Crop Profile for Watermelons in Virginia

Prepared: April, 2003

General Production Information

- In 2001, 1,600 acres of watermelons were planted and 1,400 acres were harvested inVirginia.
- Watermelon production in Virginia averaged 210 cwt./acre or 21,000 lbs./acre in 2001.
- A total of 294,000 cwt. or 29,400,000 lbs. of fresh market watermelons were produced in Virginia in 2001.
- The 2001 crop was valued at $2,058,000 or roughly $7.00/cwt. ($0.07/ lb.).
- Virginia ranked 16th of 18 watermelon-growing states, accounting for 0.73% of the national watermelon production in 2001.

Production Regions

The largest amount of watermelon acreage, slightly less than 1,000 acres in 2002, is located in Southampton County. Other watermelon-producing areas include the Eastern Shore, Northern Neck, and Richmond/Hanover County. Each of these areas accounts for a few hundred acres annually.

Cultural Practices

Both seeded and seedless varieties are recommended for growth in Virginia. Variety selection depends on several factors such as market acceptability, yield, and horticultural characteristics. Standard seeded varieties recommended in Virginia include: *Crimson Sweet*, *Fiesta**, *Mardi Gras**,*Mirage**, *Royal Majesty**, *Royal Star*, *StarBrite*, and *Stars & Stripes**. Seedless varieties include: *Crimson Trio**, *Freedom**, *Millennium**, *Millionaire**, and *SS5244**. Within the seeded varieties, producers may choose from open-pollinate and hybrid varieties (indicated by *). Open-pollinate seed is produced by self-fertilization of the flowers within one variety, while hybrid seed is the result of cross-fertilization between male and female parents. Seedless varieties are hybrids by design.

Planting dates for transplants vary from May 1st in southern regions to June 20th in northern areas. Container-grown plants should be transplanted through plastic mulch when daily temperatures have reached 60°F. Early plantings should be protected from winds with hot caps, tents, row covers, or rye strips. Direct seeding occurs April 20th to May 15th in Virginia and usually 3-5 lbs. of seed are needed per acre.

When mulching, lay clear, plastic mulch before field plantings. This conserves moisture, increases soil temperature, and increases early total yield. Fumigated soil also aids in control of weeds and soil-borne disease. Plastic and fumigant should be applied on well-prepared planting beds 30 days before field planting. Plastic should be 4 ft wide and laid on 6- or 8- ft centers immediately over the fumigated soil. The soil must be moist when laying the plastic. Fumigation alone may not provide satisfactory weed control under clear plastic. Herbicides labeled and recommended for use on watermelons may not provide satisfactory weed control when used under clear plastic mulch on non-fumigated soil. Black plastic or paper can be used without a herbicide. Fertilizer, at least 50% of the nitrogen should be in the nitrate form, must be applied during bed preparation.

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The recommended spacing for watermelons is 6-8 feet between rows with 3-4 feet between plants in the row. If seedless varieties are used, a pollinator variety will need to be incorporated every third row to assure good fruit set. Honeybees are also important in this capacity, and care should be taken when applying insecticides to ensure optimum pollinator safety.

There are several maturity indicators that may help determine when to harvest watermelons. No single indicator is absolute for determining ripeness because maturity differs with variety, location and plant growth. Look for a combination of these signs of maturity for best results:

- tendrils or pigtails on vines nearest the fruit are wilting and have changed color from green to brown.
- the ground spot on the belly of the melon has changed from white to light yellow.
- the thumping sound changes from a metallic ringing when immature to a soft hollow sound when mature.
- the green bands (striped varieties) gradually break up as they intersect at the blossom end of the melon.

Harvest dates typically range from the middle of July through August. When harvesting, watermelons should be cut from the vine rather than pulled, twisted or broken off. Pulling stems out provides an entrance for bacteria and fungi that can cause souring and can decay the internal flesh. As melons are cut from their vines, the bottoms, which are subject to sunscald, should be turned down. The typical field harvesting crew may range from nine to 12 people, including two to three cutters, four to six loaders, two stackers and one truck driver. When storing the watermelons, temperature management is important for optimum watermelon quality. The optimum storage temperature for melons is 60°F. Transit temperatures of 55° to 70°F with ventilation are recommended.

During the growing season, worker activities in the field could include such things as transplanting (April-May), cultivating, scouting, spraying, occasionally hand weeding, and harvesting (July-August). The workers risk potential exposure to pesticides during these activities and should follow all safety procedures determined by the label, mostly wearing proper personal protective equipment (PPE) and strictly following Re-Entry Intervals (REIs) when returning to the field. Activities that bring workers in direct contact with the plants during the growing season are generally limited to harvest time, due to the fruit being hand-picked by the workers.

While several alternatives can be worked in, the basic production system consists of direct-seeding of melons into worked ground, herbicide application for weed control, then irrigation, pest control, and cultivation, as needed, followed by harvest.

Special Use Labels

Section 18 Emergency Use Exemption and Special Local Need (24C) labels are used to supplement the chemical tools available to producers for pest control. Once the problem or gap in pest control has been identified, specialists submit the proper documentation for the emergency/special label. Thus far, Extension specialists have been successful in obtaining these labels, which must be applied for annually and are usually only valid for limited time intervals. Given the temporary nature of the emergency/special labels, compounds labeled in this manner were not included in chemical pest sections found below. Without these, pest control in vegetable crops would be extremely difficult for producers.

Insect Pests

Control recommendations found below were modified from information presented in the 2002 Commercial Vegetable Production Recommendations -Virginia [2], unless otherwise noted.

INSECTS

In general, cucumber beetles are the most economically important insect pests of watermelon in Virginia. Other important pests include: spider mites, which can be particularly devastating in hot, dry years, and aphids, especially after cool springs. Other minor pests include: seed corn maggots, serpentine leafminers, pickleworms, cabbage loopers, and cutworms.

Aphids
Green Peach Aphid, *Myzus persicae*
Melon Aphid, *Apis gossypii*

Both the green peach aphid and the melon aphid are pests on watermelon. However, the latter is the primary species infesting watermelon plants in Virginia. In general, aphids feed on plant sap, which may reduce plant vigor, size, and yield. Also, as they feed on the underside of the leaves, aphids excrete honeydew. This, in turn, leads to the growth of black sooty mold, which may block out sunlight and thus reduce plant yield. In addition, aphids can vector certain plant viruses. In particular, the melon aphid is instrumental in transmitting the cucumber mosaic virus, which can be devastating to watermelon production.

Monitoring: If a systemic insecticide such as imidacloprid or thiamethoxam is not applied at planting, then aphid scouting is recommended. Scouting for melon aphids should begin as soon as plants form runners. Examine 5 runners from each of 10 locations in the field and record the percentage of runners with 5 or more aphids per leaf. Insecticide treatments are recommended when 20% or more of the runners are infested with 5 or more aphids/leaf [3]. Thorough spray coverage beneath leaves is important.

Chemical Control: See the *Chemical Insect Control* section.

Biological Control: A number of natural enemies such as lady beetles (adults and larvae), lacewing larvae, syrphid larvae, parasitic wasps, and fungal pathogens will reduce aphid populations. Natural enemies will often keep aphid populations below damaging numbers and, therefore, should be considered before an insecticide application. However, if the spread of virus is of concern, chemical treatment will be necessary.

Cultural Control: Many watermelon cultivars are resistant to plant viruses and should be considered in the pest management decision-making process for aphids. Plant disease-free certified seed. Avoid planting fields immediately downwind of a barrier such as hedgerows or woodlots, which reduce wind velocity and increase the number of dispersing aphids falling into fields. These barriers can also cause over-fertilization with nitrogen, which results in lush growth attractive to aphids.

Cabbage Looper, *Trichoplusia ni*

Cabbage loopers may be identified by their pale green color and thin white stripes down the back and sides and also by their doubling-up or looping as they move. These insects feed on the underside of leaves, producing ragged holes of various sizes. Feeding begins in late July or early August and usually continues through harvest. Healthy plants can usually sustain feeding injury unless populations become exceedingly large. Several generations can occur during a year. Loopers are not usually serious pests of watermelon in Virginia.

Monitoring: Check leaf-feeding levels in the field at least weekly. Healthy and older plants can usually withstand moderate defoliation before economic yield loss to the fruit occurs. Moth activity can be monitored at blacklight traps.

Chemical Control: See the *Chemical Insect Control* section.

Biological Control: There are several parasitic wasps and predators that attack the cabbage looper. Also, a nuclear polyhedrosis virus (NPV) can substantially reduce population levels of larvae, especially after a period of precipitation.

Cultural Control: No current recommendations for commercial production.

Cucumber Beetles (Rindworms)
Spotted cucumber beetle, *Diabrotica undecimpunctata howardi*
Striped cucumber beetle, *Acalymma vittata*

Both the spotted and striped cucumber beetles (adults and larvae) may severely reduce watermelon productivity. These pests are the number one concern of growers in Virginia. Adults overwinter in wooded areas and fields, then migrate in

the spring to cucurbit crops. Adults mass on plants and feed voraciously on the foliage and stems, often causing girdling, which will greatly reduce plant stands. Adults will also feed on the blossoms of developing plants, causing later scarring of the fruit [4]. Cucumber beetles also have the potential to transmit bacterial wilt, although many watermelon cultivars are resistant to this virus.

In addition to the damage adult cucumber beetles bring about, the larval stage, otherwise known as a rindworm, feed directly on the roots and on the watermelons as well. This feeding typically occurs at the bottom of the fruit where the melons contact the soil, rendering them commercially unmarketable.

Monitoring: Begin weekly scouting for beetles following transplant or as soon as the plants emerge. Treat when an average of 2 beetles/plant is found.

Chemical Control: Management of adult populations is necessary to reduce the number of rindworms (larvae) present. Direct control of rindworms is difficult. See *Chemical Insect Control* section.

Biological Control: No current recommendations for commercial production.

Cultural Control: Plant varieties resistant to bacterial wilt. Always cultivate the soil thoroughly before planting. The use of plastic or straw as bedding for the developing watermelons may deter rindworm feeding. In the fall, eliminating surrounding weeds will reduce the overwintering sites for the beetles.

Cutworms
Black cutworm, *Agrotis ipsilon*
Variegated cutworm, *Peridroma saucia*
Granulate cutworm, *Feltia subterranea*

Cutworms are sporadic pests of numerous crops. Several species of cutworm may be found in Virginia. Most are night feeders that hide under plant and soil debris common in weedy or minimum-tillage fields. Another distinguishing quality is their act of rolling into a tight C-shape if disturbed. Newly hatched cutworm larvae feed on young plants at the soil line, often severing the stems. Later generations of cutworms feed on developing melons and in severe cases may tunnel completely through the fruit, greatly diminishing marketability.

Monitoring: Even if a preplant, broadcast insecticide treatment is used, fields should be scouted for cutworm damage within a week of planting or plant emergence. Cutworms are not typically seen in the open during the day; however, digging the soil around injured plants may reveal their presence. If cutworms are actively cutting plants, a postplanting contact treatment may be used.

Chemical Control: See the *Chemical Insect Control* section.

Biological Control: Cutworms are attacked by numerous ground-dwelling insect predators, especially carabid beetles. Also, pathogens such as *Beauveria bassiana* and entomopathogenic nematodes often will infect larvae.

Cultural Control: Proper tillage will help eliminate some species of cutworms that may move off of cover crops.

Leafminers
Serpentine Leafminer, *Liriomyza brassicae*

Leafminers cause injury to leaves primarily as a result of their mining of leaves, which results in the destruction of leaf mesophyll tissue. As the larvae hatch from eggs deposited within the leaf tissue, they create slender, winding, white tunnels in their search for food. Mature larvae emerge from inside the leaf and drop to the soil, where they pupate in soil crevices or, in rare cases, the leaf. Leaf mining depresses the level of photosynthesis and may result in leaf droppage. Fewer leaves in the canopy can result in sun scalding of fruit. Many generations occur annually in Virginia, but the first is usually the most damaging.

Monitoring: The economic consequences of leaf mining are not well understood; thus, adequate scouting procedures have

not been developed. Tomatoes have been shown to tolerate an average of 1-3 mines per leaf before economic damage occurs.

Chemical Control: See the *Chemical Insect Control* section.

Biological Control: Parasitoids often provide excellent suppression of leafminers if broad-spectrum insecticides are not applied to the crop.

Cultural Control: No current recommendations for commercial production.

Pickleworm, *Diaphania nitidalis*
Melonworm, *Diaphania hyalinata*

The melonworm is generally a foliage feeder (unlike the pickleworm, which attacks the developing leaf and flower buds) but also causes damage to the vines and fruit. The adults overwinter in the warmer southern regions, and begin to migrate north when temperatures warm. Females deposit eggs on the leaf surface and the larvae emerge several days later, feeding on the flowers, vines, and fruit for up to 2 weeks. Although several generations can occur during a year, pickleworm and melonworm are rarely serious pests of watermelon in Virginia.

Monitoring: As soon as pickleworms or their damage appears, begin insecticide treatments.

Chemical Control: See the *Chemical Insect Control* section.

Biological Control: No current recommendations for commercial production.

Cultural Control: After harvest, remove all debris from the field, destroy vines and unused fruit, and control adjoining weeds. Also, plowing early in the fall will bury the pupae. In the spring, planting early will help the crop establish itself, thus preventing major damage. Resistant varieties are also available.

Seed Corn Maggot, *Hylemya platura*

The seed corn maggot is most noted for its damage to seeds or seedlings in bedding trays and early-planted fields, especially during cool, wet growing seasons. Adults emerge in early spring to lay their eggs, preferably in moist, organically rich soils, such as freshly plowed fields or greenhouse flats. Larvae or maggots hatch from the eggs and bore into seeds, cotyledons, or rotting crop debris. The maggots feed for one to three weeks before tunneling into the soil, where they pupate for a period of about one to four weeks or for the duration of the winter. Multiple generations occur annually in Virginia.

Monitoring: Once seed corn maggot damage has been observed, treatments are ineffective. Therefore, management options must be applied to high-risk fields before planting. High-risk fields can be defined as those having previous seed corn maggot infestations or high organic matter soils.

Chemical Control: Control is best achieved by using seed treatments such as chlorpyrifos (*Lorsban*), or diazinon (*Agrox D-L Plus, Agrox* B-3, or *Kernel Guard*). The use of imidacloprid (*Admire* 2F) at planting will also reduce seed corn maggot populations. See the *Chemical Insect Control* section for recommendations. Seed treatments containing malathion or lindane or seed commercially treated at low rates for seed storage will not control seed maggots. *Don't ever use treated seed for food or feed.*

Biological Control: No current recommendations for commercial production.

Cultural Control: Several management practices can be used to reduce the potential for damage resulting from seed corn maggot infestations. These include plowing weeds or cover crops at least two weeks before planting or transplanting, avoiding over-fertilization with manure, and completely plowing under crop debris immediately after harvest to prevent plant remnants.

Two-spotted Spider Mites, *Tetranychus urticae*

Spider mites can be a very serious pest of watermelons. Typically they feed on the undersides of leaves, often causing them to turn brown and fall off. Severe infestations especially of smaller, stressed plants may result in death. Mite problems are often associated with hot, dry weather and as such have become a regular problem in Virginia during years with low rainfall.

Monitoring: Scout fields, especially areas that border roadsides or weedy edges or areas of the field that are sandy. Examine both the upper and lower sides of 5 crown leaves from 5-10 locations and look for white stippling. Also note the condition of terminal leaves. Treatment should be made when 10-15% of the crown leaves are infested in the early season, or when 50% of the terminal leaves are infested later in the season.

Chemical Control: Spot treatment of "hot spots" and areas along the edges of fields is recommended to control mite populations when problems are first noticed. Use of dimethoate for leafminer control will reduce mite populations. The products *Agri-Mek, Kelthane MF,* and *Capture 2EC* are excellent miticides. Continuous use of carbofuran (*Furadan*) and carbaryl (*Sevin*), or the pyrethroids for other pests may result in mite outbreaks.

Biological Control: Natural predators and diseases of mites are present in fields, but rarely at levels high enough for adequate control during outbreaks.

Cultural Control: If possible, avoid mowing field margins and grassy areas until after midsummer since this forces mites in the crop.

Chemical Insect Control

The list below contains all of the products available to producers for insect control in watermelons along with the recommended application rates.

- **abamectin -** (*Agri-Mek* 0.15EC) - PHI - 7 days. Avermectin. For control of leafminers and mites, apply at a rate of 0.009-0.019 lb. a.i./A. Do **NOT** exceed 0.056 lb. a.i./A per season and do not make more than two sequential applications. REI - 12 hours
- **azinophos-methyl** (*Guthion* 2L) - PHI - 0 or 7 days. Organophosphate. For the control of cucumber beetles, apply at a rate of 0.50 lb. a.i./A. Do **NOT** apply more than three times per season. REI - 5 days. *Registration will be discontinued by 2005*.
- ***Bacillus thuringiensis*** (various formulations) - PHI - 0 days. Microbial. For the control of cabbage looper, consult various labels for rates and restrictions. REI - 4 hours.
- **bifenthrin** (*Capture* 2EC) - PHI - 3 days. Pyrethroid. For control of cabbage loopers, cucumber beetles, cutworms, and rindworms, apply at a rate of 0.04-0.10 lb. a.i./A. For control of two-spotted spider mite, apply at a rate of 0.08-0.10 lb. a.i./A. Do **NOT** apply more than 0.30 lb. a.i./A per season. REI - 24 hours.
- **carbaryl** (*Sevin* 80S) - PHI - 3 days. Carbamate. For control of pickleworm and melonworm, apply at a rate of 0.5-1.0 lb. a.i./A. For control of cucumber beetle, apply at a rate of 1.0 lb. a.i./A. Do **NOT** apply more than 6.0 lb. a.i./A per crop. REI - 12 hours. *Carbaryl is not used as extensively anymore because of its high toxicity to bees.*(*Adios*) - PHI - 0 days. Carbamate. For control of cucumber beetles, apply at a rate of 0.07-0.10 lb. a.i./A. Do **NOT** apply more than 0.50 lb. a.i./A per crop per season and do **NOT** apply with screens or nozzles finer than 20 mesh. REI - 12 hours. *As of 1999, BASF had discontinued Adios.*
- **dicofol** (*Kelthane* 50WP) - PHI - 2 days. Chlorinated hydrocarbons. For mite control, apply at a rate of 0.63 lb. a.i./A. Do **NOT** feed treated crops or crop residues to animals and do **NOT** make more than 2 applications per season. REI - 48 hours.
- **dimethoate** (*Dimethoate* 4EC) - PHI - 3 days. Organophosphate. For control of leafminers, apply at a rate of 0.50 lb. a.i./A. REI - 48 hours.
- **endosulfan** (*Thiodan* 3EC) - PHI - 2 days. Pyrethroid. For control of cucumber beetles, pickleworm, melonworm, green peach aphid, melon aphid, and rindworms, apply at a rate of 0.5-1.0 lb. a.i./A. Do **NOT** apply more than six times per season. Do **NOT** exceed more than 3.0 lb. .a.i./A/season. REI - 48 hours.
- **esfenvalerate** (*Asana* XL) - PHI - 3 days. Pyrethroid. For control of cucumber beetles, cutworms, pickleworms, melonworms, rindworms, and cabbage looper, apply at a rate of 0.03-0.05 lb. a.i./A. Do **NOT** exceed 0.25 lb. a.i./A per season. REI - 12 hours.
- **fenpropathrin** (*Danitol* 2.4EC) - PHI - 7 days. Pyrethroid. For mite control, apply at a rate of 0.2-0.3 lb. a.i./A. Do **NOT** exceed 0.8 lb. a.i./A per season. REI - 24 hours.

- **imidacloprid** (*Admire* 2F) - PHI - 21 days. Chloronicotinyl. For control of cucumber beetles, green peach aphid, melon aphid, and seed corn maggot apply at a rate of 0.25-0.38 lb. a.i./A Do **NOT** apply more than 0.5 lb. a.i./A per acre per year. REI - 12 hours.
- **methomyl** (*Lannate* LV) - PHI - 3 days. Organophosphate. For control of cucumber beetles, cutworms, pickleworms, melonworms, green peach aphids, melon aphids, and cabbage loopers, apply at a rate of 0.45-0.90 lb. a.i./A. Do **NOT** apply more than 5.4 lbs. a.i./A per crop and do not make more than 12 applications. REI - 48 hours.
- **oxamyl** (*Vydate* L 2L) - PHI - 1 day. Carbamate. For the control of leafminers, apply at a rate of 0.50-1.00 lb. a.i./A. Do **NOT** apply more than 6 lb. a.i./A per season. REI - 48 hours.
- **oxydemeton-methyl** (*Metasystox*-R 2SC) - PHI - 7 days. Organophosphate. For control of aphids and mites, apply at a rate of 0.38-0.50 lb. a.i./A. Do **NOT** apply more than twice per season. REI - 24 hours.
- **permethrin** (*Ambush* 2EC, *Pounce* 3.2EC) - PHI - 0 days. Pyrethroid. For control of leafminers, apply at a rate of 0.20 lb. a. i./A. and for control of cabbage loopers, cucumber beetles, cutworm, melonworm, pickleworm, and rindworm, apply at a rate of 0.10-0.20 lb. a.i./A. Do **NOT** apply more than 1.60 lb. a.i./A per season. REI - 24 hours.
- **pymetrozine** (*Fulfill* 50WP) - PHI - 14 days. Pyridine azomethine. For control of green peach aphids and melon aphids, apply at a rate of 0.09 lb. a.i./A. Do **NOT** exceed 0.20 lb. a.i./A per season. REI - 12 hours.
- **spinosad** (*SpinTor* 2SC) - PHI - 3 days. Spinosyn. For control of leafminers, apply at a rate of 0.09-0.13 lb. a.i./A. For control of cabbage loopers, melonworms, pickleworms, and rindworms, apply at a rate of 0.06-0.13 lb. a.i./A. Do **NOT** exceed 0.45 lb. a.i./A per season. REI - 4 hours.
- **thiamethoxam** (*Actara* 25 WDG, *Platinum* 2SG) - PHI - 0 days. Nicotinoid. For control of aphids, apply at a rate of 0.03-0.05 lb. a.i./A. Do **NOT** exceed 0.125 lb. a.i./A per season. REI - 12 hours. (*Platinum*) - PHI - 30 days. Neonicotinoid. For control of aphids, apply at a rate of 0.078-0.125 lb. a.i./A. Do **NOT** exceed 0.125 lb. a.i./A per season or use less than 0.078 lb. a.i./A per season. REI - 12 hours.

Disease Pests

Control recommendations found below were modified from information presented in the 2002 Commercial Vegetable Production Recommendations--Virginia. [5]

DISEASES

Disease in watermelons can slow down development and cause injury to the leaves and fruit, greatly reducing the yield and making the crop less profitable. Each of the diseases listed below occurs within Virginia and depends primarily on weather conditions but also on a number of other factors such as site location, seed quality, and effective management procedures. Good sanitation and management practices are key to a successful disease control program. *Gummy Stem Blight*, *Powdery Mildew*, and *Anthracnose* are the most important diseases in Virginia.

Alternaria Leaf Blight, *Alternaria cucumerina*

Alternaria leaf blight causes damage by defoliating the vines and reducing fruit yield, size, and quality. This disease usually attacks the oldest leaves or crown leaves, showing round, water-soaked lesions or transparent spots near the center of the hill. Warm, humid weather causes the lesions to blacken and to grow rapidly, eventually spreading to the younger leaves on the tip of the vine. On the fruit, circular sunken spots develop that later become covered with a dark olive green to black mold.

Monitoring: Monitoring your crop on a regular basis for disease will help you apply pesticides when needed.

Chemical Control: Begin spraying when vines begin to run. Alternate chlorothalonil with azoxystrobin (*Quadris*) every seven days. This is especially important to delay the development of resistant strains of the pathogen to azoxystrobin (*Quadris*). See *Chemical Disease Control* section for more information.

Biological Control: No commercially effective controls are available.

Cultural Control: Using resistant varieties whenever possible and following a proper management routine will help reduce

the risk of infection. Make sure you rotate cucurbits out with other vegetables for three or four years. After harvest, plow under or burn any crop debris left in the field.

Anthracnose, *Colletotrichum lagenarium*

Symptoms appear as raised, circular, water-soaked spots on the crown leaves after the vines begin to run. These spots tend to start off yellow in color and then dry out to black, rapidly growing and eventually falling away, killing the entire leaf. Symptoms on the fruit appear to have dark lesions with a slimy pinkish spore mass in the center.

Monitoring: Frequent rains and humid weather promote the development and spread of the disease. Wind, raindrops, and anything moving from vine to vine can carry and spread the spores from plant to plant.

Chemical Control: Begin fungicide applications when vines run or earlier if symptoms begin to develop. Alternate chlorothalonil with azoxystrobin(*Quadris*) every seven days. This is especially important to delay the development of resistant strains of the pathogen to azoxystrobin (*Quadris*). See *Chemical Disease Control* section for more information.

Biological Control: No commercially effective controls are available.

Cultural Control: Some varieties offer excellent resistance, so use them whenever possible. For disease control in susceptible varieties, it is important to combine protectant fungicide applications with seed treatments and crop rotation with noncucurbits. If infection does occur, know that the disease overwinters in infected seeds, leaf litter, and plant debris and can remain in the soil for several years. After harvest, be sure to remove all plant debris to avoid a possible re-infection.

Bacterial Fruit Blotch, *Acidovorax avenae* subsp. *citrulli*

Bacterial fruit blotch infection usually begins in the contaminated seeds, and greenhouses make excellent environments for the spread of the disease. Moving infected transplants into the field makes spread of the disease easy, especially with high humidity, high temperatures, and wet weather. Symptoms of transplants and leaves resemble small, dark brown, water-soaked angular spots that can be inconspicuous to the eye. The characteristic symptoms of the infected fruit are usually a dark green/olive-colored stain on the top surface. It starts out small but quickly expands over the fruit. In advanced stages of the disease the rind becomes weakened and ruptures, allowing secondary bacteria to set in the flesh of the fruit. This causes decay and collapse of the fruit.

Monitoring: Monitoring your crop on a regular basis for disease will help you apply pesticides when needed.

Chemical Control: Beginning at first bloom, apply fixed copper and repeat every seven days. See *Chemical Disease Control* section for more information.

Biological Control: No commercially effective controls are available.

Cultural Control: When planting begins, obtain disease-free seed. During transplant production, practice good sanitation. Segregate different seed lots in the transplant house to reduce the chance of cross-contamination. Use transplants from houses in which there were no seedling symptoms of the fruit blotch disease. Should the field become infected, it should be plowed in the fall and volunteer seedlings removed the following year to prevent inoculum sources. Rotate crops to allow two or more years between watermelon plantings.

Damping-Off, *Rhizoctonia solani*

This disease causes young seedlings to wilt and die, or to not emerge at all. Generally, this disease is most effective at low temperatures and under wet weather or high humidity conditions.

Monitoring: Monitoring your crop on a regular basis for disease will help you apply pesticides when needed.

Chemical Control: To protect against all damping-off pathogens, seeds are usually treated with broad-spectrum

contact fungicides. See *Chemical Disease Control* section for more information.

Biological Control: No commercially effective controls are available.

Cultural Control: Practices that promote healthy seedlings can prevent or reduce the disease, but because damping-off is so difficult to contain once it starts, it's best to avoid it all together.

Downy Mildew, *Pseudoperonospora cubensis*

Downy mildew is most prevalent at low temperatures and under wet weather or high humidity conditions. Symptoms appear as irregular yellowish to brown spots on the upper leaf surface, eventually becoming more distinct on both sides of the leaves. On wet mornings, the underside of the leaves may exhibit a brown to gray fungal growth. These spots grow rapidly and turn black, eventually causing the leaf to wilt and die. This can lead to a major foliage loss in the crop.

Monitoring: Scout fields for disease incidence beginning in mid-July, even though generally this disease does not occur until mid-August.

Chemical Control: Begin sprays when vines run or if disease occurrence is predicted for the region. Use chlorothalonil or mancozeb every seven days. Other effective fungicides, such as mefenoxam *plus* chlorothalonil, copper hydroxide (*Ridomil Gold Copper*), and mefenoxam (*Ridomil Gold*), should be applied every 14 days. Apply the first two mentioned on alternate weeks when using these fungicides. See *Chemical Disease Control* section for more information.

Biological Control: No commercially effective controls are available.

Cultural Control: Crop rotation has little effect on prevention of downy mildew It is important to promote healthy, vigorous growth and a good nutritional program in the crop, as plants under nutritional stress are more susceptible to developing the disease. Also, avoid overhead irrigation.

Fusarium Wilt, *Fusarium oxysporum f.sp. niveum*

This fungus attacks watermelon plants at any growth stage. If infection is already present, seedlings will start to wilt and will die soon after emergence. The most characteristic symptom is that the large roots and internal tissues near the ground are stained a brick red color. High temperatures can make the infestation more severe, along with nematodes, which can enter as a secondary pathogen.

Monitoring: Monitoring your crop on a regular basis for disease will help you apply pesticides when needed.

Chemical Control: See *Chemical Disease Control* section for more information.

Biological Control: No commercially effective controls are available.

Cultural Control: Use a long rotation with other crops for at least five years. Whenever possible use resistant varieties. However, if pathogen populations are high, even resistant cultivars can wilt and die. *Race 2*, which results in wilting of resistance varieties, has been detected in Maryland and Delaware. Rotate watermelon out of fields where *Race 2* is present.

Gummy Stem Blight, *Didymella bryoniae*

This disease primarily occurs in late summer and can attack all parts of the plant except the roots. It also can occur at any growth stage, from seedlings to mature plants. The first symptoms appear on as reddish-brown lesions on the main stems and dark circular lesions on the leaf margins. If constant rain or high humidity occurs, these lesions can spread very quickly and cause curling, shriveling, and even leaf death.

Monitoring: Monitoring your crop on a regular basis for disease will help you apply pesticides when needed.

Chemical Control: Begin sprays when vines begin to run. Alternate chlorothalonil with azoxystrobin (*Quadris*) every seven days. This is especially important to delay the development of resistant strains of the pathogen to azoxystrobin (*Quadris*). See *Chemical Disease Control* section for more information.

Biological Control: No commercially effective controls are available.

Cultural Control: As there are no resistant varieties available, crop rotation with non-cucurbits for three to four years is very important. To reduce survival of the fungus, plow any crop refuse deeply into the ground right after harvest is complete.

Ozone Injury

Ozone can cause chlorosis and upper surface scorching on the older leaves, which leads to defoliation. One of the more sensitive varieties is *Sugar Baby*. It is important not to confuse foliar diseases with ozone injury, as fungicides are not effective against it. The only way to avoid ozone injury is with resistant varieties, proper growing conditions, and good management of irrigation and fertility.

Phytophthora Blight, *Phytophthora capsici*

This highly destructive disease can cause many different problems for a crop, including: seedling damping-off, leaf spots and fruit rot, and possibly total crop loss. Stem and leaf petiole lesions appear as light to dark brown, water-soaked, and irregular in shape, eventually becoming dry, brittle, and papery. Older plants, with root infections, may suddenly wilt even though they show no signs of stem or vine lesions. In fruit the symptoms begin as small, water-soaked lesions in the rind, which enlarges quickly and becomes a soft, sunken area covered with white fungal growth. This eventually will lead to fruit collapse in the field or storage. During periods of heavy rainfall, this disease can spread rapidly, quickly becoming a very serious problem.

Monitoring: Monitoring your crop on a regular basis for disease will help you apply pesticides when needed.

Chemical Control: For protection against the stem and fruit rot phase of the disease, add fixed copper to each fungicide application used for downy mildew or gummy stem blight. See *Chemical Disease Control* section for more information.

Biological Control: No commercially effective controls are available.

Cultural Control: To reduce the risk of infection, a complete management program should be implemented with emphasis on water management. Fields should be adequately drained to ensure that soil water does not accumulate around the base of the plants. In addition, when the vines begin to run, subsoil between rows to allow for faster drainage following rainfall. Avoid overhead irrigation, and rotate out susceptible crops out for two or more years.

Viruses (CMV, WMV, PRSV, AND ZYMV)

Viruses can be spread in the field by insect feeding, cuttings, and infected seeds. In the cucumber mosaic virus (CMV), the leaves show a distinctive yellow and green mosaic pattern on the youngest leaves near the growing tip. Over time, the leaves become malformed and curled, stunting of the vines occurs, and little fruit is produced. The watermelon mosaic virus (WMV) causes the leaves to become distorted and blistered and displays the same yellow and green mosaic pattern on the newest leaves. If plants are infected young, they can become stunted. The fruit can become misshapen, dwarfed, mottled, or spotted. Papaya ringspot virus (PRSV), formerly known as watermelon mosaic virus - 1, causes severe plant stunting. A green mosaic pattern is visible on the leaves and is usually accompanied by malformations, leaf distortions, and narrowing leaf blades. The fruit can be malformed and present a break in color pattern. Zucchini yellow mosaic virus (ZYMV) also causes plant stunting and exhibits a yellow mosaic pattern, leaf malformations, and dead patches on the leaves. In the fruit, deep cracks can occur, allowing secondary bacteria to invade the flesh of the fruit.

Monitoring: Monitoring your crop on a regular basis for disease will help you apply pesticides when needed.

Chemical Control: Soaps and oils can be used to control virus-transmitting aphids, but once the virus is established in the crop, there are no effective chemical controls available. Reducing insect vectors with insecticides is an option, but remember that insecticides are not always effective in reducing virus spread because the virus may have been transmitted before the insecticide kills the insect.

Biological Control: No commercially effective controls are available.

Cultural Control: Always use virus-resistant cultivars whenever possible and keep weeds mowed around fields that may harbor viruses over the winter. Plant crops early to escape peak aphid season, and plant as far away from existing cucurbit plantings as possible to prevent aphid transmissions of viruses from existing fields to new fields.

Chemical Disease Control

The list below contains all of the products available to producers for disease control in watermelons along with the recommended application rates of these chemicals.

- **azoxystrobin** (*Quadris* 2.1F) - PHI - 1 day. Apply at a rate of 0.18-0.25 lb. a.i./A for control of anthracnose and alternarial leaf blight. For resistance management, do **NOT** apply more than one application of *Quadris* before alternating with a fungicide that has a different mode of action. Do **NOT** make more than 4 applications per acre per crop per season or apply 1.0 lb. a.i./A per crop per season. REI - 4 hours.
- **benomyl** (*Benlate* 50WP) - PHI - 1 day. Benzimidazole. For control of anthracnose, apply at a rate of 0.13-0.25 lb. a.i./A. Apply when disease appears or when runners begin. Repeat at 7- to 14-day intervals. Do **NOT** apply more than 1.0 lb. a.i./A per season. REI - 24 hours. *As of December 2001, Dupont phased out benomyl and Benlate® is no longer sold.*
- **chlorothalonil** (*Bravo, Echo, Equus*) - (*Bravo*) PHI - 0 days. Substituted aromatic. For control of anthracnose and downy mildew, apply at a rate of 1.20-1.40 lb. a.i./A and for control of alternaria leaf blight and gummy stem blight, apply at a rate of 1.40-2.20 lb. a.i./A. REI - 48 hours. (*Echo*) PHI - 0 days. Substituted aromatic. For control of anthracnose and downy mildew, apply at a rate of 1.10-1.50 lb. a.i./A and for control of alternaria leaf blight and gummy stem blight, apply at a rate of 1.50-2.30 lb. a.i./A. Do **NOT** exceed 15.75 lb. a.i./A/season. REI - 12 hours. (*Equus*) PHI - 0 days. Substituted aromatic. For control of anthracnose and downy mildew, apply at a rate of 1.20-1.50 lb. a.i./A and for control of alternaria leaf blight and gummy stem blight, apply at a rate of 1.50-2.20 lb. a.i./A. REI - 12 hours. When apply cholorthalonil, do **NOT** apply during intense heat, sunlight, or drought conditions and/or if there is a poor vine canopy.
- **copper, fixed** (*various formulations*) - PHI - 0 days. Inorganic. For protection against the stem and fruit rot phase of the disease phytophthora blight, add to each fungicide application used for downy mildew or gummy stem blight at a rate of 0.75 lb. a.i../A. Apply fixed copper at a rate of 0.81 lb. a.i./A, beginning at first bloom and repeating every 7 days for control of bacterial fruit blotch. REI - 24 hours.
- **copper hydroxide** (*Ridomil Gold Copper* 65WP) - PHI - 5 days. For control of downy mildew, apply at a rate of 1.3 lb. a.i./A. Begin applications when conditions are favorable for disease, but before infection. Avoid late-season application when plants reach full maturity or begin senescence. REI - 48 hours.
- **mancozeb** (*Dithane, Manex II, Manzate, Penncozeb*) - (*Dithane*) PHI -5 days. Substituted aromatic. For control of alternaria leaf blight, anthracnose, downy mildew, and gummy stem blight, apply at a rate of 1.50-2.25 lb. a.i./A. REI - 24 hours. (*Manex II*) PHI -5 days. Substituted aromatic. For control of alternaria leaf blight, anthracnose, downy mildew, and gummy stem blight, apply at a rate of 1.60-2.40 lb. a.i./A. REI - 24 hours. (*Manzate*) PHI -5 days. Substituted aromatic. For control of alternaria leaf blight, anthracnose, downy mildew, and gummy stem blight, apply at a rate of 1.60-2.40 lb. a.i./A. REI - 24 hours. Some watermelon varieties may be sensitive to mancozeb. Growers should check with their local extension agent before applying. (*Penncozeb* 75DF) PHI -5 days. Substituted aromatic. For control of alternaria leaf blight, anthracnose, downy mildew, and gummy stem blight, apply at a rate of 1.50-2.25 lb. a.i./A. Apply as soon as the plants begin to run or when disease threatens. REI - 24 hours.
- **mefenoxam** (*Ridomil Gold* 4E) (*Ultra Flourish* 2E) - PHI - 0 days. Phenylamides. For control of damping off, apply 0.5-1.0 lb. a.i./A in a 7-inch band at planting. REI - 48 hours.
- **mefenoxam *plus* chlorothalonil** (*Ridomil Gold/Bravo* 76WP)* - PHI - 0 days. For control of downy mildew, apply at a rate of 1.52 lb. a.i./A. Begin applications before infection but when conditions are favorable. Continue at 14-day intervals until the threat of disease is over. Avoid late-season applications when plants reach full maturity and begin senescence. REI - 48 hours. (*Flouronil* 76WP)* - PHI - 14 days. For control of downy mildew, apply at a rate of 1.52 lb. a.i./A. Begin applications before infection but when conditions are favorable. Continue at 14-day intervals until the threat of disease is over. Avoid late-season applications when plants reach full maturity and begin senescence. REI - 48 hours.
  ***** *Up to 4 applications can be made per crop*.

- **myclobutanil** (*Nova* 40W) - PHI - 0 days. Triazoles. For downy mildew control, apply at a rate of 0.06-0.13 lb. a.i./A. Do **NOT** apply more than 0.6 lb. a.i./A per crop. REI - 24 hours.
- **thiophanate-methyl** (*Topsin* M 70WP) - PHI - 0 days. Benzimidazole. For anthracnose control, combine with chlorothalonil to improve the performance and apply at a rate of 0.18-0.35 lb. a.i./A REI - 12 hours.

Nematode Pests

Control recommendations were taken from 2002 Commercial Vegetable Production Recommendations-Virginia. [6]

NEMATODES

The root-knot nematode (*Meloidogyne spp.)* is the most important species of nematode affecting watermelons in Virginia. [7] Symptoms and damage can mimic other diseases and pests, making identification nearly impossible to determine on site. Soil and root samples should be collected and analyzed by an expert for determination.

Monitoring: Both diagnostic and predictive nematode assay programs in Virginia provide data to producers on the numbers and kinds of nematodes in soil along with recommendations for control. Soil samples for diagnostic assays are processed without charge to determine the cause of production problems during the growing season. Predictive nematode assays are done on samples collected after harvest. These samples are processed at a cost of $11 per sample and must be collected in the fall no later than November 20.

Chemical Control: When using soil fumigation, it is important that the fields be sufficiently prepared for planting. All crop debris and clods should be removed, and soil moisture should be adequate. Otherwise, soil fumigation will not be effective due to lack of penetration of all soil particles by the gaseous fumigant. It is also necessary to allow an aeration period between fumigant applications and planting. Otherwise, crop injury will occur. For recommendations, see the *Chemical Nematode Control* section below.

Biological Control: No commercially effective controls are available.

Cultural Control: Sanitation and good cultural practices are the best preventative measures against nematodes. Examples include obtaining nematode-free roots and washing soil from machinery and tools before using them at different locations. Crop rotation with non-host crops to lower their population size is highly recommended in the event of nematode activity.

Chemical Nematode Control

Several chemicals are currently available for nematode control, although this may change in the next few years. Currently, the multipurpose soil fumigants chloropicrin, metam sodium (*Busan, Nemasol, Vapam HL*), and methyl bromide (*Terr-O-Gas 67, MC-33*) are recommended for use in Virginia.In addition, dichloropropene (*Telone II*), chloropicrin and dichloropropene (*Telone C-17, Telone C-35*) are soil fumigants used only for nematodes. The non-fumigant nematicide oxamyl (*Vydate L*) is also recommended for use in watermelons. Typically, chemical controls are used only when cultural practices are unable to provide adequate control. However, these chemicals are still important tools when other methods of control have failed.

Weed Pests

Control recommendations were taken from 2002 Commercial Vegetable Production Recommendations-Virginia. [8]

WEEDS

The herbicides currently labeled for weed control in watermelon work on annual grasses, certain perennial grasses, and certain broadleaf weeds. However, producers in Virginia are faced with a multitude of additional broadleaf weed problems including common lambsquarter, common cocklebur, and jimsonweed. If not controlled, weeds can greatly reduce root quality and may interfere with the harvest. Successful weed management is vital to the production of quality watermelons. Weeds compete with the crop for light, space, nutrients and, particularly, water. Weed growth promotes disease problems and can harbor deleterious insects and diseases. Weeds also impair the ability to harvest effectively, reducing the quantity of marketable fruit and increasing labor costs. Watermelons, as with most crops, require early season weed control to ensure a quality crop. In addition, the spreading nature of this crop makes weed control difficult once the vines begin to form.

Monitoring: Proper weed identification is an important part of effective weed control. Weeds observed in previous crops within a given field should be noted to aid in future herbicide decisions. It is also important to monitor the effectiveness of preplant incorporated and preemergent herbicides once the crop emerges.

Chemical Control: To provide additional pest control, a Special Local Need (24C) label has been approved in Virginia for the postemergence and postharvest use of parquat (*Gramoxone Max* 3SC). Recommended rates can be found in *Chemical Weed Control* section below.

Biological Control: No commercially effective controls are available.

Cultural Control: Cultivation is a very important component of weed control. Weeds will outcompete a crop for nutrients, water, and sunlight, reducing yield and making the crop less profitable. Mechanical cultivation provides very effective weed control but is limited to small weeds that can be easily uprooted or covered. More importantly, mechanical cultivation should not be performed once the plants have begun to vine ("run"). These vines are very tender and are easily damaged by tractor wheels or cultivators. Mechanical control must be supplemented with chemical or hand weeding to remove weeds in the rows or after the plants produces vines. Hand weeding provides very effective weed control and is safe to the crop. Weeding should be performed when the crop and weeds are small to reduce crop damage and to allow hoeing. Removal of large weeds with extensive root systems may damage crop roots or vines. Hand weeding, however, is costly in terms of labor. Incorporating cultivation with herbicides is the most cost effective way to combat weeds and to produce a high yield. Crop rotation is also important to prevent domination of any one weed species year after year. Also, avoiding fields with a history of severe weed infestations may be an appropriate action.

Chemical Weed Control

The list below contains all of the fully labeled products available to producers for weed control in watermelons. Use estimates are also included based on anecdotal data. [9]

- **bensulide** (*Prefar* 4EC) - PHI - N/A Preplant incorporate 2 inches deep or less before seeding and transplanting. Apply at a rate of 5-6 lbs. a.i./A primarily for grass control. Weak on many broadleaf weeds, including common lambsquarter, common cocklebur, and jimsonweed. No unlabeled crop is to be planted in the field for 4 months. Labeled crops include tomatoes, certain cole crops, lettuce, and certain other vegetables. REI - 12 hours. Estimated acres treated - 5%.
- **bensulide *plus* naptalam** (*Prefar* 4EC **plus** *Alanap* 2SC) - PHI -N/A Preplant incorporate 2 inches or less before seeding and transplanting. Apply at a rate of 5-6 lbs. a.i./A *plus* 2 lb. a.i./A to control for annual and certain broadleaf grasses. Tank mix is approved. REI - 48 hours.
- **clethodim** (*Select* 2EC) - PHI - 14 days. Postemergence. Apply at a rate of 0.094-0.125 lbs. a.i./A with oil concentrate to be 1% of the spray solution to control many annual and certain perennial grasses, including annual bluegrass. However, it will not consistently control goosegrass. The use of oil concentrate may increase the risk of crop injury when hot or humid conditions prevail. To reduce the risk of crop injury, omit additives or switch to nonionic surfactant when grasses are small and soil moisture is adequate. Control may be reduced if grasses are large or if hot, dry weather or drought conditions occur. For best results, treat annual grasses when they are actively growing and before tillers are present. Repeated applications may be needed to control certain perennial grasses.. Yellow nutsedge, wild onion, or broadleaf weeds will not be controlled. Do **NOT** tank-mix with or apply within 2 to 3 days of any other pesticide unless labeled, as the risk of crop injury may be increased, or reduced control of grasses may result. REI - 24 hours. Estimated acres treated - 5%.
- **ethalfluralin** (*Curbit* 3E) - PHI - N/A Preemergence that controls annual grasses and certain broadleaf weeds. Apply at a rate of 1.13-1.70 lbs. a.i./A (based on soil texture). Control of many broadleaf weeds, including pigweed sp.,

common lambsquarter, jimsonweed, morningglory sp., ragweed sp., mustard sp., and others may not be acceptable. Dry weather following application may reduce weed control. Cultivate to control tolerant weeds or if rainfall or irrigation does not occur before to weed emergence. Do **NOT** preplant incorporate, apply under plastic mulch or tunnels, use on transplanted watermelons, or use when soils are cold or wet. This could result in crop injury. REI - 24 hours. Estimated acres treated - 95%.

- **naptalam** (*Alanap* 2SC) - PHI - N/A Preplant incorporate 2 inches deep before seeding and transplanting. Apply at a rate of 2 lbs. a.i./A to control annual and certain broadleaf grasses. Weed control may not be satisfied on sandy soils with less than 1% organic matter. For postemergence, apply at a rate of 1-2 lbs. a.i./A when the crop is ready to vine to extend residual weed control and to suppress or control smooth pigweed. Do **NOT** use when growing conditions are adverse - such as cold or wet weather or if rainfall is expected within 6 hours - or mix with liquid fertilizer. REI - 48 hours. Estimated acres treated - 3%.
- **paraquat** (*Gramaxone Max* 3SC) - PHI - N/A Delayed preemergence. Apply at a rate of 0.3 lbs. a.i./A in 30 gallons of water just before emergence of crop to control early germinating weeds. Use wetting agent as directed on the label. REI - 12 hours. Postemergence. Apply at a rate of 0.6 lbs. a.i./A as a directed spray to control emerged weeds between the rows after the crop has been established. Add nonionic surfactant according to the labeled instructions. Do **NOT** allow spray or spray drift to contact the crop or injury may result. See label for additional information and warnings. REI - 12 hours. Estimated acres treated - 5%. Postharvest. Apply at a rate of 0.6 lbs. a.i./A as a broadcast spray after the last harvest. Add nonionic surfactant according to the label instructions. Use to prepare plastic mulch for replanting or to aid in the removal of the mulch. See the label for additional information and warnings. REI - 24 hours. Estimated acres treated - 5%.
- **sethoxydim** (*Poast* 1.5EC) - PHI - 14 days. Postemergence. Apply at a rate of 0.2-0.3 lbs. a.i./A with oil concentrate to be 1% of the spray solution to control annual grasses and certain perennial grasses. For best results, treat annual grasses when they are actively growing and before tillers are present. Repeated applications may be needed to control certain perennial grasses. Yellow nutsedge, wild onion, or broadleaf weeds will not be controlled. Do **NOT** tank-mix with or apply within 2 to 3 days of any other pesticide unless labeled, as the risk of crop injury may be increased, or reduced control of grasses may result. Do **NOT** apply more than 0.6 lbs. a.i./A in one season. REI - 12 hours. Estimated acres treated - 15%.

Table 1: Effectiveness of herbicides recommended for weed control in watermelons. [10]

Herbicide	Barnyardgrass	Crabgrass, Large	Fall Panicum	Foxtail sp.	Goosegrass	Johnsongrass (Seedlings)	Yellow Nutsedge	Carpetweed	Cocklebur, Common	Cranesbill	Galinsoga, Hairy	Jimsonweed	Lambsquarters, Common	Morningglory sp.	Shepherdspurse	Pigweed sp.	Purslane, Common	Ragweed, Common	Smartweed, Pennsylvania	Nightshade, Eastern Black	Velvetleaf
Preplant or Preplant Incorporated																					
Prefar	G	G	G	G	G	G	G	G	P	G	N	P	F	F	-	G	G	P	P	F/G	F/G
Preemergence or Preplant Incorporated																					
Alanap	P	P/F	P	F	P/F	-	N	F	P	N	F	F	F	F	N	F/G	F/G	F	P	P	F
Postemergence																					
Poast	G	G	G	G	G	G	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Select	G	G	G	G	P	G	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N

Herbicide performance is affected by weather, soil type, herbicide rates, weed pressure, and other factors. These ratings indicate ONLY relative effectiveness in tests conducted by the University of Delaware, University of Maryland System, The Pennsylvania State University, Rutgers, The State University of New Jersey, and Virginia Polytechnic

Institute and State University. Actual performance may be better or worse than indicated in this chart.

G = good F = fair P = poor N = no control - = insufficient data

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On-Line Resources

C&P Press Online Crop Protection Reference
http://www.greenbook.net/free.asp

Crop Data Management Systems - Pesticide Labels
http://www.cdms.net

Insects and Related Pests of Vegetables
http://ipmwww.ncsu.edu/AG295/html

Pests of Vegetables and Fruit Trees
http://everest.ento.vt.edu/~idlab/vegpests/vegfact.html

UGA College of Ag. & Environmental Sciences: Commercial Watermelon Production
http://www.ces.uga.edu/pubcd/B996-w.htm

Virginia Tech Pesticide Programs
http://www.vtpp.ext.vt.edu

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