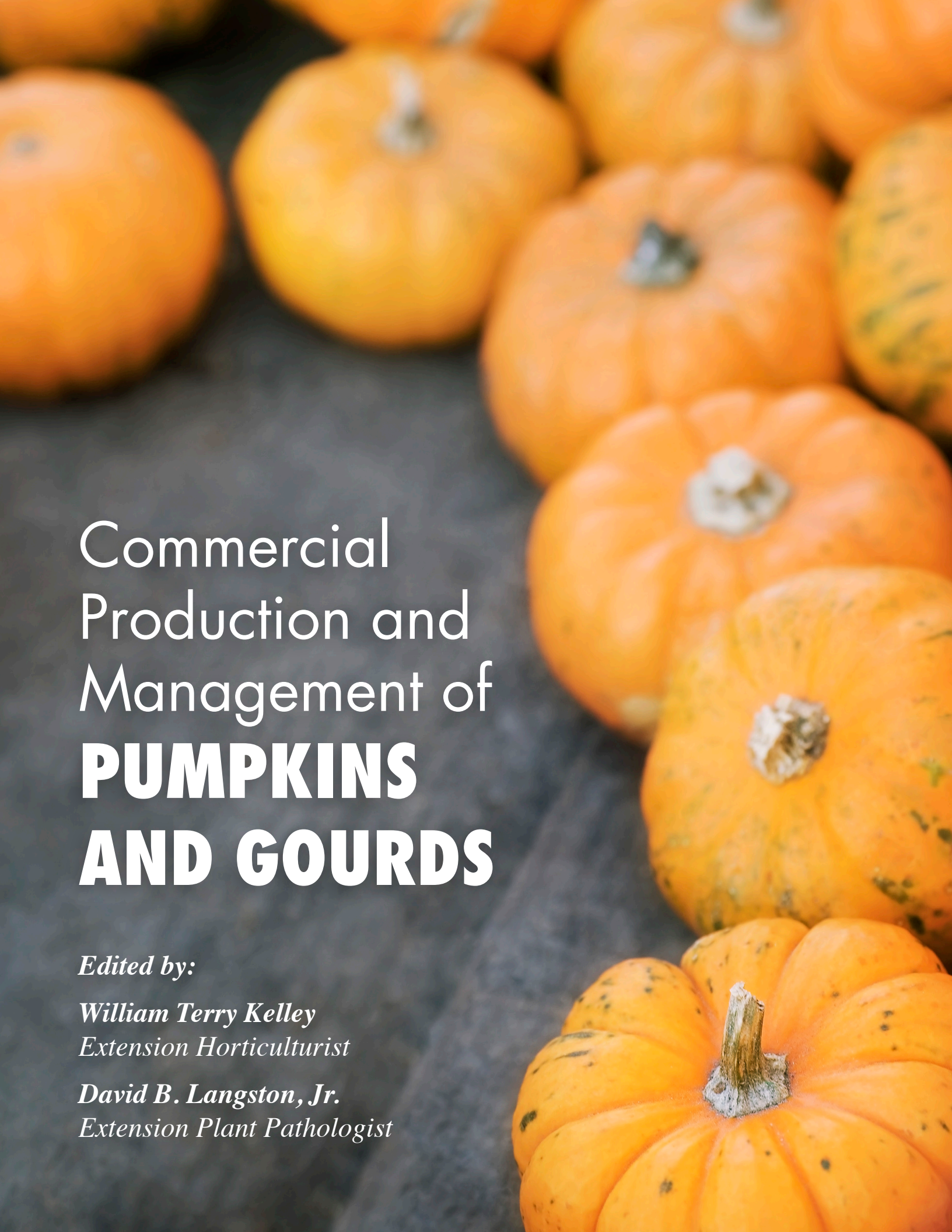

Commercial Production and Management of **PUMPKINS AND GOURDS**

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Foreword

This publication is the result of a joint effort among four of the disciplines in the University of Georgia College of Agricultural and Environmental Sciences that serve the Georgia vegetable industry. The seven topics covered in this bulletin are all integral parts of a successful pumpkin/gourd management program. Each topic is designed to focus on a particular aspect of production and provide the latest management technology for that phase of production. It is hoped that the information contained in this publication will assist growers in improving profitability. Chemical pest control recommendations are subject to change from year to year and, thus, only general pest control guidelines are mentioned in this publication. Growers are urged to consult the current *Georgia Pest Control Handbook* or check with their local county extension agent regarding the most recent chemical recommendations. Mention of trade names in this publication is not an endorsement of a particular product nor a lack of endorsement for similar products not mentioned.

Acknowledgements

The authors would like to express their gratitude to the following persons without whose help this publication would not have been possible: Mrs. Jan Howell, Department of Biological and Agricultural Engineering; Mrs. Kay Dunn, Department of Horticulture; Mrs. Soccoro Seela, Department of Entomology; Mrs. Priscilla Dolney, Department of Biological and Agricultural Engineering; Mrs. Machelle Clements, Department of Plant Pathology; and Dr. Johnny Dan Gay, former Extension Plant Pathologist.

Table of Contents

Botanical Classifications, Origins and Uses

William Terry Kelley, Darbie M. Granberry and George E. Boyhan
Extension Horticulturists

Both pumpkins and gourds are members of the cucurbit family – *Cucurbitaceae*. Other vegetables in this family include watermelons, squash, cucumbers and cantaloupes. The cultivation of both plants predate colonial America. In fact, gourds were probably one of the first plants domesticated by man and were used for utensils as early as 2400 B.C. Remains have been found in the southwestern United States, Peru and Mexico; some date back to 7000 B.C. Remains found in South America date back to 13,000 B.C. Native Americans cultivated pumpkins before the arrival of European settlers to the Americas. Although members of the same family, cultivated species of pumpkins and gourds vary widely; there is, however, some overlap.

Pumpkins

The origins of the pumpkin can be traced to the southern regions of North America and the northern regions of South America. Botanically pumpkins and squash are quite similar since varieties of both can be found in *Cucurbita pepo*, *C. argyrosperma*, and *C. moschata* species. *C. maxima* is also a species of pumpkin generally associated with the larger pumpkins.

Mature and immature fruit of the pumpkin are generally edible. However, a large portion of the commercially produced pumpkins are used for decorative purposes. The use of the pumpkin as a jack o' lantern during Halloween has a long history in the United States.

Characteristics of Various Species Of Pumpkins

Cucurbita pepo - Most of the traditional and naked-seed type pumpkins are included in this classification. Naked seed types include Eat-All, Lady Godiva and Trick-or-Treat. Traditional varieties in this classification include most of the small to large types excluding the giant pumpkins. Varieties in this category include Connecticut Field, Howden's Field, Spirit, Small Sugar, Funny Face and Jackpot.

Cucurbita moschata - Varieties such as Dickinson Field, Golden Cushaw and Kentucky Field are in this classification.

Cucurbita maxima - This classification is characterized by its large fruit and includes the mammoth and giant varieties including Big Max, Mammoth Prize and Atlantic Giant.

Cucurbita argyrosperma - Few commercial varieties are produced from these varieties which include Green-Striped Cushaw, Japanese Pie, Tennessee Sweet Potato and White Cushaw.

Gourds

There are two groups of gourds that are distinguished by a variety of botanical attributes. *Lagenaria* gourds likely originated on the African continent where the greatest diversity of gourd forms are found. However, ancient remains of gourds have been found in South America as well, and varied explanations exist as to how the species was spread to that region. *Cucurbita sp.* gourds are believed to be native to North America.

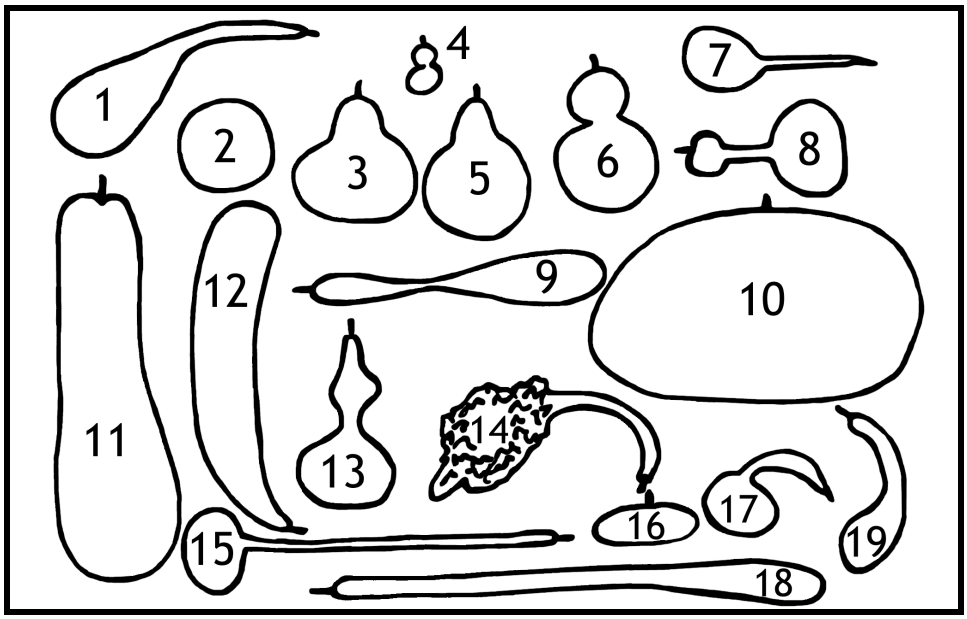
The gourd has a storied history of use in both practical as well as decorative purposes. Until the advent of indoor plumbing, most drinking wells in the United States were equipped with a long-handled dipper gourd. Gourds were used in ancient times as containers in which to bury food, as masks, as protection from the sun, and as bowls, pipes and musical instruments. Present day use of the gourd has expanded to birdhouses, and one type is used to produce a very popular natural sponge. Immature fruit of some types are edible, but the predominant use continues to be for decorative purposes or other uses mentioned above.

Characteristics of Various Classifications Of Gourds

A. Plants that produce yellow flowers (also produce fruits damaged by frost or cold weather). These are the *Cucurbita sp.* gourds, which are mostly thick-shelled and difficult to cure.
   1. *Cucurbita pepo* var. *ovifers* - These fruits are generally small and have a variety of shapes and colors and are not edible. The leaves have prominent lobes with a prickly surface. Seeds measure ½-1 inch long, are fairly flat and cream-colored with a rounded or horizontal scar. Flowers are large but somewhat hidden by foliage. They open early in the day and whither by midday. Most of the common ornamental gourds are in this group and include:

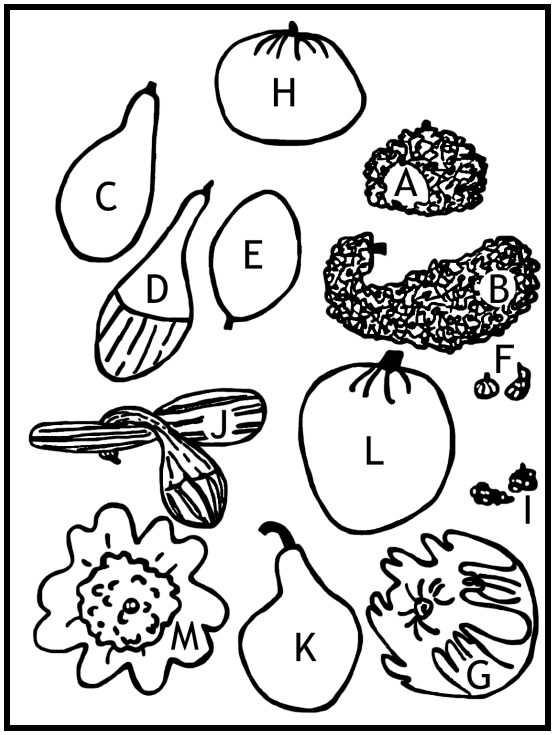
Egg	White Pear	Apple	Broad Striped
Striped Pear	Ladle or Scoop	Mock Orange	Bicolor Pear
Bell	Spoon	Big Bell	Miniature

The Various Shapes and Sizes of Gourds



Hardshell Gourds

1. club, cave man's club, Hercules club; 2. basketball; 3. kettle; 4. miniature bottle; 5. Mexican bottle, birdhouse gourd; 6. bottle, dumbbell, Chinese bottle; 7. retort, siphon; 8. Indonesian bottle, Costa Rican bottle; 9. siphon, Japanese bottle, penguin; 10. bushel basket; 11. zucca; 12. Hercules club, calabash, sugar trough; 13. lump-in-the-neck bottle; 14. maranka, dolphin, cave man's club; 15. ball and chain, long-handled dipper, baton; 16. tobacco box, canteen, sugar bowl; 17. short-handled dipper; 18. baton, club, snake, longissima; 19. penguin, powder horn.



Ornamental Gourds

A. warted gourd; B. crooknecked warted gourd; C. pear; D. bicolor (top yellow, bottom green); E. egg; F. smooth miniatures; G. crown of thorns, finger gourd, ten commandments gourd; H. apple; I. warted miniatures; J. spoons; K. bell; L. orange; M. star

2. *Cucurbita maxima* - Fruits in this group are medium to medium large. The smaller types in this group have hard and durable shells. The leaves are rounded with irregular lobes. The flowers have a broad corolla. Seeds average $^5/_8$-1 inch in length and $^3/_8$ inch wide. Their color is creamy white with a slanting scar. Varieties in this group include Turks Turbin and Aladin.
3. *Curcurbita ficifolia* - Most fruits are melon shaped, vines are vigorous with fig-shaped leaves. Fruits are not everlasting but will keep for several months. Seeds are black, $^5/_8$ inch long. Flowers are yellow to light orange and measure 4 to 5 inches across. The Malabar Melon (also called Figleaf, Siamese or Angora gourd) is in this group.

B. Plants that have white flowers (fully mature fruit not damaged by frost).
1. *Lagenaria siceraria* - Vine growth is very vigorous. Leaves are large with a soft, velvety texture. Leaf margins are irregular but not lobed. Tendrils are long and forked. Vines have a musky scent. Flowers, which are perched on long, slender stems and have a sweet scent, bloom only at night and are pollinated by moths. Fruit size varies from medium small to very large. The mostly thin-shelled fruit can be dried to form a mostly empty shell. Seed size and color is too variable to delineate. Some forms include:

Bottle (Dumb-bell)	Giant African	Penguin
Dolphin (Maranka)	Dipper	Sugar Trough
Caveman's Club	Powder Horn	Kettle
Hercules Club	Giant Bottle	

C. **Vegetable Sponges** - Plants have yellow to white flowers, and the large staminate flowers occur in clusters while the pistillate flower occurs as a single flower. Immature fruits are green, ridged and turn a straw color when mature. Seeds are flat, similar to watermelon seed, colored black to blackish brown and are about $^5/_8$ inch long. Tendrils are branched and vines are vigorous.
1. *Luffa acutangula* (ridged luffa) - These produce club-shaped fruit up to 12 inches long with 10 sharp ridges. They produce a fibrous sponge that has less commercial value. Fruit are generally grown to be consumed at an immature stage.
2. *Luffa aegyptiaca* (smooth luffa) - This is the vegetable sponge plant, also called rag gourd, dishcloth gourd and Chinese luffa. This species is edible in the immature stage and is also called running okra.

Variety Selection and Culture

William Terry Kelley, George E. Boyhan and Darbie M. Granberry, Extension Horticulturists

Pumpkins

Choice of pumpkin varieties is based primarily on market intentions and local performance of specific varieties. Pumpkin varieties produce fruit that range in size from less than a pound to more than 1,000 pounds. Selection of the variety is based primarily on the size that the intended market desires. Retail sales can include a range of sizes, but those grown for wholesale will generally be medium to large. Generally the miniature sizes (< 1 pound) are used for decorative purposes. Pie pumpkins may come in many sizes but the 5-10 pound varieties are most often used. The 10-25 pound types can be used for processing but are the primary type used for the jack o' lantern market. Giant pumpkins may range from 25 pounds on up. Most of these will range in size from 25-75 pounds. It is unusual, but not impossible, to produce pumpkins in excess of 150 pounds in Georgia. The record-producing sizes of 800 to 1,000 pounds require specific production practices and are not grown for commercial production.

Other characteristics important in pumpkin variety selection include outer color, shape, vining habit and, of course, yield. Traditional orange colors and ribbed shapes are generally preferred except for specific markets. Pumpkin varieties may have vining, semi-vining/semi-bush or bush growth habits. The selection of growth habit is important in regard to the space that the grower has on which to produce the crop. Many open-pollinated pumpkin varieties perform well. Newer hybrids may produce a higher yield, particularly of the medium-sized pumpkins. There is little disease resistance currently offered in commercially available varieties. There are varieties now available with powdery mildew resistance. Some of the varieties that have proven to be successful in the Southeast are listed in Table 1.

Gourds

Gourd varieties are almost as numerous as gourds themselves. Indeed, even within varieties there can be considerable variation among fruit produced – even those produced on the same vine. For that reason many gourd seed are sold as a mixture of seed of various varieties. Most variety names describe the general appearance of the gourd that they are supposed to produce. Like pumpkins, gourds produced commercially will have to meet the demands of the intended market. Many small gourds are produced for decoration and arrangements. Larger gourds are often used for making decorative utensils or for painting/artwork. Still others are produced for sponges. Table 2 is a partial listing of varieties of gourds that are commercially available. There are many sources of gourd seeds. Always obtain seed from a reputable source to ensure the best results. Luffa seed may benefit from scarification by scratching the seed coats with sandpaper. Whether scarified or not, Luffa seed should be soaked in warm water for 24 hours prior to planting. Gourd variety names often describe the shape of the gourd. A diagram of several gourd shapes follows.

Table 1. Varieties of pumpkins with their growth habit, size and maturity that perform well in Georgia.

Variety	Habit	Hybrid/OP	Size (lbs)	Maturity
Pro Gold #500	vine	Hybrid	20-24	95 days
Appalachian	semi-bush	Hybrid	20-25	95 days
Aspen	semi-bush	Hybrid	16-22	90 days
Atlantic Giant	vine	OP	50-900*	115-125 days
Big Autumn	semi-bush	Hybrid	12-18	90 days
Casper	vine	OP	10-20	90 days
Frosty	bush	Hybrid	10-15	90 days
Funny Face	semi-bush	Hybrid	10-15	100 days
Merlin	vine	Hybrid	15-25	115 days
Magic Lantern	semi-vine	Hybrid	16-24	115 days
Jack-Be-Little	vine	OP	< 1	95 days
Lumina	vine	OP	10-12	90 days
Munchkin	vine	OP	< 1	85-100 days
Mystic Plus	semi-vine	Hybrid	7-8	105 days
Prizewinner	vine	Hybrid	100-300	120 days
Small Sugar	vine	OP	5-6	110 days
Spirit	semi-bush	Hybrid	10-15	95-100 days
Sweetie Pie	vine	OP	< 1	95 days
Trick or Treat	semi-bush	Hybrid	8-16	105 days
Autumn King	vine	Hybrid	20-25	105 days
First Prize	vine	Hybrid	50-200	120 days
Jumpin' Jack	vine	OP	20-24	120 days
Touch of Autumn	semi-bush	Hybrid	2-3	95 days
Gold Bullion	semi-bush	OP	18	110 days

*Sizes of this nature are unlikely in Georgia.

Table 2. Varieties of gourds with their descriptions.

Variety Name	Description
Birdhouse Gourd	long-handled neck; ball shaped bottom
Caveman's Club	club-shaped, wrinkled head, 15-18" long, 6" diameter
Calabash (Powderhorn)	short, curved neck; 12-15" long, 5" diameter, smooth, tan
Corsica Flat	round (6-12" diameter), flattened (3.5-5" height)
Cucuzzi	long and thin, edible at young stage
Dudhi (bottle)	round, early bottle gourd, light green
Harita (sponge, hybrid)	cylindrical, 9-12" long, light green, smooth
Italian	edible at young stage, 2-3 feet long, 4-5" diameter
Karela (bitter gourd)	dark green, 7" long, thick skin
Large Bottle	basically same as birdhouse
Large mix	mixture of large types such as birdhouse, snake, bottle, etc.
Luffa (angled, ridged)	eaten like okra at young stage; not best for sponges
Luffa, smooth short	tube-shaped, 6-8" long, 2-3" diameter
Luffa, smooth medium	tube-shaped, 10-12" long, 2-3" diameter
Luffa, smooth long	tube-shaped, 15-18" long, 2-3" diameter
Nest Egg Gourd	smooth, white, hard; similar in size and shape to ordinary eggs
Orange	round, smooth, bright orange; average 3" diameter
Pear Bicolor	pear-shaped, yellow upper half, green lower half
Shenot Crown or Thorns	thorn-like protuberances, round, various colors or striped
Small fancy mix	mixture of pear, nest egg, dipper, etc.; various colors and shapes
Small warted mix	mixture of color combinations and shapes, all warted
Spoon	curved, club-shaped, slender handle, solid or bicolor
Surekha (ridged hybrid)	thin-ridge gourds, 14" long; can eat raw like cucumber when young
Swan Gourd	necked fruit, wider near top; 14-18" long, 6-8" base (Goose gourd)
Turk's Turban	flattened (8-10" diameter), orange red, prominent turbans, striped

Climatic Requirements

Pumpkins and gourds are produced in a similar fashion with similar requirements, since they are so closely related. Both are warm-season annuals whose vines and immature fruit are sensitive to frost and chilling injury. They require a sunny environment as well as a long growing season of 80 to 130 days. Delay planting until the soil has warmed to 70-80 degrees F and the mean air temperature is 65-75 degrees F for good germination. Pumpkin and gourd seed may decay if planted into cold, wet soil. Pumpkins and gourds may be planted from mid-March through July in Georgia with earliest plantings in the southern part of the state and successively later plantings in middle and northern regions. In south Georgia, an early to mid-July planting will produce mature pumpkins by early October. In north Georgia, plant pumpkins in late May through June to achieve an October harvest. It is increasingly more difficult to grow pumpkins and gourds the farther south they are planted in Georgia due to increasing disease pressure.

Planting and Spacing

Pumpkins

Row width and spacing within the row can vary considerably depending on the type of equipment used, vining characteristics of the variety, and grower preference. Plant **populations** from 600 to 3,000 plants per acre are used for pumpkins. Bush type pumpkins may be planted in drills and thinned. Vining pumpkins should

Table 3. Plant spacings and population densities for pumpkins.			
	Spacings/Populations		
Vine Type	**In-row spacing**	**Between-row spacing**	**Population (plants/A)**
Bush	3-5 plants/8 row feet	5-8 feet	2,000-3,000
Semi-bush/vining	2-3 plants/8 row feet	8-feet	1,500-2,000
Vining	2 plants/8 row feet	8-12 feet	1,000-1,200

Table 4. Plant spacings and population densities for gourds.			
	Spacings/Populations		
Gourd Type	**In-row spacing**	**Between-row spacing**	**Population (plants/A)**
Cucurbita	2-4 feet	6-8 feet	1350-3500
Lagenaria	6-8 feet	10-15 feet	350-725
Luffa	12-18 inches	6-8 feet	3500-7000

be planted in hills. Pumpkins grown for competitive size contests may require as much as 2,000 square feet per plant. Plant spacings and densities are shown in Table 3.

The amount of seed required to plant an acre varies from 2 to 4 pounds, depending on the size of the seeds, the planting distances and the type of seeder. Cover the seed to a depth of about one inch. Slightly deeper planting may be required in light soils. Plant one or two seed per hill and thin pumpkins to the desired population when they are 4 to 6 inches tall. At the time of the year most crops are established in Georgia, direct seeded pumpkins are more vigorous and, except for early spring, are seldom transplanted.

Gourds

Row and hill spacing will also vary among gourd types, depending on the space required for particular varieties. Larger fruited gourds have 125-150 seed per ounce while smaller-fruited gourds will have 300-400 seed per ounce. The *Cucurbita sp.* vines will achieve a length of 12-15 and hills should be spaced four feet apart for larger types and two feet for smaller ones. *Lagenaria* vines can reach 20-30 feet in length. Plant spacings for the various types are presented in Table 4. Plant gourd seed approximately 1 inch deep. Gourds can benefit from the use of plasticulture. Although it is not necessary, increased water and fertilizer efficiency as well as better fruit quality can be achieved with this method. See University of Georgia Cooperative Extension Service Bulletin No. 1008 for more information on this type of culture. Although gourds can be grown from transplants started indoors to extend the growing season, transplanting is not recommended in Georgia.

Trellising and Pruning

Generally pumpkins are not trellised, but gourds can benefit from a well-constructed trellis. This can allow maximization of space by controlling vine growth as well as protecting the fruit from rot. Trellising also will allow production of fruit with more uniform shape and color and will allow longer gourds to grow straight.The most common trellis is a single overhead wire supported every 10 to 12 feet with a strong post (such as a 4" x 4"). Posts should be set at least 24 inches into the ground with at least 5 to 6 feet of post above ground. Vines can be trained to the trellis by tying a twine in a loose loop around the base of the plant when the plants are 12-18 inches tall. Tie the other end of the twine to the overhead wire. The vines can then be trained around the twine until they reach the wire. Secure the vines to the wire until tendrils develop to hold the vine in place. Gourds may also be grown on an arbor as long as it is no more than three to 4 feet wide.

Vines of *Lagenaria* and *Luffa sp.* can be pruned lightly to increase marketable yield per vine. The first flowers produced are generally male flowers. Appearance of female flowers is greatly influenced by weather conditions. Do not be concerned if the appearance of female flowers is delayed for several days after the first male flower appears. Most fruit are produced on the lateral branches, so pruning the main stem to encourage lateral

branch growth is a good idea. For *Lagenaria* gourds, remove the end of the main stem when it reaches 10 feet in length. The first three to four lateral vines can be removed on luffa gourds to increase yield. Do not prune gourds of the *Cucurbita* type. Pumpkins are generally not pruned.

Pollination and Seed

As with most cucurbits, gourds and pumpkins are monoecious, producing separate male and female flowers on the same plant. As a result they must have some pollinating agent present. It is a good idea to place one hive of bees for each acre of gourds or pumpkins to aid in pollination. Native bee populations are generally not prevalent enough to adequately pollinate a large planting. Avoid application of insecticides during the early and midday hours to prevent killing pollinating bees. Gourds and pumpkins require seven to 10 bee visits per flower for complete pollination. Flowers generally only remain open for one day. Incomplete pollination produces poorly developed fruit that is often unmarketable, and reduces fruit set and thus yield. Flowers of hardshell gourds open in late afternoon and evening and require pollination by nocturnal insects. They can also be hand pollinated by using a small paintbrush to transfer pollen from the male to female flowers. Consult University of Georgia Extension Bulletin 1106, *Pollination of Georgia Crop Plants* for more information on management of honeybees in pumpkins and gourds.

Some research has shown that in boron-deficient soils, fruit set may be enhanced by spraying 0.2 pounds of boron per acre in weekly applications beginning at first bloom and continuing during flowering. Boron can be appled with regular fungicide and insecticide sprays.

Many growers prefer to save seed from the previous crop for the following year's planting. For open-pollinated varieties this can work well. However, do not attempt to save seed from hybrid varieties since the fruit produced from those likely will NOT resemble the fruit from which they were saved. Since both crops are cross-pollinated, they are subject to pollination by other related crops in the vicinity. Fruit will generally be true to type designated on the seed packet and cross-pollination with other varieties or types will not affect the fruit on the current year's crop. However, to maintain a true breeding stock, separate cross-pollinating varieties by at least a quarter mile. Not all varieties of pumpkins and gourds will cross pollinate with other pumpkins, gourds or squash. See Table 5 for a reference of those varieties that are likely to cross pollinate with one another. Pumpkins and gourds will not cross pollinate with cucumbers, muskmelons or watermelons.

To save seed of non-hybrids, select mature fruit and separate seed from the pulp. Spread seed on paper or absorbent cloth until dry. Store seed in a cool dry place until time for planting. Gourd and pumpkin seed should be viable for 3-5 years when stored under proper conditions.

Table 5. Cultigens of Pumpkins and the Cultigens of Squash and Gourds with which They Will Most Readily Cross *

Genus and Species	Gourds and Ornamentals**	Cultigen		
		Squash		
		Summer	*Winter*	*Pumpkin*
Cucurbita pepo	Apple	**Yellow Elongated Types**	**Acorn Types**	**Naked Seed**
	Bicolor	Butterbar	Acorn	Eat-All
	Bird Nest	Crookneck	Ebony	Lady Godiva
	Crown of Thorns	Eldorado	Table Ace	Triple Treat
	Miniature	Goldbar	Table King	
	Miniature Bottle	Golden Girl	Table Queen	Standard Type sold
	Orange	Golden Zucchini		Big Tom
	Pear	Straightneck	**Novelty Types**	Cinderella
	Spoon		Veg. Spaghetti	Connecticut Field
	Warted	**Flat-Shaped Types**	Veg. Gourd	Early Sweet Sugar
	Other Small Hard-Shelled Types	Green Tint	Edible Gourd	Funny Face
		Pattie Pan		Halloween
		Scallopini		Howden's Field
		White Scallop		Jack-O'Lantern
				Jackpot
		Green Elongated Types		Luxury
		Caserta		Small Sugar
		Cocozelle		Spirit
		Zucchini		Sugar Pie
				Tricky Jack
				Young's Beauty
Cucurbita moschata			**Butternut Types**	**Standard Types**
			Butternut Hercules	Cheese
			Hybrid Butternut	Dickinson Field
			Patriot	Golden Cushaw
			Ponca	Kentucky Field
			Waltham	
Cucurbita maxima	Aladin		Baby Blue Hubbard	**Standard Types**
	Turk's Turbin		Banana	Big Max
			Boston Marrow	King of the Mammoths
			Buttercup	Mammoth Chili
			Delicious	Mammoth Prize
			Emerald	
			Gold Nugget	
			Golden Turban	
			Hubbard	
			Hybrid R	
			Kindred	
			Marblehead	
			Sweet Meat	
Cucurbita argyrosperma				Green-Striped Cushaw
				Japanese Pie
				Tenn. Sweet Potato
				White Cushaw

*Cultigens within a species are most likely to cross-pollinate; interspecies cross-pollination is rare but can occur.
**Although listed as gourds and ornamentals, some of these are eaten, particularly Turk's Turbin. Source: Adapted from Doty (1973) and Vandemark and Cutter (1978).

Soils and Fertility

William Terry Kelley, Darbie M. Granberry and George E. Boyhan, Extension Horticulturists

Soils and Location

Optimally, a site with well-drained, moderately fertile soil, free of problem weeds and nematodes is desired. Coarse to medium textured soils are best since neither pumpkins or gourds can tolerate wet or poorly aerated soils. A soil capable of retaining moisture (such as a medium textured soil) is best where rainfall is likely to be deficient. The site should be located in full sun and should have a pH between 6.0 and 6.5. If the soil test reveals a lower pH, dolomitic lime should be applied according to soil test results at least three months prior to crop establishment. Pumpkins can tolerate a soil pH as low as 5.5; avoid extremely acidic soils (<5.5pH).

Pumpkins or gourds should not be planted in rotation with other cucurbits or each other due to the potential for disease carryover. Do not grow either in rotation with peanuts, peppers, tomatoes or tobacco. Rotation with rye, wheat or other small grain crops is most ideal although other non-cucurbit crops are acceptable. Be careful not to plant pumpkins or gourds where herbicide carryover from a previous crop can be a problem.

Land Preparation

Pumpkins have a large, deep root system. Pumpkin roots can penetrate in excess of 48 inches into the soil. Pumpkin plants, however, will get most of their water and nutrients from the upper rooting zone where there is a larger concentration of roots.

Deep turn soil (8-10 inches) to bury residual litter. Then smooth the seedbed with a rototiller or tooth harrow rather than a disc harrow. Prevent compaction in the bed area by establishing a traffic pattern with the tractor during the smoothing operation. "Ripping and hipping" is an alternative method of land preparation which should be adequate.

Fertilization

Base all pumpkin and gourd fertilization programs on soil test results. Recommended nitrogen (N) rates for pumpkins and gourds range from 80 to 120 pounds per acre on Coastal Plain soils and 80 to 100 pounds per acre on Piedmont, Mountain and Limestone Valley soils. In general, 80 to 90 pounds per acre of nitrogen should be sufficient. Additional N may be needed if leaching rains occur. Phosphorus (P) and potassium (K) rates should be based on soil test results. (See Table 6, page 12.)

Fertilizer may be broadcast or banded. Broadcast applications may require slightly higher rates (1½ times greater) of P and K than banded applications. Ideal application methods would include applying all phosphorous and one-third to one-half of nitrogen and potassium in a band three inches to the side and three inches below seed level. The remainder may be broadcast or applied as a side dressing in one to three applications. Sidedress applications should be applied before runners are 12 inches long.

Use premium grade fertilizer to supply secondary and micro-nutrients. If soil test magnesium (Mg) is low and lime is recommended, use dolomitic limestone. If soil test Mg is low and lime is not recommended apply 25 pounds of elemental Mg per acre. Apply a minimum of 10 pounds of sulfur per acre. Apply one pound of actual boron per acre. If soil test zinc is low, apply five pounds of actual zinc per acre.

"Pop-up" fertilizers have been shown to benefit cucurbits especially in early spring when soils are still cool. For early growth stimulation, apply a pop-up fertilizer using 100-150 pounds of 10-34-0 or a similar material per acre. Apply the fertilizer two to three inches below the seeds or roots.

Table 6. Recommended rates of Phosphorus and Potassium in pounds per acre for pumpkins and gourds based on soil test ratings.

Phosphorus Rating	Potassium Rating			
	Low	Medium	High	Very High
	(pounds of N*-P2O5-K2O per acre)			
Low	*-120-120	*-120-90	*-120-60	*-120-30
Medium	*-80-120	*-80-90	*-80-60	*-80-30
High	*40-120	*-40-90	*-40-60	*-40-30
Very High	*-0-120	*-0-90	*-0-60	*-0-30

* Recommendations for nitrogen:
Coastal Plain – 80 to 120 pounds per acre; Piedmont, Mountain and Limestone Valley – 80 to 100 pounds per acre

Pumpkin and Gourd Production on Plastic Mulch

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In Georgia, vegetable acreage on plastic has been increasing since the late 1980's. By 1994, approximately 10 percent of the total vegetable acreage in the state was grown on plastic. This acreage is expected to continue increasing into the next millennium.

A production *system* using plastic mulch and drip irrigation (commonly referred to as *Plasticulture*) offers many benefits. However, the extent to which benefits are *actually achieved* depends on how effectively production is managed. Plastic has the potential for increasing profitability of many vegetable crops. On the other hand, poor management of crops on plastic usually results in greater losses (disasters) than poor management of production on bare ground.

Among other things, plastic mulch and drip irrigation (1) enhances earliness during spring production, (2) increases yield and quality, (3) helps control weeds, (4) improves irrigation efficiency by application of water directly to the root zone, (5) improves moisture uniformity, and (6) facilitate more effective fertilizer management by fertigation through the drip system.

How much earlier production and how much increased yield can be achieved with a well managed plasticulture system? In any given situation, that depends on the specific vegetable being grown, the average temperatures during the production season (especially in early spring) and soil productivity. However, on the average, vegetables grown on plastic mulch are ready for harvest one to two weeks earlier and frequently yield 50 percent to 100 percent more marketable product.

Due to larger size, fewer defects, reduced contamination with soil and increased shelf life, plasticulture improves quality of most vegetables. However, environmental factors, especially rainfall and temperature, the severity of insect and disease problems, and soil characteristics affect the degree to which plastic improves quality.

Plastic mulches that block light transmittance (black, white-on-black, and certain wavelength selective plastic mulches) prevent germination or growth of most weeds except nutsedge (See "Weed Control" section in this bulletin).

Considerations for Producing Vegetables on Plastic

For technology to be a good investment, economics dictates it must increase profitability. Plastic mulch and drip irrigation can substantially increase production costs. Will you make more money by growing pumpkins on plastic? That depends on how much it costs you to use the technology relative to the added income it generates. For current estimates of production costs and expected returns, consult the latest *Vegetable Production Costs and "Risk Rated" Returns* updated periodically and available from the Department of Agricultural Economics. You may also find this information on the UGA extension website at **www.ces.uga.edu**.

Multiple Cropping with Plastic Mulch And Drip Irrigation

The anticipated increased income from the use of plastic with some crops, especially high value crops such as fresh market tomato and pepper, readily justifies the costs of plastic mulch and drip irrigation. Plasticulture may or may not increase the value of low value crops enough to justify its cost.

To help spread the costs of mulch and drip irrigation over several seasons or crops, multiple cropping on plastic (growing a second or even third crop immediately after the previous crop) has become a common practice. Rotation of cucurbit crops with a cole crop or *Solanaceous* crop is common. Proper installation of a good quality plastic mulch and drip tube is absolutely necessary for successful multiple cropping. Consult your county extension agent or plastic mulch/irrigation dealer to ensure the materials you select will adequately meet your needs.

Pumpkins and Gourds

Pumpkins or gourds can be a good crop to plant on plastic previously used for an early spring crop. When considering using plastic just for a crop of pumpkin or gourd, it is important to determine if the use of plastic will increase the value of your crop. If yes, will that increased value equal or exceed the cost of using the plastic?

Pumpkins and gourds should be planted with a single row in each bed on white-on-black plastic or on black plastic that has been painted white. Spacing for cultivars producing small to medium sized vines should be 24 inches apart in the row. Plants producing large vines should be spaced 30 to 48 inches in the row. If beds are spaced closer together than six feet from center to center, it may be advisable to plant on only every other bed.

Plasticulture for Commercial Vegetable Production

Plastic mulch and drip irrigation is a relatively new technology for Georgia vegetable growers. It is more complicated and requires a much higher level of management than production on bare ground. Limited space in this publication does not permit coverage of all the information needed for successfully growing vegetable crops on plastic. However, University of Georgia Extension Bulletin 1008 entitled *Plasticulture for Commercial Vegetable Production* is available from your local county extension office. Please refer to Bulletin 1008 for additional information. This bulletin covers the benefits of drip irrigation and fertigation in detail and thoroughly discusses effective management of plasticulture technology and how it affects crop growth and productivity.

Pumpkin and Gourd Diseases

David B. Langston, Jr., Extension Plant Pathologist

Pumpkins and gourds are subject to attack by many diseases which cause serious losses throughout the state each year. Both crops share several common diseases due to the fact that pumpkins and gourds are closely related. A clear understanding of the diseases and the strategies used to manage them is necessary for profitable pumpkin and gourd production. Each disease affecting these crops will be discussed.

Diseases Caused by Fungi

Diseases caused by fungi are the most damaging to most crops including cucurbits. Fungal inoculum (spores, hyphae, sclerotia, etc.) may be spread by wind, rain, infected plants and seed, and infested soil carried on machinery. As with most plant diseases, prevention is the key to disease management.

Alternaria Leaf Spot

Alternaria Leaf Spot is caused by *Alternaria* spp. and can cause serious damage under extended periods of wet weather. The occurrence of this disease in Georgia is sometimes sporadic but can be devastating if left unchecked.

Symptoms

The disease causes tiny brown spots on the leaves which enlarge causing a target spot with concentric rings. Older lesions will develop a dark color in the concentric pattern. The dark color is caused by spore

production which can cause new infection sites if no protective measures are followed.

Disease Management

Most fungicides used in disease management will suppress Alternaria leaf spot, however, chlorothalonil containing products are generally the most effective. There are no resistant cultivars available.

Anthracnose

Anthracnose, caused by the fungus *Colletotrichum lagenarium*, attacks all above ground parts of the cucurbit plant. The fungus causing anthracnose overwinters locally on old cucurbit vines, and may appear any time during the growing season. It may reach epidemic proportions when rainfall is above average and temperatures are between 70 degrees F and 80 degrees F.

Symptoms

The first symptom of anthracnose is observed on the oldest leaves as round, reddish-brown spots. The centers of some spots fall out, giving the leaf a "shot-hole" appearance. Often the leaves at the center of the plant are killed first, leaving the crown of the plant bare. Light-brown to black, elongated streaks develop on stems and petioles. Round, sunken lesions may appear on the fruit. These lesions are first water-soaked and then turn a dark green to brown. The pinkish ooze often noticed in the center of the lesion is a mass of spores of the fungus.

Disease Management

A one-year rotation and deep turning infected debris immediately after harvest are effective cultural practices for reducing inoculum levels in subsequent crops. Using disease-free seed produced from areas not known to have anthracnose is an essential disease prevention measure. There are several protectant fungicide options available which can be found in the *Georgia Pest Control Handbook* or by contacting your local county extension agent.

Gummy Stem Blight

Gummy stem blight, caused by *Didymella bryoniae*, attacks only the leaves and stems of cucurbits and is one of the most destructive diseases of cucurbits in the state. This disease is driven by cool moist periods, especially extended periods of leaf wetness. Gummy stem blight fungus can easily be brought into a new area on or in the seed. Once the disease becomes established, it produces millions of sticky spores. These spores are spread over the field as man, animals and machines move through wet vines.

Symptoms

It is noticeable when an individual runner or an apparently healthy plant suddenly dies. Vine cankers are most common near the crown of the plant. This disease is usually identified by finding elongated, water-soaked areas on the stems of cucurbits. These areas become light-brown cracks in the vine and usually produce a gummy ooze. On the older leaves this disease may produce brown to black spots. It spreads from the center of the hill outward, as does anthracnose and downy mildew.

Disease Management

Choosing high quality, disease free seed and transplants should be the first line of defense in preventing losses to gummy stem blight. A two-year rotation to crops other than cucurbits is another appropriate disease management tool. Protective fungicide sprays can offer the most effective disease suppression if applied in a timely manner. Please consult the *Georgia Pest Control Handbook* for details concerning protective fungicides.

Target Spot

Target spot, caused by the fungus *Corynespora cassiicola*, can defoliate and destroy an entire crop if left unchecked. It occurs very sporadically and can be confused with downy mildew and other leaf spotting diseases.

Symptoms

Target spot begins on leaves as yellow leaf flecks which later become angular with a definite outline. Later spots become circular with light brown centers surrounded by dark brown margins. Lesions coalesce to produce large dead areas with dead and shedding leaves.

Disease Management

Most protectant fungicides used to control other foliar pathogens will suppress target spot. Destroying infected debris or sanitizing greenhouse areas will greatly aid in reducing the spread of disease.

Belly Rot

Belly rot has been a common problem for pumpkins and gourds in Georgia. The two fungi primarily responsible for belly rot are *Pythium* (also called "cottony leak") and *Rhizoctonia*. Belly rot can occur on fruit at any stage of growth, however, it is most noticeable when cucurbits are mature.

Symptoms

Symptoms may vary from small, yellow sunken areas to large rotted spots on the undersides of fruit. *Pythium* causes a water-soaked lesion which develops into a

watery soft rot. White, cottony mycelium is also generally associated with *Pythium* lesions. *Rhizoctonia* belly rot typically appears as dry, sunken cracks on the underside of cucurbit fruit.

Disease Management

Rotation and deep turning are cultural practices that can reduce the amount of disease inoculum near the soil surface. Practices which ensure good drainage can also reduce losses to these fungi. Systemic fungicides such as Ridomil Gold may aid in suppression of *Pythium*, while fungicides have proven to be inconsistent in dealing with *Rhizoctonia* belly rot.

Crown Rot

Crown rot is caused by the fungus *Phytophthora capsici* and may cause serious damage once established. The fungus infects all above ground plant parts of cucurbits. This disease became established in 1994 following hurricane Alberto. It is thought that spores of the fungus were deposited over the entire state by the hurricane. The major damage occurred in squash and pepper the first year but, because of a relatively wide host range, the disease is now causing problems in watermelons, cantaloupes, pumpkins, cucumbers and eggplant. Entire plantings of the above mentioned crops were affected in 1997.

Symptoms

Symptoms on cucurbits appear as constricted, water-soaked lesions near the base of stems that are close to the soil. Infected fruit may have circular, sunken, water-soaked lesions which may contain pasty or powdery sporulation of the fungus.

Disease Management

Rotation with a non-susceptible crop has been highly effective in disease prevention. It is not advisable to plant a susceptible crop in an infested field for two years. Measures that ensure good field drainage such as using crowned beds, subsoiling and avoiding over-irrigation will lessen the severity of disease. Preventive applications of some fungicides have shown some promise.

Mildews

Mildews are common in commercial cucurbit plantings and cause growers to spray on a regular basis. This practice alone will result in increased yields and a higher percentage of marketable fruit. There are two distinct mildew diseases, each favored by a different weather pattern and each requiring different materials for control. Unfortunately, there is considerable overlap in the symptoms and occurrence of these diseases.

Powdery Mildew

Powdery mildew, caused by the fungi *Sphaerotheca fuliginea* and *Erysiphe cichoracearum*, is much more widespread on cucurbits than downy mildew, especially during dry hot periods.

Symptoms

This disease is characterized by a white or brownish, mealy growth found on the upper and lower sides of the leaves and young stems. If plants are severely attacked, the leaves and young stems may wither and die. In less severe cases, the plant may be weakened or stunted. Early defoliation resulting from the disease may cause premature ripening or sun scald.

Disease Management

The use of preventive fungicide applications is the most effective means of suppressing powdery mildew. However, some pumpkin varieties have been released which demonstrate tolerance to this disease. Fungicides used in conjunction with tolerant varieties offers the most complete disease management program for powdery mildew on cucurbits.

Downy Mildew

Downy mildew, caused by the fungus *Pseudoperonospora cubensis*, is an airborne fungus that originates in Florida and moves northward during the growing season. During wet, cool weather, however, it can cause considerable damage.

Symptoms

This disease produces irregular to angular, yellow to brownish areas on the upper side of diseased leaves. The underside of the leaves may show a pale, grayish-purple mold following damp weather. The mold may vary from white to nearly black in color. The diseased spots may enlarge rapidly during warm, moist weather, causing the leaves to wither and die. This damage may resemble frost injury since the entire vine is killed. The fruit from diseased plants is usually small and of poor quality.

Disease Management

Follow the same spray program recommended for Alternaria Leaf Spot control. Fungicides containing mefenoxam are the most effective for suppressing downy mildew. However, fungal insensitivity to these fungicides has been observed and switching to chlorothalonil products has been recommended when this problem is observed.

Diseases Caused by Bacteria

Angular Leaf Spot

Angular Leaf Spot, a bacterial disease caused by *Pseudomonas lachrymans*, attacks gourd and pumpkin leaves, stems and fruit. The bacterium which causes angular leaf spot overwinters on old plant debris and in seed. Rains splash it from the soil to the stems, leaves and later to the fruit. Once infection takes place, the organism is spread over the field on the hands of workers or by cucumber beetles. Angular leaf spot is most severe during extended rainy periods when temperatures are between 70 degrees F and 80 degrees F.

Symptoms

Spots on the foliage are straw-colored to light brown and angular shaped. Affected areas are first water-soaked, then gradually dry and split. After the diseased tissue splits open, portions of it tear out, leaving irregular shaped holes in the leaves. Small, circular spots develop on the fruit. These diseased areas later crack open and turn white.

Disease Management

The primary disease prevention tool is to use disease free seed. A 2-year rotation behind crops other than cucurbits and cultivating the soil when it is dry will decrease the ability of the bacterium to survive to infect upcoming cucurbit crops. During warm, moist periods when disease development is favorable, copper sprays may reduce the spread of the disease.

Fruit Blotch

Fruit blotch of pumpkin caused by *Acidovorax avenae* subsp. *citrulli* is a new disease of pumpkin which can cause serious losses. It is unknown how this disease is spread but it is thought to be seedborne as watermelon fruit blotch was found to be.

Symptoms

A foliar symptom associated with this disease is the appearance of a V-shaped, necrotic lesion beginning around the margin of the leaf and extends inward toward the mid-rib, which is similar in appearance to the Black-Rot disease of crucifers. Symptoms on the surface of fruit occur as round, necrotic spots or cracks a few millimeters in diameter. With age, the tissue surrounding these lesions may become soft and appear wrinkled. A soft rot expands into the flesh of the pumpkin originating from the lesions observed on the surface. In time, infected pumpkins will totally collapse.

Disease Management

Using disease free seed and transplants is the best strategy for preventing losses to this disease. The use of copper sprays may help reduce the spread of disease once fruit blotch has been identified in the field.

Nematodes

Nematodes are small, slender, microscopic round worms that live in the soil. The root-knot nematode is the most common type attacking cucurbits. If not controlled, this pest can severely damage cucurbit crops, especially on light, sandy-textured soils.

Symptoms

Root-knot nematodes enter young cucurbit feeder roots during their common feeding process, causing the roots to swell. The most common below-ground symptom is the formation of galls or knots on the roots. Because nematode injury interferes with the uptake of water and nutrients, the top portion of the plant can have an appearance which resembles a lack of moisture or a fertilizer deficiency. Stunted, yellow, irregular growth of plants in the field and rapid decline are also above-ground symptoms of nematode injury.

Control

Rotating cucurbits with a grass crop, such as rye or corn, is somewhat beneficial in managing root-knot nematodes, but this practice is no substitute for soil fumigation. In the light soils of south Georgia, where root-knot nematodes are widespread, the use of soil fumigants is essential in most fields for maximum yields. Fumigant nematicides are most effective against nematodes and must be applied three weeks before planting. Materials, rates, and methods of application can be found in the *Georgia Pest Control Handbook*.

Virus Diseases

Mosaic

This disease is caused by one or more of four major viruses. These are Cucumber Mosaic Virus (CMV), Papaya Ringspot Virus (PRSV), Watermelon Mosaic Virus 2 (WMV-2), and Zucchini Yellow Mosaic Virus (ZYMV). Gourds and pumpkins may be affected by one or a combination of these viruses. All of these viruses are transmitted by aphids in a non-persistent manner. Aphids must acquire the virus from a host reservoir and are capable of transmitting it for 10-15 minutes in most cases.

Symptoms

Symptoms of virus disease are mottling, strapping, and vein distortion. One virus may cause mild symptoms while additional viruses in the same plant cause much more dramatic symptoms. In some cases the symptoms may appear to be phytotoxic chemical damage. Fruit from infected plants may be discolored or have raised bumps or mottles.

Disease Management

Stylet oil sprayed on a 2 to 3 day schedule has been shown to delay the spread of virus, particularly in the fall. Virus diseases are much worse in the late summer and fall because the aphid populations are much higher and virus carrying hosts plants are more available which result in more virus carrying aphids. Cleaning up field borders can help reduce populations. The use of reflective mulches is expensive, but has been shown to reduce infection. Yield losses are directly related to time of infection. The later the infection occurs, the less damage observed.

Insect Management

David B. Adams, Extension Entomologist

Pumpkin and gourds are subject to attack by a variety of insect pests. These attacks do not always cause economic injury, so certain insect management practices can be used to ensure cost-effective control decisions. Indiscriminate use of insecticides often creates more favorable conditions for harder-to-control insect pests, increasing production cost.

Insects cause injury to the leaves, stems, roots and fruit. The developmental stage of the plant at the time of attack often governs what plant part may be injured by different insect pests. However, some insects feed specifically on one plant structure while others may feed on several structures.

Certain cultural practices may have a dramatic effect on the potential for economic injury by certain insects. Planting during optimum growing conditions insures rapid seedling emergence and subsequent growth. This reduces the amount of time that plants are susceptible to injury from seedling insect pests.

Pumpkin and gourd are long-season crops when compared to other members of the cucurbit family. This means longer exposure to insects pests, especially migratory pests that may be present after June. Most insect problems can be treated as needed if detected early, but no one insecticide will adequately control all the insects that may attack pumpkins and gourds. Scouting for insects is the most efficient way to determine what problems may exist and what action should be taken. Preventive treatments may be needed for certain insect pests. Preventive treatments are used against insects that are certain to cause economic injury if they are present. Preventive treatment decisions are influenced by field history, harvest dates and insect pressure in nearby production areas.

Root Maggot

The seedcorn maggot, *Hylemya platura*, is the predominant species of root maggot found in Georgia's major production areas. The seedcorn maggot adult is a fly similar to the housefly, only smaller. It has many bristles on the body. The larvae or maggot is creamy white, $^1/_4$ inch long at maturity and legless. The body tapers sharply from rear to head.

The maggot is the damaging stage. Root maggots tunnel in the seeds or the roots and stems of seedlings. Seeds usually succumb to secondary rot organisms and fail to germinate following attacks. Seedlings often wilt and die from lack of water uptake. Seedlings that survive are weakened and more susceptible to other problems.

Cool conditions favor the development of root maggot infestations. Early spring plantings are therefore most subject to attack. Egg-laying adults are attracted to soils with high organic matter. Even though soils in Georgia are characteristically low in organic matter, it

Figure 1. Root maggots

Figure 2. Wireworm (left), whitefringed beetle larvae (right)

still presents problems. Dead or dying organic matter such as weeds or previous crop residue attracts the flies.

Greenhouse grown transplants are grown in high organic soil mixtures that attract the flies in the greenhouse environment. Eggs may be laid on the soil while the plants are in the greenhouse. The eggs may hatch after the transplants are placed in the field and the maggots attack and kill the seedlings.

Several practices may be used to help control maggots. Previous crop litter and weeds should be turned deeply several weeks prior to planting so there is adequate time for decomposing. Plant during optimum conditions for rapid germination and seedling growth. Early plantings should be preceded by incorporation of a recommended soil insecticide. Plants should be maintained stress free until they are beyond the seedling stage. (Figure 1, page 17)

Wireworms and Whitefringed Beetle Larvae

Wireworms, mostly *Conoderus* spp., and whitefringed (WFB) beetle larvae, *Graphognathus* spp., can reduce stands dramatically if present in even moderate numbers (one per square yard). Wireworms are less likely to affect early planting because they are relatively inactive during the early spring.

The WFB adults (weevils) do not cause any economic damage. Larvae are creamy white and legless. They grow to about ½ inch long and are C-shaped grubs. The mouthparts are dark brown, pincher-like structures that are highly visible. The head capsule is slightly recessed and blends so well with the rest of the body that it appears headless.

Whitefringed beetle larvae pass the winter in the larval stage and may be active even during the milder winter months. Presently, no effective insecticides are labeled for control of this insect. If WFB larvae are found (one per square yard) during land preparation, do not plant in that field. Whitefringed beetles can be a problem in the Coastal Plain and do not occur in the Piedmont. (Figure 2)

Cucumber Beetles

Several species of cucumber beetles may attack pumpkins and gourds. The most common species found in Georgia are the spotted cucumber beetle, *Diabrotica undecimpunctata*, and the striped cucumber beetle, *Acalymma vittata*. The banded cucumber beetle, *Diabrotica balteata*, is occasionally found.

Cucumber beetles are sometimes mistaken for lady beetles which are beneficial predators. Cucumber beetles are more oblong than lady beetles, which are nearly hemispherical. The spotted cucumber beetle adult is about ¼ inch long with 11 black spots on its yellowish-green to yellow wing covers. The banded cucumber beetle is slightly smaller than the spotted cucumber beetle. The banded cucumber beetle is yellow with three black stripes on the back.

The larvae of the different cucumber beetles are very similar and live underground. Larvae are creamy, yellowish-white, soft-bodied worms with three pairs of inconspicuous legs. Mature larvae of the spotted cucumber beetle may be from $^{1}/_{2}$ to $^{3}/_{4}$ inch long. The striped cucumber beetle larvae are slightly smaller. Both larvae have a dark brown head and a dark brown plate on the last body segment.

Beetles and larvae may damage pumpkin and gourds. The beetles have been responsible for most economic damage. Beetles feed on the stems, foliage and flowers of the plant. Beetles feed on the stems until the plants become less attractive due to hardening, after which more foliage damage will be apparent. Feeding begins on the undersides of the cotyledons or true leaves. If beetle populations are high during the seedling stage, stand reductions can occur.

Larvae may feed on all underground plant parts and usually cause insignificant amounts of damage.

Figure 3. From left: spotted cucumber beetle, striped cucumber beetle and stem damage, cucumber beetles and foliage damage

Occasionally, larvae cause direct damage to the fruit. This is more likely to occur during excessive moisture conditions when the larvae feed on that portion of the fruit in direct contact with the soil surface. The damage consists of small trail-like canals eaten out on the surface of the fruit. The most severe consequence of larval damage is the introduction of secondary disease organisms.

Cucumber beetles can be controlled with foliar applications of insecticides when 10 percent or more of the seedlings are infested. The natural feeding behavior of cucumber beetles leads to their avoidance of insecticidal sprays, so thorough spray coverage is imperative. The most cost-effective application method is to band over-the-top and direct sprays towards the base of the plant. There are no recommendations for control of the larvae. (Figure 3)

Aphids

The melon aphid, *Aphis gossypii*, and the green peach aphid, *Myzus persicae* are common in Georgia. Aphids are soft-bodied, oblong insects that rarely exceed $^{3}/_{32}$ inch long. Adults may be winged or wingless, most often wingless. Aphids have two exhaust pipe-like structures called cornicles located on the rear of the abdomen. Immature aphids are wingless and look like the adults, only smaller.

Aphids are slow moving insects that live in colonies on the undersides of leaves. Aphids feed on the leaves with their piercing-sucking mouthparts. As they remove plant sap the leaves curl downward, giv-ing them a puckered appearance. Heavy populations cause plants to yellow and wilt. Aphids secrete a substance known as honeydew that collects on the surface of the lower leaves. Under favorable conditions the honey-dew provides the sustenance for the growth of sooty mold, a fungus that blackens the leaf surface. This reduces photosynthesis, thereby, reducing quality and/or yield.

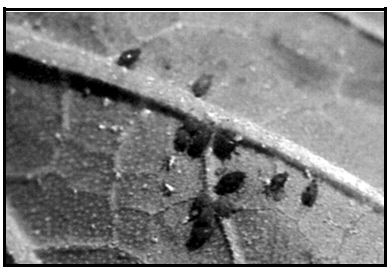

Figure 4. Colony of aphids

The greatest damage caused by aphids is indirect. Aphids vector several viruses that can reduce fruit quality. For this reason, aphid populations should be kept to a minimum. Winged aphids are the primary vectors of such diseases and should be monitored until pumpkin or gourds are full size.

Several insecticides are effective on light to moderate populations of aphids. If winged aphids are easily found (10 percent of plants infested), treatment is warranted. Thorough coverage is essential since aphids live on the underside of leaves. (Figure 4)

Thrips

Several species of thrips may inhabit pumpkin and gourd fields, but they are not very well understood as a pest. Thrips are very small, spindle shaped insects $^{1}/_{10}$ inch or less long. Immature thrips are wingless while the adults have wings with hair-like fringe.

The thrips that cause early foliage damage are often different from those present during the period of heavy fruit set in spring plantings. The most noticeable damage is to the foliage. Narrow bronze lesions appear on the leaf surface. The entire field may have silvery appearance from heavy feeding. This damage is caused by the thrips rasping the leaf surface prior to its expansion. The most severe damage occurs during the periods of slow growth. Damage is quickly outgrown during periods of rapid growth, and usually no treatment is required.

The western flower thrips (WFT), *Frankliniella occidentalis*, is the species most common during rapid fruit set. WFT is a large species two to three times larger than the common onion and tobacco thrips often

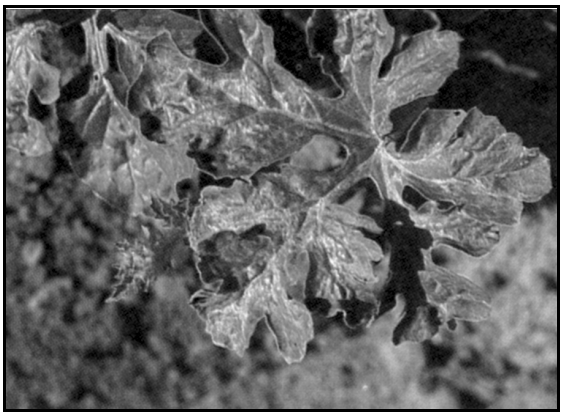

Figure 5. Thrips damage, seedling (far left); thrips damage, mature leaf, (left)

found infesting early plantings. It is not well known if WFT or any other species causes any significant damage to pumpkin or gourd. Thrips mechanically damage plants during the feeding process. If thrips fed on pre-pollinated fruit, the damage would not be noticeable until the fruit were larger. Physical damage of this type would appear as catfacing, light russeting or other deformities on the surface of the fruit.

Thrips can be controlled with foliar insecticide applications. There are no treatment thresholds developed for thrips. As a rule-of-thumb, treatments are not generally necessary if thrips are damaging only the foliage. Treatments for thrips during early fruit development may be initiated when a majority of the blooms are found infested with large numbers of thrips, 75 or more per bloom, however, treatments are rarely justified. (Figure 5)

Cutworms

The granulate cutworm, *Feltia subterranea*, is the predominant species found in the Coastal Plain of Georgia. The adult is a nondescript moth. Larvae are greasy looking caterpillars that may be $1^1/_2$ to $1^3/_4$ inches long at maturity. Young larvae may be pinkish-gray while older larvae are usually dingy gray. There is a series of chevron-shaped markings along the back that are a slightly lighter gray than the body.

Figure 6. Cutworms

Cutworms feed at night and remain inactive during the day, either on the soil surface, or below ground. Cutworms may attack all plant parts, but the most severe damage occurs when they feed on young seedlings or developing fruit. Cutworms damage young plants by chewing on the stem slightly above or below ground. Stand reductions may occur. Damage to the fruit is often confined to the fruit surface. Cutworm feeding results in trails or patches of tan to russet callus tissue.

Cutworms can be difficult to control, but understanding their behavior can help. Cutworms pass the winter months in the larval stage. This means that the larvae may be present at the time of planting. In these cases stand reductions will be likely. Inspect fields during land preparation and just prior to and during the planting operation. If cutworms are found, treatments should be made either by incorporation of a soil insecticide or a directed spray if plants are already present. Foliar sprays should be made as late in the day as possible to coincide with the greatest larval activity. (Figure 6)

Pickleworm and Melonworm

The pickleworm, *Diaphania nitidalis*, and melonworm, *D. hyalinata* are migratory insects that overwinter in areas from southern Florida to South America. Pumpkins are more preferred than gourd. Pickleworms bore and tunnel into the fruit and are more serious than the melonworm which feeds mainly on the foliage. Both pests are more prevalent after June. Preventive sprays should be made if they are observed in the field or infestations are known to be in the other production areas. (Figure 7)

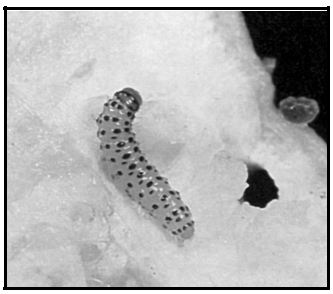

Figure 7. Pickleworm, young larva (left); pickleworm, mature larva (right)

Miscellaneous Insect Pests

Some insects are occasional pests when other hosts are not available, populations are very high or environmental conditions are just right for rapid development. Flea beetles, spider mites, leaf miners, stink bugs, leaf hoppers, squash bugs, whiteflies and grasshoppers are just a few. These problems can be addressed on a case-by-case basis. Contact your local county extension agent if there are questions on the treatment of these insects.

Honey Bees

Honey bees are necessary to ensure adequate pollination, and since most insecticides are toxic to honey bees, follow these practices to prevent bee kills. Honey bees may be active from dawn to dusk. Make insecticide applications late in the day, after sunset if possible, after bee activity has ceased. If it is necessary to spray large acreages during the day, remove hives from the field on the preceding day. If these precautions are followed, bee kills will be kept to a minimum. Once dried on the leaf surface, the toxic effects of most insecticides are dramatically reduced.

Weed Control in Pumpkins and Gourds

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As with any vegetable crop, successful weed management is vital to the production of quality pumpkins and gourds. Weeds compete with the crop for light, space, nutrients and water. Excessive weed growth can contribute to disease problems, hinder disease and insect management and harbor insect and disease pests. Weeds can also interfere with harvest efficiency, reducing the quantity of marketable fruit and increasing labor costs. Pumpkins and gourds as with most crops, require early season weed control to ensure a quality crop. In addition, the vining habit of these crops makes weed control difficult once the vines begin to run.

Factors Affecting Weed Control

Since chemical weed control materials are limited, the most important factor to consider when growing pumpkins and gourds is site or field selection. Fields with heavy infestations of Texas panicum, sicklepod, cocklebur and other hard-to-control species should be avoided. In addition, perennial weeds, such as nutsedge or bermudagrass, can cause problems since they can be extremely hard to control. With perennial weeds such as these, frequent discing or mechanical disturbance prior to planting may reduce the severity of these species. Non-selective herbicides may also be used to reduce perennial weed infestations. Crop rotation can be used to control weeds which can be managed in alternate crops. Weed identification is essential particularly at the seedling stage. Seedling weeds are generally easier to control and in many cases control can only be obtained at the seedling stage. Another important factor is crop vigor. Generally, an aggressive, healthy crop will out-compete and exclude many weeds. Proper fertilization, irrigation, disease, nematode and insect management will promote crop growth and aid in weed suppression.

Methods of Weed Control

There are limited methods of weed control for pumpkins and gourds. Selection of the method best suited for an individual grower will depend on several factors including: weed species, crop variety, stage of crop and/or weed development, and labor costs and availability.

Hand Weeding

Hand weeding provides very effective weed control and is very safe to the crop and the environment. Weeding should be performed when the crop and weeds are small to reduce crop damage and allow the use of hoeing. Removal of large weeds with extensive root systems may damage crop roots or vines.

Mechanical Control

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. 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 those weeds in the rows or those that persist after the plants produce vines. Planting pumpkins at equidistant spacing (same in-row and

between-row spacing) allows cultivation from any direction until the vines begin to run.

Chemical Weed Control

Chemical weed control is currently limited to herbicides recommended by the University of Georgia Cooperative Extension Service (See the *Georgia Pest Control Handbook* or your local county extension agent). Although this publication collectively includes pumpkins and gourds, herbicides labeled for use and herbicide tolerance vary among these crops. The *Georgia Pest Control Handbook* has specific information regarding current herbicide options.

Stale Seedbed Control

The stale seedbed technique is an effective method of control. Weed control utilizing this strategy involves chemical weed control of emerged weeds prior to crop emergence. A non-selective, contact material is primarily used. The stale seedbed method is often used in conjunction with a pre-plant incorporated herbicide treatment. If the crop is transplanted this method may be used to kill emerged weeds before transplanting. On direct-seeded plantings, apply the herbicide to those weeds that have emerged after planting, but before the crop has emerged.

Fumigation

Fumigation with some materials will provide substantial weed control but is expensive and must be performed by trained personnel. To ensure proper fumigation the soil is covered with a non-porous material such as plastic. The fumigant is placed under the plastic and the edges are sealed with soil. The length of time required before removal of the cover varies with fumigant. After this time, the cover can be removed or holes can be punched into the cover. Allow the soil to air out for 7 to 10 days before planting to avoid crop injury. Most small-seeded broadleaves and grasses will be controlled, but many larger seeds and nutsedge tubers will not. Unless fumigation is utilized for disease or nematode control, this method is generally impractical for weed control.

Plastic Mulch

Plastic mulch is a very effective method of weed control. Black or non-light transmitting plastic is preferred, eliminating light required for weed germination and growth. This will eliminate most weeds except nutsedge. The tightly folded and pointed leaves of this species will penetrate the plastic and emerge. Plastic is used to cover the plant beds and should be tight-fitting and sealed along the edges to prevent wind disturbance. Once covered, a small hole is made in the plastic and the transplant or seeds inserted. The smallest hole possible is advantageous to eliminate weed emergence from the hole. Those areas between the beds should be treated with only a herbicide registered for the crop, since the crop roots may extend into the row middles and contact the treated soil.

Pesticide Application

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Two types of sprayers, boom and air-assisted, are used for applying insecticides, fungicides, herbicides and foliar fertilizers. Air-assisted sprayers (Figure 1, page 23) utilize a conventional hydraulic nozzle. Then supplemental air is used to force the spray into the plant foliage. Boom sprayers (Figure 2, page 23) get their name from the arrangement of the conduit that carries the spray liquid to the nozzles. Booms or long arms on the sprayer extend across a given width to cover a swath as the sprayer passes over the field.

Pumps

Three factors to consider in selecting the proper pump for a sprayer are:

1. *Capacity.* The pump should be of proper capacity or size to supply the boom output and to provide for agitation (5 to 7 gallons per minute [gpm] per 100-gallon tank capacity). Boom output will vary depending upon the number and size of nozzles. Also, allow 20 to 30 percent for pump wear when determining pump capacity. Pump capacities are given in gallons per minute.
2. *Pressure.* The pump must produce the desired operating pressure for the spraying job to be done. Pressures are indicated as pounds per square inch (psi).
3. *Resistance to corrosion and wear.* The pump must be able to withstand the chemical spray materials without excessive corrosion or wear. Use care in selecting a pump if wettable powders are to be used as these materials will cause pump wear.

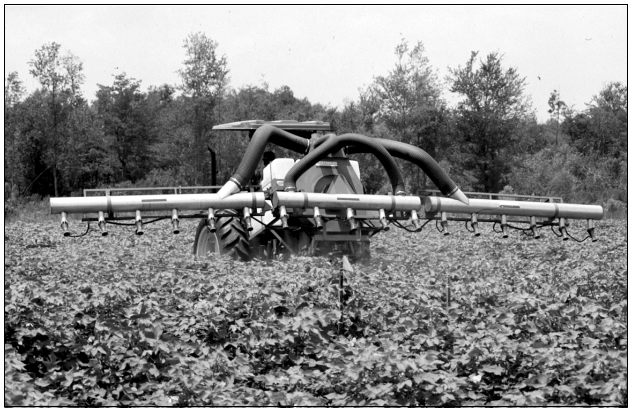

Figure 1. Air assisted sprayer.

Figure 2. Hydraulic boom sprayer.

Before selecting a pump, consider factors such as cost, service, operating speeds, flow rate, pressure and wear. For spraying vegetable crops, a diaphragm pump is preferred because of serviceability and pressures required.

Nozzles

Nozzle section is one of the most important decisions to be made related to pesticide applications. The type of nozzle determines not only the amount of spray applied, but also the uniformity of the applied spray, the coverage obtained on the sprayed surfaces, and the amount of drift that can occur. Each nozzle type has specific characteristics and capabilities and is designed for use under certain application conditions. The types most preferred for ground application of agricultural chemicals for pumpkins and gourds are the fan and cone nozzles.

Herbicide Application

The type of nozzle used for applying herbicides is one that develops a large droplet and has no drift. The nozzles used for broadcast applications include the extended range flat fan, drift reduction flat fan, turbo flat fan, flooding fan, turbo flooding fan, turbo drop flat fan, and wide angle cone nozzles. Operating pressures should be 20 to 30 psi for all except drift reduction and turbo drop flat fans, flooding and wide angle cones. Spray pressure more than 40 psi will create significant drift with flat fans nozzles. Drift reduction and turbo drop nozzles should be operated at 40 psi. Flooding fan and wide angle cone nozzles should be operated at 15 to 18 psi. These nozzles will achieve uniform application of the chemical if they are uniformly spaced along the boom. Flat fan nozzles should be overlap 50 to 60 percent.

Insecticide and Fungicide Application

Hollow cone nozzles are used primarily for plant foliage penetration for effective insect and disease control, and when drift is not a major concern. At pressures of 60 to 200 psi, these nozzles produce small droplets that penetrate plant canopies and cover the underside of leaves more effectively than any other nozzle type. The hollow cone nozzles produce a cone shaped pattern with the spray concentrated in a ring around the outer edge of the pattern. Even fan and hollow cone nozzles can be used for banding insecticide or fungicides over the row.

Nozzle Material

Various types of nozzle bodies and caps, including color coded versions, and multiple nozzle bodies are available. Nozzle tips are interchangeable and are available in a wide variety of materials, including hardened stainless steel, stainless steel, brass, ceramic, and various types of plastic. Hardened stainless steel and ceramic are the most wear-resistant materials. Stainless steel tips, with corrosive or abrasive materials, have excellent wear resistance. Plastic tips are resistant to corrosion and abrasion and are proving to be very economical for applying pesticides. Brass tips have been common but wear rapidly when used to apply abrasive materials such as wettable powders. Brass tips are economical for limited use, but other types should be considered for more extensive use.

Nozzle Arrangements

When applying insecticides and fungicides, it is advantageous to completely cover both sides of all leaves with spray. When spraying pumpkins and gourds, use one or two nozzles over the top of the row (up to 12 inches wide). Then as the plants start to spread, place nozzles on 10 to 12 inch centers for broadcast spraying.

Water Rates (GPA)

The grower who plans to use spray materials at the low water rates should follow all recommendations carefully. Use product label recommendations on water rates to achieve optimal performance. Plant size and condition influence the water rate applied per acre. Examination of the crop behind the sprayer before the spray dries will give a good indication of coverage.

Agitation

Most materials applied by a sprayer are in a mixture or suspension. Uniform application requires a homogeneous (well-blended) solution provided by proper agitation (mixing). The agitation may be produced by jet agitators, volume boosters (sometimes referred to as hydraulic agitators), and mechanical agitators. These can be purchased separately and installed on sprayers. Continuous agitation is needed when applying pesticides that tend to settle out, even when moving from field to field or when stopping for a few minutes.

Calibration

Calibration is important for proper application of recommended rates of pesticides. The procedure below is based on spraying $^{1}/_{128}$ of an acre per nozzle or row spacing and collecting the spray that would be released during the time it takes to spray the area. Because there are 128 ounces of liquid in 1 gallon, this convenient relationship results in ounces of liquid collected being directly equal to the application rate in gallons per acre.

Calibrate with clean water when applying toxic pesticides mixed with large volumes of water. Check uniformity of nozzle output across the boom. Collect from each for a known time period. Each nozzle should be within 10 percent of the average output. Replace with new nozzles if necessary. When applying materials that are appreciably different from water in weight or flow characteristics, such as fertilizer solutions, etc., calibrate with the material to be applied. Exercise extreme care and use protective equipment when an active ingredient is involved.

1. From Table 7, determine the distance to drive in the field (two or more runs suggested). For broadcast spraying measure the distance between nozzles. For band spraying, use band width. For over the row or directed, use row spacing.
2. Measure the time (seconds) to drive the required distance; with all equipment attached and operating. Maintain this throttle setting!
3. With sprayer sitting still and operating at same throttle setting or **engine RPM** as used in Step 2, adjust pressure to the desired setting. **Machine must be operated at same pressure used for calibration.**
4. For *broadcast* application, collect spray from **one** nozzle or outlet for the number of seconds required to travel the calibration distance.
   For *band* application, collect spray from **all** nozzles or outlets used on one band width for the number of seconds required to travel the calibration distance.
   For *row* application, collect spray from **all** outlets (nozzles, etc.) used for one row for the number of seconds required to travel the calibration distance.
5. Measure the amount of liquid collected in fluid ounces. **The number of ounces collected is the gallons per acre rate** on the coverage basis indicated. For example, if you collect 18 ounces, the sprayer will apply 18 gallons per acre. Adjust applicator speed, pressure, nozzle size, etc., to obtain recommended rate. If speed is adjusted, start at Step 2 and re-calibrate. If pressure or nozzles are changed, start at Step 3 and re-calibrate.

Table 7. Distance to measure to spray $^{1}/_{128}$ acre. One ounce discharged = one gallon.

Nozzle Spacing (inches)	Distance (feet)	Nozzle Spacing (inches)	Distance (feet)
6	681	20	204
8	510	22	186
10	408	24	170
12	340	30	136
14	292	36	113
16	255	38	107
18	227	40	102

To determine a calibration distance for an unlisted spacing, divide the spacing expressed in feet into 340. Example: calibration distance for a 13" band = 340 ÷ $^{13}/_{12}$ = 313 feet.

Irrigation

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Water is a critical component in the production of pumpkins and gourds. Pumpkins and gourds consist of over 90 percent water (a 30-pound pumpkin contains more than 3 gallons of water). Thus an adequate water supply is critical to the yield and quality of these crops.

Pumpkins and gourds are potentially deep rooted (4 to 6 feet); in Georgia soils, however, the effective rooting depth is generally much less. Actual rooting depths will vary considerably depending on soil conditions and cultural practices. The restricted rooting depth, and the fact that pumpkins and gourds are commonly grown in sandy soils with a low water holding capacity, make irrigation necessary for consistently high yields of quality pumpkins and gourds in Georgia.

Water deficits during the establishment of pumpkins and gourds delay maturity and may cause gaps in production due to uneven stands. Water stress in the early vegetative stage results in reduced leaf area and reduced yield. The most serious yield reductions result from water stress during flowering and fruit development. Water stress at this time may also result in small and/or misshapen fruit.

Several types of irrigation systems may be used successfully on pumpkins and gourds in the Southeast. Ultimately, the decision about which type to choose will be based on one or more of the following factors:

1. Availability of existing equipment
2. Field shape and size
3. Amount and quality of water available
4. Labor requirements
5. Fuel requirements
6. Cost

Sprinkler Irrigation

Currently, most pumpkins and gourds are irrigated with some type of sprinkler irrigation. These systems include center pivot, linear move, traveling big-gun, permanent set and portable aluminum pipe with sprinklers. Any of these systems are satisfactory if they are used correctly. There are, however, significant differences in initial cost, fuel cost and labor requirements.

Any sprinkler system used on pumpkins and gourds should be capable of delivering at least an inch of water every four days. In addition, the system should apply the water slowly enough to prevent run-off. With most Georgia soils, a rate less than 2 inches per hour safely prevents runoff.

Sprinkler systems with a high application uniformity (center pivot and linear move) can be used to apply fertilizer through the system. This increases the efficiency of fertilizer utilization by making it readily available to the plant and reducing leaching.

Drip Irrigation

Drip irrigation is gaining popularity for production of some vegetable crops. It can be used with or without plastic mulch. One of the major advantages of drip irrigation is its water use efficiency if properly managed. Studies in Florida have indicated that 40 percent less water was required for drip irrigated vegetables than sprinkler irrigated vegetables. Weeds are also less of a problem since only the rows are watered and the middles remain dry. Some studies have indicated that drip also enhances earlier yields and fruit size.

Drip tubing (or tape) may be installed on the ground surface or buried just below the surface. When used in conjunction with plastic mulch, the tape can be installed at the same time the plastic mulch is laid. It is usually desirable to offset the tubing slightly from the center of the bed. This prevents the tubing from being damaged during the hole punching and the planting operation.

Typically, one line of tubing is installed beside each row. A field with a 6-foot row spacing will require 7,260 feet of tubing per acre.

The tape is available in various wall thicknesses ranging from 4 mils to 25 mils. Most growers use thin wall tape (less than 10 mils) and replace it every year. Heavier wall tape can be rolled up at the end of the season and reused; however, be careful removing it from the field.

Drip systems can be easily adapted for the injection of fertilizer. This allows plant nutrients to be supplied to the field as needed. This method also eliminates the need for heavy fertilizer applications early in the season that tend to leach beyond the reach of root systems or cause salt toxicity problems. Only water soluble formulations can be injected through the drip systems. The system should be thoroughly flushed following each injection.

Water used in a drip irrigation system should be well-filtered to remove any particulate matter which might plug the tubing. The water should be tested for minerals which might cause plugging problems.

Scheduling Irrigation

The water used by a crop and evaporated from the soil is called evapotranspiration (ET). ET rates for pumpkins and gourds have been estimated as high as 0.3 inches per day. Factors that affect ET are stage of crop growth, temperature, relative humidity, solar radiation, wind speed and plant spacing.

The following is a general recommendation for irrigation rates on sprinkler irrigated pumpkins and gourds:

From planting until plants begin to vine

- Apply ½ inch whenever soil in top 6 inches becomes dry (about every five or six days when weather is dry).

From time plants begin to vine until first bloom

- Apply $^3/_4$ inch every five days during dry weather.
- If wilting occurs before noon, increase frequency of irrigation.

From first bloom until harvest

- Apply 1 inch every four days during dry weather
- During extremely hot weather (over 95 degrees F), frequency may need to be increased to every three days to avoid stress.

Sandy soils may require more frequent, lighter applications than heavier soils to prevent moisture stress. Drip irrigation systems need to be operated more frequently than sprinkler systems. Typically, they are operated every day or every other day. Do not over water, especially when using plastic, since the plastic will keep the soil from drying out.

Soil moisture monitoring can be used to fine tune irrigation applications. This ensures that soil moisture is adequate to prevent crop stress. The irrigations schedule should be adjusted whenever soil moisture measurements indicate overly wet or dry conditions.

Soil moisture may be monitored using either electric resistance blocks (such as the Watermark™ soil moisture sensor) or tensiometers. Install two sensors at each monitoring location – one about 8 inches deep and one about 16 inches deep. Each field should have a minimum of two monitoring locations – more for fields larger than 20 acres or if soil types vary considerably.

The 8-inch sensors are near the middle of the root zone and will indicate when irrigations should be started. Until first bloom, readings should not exceed 50 centibars. Afterward, they should not exceed 30 centibars. The optimum range for soil moisture is 5-30 centibars. The 16-inch sensor is used to evaluate previous irrigations. If readings remain low (less than five centibars), then irrigations amounts should be decreased. If they continue to increase even after an irrigation, then irrigation amounts should be increased. Read soil moisture sensors at least three times per week during dry weather.

Harvesting, Curing and Storing Pumpkins and Gourds

George E. Boyhan, William Terry Kelley and Darbie M. Granberry, Extension Horticulturists

Pumpkins and gourds are harvested at full maturity. This means a growing season of 90 to 120 days will be required. The actual amount of time to produce the crop will vary based on selected gourd or pumpkin variety grown as well as the time of year. Generally, production during the spring for summer harvest will be shorter than summer production for fall harvest. Pumpkins are fully mature when they resist penetration with your thumbnail or when they will not scratch easily when you drag your fingernail across the outer surface. Don't try this with gourds since breaks or dents in the surface of immature gourds can destroy quality. The fruit surface can be quite hard at maturity and often turns from a shiny to a dull appearance. In gourds, the stem attached to the fruit should be completely dry. Senescing vines are also an indication of ripeness. When harvesting leave a few inches of dry stem attached to each fruit. Never pick up freshly harvested fruit by this stem since it may separate from the fruit.

Since there are several different genera and species that are considered either pumpkins or gourds, the time of harvest varies slightly. *Cucurbita* gourds should be harvested when fully mature but before frost or freezing temperatures. Pumpkins can withstand a light frost but should be harvested before a hard freeze (temperatures below 32 degrees F for several hours).

Fruit color can aid in harvest decisions. Many pumpkins and gourds have characteristic colors at maturity. Know the species and/or variety you are growing to know what color it should have at maturity. For example, many pumpkin varieties will have a bright orange color at maturity, but, depending on the variety, color can range from green, white, or red to brown.

Lagenaria, or bottle gourds, are harvested at full

maturity and are not damaged by light frost and, if near or at maturity, will not be damaged by freezing temperatures. The fruit of this genus will lose weight at maturity turning from green to brown. It is recommended that these gourds be grown on trellises to aid drying. It is preferable to leave these on the vine until the vine has died or frost is imminent. Properly handled fruit of this genus will last for many years.

Luffa gourds should be harvested when brown and completely dry. Since these gourds are harvested for their dry sponge-like interiors it is recommended that they be grown on trellises to aid fruit drying.

Gourds grown for ornamental purposes should be harvested as soon as maturity is reached and before frost. The bright colors in these gourds can fade if left in the sun for too long. However, gourds picked green will not color. Most cured ornamental gourds will only last for one season.

When harvested, gourds should be washed in a non-bleaching disinfectant (such as vinegar) and wiped dry. Wiping with a vinegar-dampened cloth may be sufficient if they are only slightly dirty. If excessive dirt is present, wash in warm, soapy water and rinse with clean water; then dry with a soft cloth.

In handling gourds and pumpkins take care to avoid rough handling. Avoid excessive cuts and bruises on fruit, since this can be an entry point for decay organisms. At relatively high temperatures (85 degrees F) and humidity (85%), small cuts will suberize, or heal over, and fruit may then be placed in dry storage. Instruct harvesting personnel to cut fruit from the vine with a sharp knife or snips and use patience in handling and loading. Line trailers and bins used in harvesting with a soft material (straw, padding, etc.) that will help prevent bruising injury. Fruit should not be stacked so high as to cause damage to fruit on the bottom of the stack.

Curing and Storage

Southern grown pumpkins and gourds do not generally store well and should be harvested as close to shipping as possible. Pumpkins and gourds should be well matured and free from injury and decay when placed in storage. They should be kept dry, and storage areas should have good air circulation. Curing at 80 to 85 degrees F and 80 to 85 percent relative humidity before storage is recommended for pumpkins and gourds. This period should be for 10-20 days for pumpkins, 7 to 10 days for thin-shelled gourds, and two to three weeks for fleshy gourds. Large bottle gourds can take up to six months to cure. Gourds are often placed in open wooden crates or spread on slotted shelves for curing, enabling air circulation to continue. Gourds can also be placed in mesh bags and suspended in a well-ventilated, dry area.

After curing, store pumpkins at 50-55 degrees F and 50-70 percent relative humidity. Pumpkins stored in this manner may keep two to three months. Storage temperatures above 60 degrees F maintain respiration rates at excessive levels and result in loss of weight and moisture, which reduces quality. Pumpkins and gourds stored below 50 degrees F are subject to chilling injury, which can cause rotting. Pumpkins are stored best in single layers to reduce rot and decay and encourage air circulation. Store gourds in a dry, dark place. They should never be stored in damp or unventilated places. Storage temperatures of 50-60 degrees F and relative humidity of 70-75 percent are ideal for gourds.

Thin-shelled gourds are fully cured when you can hear the seeds rattling inside. They can then be carved and a coat of paint or varnish can be applied. Decorative gourds can benefit from a protective coating of paste wax and a soft buffing. This can increase their shelf life by four to six months.

Marketing Tips

Pumpkins are marketed in a number of ways. For bulk sales, they are usually shipped in large bulk boxes or in bulk trucks. Pumpkins are also a popular item for sale at roadside markets, farmer's markets and local grocers. A newer trend that has become popular with the urban population is a variation on the pick-your-own theme. This marketing scheme allows the public to come into the field and select their own pumpkins from the patch, much like picking out a Christmas tree. These venues often augment their attraction by offering hayrides to the patch in the autumn season and serving snacks and drinks to patrons. Gourds can be marketed in ways similar to pumpkins. Often they are included in pumpkin marketing programs as companion sales items. Painting or carving thin-shelled gourds can increase their profit potential.

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