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COOPERATIVE EXTENSION
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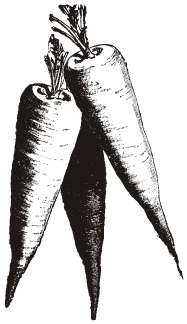

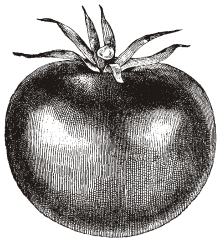

Commercial Organic Vegetable Production

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Commercial Organic Vegetable Production

George Boyhan and Terry Kelley, Extension Horticulturalists
David Langston, Extension Plant Pathologist
Stormy Sparks, Extension Entomologist
Stanley Culpepper, Extension Weed Scientist
Greg Fonsah, Extension Economist

Introduction

This publication is to help growers increase their sustainable practices and consider organic production. Conventional growers may benefit from this publication with information to increase their sustainability and perhaps lower production costs. For growers contemplating organic production, this publication lays the foundation for production practices and methods. This publication is not a how-to for certified organic production. Many of the methods and practices are also applicable to conventional production systems and growers may wish to consider adopting some of these practices.

Organic production is one of the fastest growing sectors in U.S. agriculture and has been estimated to be growing at about 20 percent per year for the past 10 years. It still represents less than 1 percent of total U.S. production. Georgia has even less organic vegetable production compared to many other states with approximately 1,000 acres in organic production compared to over 190,000 acres of total vegetable production alone. Although the Georgia organic industry is small, it is vibrant and active and continues to grow and attract interest.

Before undertaking any new enterprise, a business plan should be prepared. It may be worthwhile to consult an expert in this area so that all contingencies can be considered. You may wish to contact your local county extension office for assistance. They can draw on university resources in developing such a plan.

Potential growers need to consider production, labor, capital, land and marketing. Do you plan on working at this part-time while holding another job or is this a full time endeavor? Have you planned for sufficient income to live on while you develop and establish the business? Most businesses fail in the first year because they have not planned properly or they don't have sufficient resources to sustain the business while it becomes established.

With the adoption of the USDA's National Organic Program (NOP), a standard set of rules has been adopted nationwide defining certified organic production. This has been a great marketing tool for buyers and sellers of organic products that insures the integrity of what is sold. This program is voluntary and growers are not required to participate. Growers may not use the term "organic" if they are not certified, but this does not preclude growers who adhere to organic principles and techniques from marketing their produce. The only exception is growers with gross sales less than $5,000.00, which do not have to be certified, but if they use the term "organic" must adhere to the standards. Many growers with established clients and a track record of organic production may not wish to become certified, but may continue marketing their products under such terms as "sustainable," "natural," "environmentally friendly," etc.

Certification

In October 2002, the USDA adopted rules for certified organic production. These rules were 10 years in the making and included considerable input from the organic community. The initial rules were not considered adequate by many in organic production because they allowed the use of genetically modified organisms (GMOs), irradiation, and biosolids. The rules were rewritten forbidding the use of these materials. Certification is strictly a voluntary program to help organic growers and handlers sell their product.

Meat, poultry and dairy products are required to undergo USDA inspection and meet certain standards and grades for sale. Produce, in most cases, is not required to undergo USDA inspection and grading, although many growers do request this, because it helps to sell their product to distant markets that would otherwise not know the quality of their product. In this same fashion the organic standards allow organic growers to assure customers that their products meet federal standards for organic production.

The NOP website has the complete set of rules governing organic certification (Table 1, page 4). These rules include the methods and procedures that are allowed in organic production as well as allowed and prohibited materials. You should become familiar with the methods, procedures and materials allowed in certified organic production if you plan to become certified.

Table 1. Useful Websites.

USDA National Organic Program	http://www.ams.usda.gov/nop/indexIE.htm
USDA Fruit and Vegetable Grade Standards	http://www.ams.usda.gov/standards/stanfrfv.htm
Georgia Organics	http://www.georgiaorganics.org/
Georgia Department of Agriculture	http://www.agr.state.ga.us/
Organic Materials Review Institute	http://www.omri.org/
Appropriate Technology Transfer for Rural Areas	http://www.attra.org/
Local Harvest	http://www.localharvest.org/
Team Agriculture Georgia	http://www.teamaggeorgia.com/
UGA College of Agriculture and Environmental Science	http://www.caes.uga.edu/
Georgia Commercial Vegetable Information	http://www.cpes.peachnet.edu/veg
UGA CAES Cooperative Extension Service	http://www.caes.uga.edu/extension
Cooperative Extension Service - Horticulture	http://pubs.caes.uga.edu/ceaspubs/horticulture/horthome.htm

In Georgia, private companies and non-profit organizations handle certification. The complete list of certifying agencies is available on the NOP website. There are over 90 organizations worldwide recognized by the NOP to conduct organic certification. Growers in Georgia may use any of these organizations to handle their certification, but from a practical standpoint, growers will probably wish to choose a certifier close to home (Table 2, page 5).

New farms that have not been in conventional production or have not had any prohibited chemicals or practices for the past 3 years may acquire organic certification almost immediately. If the land has been used in conventional production or has had prohibited materials used within the past 3 years, it will be required to undergo 3 years of transitional production following approved organic practices before it can be certified. During this time, it cannot use the term "organic" but may indicate it is in transition.

If you plan on selling your produce packaged either raw or processed you will have to adhere to the standards concerning labeling as well. There are three categories of organic products that may be sold, "100% organic," "organic" and "made with organic." One hundred percent organic must be by weight or volume 100 percent organic ingredients excluding water and salt. Using the term "organic" must have 95 percent of their ingredients organic. Products with 100 or 95 percent organic ingredients may display the USDA organic seal (Figure 1). In addition to the USDA organic seal the product will have to have identifying information for the certifier. When applying for certification, the label that will be used on packaging should be submitted for approval.

The cost of certification usually ranges from $500.00 to $1,000.00 with recurring annual fees (check with the individual certifier for their fee structure). The process of certification will begin with the acquisition of a packet of information including a detailed questionnaire about your operation. Questions about past land history, land use plan, and crop production will have to be answered in detail. Along with this questionnaire, you will be asked to supply site maps, soil and water tests, a land management plan, and other documentation depending on your specific situation. The certifier can answer many of your questions, but remember they are a regulatory agent not an educational entity. The soil conservation service can supply information about your land and your local county extension agent can help you put together your packet of information. Along with this information, a fee will be required by the certifier to continue the process.

After the certifier receives your packet, they will review the information and contact you concerning any additional information they may require. An inspection will be arranged for the certifier's inspector to come and evaluate your operation. They will inspect your land and facilities to make sure it is in compliance with the rules.

After the inspection there may be additional information or operational changes that the certifier may require. Once all of these have been met, a certificate will be issued.

Figure 1. USDA Organic seal used on products 100% or 95% organic

Table 2. List of certifiers Georgia growers may use for certification*.	
Fertilizer and Seed Certification Services Clemson University 511 Westinghouse Rd. Pendleton, SC 29670 Contact: David s. Howle (864)646-2140 dhowle@clemson.edu Accredited: 4/29/2002	Georgia Crop Improvement Association, Inc. 2425 South Milledge Ave. Athens, GA 30605 Contact: Terry Hollifield (706)542-2351 georgiacrop@aol.com Scope: crop, livestock, handling Accredited:4/29/2002
Quality Certification Services (Formerly FOG) P.O. Box 12311 Gainesville, FL 32604 Contact: Marty Mesh (352)377-6345 fogoffice@aol.com Scope: crop, livestock, wild crop, handling Accredited: 4/29/2002	North Carolina Crop Improvement Association 3709 Hillsborough St. Raleigh, NC 27607-5464 Contact Myron O. Fountain (919)515-2851 myron_fountain@ncsu.edu http://www.nccia.ncsu.edu Scope: crop, livestock, handling Accredited: 7/9/2002
* Any certifier listed on the NOP website can be used. (http://www.ams.usda.gov/nop/CertifyingAgents/Accredited.html)	

One of the most important aspects is record keeping. What you plant, when you plant, and how crops are managed must be documented and available for inspection. The best way to do this is to keep a daily log of activities. You will have to demonstrate your ability to keep these records and show that they will be available for future inspection to keep your certification. Dual use operations (both organic and conventional) have the greatest burden to ensure organic products are not cross contaminated. Equipment used in both operations must be carefully cleaned before use in the organic operation. This requires diligence in record keeping to prevent future problems.

The final step after certification is to register with the Georgia Department of Agriculture, which keeps records of certified and non-certified organic growers. The Georgia Department of Agriculture website has the necessary forms (Table 1).

Organic certification is not required, however, the use of the word "organic" is restricted to certified organic growers. The only exemption from this rule is for growers with less than $5,000.00 in sales per year. Growers who use organic practices and methods, but not wishing to be certified can use terms such as all natural, environmentally friendly, sustainable, etc. but are precluded from using the term "organic."

Site Selection

The site chosen for vegetable production should receive full sun with no shade. In addition to shading, nearby vegetation can rob the soil of nutrients and water required by the crop. It should be well drained and have access to sufficient irrigation to supply the water needs of the crops. The site should be free of invasive, aggressively growing weeds. Also consider equipment access for farm operations, including harvesting and transporting product. The slope of the land should not be greater than 1.5 percent (18 in. in 100 ft.). On sites that are sloping, the grower may wish to consider terracing or contour planting where the rows are planted following the contour of the land to avoid topsoil loss to erosion.

In many cases not all of these site requirements can be met, but steps can be taken to minimize their effect. Full sun is very important for maximum productivity. If the site is shaded, even for part of the day, yields can be dramatically affected. Consider a different site or remove trees and shrubs that are shading the site or may be using nutrients or water from the site.

Drainage problems should be corrected prior to using a site. If water tends to accumulate at the site, consider tiling. Tiling involves burying tile cylinders or rigid perforated plastic pipe at the site where water accumulates. This will improve drainage by allowing water to drain away from the site. Another method to help control water accumulation is to use raised beds. These raised beds will drain more easily and the water can be directed away from the site. Growers should consider these solutions on problematic sites prior to planting. It is easier to prevent problems than to have to deal with chronic problems of erosion or lack of sunlight.

Irrigation water should be readily available to the site. Large wells (pipe diameter greater than 4 inches) require permits to dig and the permits may be difficult to acquire in some parts of the state. Remember one acre-inch is 27,154 gallons and you will need about 1-2 inches per week to produce most vegetables. Surface water can also

be used, but may require additional filtration particularly if a drip irrigation system is used. Pumps will either need access to electricity or be gasoline or diesel operated. If water is limited, conservation measures such as the use of drip irrigation and/or plastic mulch may be employed.

Organic content of 5 percent or more would be ideal for vegetable production, but may be impractical on the mineral soils of Georgia. Growers should increase organic matter through the addition of compost and green manuring. An increase to 2 percent organic matter is an attainable goal. Organic matter increases water and nutrient holding capacity for the crop as well as acting as a source of nutrients as it mineralizes over time. It can also improve aeration of the soil and increase the number and activity of microorganisms and earthworms.

Most soils in Georgia will have less than 1 percent organic matter. The high temperatures and humidity coupled with the mild winters means that organic matter breaks down rapidly in the soil. To increase and maintain higher levels of organic matter will require additions of organic matter annually, long rotations with green manuring, or using a no-till or strip-till system or some combination of the three.

Sites with invasive weeds such as bermudagrass or nutsedge should be avoided or steps taken to eradicate them prior to planting. Under organic production practices this may be difficult. Soil solarization, deep turning, and aggressive continued plowing may help, but such weeds can be very difficult to control.

Field access for farm equipment is crucial. Even shortly after periods of heavy rainfall it may be necessary to access fields for farm operations and harvesting. Field perimeter roads as well as public roads must be kept in good repair for access. Proper drainage and grading are essential. County governments are responsible for upkeep of public roads and should be contacted as soon as problems arise. Access to paved roads near farm fields is the ideal situation.

Many locations, even in urban areas, can be plagued by animals that will feed on and destroy crops. In unincorporated, isolated areas of many counties, nuisance permits for the control of such wildlife are available. In more populated areas these control measures may not be available. Fences of sufficient height, preferably electric, are ideal for controlling many nuisance animals. These animals can destroy an entire crop in a single night, so if there is any possibility of damage, corrective measures should be taken early. Control of nuisance birds may require the use of noisemakers and/or fine netting.

Domestic animals such as cats or dogs as well as farm animals should be excluded from growing areas. Animals can destroy crops by trampling or feeding and fecal matter can be a serious source of human pathogens.

In operations where direct marketing to the public will be undertaken, as direct sales or pick-your-own, growers should consider public access. This includes ease of access to fields, walkways, parking, and handicap access. Restroom facilities may also be required. A well maintained and landscaped operation will increase traffic and enhance sales. Liability insurance is strongly recommended and safety should be paramount.

Site Preparation

Site problems and the size of the location will often determine what methods are used to prepare for planting. With small sites, permanent raised beds may be a good choice that minimizes compaction, holds organic matter in place, and can be easy to work and harvest.

Larger sites where tractors and other equipment will be used should be prepared in one of several ways. Most vegetable production in Georgia relies on clean cultivation where all the previous crop residue has been worked into the soil, often deep turned resulting in soil free of crop residue. The advantage of such preparation is that no allelopathic (killing) effects from previous crop residue occurs. A smooth, debris-free bed is ideal for direct seeding where precision of seed placement is critical. The disadvantage of clean cultivation is that organic matter is lost more quickly with such preparation. Accelerating the loss of organic matter in a hot, humid environment already suited to rapid loss of organic matter can be problematic when trying to increase organic matter in the soil. In most cases this will require the addition of organic matter annually in order to see a benefit.

Deep turning and/or using a chisel plow can aid in root growth, water infiltration, and improve soil aeration. Many soils particularly heavier clay soils are prone to compaction and the formation of a hardpan. Hardpans are hard impervious layers that develop below the surface at the plow depth. These can be difficult to breakup and may require the use of a large tractor capable of pulling a chisel plow. Hardpans are less likely to occur on the sandy loam soils of south Georgia, but deep turning can still be an aid to crop performance. Many of the lighter soils of south Georgia are underlaid with a clay horizon. This clay horizon can often be brought to the surface with deep turning and may affect the soil pH in the root zone. This clay is often visible at the surface after deep turning as a yellowish layer. Such soils should have their pH retested and limed if required.

Soil Management

If organic production were represented as a pyramid, soil management would be the base of that pyramid. Careful planning and management of this resource leads to successful crop production. Managing this resource to

produce good yields of high quality produce requires a long-term commitment. Yields can be substantially lower during the period when fields are transitioning from conventional to organic production.

Organic vegetable production relies primarily on soil management to produce the crop. Good management of the soil begins with a soil test. This will give you information on the relative fertility of the soil, the pH of the soil, and fertilizer recommendations. Organic growers should have the percent of organic matter present determined. Although organic growers don't use inorganic fertilizers, these recommendations can be helpful in gauging the fertility of the soil. Soil pH is an important factor in determining nutrient availability. Most soils in Georgia tend to be acid so periodic liming is required to insure a pH of 6 to 6.5, which is ideal for most vegetable production.

Several methods are used to increase and maintain productivity. These methods increase the number of organisms in the soil that are beneficial for plant growth. The most important method is the addition of organic matter. An acre-furrow slice is estimated to weigh 2 million pounds therefore to increase the organic matter to 5 percent would require the addition of 100,000 pounds or 50 tons per acre of organic matter. Although having 5 percent organic matter would be ideal, increasing organic matter to 2 percent is beneficial. Ideally, this organic matter will be produced on-farm, increasing sustainability (reducing off-farm inputs). In many cases it will not be feasible to produce this much organic matter on-farm. Various sources are available for organic matter that can be added to the soil.

Table 3 lists several sources that may be available. These should be composted prior to application,

Table 3. Guide to Mineral Nutrient Value of Organic Materials.

Materials	Percent[1]			Availability
	N	P_2O_5	K_2O	
Bone Meal (raw)	2 to 6	15 to 27	0	Slow
Bone Meal (steamed)	.7 to 4	18 to 34	0	Slow Medium
Castor Pomace	5	1.8	1	Slow
Cocoa Shell Meal	2.5	1	2.5	Slow
Compost (not fortified)	1.5 to 3.5	.5 to 1	1 to 2	Slow
Cottonseed Meal (dry)	6	2.5	1.7	Slow Medium
Dried Blood (dry)	12	1.5	.6	Medium Rapid
Fish Meal (dry)	10	4	0	Slow
Fish Scrap (dry)	3.5 to 12	1 to 12	.08 to 1.6	Slow
Guano (bat)	5.7	8.6	2	Medium
Guano (Peru)	12.5	11.2	2.4	Medium
Kelp[2]	.9	.5	4 to 13	Slow
Manure[3] (fresh)				
Cattle	.25	.15	.25	Medium
Horse	.3	.15	.5	Medium
Sheep	.6	.33	.75	Medium
Swine	.3	.3	.3	Medium
Poultry (75% water)	1.5	1	.5	Medium Rapid
Poultry (50% water)	2	2	1	Medium Rapid
Poultry (30% water)	3	2.5	1.5	Medium Rapid
Poultry (15% water)	6	4	3	Medium Rapid
Marl	0	2	4.5	Very Slow
Mushroom Compost	.4 to .7	.57 to .62	.5 to 1.5	Slow
Peat and Muck	1.5 to 3	.25 to .5	.5 to 1	Very Slow
Sawdust	4	2	4	Very Slow
Soybean Meal (dry)	6.7	1.6	2.3	Slow Medium
Tobacco Stems (dry)	2	.7	6	Slow

especially if a food crop is going to be planted immediately after application. In Georgia, various animal manures, cotton gin trash, peanut hulls, and yard waste are common sources of organic matter. High quality compost may also be available from commercial sources. For large-scale application, a manure spreader is the fastest and most economical method of application.

Another important part of soil management is the use of cover crops and green manure. Cover crops help keep topsoil in place when fields are not being used for production. They also help hold nutrients in place until needed for the next crop. These cover crops may be turned under to increase the organic matter of the soil and make nutrients in the plant available for subsequent crops. Turning under a crop for this purpose alone is called green manuring and the crop is called a green manure. Table 4 lists a number of common crops grown as green manures. Legumes are especially good as green manure crops because of their ability to form symbiotic relationships with nitrogen-fixing bacteria. These bacteria, that colonize the roots of legumes, are capable of extracting nitrogen from the atmosphere and converting it to a form that plants can use. This nitrogen is made available to the legume crop and when turned under and allowed to decompose becomes available for the next crop. In some cases up to 60 pounds of nitrogen per acre can be made available for subsequent crops, although 30 pounds per acre of nitrogen is more realistic.

Cover crops must be carefully monitored so they are turned under at the optimum time. If small grains are used, they must be turned under before their flowers mature and seed is dispersed. This seed can become a source of weeds in subsequent crops.

In the south, due to the long growing season, it is possible to plant successive crops. Successive planting is planting different crops on the same ground within the same year. This differs from rotation, which is planting different crops on the same ground in different years. In both cases, soil fertility can be maintained or improved and soil borne diseases can be minimized.

Planning is the key to successful use of successive or rotation planting. For example, a spring crop of snap beans (legume) may be followed by a fall crop of cabbage. Snap beans add nitrogen to the soil and cabbage, which is a heavy feeder, benefit from this added nitrogen.

Crop rotation on the other hand is practiced over years and in some cases may extend from 3-8 years with different crops. Along with managing soil fertility with successive planting, soil borne diseases such as nematodes can be reduced. Non-host species such as small grains or marigolds may be planted on a site one or more years to reduce nematode populations which will help the subsequent crop production, particularly if a highly nematode susceptible crop such as okra is planted.

Very small operations can be highly productive by establishing and maintaining small plots of very fertile soil. This is often accomplished in raised beds surrounded by walkways. The soil in these beds is carefully managed to maintain optimum fertility. Under such circumstances, plants can often be planted closer for increased productivity. Trellises and staking can also be used to maximize yield and quality.

Because of the long growing season and relatively mild winters in Georgia, breakdown of organic matter occurs almost continuously. This makes it difficult to increase and maintain organic matter in the optimum range for growth in Georgia. This is particularly true when soils are subject to frequent cultivation. An alternative is to use conservation tillage methods that reduce or eliminate soil cultivation.

No-till production uses no form of cultivation in production. This year's crop is planted in the stubble of the previous crop or cover crop residue. The soil is never disturbed more than to put seed or plants in the ground.

Table 4. Green manure crops, season of growth, amount of seed per acre, type, and nitrogen per ton of material

Crop	Season	Seed (lbs./acre)	Type	Nitrogen (lbs./ton dry material)
Crimson Clover	Winter	15	legume	45
Vetch	Winter	30-50	legume	62
Southern Pea	Summer	90	legume	60
Soybean	Summer	75	legume	46
Buckwheat	Summer	75	non-legume	14
Sudan Grass	Summer	25	non-legume	28
Rye	Winter	75	non-legume	21
Wheat	Winter	75	non-legume	20

This type of production usually requires a higher horsepower tractor to deal with the added resistance expected when pulling seeding and/or transplanting equipment through the previous crop stubble. Tractor size may not be as much of an issue in south Georgia where light sandy loam soils exist. In the heavier north Georgia clay soils this may be a critical factor. The no-till seeding and transplanting equipment is specially designed to open a furrow for planting in this stubble. This is done with the addition of coulters, usually two, to cut open the ground.

Modifications of the no-till system have also been used such as strip-tilling. In this system narrow strips of ground are prepared as in conventional tillage, but the surrounding area is left undisturbed. This has the advantage of keeping previous crop and/or cover crop residues away from the new crop. This can be important because of allelopathic effects of previous crops. This can be particularly true with wheat or rye, which both exhibit strong allelopathic effects. In addition, research has shown that no-till systems tend to delay harvest; therefore if earliness is an important factor in production growers may not wish to use these systems.

Finally, weed control can be a difficult problem in no-till systems. The previous or cover crop may become a source of weeds. A no-till approach is unlikely to wrok alone in organic production. Seed from the previous crop and/or other weeds will have to be dealt with. Adding various mulching materials to suppress weeds or additional mechanical weed control will be necessary.

Under the NOP rules plastic mulch is allowed as long as it is removed from the field and disposed of appropriately. Every attempt should be made to reuse and/or recycle the material. There are several different types of plastic available with varying grades of thickness and color. The most commonly used plastic mulch will be black, but other colors, such as red, green, and even reflective silver are available.

For very small areas plastic mulch can be put out by hand, but this is impractical with larger areas. Plastic laying equipment is available and can lay plastic efficiently and rapidly. This equipment is designed to lay plastic so that it is in close contact with the soil surface, with a taut surface that has been properly tucked at the edges preventing it from coming loose. This equipment will also be able to lay drip-irrigation tape under the plastic in the same pass.

Plastic mulch can have many beneficial effects on plant growth, however, some organic growers may object to using a synthetic material like this. It is allowed under NOP rules as long as it is removed from the field and/or disposed of properly. Plastic mulch can be particularly helpful for weed control (see weed control section). It can also help in conserving soil moisture, increasing or decreasing soil temperature, promoting early plant growth, and controlling insects and diseases (see insect and disease control sections).

Black plastic will help warm the soil as it absorbs sunlight. This can be important in accelerating plant growth in the spring. Plastic mulch will conserve soil moisture resulting in lowering irrigation needs. Mulches of different colors (green, blue, red, yellow, etc.) have been evaluated experimentally with varying effects, but they have not been shown to have consistent practical applications. White plastic is often used for fall crops to reduce soil temperatures while offering other benefits of using plastic.

In some cases, plastic mulch can be lifted and reused, but this is generally done in very small operations. Using thicker films can extend the usefulness of the mulch over more than one season. The plastic can sometimes be used for three or four crops over a 2-year period before having to be removed.

Plastic mulch is recyclable into dimensional lumber. The material should be as clean as possible containing little soil and crop residue. Plastic mulch that contains too much soil and plant residue cannot be recycled. Recycling is only cost effective if sufficient amounts of the material are available for pickup. Small growers should pool materials to make recycling cost effective. Your local county extension agent will be able to assist you.

Fertilization

In organic systems it is often said feed the soil not the plant. Conventional production systems rely on supplying the necessary nutrients, particularly the primary nutrients of nitrogen, phosphorus, and potassium (N, P, & K) in the necessary quantities to maximize yield and quality. Organic systems rely on the intrinsic fertility of a well-managed soil that has a high degree of organic matter with a healthy micro-flora and micro-fauna. It is unlikely that the organic matter alone will be sufficient to supply the required nutrients in a timely fashion particularly in the first year or two of production. Supplemental sources of fertilizer particularly high in nitrogen will be required. Organic production is cognizant of the potential for nitrogen runoff with the concomitant environmental degradation, so be careful when applying..

There are several sources of high nutrient content organic fertilizers. With the advent of national organic standards there has been an increase in commercial organic fertilizer products. These materials offer convenience and repeatability of results, but are often quite expensive with limited local availability. As organic production increases in Georgia, the necessary supply chains may develop offering more choices of reasonably priced organic fertilizers.

Poultry litter is a locally available cheap material that is relatively high in nitrogen. Poultry litter is the material removed from poultry houses after the birds have been harvested. The starting material is ground pine bark or wood shavings spread in the poultry house at the start of production to absorb bird droppings. This material is removed from the house at the end of each production cycle. It usually contains about 30 pounds of available nitrogen per ton of material with an additional 30 pounds tied up in the organic matter. The advantage of this material is its wide availability and relatively low cost. It is usually delivered and spread as part of the purchase price (minimum purchase required, usually 5 yards or more). Another advantage of this material is it is a good source of nitrogen to catalyze composting (See section on composting). The disadvantage of this material is the strong ammonia odor and the possibility that the material may be a source of Salmonella. Rubber gloves and a dust mask should be used whenever handling this material.

Other sources of organic fertilizer include other animal manures. These would be restricted to those animals that are routinely confined. Dairy and swine operations, as well as horse farms may be sources of animal manures. Materials from these operations are not generally transported off site and will probably require special arrangements with the owners. The same disadvantages concerning human pathogens as mentioned with poultry litter would apply here. Cattle manure, for example, can be a source of *E. coli* O157:H7. These can be excellent materials for use in composting, which would also minimize pathogenic problems. The NOP rules require that any fresh animal manure used in organic production be applied at least 90 days prior to harvest for crops that will not have the harvested portion in contact with the manure. For crops such as root crops where the harvested portion will be in contact with the manure the requirement is 120 days.

Plant material wastes such as yard waste, tree trimmings, cotton gin waste, etc. are not as effective as fertilizers, but are excellent materials for composting (See section on composting). The fertility value of compost may not be evident the first year it is applied particularly in new operations. It may take a year before sufficient mineralization occurs to release the nutrients. Its value initially lies in its ability to affect water holding capacity, tilth, and nutrient holding capacity of a soil. It may take 2 to 3 years for organic operations to see their soil improve with increased productivity.

Weed Control

Weed control is the most problematic issue in organic production. Herbicides are not generally used; therefore, growers must rely on other methods to control weeds. Weeds can very quickly overcome production if left unchecked. Growers need to plan ahead and decide what they will do to combat this problem. A grower may have to scale back production; better to produce reasonable yields of high quality produce than to produce weeds, with little or no yield.

If site selection is possible, avoid sites with particularly troublesome weeds like nutsedge and bermudagrass. Nutsedge reproduces asexually from underground nodules ("nuts") that make it very difficult to control. When these weeds are pulled these nodules remain in the soil and new growth can quickly form. Nutsedge can quickly spread covering large areas from a single nodule. Bermudagrass is another aggressive weed that grows from prostrate stems called stolons. This weed can reproduce from any piece of stem material remaining in the soil, rapidly covering an area.

One method that can be very effective at controlling weeds is stale seedbed preparation. This will work only with seed propagated weeds. After the seedbed has been prepared allow it to sit undisturbed for a week or two. This will allow many weed seeds to germinate. At this time lightly till the soil (top 2-3 inches) to kill these weeds. This will dramatically reduce the first flush of weeds. Don't deep turn the soil, as this tends to bring weed seeds up from deeper in the soil.

Plastic mulch has also been used effectively against many weeds. These mulches are available in a number of different colors as well as clear. Some organic growers may object to using a synthetic product like this, but under the national rules it is allowed as long as the material is removed at the end of use. Black plastic is the most commonly used plastic mulch and can be very effective in controlling many weeds. It will not be effective in controlling nutsedge, which is capable of pushing through this mulch. In addition, weed emergence in the planting hole can cause severe yield loss if not managed.

The use of clear plastic on fallow land to help control soil borne diseases, weeds, and insects is called solarization. Clear plastic is laid over turned, slightly moistened soil and is left in place for a minimum of 4 weeks. This is more effective in regions of the world with plenty of sunshine for prolonged periods of time. This method is not as effective in Georgia with its frequent rainfall and overcast days. Months that are traditionally dry are probably the best. Ideally the soil temperature should be raised to 140-180 degrees F in the top 4-6 inches for this to be effective.

Biodegradable plastics have recently become available. These plastic mulches are manufactured from biodegradable products and will eventually break down. The breakdown of these products can be rapid, with tears occurring within 30-45 days of application. This may not

be long enough for these products to effectively control weeds throughout the production cycle.

Other materials can also be used as mulches to control weeds. Natural materials such as hay or straw, wood chips, pine straw, and pine bark can be used as mulches. Some materials such as wheat or oat straw have strong allelopathic effects and will inhibit the growth of other plants. This can be extremely advantageous with long-term control of weeds. It can also be a disadvantage if care in placement is not exercised since these same allelopathic effects can adversely affect your crop. Most of these materials are widely available in Georgia and for a reasonable price.

Physical means of weed control are the most important methods in organic production. This can be anything from the hoe to more sophisticated power driven equipment.

Hand weeding equipment can be selected for specific situations. To get between closely spaced plants, narrow or pointed hoes are available. Scuffle hoes with a narrow horizontal blade can be very effective on small weeds between rows.

There are a number of different weeding mechanisms available. Some are highly specialized for specific crops or situations and many can be quite expensive. Table 5 lists several types of equipment with their respective uses, pros and cons. Figures 2 and 3 (page 12) show types of tillage equipment. Before purchasing such equipment, it is a good idea to see the equipment in operation. It would be particularly beneficial to see the equipment operating in the crop(s) you plan to grow. Some of this equipment can be very expensive, so knowing it will be appropriate for your situation is critical.

Flame weeding is available for weed control. This relies on propane gas and burners that direct a flame to control weeds. Some are tractor mounted to control weeds in multiple row applications. Hand held units are available that can be directed around individual plants. This equipment can be very effective in controlling weeds, even very difficult to control weeds. The flame can be difficult to see in bright sunlight and care must be exercised not to damage plants or cause personal injury. Use at dawn or dusk can help to view the flame and avoid these problems.

Table 5. Weed Control Equipment for Organic Purposes.

Equipment Type	Use	Pros	Cons
Field Cultivator	Final bed preparation, clear debris, break clods	Relatively low horsepower requirements, preplant bed preparation	Not used for heavy weed removal, cannot be used after planting
Flex-tine Weeder	Blind cultivation after seeding/ Between row weeding	Inexpensive. Several versions to choose from, both flexible and rigid tines available	Between row accuracy not as good as other devices. Weeds should be small.
Rotary Hoe	Between row cultivator	Ground driven. Can handle larger weeds.	Accuracy not as good as other devices.
Basket Weeder	Between row cultivator	Good accuracy	Use on small weeds. Not very effective on heavy soils.
Finger Weeder	Between row and in-row weeder	Very accurate. Lateral movement can be controlled during operation on some models. Can handle larger weeds.	Expensive. Rubber coated fingers can clog with clay. Contact with plants may cause damage.
Sweep & S-tine	Between row cultivator	Sweeps are very effective where erosion may be a problem.	Operator experience important to prevent damage to plants.
Brush Hoe	Between row and in-row cultivator	Very accurate in weed control.	Expensive. Many require second person to operate.





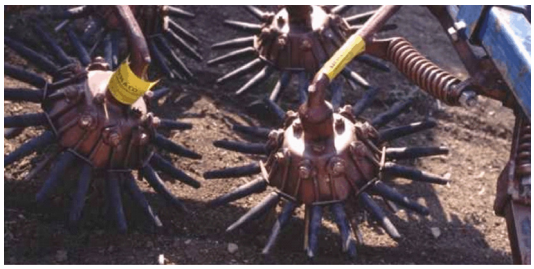
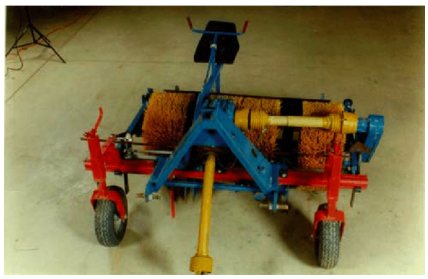



Figure 2. Examples of cultivating equipment. Field Cultivator (top left), Flex-tine weeder (top center), Rotary hoe (top right), Rotary hoe (middle left), Basket Weeder (middle center), Finger weeder (middle right), S-tine cultivator (bottom left), and Sweeps (bottom right)

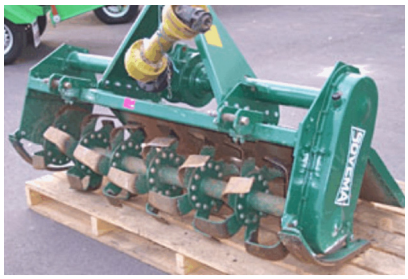



Figure 3. Additional cultivation equipment. Vertical brush hoe (top left), Horizontal brush hoe (top center), Shielded rototiller (top right), PTO driven rototiller or rotovator (bottom left), Garden rototiller (bottom right)

Several different natural herbicides currently are being marketed. Most of these are based on citric acid or clove oil. They are non-selective contact herbicides. These products will burn-down contacted plants but generally will not kill plants completely requiring a second application. These products are also expensive and may not be cost effective for weed control where constant application is required.

Disease Control

Diseases require a susceptible host, a pathogen, and an environment conducive for development. Some diseases require a vector, usually an insect, to transmit the disease from one plant to another.

There are many cultural practices growers can use to control diseases. One step growers can take is to minimize leaf wetness for extended periods of time. Many diseases, particularly fungal pathogens. require moisture to survive and spread. Using drip irrigation rather than overhead irrigation and irrigating when conducive for rapid drying of leaf surfaces may help but will not completely control all diseases. Splashing rain spreads diseases, particularly bacterial diseases, from the soil and from one plant part to another. Mulches can help minimize this problem.

Plants that can be trellised or staked, such as tomatoes or peppers, can be helped by keeping plant parts from contacting the soil, which may accelerate disease development. Avoid or correct problems of standing water, which can increase certain disease problems. Vining crops, such as cantaloupe and cucumbers, can be helped by keeping fruit from contacting the soil. This is usually done by growing them on plastic mulch.

Sanitation is also important in minimizing disease. Compost diseased plant parts in such a manner that they undergo sufficient heat to kill the pathogen. If you are unsure about such material, remove it and disposed of it so it will not infect subsequent crops. Clean cultivation with deep turning previous crop residue can also help control diseases.

Under NOP rules, the copper fungicide, Bordeaux mixture can be used. This fungicide is a mixture of copper sulfate and lime and has been effective in many situations. Bordeaux mixture is both a fungicide and bactericide and can be used to control both types of diseases.

When available, use of resistant crop varieties can help in controlling diseases. Check with seed companies to see what varieties are available with disease resistance. This is often the only method of effectively controlling many diseases.

It may be possible to avoid some diseases. Some diseases are more prevalent during certain times of year either because of temperature or other factors that are conducive for disease development. For example, virus diseases in squash are more prevalent in the fall than in the spring because they are spread by aphids, which are more prevalent later in the season.

Reflective mulches have been effective in reducing certain insect infestations, which transmit viruses. This is evident with aphid transmitted viruses in summer squash. The reflective surface is believed to confuse the insect, which does not light on the plant and consequently does not infect the plant. This method of control usually delays infection so more fruit can be harvested, but eventually the plants are infected.

Insect Control

Insects can be difficult to control when they reach epidemic proportions. The key is to not let insect populations get to this level if possible. Begin by evaluating your production area. There are many natural predators that should be encouraged and protected in your production system. For example, have places that encourage wasps and other predators to build nests. This can be as simple as a board nailed to a fence so that they can build a nest out of the rain. Planting annuals and perennials that encourage predator insects. Small flowering annuals such as alyssum or buckwheat will attract insects such as big-eyed bugs. Border shrubs offer a sanctuary for predators particularly between crops. Insect predators will help keep pests under control, but will not offer total control, after all the predators have to continue to feed on something. In this kind of scenario, some damage has to be tolerated, the point is to avoid catastrophic loss from epidemic pest populations.

As the organic industry has matured, several companies offer predators you can buy and release to help control insect pests. These insects work better under enclosed production such as greenhouses or hoop houses. In some cases, they may not be very effective because of the time of year, stage of life cycle or environmental conditions.

Natural products can be used to control insects. Products such as Bt represent a unique approach for insect control. Bt, or *Bacillus thuringiensis*, is a bacteria that infects lepidopterous pests. In the caterpillar stage, as the insect feeds on the plant and ingests the Bt, it infects the insect. Caterpillars will eventually stop feeding and die. Growers should investigate these products and use them as needed. Remember these products target only specific insect pests and must be ingested by the insect to be effective. Special devices for the application of Bt (Zea-Later II, Johnny's Selected Seed, Winslow, ME) have been developed to apply the product directly onto developing corn ears, which increases its effectiveness.

Planting date can be important in minimizing or eliminating insect pest problems. Generally, spring planted crops will have less problems with insects than fall planted crops. The warm spring and summer, with abundant food, allows many insects to rapidly increase their population, which can reach epidemic levels during fall production. Market timing is important for crop production. You may not have any alternative but to grow fall crops, which should be carefully scouted regularly in order to act quickly and minimize problems.

Using trap crops can also be helpful in controlling some insect pests. Many pests have a preference for specific plants. For example, diamondback moth can be reduced in cabbage that has been surrounded with a planting of collards.

Crop selection can also be an important method of minimizing insect problems. The brassicas can be plagued with caterpillar damage. Controlling caterpillars in cauliflower or broccoli is more difficult than in kale or collards. The caterpillars can get into the flower where it is almost impossible to control.

Early spring can be problematic for thrips, especially in years with a mild winter. They can cause physical damage to the plant and are known to transmit Tomato Spotted Wilt Virus (TSWV).

Using insect resistant varieties is a good way to minimize damage and crop loss. Most insect resistance is highly specific to a particular insect and therefore may not be satisfactory, since other insects may fill the void. Although there are many examples of insect resistant plants, there may not be many varieties that are commercially available for a particular vegetable.

Composting

Composting is the aerobic (requires oxygen) breakdown of formerly living tissue into an amorphous organic material in which the parent material is largely unrecognized. In nature, a similar material forms in ecosystems such as forests and prairies where plant material returns to the soil and is slowly broken down and the constituent minerals are again made available for plant growth. Compost is a nutrient rich amendment that improves soil in several ways. Along with being a source of plant nutrients, compost will improve both the nutrient and water holding capacity of soils. It can improve the structure of soil by aggregating particles, which improves aeration and water infiltration.

There are two methods of composting, passive and active composting. In passive composting, organic materials are added to the compost pile and allowed to breakdown naturally. In active composting, the pile is turned on a regular basis which accelerates and maintains the composting process.

Passive composting can be slow and, if there is not enough oxygen present, it can begin to break down anaerobically (without oxygen), which will begin to smell. This often occurs if it is too moist in the pile without adequate drainage. This can occur particularly during times of heavy rain. Passive composting, however, does not require much work. It may take a year or longer to complete depending on the material. With passive composting, new material is regularly brought in, piled, and allowed to decompose, while older material is moved to fields for incorporation. Planning is key because of the long duration of passive composting.

Active composting is usually done in batches with the proper ratio of materials combined and turned regularly until the compost is finished. If animal manures (cow manure or poultry litter) are used, use active composting. Turning the pile ensures that all parts of the material are exposed to the high temperatures required to kill human pathogens. The materials used in composting are often referred to as feedstocks. Building a proper compost pile requires the right mix of feedstocks to start and maintain the composting process. Commercial operations refer to the proper carbon: nitrogen ratio for good composting. According to the NOP this range is required to be between 25:1 to 40:1. An easy way to look at this is the proportion of brown and green materials. Brown materials are rich in carbon and relatively low in nitrogen, which would include leaves, ground pine bark, shredded or chipped wood, and straw. Green materials are rich in nitrogen and include grass clippings, poultry litter and manures. When forming a compost pile expect about 80 percent of the material by volume to be brown materials and 20 percent to be green materials for optimum composting. These should be thoroughly mixed to begin the process. Turning a compost pile every 3-7 days ensures the process goes to completion and occurs rapidly, but is not absolutely required. You can be sure the process is ongoing by the heat generated within the pile. A properly prepared and maintained compost pile can reach temperatures of 130-170 degrees F. If there is no heat, then the process is not occurring. After 4-6 weeks, the heating process will dissipate (dropping below 100 degrees F) followed by 8-12 weeks during which the compost will mature. Without turning, the process may stop before the breakdown is complete and may take much longer.

Large scale active composting can be done in several ways. Dedicated composting operations will often use a static or in-vessel process or a windrow system (Figure 4). Static systems contain all of the feedstocks within a vessel or building. This environment is then manipulated to start and maintain the process. This often includes mechanical mixing or forcing oxygen into the system.

Figure 4. In-vessel composter (top) and Windrow composting operation (bottom).

Avoid fresh sawdust; particularly from old pressure treated lumber. Fresh sawdust takes a long time to break down and can deplete nitrogen, stopping the composting process. New pressure treated wood uses a less toxic process, but old pressure treated wood relied on arsenic compounds which are very toxic. Leaves, twigs and branches will compost more quickly if they are shredded or chipped before adding to the compost pile.

Meats, bones, grease, and similar items should be avoided. The odor can attract vermin, and grease blocks air flow. Do not add manures from your cat or dog. They will smell and may present a disease problem. Manures from horses, cows, and chickens are usable, but should be handled carefully. Rubber gloves and a dust mask are recommended if handled in enclosed areas. These products should be handled with the same caution used when handling pesticides. Neighbors may not appreciate the barnyard smells. Poultry litter, in particular, has a very strong ammonia odor.

Once the compost has stopped heating it must be allowed to mature for 2-3 months. There can be materials in the compost that are toxic to plants if it is not allowed to mature. This can be particularly problematic if you plan on using the compost in media to start seedlings. Once compost has matured it can be added to your fields, used in landscaping, used as mulch, or as an addition to seedling media.

It is unlikely that a small organic operation will generate enough organic refuse to supply sufficient feedstocks for composting. Growers will have to find reliable sources of feedstocks in order to produce compost for their operations. There are many sources available in Georgia including cotton gin trash, peanut hulls, packing shed waste, municipal yard waste, and poultry litter. Growers may not wish to produce any compost at all, choosing to purchase compost from a reliable commercial source.

Vegetable Selection

The most important criteria needed for vegetable selection is what the market demands. There is no point growing vegetables that no one wants to buy. A good business plan with identified markets of specific crops is the primary reason for selecting a particular vegetable to grow.

Not all vegetables are suitable for all situations. Climate, disease, and insect problems will be important criteria when selecting vegetable crops. One year's results might not be enough to determine the success of a particular vegetable. A mild winter may result in a greater insect problem than one might expect the following season. On the other hand, a cold winter may result in sufficient suppression of the insect to make for a successful year. Organic production has greater challenges in many cases because pesticide use is discouraged. Some vegetables are particularly susceptible to certain insects or diseases that may make it uneconomic to produce organically. Timing can also be an important part of the selection process. Trying to hit a specific market window or avoiding certain diseases or insects are important considerations. Vegetables commonly grown in your area are your best bet for success. Other growers and your local county extension agent are good sources of information for crop selection. As you try different crops keep detailed records so that this information can be used in planning subsequent years. Don't rely on your memory. Many growers recommend the use of a calendar book, where information can be recorded each day.

Variety Selection

Variety selection is another important consideration when selecting crops to be grown. The market and your buyers may have specific requirements on variety selection. They may want specific characteristics of color or form or they may in fact request specific varieties.

When available, varieties with disease and insect resistance are best. Resistance however is seldom 100 percent, and the plant may show some symptoms, but less severe symptoms than with susceptible varieties.

Varieties can be grouped into two broad categories based on how they were developed. F_1 hybrids are developed from crossing lines, which have been inbred for several generations. These varieties have advantages of increased uniformity and, often, increased yield The disadvantage of these varieties is the seed are more costly and seed saved from hybrids will not perform as well as initial seed (they are said not to be true-to-type). The seed companies are constantly changing F_1 hybrid varieties, so an F_1 variety you particularly like may be difficult or impossible to buy after a few years. Not all vegetables lend themselves to F_1 production. Because of the low amount of seed produced from each cross, beans and peas are not available as F_1 hybrids.

Open-pollinated varieties are less expensive and popular open-pollinated varieties will remain in the market for years. These seeds are true-to-type from one year to the next.

Most older varieties are open-pollinated types. Very old varieties that have been passed down through families are called heirloom varieties, and many can be dated to the 19th century and earlier. These varieties are often sources of unusual colors, shapes, and flavors. There has been growing interest in heirloom varieties. Their popularity has resulted in many now being available from commercial sources.

Several vegetables are reproduced vegetatively, or from parts of the plant itself. These would include such things as sweet potatoes and Irish potatoes. To improve results with these crops, buy certified slips for sweet potatoes and seed pieces for Irish potatoes. Certification insures true-to-type, disease-free material.

In certified organic production, genetically modified organisms (GMOs) are not allowed. Under NOP rules, growers are required to attempt to source organic seed, but may use non-organic seed if organic seed of the vegetable and variety they wish to grow is not available, but it must, in either case, be untreated.

Along with market demand and insect and/or disease resistance, there may be other criteria for selection. Earliness, ease of harvest and handling a should also be considered.

There is a growing interest among organic growers to save their own seed. Specific varieties, particularly heirloom varieties, may not be readily available or not available at all unless you save the seed. There are many good information sources on harvesting, extracting, cleaning and storing your own seed. Some open-pollinated varieties are patented, however. These varieties will often have the designation PVP, which stands for plant variety protection. It is illegal to save these seeds without making arrangements with the patent holder or paying royalties.

Organic seed production, particularly for the certified organic market, has been under served and may be a good source of income.

Production of Selected Vegetables

It is impossible to give detailed instructions on organic production of all the vegetables that can be produced, nor all the methods used in their production. A selection of the more important vegetables grown organically will be reviewed with suggestions concerning cultural practices, varieties, pests, and fertilization. Although many organic growers will not use specific recommendations of pounds per acre of nitrogen, phosphorus, and potassium, these numbers can be helpful in determining the fertility demands of specific vegetables and if they are heavy, medium or light feeders.

Vegetables are classified into two broad groups based on their adaptation to temperature. There are cool season and warm season vegetables. These groups are further broken down into hardy and half-hardy cool season vegetables and tender and very tender warm season vegetables. Hardy vegetables can withstand some freezing temperatures with frosts. Half-hardy can withstand frosts, but not freezing temperatures. Tender vegetables can withstand some time below 55 degrees F, but require warmer weather for good growth. Very tender vegetables cannot stand temperatures below 55 degrees F.

Beans

There are several different species of beans that can be grown in Georgia, snap beans being the most common, but lima beans, fava beans, and other legumes can be produced in the state. All beans are tender with the exception of fava or broad beans, which are hardy. All bean varieties are open-pollinated since it is uneconomical, due to the small number of seeds per cross, to produce hybrids. They are easy to grow and add nitrogen to the soil. They can be planted in masses with the seed lightly turned under. As seedlings emerge they form a ground cover shading out weeds. They can be harvested immature for fresh markets or allowed to fully mature as dry beans. A variety of colors are available for dry bean production. Because they are all open-pollinated varieties, they will breed true-to-type if the seed is saved.

Spacing	Varieties	
Rows: 30-36" **In-row**: 3-6" Other arrangements possible	Bronco, Blue Lake 274, Roma II, Kentucky Wonder 191 (pole), Rattle Snake (pole), Henderson Bush (Lima), Fordhook 242 (Lima)	
Nitrogen Fertilization*	**Planting Dates**[+]	**Days to Harvest**
Coastal Plains Beans: 70-100 Pole Beans: 100-140 **Piedmont** Beans: 60-80 Pole Beans: 90-120	**North** Spring: 5/1-7/15 Fall: NR **South** Spring 2/15-4/30 Fall: 7/15-9/15	50-90 days ^

^ Dry beans will take longer to reach ful maturity

[+] NR - Not Recommended

*Nitrogen recommendation is for lbs/acre. For phosphorus and potassium requirements, a soil test should be taken.

Brassicas

Brassicas encompass a large assortment of cool season vegetables including collards, broccoli, cauliflower, kale, mustard, and cabbage. They may be hardy as in cabbage or collards or they may be half-hardy such as cauliflower. There are other less well-known specialty items in this family you may wish to grow as well. Many of these vegetables, particularly those grown for leaves (ex., collard and mustard), are harvested immature while the leaves are extremely tender. These "baby" vegetables are often harvested several times from mass plantings by clipping the new growth as it appears. This harvest is particularly prized by high-end restaurants and gourmet cooks. Brassicas can be plagued by several species of caterpillars that, in some cases, can be difficult to control. Careful scouting, and use of Bt products is recommended.

Spacing	Varieties	
Rows: 36-48" **In-row**: 9-24" Other arrangements possible	Too numerous to mention. Check with your buyer, county agent, and/or vegetable seed company	
Nitrogen Fertilization*	**Planting Dates**[+]	**Days to Harvest**
Coastal Plains 175-225 **Piedmont** 150-180	**North** Spring: 3/15-4/30 Fall: NR **South** Spring 2/1-3/31 Fall: 8/1-10/31	55-125 days ^

^ Depends on transplanted vs, direct seeded, brassica grown, and if harvested immature.

[+] NR - Not Recommended

*Nitrogen recommendation is for lbs/acre. For phosphorus and potassium requirements, a soil test should be taken.

Carrots

Commercial carrot production is a relatively new for Georgia. Large acreage was planted beginning the mid-1990s with a state initiative to form a sweet carrot cooperative in the Alma area. Growers from the Lake Apopka region of Florida moved into south Georgia when their land was purchased by the state of Florida to control agricultural pollution. Carrots, which are considered half-hardy, are grown in Georgia primarily as a winter crop in the southern part of the state. They are slow growing requiring low to moderate fertility throughout their growth with even moisture. Spikes in fertility and/or wet dry cycles can cause splitting. The light deep soils of south Georgia are ideal for carrot production particularly the longer Imperator types. Carrots are available from very short (French forcing or golf-ball type) to longer types such Chantenay, Nantes, and finally the Bugs Bunny type (Imperator). Cooler temperatures are better for carrots as they can take on a bitter flavor with warmer temperatures.

Spacing	Varieties	
Rows: 12-14" in beds of 4-5 rows **In-row**: 1-2"	Cheyenne, Choctaw, Apache, Davers 126, Navajo, Sugar Snax, Top Notch	
Nitrogen Fertilization*	**Planting Dates**[+]	**Days to Harvest**
Coastal Plains 100-130 **Piedmont** 90-110	**North** Spring: 5/15-7/15 Fall: NR **South** Spring NR Fall: 8/1-11/30	50-95 days

[+] NR - Not Recommended

*Nitrogen recommendation is for lbs/acre. For phosphorus and potassium requirements, a soil test should be taken.

Cucumbers

Cucumbers can be grown for either pickling or for fresh market as slicing cucumbers and there are specific varieties available for both. Cucumbers are considered very tender and should not be planted until the soil has warmed sufficiently. The varieties should not be interchanged. Pickling cucumbers have a thinner rind than slicing types so they can absorb the brine or vinegar solution readily. Processing (pickling) companies will often indicate to growers specific varieties they wish grown and when they should be harvested. Gynecious varieties are available where the plants produce exclusively female flowers. Approximately 10 percent of the seed with such varieties will produce male flowers for pollination.

Spacing	Varieties	
Slicers Rows:3-4' In-Row: 9-12" **Pickling** Rows: 3-4' In-Row: 6-8"	**Slicers**: Dasher II, Poinsett 76, Marketmore 76, Speedway	
Nitrogen Fertilization*	**Planting Dates**[+]	**Days to Harvest**
Coastal Plains 100-150 **Piedmont** 80-120	**North** Spring: 4/15-7/15 Fall: NR **South** Spring 3/1-4/30 Fall: 8/1-9/15	48-72

[+] NR - Not Recommended

*Nitrogen recommendation is for lbs/acre. For phosphorus and potassium requirements, a soil test should be taken.

Eggplant

Eggplant are very tender and extremely easy to grow and can be quite prolific. The name comes from earlier forms that had pure white fruit, unlike the more common purple fruit today. Various colors and sizes are available, particularly as heirloom varieties. Eggplant can be ratooned, whereby plants are cut back almost to the ground and allowed to regrow, producing a second crop within the same season. Eggplants have few problems other than flea beetles, which mainly damage seedlings or young plants.

Spacing	Varieties	
Rows: 4-5' **In-row**: 2-3' Staking is helpful	Classic, Epic, Possalita, Rossita, Santana, Ghost	
Nitrogen Fertilization*	**Planting Dates**[+]	**Days to Harvest**
Coastal Plains 125-175 **Piedmont** 125-150	**North** Spring: 4/15-7/15 Fall: NR **South** Spring: 3/1-4/30 Fall: 7/15-8/30	50-80 days from transplanting^

^White varieties

[+] NR - Not Recommended

*Nitrogen recommendation is for lbs/acre. For phosphorus and potassium requirements, a soil test should be taken.

Garlic and Elephant Garlic

Garlic and elephant garlic are propagated asexually from cloves. Cloves are the individual sections of the bulb. For best performance, disease free cloves from a reputable source specifically produced as propagules should be used. Garlic and elephant garlic are hardy vegetables grown as an overwintering crop. The main type of garlic that can be grown in Georgia is California Early. California Late and northern hardneck types are not suitable because they mature too late. Elephant garlic is not a true garlic but is more closely related to leek.

Spacing	Varieties	
Rows: 12-16" on beds of 4-6' with 4 rows per bed **In-row**: 3-4"	California Early, Elephant Garlic	
Nitrogen Fertilization*	**Planting Dates**	**Days to Harvest**
Coastal Plains 125-175 **Piedmont** 125-150	**North** 9/15-11/10 **South** 10/1-11/30	7-8 months

*Nitrogen recommendation is for lbs/acre. For phosphorus and potassium requirements, a soil test should be taken.

Greens, Turnips and Spinach

Greens, turnips, and spinach are all grown for their leaves and turnips are also grown for their roots. These are hardy vegetables, which can withstand some freezing temperatures. Some turnip varieties are just for leafy greens. Top and roots are harvested in Purple Top White Globe variety. Successive plantings within the recommended planting dates will extend the availability of the crop. These are often harvested immature for extra tenderness. Spinach is often used in salad mixes.

Spacing	Varieties	
Rows: 12-24" **In-row**: 1-2"	Savannah (G), Tendergreen (G), Florida Broadleaf (G), Purple Top White Globe (T), Southern Green (T), Top Star (T) Bloomingdate types (S) Melody (S), Tyee (S)	
Nitrogen Fertilization*	**Planting Dates**	**Days to Harvest**
Coastal Plains 175-225 **Piedmont** 150-180	**North** Spring: 3/15-4/30 Fall: 8/1-9/15 **South** Spring 2/1-3/31 Fall: 8/1-9/30	37-75 days ^

^ G - Greens, T - Turnips, S - Spinach

*Nitrogen recommendation is for lbs/acre. For phosphorus and potassium requirements, a soil test should be taken.

Leeks

Leeks are grown for their mild flavored stems. These are often blanched by piling soil along the base of the plants. This hardy vegetable can be produced as an overwintering crop.

Spacing	Varieties	
Rows: 20-30" **In-row**: 4"	Alora, Arena	
Nitrogen Fertilization*	**Planting Dates**	**Days to Harvest**
Coastal Plains 100-125 **Piedmont** 75-100	**North** Spring: 3/15-4/30 Fall: 9/15-10/31 **South** Spring: 2/1-3/31 Fall: 9/1-10/15	150 days

*Nitrogen recommendation is for lbs/acre. For phosphorus and potassium requirements, a soil test should be taken.

Lettuce, Endive and Escarole

These can be grown in massed beds (wide bed, 2-4 ft. across seeded for complete coverage) for harvesting immature leaves. They are half-hardy vegetables that prefer cool temperatures, but should be protected from freezing temperatures. Multiple clipping and successive planting can extend the harvest. Many types, colors, and varieties are available for mixed salad use. Various loose leaf and head lettuce are available, however, for organic production the loose-leaf types are probably best. The head lettuce types can take a longer to develop.

Spacing	Varieties	
3-4 rows on 6' beds spaced 12-14" **In-Row**: 9-12" Tighter spacing possible	Too numerous to mention. Head, Green leaf, Red leaf, Cos, butterhead are all types of lettuce.	
Nitrogen Fertilization*	**Planting Dates**	**Days to Harvest**
Coastal Plains 125-150 **Piedmont** 75-125	**North** Spring: 4/15-5/30 Fall: 8/1-8/30 **South** Spring: 2/1-3/31 Fall: 8/1-10/15	40-85 days

*Nitrogen recommendation is for lbs/acre. For phosphorus and potassium requirements, a soil test should be taken.

Onions and Other Alliums

Southeast Georgia is the home of Vidalia onions. If you are in the growing district for these onions you can grow organic Vidalia onions, which command a premium in the marketplace. Onions can be grown either from seed or from transplants. They are long season, labor-intensive crops that are well suited to south Georgia production. Overwintering onions in north Georgia is not recommended. Overwintering is the preferred method of producing these hardy vegetables in south Georgia. If you plan on producing organic Vidalia onions, you will have to register with the Georgia Department of Agriculture.

Spacing	Varieties	
4-5 rows on 6' beds on centers **In-row**: 5-6"	Sapelo Sweet, Nirvana, Sweet Vidalia, Century, Savannah Sweet	
Nitrogen Fertilization*	**Planting Dates**[+]	**Days to Harvest**
Coastal Plains 125-150 **Piedmont** 110-130	**North** NR **South** Fall: 9/1-10/15	210-240 days

[+] NR - Not Recommended

*Nitrogen recommendation is for lbs/acre. For phosphorus and potassium requirements, a soil test should be taken.

Cantaloupes

Cantaloupes are a very tender, warm season vegetable with many varieties. They are often referred to as muskmelons. Most commercial production is with Athena or Eastern shipping types. These are larger than Western shipping types and have less netting. Various specialty melons such as Casaba, Crenshaw, and Christmas melons are available. Honeydews grow well in Georgia, but do not slip from the vine when ripe. Many specialty melons may not have disease tolerance for Georgia conditions.

Spacing	Varieties	
Rows: 2-4' **In-row**: 1.5-4'	Athena, Sprite	
Nitrogen Fertilization*	**Planting Dates**	**Days to Harvest**
Coastal Plains 100-150 **Piedmont** 80-120	**North** Spring: 4/15-6/15 Fall: 8/1-8/30 **South** Spring: 3/1-4/30 Fall: 8/1-915	85-110 days

*Nitrogen recommendation is for lbs/acre. For phosphorus and potassium requirements, a soil test should be taken.

Okra

Okra is a warm season, very tender vegetable that will require frequent picking. The pods should be harvested when only a few days old since they quickly become woody. They are highly susceptible to nematodes, particularly on sandy sites. Using a small grain in rotation can dramatically reduce nematodes. Okra can be ratooned to about 6-8 inches and will come back and produce a second fall crop if spring planted.

Spacing	**Varieties**	
Rows: 3.5-4.5' **In-row**: 12-24"	Annie Oakley II. Cajun Delight, Clemson Spineless, Emerald	
Nitrogen Fertilization*	**Planting Dates**	**Days to Harvest**
Coastal Plains 125-175 **Piedmont** 100-125	**North** Spring: 5/1-7/15 Fall: 7/15-8/15 **South** Spring: 3/15-5/31 Fall: 8/1-8/30	50-60 days

*Nitrogen recommendation is for lbs/acre. For phosphorus and potassium requirements, a soil test should be taken.

Parsley and Cilantro, Herbs

Parsley is available both in a flat leaf and curly leaf form. The flat leaf form is more aromatic and is used in flavoring, while the curly leaf form is used primarily as a garnish. Cilantro is the leaves of coriander (seed crop), and is generally used fresh. It is best grown during cool weather. Other herbs take in a wide selection of different plants all with different cultural requirements. In general, herbs require drier conditions for best flavor and aroma development. Cultural requirements for a specific herb should be researched prior to planting.

Spacing	**Varieties**	
Parsley & Cilantro Rows: 15-18" In-row: 6-8" **Parsley** 2-5" **Cilantro & other herbs** Varies	Parsley: Banquet (curly leaf), Plain Italian (flat leaf) Cilantro: Jantar Longstanding Other herbs: too numerous to list	
Nitrogen Fertilization*	**Planting Dates**[+]	**Days to Harvest**
Coastal Plains 90-120 **Piedmont** 80-100	**North** Spring: 3/15-5/30 Fall: NR **South** Spring: 2/1-3/31 Fall: 8/1-9/30	40-80 days

[+] NR - Not Recommended

*Nitrogen recommendation is for lbs/acre. For phosphorus and potassium requirements, a soil test should be taken.

English Peas

English or garden peas are a cool season, hardy vegetable. There are both edible pod types often referred to as sugar snaps and those in which the pea is removed from the pod. Vining and non-vining types are available. Vining types do best when trellised. Non-vining types are often machine harvested.

Spacing	**Varieties**	
Trellised **Rows**: 24-48" **In-row**: 1-3"	Dual, Little Marvel, Laxton, Progress #9, SugarAnn, Sugan Snap	
Nitrogen Fertilization*	**Planting Dates**	**Days to Harvest**
Coastal Plains 75-100 **Piedmont** 50-75	**North** Spring: 3/15-4/30 Fall: 8/1-8/31 **South** Spring: 2/1-3/31 Fall: 8/1-9/31	55-75 days

*Nitrogen recommendation is for lbs/acre. For phosphorus and potassium requirements, a soil test should be taken.

Southernpeas

Southernpeas are an easy to grow legume requiring very little fertility and can be used as a green manure after harvest. They are a tender warm season crop. They are attacked by cowpea curculio, which lays eggs in the growing seed. Old timers often referred to the peas being "stung" when infested with the curculio egg and larva and such peas were removed by hand prior to cooking.

Spacing	**Varieties**	
Rows: 20-42" **In-row**: 2-12" Bush and Vining types available	California Blackeye #5, Knuckle Purple Hull, Pinkeye Purple Hull, White Acre	
Nitrogen Fertilization*	**Planting Dates**[+]	**Days to Harvest**
Coastal Plains 50-75 **Piedmont** 40-60	**North** Spring: 5/15-7/15 Fall: NR **South** Spring: 3/15-5/15 Fall: 7/15-8/30	65-80 days

[+] NR - Not Recommended

*Nitrogen recommendation is for lbs/acre. For phosphorus and potassium requirements, a soil test should be taken.

Peppers

There is a wide variety of peppers to choose from with varying levels of capsaicin, which determines how hot they are. Peppers are a very tender, warm season crop. Mild or sweet peppers include bell and sweet banana, which contain no capsaicin. Habenero are the hottest peppers. Heat in peppers is measured in Scoville units, which is the reciprocal of a dilution series of pepper juice. Habeneros can measure 300,000+ Scoville units. Bell peppers are usually sold immature and green; if allowed to mature, they can be a variety of different colors from yellow, orange, brown, purple, etc. These will command higher prices. Larger fruited peppers such as bell pepper grow better if staked.

Spacing	**Varieties**	
Rows: 4-5' **In-row**: 12-18" with double rows	Camelot (B), Stiletto (B), Capistrano (B), Anaheim, Habanero, Hungarian Wax, Long Thin Cayenne, Inferno, Mitla	
Nitrogen Fertilization*	**Planting Dates**[+]	**Days to Harvest**
Coastal Plains 150-200 **Piedmont** 100-150	**North** Spring: 5/15-6/30 Fall: NR **South** Spring: 3/1-4/30 Fall: 7/15-8/30	65-80 days from transplanting

[+] NR - Not Recommended

*Nitrogen recommendation is for lbs/acre. For phosphorus and potassium requirements, a soil test should be taken.

Irish Potatoes

Irish potatoes are a cool season half-hardy vegetable grown from seed pieces. Use certified seed pieces for maximum yield. Do not use potatoes from the store; they may have been treated with sprout inhibitors. Colorful varieties with red, gold, blue and purple flesh are available, but their performance in Georgia is unknown.

Spacing	**Varieties**	
Rows: 34-36" **In-row**: 7-12"	Atlantic, Kennebec, Red LaSoda, Red Pontiac, Superior, Yukon Gold, Fingerling types	
Nitrogen Fertilization*	**Planting Dates**[+]	**Days to Harvest**
Coastal Plains 150-200 **Piedmont** 120-150	**North** Spring: 3/15-4/30 Fall: NR **South** Spring: 2/1-3/31 Fall: NR	90-120 days

[+] NR - Not Recommended

*Nitrogen recommendation is for lbs/acre. For phosphorus and potassium requirements, a soil test should be taken.

Pumpkins and Winter Squash

Pumpkin types are available for both Halloween or ornamental use and for cooking. All are tender, warm season vegetables. A wide range of sizes, colors and textures are available for winter squash. Several species of cucurbits contribute to pumpkins and winter squash. They are harvested at full maturity when the rind is hard and can be stored at room temperature for several months. A wide range of disease resistance exists among these vegetables. Some are highly susceptible while others have a high degree of resistance. Check with your local extension agent for more information.

Spacing	**Varieties**	
Bush Types Rows: 5-6' In-row: 2-3' **Semi-Vine Types** Rows: 6-8' In-Row: 2-4' **Vine Types** Row: 8-10' In Row: 4-5'	Too Numerous to list	
Nitrogen Fertilization*	**Planting Dates**	**Days to Harvest**
Coastal Plains 100-150 **Piedmont** 80-120	**North** Spring: 4/15-6/15 Fall: 5/1-6/15 **South** Spring: 3/15-5/15 Fall: 3/1-6/30	85-120 days

*Nitrogen recommendation is for lbs/acre. For phosphorus and potassium requirements, a soil test should be taken.

Summer Squash

Summer squash are *Cucurbita pepo* species that are harvested immature before the seed become hard. They are a very tender annual vegetable. Yellow straightneck, crookneck, zucchini and scalloped types are grown. They are generally highly susceptible to a variety of aphid transmitted viral diseases. These diseases are more evident and damaging during fall production when aphid populations are at a maximum. Disease resistance to some viruses is available. There are three sources of virus resistance: transgenic varieties (GMOs), interspecific crosses and precocious yellow gene. GMOs are not allowed in certified organic production. Interspecific resistance is not resistant to all viruses that can infect summer squash. Precocious yellow resistance is not true resistance, but these varieties don't have the gene for green peduncles, therefore the fruit does not show the green mosaic pattern when infected.

Spacing	Varieties	
Rows: 3-6' **In-row**: 1.5-2.5'	Gentry, Meigs (R,P) Cougar (R,I), Lynx (R,I), Tigress (R,I)	
Nitrogen Fertilization*	**Planting Dates**[+]	**Days to Harvest**
Coastal Plains 100-150 **Piedmont** 80-120	**North** Spring: 5/1-8/15 Fall: NR **South** Spring: 3/1-4/30 Fall: 7/15-9/15	40-50 days

R-Virus Resistant, I-Interspecific, P-Precocious Yellow

[+] NR - Not Recommended

*Nitrogen recommendation is for lbs/acre. For phosphorus and potassium requirements, a soil test should be taken.

Sweet Corn

Sweet corn is wind pollinated and it must be planted in blocks of 4-5 rows for adequate pollination. It is a tender vegetable, but is often planted very early to take advantage of early markets. There are three known genes that contribute to sweetness in sweet corn. There is the sugar gene (su), the sugary enhanced (se), and the shrunken gene (sh_2). The sh_2 varieties are often referred to as super sweets. Isolation in space (300 ft) or time (3 weeks) is required for maximum quality with se and sh_2 varieties.

Spacing	Varieties	
Rows: 36" **In-row**: 8-12"	Silver Queen, Sweet Ice, Ice Queen, Sweet Riser, Bandit, Polaris, Sweet Symphony	
Nitrogen Fertilization*	**Planting Dates**[+]	**Days to Harvest**
Coastal Plains 200-250 **Piedmont** 150-200	**North** Spring: 4/15-4/30 Fall: NR **South** Spring: 2/1-3/31 Fall: 7/15-8/15	65-95 days

[+] NR - Not Recommended

*Nitrogen recommendation is for lbs/acre. For phosphorus and potassium requirements, a soil test should be taken.

Sweetpotato

Sweetpotatoes are a long season, asexually propagated, very tender vegetable. Sweetpotatoes are grown from slips, which are rooted vines grown from seed sweet-potatoes. They are easy to grow and require relatively low fertility. Although you may wish to produce your own sweetpotato slips, we recommend that certified sweetpotatoes be used to avoid the accumulation of diseases and mutations. The accumulation of diseases and mutations results in the sweetpotatoes "running out."

Spacing	Varieties	
Rows: 36-48" **In-row**: 8-14"	Beauregard, Hernandez, Jewel	
Nitrogen Fertilization*	**Planting Dates**	**Days to Harvest**
Coastal Plains 60-90 **Piedmont** 50-80	**North** Spring: 5/15-6/30 **South** Spring: 4/1-6/15	120-150 days

*Nitrogen recommendation is for lbs/acre. For phosphorus and potassium requirements, a soil test should be taken.

Tomato

Tomatoes are one of the most popular vegetables grown, but they can be difficult to grow in south Georgia because of Tomato Spotted Wilt Virus (TSWV). This devastating disease can stunt and kill plants and can cause discolorations with faint rings on the fruit. They are a tender warm season vegetable. There are a number of different fruit and plant types with a variety of colors that are becoming more popular in organic production.

Spacing	Varieties	
Trellised **Rows**: 5-6' **In-row**: 18-24"	Amelia VR, BHN 640, Celebrity, Better Boy, Sun Chaser, Elfin, Jolly Elf, Plum Crimson	
Nitrogen Fertilization*	**Planting Dates**[+]	**Days to Harvest**
Coastal Plains 150-200 **Piedmont** 100-150	**North** Spring: 4/15-6/15 Fall: NR **South** Spring: 3/1-4/30 Fall: 7/15-8/30	60-90 days from transplanting

[+] NR - Not Recommended

*Nitrogen recommendation is for lbs/acre. For phosphorus and potassium requirements, a soil test should be taken.

Watermelon

There are many fruit types available for watermelon with both red and yellow-fleshed types. Seedless watermelons are actually triploids in which the seed is incapable of developing fully and remain soft and edible. About one-third to one-quarter of the planting must be planted with normal diploid plants to insure pollination of the triploids. Watermelons are available from very small (palm) fruit of 3-5 pounds to large 25-30+ pound varieties. There are round as well as oblong fruit available. Watermelons are a very tender, warm season vegetable.

Spacing	Varieties	
Rows: 6-10' with 24-30 square feet per plant	Precious Petite, WS Red Seedless, MF, WS Yellow Seedless F, AU-Producer, Jubilee II, Sangria, Stars N Stripes, Gold Strike, Cooperstown, Millionaire, Ole	
Nitrogen Fertilization*	**Planting Dates**	**Days to Harvest**
Coastal Plains 100-150 **Piedmont** 80-120	**North** Spring: 5/15-6/15 **South** Spring: 3/1-5/15	75-95 days

*Nitrogen recommendation is for lbs/acre. For phosphorus and potassium requirements, a soil test should be taken.

Marketing

It is critical before undertaking the enterprise of organic production that you consider where you will market your produce. Markets should be carefully researched and understood.

Conventional growers are used to dealing with a variety of marketing outlets such as brokers, wholesale marketing to chain stores, marketing through farmers' markets, and various retail outlets. All of these may be available to organic growers as well. There is a growing market for organic produce through such outlets. Whole Foods Market is one of the better-known chains that markets organic produce.

State run farmer's markets are available for growers to sell their produce. For more information about the various state farmers' markets contact the Georgia Department of Agriculture for more information. Local farmer's markets that focus on organic produce may also be a good outlet. The Morningside Farmer's Market in Atlanta is a good example. Georgia Organics, the grower group in Georgia, would have information about such markets and marketing opportunities.

Upscale restaurants that feature fresh seasonal vegetables on their menu are another good market. These restaurants are more likely to be in urban areas and need to be contacted individually to determine their needs. Grower cooperatives that pool their produce to market to such outlets are a good opportunity for many growers. Again organizations like Georgia Organics or the Georgia Department of Agriculture may be able to help.

There has been a long tradition of farmers selling produce directly to the public; consequently there is not much regulatory requirements with such sales. Historically many growers sold produce on the courthouse square in rural counties. Although this has dramatically diminished over the years it may still be possible to sell your produce in such a fashion. Check with your local county government concerning any regulations.

Organic growers have pioneered community supported agriculture or CSAs. Consumers buy shares from the farmer for an allotment of produce that is made available on a weekly basis during the growing season. Usually 30-40 families willing to pay $700-$1,000 per year are then given a share of weekly produce. This allows a small grower to make a modest living while participating families have a source of fresh produce.

Pick-your-own operations, although more popular with fruits such as strawberries, may also be a good opportunity for organic growers.

There is growing interest in agriculture for tourism possibilities. Agritourism involves a wide variety of rural activities that may have tourism possibilities: A weekend visit to a farm to pick fresh produce; a week-long vacation in the country to learn about vegetable gardening or country crafts; a quiet vacation away from the stress of everyday life. All of these may offer opportunities to organic growers to expand their operations and their incomes.

Post-Harvest Handling and Processing

Although not required, organic growers may wish to explore USDA grading standards for vegetables. USDA graded produce like certified organic insures buyers of a specific quality standard. For more information on USDA grades visit their website (Table 1, page 4).

Minimally processed produce such as premixed salads may be a possibility for organic growers. More elaborate postharvest processing such as frozen or canned products may also be a possibility. Such operations require specialized facilities and considerable government oversight to ensure quality and safety.

Learning for Life

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