Historical Perspective

Summer squash (Cucurbita pepo L.) is grown throughout Alabama. The word squash comes from the Massachusetts Indian word askutasquash, meaning “eaten raw or uncooked.” Summer squash is a member of the Cucurbitaceae family (commonly referred to as Cucumber, or Gourd family), which also contains pumpkins, watermelons, muskmelons (cantaloupes), and ornamental gourds. Collectively, these crops are referred to as “cucurbits.”

Unlike many vegetable crops cultivated in the United States, summer squash originated in the New World. It is found from the southern temperate zone of North America to the northern subtropical zone of South America. Worldwide, summer squash ranks high economically among other vegetables produced.

There are four groups of summer squash: (1) straightneck, yellow cylindrical or bottle shaped fruit with a straightneck; (2) crookneck, yellow elongated fruit with a narrow, long curved neck; (3) scallop, white, green or striped flattened fruit with scalloped or ridged edges; and (4) zucchini and cocozelle, green or yellow cylindrical fruit, referred to as vegetable marrows. The zucchini is uniformly cylindrical and green.

Planting Recommendations

Planting Dates

Summer squash is a warm-season crop that is relatively easy to grow requiring a short season to produce a marketable crop. Most varieties require 40 to 50 days from sowing to reach market maturity. This fact allows for the production of two, and in some parts of Alabama, three consecutive crops of summer squash in a single growing season.

Summer squash is typically direct seeded after all danger of frost is passed. Soil temperatures should be between 70°F and 90°F for optimal seed germination. Although direct seeding is the best method, growers can transplant summer squash provided great care is taken. If transplants are used, always use containerized plants (never bare root transplants) that are no more than 3 weeks old. Many growers opt for transplants to enhance earliness and uniformity of plant stands, but great care must be taken when transplanting squash and most other members of the Cucumber family as roots of young plants are easily damaged.

When transplanting or direct seeding, plant summer squash no earlier than March 10 to 30 in south Alabama; April 1 to 15 in central Alabama; and April 15 to May 10 in north Alabama. Make successive plantings of summer squash every 10 to 14 days throughout the summer and fall to ensure a steady supply of fruit. For plantings in the late fall, sow no later than 60 to 70 days before the first frost date.

Soil and Fertility

With proper care, summer squash can be successfully grown on most soils in Alabama. Avoid low, poorly drained soils. Well drained, sandy loams with high levels of organic matter and a pH of 6.0 to 6.5 are preferred. To avoid potential soil-borne diseases and nematode problems, plant summer squash in soils that have not grown a crop of watermelons, muskmelons (cantaloupes), pumpkins, or other members of the Cucumber family in the past 2 to 3 years.

Timely and appropriate applications of fertilizer can make a significant difference in the quality and quantity of fruit, and may promote earlier harvests. In the winter or early spring, collect soil samples from each area you intend to crop and have a soil analysis performed on each sample. Soil testing eliminates much of the guesswork involved in a fertilizer program. Be sure to apply lime several months prior to planting. Contact your county Extension agent for information on how to collect and submit a soil sample.

If a soil test is not done, a general recommendation is to apply enough fertilizer to supply 60 to 80 pounds of nitrogen (N), phosphorus (P2O5), and potassium (K2O). This can be done by applying 500 pounds of 8-24-24 in the row before planting; then sidedress with 30 to 40 lb. of nitrogen when the plants are 8 to 10 inches tall (3 to 4 weeks after planting).
Seeding Rate and Spacing

Prepare the land to ensure establishment of a uniform stand. Turn the soil in the fall or early spring so that crop residues fully decompose before planting summer squash. Early land preparation also allows time for weed seed to germinate, allowing for early cultivation to destroy young weeds.

Seed the summer squash to produce stands with plants spaced 18 to 24 inches apart in rows on 36 to 48 inch centers. Plant seeds ⅛ to ⅛ inches deep. To achieve the maximum stand, plant two to three seeds per hill and thin to a single plant leaving the healthiest seedling.

Direct seeding will require three to five pounds of seed per acre. Summer squash contain about 3,500 seeds per pound (220 seed/ounce). Use Table 1 to determine the number of plants per acre required at various spacings. Note: if you are using double-rows of plants within a bed such as with polyethylene mulch, the number of plants per acre will double at the various spacings in the preceding table. On plastic, plant double rows of summer squash per bed with plants spaced 18 x 18 inches.

Table 1. Spacing and Number of Plants Per Acre.

<table>
<thead>
<tr>
<th>Between row spacing</th>
<th>Spacing between plants 18”</th>
<th>20”</th>
<th>22”</th>
<th>24”</th>
</tr>
</thead>
<tbody>
<tr>
<td>36”</td>
<td>9,680</td>
<td>8,712</td>
<td>7,920</td>
<td>7,260</td>
</tr>
<tr>
<td>42”</td>
<td>8,297</td>
<td>7,467</td>
<td>6,788</td>
<td>6,222</td>
</tr>
<tr>
<td>48”</td>
<td>7,260</td>
<td>6,534</td>
<td>5,940</td>
<td>5,445</td>
</tr>
</tbody>
</table>

Varieties

Contact your county Extension agent for a copy of the latest edition of the “Spring Vegetable Variety Trials” from the Alabama Agricultural Experiment Station at Auburn University. In the report you will find information on the performance of selected summer squash varieties trialed in several locations throughout Alabama. As there are a large number of commercial varieties available, grow only those adapted to Alabama. It is advisable to grow a small trial plot of several varieties each year to determine which varieties are best suited to your growing conditions and marketing outlets.

Successful Pollination of Squash

The following information is adapted from Cucurbit Production and Pest Management, Circular E-853, Oklahoma Cooperative Extension Service, Oklahoma State University.

Cucurbit crops are highly dependent on active pollination by bees. Not only does adequate pollination increase yield, but good pollination may improve the earliness and quality of the crop. Because pollen is borne on male flowers, bees are essential to transfer pollen to female flowers. Cucurbit pollen is not effectively moved by wind.

Several factors play a significant role in effective pollination of a crop. Among these, weather is one of the most important. Bees are less likely to forage for nectar and pollen during bad weather. If poor pollinating conditions exist during the flowering period, additional beehives may have to be supplied to the crop above the recommended level in order to compensate.

A second factor in managing bees for pollination is the presence of “competing blooms” during the flowering period of summer squash. Most cucurbit flowers are poor sources of nectar and pollen. They may be less attractive to bees than adjacent flowering weeds or other crops. In such cases, crops which may attract bees away from summer squash during the blooming period should not be planted nearby (at least a ½ mile buffer is desirable). Similarly, destroy weeds adjacent to the crop which may serve as competing blooms before the crop begins to bloom. Although such wild flowers can be detrimental if they are blooming in mass at the same time as the target crop, their availability during other times helps assure that bee colonies are well nourished and remain healthy.

The use of domesticated honey bees is the most effective means to pollinate cucurbit crops. However, wild bees or feral honey bees can be extremely important as pollinators. Wild bees include several species of native, ground nesting bees that prefer pollen and nectar from squash and other cucurbits. The abundance of wild bees varies greatly by location and from year to year, making them less dependable than domesticated bees. For this reason, it is strongly recommended that managed honeybee colonies supplement any wild bee activity.

Fruit size and seed set of cucurbits are strongly related to bee activity as movement of pollen to female flowers by insects is essential for fruit production. Cucurbit flowers are open for only 1 day, and squash are usually open only in the morning. Because of the large size of flowers and pollen, the small honey bees do not pollinate squash as efficiently as do the larger native bees. The pollination requirement for squash and pumpkin is similar to cantaloupe; one bee per ten “female” flowers is considered the minimum level of activity to maximize production. A minimum of one honey beehive per acre is normally necessary to achieve this level of activity. Yield increases have been achieved with up to three hives per acre.
Irrigation

Whether you are using overhead or drip irrigation, provide sufficient water to the crop to ensure the production of high yields of quality fruit. In summer squash, irrigation is most critical when fruit are sizing and has very little tolerance to any degree of moisture stress. Water stress during fruit sizing will appear as pointed and missappened fruit which are unmarketable. Irrigation can greatly increase yields.

Mulching and Drip Irrigation

Using polyethylene (black plastic) mulch offers several advantages to growers. Black plastic mulch increases the soil temperature earlier in the growing season and conserves moisture. It also reduces several common problems: soil compaction and crust; ground rot of fruit; fertilizer leaching; drowning of crops; evaporation; and competition from weeds.

These benefits promote increased quality and quantity of fruit yields, as well as earlier production, especially when used in combination with transplants. The use of transplants with plastic mulch generally results in harvests that begin 7 to 14 days earlier in comparison to bare ground production.

Although using mulch will increase production costs, increased profits from earlier and larger yields offset those costs. Drip irrigation systems must be used with plastic mulch. In addition, growers can plant multiple crops (double-cropping) into the plastic mulch provided care is taken to avoid excessive damage (tears, holes, etc.) to mulch. With summer squash, double rows of plants within each row can be used. Be sure to place drip tape down the middle of the bed, buried 2 to 3 inches deep. Contact your county Extension agent for more information regarding the use of plastic mulch and drip irrigation.

Weed Control

Chemical weed control options for summer squash are very limited. Most herbicides registered for use provide annual grass and small-seeded broadleaf weed control (pigweed), but do not control large-seeded broadleaf weeds such as sicklepod, annual morningglory, or common cocklebur. Refer to Extension publication ANR-500-A, *Alabama Pest Management Handbook—Volume 1*, for a listing of herbicides currently registered for summer squash. For better weed control select locations with low weed populations and no perennial weed problems such as nutsedge; use mechanical cultivation between rows; and use production practices which encourage rapid development of squash. When using mechanical cultivation, only cultivate the soil to a 1 to 2 inch depth as summer squash are shallow rooted and sensitive to root pruning. Some hand weeding may be needed.

Insect Management

A variety of insects can have an impact on cucurbit (squash, cucumber, melons) production in Alabama. Often, they occur as pests, but the benefits from some insects, like bees, are essential for successful production of cucurbit crops (see section above on pollination). Therefore, take care to preserve populations of beneficial insects when developing a pest management program. Please refer to Extension publication ANR-500-A, *Alabama Pest Management Handbook—Volume 1*, for a list of insecticides currently labeled for use in summer squash.

Insect Scouting Methods

Depending on location in the state and when the crop is planted, insect problems in squash may vary from non-existent to severe. Identifying the pest and understanding its potential for damage is necessary when selecting appropriate control methods. All pests do not respond the same way to a given control method. Monitor fields at least once per week. Walk a “V” or “W” pattern through the field and select plants from 10 random locations along the pattern. When plants are still small (up to 10 leaves), examine five adjacent plants per location for insect and disease pests. As plants get larger, sample two leaves per plant on five adjacent plants per location (total of 100 leaves). Using a hand lens helps detect small pests like aphids and spider mites.
Soil Insects

Feeding damage by soil insects is usually detected early in the season, when plants are young and not fully established, and can result in poor stands. Soil insects may also destroy seedlings as they begin to germinate. Feeding on young roots by soil insects such as whitefringed beetle grubs, white grubs (larvae of May beetles), wireworms and larvae of cucumber beetles reduces nutrient and water uptake causing plants to wilt and die. Cutworms also feed on roots or they may cut young stems above the soil line. White grubs and wireworms are most abundant in “new land,”—fields which were previously in pasture, planted to a grass crop, or left fallow with large weed populations.

Make the decision to treat for soil insects on the basis of field cropping history and the potential of the field to have pest problems. A pre-planting application of a soil insecticide is recommended if summer squash is planted in an area previously in pasture or was infested with weeds. If cutworm damage is suspected, check the soil around the plants for dark caterpillars that roll into a “C” shape when disturbed. Control cutworms after planting by using a recommended insecticide spray directed towards the base of the plants.

Cucumber Beetles

Spotted and striped cucumber beetles can attack young seedlings as soon as they emerge preferring to feed on cotyledons and stems. The beetles are yellow to greenish-yellow, with black spots or stripes (Figure 1). If beetles are numerous, feeding damage may weaken or kill seedlings, resulting in stand loss. Aside from stand loss, beetles also carry and transmit bacterial wilt disease which can affect squash, cantaloupe, and cucumber. It is thought that beetles pick up the bacteria from adjacent weeds and carry it into cucurbit fields. Infected plants exhibit wilting symptoms. Younger plants, before bloom, are most susceptible to the disease and die rapidly after infection. Older plants are not affected as adversely as younger ones.

The critical period for cucumber beetle control is within the first 2 to 3 weeks after plant emergence. Apply a recommended insecticide if beetles are detected on plants during this period, particularly if the field has a history of bacterial wilt disease. Alternatively, use row covers to protect plants from beetles during the period from emergence to bloom. Weed control reduces the amount of bacterial wilt inoculum transmitted by beetles.

Squash Bug

Squash bugs cause damage with their piercing-sucking mouth parts. Adults emerge in the spring from overwintering sites in field debris, along field borders, or in nearby woods. The adults are about ½ to ¾ inch long and dark- to gray-brown in color (Figure 2). The tops of their bodies are flattened, with wings not completely covering the orange and brown edges of the abdomen. Eggs are laid in a mass, usually on the leaf underside, and turn metallic bronze in color within a few hours. Newly-hatched squash bugs (nymphs) are wingless and pale-green to white, with reddish-brown heads and legs (Figure 2). Older nymphs are gray with black legs.
Adults and nymphs suck sap from the plant. If feeding is severe the leaves turn brown and die. Vines that are fed upon wilt from the point of attack to the end of the vine. Large populations of squash bugs can cause plants to wilt under hot, dry conditions. However the plant can recover if squash bugs are controlled in time. Feeding may also occur on squash fruit, causing deformities.

There are two critical periods for management of squash bugs—the seedling stage and the early flowering stage. Monitor newly planted squash fields for squash bug adults and/or wilting of plants. If wilting is observed, check the underside of leaves for squash bug adults or for evidence of their feeding. An application of a pyrethroid insecticide will control adults during this stage.

Once plants are established, monitor at least once a week for adults and eggs. A foliar insecticide application is recommended if the average number of egg masses per plant before or after flowering exceeds 1 per plant. Time sprays to kill small nymphs, which are more susceptible to insecticides than older nymphs and adults. Good spray coverage is important (at least 30 GPA by ground application) for effective control with insecticides.

Removal and destruction (shredding and disk ing) of crop debris after harvest reduces overwintering squash bug populations. Hand destruction of adult squash bugs and egg masses is effective in home gardens. Place boards on the ground near squash plants to trap squash bugs. The bugs gather under the boards at night. Collect and destroy them the next morning.

**Pickleworm**

Pickleworm is one of the most damaging insect pests attacking squash and other cucurbits in Alabama. It is a more severe pest in the southern counties of Alabama since it does not overwinter above northern Florida. Because pickleworm is a migratory species, greater infestations are found in later-planted cucurbits in central and north Alabama. Early plantings in these areas often escape damage. Pickleworm development is mostly restricted to cucurbit crops (squash, cucumber, zucchini, watermelons) and to weeds in the cucurbit family.

The pickleworm moth is small, and the body and wings are yellowish brown with a purplish sheen. The wings have a broad, light brown border. The tip of the abdomen contains dark, brush-like hairs that are waved in the air when the moth is resting. Pickleworm moths fly mostly between dusk and early morning, and are not usually seen in fields during the day. Female moths lay eggs on leaf and flower buds, leaves, stalks, and young fruit. Young pickleworm larvae are a pale, yellowish-green with many black spots. Older larvae are yellowish-green or coppery with no spots and a brown head (about ¾ inch long) (Figure 3).

Newly hatched larvae can feed on leaves, but prefer to move into protected areas like developing leaf and flower buds and stems. Young larvae may also create a “feeding chamber” by rolling up young leaf tissue or boring into stems. Later, mature larvae tunnel into vines and fruit (Figure 3). Pickleworms may reduce fruit set due to feeding on leaves and flowers. Feeding tunnels in fruit reduce quality and introduce secondary fungi and bacteria. Because of a low tolerance for fruit damage, particularly in the pickling cucumber industry, treatment thresholds are very low. However, because pickleworm do not overwinter to any great extent in Alabama, moths relocate to fields each year. Therefore, insecticide controls, particularly in early plantings, may not be necessary during each season.

**Figure 3. Pickleworm larvae and characteristic damage on fruit.**

Scouting for pickleworm larvae is the best method to determine whether insecticide sprays are needed. Scout at least once a week and begin when plants are still small before the flower buds form. Scouts can detect pickleworm larvae by opening up the newly developing leaf and flower buds. This should be done in approximately 10 to 20 representative locations in each field. At each location, examine the foliage on 12 to 18 feet of row. A 10X hand lens will be helpful to detect small larvae.

If larvae are detected, a labeled insecticide (such as Asana XL; 6-9 fl. oz per acre) is recommended at 7 to 10 day intervals; 7 day intervals for heavy infestations and 10 day intervals for lighter infestations. Refer to Extension publication ANR-500-A, *Alabama Pest Management Handbook—Volume I*, for insecticide recommendations and harvest interval restrictions.

Scouting is important because it provides growers with knowledge about pickleworm presence and density that can be used to determine if insecti-
icide sprays are needed. If scouting is not feasible, growers can decide not to treat and risk damage, or they can apply insecticides and risk making unnecessary treatments.

If insecticide treatments are applied for pickleworm “prophylactically” without scouting, begin spraying when the first flower buds are present, but before the flowers open. Studies in Alabama indicate that if pickleworm is present, delaying sprays until the open flowering stage will not protect fruit from damage. This is likely because larvae may already be inside the leaf or flower bud tissue and protected from sprays by the time the flowers begin to open.

Squash Vine Borer

Squash vine borers are usually more of a problem on squash grown in home gardens than in large, commercial fields. There is usually no need for vine borer control in fields with no history of vine borer infestation. However, vine borer damage is usually not noticed until after the damage is done.

The adult vine borer is a “clear-wing” moth that resembles a wasp more than a moth. The body is reddish-white, with black bands on the abdomen. Females lay eggs at the base of the plant and the emerging larvae enter the plant stems just above the soil line. Larvae feed inside the stem or vines resulting in wilt and eventual death of occupied parts of the plant (Figure 4). Infested stems can be identified by entry holes with piles of “frass” or excrement. Squash vine borers prefer squash varieties with large-diameter stems, such as Hubbard.

In areas with a history of vine borer problems, monitor plants regularly for the presence of borer frass and entry holes. If frass is found, split stems to check for presence of young borers. If young larvae are detected, further infestation by hatching larvae may be reduced by two insecticide applications spaced 5 to 7 days apart. In home gardens, remove larvae by hand and place soil around the stem to facilitate new growth. Plantings in late summer or fall usually escape vine borer infestations.

Aphids

Aphids are small, soft-bodied insects, usually green or red, with piercing-sucking mouth parts. Developing aphid colonies are usually found on new growth or on the underside of leaves. Infested leaves may be distorted or cupped in appearance. If numerous, aphids can cause direct damage to plants by their feeding, or their production of honeydew (syrupy excrement) and accompanying “sooty-mold” that may cover fruit. The main damage to crops, however, results from the many plant viruses that they can transmit.

Fortunately, aphids have many parasite and natural predator enemies that help keep populations in check. Application of insecticides that wipe out natural enemies may actually result in increased numbers of aphids. Insecticides are not effective in preventing aphid transmission of viruses because the virus is passed very quickly to the plant, before the aphid is killed by contact with the insecticide.

Insecticides are only recommended to control aphids if they are present in sufficient numbers to cause direct damage to plants. An insecticide application is warranted if aphids are present on 10 to 20 percent or more of leaves, and their feeding is causing obvious stress to the plants.

Cultural or mechanical control methods are usually more effective than insecticides for aphid and virus management. Elimination of weeds in and around crop fields that may be alternate hosts for aphids and for viruses will decrease their chances of movement into the squash. The use of reflective mulch under squash repels aphids from young plants delaying infection of aphid-transmitted viruses.

Virus effects on fruit yield and cosmetic quality are much less severe if infection occurs after plants have set fruit. Covering plants with row covers until bloom will protect young plants from aphids and virus infection. Late summer or fall plantings of squash are more likely to experience severe virus problems than are earlier plantings.

Spider Mites

Mites are not insects, but are more closely related to spiders. They are tiny, about 1/25 to 1/50 inch long, and are either red in color or whitish-yellow with black spots on either side. They feed by sucking sap from plants, and are almost always located on the underside of leaves. They are easily seen with a hand lens, along with their round, yellow eggs and webbing that they produce.

Figure 4. Squash vine borer and characteristic damage on fruit.
The first signs of feeding is the appearance of light-colored specks on the upper leaf surface. Leaves turn yellow, then bronze, and eventually turn brown and dry-up. Once mite populations become large with large amounts of webbing and plant damage, they are nearly impossible to control. Hot, dry conditions favor mite development. Mites, lifted by wind currents, “float” onto plants using their silk as a parachute.

Mite infestations usually begin on field borders. Check field borders regularly, particularly during hot, dry weather. Plants that become covered with dust raised by vehicular traffic are also more prone to severe mite infestations. If mites are found along a field border, examine the interior of the field to see how far the infestations has spread. If only the border is affected and conditions favor mite development, spot-treat the border and about 100 feet beyond the infestation with a recommended miticide.

Some insecticides, particularly carbamate and pyrethroid insecticides, can worsen mite problems by destroying natural enemies. Insecticidal soap is effective for control of soft-bodied pests like aphids and mites without destroying natural enemies.

**Cucurbit Diseases, Nematodes, and Their Control**

**Downy Mildew**

Downy mildew, caused by the fungus *Pseudoperonospora cubensis*, attacks most commonly grown cucurbits in Alabama. The disease can be confused with symptoms of powdery mildew on squash. However, the two diseases are favored by different weather conditions.

**Symptoms.** The first symptom of downy mildew is the appearance of pale green areas on the upper leaf surface, which may be confused with symptoms of a mosaic-type virus. These areas eventually turn into angular (limited by leaf veins), yellow to tannish-brown spots (Figure 5). During periods of wet weather the corresponding lower leaf surface may show a white to grayish-purple mold. Spots may enlarge rapidly during warm, moist weather, causing the leaves to wither and die. Dead leaves often remain erect while the edges of leaf blades curl inward.

Downy mildew first infects the older crown leaves, usually about the time of fruit set. Severe infections result in defoliation, stunted plants, and poor fruit development. Symptoms of downy mildew do not occur on squash fruit.

**Transmission and Persistence.** The fungus survives season to season in contact with a cucurbit host. Also, air currents can carry spores of the fungus long distances. Spread of the disease within a field is usually by wind, rain, insects, or by contact with field workers or tools. The disease develops very rapidly in moderate to warm temperatures (between 61°F and 72°F) provided there is moisture on the leaves. Fog, dew, frequent rains, and high relative humidity provide conditions favorable for disease development. Extended periods of hot dry weather reduce the severity and spread of the disease.

**Control.** Practices that reduce leaf wetness and lower relative humidity within the plant canopy will reduce disease development. Choose planting sites with all-day sun, good soil drainage, and free air movement. Increase row spacings to avoid dense plant canopies. Avoid overhead irrigation. Maintain adequate, but not excessive, nitrogen levels to help reduce damage from downy mildew.

A fungicide program is usually necessary to control downy mildew when favorable weather conditions persist. Fungicides with the active ingredient metalaxyl, chlorothalonil, maneb, mancozeb, or copper are effective in controlling downy mildew. When using a fungicide it is important to get good coverage on the lower leaf surfaces, since infections commonly occur on the underside of leaves. Follow all of the manufacturer’s label directions and restrictions when using any pesticide.

**Powdery Mildew**

Powdery mildew, caused primarily by the fungus *Erysiphe cichoracearum*, may attack all cucurbit crops. The strain of powdery mildew that attacks cucurbits does not attack other crops. When uncontrolled, the disease can reduce yields significantly by reducing the number and size of fruit as well as the length of time a crop can be harvested. Powdery mildew is a common problem on summer squash in Alabama.

**Symptoms.** Powdery mildew first appears as pale yellow spots on stems, petioles, and leaves (Figure 6). These spots expand and merge and become covered with a superficial, powdery, white to gray fungal growth. This white growth may also appear on the lower leaf surface (Figure 7). Mature, fruit bearing plants are usually affected first and the older, shaded leaves are most susceptible. Severely infected leaves gradually turn yellow, then wither and die becoming brown and papery. Early leaf drop results in fruit of poor quality. Fruit may be malformed, sunburned, and ripen prematurely resulting in poor flavor and texture. Under favorable conditions an entire field may appear white from mildew within a week.

**Transmission and Persistence.** The powdery mildew fungus commonly overwinters on weeds. The disease spreads from plant to plant by insects and farm machinery. Air currents can carry spores of the fungus long distances. Infection can take place when the leaves are dry although high humidity (50 to 90 percent) is necessary for infection to occur. Disease
development is favored by excessive plant growth, moderate to high temperatures, low light intensity, and dews.

**CONTROL.** The principal control measures for powdery mildew are the use of resistant varieties and timely applications of fungicides. A few summer squash varieties with resistance to powdery mildew are available. Consult current seed catalogs and trade publications for varietal availability. Weed control and good sanitation practices will help control powdery mildew. Crop rotation has no beneficial effect on managing this disease.

Apply a recommended fungicide beginning when symptoms of powdery mildew are first observed. Continue applications at 7 to 14 day intervals throughout the season. Fungicides with the active ingredient benomyl, chlorothalonil, or triadimefon are effective in controlling powdery mildew. Thorough coverage of the foliage is essential for good control. Adequate management requires that the fungicide reach the underside of leaves and the lower part of the plant. Always follow the manufacturer’s label directions and restrictions when using any pesticide.

**Choanephora Wet Rot**

Wet rot, caused by the fungus *Choanephora cucurbitarum*, is a fruit rot of summer squash.

**SYMPTOMS.** Fruits rot rapidly and white fungal mold appears on the infected area. With time, fruit look like a pin cushion with numerous small, black-headed pins stuck in it (Figure 8). Initially, the heads are white to brown but turn purplish-black within a few days. Affected flowers, pedicels, and immature fruit become water-soaked, and a soft, wet-rot develops. An entire fruit can rot in a 24 to 48 hour period. Symptoms usually begin on the blossom end of the fruit.

**PERSISTENCE AND TRANSMISSION.** The fungus overwinters as a saprophyte (living on dead plant tissue) and/or in a dormant spore form (such as a chlamydospore or zygospore). In spring, fungal spores are spread to squash flowers by wind and by insects such as bees and cucumber beetles. Infection occurs through the blossom, into the fruit and stem. Development of wet rot is favored by high relative humidity and excessive rainfall.

**CONTROL.** There are no effective control practices available for wet rot at this time. Fungicide sprays are impractical because new blossoms open daily and need to be protected soon after development. Drip
irrigation may reduce development and spread of the disease during dry seasons.

**Mosaic Viruses**

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

**Cucumber Mosaic Virus (CMV)**

**SYMPTOMS.** CMV attacks more than 40 families of plants worldwide, including all vine crops. Strains of CMV differ in their host range, symptoms, and method of transmission. Cucurbits are susceptible at any stage of growth.

When plants become infected in the six- to eight-leaf stage, symptoms first appear on the youngest, still expanding leaves. A mosaic pattern develops (healthy dark green leaf tissue intermingled with light green and yellow tissue). Leaves are often distorted, crinkled, curled, and stunted. Vines may appear bushy due to the shortening of the internodes. In severe cases, older leaves may die. Typical mosaic symptoms develop only on actively growing leaves.

When a plant becomes infected at mid-season, previous growth remains normal and produces healthy fruit. Few fruit set on plants infected early in the growing season. Fruit that do set are often of poor quality and may be mottled green and yellow or have dark green warts (Figure 9).

**PERSISTENCE AND TRANSMISSION.** CMV survives in close to 800 species of plants, including many weeds found in Alabama. These weeds often act as reservoir hosts and allow the virus to overwinter. CMV is spread and transmitted by more than 60 species of aphids.

**Squash Mosaic Virus (SqMV)**

**SYMPTOMS.** SqMV affects most cucurbits but is rarely a problem in watermelon. Initial symptoms on squash include yellow spotting of the younger leaves. Infected leaves cup upward and develop a light to dark green mosaic pattern. Squash leaves may become distorted (Figure 10) and fruit are often malformed with raised, dome-like swellings.

**PERSISTENCE AND TRANSMISSION.** SqMV overwinters in weeds, seed, and cucumber beetles. Cucumber beetles are efficient vectors of SqMV, spreading the virus during feeding.

**Watermelon Mosaic Virus (WMV)**

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

**PERSISTENCE AND TRANSMISSION.** WMV overwinters in seed or infected weeds. In spring, the virus is spread by many species of aphids. Later plantings risk greater damage as disease incidence and aphid populations increase during the growing season.

**CONTROL OF CMV, SqMV, AND WMV.** Control of mosaic viruses in squash begins with eradication of biennial and perennial weeds and wild reservoir hosts in and around gardens and fields. Applications of insecticides to prevent the buildup of large aphid and cucumber beetle populations, as well as other insects, may reduce virus incidence and spread. When possible, plant certified virus-free seed and plant resistant varieties. Isolate later planting as far away as possible from earlier settings, especially if virus incidence was high. Removing infected plants when symptoms first appear may reduce or delay spread of the virus. Reflective mulches and row covers also reduce damage from insect transmitted viral diseases.
Root-Knot Nematodes

Root-knot nematodes, *Meloidogyne* spp., can attack cucurbits as well as more than 2,000 other species of plants. Nearly 40 species have been described. Nematodes damage the root system by disrupting the flow of water and nutrients and by producing wounds that give access to soil-borne diseases.

**Symptoms.** When root-knot nematode populations are high, plants are often stunted and may wilt during dry conditions or during the hottest part of the day. Root-knot in the field is easily detected by examining roots of symptomatic plants. The nematodes cause knots or galls to develop on both large and small roots (Figure 11). Knots range in size from the head of a pin to 1 inch in diameter.

**Persistence and Transmission.** Root-knot nematodes have a wide host range that includes summer squash and many other cultivated crops as well as many weed species. The nematodes survive in the soil from year to year and become active as soil temperatures increase in the spring.

**Control.** Crop rotations with grasses or nematode-suppressive crops and clean fallowing during the off-season will reduce nematode populations (see Extension publication ANR-856, “Nematode Suppressive Crops”). Soil fumigation is an effective means of reducing damaging population levels temporarily (one growing season). Soil solarization is effective in reducing nematode populations when environmental conditions are favorable for its use. See Extension publications ANR-30, “Nematode Control in the Home Garden,” ANR-500-A, *Alabama Pest Management Handbook—Volume 1*, and ANR-713, “Soil Solarization for the Control of Nematodes and Soil-Borne Diseases.”

**Harvesting**

Pick summer squash when they are shiny, young, and tender (as immature fruit). This generally requires harvesting every other day. Under exceptional growing conditions, plants may need to be harvested daily. Take care to prevent cuts and bruises to fruit. The skin of the young squash fruit is easily damaged. It is best to cut fruit from plants rather than pulling or twisting it.

The first squash harvested from a planting are generally the best quality. Plan to harvest any given planting only 2 to 3 weeks and then start harvesting from another planting as quality decreases as plantings age. This will ensure that harvested fruit is of high quality. A good yield of summer squash is 300 cwt./acre. Table 2 lists the approximate number of days from pollination to market maturity for several types of summer squash under warm growing conditions.
Storage

The following recommendations are adapted from *The Commercial Storage of Fruits, Vegetables, and Florist and Nursery Stock*, 1986, USDA, Agricultural Handbook No. 66.

Summer squash are quite perishable, as its skin is tender and easily wounded in handling. Normally fruit is not stored except for normal delays in marketing such as holidays and weekends. Fruit can be held 1 to 2 days below 41°F with no discernible damage. Avoid prolonged storage since summer squash are chilling sensitive (damaged by exposure to low temperatures). Holding summer squash longer than 4 days at 32°F will cause chilling damage (surface browning, pitting) and rapid deterioration of the fruit. The recommended storage temperature range is 41°F to 50°F with 95 percent relative humidity. The storage life is only 1 to 2 weeks.

<table>
<thead>
<tr>
<th>Type of squash</th>
<th>Time to Market Maturity (days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crookneck</td>
<td>6-7*</td>
</tr>
<tr>
<td>Straightneck</td>
<td>5-6*</td>
</tr>
<tr>
<td>Zucchini</td>
<td>3-4*</td>
</tr>
</tbody>
</table>

*for a weight of 0.25 to 0.5 lb. per fruit
Use pesticides only according to the directions on the label. Follow all directions, precautions, and restrictions that are listed. Do not use pesticides on plants that are not listed on the label.

The pesticide rates in this publication are recommended only if they are registered with the Environmental Protection Agency and the Alabama Department of Agriculture and Industries. If a registration is changed or cancelled, the rate listed here is no longer recommended. Before you apply any pesticide, check with your county Extension agent for the latest information.

Trade names are used only to give specific information. The Alabama Cooperative Extension System does not endorse or guarantee any product and does not recommend one product instead of another that might be similar.

For more information, call your county Extension office. Look in your telephone directory under your county's name to find the number.

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