C will slow the growth and maturation of the crop. Cantaloupes are very sensitive to cold temperatures and even a mild frost can damage the crop. These melons are very tender and should be planted after the last chance of frost has passed.
Soil requirements

Muskmelons grow well on a wide range of soil types. Medium-textured soils (loams) will generally produce higher yields and better-quality melons. Where early harvest is of importance, lighter soils located where there is good air drainage are best. Heavier soils produce higher yields and are better for later-season production. Windbreaks are advisable on sandy soils to reduce “sand blast” damage and stunting to young seedlings during spring winds. To reduce the risk of diseases, crop rotation is important where cantaloupe is to be planted, especially in land where watermelon, squash, cucumber or pumpkin have been grown during the past three years.

In all cases the soil must exhibit good internal and surface drainage. The pH should be above 5.8 and preferably near 6.2. Rows should be raised 15 to 20 cm to facilitate soil drainage.

Site selection

Vine crops require full sun, heat and a long growing season. Well-drained soils that warm up quickly are best suited for muskmelon. Poorly-drained soils tend to stay cool longer in the spring and contain less soil oxygen, which increases the incidence of root rot diseases.

PART 2: CULTIVATION PRACTICES

Propagation

Muskmelons may be planted by direct seeding or by transplants after all danger of frost has passed.

Seeding

Direct-seeded melons should be sown when the soil temperature is above 18°C, but the optimum temperature range for germination is between 21 and 35°C. Use fungicide-treated seed, as muskmelons are sensitive to damping off, especially under cool, wet soil conditions.

Transplanting

Some growers prefer to purchase or grow transplants as a way of reducing seed cost and/or obtaining early melons. This works well, especially when growing on film mulches. When growing transplants, seeding 2 to 4 weeks ahead of transplanting date is normally the best method. Commercial potting mixes work well because the growing medium must be sterile and drain freely. The diameter of transplant
containers can range between 2 to 10 cm, with 8 cm being optimum for early production. If weather conditions limit time of field transplanting, transplant growth can be minimised by reducing temperature and watering.

**Soil preparation**

Weed control is required prior to planting the bed. Beds should be worked 16 to 20 cm deep to promote deep rooting. Raised beds or hills are an alternative to the conventional field planting method. This planting system improves soil drainage and allows access to the crop without causing soil compaction. Raised beds are typically 1 m to 2 m wide and 30 m long. The width is determined by the type of equipment used and by the crop.

**Planting**

*Planting period*

It is best to plant when the soil temperature is at least 15 °C for germination. Seeding about 0.5 to 0.75 cm deep is considered as best when planting by hand. When seeding, unless you use a precision-type seeder, about 15 000 seeds per kilogramme will be required per hectare. One should consider a precision seeder or the use of transplants if planting a substantial number of hectares with expensive hybrid seed. For good plant establishment, an insecticide and fumigant should be used to control seedcorn maggot and seedling damping off.

*Spacing*

Commercially produced cantaloupes generally are started as transplants in the greenhouse 18 to 24 days prior to planting in the field. Because cantaloupes are a warm-season crop, they should not be transplanted until the soil temperature 8 cm beneath the soil surface reaches 15 °C. Growers generally plant between 2 200 and 4 200 plants per hectare in single rows 1 to 2 m apart, on mulched beds with 60 to 76 cm between plants in the row.

Another spacing of row widths of 1 to 2.3 m is desirable and in-row spacing should be 46 to 60 cm. These combinations will give you a range of about 3 600 to 5 500 plants per hectare.

*Seeding rate*

Sowing seed at a depth of 2 cm seeding will require 1 to 2 kg/ha (16 000 to 20 000 seeds per kilogramme), unless a precision-type seeder is being used.
Fertilisation

Field fertilisation

Application rates are most accurate when a soil test is taken and recommendations followed. If soil is not tested, side place 18 to 23 kg of nitrogen and phosphorus (in the form of \(P_2O_5\)), and 45 to 54 kg of potassium (\(K_2O\)) per acre at planting. At lay-by, an additional 18 to 23 kg of nitrogen per hectare will be needed. In some soils, 18 to 36 kg of potash per hectare will improve yield and quality.

Irrigation

Irrigation prior to and after planting should be applied to ensure seed germination, emergence and stand establishment. Overhead irrigation is most frequently used. However, drip irrigation, with plastic, is becoming more frequent and is highly desirable. Drip irrigation provides the plants with a more uniform application of water, placing it near the root zone and using less water. Drip irrigation also minimises the quantity of foliage and incidence of fruit disease compared to overhead irrigation. Furthermore, drip irrigation does not interfere with honeybees and subsequent pollination and fertilisation.

Using p-film

Plastic mulch should be used with trickle (drip) irrigation because it is very difficult to maintain proper soil moisture under the mulch using overhead irrigation. Fertiliser should also be applied through the drip tube. Again, the use of plastic mulch without irrigation is not recommended.

Polyethylene (black plastic) mulch can offer several advantages to growers. Black plastic mulch increases the soil temperature earlier in the growing season, conserves moisture and reduces several problems: soft compaction and crusting, ground rot of fruit, fertiliser leaching, flooding of crops, evaporation and competition from weeds. These benefits promote increased quality and quantity of fruit yields and result in earlier yields, especially when used in combination with transplants.

The use of transplants with plastic mulch generally results in harvests that begin 7 to 14 days earlier as compared to bare ground production. Although using mulch will increase production costs, these costs should be offset by increased profits from earlier and larger yields. Drip irrigation systems must be used with plastic mulch. Be sure to offset the drip tape 8 to 10 cm from the centre of the bed, 5 to 8 cm deep.

Weed control

A weed control programme for any crop begins before planting, but this is especially true for muskmelons because only a handful of herbicides are registered for
use on this crop. If possible, select an area for planting where weed populations are low and there are no perennial weeds such as nut grass, Bermuda grass, or vines. Perennial weeds generally require powerful herbicides or fumigation to control. Primary tillage, including mouldboard plowing, disking and bedding are considered weed control methods, because these operations generally kill most emerged weeds. It is critical to start with a clean field before planting the crop, because any emerged weeds will have a significant advantage over the young muskmelon seedlings in competing for water, fertiliser and sunlight.

Cultivation can provide effective weed control between rows as long as the cultivator can be used without damaging the crop. If plastic mulch is used, between-row cultivation may not be practical or may be limited because of potential damage to the plastic. Soil-active herbicides can be applied before mulching, but the effectiveness of post-emergence treatments may be limited because of plastic mulch. Hand weeding between rows may be a viable option in small-acreage situations.

**Pest control**

**Cucumber beetles**

Two species of cucumber beetles—striped and spotted—may infest muskmelon. Both species have a yellow-green background colour. The striped cucumber beetle has three black stripes along the length of the body, and the spotted cucumber beetle has 12 black spots on its back. The beetles begin feeding on alternate weed hosts in the early spring and can move into spring-planted melons just after seed emergence or transplanting. Cucumber beetle larvae feed on roots and stems and may cause stunting of small plants. When populations are high, the cucumber beetle adults feed on foliage and can stunt or kill seedlings or young transplants. Beetles also feed on the melon rind later in the season, which results in cosmetic damage that reduces the number of marketable fruit.

Cucumber beetles also serve as vectors for the transmission of a bacterium that causes bacterial wilt, a serious disease of cucurbits. The bacterium overwinters in the digestive tract of the beetles and can be transmitted to susceptible plants the following spring when the beetles become active. Transmission to plants occurs through injuries on leaves created by feeding. Once infected, the plants become wilted and die off. The only way to avoid bacterial wilt is to prevent the beetles from feeding on the plant.

There are two options for cucumber beetle control. If the area has a history of cucumber beetle and bacterial wilt problems, growers may opt to use the systemic soil insecticide carbofuran at planting. The other control option is to monitor plants regularly, particularly during the susceptible early season stage, and to apply foliar insecticides if beetles are present. Pyrethroid insecticides will give the longest re-
sidual control (about 7 days). Foliar insecticides are not usually needed after beetle populations decline and plants mature.

The beetles become active early in the spring when temperatures reach 21°C. Eggs are deposited at the base of the plant and larvae may feed on the roots. These are the most troublesome on young plants. Fields should be scouted for these and other insects routinely (twice a week). An important part of scouting is identifying the insect(s) accurately. Once the insect(s) is identified and the number has been established, the best control measures can be implemented to treat the pest(s).

**Aphids**

Aphids are small, soft-bodied insects that feed by sucking sap from the plant. Infestations begin when winged adults fly into fields from weeds or other crops. Later, colonies of wingless aphids, which feed near the plant base or on the undersides of young leaves, are produced on the plants. This feeding results in cupping of the leaves. When plants are heavily infested, leaf distortion and stunting are common, and fruit set may be reduced. Upper leaf surfaces may be covered with “honeydew,” a substance secreted by the aphids. The honeydew also causes stickiness on fruit surfaces and is associated with the growth of black, sooty mould fungus.

In addition to feeding damage, aphids can transmit plant viruses (for example, cucumber mosaic virus, watermelon mosaic virus; see section on melon diseases for further information). Control of aphids and aphid-borne viruses is difficult with insecticides. In fact, application of some insecticides like the pyrethroids destroys the aphids’ natural enemies and results in increased aphid populations. Therefore, use of pyrethroids should be avoided if possible. Overfertilisation with nitrogen can also increase aphid numbers. Reflective mulches can be used to delay colonisation by winged aphids and subsequent transmission of viruses. Control of weeds within the field along field borders is also of value in reducing the potential for aphid infestation. Weekly application of highly refined oils (for example, stylet oil) using a high spray volume and pressure has been shown to reduce aphid-transmitted virus infection by as much as 90%.

Aphid colonies are initiated in the terminals on the underside of the leaf, therefore scouting observations should be made in the plant terminal.

**Mites**

Mites are actually arthropods more closely related to spiders than insects. They are tiny and pale yellow or red in colour. A hand lens is necessary to see them clearly. They are primarily found on the undersides of leaves, where they suck plant sap and, in hot, dry weather, can defoliate vines in a few weeks. Defoliated plants yield
small, poor-quality fruit. Mite infestations usually occur along the edge of a field, frequently next to gravel or a dirt road or grassy area.

Dusty conditions promote mite development. As mite populations increase, infested leaves turn yellow. The underside of an affected leaf appears tan or yellow and has a crusty texture. Mites can be identified by shaking leaves onto a sheet of white paper and watching for moving specks or by observing leaves with a hand lens. As with aphids, pyrethroid and carbamate insecticides may actually increase mite populations by destroying the natural enemies of mites.

Because mite infestations usually begin on the field edges, these areas should be inspected regularly, particularly during periods of hot, dry weather. If a mite infestation is found, the infested areas may be spot treated with a recommended acaricide, followed by another treatment within 5 days. Continue to monitor the affected area to ensure that the mite infestation does not spread.

**Pickleworm**

The pickleworm is one of the most damaging insect pests of cucurbits. This pest does not overwinter, but the adult moths migrate into the northern states as the growing season progresses. Pickleworm moths are small, and easily recognisable by the wide, yellowish-brown band on the outer wing margins. The body is also yellow-brown, with a purplish tinge. The tip of the abdomen has a prominent rounded brush of long hair-like scales. The closely related melon worm moth (not a serious pest) is similar in appearance, but the body behind the wings is silvery white rather than yellow-brown, and the band around the wing margins is narrower than that of the pickleworm.

Pickleworm moths are night flyers, rarely seen during the day. Females lay egg clusters on tender buds and new leaves and sometimes on the fruit. After hatching, young larvae develop inside the buds, blossoms and leaf terminals. Older larvae are capable of moving to the fruit where they enter and complete development. Damage from a single larva boring inside a melon will make the fruit unmarketable. The small larvae are pale green with many black spots on their upper surface; older larvae are a green-copper colour, except for the brown head and brown area just behind the head.

Management of pickleworm with insecticides can be difficult, because the larvae are almost always in protected locations on or in the plant itself. The best management scheme is to monitor plants weekly, beginning when the first developing leaf buds and terminals are formed. If present, young pickleworm larvae can be detected by pulling apart the leaf terminals or buds. Although larvae may also be found in flower buds, the majority will be located in the developing leaf tissue. Newly hatched larvae blend in with the green plant tissue, but they can be detected with some practice (a hand lens helps). Larval treatment thresholds have not been
developed for pickleworm; therefore, the current recommendation is to begin a weekly spray programme with a recommended insecticide if any larvae are found on the plants. Growers who are not willing to monitor plants for signs of pickleworm usually begin a preventive spray programme when the flower buds first start to form. A successful cultural management strategy for pickleworm is early planting and harvesting. As pickleworms are migratory, large populations do not develop until later in the season.

As with pickleworm, control with insecticides is not highly effective, because the larvae are protected inside the stems. Fortunately, this insect is not usually a serious problem in commercial melon production. Commercial growers with a history of borer problems usually watch for moth activity around the plants, then begin a weekly spray programme with a recommended insecticide if moth activity is observed.

A fairly effective home-garden management strategy is to check the base of the plant stems for holes or excrement, which indicates borer infestation. If infested, stems may be cut lengthwise at the point of attack and the larvae destroyed. The stems may then be covered with moist earth to encourage development of roots. To reduce damage the following year, all vines should be destroyed soon after the final harvest. The soil should be raked or disked in the fall and turned under deeply in the spring to prevent the emergence of adults from cocoons.

**Squash vine borer**

This insect is usually a greater problem on squash and pumpkins than on muskmelon, but melons, particularly in the home garden, can sometimes be attacked. The adult is a “clearwing moth,” and actually looks more like a wasp. The front wings are covered with metallic, shining, olive-brown scales, but the hind wings are transparent. The abdomen is ringed with red, black and copper, and the moth flies swiftly and noisily about the plants in the daytime. Eggs are laid on stems near the base of the plant. Upon hatching, the larvae bore into the stems and tunnel along, eating the inner tissue. Larvae are a whitish cream colour with a brownish head.

**CONTROL MEASURES**

Home gardeners may try excluding the pest with sleeves or collars on the vine stems at the base of the plants or removing borers from vines. When adults are flying, insecticides can be repeatedly applied to the base of the plants.

**White-fringed beetles**

White-fringed beetles are named for the white stripe on both sides of the adults. As with wireworms, the soil-inhabiting larvae cause the most serious damage by feeding on the roots of young plants. Larvae are pale white to yellow, legless grubs
with a dark head capsule. Severe white-fringed beetle infestations can result in poor plant stands because of the destruction of the root system by the larvae. As with wireworms, white-fringed beetles are most likely to be a problem when melons are planted into new land. However, white-fringed beetles prefer a wide variety of broadleaf weeds (particularly legumes) over grasses. If a white-fringed beetle infestation exists, the grubs can be detected in the spring before planting by turning over the soil with a spade. If grubs are observed, a recommended preplant soil insecticide treatment is warranted. There is no available control post planting for white-fringed beetle.

**Wireworms**

Wireworms are the soil-inhabiting larvae of click beetles. They have a cylindrical, hard-bodied, wire-like appearance. They are shiny, brownish yellow, and long. Wireworm damage usually occurs just after transplanting or seed emergence. Larvae feed on the roots and stems of young plants, causing plants to become stunted and to wilt. Stems may have shallow, oval feeding scars or deep, circular holes where wireworms have entered.

Wireworms are most likely to be a problem when melons are planted on “new” land (for example, pasture that contained grasses) or following plantings of sod or small grains. Damage is most often observed under cool, moist soil conditions and in heavier soils. There is no “rescue treatment” for wireworm damage. If a wireworm infestation is detected or suspected, a recommended preplant soil insecticide treatment is warranted.

**Disease control**

Vine crops are susceptible to many plant diseases. The diseases described here are economically important. With the exception of viruses, which can infect plants at any stage of growth, diseases are listed in the order they are likely to appear.

**Damping off**

Hosts and severity: Damping off is one of the first diseases to appear after seedlings are susceptible. Three fungi are commonly associated with damping off: *Pythium* spp., *Rhizoctonia solani* and *Thielaviopsis basicola*.

The pathogens infect plant roots soon after germination. The tissue at or below the soil line becomes soft and can no longer support the plant, causing it to topple over. As plants mature, the stems become more woody and resistant to infection. Damping off is often limited to low spots of the field. Heavy, wet soils tend to have more problems with this disease than lighter, well-drained soils. Excess nitrogen can increase the incidence of disease.
Disease cycle: The fungi that cause damping off are soil borne and infect the roots of seedlings soon after germination. *Rhizoctonia solani* can live indefinitely in the soil. *Pythium* and *Thielaviopsis basicola* can live for 2 to 3 years.

Symptoms: The first sign of infection is the presence of small, firm, dark-green spots. These spots later turn tan or brown and collapse. In wet weather, threadlike, white to cream-coloured mycelia may cover the lesions. Secondary soft rots may succeed *Rhizoctonia infections*.

Management: To prevent outbreaks on transplants, sterile, soilless potting mix should be used. Direct-seeded plantings may be protected by treating the seed with a fungicide prior to planting. Because *Rhizoctonia solani* can live indefinitely in the soil, rotating of vine crops for at least 4 years must be considered. Maize and small grains are not susceptible. Ripe fruit should be harvested promptly and crop residue destroyed to prevent the build-up of the pathogen in the soil.

**Angular leaf spot**

Hosts and severity: Angular leaf spot is a bacterial disease that can be economically important on cucumbers, honeydew melon and zucchini. The bacteria, *Pseudomonas syringae* pv. *Lachrymans*, infect leaves, stems and fruit.

Disease cycle: The bacteria survive in the soil on plant debris for up to 2 years. The bacteria are spread by cucumber beetles and human activity. Prolonged leaf wetness favours infection.

Symptoms: Initial lesions appear as small, tan, water-soaked spots that are delineated by the leaf veins. As the lesions enlarge, the dead centres fall out. Infected fruit may appear healthy but later develops soft spots as lesions form beneath the rind. The lesions eventually crack open, providing an entry point for soft rot organisms.

Management: To reduce the likelihood of infection, crop rotation of cucurbits for at least 2 years and disease-free seed are used. Copper fungicides applied every 5 to 10 days may be helpful, particularly after rain or wind storms.

**Alternaria leaf blight**

Hosts and severity: Alternaria leaf blight is a fungal disease caused by the pathogen *Alternaria cucumerina*. Infected plants eventually lose their leaves, reducing fruit size and quality. It can be particularly severe on muskmelon but also affects squash, cucumbers and watermelon. Infection is most likely to occur on vine crops weakened by poor growing conditions or aging.
Disease cycle: The fungus overwinters in infected plant debris, cucurbit weeds and infected seed. Spores may be spread by wind, water and human activity. The fungus survives for less than a year.

Symptoms: Symptoms first appear in the middle of the season on the leaves nearest to the centre of the plant. The lesions are tan, often water-soaked and roughly circular in shape. The lesions become target-shaped and may enlarge to 0.75 cm in diameter on muskmelons. Infected fruit have circular, sunken, brown spots that develop into a dark olive-green or black powdery mat.

Management: To help prevent this disease, proper soil fertility and moisture should be maintained throughout the season. Working the field when the soil is wet should be avoided to reduce compaction. If the crop becomes infected, crop rotation should be done for at least 1 year. Edisto is a resistant muskmelon cultivar. Fungicide treatments will protect healthy plants. Treatment should begin as soon as symptoms appear.

**Powdery mildew**

Hosts and severity: Powdery mildew is a foliar disease that occurs late in the season on muskmelons. It is less common on watermelon. On susceptible crops, this disease is often severe enough to significantly reduce yields.

Disease cycle: Two fungi are responsible for powdery mildew: *Erysiphe cichoracearum* and *Sphaerotheca fuliginea*. These fungi overwinter on perennial hosts. Each year fungal spores are blown. Infection is favoured by warm, humid weather.

Symptoms: Symptoms first appear as pale yellow spots on the oldest leaves. As the disease progresses, a white or brownish powdery growth covers affected plants. Eventually, affected plants wilt and die off.

Management: On susceptible crops, fungicides may be applied every five to seven days once the disease appears in the field to protect healthy plants. Treatment should continue until harvest.

**Bacterial wilt**

Hosts and severity: Bacterial wilt is a common and severe disease of vine crops. Muskmelons are the most severely infected but watermelons are also susceptible.

Disease cycle: The bacterium, *Erwinia tracheiphila* overwinters in the cucumber beetle. It is transmitted when the beetle feeds. Once the bacteria are in the plant, they travel through the vascular system and block the food and water-conducting vessels. Seven to 10 days after infection occurs, leaves begin to flag or wilt.
Symptoms: Initially leaves wilt during the day but recover at night or on cloudy days. To distinguish wilting caused by *Erwinia* from that caused by the squash vine borer or *Fusarium*, cut the stems of symptomatic plants. Hold the cut edges together for 10 seconds, then slowly pull them apart. If you find a sticky white sap, the plant is infected with the bacteria. Plants of any age are susceptible.

Management: There is no treatment for infected plants. It is therefore important to control cucumber beetles early in the season to prevent spread of this disease. Infected plants must be removed immediately or they will serve as a reservoir for the pathogen. Growing extra transplants to replace plants lost early in the season should also be considered as an alternative method.

**Fusarium wilt**

Hosts and severity: A second wilt disease of cucurbits is *Fusarium* wilt. Each host crop is susceptible only to its own particular strain of the fungus. *Fusarium oxysporum* f.sp. *melonis* affects muskmelon and *F. oxysporum* f.sp. *niveum* affects watermelon. Within each strain of the fungus, different races attack various cultivars.

Disease cycle: *Fusarium* is a soil-borne fungus that overwinters in plant debris, seed and soil. The pathogen can attack plants at any stage of growth. Warm temperatures and excessive wetness favour the infection.

Symptoms: On infected seedlings, the cotyledons and small leaves turn pale green and wilt. Older plants wilt at midday, starting from the tips of the runners and moving toward the crown of the plant. In muskmelon, early symptoms appear as a stunting or yellowing with a water-soaked tan streak along the vine. Vines may crack open and ooze sap. Late in the disease, vines may be covered with white or pink mycelium. To distinguish these wilt symptoms from those caused by bacterial wilt or squash vine borer, cut open the lower stem. Plants infected with *Fusarium* will show yellow, brown or reddish-brown discolouration.

Management: Rotating fields out of cucurbits for 5 to 10 years is advisable to prevent the build-up of the pathogen in the soil.

**Root-knot nematodes**

Root-knot nematodes, *Meloidogyne* spp., can attack cucurbits as well as more than 2 000 other species. When root-knot nematode populations are high, plants are often stunted and may wilt during dry conditions or during the hottest part of the day. Nematodes damage the root system by disrupting the flow of water and nutrients and by causing injuries that give access to diseases such as *Fusarium* wilt. Detecting root-knot nematodes in the field is done easily by examining the roots of symptomatic plants. The nematodes cause knots or galls to develop on both large and small roots; knots range in size from the head of a pin to 2,54 cm in diameter.
Root-knot nematodes have a wide host range that includes many cultivated crops as well as many weed species. The nematodes survive in the soil from one year to the next and become active as soil temperatures increase in the spring. The most effective control of root-knot nematodes is through the use of resistant varieties. Rotation with grasses and other nematode-suppressive crops or clean fallowing during the off-season will reduce nematode populations. Soil fumigation is an effective means of reducing damaging population levels temporarily (one growing season). Soil solarisation has also been shown to be effective in reducing nematode populations when environmental conditions are favourable for its use.

**Fusarium fruit rot**

*Fusarium* fruit rot of muskmelon is caused by the soil-borne fungus *Fusarium roseum*. Usually ripe fruit is affected. Lesions may occur anywhere on the fruit but are frequently found at the stem end. Tan-coloured spots that are about 2 cm in diameter develop on fruit. Internal decay may be shallow or may extend into the seed cavity. The rotted tissue is white to rose coloured, dry and spongy. This tissue can easily be separated from the surrounding healthy tissue. A white mould develops on the surface of infected fruit during wet conditions and in storage.

This fungus is common in soil. An injury caused by insect or mechanical damage is necessary for infection. The disease is more common in thin-skinned varieties. Further infections can occur during harvesting if knives become contaminated through contact with infected plants or infested soil. Control consists of management practices that reduce fruit injury, prevent fruit contact with the soil surface, or reduce moisture on the fruit surface.

**Gummy stem blight**

Gummy stem blight, caused by the fungus *Mycosphaerella melonis*, is a common disease of muskmelon, watermelon and cucumber. Symptoms first appear as greyish-green, circular spots between the veins in the lobes of leaves. Spots turn dark brown to black with age. The leaf-spot stage can be confused with anthracnose; however, gummy stem lesions are darker with target-like or zonate patterns with less deterioration of the leaf tissue. The spread of the disease begins in the centre of the plant and spreads outward. Lesions develop first on the vines at the nodes and elongate into water-soaked streaks that become pale brown to grey with time. Stem tissue often cracks and a characteristic gummy ooze exudes from the injury. Infected vines and, occasionally, entire plants die off. The disease, unlike anthracnose, does not attack fruit.

Although the fungi that cause gummy stem blight and anthracnose are two completely different organisms, their spread and their control are very similar.
Anthracnose

Anthracnose, caused by the fungus *Colletotrichum lagenarium*, can be a destructive disease of muskmelons during warm, wet growing seasons. The disease also attacks watermelon, cucumber and gourds.

All above-ground plant parts are susceptible to infection and plants can become infected at any stage of development. Older leaves first show small, water-soaked or yellowish areas that enlarge rapidly and turn tan to reddish brown (mostly cucurbits) or black (watermelon). Spots are often circular to angular. Later, spots may merge, blighting large sections of the leaf. These areas become dry and tear away, typically giving the foliage a ragged appearance. Often the leaves at the centre of a plant are attacked first, leaving stems and runners bare. Tan to black, elongated, slightly sunken streaks (cankers) form on petioles and stems that can girdle the vine, causing die-off of the tissue beyond the lesion.

Fruit, if infected early, may turn black, shrivel, and die off. Round, water-soaked spots, 0.25 cm to 0.50 cm in diameter, develop on the older fruit. Spots turn dark green to brown with age and may become sunken. Under wet conditions, pinkish coloured spore masses can be seen oozing out of the sunken spots.

The fungus overwinters in debris from previous host crops, in seed, or in weeds of the cucurbit family. Warm (24 °C), wet conditions (frequent rains, poor drainage) favour rapid development and spread of the disease. Anthracnose can appear anytime during the season, but most damage occurs late in the season after the fruit is set.

CONTROL MEASURES

A combination of seed treatment, crop rotation and fungicide applications is necessary for control on susceptible varieties. Follow general management practices; start the spray schedule at first appearance. Vines should be thoroughly covered with fungicide spray. Avoid soaking seed before planting. It is advisable to grow watermelons, cucumbers, squash or pumpkins only once every 5 years on the same land.

Downy mildew

Downy mildew, caused by the fungus *Pseudoperonospora cubensis*, affects muskmelon and cucumber. The disease can reduce yield and fruit quality. If plants are infected early in the season, downy mildew can kill off plants. The fungus causes irregularly shaped, yellowish to brown spots on the upper leaf surface. Spots are
often angular and are restricted by the small veins of the leaf. Under moist, humid conditions, a fluffy, purplish to grey fungal growth appears on the underside of the leaf corresponding to the leaf spots above. As the spots enlarge, the leaves turn yellow and eventually die off. Infected leaves that die off remain erect while the edges of the leaf blade curl inward. Severe infections result in defoliation, stunting of plants and poor fruit development. The disease usually affects older leaves first and progresses outward.

Temperatures between 15°C and 21°C, heavy dews, or frequent rains favour development. The fungus can overwinter in an area or can be introduced on wind currents from considerable distances.

CONTROL MEASURES

Downy mildew severity can be decreased by taking actions that encourage airflow and reduce leaf wetness. However, such actions are often insufficient during prolonged, favourable environmental conditions and in the presence of high inoculum levels. Growing cucurbits in environments where humidity levels can be manipulated can help to manage downy mildew. For example, trellising cucurbits, increasing plant or row spacing or growing in passive or traditional greenhouses can help reduce relative humidity and leaf wetness.

Viruses

More than 30 virus diseases affect cucurbits. Many can be very destructive and difficult to control. Some viruses are seed-borne while others must be transmitted to susceptible plants by insect vectors. Once a plant becomes infected with a virus, there is no cure. Therefore, prevention is the best control. Controlling the vector transmitting the disease is one of the first things that need to be done (controlling weeds that may serve as reservoirs for the virus) and using resistant cultivars.

Mosaic viruses

Three viruses found commonly in muskmelons are cucumber mosaic virus (CMV), squash mosaic virus (SqMV), and watermelon mosaic virus (WMV). These viruses differ in their host range, method of transmission and in how they overwinter. Symptoms produced by these viruses are similar, making field identification impossible. Special laboratory testing is required for positive identification.

CMV attacks more than 40 families of plants worldwide, including all vine crops. Strains of CMV differ in their host range, symptoms and method of transmission. Cucurbits are susceptible at any stage of growth. When plants become infected in the six to eight-leaf stage, symptoms first appear on the youngest, still expanding leaves. A mosaic pattern develops (healthy dark-green leaf tissue intermingled with light-green and yellow tissue). Leaves are often distorted, crinkled, curled and stunted. Vines may appear bunchy because of the shortening of the internodes. In
severe cases, older leaves may die off. Typical mosaic symptoms develop only on actively growing leaves. When a plant becomes infected at midseason, previous growth remains normal and produces healthy fruit. Few fruit set on plants that are infected early in the growing season. If fruit does set, however, it is often of poor quality and may be mottled green and yellow or have dark green-warts.

CMV survives in almost 800 species of plants, including many weeds found in Alabama. These weeds often act as reservoir hosts allowing CMV to overwinter. The virus can be spread and transmitted by more than 60 species of aphids. Transmission is in a non-persistent manner, meaning that the aphids only need to feed on a CMV-infected plant for only a few seconds to pick up the virus.

SqMV infects most cucurbits but is rarely a problem in watermelon. On muskmelon, SqMV causes yellow spotting, a green and yellow mosaic, and green vein-banding on the leaves. A few leaves may become malformed with veins protruding beyond the leaf margin. The virus can overwinter in weeds, seed, and in cucumber beetles. Cucumber beetles are efficient vectors of SqMV, spreading the virus during feeding.

WMV affects all cucurbits and a few others, including English peas and alfalfa. Symptoms vary, depending on the host and plant age at the time of infection. Symptoms on most cucurbits may include stunting, leaf malformation, yellowing or light-green mottling and marginal chlorosis. Plants that are infected when they are young produce few marketable fruit. Fruit that is produced may be dwarfed, mottled, or spotted.

WMV overwinters in seed or in infected weeds. In spring, the virus can be spread by many species of aphids in a non-persistent manner. Later plantings risk greater damage as disease incidence and aphid populations increase during the growing season.

Control of mosaic viruses in cucurbits begins with eradication of biennial and perennial weeds and wild reservoir hosts in and around gardens and fields. Applications of insecticides to prevent the build-up of large aphid and cucumber beetle populations, as well as other insects, will reduce virus incidence and spread. When possible, use plant certified virus-free seed or transplants. Isolate later plantings far from earlier settings, especially if virus incidence was high. Removing infected plants when symptoms first appear, may reduce or delay spread of the disease.

**Other cultivation practices**

*Pollination*

Muskmelons require bees for pollination. A large, active honeybee population is essential for complete pollination and fruit set. One hive per hectare is recommended for maximum fruit production. Insecticides applied to flowers or weeds in bloom can adversely affect pollinating insect populations. With some insect pests infecting cantaloupes during bloom, extreme care must be taken in the choice of insecticides during this crucial period.
ROW COVERS AND WINDBREAKS

Spun bonded polyester and perforated polyethylene row covers may be used for 4 to 8 weeks immediately after transplanting to further enhance earliness. Covers should be removed when plants begin to flower to allow proper pollination. Row covers may be replaced after pollination is completed (after three to five fruit per plant has been pollinated) to further enhance earliness.

Windbreaks are recommended where wind erosion is likely. Temporary windbreaks of winter wheat or rye prevent sandblasting of young seedlings and whipping of vines as plants begin to run. As with row covers, windbreaks also provide additional heat accumulation in the spring.

During spring, cold winds and wind-blown sand are serious problems for young melon seedlings. Both row covers and rye strips protect the seedlings and may result in one to two-week earlier harvests. A rye strip (one grain drill width) every five to six rows reduces the problem. Autumn-planted rye (perpendicular to the wind direction) is most effective. Row covers are not only more costly for crop protection than rye strips, but must be removed for pollinators and when temperatures warm up.

Pruning of melons

Many melon cultivars produce extensive vine growth. Pruning the vines may be necessary if the melons are trellised. Pruning is performed to achieve a balance between vine growth and fruit set. Pruning increases average fruit weight while reducing the number of unmarketable (cull) fruit.

Each melon vine produces a primary stem or leader with many secondary branches or laterals. A suitable pruning treatment for high-tunnel muskmelons is to retain the primary stem and one of the first laterals while pruning all additional laterals up to and including the eighth leaf node. All secondary branches after the eighth node can be left unpruned on the plant. This method of pruning permits the vine to be easily trellised either by a nylon net trellis or by using strings and vine clips as in greenhouse tomato production. Prune off any misshapen fruit or fruit that was not pollinated.

Trellising

Training melons to grow vertically is referred to as trellising and is one of the advantages of growing melons in a high-tunnel. Most melon cultivars and personal size (less than 3.71 kg) melon cultivars are amenable to trellising. Trellising improves light interception by the crop canopy, makes harvest easier, improves pollination and reduces damage to the vines during harvest. Trellising is necessary if the high tunnel is used to grow crops in addition to melons, because melon vines will overrun other plants if not trained.

Various types of trellises can be used for high-tunnel melons and watermelons. Using a trellis with a plastic (nylon) net (15 by 18 cm openings) that is about 2 m
high is a suitable trellis for pruned and unpruned vines. The trellis must be supported by a tensile wire, which runs parallel to the row and slightly higher than the trellis. This wire can be secured to the frame of the high tunnel or attached to posts at each end of the row. The mesh trellis is, in turn, secured to the wire. The vines gradually grow up the trellis, using their tendrils to cling to the mesh trellis, but they will require training to keep the growth vertical. Assume the static load on the wire will be about 4 to 5 kg per 30.48 cm.

Another form of trellis is an option when each vine has been pruned to one or two stems. Tie a length of nylon twine to a tensile wire 1 m off the ground and secure it to the ground using anchor pins. The primary stem of the muskmelon plant is secured to the twine using plastic vine clips. As the vine continues to grow, it is clipped to the vertical twine. If the vine grows taller than the height of the trellis, it can be trained from the top down on another length of twine. Woven wire fence or livestock panels can also be used as a trellis for cucurbits.

Fruit may require support as it grows on the trellis. Some muskmelon cultivars have fruit with rigid peduncles (fruit stems) and may not need support. Small, mesh bags (onion sacks), cheesecloth or nylons can be used as slings to support the fruit. The bags can be tied to the trellis or the support wire. The bag should allow light penetration and not hold moisture. When the fruit is ripe, the bag can be cut from the trellis.

**Thinning**

Cantaloupe seedlings are sensitive and easily disturbed by weeding and thinning. Seedlings are normally thinned when they reach 10 cm in height.

**Harvesting**

Harvest from early plantings usually begins in late June. Harvesting requires a great deal of hand labour. Melons are usually picked every other day for the first two or three picking days and every day for the next 20 to 25 days. Length of harvest in a planting depends on condition of the vines, number of melons, season of year and the market.

**Harvesting methods**

Approximately 30 to 35 days are required from fruit pollination to harvest. Transplanted melons and those grown on plastic mulch will likely start seven to 14 days earlier. Muskmelons separate from the stem at maturity. When the stem separates completely (full slip) the fruit has achieved its maximum sugar development and if not consumed or cooled soon thereafter, its quality will deteriorate. Some growers harvest at “one-half slip” or “one-quarter slip” to enter the market earlier and give more time for the marketing process. However, there is a trend
away from this practice as the consumer demands higher quality. The majority of melons for local sale are harvested at full slip.

For shipping, fruit is most often harvested at one-half slip. Harvests may be required each day if high temperature conditions exist at picking. Frequent picking is critical to assure melons are picked when they are at the best quality. Assuming good cultural practices are followed, one can expect to harvest about 2,000 to 5,000 melons per hectare when grown on bare ground and between 6,000 to 12,000 when using plastic mulch. Up to 20,000 fruit may be obtained with some of the smaller-fruited varieties (less than 1 kg).

**Harvest recommendations**

When properly matured for shipping (market maturity), cantaloupes should be “half slip,” firm, well netted, and not deeply coloured. At half slip, the abscission layer between the stem and fruit is half formed and will allow the remaining half to separate from the melon with a slight pull. A cantaloupe that has not reached half slip is not fully developed and has not obtained maximum sweetness, flavour and aroma. Eating maturity follows about three days after half-slip harvest when the cantaloupe is held at room temperature. The best flavour is attained if melons are held near 21 °C for final ripening and then chilled for serving. Cantaloupes are either hand picked into picking bags or buckets which are emptied into field trailers, or they are picked and placed directly into a nearby hauling vehicle.

**PART 3: POST-HARVEST HANDLING**

**Sorting and grading**

At the packing location, melons are graded, sorted and packed into crates or cartons according to size for shipping/marketing.

**Packaging**

For short-distance shipping or local markets, melons are often hauled in bulk. Several sizes are packed: 12, 15, 18, or 23 melons in a crate weighing 16 to 18 kg. The smaller the number, the larger the melons. The 15s are generally the most desirable. Until recently, few cantaloupes were cooled before shipment. However, cooling prior to shipment improves marketability and increases the time for melons to reach full ripeness, which extends shelf life. Most buyers will be demanding that melons be cooled prior to shipment.

**Cooling and packing**

Muskmelons need precooling soon after harvest to reduce field heat in melons. Field heat is heat accumulated by the fruit growing in a field. On days with high
air temperatures, internal temperatures within the fruit will often be equal to the air temperature. If field heat is not removed, melons will degrade prematurely, resulting in poor-quality fruit with a greatly reduced shelf life. Precooling can be done with cold water, cold air, or ice.

Hydro-cooling is the most efficient method, but the choice among cooling methods depends primarily on economic factors and the type of shipping container used. Room cooling and forced-air cooling are also suitable for melons, but require more time than the methods above.

Room cooling is necessary after precooling in order to maintain fruit quality. Muskmelons harvested at partial slip can be held for up to 15 days at 2 to 5 °C at 95% relative humidity. Muskmelons harvested at full slip may be held for 5 to 14 days at 0 to 2 °C at 95% relative humidity.

The major quality factor in melons, soluble solids, is the sugar content of the fruit. A full-slip melon can have as high as 15% soluble solids. Melons harvested at partial slip can have soluble solids ranging from 8 to 12% soluble solids. Soluble solids can be measured quickly in the field with a hand-held refractometer. To maintain the sugar content as high as possible, keep the foliage healthy by controlling foliar diseases, nematodes, insect pests and weeds. Also be sure to maintain a good fertilisation and irrigation programme.

The buyer will usually specify packaging and shipping requirements. In general, melons are cooled by forced air or hydro-cooling and packed in cartons for long-distance shipping. At temperatures of 0 to 2 °C, full-slip melons can be held for about 14 days without significant loss in quality.

Storage

Cantaloupes are highly perishable. Even when harvested, handled and held under optimum conditions, they will be of only fair quality two weeks after harvest. If cantaloupes that are half slip to three-fourths slip are held or stored, they should be at 2 to 7 °C. Ripened cantaloupes (equivalent to full slip) may be stored at 0 to 2 °C.

Market preparation

The bulk of the commercial crop is shipped out and sold on the open market at prevailing prices. Many are sold from smaller plantings through temporary or permanent roadside stands or at farmers’ markets. Although earliness usually results in higher prices, quality and maturity should be of prime importance in marketing cantaloupes and other muskmelons.
PART 4: PRODUCTION SCHEDULE

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PART 5: UTILISATION AND NUTRITIONAL VALUE

Culinary/Cooking

Uses

Cantaloupe is normally eaten as a fresh fruit, as a salad, or as a dessert with ice cream or custard. Melon pieces wrapped in prosciutto are a familiar antipasto.

In addition to consumption of the fresh fruit, melons are sometimes dried and stored as melon leather. Other varieties are cooked as vegetables or grown for their seeds, which are processed to produce melon oil. Still other varieties are grown only for their pleasant fragrance.

Because the surface of a cantaloupe can contain harmful bacteria (in particular, *Salmonella*) it is always a good idea to wash a melon thoroughly before cutting and consumption. Only store the fruit for less than three days after cutting to prevent the risk of *Salmonella* or other bacterial pathogens.
Nutritional value

Cantaloupes are a source of polyphenol antioxidants, chemicals which were thought to provide certain health benefits to the cardiovascular system and immune system by regulating the formation of nitric oxide, a key chemical in promoting health of the endothelium and prevention of heart attacks. However, recent research has indicated that they may overcompensate, as the body already has mechanisms to deal with oxidation.

Cantaloupe melons are a good source of potassium, Vitamin A, and folate and are an excellent source of vitamin C.
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