

Crop Profile for Squash in Delaware

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Production Facts

- In 2002, 71,236 acres of squash were harvested in the United States. Of these, 8,453 acres were for processing (1).
- In 2002, 125 acres of squash were planted in Delaware (2).
- The value of squash production in Delaware is combined with that of other vegetables to avoid disclosure of individual operations. In 2005, the value of "Other Vegetables" for fresh market was \$1,836,000. The value of "Other vegetables" for processing was \$5,812,000 (3).

Production Regions

Squash can be grown throughout Delaware.

Cultural Practices (4)

Summer squash is harvested and eaten in the immature stages when the rind is still very soft. Grown on bush-type plants, most summer squash will mature in 45 to 60 days, yielding about 8 to 12 pounds per plant. Many excellent varieties are available:

Straightneck types - Early Prolific, Straightneck, Seneca Prolific

Crookneck types - Golden Summer, Crookneck, Sundance

Zucchini types - Black Magic, Aristocrat, Elini

Scallop types - Patty Pan Hybrid, Peter Pan

Winter squash is harvested when the fruit is mature and the rind is hard, which can be 70 to 110 days after planting, depending on variety. Winter squash usually grow on vines, but some are of the bush type. Included in the winter squash category are: hubbards, butternut, gold nugget, acorn, and buttercup. Expected yield for the vine types is about 30 pounds per hill, and for bush types about 5 pounds per hill. Some of the most popular varieties in this category are:

Hubbards - Blue Hubbard, Improved Green Hubbard

Butternut - Early Butternut, Waltham Butternut

Gold Nugget - Gold Nugget

Acorn - Jersey Golden Acorn, Table King, Table Queen, Table Ace, Royal Acorn

Buttercup - Sweet Mama, Buttercup

Squash do well in most well-drained soils, high in organic matter and with a pH of 6.0 to 6.8. Before planting, broadcast 5 pounds of a complete fertilizer such as 5-10-10 or 5-10-5 per 100 sq. feet. If manure is used, broadcast 2 to 4 bushels plus about 3 pounds of a complete fertilizer per 100 sq. feet. After spreading the fertilizer and lime, till to a depth of 6 to 8 inches to develop a good seed bed. Squash can be started by planting seeds after danger of frost is over. Plant bush type summer squash in rows 5 to 6 feet apart and space the hills about 3 feet apart within the row. For vine types of winter squash, plant seeds in rows 6 to 12 feet apart and space hills 3 to 10 feet apart, depending on variety. When summer squash begins to bear or when vine types begin to run, apply fertilizer around each plant.

Worker Activities and Timing (4, 5)

Seeding – April 15 to August 15. Container grown plants are planted through the plastic when daily mean temperatures have reached 60F.

Cultivation/ weed control – Weed control is accomplished primarily through fumigation, use of plastic mulch or foil mulch, and use of herbicides.

Harvest – 45 to 60 days after planting. Squash is harvested by hand.

Insect Pests

The major insect pests of both processing and fresh market squash are striped and spotted cucumber beetles and melon aphids. Although only a pest of concentrated squash acreage, squash vine borer can also cause economic losses.

Striped and spotted cucumber beetles

Damage and Life Cycle

Striped cucumber beetles, *Acalymma vittata* (Fabricius), and spotted cucumber beetles, *Diabrotica undecimpunctata howardi* (Barber), are the most destructive insect pests of cucumbers, squash and related crops in the mid-Atlantic area. Both cucumber beetles share a similar life cycle and inflict similar damage to host plants. Both species overwinter as adults in neighboring woodlands or other protected areas and move onto crops in May, just after plant emergence or transplanting. Beetle feeding on the young seedlings often kills the plants within 1 to 2 days. Female cucumber beetles deposit eggs in the soil at the base of host plants or on the underside of leaves. Larvae feed on the roots of the plants for 2 to 3 weeks before they pupate in the soil. A second generation of beetles appears later in the summer. Squash are particularly susceptible to cucumber beetle damage, since planting dates often coincide with high levels of beetle

activity. Cucumber beetles feed on the stems, foliage, and fruit, and can cause direct damage to the rind of winter squash.

More importantly, both species of cucumber beetles are vectors of bacterial wilt, a serious disease in cucurbits. Bacterial wilt is a major consideration in the production of squash grown for processing and the fresh market. There is a variable level of resistance to bacterial wilt among squash cultivars, but when cucumber beetle populations are high even the more resistant varieties will show signs of stress that translate into a reduction in fruit quality and yield. Beetle emergence is well synchronized, and a field with few beetles may become densely infested literally overnight. Cucumber beetles are very active dispersers and can quickly locate host plants. For this reason crop rotations to control for cucumber beetles are of limited value, particularly on smaller farms. The major feeding injury and disease transmission takes place from the time cucurbits are transplanted or emerging through the surface until they form runners. Older plants are far less susceptible to disease transmission. Some evidence indicates that cucumber beetle may also transmit certain plant viruses, but this has not been proven.

Frequency of Occurrence

Cucumber beetles are regular annual pests of both fresh market and processing squash. Although their feeding injury does not always result in economic loss, their control is critical to protect the crop from bacterial wilt. Beetle size and timing of cucumber beetle populations can vary widely depending upon weather conditions in winter and in late spring when beetles emerge.

IPM Program

Both preventative controls and foliar sprays are used to control cucumber beetles on fresh market and processing squash. The use of foliar rescue treatments alone is not a viable control strategy for cucumber beetles. Beetles often have irregular distribution in the field, and localized populations can be overlooked while scouting. The resulting yield loss due to bacterial wilt infected plants can be significant. Preventive insecticide treatments are used on most of the squash acreage to control beetles during the early growth stage when squash plants are most susceptible to bacterial wilt transmission.

Chemical Controls

Insecticides should be applied before beetles feed extensively on the cotyledons and first true leaves. If foliar insecticides are used, begin spraying shortly after plant emergence, and repeat applications at weekly intervals if new beetles continue to invade fields.

Summer Squash:

- Admire Pro--7.0-10.5 fl oz 4.6 F/A
- imidacloprid (Admire; generics available)--16-24 fl oz 2F/A
- Asana XL--5.8-9.6 fl oz 0.66EC/A
- Baythroid XL--2.4-2.8 fl oz /A
- bifenthrin (Capture; generics available)--2.1-6.4 fl oz 2EC/A
- Furadan--A Special Local-Needs Label 24(c) is in effect for the use of liquid Furadan at 3.8 fl oz 4F/1,000 ft of row at planting.
- Lannate--1.5-3 pt LV/A
- Platinum--5-8 oz 2SG/A
- Sevin--1.25 lb 80S/A
- Thionex--0.67-1.33 qt 3E/A

Winter Squash:

- Admire Pro--7.0-10.5 fl oz 4.6 F/A
- imidacloprid (Admire; generics available)--16-24 fl oz 2F/A
- Asana XL--5.8-9.6 fl oz 0.66EC/A
- Baythroid XL--2.4-2.8 fl oz /A
- bifenthrin (Capture; generics available)--2.6-6.4 fl oz 2EC/A
- Danitol--10.66-16 fl oz 2.4 EC/A
- Furadan--A Special Local-Needs Label 24(c) is in effect for the use of liquid Furadan at 3.8 fl oz 4F/1,000 ft of row at planting. Use of Furadan at planting frequently leads to spider mite outbreaks later in the season
- permethrin--4-8 fl oz 3.2EC/A
- Platinum--5-8 oz 2SG/A
- Sevin--1.25 lb 80S/A
- Thionex--0.67-1.33 qts 3EC/A

Alternative Controls

No alternative strategies are available for controlling cucumber beetle on squash in Delaware.

Melon Aphids

Damage and Life Cycle

Many species of aphids feed on squash; however, the predominant species is the melon aphid. All inflict similar types of injury to plants. Aphids overwinter as eggs on a variety of host plants. Nymphs hatch in spring and feed until they mature. Adults of this first generation reproduce sexually, bearing live young which become winged adults which migrate to crops. This generation feeds on plants and rapidly reproduces asexually, with a generation time of 5 to 7 days. Melon aphids are found primarily on the underside of the leaves, where they suck

sap from the plant and cause a reduction in the quality and quantity of the fruit. Infested leaves curl downward and may turn brown and die. In addition to feeding damage, aphids produce "honeydew," a sticky excretion which can cover fruits and promote the growth of a sooty black mold. More importantly, the melon aphid is also one of the primary vectors of cucumber mosaic virus, which may reduce yields as much as 50-80% in plants infected prior to fruit set.

Frequency of Occurrence

Aphids are rarely a problem on fresh market squash, and are generally controlled by insecticides applied for major pests. However, populations occasionally reach damaging levels. Aphids are more problematic on winter squash than summer squash because of the longer growing season. The worst infestations usually occur during hot, dry summers following cool, dry springs, since such weather conditions reduce the efficiency of aphid natural enemies. Chemical applications which deplete populations of beneficial insects may also lead to aphid outbreaks.

IPM Program

Scouting for aphids is done by looking for wilting and curled leaves throughout the field. When aphids are detected, more intense sampling is done to determine infestation levels and natural enemy activity. An insecticide is applied if more than 20% of runners have 5 or more aphids, natural enemy populations are low, and humidity is low to moderate.

Chemical Controls

Thorough spray coverage beneath leaves is important. Treat seedlings every 5 to 7 days or as needed

Winter Squash:

Green Peach Aphid

- Admire Pro-- 7.0-10.5 fl oz 4.6 F/A
- imidacloprid (Admire; generics available)--16-24 fl oz 2F/A
- Fulfill--2.75 oz 50WDG/A
- Metasystox-R--1.5-2 pt 2SC/A
- Platinum--5-8 oz 2SG/A
- Thionex--0.67-1.33 qts 3EC/A or OLF
- Venom--5-6 oz (soil); 1-4 oz(foliar) 70SG/A

Melon Aphid

- Admire Pro--7.0-10.5 fl oz 4.6 F/A
- Imidacloprid (Admire; generics available)--16-24 fl oz 2F/A
- Fulfill--2.75 oz 50WDG/A
- Metasystox-R--1.5-2 pt 2SC/A

- Platinum--5-8 oz 2SG/A
- Thionex--0.67-1.33 qts 3EC/A or OLF
- Venom--5-6 oz (soil); 1-4 oz(foliar) 70SG/A

Summer Squash:

Green Peach Aphid

- Admire Pro--7.0-10.5 fl oz 4.6 F/A
- imidacloprid (Admire; generics available)--16-24 fl oz 2F/A
- Fulfill--2.75 oz 50WDG/A
- Metasystox-R--1.5-2 pt 2SC/A
- Platinum--5-8 oz 2SG/A
- Thionex--0.67-1.33 qts 3EC/A or OLF
- Venom--5-6 oz (soil); 1-4 oz (foliar) 70SG/A

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- Admire Pro--7.0-10.5 fl oz 4.6 F/A
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- Platinum--5-8 oz 2SG/A
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- Venom--5-6 oz (soil); 1-4 oz(foliar) 70SG/A

Natural Enemies

When making a treatment decision, natural enemy populations are considered. Aphids may be controlled by parasitic wasps and a variety of predators, including lady beetles and their larvae, lacewing larvae, and syrphid fly larvae. All of the insecticides used in squash are detrimental to beneficial insects. During periods of high humidity, fungal diseases may also help reduce aphid populations. Natural enemies are important to a certain extent but do not always keep pest populations in check.

Cultural Controls

Foil mulches on squash planted after July 1 may repel aphids that transmit mosaic virus. A few small fresh market growers may use this strategy on late planted squash, but it is rare. Mosaic-resistant winter squash cultivars are available.

Minor Insect and Mite Pests in Delaware

Most of the minor pests listed in this section do not cause economic damage every year. Typically, they are adequately controlled by insecticide applications

directed against cucumber beetles and aphids. Summer squash is very short-lived and thus rarely experiences significant problems with minor pests; whereas, winter squash has a long crop season and is more vulnerable to these late developing pests.

Spider mites

Damage and Life Cycle

Spider mites can be a serious problem on squash during hot, dry weather. Adults migrate into fields in the summer and begin feeding on the underside of leaves. Each female can lay 5 to 6 eggs per day for a total of 70 to 200 eggs in her lifetime. Eggs hatch into 6-legged nymphs which quickly develop into adult mites. The life cycle can be completed in as few as 6 days during hot weather. These minute mites feed on the contents of individual cells of the leaves, which become blotched with pale yellow and reddish-brown spots ranging from small specks to large areas on the tops of leaves. Damage can develop very quickly, and a severe infestation can seriously stunt the growth of plants.

Frequency of occurrence

Mites are a sporadic pest problem in squash and are more problematic on winter squash than summer squash because of the longer growing season. Outbreaks are typically more severe during hot and dry weather or when insecticide applications, particularly of carbofuran, reduce natural predator populations.

IPM Program

Because of their small size, spider mites are hard to detect until the vines are damaged with hundreds of mites on each leaf. The problem with scouting for mites is that populations may be spotty and easily missed even by a thorough scout. Fields are scouted by some growers weekly, from early July through August during hot, dry weather. Mites may be concentrated around field edges during the early stages of infestation, or they may balloon into the center of the fields and spread from there. If feeding injury is detected, plants are sampled to determine the extent of mite infestation. An acaricide is applied if 10-15% of the crown leaves are infested early in the season, or in mid-summer if 50% of the runners show leaf injury and mites are present.

Chemical Controls

Most fresh market growers seldom treat for spider mites. When infestation levels are low, chemical control of mites is unnecessary. During the worst infestations, two sprays may be used on about 30% of the acres. Even when mite populations are high, infestations tend to be localized and may be spot-treated. Applications to control mites on processing squash are not needed every year. Typically, less

than 13% of processing squash acres are treated every 2 or 3 years for spider mites. Spider mite outbreaks may occur about once every 5 years. In the worst cases, up to 50% of acres are treated.

Continuous use of Furadan, Sevin, or pyrethroids may result in mite outbreaks.

- Acramite--0.75-1.0 50W/A
- abamectin (Agri-mek;generics available)--8-16 fl oz 0.15EC/A
- bifenthrin (Capture; generics available)--5.12-6.4 fl oz 2EC/A
- Danitol--10.66-16 fl oz 2.4EC/A
- Kelthane--1.25 lb 50WSP/A
- Oberon--7-8.5 fl oz 2SC/A

Alternative Controls

Mite infestations generally begin around field margins and grassy areas. Do not mow or maintain these areas after midsummer since this forces mites into the crop.

Squash Bug (*Anasa tristis*)

Damage and Life Cycle

The squash bug attacks all the cultivated plants of the cucurbit family but favors squash and pumpkins. Both adults and nymphs feed on the leaves by piercing through the surface with their sharp mouthparts and sucking the plant sap. In the process of feeding, they inject toxins which interfere with the physiological functions of the leaf. The first evidence of injury is the formation of pale green areas on the leaves. These areas later wilt, turn brown and die. When squash bugs are abundant, the foliage has a somewhat burnt appearance

Frequency of Occurrence

The squash bug is an important pest in home gardens but is only an occasional pest in commercially grown fresh market squash and is never a pest on squash grown for processing . It is more problematic on winter squash than summer squash because of the longer growing season.

IPM Program

Squash bug control is not considered in IPM programs in Delaware.

Chemical Controls

Treatment threshold is greater than one egg mass per plant. Treatments begin shortly after vines run and are repeated every 7 to 10 days or as needed. Sprays should target nymphal stages. For best squash bug control, under leaf spray

coverage is essential. Use of Venom for aphid control will reduce squash bug populations in summer squash. Chemicals used for squash bug control in fresh market squash include the following.

Winter squash:

- Asana XL--5.8-9.6 fl oz 0.66EC/A
- azadirachtin (Azatin, Ecozin, Neemix)--11-21 fl oz EC/A. Apply when pests first appear and are in their early nymphal stages
- bifenthrin (Capture; generics available)--2.6-6.4 fl oz 2EC/A
- permethrin--8 fl oz 3.2EC/A
- Sevin--1.25 lb 80S/A
- Thionex--2/3-1 1/3 qt 3EC/A

Summer squash:

- Asana XL--5.8-9.6 fl oz 0.66EC/A
- bifenthrin (Capture; generics available)--2.1-6.4 fl oz 2EC/A
- permethrin--8 fl oz 3.2EC/A
- Sevin--1.25 lb 80S/A
- Thionex--2/3-1 1/3 qt 3SC/A

Processing squash is never treated specifically for squash bug.

Alternative Controls

There are no alternative control strategies for squash bug in squash in Delaware.

Squash Vine Borer (*Elasmopalpus lignosellus*)

Damage and Life Cycle

Squash vine borers are pests of squash and pumpkins, particularly in the home garden . Moths overwinter as pupae in the soil . After emergence, the wasp-like moth can be seen flying swiftly and noisily about plants during the daytime from June through August. Eggs are laid singly at the base of blooming plants and hatch in 7 to 10 days . Small larvae usually are found tunneling out the inner tissues of petioles near the base of the plant, where they feed for 14 to 30 days. Later in the season, older larvae are located throughout the stems and sometimes in the fruit. The first indication that the borer is present is the sudden wilting of one runner or the entire plant. Inspection of the wilted vine usually reveals masses of coarse greenish-yellow excrement pushed out of holes in the vines. Infested vines often are completely girdled and usually rot and die.

Frequency of Occurrence

The squash vine borer is a rare, sporadic pest of fresh market and processing squash in Delaware. Commercial plantings usually escape noticeable injury in the mid-Atlantic area. However, in areas where squash is planted every year, we have seen an increase in problems.

IPM Program

There are no practical methods for direct sampling of adults or eggs in the fields. Pheromone traps used for clear-wing moths have been used to get a general indication that moths are flying and laying eggs. Plants are checked for general vigor and other factors, and borer damage may be detected, but no regular monitoring is done specifically for this pest in either fresh market or processing squash.

Chemical Controls

When vines begin to run, apply to bases of plants four times at 7-day intervals. Use of SpinTor for looper control will reduce squash vine borer populations.

Summer Squash:

- Asana XL--5.8-9.6 fl oz 0.66EC/A
- bifenthrin (Capture; generics available)--2.1-6.4 fl oz 2EC/A
- permethrin--4-8 fl oz 3.2EC/A
- Thionex--0.67-1.33 qts 3E/A

Winter Squash:

- Asana XL--5.8-9.6 fl oz 0.66EC/A
- bifenthrin (Capture; generics available)--2.6-6.4 fl oz 2EC/A
- Thionex--0.67-1.33 qts 3EC/A

Alternative Controls

In small plots, infested runners may be removed or infested plants destroyed, but no cultural or alternative practices are used by commercial growers.

Table. Squash insecticides REI, PHI, % of crop treated.

Insecticide	REI (hours)	PHI (days)	% summer squash treated	% winter squash treated
bifenthrin (Acramite)	12	3	0	0
abamectin (Agri-mek)	12	7	0	0

esfenvalerate (Asana XL)	12	3	5	5
azadirachtin	12	0	0	0
<i>Bacillus thuringiensis</i>	4	0	0	0
cyfluthrin (Baythroid XL)	12	0	0- just labeled in 2006	0- just labeled in 2006
bifenthrin (Capture)	12	3	10	10
fenproparthrin (Danitol)	24	7	<5	<5
spinosad (Entrust)	4	3	<1	<1
pymetrozine (Fulfill)	12	0	<1	<1
carbofuran (Furadan)	48	At plant	10	10
imidacloprid (Admire)	12	21	20	20
methoxyfenozide (Intrepid)	12	3	0	0
dicofol (Kelthane)	48	2	<1	<1
methomyl (Lannate)	48	3	5	5
oxydementon methyl (Metasystox-R)	48	14	<1	<1
spiromesifen (Oberon)	12	7	0	0
thiamethoxam (Platinum)	12	30	10	10
permethrin	12	0	10	10
carbaryl (Sevin)	12	3	0	0
spinosad (SpinTor)	4	3	<2	<2
endosulfan (Thionex)	24	2	10	10
cyromazine (trigard)	12	0	0	0
dinotefuran (Venom) (soil/foliar)	12	21/1	0 – justlabeled in 2006	0 just labeled in 2006
oxamyl (Vydate)	48	1	?	?

Diseases

Damping-Off

Apply the following in a 7-inch band after seeding.

- mefenoxam--1-2 pt Ridomil Gold 4E/A or 2-4 pt Ultra Flourish 2E/A

Viruses (CMV, WMV2, PRSV, and ZYMV)

Resistance to many viruses is available. The winter squash variety “Magician” is resistant to ZYMV. Summer squash varieties expressing the precocious yellowing gene such as “Multipik” mask the greening caused by WMV and CMV but will become distorted when infected with either PRSV or ZYMV. PRSV is devastating in some squash fields in the region and, where this virus is present, resistance to all viruses is necessary. The following control measures should also be used.

- Plant fields as far as possible from existing cucurbit plantings to prevent aphid transmission of viruses from existing fields to new fields.
- Also, use reflective mulch to prevent aphid transmission of viruses.

Angular Leaf Spot/ Bacterial Leaf Spot (Winter squash)

Both diseases can produce foliar symptoms that are often over-looked. Early detection is important, since control of the foliar phase can reduce infection in developing fruit. Both diseases are seedborne and can survive on infested debris for at least one year or until the debris decomposes. Apply the following when disease is first detected on the foliage and repeat every 7 to 10 days.

- copper, fixed

Bacterial Wilt

Insect control is essential for prevention of wilt. Control cucumber beetles before they feed on plants. See preceding "Cucumber Beetle" section under “Insect Control” for specific recommendations.

Powdery Mildew

The fungus that causes powdery mildew has developed resistance to several classes of fungicides. Strains of the pathogen that are highly resistant to the strobilurins/FRAC group 11 fungicides have been reported in the Eastern U.S. Powdery mildew generally occurs from mid-July until the end of the season. Make first application when powdery mildew is observed in the area or is detected by scouting (one lesion on the underside of 45 old leaves), begin the following fungicide program for summer squash:

Alternate:

chlorothalonil-2-3 pt 6F/A *plus* Nova--5 oz 40WP/A, or
chlorothalonil--2-3 pt 6F/A *plus* Procure--4-8 oz 50WS/A,

With:

a tank mix containing chlorothalonil *plus* Pristine--12.5-18.5 oz 38WG/A

For winter squash:

Alternate:

chlorothalonil--2-3 pt 6F/A *plus* Nova--5 oz 40WP/A, or
chlorothalonil--2-3 pt 6F/A *plus* Procure--4-8 oz 50WS/A,

With:

Micronized Wettable Sulfur--4 lb 80W/A, sulfur may injure plants especially at high temperatures. Certain varieties can be more sensitive. Consult label for precautions, or a tank mix containing:
chlorothalonil *plus* Pristine--12.5-18.5 oz 38W/A

Downy Mildew

Scout fields for disease incidence early in the growing season. Begin sprays when plants meet in the row or if disease occurrence is predicted for the region. Refer to the Cucurbit Downy Mildew Forecasting website (www.ces.ncsu.edu/depts/pp/cucurbit/) for current status of the disease. Preventative applications are much more effective than applications made after disease is detected. The following are the most effective materials. Tank mix these products with a protectant such as chlorothalonil--1.5-2 pt 6F/A or (winter squash) maneb (Manex) – 2-3 pt 4F/A:

- Ranman--2.1-2.75 fl. oz. 400 SC/A
- Previcur Flex--1.2 pt 6F/A
- Gavel (summer squash) --1.5-2 lb 75 DF/A (Gavel contains mancozeb, which is a protectant, and does not need a tank mix partner.)
- Curzate--3.2 oz 60DF/A
- Tanos--8 oz 50WDG/A

Materials with different modes of action (FRAC groups) should be alternated. Sprays should be applied on a 7-day schedule. Under severe disease conditions spray interval may be reduced if label allows.

Plectosporium Blight (*Microdochium* Blight)

Rotate with crops other than cucurbits. It is important to achieve maximum foliage coverage with the fungicide application. Once symptoms appear on petioles or after fruit form, apply one of the following and repeat every 7 – 10 days.

- chlorothalonil--2-3 pt 6F/A
- mancozeb (summer squash) --2-3 lb 75DF/A
- maneb (Manex)—summer squash: 1.2-1.6 pt 4F/A; winter squash: 2-3 pt 4F/A

A spray schedule that alternates Cabrio or Flint with chlorothalonil will also provide control.

Blossom Blight (summer squash)

This is a serious problem in some years. The fungus becomes established in senescent blossoms and grows into young fruit. Improve aeration through wider plant spacing and good weed control.

Scab

Disease occurs during cool periods. Use resistant varieties when possible. Begin sprays as true leaves form. Repeat every 5 to 7 days.

- chlorothalonil--2-3 pt 6F/A

Gummy Stem Blight (Black Rot) and Anthracnose (winter squash)

Rotate to provide at least 2 years between cucurbit plantings. Fungicides at risk for resistance development such as Qol's (strobilurins, FRAC group 11 fungicides) should be tank-mixed with a different group of fungicide to delay onset of resistance. When tank-mixing use at least the minimum labeled rate of each fungicide in the tank mix. Alternate with a non-Qol fungicide effective against black rot. Do not apply a Qol fungicide (FRAC group 11) more than 4 times per season. If resistance to Qol fungicides exists in the area, do not use Qol fungicides. Use a fungicide from a different fungicide group. Begin the following fungicide program when fruit start to form:

Alternate:

chlorothalonil--2-3 pt 6F/A (use low rate early in season)

With:

a tank mix containing chlorothalonil *plus* Pristine--12.5-18.5 oz 38WG/A,
or

azoxystrobin (Quadris--11.0-15.4 fl oz 2.08F/A or Amistar--3.5-5.0 oz 80WDG), or

Cabrio--12-16 oz 20 WG/A

Maintain fungicide schedule until harvest. Fungicide application for black rot control will help maintain "handles" on the fruit. Harvest carefully because wounding can negate benefits from a season-long fungicide program.

Phytophthora Blight

To minimize the occurrence of this disease, summer squash should be grown on raised beds. Winter squash should be rotated with crops other than peppers, eggplants, tomatoes, and other cucurbits. Fields should be adequately drained to ensure that soil water does not accumulate around the base of the plants. In summer squash, mefenoxam (Ridomil Gold or Ultra Flourish) should be applied preplant for early season control. In winter squash, broadcast soil fumigation 2 to 3 weeks prior to seeding is beneficial in areas that justify the expense.

Once the canopy of summer squash closes, subsoil between the rows to allow for faster drainage following rainfall. When conditions favor disease development, apply one of the following for suppression only and always tank mix with fixed copper:

- Forum--6.0 oz 4.18SC/A(must be tanked mixed)
- Gavel--1.5-2 lb 75DF/A
- Tanos--8-10 oz. 50WDG/A
- Ranman--2.75 fl. oz. 400 SC/A *plus* an adjuvant (do not tank mix with copper)

For suppression of the fruit rot phase of the disease in winter squash, apply one of the following when conditions favor disease development:

- Forum--6.0 fl oz 4.18SC/A (must be tank mixed with another fungicide active against *Phytophthora* blight such as fixed copper)
- Ranman--2.75 fl oz 400 SC/A (*plus* an adjuvant, do not tank mix with copper)
- Tanos--8-10 oz 50 WDG/A

Nematode Control

Vydate L--1-2 gal 2L/A. Incorporate into the top 2 to 4 inches of soil 2 to 4 pints 2L per acre applied 2 weeks after planting and repeat 2 to 3 weeks later.

Table. Squash fungicides: REI, PHI

Fungicide	REI (hours)	PHI (days)
azoxystrobin (Amistar)	4	1
pyraclostrobin (Cabrio)	12	0
chlorothalonil	12	0
copper, fixed	24	0
cymoxanil (Curzate)	12	3
flouronil	48	14
dimethomorph (Forum)	12	0
zoxamide + mancozeb (Gavel)	48	5
mancozeb	24	5
maneb	24	5
myclobutanil (Nova)	24	0
propamocarb hydrochloride (Previcur Flex)	12	2
pyraclostrobin + boscalid (Pristine)	48	0
triflumizole (Procure)	12	0
azoxystrobin Quadris	4	1
cyazofamid (Ranman)	12	0
mefenoxam (Ridomil Gold)	48	0
mefenoxam + chlorothalonil (Ridomil Gold Bravo)	48	0
mefenoxam + copper hydroxide (Ridomil Gold Copper)	48	5
Sulfur Micronized Wettable	24	--
mefenoxam + mancozeb (Ridomil Gold MZ)	24	5
famoxodone + cymoxanil (Tanos)	12	3

Ultra Flourish	48	0
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Weeds

Weeds compete with cultivated plants for sun and water. They can be a hindrance with harvesting equipment and they can harbor damaging insects and diseases. Crops can become contaminated with weed plant parts during harvesting which can result in reduced selling price or in severe cases, rejection of the crop. A wide range of weed species is present in squash fields in DE. Some of the more common weeds include common lambsquarters, pigweed species, common ragweed, morningglory species, and various annual and perennial grasses.

Cultural Control Practices: Herbicides alone seldom control all weed species. They must be used in conjunction with cultivation to ensure high yields in squash crops. When weed escapes occur, cultivation is preferable to hoeing or applying post-emergence herbicides. Hoeing is more expensive and labor intensive than cultivation, and post-emergent herbicides may injure the crop and cause a delay in harvest. Also, since post-emergent herbicides are selective, it is unlikely that all weed escapes will be controlled.

Weed Control Under Plastic Mulch

Black plastic mulch effectively controls most annual weeds by preventing light from reaching the germinated seedling. Herbicides are used under plastic mulch to control weeds around the planting hole, and under the mulch when clear plastic is used. Trickle irrigation tube left on the soil surface may cause weed problems by leaching herbicide away at the emitters. The problem is most serious when clear plastic mulch is used. The trickle tube should be buried several inches deep in the bed to reduce this problem.

Bensulide--5-6 lb/A. Apply 5 to 6 quarts per acre Prefar 4E preemergence in a band under the plastic, immediately before laying the mulch. Condensation that forms on the underside of the mulch will activate the herbicide. Annual grasses and certain annual broadleaf weeds will be suppressed or controlled under the mulch and around the plant hole. Use the maximum recommended rate to improve control of annual broadleaf weeds including common lambsquarter, smooth pigweed, and common purslane.

Soil Strips Between Rows of Plastic Mulch (Directed and Shielded Band Applications)

Apply Gramoxone in bands to the soil strips between the plastic mulch before the crop emerges or is transplanted, and/or as a shielded spray postemergence to control emerged weeds. Use in combination with residual herbicides that are registered for use.

Preemergence

Bensulide--5-6 lb/A. Apply 5 to 6 quarts per acre Prefar 4E as a banded directed shielded spray preemergence to the weeds and activate with one-half inch of sprinkler irrigation within 36 hours to control most annual grasses. Use the maximum recommended rate preemergence followed by irrigation to suppress certain annual broadleaf weeds including common lambsquarter, smooth pigweed, and common purslane.

Clomazone--0.094-0.188 lb/A. (summer squash only.) Apply 4 to 8 fluid ounces per acre Command 3ME as a banded directed shielded spray preemergence to the weeds to control annual grasses and many broadleaf weeds including common lambsquarter, velvetleaf, spurred anoda, and jimsonweed. Mustards, morningglory species, and pigweed species will not be controlled. Use lowest recommended rate on coarse-textured, sandy soils low in organic matter. Higher rates should only be used on medium- and fine-textured soils and sites that have been heavily manured. Combine with Curbit 3EC to control pigweed species where Curbit is registered for use, or use Strategy, the jug-mix that contains clomazone (Command) and ethalfluralin (Curbit). **WARNING:** Command spray or vapor drift may injure sensitive crops and other vegetation up to several hundred yards from the point of application. Do not apply when wind or weather conditions favor herbicide drift. Do not apply to fields adjacent to horticultural, fruit, vegetable, or other sensitive crops (see label). Drift injury from offsite Command movement is extremely apparent; therefore, do not use Command on fields near sensitive locations. Herbicide residues may limit subsequent cropping options when Command is used for weed control in cucumbers.

Ethalfluralin--0.38-0.75 lb/A. Apply 1 to 2 pints per acre Curbit 3E as a banded directed shielded spray preemergence to control annual grasses and certain annual broadleaf weeds, including carpetweed and pigweed sp. Control of many other broadleaf weeds, including 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 emerged weeds if rainfall or irrigation does not occur prior to weed emergence. **DO NOT** preplant incorporate. **DO NOT** apply under plastic mulch or tunnels. **DO NOT** use on transplanted summer squash. **DO NOT** use when soils are cold or wet. Crop injury may result.

Ethalfluralin *plus* Clomazone (jug-mix)--0.394-1.575 lb/A. Apply 1.5 to 6 pints per acre of Strategy 2.1SC preemergence to control annual grasses and many annual broadleaf weeds. Use the lowest recommended rates on coarse-textured sandy soils low in organic matter. Higher rates should only be used on medium and fine textured soils and sites that have been heavily manured. Strategy is a jug-mix of ethalfluralin (Curbit 3E) and clomazone (Command 3ME).

Halosulfuron--0.023-0.047 lb/A (summer squash only). Apply 0.5 to 1.0 dry ounce Sandea 75WG as a banded directed shielded spray between rows of plastic

mulch to suppress or control broadleaf weeds including common cocklebur, redroot, pigweed, smooth pigweed, ragweed species, and galinsoga. Use the lower rate on coarse-textured soils low in organic matter and higher rates on fine-textured soils and on soils with high organic matter. Rainfall or irrigation after application is necessary before weeds emerge to obtain good control. Occasionally, slight stunting may be observed following Sandea use early in the season. When observed, recovery is rapid with no effect on yield or maturity. Sandea is an ALS inhibitor. Herbicides with this mode of action have a single site of activity in susceptible weeds. The risk of the development of resistant weed populations is high when herbicides with this mode of action are used continuously and exclusively to control a weed species for several years or in consecutive crops in a rotation. Integrate mechanical methods of control and use herbicides with a different mode of action to control the target broadleaf weeds when growing other crops in the rotation. Do NOT apply Sandea to crops treated with a soil applied organophosphate insecticide, or use a foliar applied organophosphate insecticide within 21 days before or 7 days after a Sandea application. DO NOT exceed a total of 0.047 pound per acre, equal to 1 dry ounce of Sandea, applied preemergence. Do NOT exceed total of 0.094 pounds per acre, equal to 2.0 dry ounces of Sandea per crop-cycle. DO NOT exceed a total of 0.094 pound per acre, equal to 2 dry ounces of Sandea, in a year.

Postemergence

Halosulfuron--0.023-0.031 lb/A. Apply 0.5 to 0.66 dry ounce Sandea 75WG as a banded directed shielded spray between rows of plastic mulch to suppress or control yellow nutsedge and broadleaf weeds including common cocklebur, redroot pigweed, smooth pigweed, ragweed species, and galinsoga when the crop has 2 to 5 true leaves but has not yet begun to bloom or run. Sandea applied postemergence will not control common lambsquarter or eastern black nightshade. Add nonionic surfactant to be 0.25 percent of the spray solution (1 quart per 100 gallons of spray solution). Do NOT use oil concentrate. Susceptible broadleaf weeds usually exhibit injury symptoms within 1 to 2 weeks of treatment. Typical symptoms begin as yellowing in the growing point that spreads to the entire plant and is followed by death of the weed. Injury symptoms are similar when yellow nutsedge is treated but may require 2 to 3 weeks to become evident and up to a month for the weed to die. Occasionally, slight yellowing of the crop may be observed within a week of Sandea application. When observed, recovery is rapid with no effect on yield or maturity. Sandea is an ALS inhibitor. Herbicides with this mode of action have a single site of activity in susceptible weeds. The risk of the development of resistant weed populations is high when herbicides with this mode of action are used continuously and exclusively to control a weed species for several years or in consecutive crops in a rotation. Integrate mechanical methods of control and use herbicides with a different mode of action to control the target broadleaf weeds when growing other crops in the rotation. DO NOT apply Sandea to crops treated with a soil applied organophosphate (OP) insecticide, or use a foliar applied organophosphate (OP) insecticide within 21 days before or 7 days after a Sandea application. DO NOT

exceed a total of 0.031 pound per acre, equal to 0.66 dry ounces of Sandea, applied postemergence. DO NOT exceed total of 0.094 pounds per acre, equal to 2.0 dry ounces of Sandea per crop-cycle. DO NOT exceed a total of 0.094 pound per acre, equal to 2 dry ounces of Sandea, in a year.

Paraquat--0.6 lb/A. A Special Local-Needs 24(c) label has been approved for the use of Gramoxone Inteon 2SC postemergence as a directed shielded spray in Delaware. Apply 2.4 pints per acre Gramoxone Inteon 2SC as a directed spray to control emerged weeds between the rows after crop establishment. Add nonionic surfactant according to the labeled instructions. Do not allow spray or spray drift to contact the crop or injury may result. Use shields to prevent spray contact with the crop plants. Do not exceed a spray pressure of 30 psi.

Clethodim--0.094-0.125 lb/A. Apply 6 to 8 fluid ounces per acre Select 2EC with oil concentrate to be 1 percent of the spray solution (1 gallon per 100 gallons of spray solution) or 12 to 16 fluid ounces of Selectmax 0.97EC with nonionic surfactant to be 0.25% of the spray solution (1 quart per 100 gallons of spray solution) postemergence to control many annual and certain perennial grasses, including annual bluegrass. Select 2EC will not consistently control goosegrass. The use of oil concentrate with Select 2EC 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. Observe a minimum preharvest interval of 14 days.

Sethoxydim--0.2-0.3 lb/A. Apply 1 to 1.5 pints per acre Poast 1.5EC with oil concentrate to be 1 percent of the spray solution (1 gallon per 100 gallons of spray solution) postemergence to control annual grasses and certain perennial grasses. 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. Observe a minimum preharvest interval of 14 days and apply no more than 3 pints per acre in one season.

For Seeding Into Soil Without Plastic Mulch (Broadcast Applications)

Preplant Incorporated or Preemergence

Bensulide--5-6 lb/A. Apply 5 to 6 quarts per acre Prefar 4E before planting and incorporate 1 to 2 inches deep with power-driven rotary cultivators, or apply preemergence and activate with one-half inch of sprinkler irrigation within 36 hours to control most annual grasses. Use the maximum recommended rate preemergence followed by irrigation to suppress certain annual broadleaf weeds including common lambsquarter, smooth pigweed, and common purslane.

Preemergence

Clomazone—Summer squash: 0.094-0.188 lb/A. Apply 4 to 8 fluid ounces per acre Command 3ME. Winter squash: 0.25-0.5 lb/A. Apply 0.66 to 1.3 pints per acre. Apply preemergence to a direct-seeded crop to control annual grasses and many broadleaf weeds including common lambsquarter, velvetleaf, spurred anoda, and jimsonweed. Mustards, morningglory species, and pigweed species will not be controlled. In winter squash, carpetweed and yellow nutsedge will not be controlled. Use lowest recommended rate on coarse-textured, sandy soils low in organic matter. Higher rates should only be used on medium-and fine-textured soils and sites that have been heavily manured. Combine with Curbit 3EC to control pigweed species where Curbit is registered for use. Some temporary crop injury (partial whitening of leaf or stem tissue) may be apparent after crop emergence. Complete recovery will occur from minor early injury without affecting yield or earliness. Banding the herbicide reduces the risk of crop injury and offsite movement due to vapor drift.

Ethalfuralin—Summer squash: 0.38-0.75 lb/A. Apply 1 to 2 pints per acre Curbit 3E. Winter squash: 0.56-0.75 lb/A. A Special Local Needs Label 24(c) has been approved for the use of Curbit 3E on winter squash in Delaware. Apply 1.5 to 2 pints per acre. Apply preemergence to control annual grasses and certain annual broadleaf weeds, including carpetweed and pigweed sp. Control of many other broadleaf weeds, including 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 emerged weeds if rainfall or irrigation does not occur prior to weed emergence. DO NOT preplant incorporate. DO NOT apply under plastic mulch or tunnels. DO NOT use when soils are cold or wet. Crop injury may result.

Ethalfuralin *plus* Clomazone (jug-mix)--0.394-1.575 lb/A. Apply 1.5 to 6 pints per acre of Strategy 2.1SC preemergence to control annual grasses and many annual broadleaf weeds. Use the lowest recommended rates on coarse-textured sandy soils low in organic matter. Higher rates should only be used on medium and fine textured soils and sites that have been heavily manured. Strategy is a jug-mix of ethalfuralin (Curbit 3E) and clomazone (Command 3ME).

Postemergence

Paraquat (Winter squash only) -- 0.6 lb/A. A Special Local-Needs 24(c) label has been approved for the use of Gramoxone Inteon 2SC postemergence as a directed shielded spray in Delaware. Apply 2.4 pints per acre Gramoxone Inteon 2SC as a directed spray to control emerged weeds between the rows after crop establishment. Add nonionic surfactant according to the labeled instructions. Do not allow spray or spray drift to contact the crop or injury may result. Use shields to prevent spray contact with the crop plants. Do not exceed a spray pressure of 30 psi.

Clethodim--0.094-0.125 lb/A. Apply 6 to 8 fluid ounces per acre Select 2EC with oil concentrate to be 1 percent of the spray solution (1 gallon per 100 gallons of spray solution) or 12 to 16 fluid ounces of Selectmax 0.97EC with nonionic surfactant to be 0.25% of the spray solution (1 quart per 100 gallons of spray solution) postemergence to control many annual and certain perennial grasses, including annual bluegrass. Select 2EC will not consistently control goosegrass. The use of oil concentrate with Select 2EC 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. Observe a minimum preharvest interval of 14 days.

Halosulfuron (Winter squash) --0.023-0.031 lb/A. Apply 0.5 to 0.66 dry ounces of Sandea 75WG to suppress or control yellow nutsedge and broadleaf weeds, including common cocklebur, redroot pigweed, smooth pigweed, ragweed species, and galinsoga when the crop has 2 to 5 true leaves, but has not yet begun to "run" or bloom. Sandea applied postemergence will not control common lambsquarter or eastern black nightshade. Add nonionic surfactant to be 0.25% of the spray solution (1 quart per 100 gallons of spray solution). Susceptible broadleaf weeds usually exhibit injury symptoms within 1 to 2 weeks of treatment. Typical symptoms begin as yellowing in the growing point that spreads to the entire plant, and is followed by death of the weed. Injury symptoms are similar when yellow nutsedge is treated, but may require 2 to 3 weeks to become evident, and up to a month for the weed to die. Occasionally slight yellowing of the crop may be observed within a week Sandea application. When observed, recovery is rapid, with no effect on yield or maturity. Sandea is an ALS inhibitor. Herbicides with this mode of action have a single site of activity in susceptible weeds. The risk of the development of resistant weed populations is high when herbicides with this mode of action are used continuously and exclusively to control a weed species for several years or in consecutive crops in a rotation.

Integrate mechanical methods of control and use herbicides with a different mode of action to control the target broadleaf weeds when growing other crops in the rotation. DO NOT apply Sandea to crops treated with a soil applied organophosphate (OP) insecticide, or use a foliar applied organophosphate (OP) insecticide within 21 days before or 7 days after a Sandea application. DO NOT exceed total of 0.047 pounds per acre, equal to 1.0 dry ounce of Sandea, applied postemergence, per crop-cycle. DO NOT exceed a total of 0.094 pound per acre, equal to 2 dry ounces of Sandea applied to multiple crops in one year.

Sethoxydim--0.2-0.3 lb/A. Apply 1 to 1.5 pints per acre Poast 1.5EC with oil concentrate to be 1 percent of the spray solution (1 gallon per 100 gallons of spray solution) postemergence to control annual grasses and certain perennial grasses. 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. Observe a minimum preharvest interval of 14 days and apply no more than 3 pints per acre in one season.

Postharvest

With or Without Plastic Mulch

Paraquat--0.6 lb/A. A Special Local-Needs 24(c) label has been approved for the use of Gramoxone Inteon 2SC for postharvest desiccation of the crop in Delaware. Apply 2.4 pints per acre Gramoxone Inteon 2SC as a broadcast spray after the last harvest.

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