



MWESIGE EMMANUEL

A
FARMERS'

Guide to Growing

WATERMELONS

A FARMERS' GUIDE TO GROWING WATERMELONS

This book is dedicated to you by Emmanuel Mwesige because you are the reason why it has been written!

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INTRODUCTION



About the Watermelon

Watermelon (*Citrullus lanatus*) 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 very high water content (93ml/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.

Watermelons need five things to grow and produce fruit: **sun, water, bees, nutrients, and a lot of space!** They thrive in sandy or sandy loam soil. Give each plant at least 5 feet of space, as their vines spread rapidly. Watermelon can be grown from seed or transplants from a nursery.

Honeybees must pollinate the watermelon blossom for fruit to be produced.

Common Watermelon Growing Areas in Uganda

The fruit is grown in most parts of the Country however it's mostly grown in the following areas.

- Luweero
- Mpigi
- Kayunga
- Bugerere
- Mayuge
- Masaka
- Mubende
- Masindi
- Bushenyi

Common Watermelon Varieties (cultivars) in Uganda

Selecting the best watermelon variety is the most important decision made by a farmer. Planting a variety that is not suited for the available market and the particular production situation leads to lower profits or possibly crop failure. In addition to market acceptability, a variety must have acceptable yield, be adapted to the production area and have the highest level of needed pest resistance available.

Light-green and grey-green watermelons are less subject to sunburn injury than dark-green and striped varieties. Resistance to races of Fusarium wilt and anthracnose disease is an important varietal characteristic to consider. Most varieties have varying levels of resistance to one or more races of Fusarium wilt and/or anthracnose. Resistance to race 2 anthracnose disease, the prevailing race, is not available. None of the watermelon varieties are resistant to all races of Fusarium or anthracnose, so these diseases can occur even though a variety is usually referred to as being resistant. No varieties are known to have insect or nematode resistance.

All varieties of watermelon share a distinct mouth-watering, thirst quenching, sugary flesh encased by a solid rind. Some watermelon types have higher sugar content and are sweeter; and some varieties have different colored rind and flesh. Most of us are familiar with the oblong, dark green watermelon with vibrant ruby red pulp, but melons may also be light pink, yellow and even orange.

There are many watermelon varieties all over the world but the major ones in Uganda are:

Sugar baby

Features of the sugar baby watermelon variety:

- Round in shape
- Dark green in color;
- The flesh is red;
- Very sweet
- Average weight is 4 to 5kg per fruit
- Maturity time is 75-85 days



(b) **Sukari F1**: Medium to early maturity (90 days) hybrid with good fruit setting ability. Fruits are oblong in shape with an average fruit weight of 7-8 kg - some may grow to up to 12 kg. Rind is light green with dark green stripes. Flesh is deep crimson with good granular texture and high sugar content (12-13%). Has good transport and keeping qualities. Yield up to 20-25 tons/acre.



(c) **Zuri F1**: It takes about 90 days after planting. Round fruits weighing up to 12 kg. Strong rind with an attractive fade resistant dark green colour. Bright red flesh with small seeds. Flesh is crispy, sweet solid and delicious. Has good transport and keeping qualities. Yields up to 25-30 tons/acre.



(d) **Galia F1**: A very popular green-fleshed hybrid which is in great demand in the export market, especially in Europe. Resistant to powdery mildew. The fruit is round with a small cavity and weighs about 1-1.2 kg. The rind is yellow - orange with medium net, the flesh is light green, very sweet, aromatic and excellent taste. Good shelf life.



Charleston Gray



- This variety has an average weight of 9kg.
- It is late maturing (85-110days)
- It is also the best drought resistant variety.

(f) **Early Scarlet F1:** It is early maturing (about 85 days), weighs up to 12 kg and can yield up to 60 tons per acre. It has deep-red flesh and a dark-green striped outer rind.

Crimson Sweet:



Description of the Plant

Watermelons are a member of the Cucurbitaceae family, which includes squash, pumpkins, cucumbers, muskmelons and gourds. Individual plants produce both male and female flowers and fruit size varies from 2 to 14 kg, depending on variety. However, seedless varieties will require pollinators.

BOTANY

Watermelon grows as a vine that sends out long runners along the ground.

ROOTS

The watermelon root system formation begins prior to emergence of cotyledons to the soil surface and reaches maximum extension by the time of flowering. Watermelon features a highly branching taproot extending up to 1 m deep into the soil. Some 15, occasionally more, lateral roots branch from the main root.

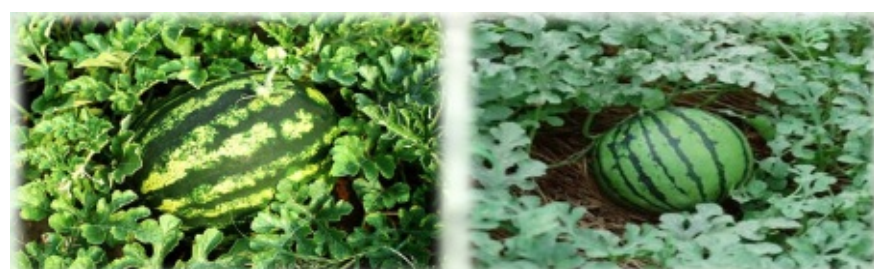
STEM

The stem is a long, trailing vine reaching, in some seasons, 5 m and more in length, highly branched; forming secondary side shoots which, in turn, branch out. The vines, especially the younger shoots, are covered with long, woolly hairs protecting the plant from overheating.



LEAVES

Watermelon leaves are dark green, with prominent veins. They have three large lobes, each further divided into smaller lobes. Watermelon leaves are heart shaped with three to seven lobes per leaf and are produced on trailing vines.



FLOWERS

Watermelon flowers are yellow, five-petaled flowers about 1 cm in diameter (smaller than some of the other vine fruit). Watermelon vines like squash, pumpkin and cucumber have separate male and female flowers on the same plant. Plants are monoecious with yellow flowers that are approximately 3 cm in diameter.



FRUIT

Fruit shape and appearance are quite varied, ranging from round to cylindrical and a single colour to various striped patterns on the fruit surface.

Watermelon fruit is very large, smooth and oval to round. The skin can be solid green or green striped with yellow. The edible flesh is usually pink with many flat, oval, black seeds throughout. Seedless varieties also exist, as well as types with orange, yellow or white flesh.

Small “icebox” watermelons weigh 3 kg to 4 kg and are produced early. They are well suited for local sale and home gardens.



WATERMELON CULTIVATION PRACTICES

STEP 1: SITE SELECTION

Melons are vining crops that require a lot of space, especially watermelons. For this reason they are not well suited to small gardens and should be grown only in lot-size gardens in urban areas or larger gardens in rural areas. Melons can be grown in small gardens if the vines are trellised and the fruit is supported.



Secondly, the site for watermelon must have enough sunlight. Remove all shade plants; the soil must be fertile with good organic matter content. Melons grow best on a deep, well drained, sandy or sandy loam soil with plenty of organic matter. Heavy soils with a lot of clay often cause small, weak plants that produce fewer melons. Melons prefer soils with a neutral pH, and if the soil is too acidic the plants will drop their blossoms.

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 1,000m normally provide suitable conditions for growth although excessively high temperatures of more than 30°C may be harmful, reducing the degree of fertilization. Stable day-night temperatures promote a rapid growth rate.

STEP 2: LAND PREPARATION



Clear the land of all vegetation covers and plant debris. Spray a systemic herbicide (Glyphosate) to control noxious weeds such as spear grass, etc. Prune trees; remove other shrubs that could impose shade. Plant residue need not be burned as they could be used as mulch material. Conservation tillage is best for watermelon especially when the soil is of sandy loamy texture class. But in cases where the soil texture is clayey, a little ploughing and harrowing may be necessary to facilitate deeper rooting and moisture penetration.

Watermelons grow best on non-saline sandy loam or silt loam soils. Light-textured fields warm up faster in the spring and are therefore favored for early production. Very sandy soils have limited water-holding capacity and must be carefully irrigated and fertilized to allow for high yield potential. Clay soils are generally avoided for watermelon culture, but they can be productive if irrigated with care to prevent prolonged saturation of the root zone (a condition

that favors the development of root rot pathogens) and to allow good drainage between irrigations.

If organic matter or manure is added, it should be well composted. Apply manure or compost at 50 to 100 pounds (23kgs to 45kgs) per 1,000 square feet, or about 2 to 4 tons per acre, to build the organic matter content of the soil. Turn the soil over so all organic matter is covered completely.

Since melons require well-drained soils, work the soil into ridges or hills 4 to 8 inches high and 12 to 14 inches wide for planting. Heavier soils require higher ridges.

Place the rows of irrigated watermelons 10 to 12 feet apart, and rows of un-irrigated watermelons 12 to 16 feet apart.

STEP 3: ACQUIRING SEED FOR PLANTING

Selecting the best watermelon variety is the most important decision made by a producer. Planting a variety that is not suited for the available market and the particular production situation leads to lower profits or possibly crop failure.

In addition to market acceptability, a variety must have acceptable yield, be adapted to the production area, and have the highest level of needed pestresistance.

Buy hybrid watermelon seed from the seed store. This guarantees good taste, good fruit sizes, and disease resistance that conform to varietal specification.

Do not use seed from previous watermelon fruit as such will produce crops with low yield, reduced sweetness, and disease susceptibility.

STEP 4: SEED PREPARATION FOR PLANTING

Seedling Production

The seed of triploid watermelons is notoriously sensitive to very specific conditions during germination, as the tiny embryo is contained in a relatively large, hard seed coat. Temperature and moisture control is crucial to success, and too much moisture during germination can kill the seed.

Due to the higher seed cost, and since the outside climate is very difficult to control or predict, it is highly recommended to have seedlings made by a reputable nursery.

A farmer needs about 500gms of watermelon seeds per acre.

Transplanting Seedlings



Seedlings must be transplanted and watered as soon as possible after they have been obtained from the nursery. Planting trays should be kept cool and moist in the shade until used. When transplanting, roots should not be damaged by application of unnecessary pressure around the root module. Soil should be watered into contact with the roots rather than pressed in.

STEP 5: PLANTING

Start the water melon seeds in the ground, right where they are supposed to grow. They do not like transplanting and so not necessary to put the seeds in a nursery bed. Put enough manure to the soil before planting and plough to mix well with the soil. 1 table spoon of DAP (Diammonium phosphate) should be put in every hole and properly mixed with the soil to make sure that the fertilizer does not burn the seed. DAP (Diammonium phosphate) contains phosphorus and helps the crop with root development. Always fertilize the soils after every three to four weeks with CAN (Calcium ammonium nitrate) also known as *nitro-limestone* which helps to fix nitrogen in the soil. Watermelon fruit grow well in soils with alkaline pH. It is therefore wise to add lime to the soil to maintain an alkaline pH. This tough should be done at intervals of 3years. Watermelon germinates in 7 days and the first fruits are seen from day 30.

Spacing

Plant the watermelon seed with a spacing of 2m between rows and 1m between the holes where the seeds are to be planted. If there is not enough rainfall, water regularly to keep the soil moist. It is best to have a watering schedule if using irrigation because the fruit becomes stressed when the pattern changes and this affects the fruit development and the spray program.

Dig holes of 45cm wide, 45cm length and 30cm deep. Mix top soil with 2 spades full of manure and fill the hole leaving a space of 15cm. Sow two seeds per hole. Watermelon vines require considerable space.

Two crops can be planted in a year. Plant the first crop with the first or second rain, which occur mostly around February or early March (at this time moisture is not so much; as the plant establishes, the moisture increases into the growing season). The crop sown at this time will hit the market between May and June.

Plant the second crop in September (at this time, the moisture is reduced as the season is gradually folding out). The crop planted at this time will hit the market around December.

Growing Watermelons in Containers



Watermelon has long taproot and it does not transplant well that is why it is better to sow the seeds directly in a pot. Sow 3-4 seeds directly in a pot once the temperature starts to reach 65°F (19°C) and above in the dry season. The germination takes place within 6 to 10 days. Thin out and leave only one of the strongest seedlings per pot.

Choosing a Pot

Growing watermelon in containers is not much difficult though tricky. You need to understand the basics. As watermelon has long taproot choosing a deep pot is essential. A large pot or bucket that is at least 2 feet deep and half wide is required.

Requirements for growing watermelon in containers

Watermelons should be grown in a sunny position. If you are growing it on a balcony or on a roof garden where space is tight, growing watermelon vertically on a trellis is a solution. Trellis should be minimum 4 feet tall and sturdy enough to carry the weight of melons.

Temperature

Watermelons are warm weather annuals but they can be planted in both tropical and temperate regions easily. It is possible to grow watermelons in temperature around 50-95°F (10-35°C). The optimum growing temperature is around 65-85°F (18-30°C).

Soil

Sandy and loamy soil is suitable for growing watermelons. Ideal soil pH is around 6-6.8. Avoid compact, clayey soils. Airy and well-drained substrate promotes the growth of the plant. Also, application of the well-rotted horse, rabbit or cow manure improves the texture of soil and provides nutrients constantly.

Water

Watermelon requires a lot of water. Keep the soil evenly moist but not wet, the water must drain freely from the bottom. When growing watermelon in containers, you'll need to water the plant every day and sometimes twice in a warm day. Once the fruits start to swell up and mature, reduce the watering. In that period, water carefully and moderately. Avoid overwatering and under watering both to get the sweetest melons.

STEP 6: WEED CONTROL



It is important to weed the land to remove weeds that compete for water and nutrients with the plant. It can be done the 2nd or 3rd week after germination using herbicides or hoe.

If not controlled continuously, weeds can reduce watermelon quality and yields. Weeds compete for sunlight and moisture and create conditions favorable for disease and insect growth.

Weed control consists of hand weeding, mechanical cultivation, and the use of herbicides. Increasingly, growers are using black plastic mulch and herbicides as a weed control method. Plastic mulch controls weeds within the rows, while herbicides are used for weed control between the rows.

Apply pre-emergence herbicide prior to or within 12 hours of planting.

Several brands of pre-emergence herbicides are available to control germinating broadleaf weeds and grasses in seeded watermelons if used properly. Herbicides are economical when used appropriately. The following herbicides are commonly used in Uganda.

Shallow mechanical cultivation or hoe weeding are needed to control weeds before the vines start trailing. Pruning roots and vines with cultivating equipment slows melon development and reduces yield.

Watermelon vines should be mulched to keep down the weeds and conserve moisture, but the mulch should not be applied until the soil is thoroughly warm. In the meantime, keep the area clean with shallow hoeing. Straw, hay or chopped leaves are the best mulching materials to use.

Spread them in a six-inch mulch over the entire watermelon patch and draw the mulch up to the base of the vines. This should be done before fruits begin to form, because the small fruits may be damaged by handling. The best time to apply mulch is right after a rain, when the soil is thoroughly damp.

STEP 7: PEST AND DISEASE CONTROL

Insect Identification and Control

Treat fields previously in sod (*the surface of the ground, with the grass growing on it; turf*) or fields with heavy infestations of weeds in the previous year with a soil applied insecticide at planting to control soil insect pests including cutworms.

Seedling plants are extremely susceptible to feeding damage from adult striped and spotted cucumber beetles; you may need to treat plants with a foliar applied insecticide to prevent

complete defoliation.

Aphids



Aphids are soft-bodied (usually wingless) insects that feed on the undersides of the leaves with their piercing-sucking mouthparts. The leaves of plants curl downward as the aphids suck the plant sap. Heavy populations cause plants to turn yellow and wilt.

Aphids secrete a substance known as “honeydew,” which collects on the surface of the lower leaves. Under favorable conditions, honeydew promotes the growth of sooty mold, a fungus that blackens the leaf surface. Sooty mold reduces the plant's ability to photosynthesize, thereby reducing melon quality and/or yield. Aphids also transmit several viruses that can reduce melon quality.

Aphid Control Measures

- **Promote insects/organisms that feed on the aphids (natural enemies).** The most common natural enemies of aphids include ladybird beetles, hover fly larvae, lacewings, spiders, damsel bugs, ground beetles, rove beetles, wasps.
- **Use nitrogen fertilizers in moderation** because heavy doses of soluble nitrogen fertilizers encourage multiplication of the aphids.
- Spraying with soapy water solutions can be effective
- Apply granular systemic insecticides such as carbofuran at planting

Cucumber Beetles



Cucumber beetles feed on the stems and leaves of young watermelon plants and transmit bacterial wilt disease. Bacterial wilt is one of the more damaging diseases of watermelons. Cucumber beetles can be controlled with foliar insecticides.

Red pumpkin Beetle



In watermelon, it makes holes in the cotyledons (first leaves of the seedling) and the young seedlings die.

Control: Dusting the plants with 1% Lindane or spraying Carbaryl (4g/liter of water) or Metacid (1ml/liter of water) during the seedling stage effectively controls the pest.

Cutworms



Cutworms feed on young seedlings or developing melons.

Damage to the melon is often confined to the rind. Rind damage may be superficial.

Inspect fields during land preparation and just before and during the planting operation. Treatments should be made either by incorporation of a soil insecticide or a directed spray if plants are already present.

Melon Fly



This is the major pest of watermelon. The damage by maggots results in rotting of young and ripened fruits or drying and shriveling of fruits before maturity. Maggots of this fly causes severe damage to young developing fruits. Fruit flies are usually a problem as soon as female flower initiation takes place.

Management: The affected fruits should be regularly pinched off and buried in a pit. Place 3 Para Pheromone traps per acre to attract and trap male fruit flies. Spray with recommended fungicides.

Spider Mites



Spider mites are very small spiders found on the undersides of the leaves.

Mites reproduce very rapidly, completing a life cycle in five days when the temperature is 75° F or above. As a result, they can become very numerous in a short period of time.

Mites feed by sucking sap from the plants, and if present in large numbers, they stress the plant, reducing vigor and eventually yield. Mites reproduce most rapidly during hot, dry weather. Mites can be controlled with: miticide sprays; cutting and burning of severely infested plant parts reduces further multiplication of mites. Ensure proper ventilation, irrigation and clean cultivation.

Rind worm



Rind worm refers to any worm that attacks the rind of the melon, the most common of which are cutworms, corn earworms, loopers, beet worms, and armyworms. When rind damage occurs, it is important to correctly identify the culprit and treat for that specific insect.

Thrips



Thrips are very small, spindle-shaped insects that reach a maximum length of 1/10-inch. Certain thrip species cause early foliage damage, while others are present during the period of

heavy fruit set. Thrips damage plants by rasping the leaf surface during feeding. Severe damage usually occurs only during periods of slow growth. Damage is quickly outgrown when the plant is growing rapidly, and usually no treatment is required. If treatment is necessary, thrips can be controlled with foliar insecticide applications.

Nematodes



Root knot nematodes are small, eel-like worms which live in the soil and feed on plant roots, impairing the plants' ability to take up water and nutrients.

Moreover, they allow diseases like fusarium wilt to enter the plant. Serious root-knot injury results in stunted, wilted growth, a galled-root system, and reduced yields.

Root knot nematodes remain a major problem in commercial watermelon production because there are no easy-to-use nematicides. Applying fumigants effectively reduces nematode populations, but the waiting period after application often delays seeding until after optimum planting dates.

Animal Pests

Below are some of the animal pests that affect watermelons:

(a) **Field mice and rats:** These can cause major problems in melon crops prior to emergence because they dig out and eat large quantities of seed. If this occurs, you may need to replant the crops several times, resulting in delayed harvests. You can reduce losses by pre-germinating seed or planting container-grown seedlings. The fungicide thiram, when used as a seed treatment, is a good repellent against mice and rats.



(b) **Deer:** Deer like watermelons, particularly as the fruit becomes ripe. Damage inflicted by these animals usually is less extensive. They may make holes in the rind and scoop or chew some of the inside of the flesh, but they do not usually consume an entire melon. Deer hoof prints look like two elongated tear drops that almost meet at the tip to form an upside down heart shape.



(c) **Crows:** Crows can be a devastating and annoying pest. Just before harvest, they can make melons unsaleable by punching holes through the skin with their sharp beaks. Often they damage many melons, and populations of crows can wipe out an entire crop in just a few days. Crows can be deterred with a sound device, such as a gas gun or bird alarm.



(d) **Monkeys:** Monkeys are really a pain somewhere quite far from the neck! They can cause enormous damage to the fruits and hence result into huge losses.



(e) **Wild hogs:** The feral hogs will consume the watermelon fruits, seeds, leaves and the stems. As a result huge losses can be caused by these creature. Control can be by use of wire mesh fence around the garden.



Prevention and Control of Animal Pests

Fences are one of the best deterrents against deer, but they are not 100 percent foolproof. For

best results, use a wire mesh with openings of less than 4-by-6 inches and make the fence at least 5 feet tall.

Brightly colored windsocks will discourage bird invaders, or you can stretch strings across your watermelon patch and attach aluminum pie plates or strips of aluminum to ward off birds during daylight hours, when they are most active.

Disease Identification and Management

Diseases that affect watermelons are similar to those of pumpkins.

A preventive program that combines the use of cultural practices, genetic resistance, and chemical control as needed usually provides the best results.

Many of the fungal, bacterial, and nematode pathogens survive in old crop debris and in soil. Rotate fields with non-cucurbit crops for at least three years to reduce pathogen levels.

Below are the common watermelon diseases:

Bacterial Fruit Blotch

Bacterial fruit blotch is a relatively new watermelon disease. It is thought to be a seed borne disease. The symptom of bacterial fruit blotch of watermelon is a dark olive green stain or blotch on the upper surface of the fruit.



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.

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.



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.

Bacterial Wilt



Bacterial wilt causes runners to wilt, and eventually causes the entire plant to die. It is transmitted by cucumber beetles feeding on the young watermelon plant. Prevention consists of controlling cucumber beetles with foliar insecticides.

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. 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.

Damping-Off

Damping-off is a seedling disease in which the stems of young plants rot at the ground level and die. Damping-off is most serious in the presence of cool, wet weather, which retards rapid seedling emergence and early plant growth. In some years, the disease can reduce stands by up to 50 percent, while in other years, losses are very rare. Seed treatment and the use of cultural practices that encourage young plant growth are essential in preventing damping-off.

Downy Mildew



Downy mildew, a fungal disease, attacks the leaves of watermelon plants, causing lesions and wilting. Under conditions favoring the spread of downy mildew, an entire field may become infected. Downy mildew is not a problem in every year, but growers must monitor their plantings frequently for signs of the disease. Downy mildew can be controlled with fungicide sprays; Remove old plant debris. Do not overcrowd plants; avoid overhead irrigation, water plants through furrows.

Powdery Mildew



Powdery mildew also affects only the leaves, causing white, powdery mold on the leaf surfaces. Powdery mildew can be controlled with fungicide sprays; Remove old plant debris. Plant in sites with good air circulation and sun exposure; do not overcrowd plants.

Watermelon Mosaic Virus



Watermelon mosaic virus is an aphid-transmitted disease that causes plant stunting; a bumpy, mottled appearance on the fruit; and reduced yields. Extended high temperatures promote development of this disease.

Gummy Stem Blight



Round or irregular brown lesions with faint concentric rings on cotyledons; brown or white lesions on crown and stems; soft, circular brown lesions on fruit; lesions on stems and fruit may be oozing an amber coloured sticky substance. Fungus can be spread infected seed, air currents or water splash; Survives on plant debris in soil; Disease emergence is favoured by warm, wet conditions.

Rotate crops every 2-3 years to a non-cucurbit to reduce disease build up in soil. Spray:

Mancozeb, Copper Oxychloride, Chlorothalanil, Mandipropamid

Fusarium wilt

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.



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.



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.

Verticillium Wilt

Verticillium wilt, commonly known as cotton wilt, does not normally kill the entire plant, but it can cause reduced yields. Most watermelon varieties are not resistant to verticillium wilt, so the best control is to plant on soil that has not been infected with the disease.



Phytophthora Fruit Rot

Phytophthora fruit rot is caused by the soil borne 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. 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.



Alternaria Leaf Blight

The disease defoliates vines, reduces fruit yield, Size and quality. It attacks oldest leaves, show round water soaked lesions. **Management** Chemical control-*Chlorothalonil* Cultural control-Plant resistant varieties, crop rotation, remove or burn crop debris.



Physiological Disorders

Physiological disorders are caused by non-pathogenic agents that affect fruit quality. Usually, aesthetic quality is degraded. The cause can be either one or a combination of environmental, genetic or nutritional factors. The common physiological disorders include:

Blossom-end rot

Blossom-end rot is a deterioration of the blossom end of the fruit. The usual order of development is softening, slight shriveling, browning, blackening with extensive shriveling, and sometimes secondary decay.

Poor calcium nutrition and moisture stress cause blossom-end rot. Hot, dry winds, nematode damage, excessive fertilizer, low levels of calcium in the soil, pruned roots from late cultivations and other conditions are contributing factors.

Bursting may result from an uneven growth rate, which is particularly associated with heavy rainfall or irrigation when the fruit is maturing. The percentage of burst fruit is usually low, and types with round fruit are more susceptible.

Watermelons having blossom-end rot are unmarketable. Prevention includes applying adequate amounts of calcium and maintaining a uniform and sufficient supply of moisture.



Hollow Heart and White Heart

White heart is white streaks or bands of undesirable flesh in the heart (center) of the fruit. This is caused by excessive moisture (and probably too much nitrogen) during fruit maturation.

Hollow heart is a disorder that varies among varieties. Hollow heart is marked by cracks in the heart of the watermelon fruit owing to accelerated growth in response to ideal growth conditions facilitated by ample water and warm temperatures.



Sunscald or Sunburn

Sunscald (sunburn) damage is caused when the rinds are exposed to intense sunlight. Sunscald lowers quality by making the melons less attractive and may cause them to rot. Buyers usually will not purchase watermelons with sunscald damage. Sunscald can be avoided if the plants develop and maintain a leaf canopy that shades the melons from direct sunlight. Sunscald is more serious among darker-colored varieties, such as Sugar Baby, Peacock, and the all sweet varieties, than among the lighter-colored ones, including Charleston Greys and Jubilees.



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.



Bottle necks/Misshapen melons

Misshapen melons (gourd-necked or bottlenecked) are frequently produced by varieties with long fruit. Moisture stress is a cause. Occasionally melons of any variety may be misshapen because they lie on uneven ground or were damaged while small in size.

Misshapen or pear-shaped fruit can also be caused by poor pollination that leads to restricted growth at the stem end because of the absence of developing seeds. Poor pollination can be minimized by increasing the number of beehives in the field. Low temperatures can also cause misshapen fruit.



Rind Necrosis

Rind necrosis is an internal disorder of the watermelon rind. Symptoms are brown, corky, or mealy textured spots on the rind which may enlarge to form large bands of discoloration that

rarely extend into the flesh. Experienced pickers often can detect affected melons by the subtle knobiness that is visible on the surface of affected melons. The cause of rind necrosis is unknown. Bacterial infection has been reported to be a cause, although similar bacteria are found in healthy melons. Drought stress also is reported to predispose melons to rind necrosis.



Pesticide Application

Apply insecticide only when necessary using results of field surveys. For control of diseases, fungicides are most effective when applied before disease begins to increase. The potential for very rapid increase is greatest shortly before harvest when the canopy is most dense or anytime during rainy periods. Select insecticides and fungicides based on proven effectiveness.

Make applications using ground equipment (knapsack sprayer) in a minimum spray volume of 150 mm/15 liters of water. Aerial applications should be made in a minimum of 5 gallons per acre.

With the onset of fruit there is need for regular (weekly) application of insecticide to control fruit damaging insect.

Remove diseased and damaged fruits from the field to prevent the spread of pathogens to healthy fruits. Fruit must not lie on wet or damp surface.



STEP 8: IRRIGATION



Although watermelon is a deep-rooted crop able to tolerate a significant degree of soil moisture stress, peak production requires timely irrigation.

After crop establishment (either by seed or transplant), irrigation may be withheld for a period of several weeks to encourage deep rooting. However, irrigation should be managed to minimize water stress throughout the fruit set and fruit-sizing periods. Water stress during early fruit development can result in small, misshapen fruit and the occurrence of blossom-end rot (a physiological disorder in which the blossom end of a fruit ceases to grow and becomes dark and leathery). As harvest time approaches care must be taken to avoid large fluctuations in soil moisture content, as heavy irrigation (or rainfall) can result in fruit splitting.

In the past, watermelon was usually irrigated by the furrow method; irrigation was applied based on soil moisture status. In recent years, many growers have adopted drip irrigation. Drip irrigation lines are typically buried in the center of the soil beds. The irrigation system may be renovated each production season or left in place for a number of years, depending on the grower's management scheme and crop rotation. Drip irrigation scheduling is determined by potential evapotranspiration (ET_p) estimates and crop growth stage; frequency of irrigation can vary from once a week early in the season to daily during times of peak water demand. Some growers use drip irrigation lines placed in every other furrow after crop establishment. While this approach may not provide the full yield potential of a buried, in-row system, it does provide improved irrigation control compared to furrow irrigation, and the system is portable, which eliminates management issues associated with crop rotation. Regardless of irrigation technique, care must be taken to minimize wetting of the bed tops. Fruit in contact with moist soil may develop unsightly ground spots and fruit rots.

STEP 9: FERTILIZATION



A soil test is the best way to determine lime and fertilizer needs. Your county Extension office has information about soil tests. Testing at least every 3 years is a good idea.

Watermelons require moderate amounts of nitrogen (N), phosphorus (P₂O₅) and potassium (K₂O). Soil tests are generally used to indicate the availability of nutrients in the soil prior to fertilizer application. Watermelons are a relatively long-season crop, and many nutrients can be leached from the soil, especially from sandy soils, during the growing period. Therefore, split applications of most nutrients are made to reduce leaching losses.

STEP 10: POLLINATION



Watermelons require insects (honey bees) for proper pollination and fruit growth. Research has shown that each female flower must be visited, on average seven times by a pollinating insect to ensure proper fruit set. Insufficient pollination results in misshapen melons, which must be culled. Cold, rainy and windy weather reduces bee activity, which can cause poor melon production due to inadequate pollination. Early to midmorning is the best time to monitor bee activity. If numerous bees are not vigorously working watermelon flowers, two bee hives per acre is recommended.

STEP 11: WINDBREAKS AND PLANT SUPPORT



Soil preparation and fertilizer application well in advance of planting promotes improved seedbed moisture and firmness. In addition to plowing and disking, sub soiling beneath the row promotes deeper rooting in soils having a compacted layer. Where winds are a problem, windbreaks will provide some protection to young plants. The windbreak crop between the rows is cultivated or disked out as the watermelon vines begin to run. A narrow windbreak strip can be left standing between rows for wind protection later in the season, but it should be undercut or killed with chemicals to reduce competition with the watermelon crop.

It is important that the windbreak be early enough, wide and tall enough to provide protection just after the watermelons emergence. Late-planted windbreaks do little good when they are needed most. The greatest wind protection is achieved close to the windbreak row. Little

protection is achieved when windbreaks under 1m tall are farther than 9m from the watermelon plants.

STEP 12: FRUIT PRUNING



Fruit pruning in watermelons should begin as soon as defective melons are noticed. Remove misshapen and blossom-end rot fruit to promote additional fruit set and better size of the remaining melons. If a market demands larger melons, remove all but two or three well-shaped melons from each plant. To avoid disease spread, do not prune melons when vines are wet.

STEP 13: HARVESTING



The length of the growing season varies with the variety grown, the time of year planted, and the type of cultural practice. Long-season varieties transplanted during cool weather may require up to 130 days before harvest. Short-season varieties transplanted after soil temperatures have reached optimum levels, on the other hand, may yield mature melons in as little as 70 days. Using clear plastic mulch to help warm the soil and planting with transplants to reduce the establishment time may reduce the growing season by up to two weeks.

How do you tell that a watermelon has matured?

Judging the ripeness of watermelons requires skill and experience. Some signs of ripeness in watermelons are:

- **Dull sound when thumped.** This varies with the gardener and the size and type of melon and often is inaccurate.
- **Change in color of rind.** Ripe melons often lose their glossy color.
- **Change in color of soil spot.** The spot where the melon rests on the soil takes on a creamy, streaked color.

- **Death or drying of the tendril.** The tendril near the point where the melon is attached to the vine dries when ripe. This is the most dependable sign.



Watermelons are cut from the vine, rather than being pulled or broken off. Harvesting crews typically consist of cutters, loaders, stackers, and truck driver (this mainly applies to large scale watermelon farmers). The cutters select ripe melons and cut and place them along in-field roadways. Loaders pick up and pass the harvested melons to stackers located on a wagon or field truck. The melons are then hauled out of the field to a waiting over-the-road tractor-trailer for bulk loading or to a nearby packing shed for bin- or carton-packing.

Because watermelons in a given field ripen at different times, growers need to harvest several times to achieve maximum yields. The first harvest yields the largest and highest-quality melons. Size and quality generally decline with successive harvests and costs rise because the harvesting crew must glean a larger area to collect a load of melons.

Yield

The yield of watermelon varies according to the system of cultivation, season and several other factors. The average fruit yield varies from 25-30 tons per acre.

KEY NOTE

Cut melons from the vine rather than pulling, twisting, or breaking off to reduce chances of Stem decay. Leave a long stem on the fruit.

Do not harvest melons too early because the sugar content does not increase after harvest.

Do not place melons with bottom sides turned up as ground spot is easily sun scalded. Haul melons from the field in straw or paper-padded vehicles. Do not allow field hands to ride on top of the load. After harvest, load melons directly into trucks for shipments to markets.

STEP 14: POST HARVEST HANDLING AND STORAGE

Watermelons are not adapted to long storage; but will keep for 2 to 3 weeks at low temperature (11°C to 15°C). Relative humidity should be 85% to 90%; higher humidity may promote stem-end rot. At higher temperatures, watermelons are subject to decay. Watermelons should not be exposed to direct sunlight. Avoid heaping in storage.

Sugar content does not change after harvest, but flavor may be improved due to loss in acidity of slightly immature melons. Chilling injury will occur after several days below 41°F (5°C). The resulting pits in the rind will be invaded by decay-causing organisms.

Holding watermelons for up to a week at room temperature can improve flavor and color.

However, after several weeks at room temperature, they may develop poor flavor and texture.

Watermelons are sensitive to ethylene; do not store or transport them with products that emit ethylene, such as ripe pears, tomatoes, and bananas.

STEP 15: PACKING AND SHIPPING FRESH WATERMELONS

The standard method for handling watermelons has been bulk loading, which involves stacking the melons on a bed of straw on over-the-road tractor trailers. Increasingly, watermelons are packed in bins (made of corrugated fiberboard and holding around 1,100 pounds) and cartons (holding 3-5 melons). Bins and cartons offer labor savings in unloading because they permit unitized handling. In addition, they result in better quality because the added physical protection offered by the packaging reduces melon bruising and bursting.

STEP 16: MARKETING



Growers use a number of different marketing methods to sell watermelons:

- Selling the field.
- Selling wholesale through farmers' markets.
- Retailing through direct marketing outlets.
- Selling direct to truckers or stores.
- Selling through brokers or shippers.

The field method of sales, whether by the acre or by the pound, requires the grower to locate a buyer who is willing to purchase the entire field. Many growers prefer to sell their entire field because it involves less time and management than other methods of sale. Often, the buyer does the harvesting.

In selling wholesale through a farmers' market, the grower is responsible for harvesting and hauling the melons to the market. This is the most common sales method in Uganda.

Overall, however, retailing through farmers' markets, road-side stands, and pick-your-own operations accounts for a small share of total watermelon volume. With these methods, the grower is responsible for all marketing functions--harvesting, transporting, and selling. Although growers may receive a higher price than for watermelons sold wholesale, large-acreage growers do not retail their melons because of the large time and labor requirements.

Direct sales to truckers or to grocery chains is a practice that farmers can use as well. This method requires that growers have contacts and be able to meet the buyers' needs in terms of volume, variety, and timing of maturity.

Sales through brokers or shippers can also be applied. Farmers can use this method if they have contacts in the major markets, brokers and shippers can sell large volumes of melons over an extended period of time. Brokers or shippers contacts with both producers and buyers allow for matching buyers' needs with producers' supplies.

COST OF PRODUCTION

Cost of production data indicate the costs incurred by producers at different stages in the growing cycle. The cost of production data for watermelons also illustrate that the value of melons in the field is much less than their value at the first delivery point, a situation which in some circumstances may create the potential for moral hazard.

A large share of total costs for watermelons are variable expenses at the time melons are to be harvested. In most areas, harvesting and marketing account for 40-60 percent of total costs.

Cost Breakdown for One Acre (You can use the template below to feed in the cash spent as you undertake the project)

ITEMS	QUANTITY	PRICE	TOTAL
LAND			
Leasing			
Ploughing			
SEEDS			
Sukari F1 500gms			
SPRAYING AND FERTILIZER			
Chemicals & Fertilizers			
LABOUR AND FUEL			
Weeding labour			
Agronomy support			
Fuel			
Farm Manager			

TOOLS AND OTHER INPUTS			
Water pump			
Water pipes			
Pangas			
Hoes			
100 Liter tank			
Knapsack sprayer			

CONSTRAINTS TO WATERMELON PRODUCTION

The major production perils affecting watermelons include excessive rain, which can promote disease growth, excess heat, and in non-irrigated areas, drought.

Excessive Rain

Excessive rain, particularly when accompanied by other critical environmental factors, can affect the watermelon plant at every stage of growth. For example, germination can be reduced if excess rain is accompanied by cool weather at planting time, causing seed rot. Cool, wet weather following emergence of the watermelon plant increases the incidence of damping-off, which also reduces plant survival. Periods of warm, wet weather increase the incidence of foliar diseases such as anthracnose and downy mildew. Excessive rain as watermelons approach maturity can cause white heart (a physiological disorder), lower the melons' sugar content, and result in bursting of the fruit. Flooding, of course, can kill watermelon plants if the roots are submerged in water for a day or more.

Excessive Heat

Excessive heat and direct sunlight increase the likelihood of yield losses due to sunscald or sunburn, which causes yellowing of the rind. Normally, watermelon vines provide a protective canopy that shades the melons from direct sunlight. Any disturbance of this protective canopy, such as drought, harvesting activities, or diseases, increases the chance of sunscald damage.

Excessive Cold

Cold temperatures may reduce seed germination. If accompanied by excessive moisture, cold temperatures may cause severe plant losses due to seed rot and damping-off. Replanting may be necessary in such situations.

Drought

Drought may reduce watermelon yields by affecting plant growth, limiting the development and size of the melons. In severe situations, plants may die. Drought can also exacerbate losses due to sunscald.

Hail

Hail damages young watermelons by causing scars on the rind. Although the damage is only skin deep, a grower cannot sell scarred watermelons because brokers will not handle them if scar-free melons are available.

Insects

The most common insect pests affecting watermelons include root maggots, cutworms, cucumber beetles, aphids, thrips, and melon worms. Some cultural practices reduce the potential for economic injury by certain insects. Planting watermelons when optimum growing conditions insure rapid seedling growth, for example, minimizes the period when plants are vulnerable to injury from seedling insect pests, such as cutworms and root maggots. Spring plantings harvested by early July escape the period when many insect pests pose their

greatest economic threat.

UTILIZATION

Uses

The entire watermelon is edible, even the rind. In places like China, the watermelon is stir-fried, stewed and often pickled. In this case, the watermelon is being used as a vegetable. Pickled watermelon rind is also widespread in Russia.

Its fruit, which is also called watermelon, is a special kind referred to by botanists as a pepo, a berry which has a thick rind (exocarp) and fleshy center (mesocarp and endocarp). Pepos are derived from an inferior ovary and are characteristic of the Cucurbitaceae. The watermelon fruit, loosely considered a type of melon-although not in the genus *Cucumis*-has a smooth exterior rind (green, yellow and sometimes white) and a juicy, sweet interior flesh (usually pink, but sometimes orange, yellow, red and sometimes green if not ripe). It is also frequently used to make a variety of salads, most notably fruit salad.

Nutritional Value

Sweet, juicy watermelon is actually packed with some of the most important antioxidants in nature. Watermelon is an excellent source of vitamin C and a very good source of vitamin A, notably through its concentration of beta-carotene. Pink watermelon is also a source of the potent carotenoid antioxidant, lycopene. These powerful antioxidants move through the body neutralizing free radicals. Free radicals are substances in the body that can cause a great deal of damage. They are able to oxidize cholesterol, making it stick to blood-vessel walls, where it can lead to heart attacks or strokes. They can add to the severity of asthma attacks by causing the airways to clamp down and close. They can increase the inflammation that occurs in osteoarthritis and rheumatoid arthritis and cause most of the joint damage that occurs in these conditions, and they can damage cells lining the colon, turning them into cancer cells. Fortunately, vitamin C and betacarotene are very good at getting rid of these harmful molecules and can prevent the damage they would otherwise cause.



TRICKS FOR GROWING WATERMELONS SUMMARIZED JUST FOR YOU

(1) You need plenty of land to succeed with watermelon farming. Watermelons need a lot of water, nutrients, space and warmth. The plants do not grow well under extreme heat, and soggy, humid conditions will breed fungal diseases.

(2) Watermelons need enough water, regular top-dressing with fertilizers and average daily temperatures of 20-25 degrees to produce biggest and sweetest fruits. Plant the seeds when the soil is warm, in the open (for the sun) and provide constant drip irrigation if rainfall is inadequate. Weeds will deplete the available water—remove weeds regularly. Inadequate water or a nitrogen deficiency may result in yellowing of watermelon leaves.

(3) Prepare the soil around the plant. Remove the old dirt from the plant spot and replace with a 10- 10-10 granular, mixed in and then a good foot or two cover of compost. Get the compost from the farm manure. You can even add cow manure under the plants, but that is tricky and subject to weeds. Remember that watermelons do not tap deep, but spread roots out over a large surface, so prepare a good 8 to 12 foot circle.

(4) As the vine begins to grow it will begin to set flowers, the first six to seven flowers will be male flowers (blooms on long stems) that do not produce fruit. When a female flower (larger flower with tiny fruit attached) appears you may want to gently encourage pollination by picking a male flower and brushing it over the open female bloom. Pollination is important for fruit set. After you are sure you have a watermelon set you need to prune all other fruit from the vine.

(5) Consider very highly the longest melons at pollination time when choosing the melon to leave on the vine when culling. This is the length of the un-pollinated female fruit. Anything 3.0 CM or longer is best, but sometimes the best are often around 2.8 cm. The length of this fruit greatly determines the length of the final melon.

(6) Always buy watermelon seeds to get maximum returns with watermelon farming, most seeds taken directly from the fruits do not grow true to their type—they give less yields and grow slowly. Hybrid watermelon seeds give highest yields and are resistant to common watermelon pests and diseases such as leaf spot, blight and powdery mildew. Spider mites can destroy a whole crop of watermelons, as well as thrips and leaf miner.

(7) Be very careful not to damage vines. After you have chosen the melon you want to become a giant you need to protect it. Protect the belly from the ground by placing the melon on a slight hill on top of some mulch to avoid standing water. You will also need to protect the melon from animals that may want to eat it. Use a fence or screen around your melon. You will also need to protect your melon from the sun. Provide a small shelter that only shades the melon.

(8) Water-soluble fertilizers work great and soak in nicely. So does rabbit manure tea, made by half filling a large bucket with rabbit manure, and then filling the bucket with water. After a few days, pour the liquid through a screen and use to side dress the stump. This really does work, and a watermelon farmer can raise some rabbits just for this purpose.

(9) Vary the fertilizer depending on if you want to grow plant or fruit. High nitrogen in early season, extremely low nitrogen when fruit is growing (like 5-50-17), and high nitrogen again when weather turns cold. This will help limit vine growth when you are trying to grow fruit and increases density of fruit.

(10) Slowly slide back large watermelons as they grow to relieve pressure on the plant vine. Do this instead of moving the feeder vine. The fruit grows both directions, so this helps remove pressure on the stem end.

(11) Do not allow vines to get too close to the melon, and especially do not allow the fruit to sit on a vine. The vine will rot and rot will

spread to the fruit, and that's a bad thing.

(12) Drip irrigation. This is very easy, and can be a critical part of growing the giants. Get yourself an old 300-gallon plastic tank from a farmer so you do not have to fill it too often, and buy plastic piping and some irrigation drip emitters. I have also used individual sprinkler mounted on poles. One per plant.

(13) Do not mulch young watermelons. Worms that feed on tender stems love to hide under mulches, and young watermelons are vulnerable to these pests. Mulch much later when the vines

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