Variety Selection and Seed Saving

FOR ORGANIC GROWERS

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UNIVERSITY OF GEORGIA
EXTENSION

Vegetable and flower variety evaluations at Johnny's Selected Seeds.

Organic farming and vegetable production are becoming increasingly popular. Nationally, organic sales have increased 80% since 2007, organic produce has a wholesale value typically twice that of conventional produce, and 75% of organic products are sold within 100 miles of the farm (USDA, 2016; 2014). These facts suggest that there is a tremendous market potential for organic vegetables in Georgia, yet organic production remains only a fraction of conventional vegetable production. Because of our humid subtropical climate, organic production in the Southeast is continually challenged by intense disease, insect and weed pressure. University of Georgia Extension Bulletin 1011, "Growing Vegetables Organically," is a resource that explains the basic elements of production. The purpose of this guide is to detail the importance of varietal selection for organic growers.

When considering organic production, growers must be aware of the restrictions on available seed. Seeds that have been developed through direct insertion of new genes are one such restriction. These seeds are referred to as "genetically modified organisms" or "GMO," and "genetically engineered organisms" or "GE," and are not allowed in certified organic production. In addition, seeds that have been treated with non-organic pesticides cannot be used. Organic growers are required to source organically produced seed. As an organic grower, if you are not able to find the necessary cultivar or variety of organic seed after searching three seed companies, you are allowed to use seed that is not organically produced. However, that seed cannot be treated with unapproved substances, such as synthetic fungicides or other man-made materials.

These restrictions apply only to certified organic growers. Certification for organic farms is voluntary through the National Organic Program (NOP) under the United States Department of Agriculture (USDA). Many growers interested in organic production, but whose farms are not certified organic, will follow NOP guidelines even if they are not legally required to do so. NOP guidelines help to define the legal and philosophical differences between organic and non-organic production practices.

Because organic farming was built on an ecological philosophy, organic production resources and research has historically focused on soil and disease management. However, the varieties of vegetables you choose to grow can also have a tremendous impact on yield, crop losses, market sales, and resource conservation—thus, the sustainability of your farm.

SEED VARIETIES

There are several different types of vegetable varieties available with different performance characteristics and features. Most vegetables grown in Georgia are propagated by seed rather than vegetatively propagated. With seed-propagated varieties, the method of development is critical in determining these performance characteristics. There are two broad categories of seed varieties, open-pollinated and F_1 hybrids.

Pepper variety evaluation in the field.

Open-pollinated varieties are developed by diverse methods with the goal of producing an improved variety with important characteristics that will be true-to-type from one generation to the next. This means a grower can save seed of open-pollinated varieties and the next generation will perform largely the same as the current generation. There is a subclass of open-pollinated varieties that have become important for organic growers called heirloom varieties. An heirloom variety was originally understood to be a variety that was passed down in a family. These varieties had some benefit—they were regionally adapted, with specific characteristics or cultural significance—that made them worth saving, but they were not part of any formal breeding program. There are also older open-pollinated varieties that were developed through formal breeding programs. These breeding programs were often implemented through land-grant universities such as the University of Georgia. Some of these older open-pollinated varieties, such as 'Rutgers' tomato, are also referred to as heirlooms. These popular open-pollinated varieties are available from many sources and may have unique characteristics of flavor, color, or texture, often with an interesting historical background. It should be

noted that these varieties often have poor disease-resistance characteristics compared to modern cultivars. Much of the emphasis of plant breeding has focused on developing varieties with improved disease resistance.

F_1 hybrid varieties are produced through a multistep process. The first step is to develop inbred lines, which are populations that are developed with extreme uniformity between the individuals. Two inbred lines are then crossed and the resulting seed are sold to growers as F_1 hybrid seed. The 'F_1' refers to the first filial generation. Saving seed from a F_1 hybrid variety will not breed true-to-type, meaning that these seeds will not grow into plants that are identical to the F_1 hybrids. This next generation (F_2 seed) segregates into individuals with many different traits. The downside to this is that saved seed will not perform as well as the original F_1 hybrid seed.

Although farmers cannot save the seed from F_1 plants and expect it to be true-to-type, F_1 seed does have advantages. Generally, F_1 seed will perform very well because it exhibits hybrid vigor (that is, it will perform better than the parents that contributed to the F_1 population) with good yields and uniform performance from one individual to the next. F_1 seed is generally more expensive than open-pollinated seed, but the increased vigor can make it worthwhile. In addition, buying new seed every year ensures that you have high-quality seed with excellent germination.

All seed that is sold must be labeled according to federal law. At a minimum, the label should have the vegetable name, variety name, whether it has been treated (with fungicide, for example), lot number, germination percent, date of germination test, percent hard seed, net weight, and the company name and address. In addition, there are minimum germination standards for vegetable seed (Table 1). Most reputable companies will sell seed with germination rates well above these minimums.

Varieties with the designation "PVP," which stands for "plant variety protection," are seed-propagated plants that have patent protection. This means that the developer of the variety has intellectual property protection on this variety, and it is illegal to save seed for distribution without the owner's consent. Generally, PVP is obtained for open-pollinated varieties that breed true-to-type.

Another important consideration in variety selection is the seed source. Table 2 lists several companies that sell organic seed, many of which also sell non-organic seed. If you are a certified organic grower and cannot source organic seed of the variety you are interested in, you may use non-organic seed; however, it cannot be treated with prohibited substances (like non-organic fungicides) and you must provide evidence of your due diligence in attempting to source organic seed.

SEED SAVING

Seed saving can save money and can both be an enjoyable addition to vegetable production and help to conserve rare seed sources. Older varieties and local varieties may be limited in availability, so by saving the seed, you become part of the important effort in seed conservation.

Knowing the difference between open-pollinated and F1 hybrid seed can help a grower decide whether to save their own seed. There are several caveats to seed saving. Even when dealing with open-pollinated varieties, changes can occur over time, resulting in poor performance in subsequent generations. In order to maintain the traits and quality of the original variety, seed from a minimum number of plants should be saved. For crops that are primarily self-pollinated (e.g., tomatoes or beans), seed should be collected from a minimum of 20 plants. For plants that are primarily cross pollinated (e.g., corn or watermelon), seed should be saved from at least 80 plants. In addition, the individual plants chosen for seed saving will also have an impact on future generations. For example, if you save seed only from the last harvested plants in your garden, you may be selecting for late maturity, which can be an undesirable trait. Disease occurrence and pressure often increases as the growing season progresses. When selecting plants from which to save seed, always choose healthy plants that are free of disease.

If you plan on saving your own seed, you may wish to consult a resource on seed saving. Such sources give specific instructions for each vegetable on how to produce, collect, and store seed. Table 3 lists several sources that may be helpful for those considering seed saving.

Each plant has a specific stage of growth at which mature seeds should be harvested. This timing may or may not coincide with when the vegetable is harvested for consumption. In many cases, vegetables are harvested before seed are produced (e.g., lettuce, carrots, or onions). When saving seeds from biennial plants like carrots and onions, remember that they will not produce seed until the second year of growth. Bell pepper fruits are usually harvested for consumption when the fruit is green and seeds are present but the seed has not completely matured. For some plants, like cantaloupe and tomatoes, the seeds are fully ripe when the fruit is ready to eat.

In general, mature seed will either be in a fleshy fruit such as tomatoes, watermelons, or eggplant or they will be in a dry pod or flowers. Each of these needs to be handled differently. Fleshy fruit can be crushed and placed into a bucket and allowed to "ferment" for several days. The viable, or "good," seed will settle to the bottom, and the pulp and empty seed will float to the top. This good seed can then be collected by continually pouring off the pulp and empty seed with water until only good seed are at the bottom of the bucket and the remaining water is largely clear. When collecting seed from dry seedpods or flowers, you may have to bag the flowers and pods before the seed is completely mature. Once such seed is mature, the pods often "shatter," dispersing the seed onto the surrounding ground or launching them into the air. Once a seedpod shatters, there will be little seed left to collect, but by enclosing the seed head in a paper bag or other lightweight material, you can contain the spread and more easily collect the seed. For more information on handling seed for specific vegetables, refer to one or more of the sources listed in Table 3 for complete instructions.

SEED STORAGE

Seed storage is an important consideration in saving seed. Table 1 lists the number of years seed can be stored under appropriate conditions and still maintain high germination rates. Ideally, seed should be stored under cold, dry conditions. As a rule of thumb, the sum of the storage temperature and relative humidity should be less than or equal to 100. So for example, if the storage temperature is 45°F then the relative humidity should be at or below 55%. Seed should be clean and completely dry before storage. Store seed in sealed containers such as Mason jars or foil packets. Using silica gel or similar material will help maintain low relative humidity in the container.

Some seed can be stored frozen. For example, large-seeded crops such as beans and peas can be stored in a freezer. Freezing will help prevent insect damage because pests are not active at such low temperatures.

Table 4 lists recommended varieties for organic growers in Georgia. This list is not meant to be exhaustive, nor should it be construed as a list of varieties that should exclude others that may perform just as well. There are thousands of different varieties available for many vegetable crops. It is impossible to know how all of these varieties will perform. It is recommended that if you are adopting a new variety to grow, you should try it on a limited basis until you are confident that it will perform well under your conditions. As mentioned previously, older varieties may have poor disease resistance, but using grafted plants may overcome this lack of resistance. Grafting onto disease-resistant rootstocks can overcome some soilborne disease problems, but does not impact foliar disease resistance.

Varieties that do well in northern or western states may not do well in the Southeast. It is a good idea to investigate characteristics, such as disease resistance, reduced susceptibility to bolting, heat tolerance, and day-length requirements, when selecting varieties appropriate for southeastern states.

Seed germination testing in progress.

SEED GERMINATION

Seed germination is an important quality parameter when selecting or saving seed. Table 5 lists the temperature range for germinating several different vegetables. Generally, the warmer the temperature the more quickly seed will germinate. Seed are often started indoors prior to transplanting to the field. For warm-season crops such as tomatoes, seeds are started indoors in late winter or early spring when outdoor temperatures are cooler. Starting seed in a warm environment will ensure rapid emergence. Applying bottom heat through the use of heating mats when starting seeds can improve germination. When sowing directly in the field, consult Table 5 for the optimum soil temperatures for germination.

Through weather stations across the state, the University of Georgia Weather Network collects local soil and atmospheric information including soil temperatures that can be useful for sowing seed. The Weather Network can be accessed at http://www.georgiaweather.net/index.php. On the Weather Network website, select a weather station near your location for the most useful information. Not only are soil and air temperatures collected, but historical weather data are also available. This allows you to see information such as frost dates, amount of rainfall, and soil and air temperatures over many years.

Because of the mild winters in Georgia, many vegetable seeds are sown in late summer or early fall for fall and winter production. In fact, half of the revenue from fresh vegetables grown in Georgia is from winter vegetables. Temperatures can be very high during these times of the year, and many cool season vegetables may have trouble germinating and growing under these conditions. Shade may be needed for some seedlings, particularly during the hottest part of the day. Consult Table 5 for optimum germination temperatures. For vegetables where the high temperature is in the yellow or red zone, shade can be helpful for both seed germination and successfully growing these vegetable plants.

Table 1 lists the number of weeks it takes to produce a seedling for particular vegetables. Vegetables without a listing are usually sown directly in the field. The week before the anticipated date of transplanting, seedlings should be hardened off. This process involves lowering the temperature and/or reducing the amount of water available to the seedling. The easiest way to achieve this is by moving the transplants outside for the final week and allowing them to acclimate to outdoor conditions. Of course, if frost or freezing temperatures are anticipated during this time, they should be moved indoors for that period.

Your county Extension agent can help you with selecting appropriate varieties for your situation. The University of Georgia conducts routine variety trials every year and maintains lists of suitable varieties.

Table 1. Minimum required germination, days to germination, weeks for transplant production, and years for seed storage.*

Crop	Minimum Germination (%)	Germination (Days)	Time to Produce Transplants (Weeks)	Seed Storage (Years)
Bean, Fava	75	7-14	–	3
Bean, Garden	70	7-14	–	3
Bean, Lima	70	7-14	–	3
Beet	65	5-20	–	4
Broccoli	75	5-20	5-7	3-5
Brussel Sprouts	70	5-20	5-7	3-5
Cabbage	75	5-20	5-7	3-5
Cantaloupe	75	4-10	4-5	5
Carrot	55	7-14	–	3
Cauliflower	75	5-20	5-7	3-5
Celery	55	7-21	5-7	5
Collards	80	5-20	5-7	3-5
Cucumber	80	4-10	2-3	5
Eggplant	60	7-14	5-7	4-5
Garden Pea	80	7-14	–	3
Kale	75	5-20	5-7	5
Kohlrabi	75	5-20	5-7	3-5
Leek	60	4-14	–	3
Lettuce	80	4-14	4	5
Mustard	75	5-20	5-7	5
Okra	50	7-21	–	2
Onion	70	4-14	10-14	2
Parsnip	60	14-20	–	1
Pepper	55	7-14	–	4
Pumpkin	75	4-10	2-3	5
Radish	75	5-20	–	3-5
Southernpea	75	7-14	–	3
Spinach	60	7-14	–	5
Squash	75	4-10	2-3	4-5
Sweet Corn	75	5-14	–	2
Swiss Chard	65	7-14	–	4
Tomato	75	7-14	5-7	4-5
Turnip	80	5-20	5-7	3-5
Watermelon	70	4-10	2-3	5

*Minimum germination is federally mandated minimum germination for seed sales, days to germination is under optimum temperature conditions, years of storage is under ideal conditions (dry/cold storage).

Table 2. A selection of companies offering organic seed.[†]

Company	Address	Phone Number	Website
Albert Lea Seed House	PO Box 127 Albert Lea, MN 56007	(800) 352-5247	www.alseed.com
Baker Creek Heirloom Seeds	2278 Baker Creek Rd. Mansfield, MO 65704	(417) 924-8917	www.rareseeds.com
Blue River Hybrids	27087 Timber Rd Kelley, IA 50134	(800) 370-7979	www.blueriverorgseed.com
DLF Organic	PO Box 229 Halsey, OR 97348	(541) 369-2251	www.dlforganic.com
Environmental Seed Producers	PO Box 2709 1851 W. Olive Ave Lompoc, CA 93438	(805) 735-8888	www.espseeds.com
Fedco Seeds	PO Box 520 Waterville, ME 04903	(207) 873-7333	www.fedcoseeds.com
Filaree Farm	182 Conconully Hwy Okanogan, WA 98840	(509) 422-6940	www.filareefarm.com
Gourmet Garlic Gardens	12300 FM 1176 Bangs, Texas 76823	(325) 348-3049	www.gourmetgarlicgardens.com
Great Harvest Organics	6803 E. 276th St Atlanta, IN 46031	(371) 984-6685	www.greatharvestorganics.com
Harris Seeds	355 Paul Road P.O. Box 24966 Rochester, NY 14624	(800) 544-7938	www.harrisseeds.com
High Mowing Organic Seeds	76 Quarry Rd Wolcott, VT 05680	(802) 472-6174	www.highmowingseeds.com
Johnny's Selected Seeds	955 Benton Ave Winslow, ME 04901	(207) 861-3900	www.johnnyseeds.com
Organic Bean & Grain, Inc.	1795 W. Akron Rd Caro, MI 48723	(989) 673-6402	www.orbng.com
Rose-AgriSeed	29975 S. Barlow Rd Canby, OR 97013	(503) 651-2130	www.roseagriseed.com
Seed Savers Exchange	3094 N. Winn Rd Decorah, IA 52101	(563) 382-5990	www.seedsavers.com
Seeds of Change	PO Box 15700 Santa Fe, NM 87506	(888) 762-7333	www.seedsofchange.com
SeedWay	99 Industrial Rd Elizabethtown, PA 17022	(800) 952-7333	www.seedway.com
Snow Seed Organics	21855 Rosehart Way Salinas, CA 93908	(831) 758-9869	www.snowseedco.com
Southern Exposure Seed	PO Box 460 Mineral, VA 23117	(540) 894-9481	www.southernexposure.com
Sow True Seed	146 Church St. Asheville, NC 28801	(828) 254-3049	www.sowtrueseed.com
Welter Seed and Honey Co	17724 Hwy 136 Onslow, IA 52321	(800) 470-3325	www.welterseed.com

[†]This selection of organic seed sources is not meant to exclude others offering similar products.

Table 3. Seed-saving resources.†

Title	Author(s)	Copyright	Publisher
Seed to Seed, Seed Saving and Growing Techniques for Vegetable Gardeners (2nd Edition)	Suzanne Ashworth	2002	Seed Savers Exchange, Inc.
The Complete Guide to Saving Seeds: 322 Vegetables, Herbs, Fruits, Flowers, Trees, and Shrubs	Robert Gough & Cheryl Moore-Gough	2011	Storey Publishing
Seed Saving, A Beginner's Guide to Heirloom Gardening	Caleb Warnock	2017	Hobble Creek Press
Heirloom Seed Saving Handbook	Danny Gansneder	2015	Duel City Books
The Seed Garden: The Art and Practice of Seed Saving	Lee Buttala & Shanyn Siegel (Eds.)	2015	Seed Savers Exchange, Inc.
Seed Sowing and Saving	Carole B. Turner	1998	Storey Communications, Inc.
Saving Our Seeds Project Guides: http://www.carolinafarmstewards.org/seed-production-guides		2004	Carolina Farm Stewardship Association
A Seed Saving Guide for Gardeners and Farmers: https://seedalliance.org/publications/seed-saving-guide-gardeners-farmers/		2010	Organic Seed Alliance

†This selection of resources is not meant to exclude others offering similar products.

Table 4. Selection of varieties suitable for organic production in Georgia.*

Variety	F_1 Hybrids	Open-Pollinated	Heirloom
Bean, Fava		'Masterpiece' 'Sweet Lorane'	'Horse Bean' 'Windsor' 'Broad Windsor' 'Agua Dulce'
Bean, Garden		'Blue Lake 274' *(Bush)* 'Bronco' *(Bush)* 'Contender' *(Bush)* 'Roma II' *(Flat pod, bush)* 'Kentucky Wonder 191' *(Pole)*	
Bean, Lima		'Henderson Bush' *(Small seed)* 'Fordhook 242' *(Large seed)*	
Beet	'Red Ace' 'Ruby Queen'	'Chioggia' *(Red & white rings)*	'Bull's Blood' 'Detroit Dark Red'
Broccoli	'Emerald Crown' 'Bay Meadow' 'Packman'	'Romanesco Italia' 'Waltham 29'	

*The listed varieties are suggested varieties for organic production. This list should not be considered to exclude other varieties that may be suitable for production.

Table 4. Selection of varieties suitable for organic production in Georgia *(continued).**

Variety	F_1 Hybrids	Open-Pollinated	Heirloom
Cabbage	'Cheers' 'Red Dynasty' 'Bravo'		'Early Flat Dutch'
Cantaloupe	'Athena' 'Aphrodite'	'Hale's Best Jumbo'	
Carrot	'Apache' *(Imperator type)* 'Maverick' *(Danvers type)* 'Purple Haze' *(Purple, Imperator type)* 'Sugarsnax 54' 'Bolero' 'Napoli'	'Danvers 126'	'Red Cored Chantenay'
Cauliflower	'Minuteman' 'Clever' 'Snowball' 'Graffiti' *(Purple)* 'Cheddar' *(Orange)*	'Early Snowball'	
Collards	'Blue Max' *(Hi Crop)* 'Top Bunching'	'Vates' 'Bulldog' 'Champion'	'Georgia Southern'
Cucumber	'Jackson Supreme' *(Pickling)* 'Dasher II' *(Slicing)*	'Poinsett 76' *(Slicing)* 'Marketmore' *(Slicing)* 'National Pickling'	'Boothby's Blode' 'A & C Pickling'
Eggplant	'Orient Express'	'Black Beauty' 'Clara' *(White)*	'Rosita'
Garden pea		'Wando Dwarf' 'Sugar Ann'	
Garlic		'California Early' 'Elephant Garlic' 'German White'	
Kale	'Winterbor' 'Redbor *(Purple)*' 'Darkibor'	'Toscano' 'Siberian'	
Kohlrabi	'Quickstar'	'Azur Star *(Purple)*' 'Winner' 'Early Purple Vienna'	
Leek		'King Richard'	
Lettuce		'Buttercrunch' 'Winter Density' 'New Red Fire' 'Salad Bowl' 'Green Towers' *(Cos/Romaine)* 'Esmeralda'	'Grand Rapids'

*The listed varieties are suggested varieties for organic production. This list should not be considered to exclude other varieties that may be suitable for production.

Table 4. Selection of varieties suitable for organic production in Georgia *(continued).**

Variety	F_1 Hybrids	Open-Pollinated	Heirloom
Mustard		'Savannah' 'Green Wave' 'Scarlet Frills' 'Red Giant'	
Okra	'Annie Oakley II'	'Clemson Spineless' 'Burgundy *(Red)*' 'Emerald'	
Onion	'Granex 33' 'Savannah Sweet' 'Sapelo Sweet' 'Candy' 'Red Sunset'		
Parsnip	'Albion'	'Tender and True' 'All American'	
Pepper	'Touchdown' 'Aristotle' 'Red Knight' 'King Arthur'	'Sweet Chocolate' *(Small sweet pepper)* 'Carolina Wonder'	'California Wonder'
Potatoes		'Yukon Gold' 'Kennebec' 'Adrondock Blue' 'Russet Burbank' 'Red Pontiac'	
Pumpkin	'Magic Lantern' 'Aladdin' 'Field Trip'	Orange Bulldog' Dill's Atlantic Giant' Lumina'	'Long Island Cheese'
Southernpea		'Pinkeye Purple Hull' 'Texas Cream 12' 'Queen Anne' 'Colossus' 'Knuckle Purple Hull' 'California Blackeye #5' 'Zipper Cream'	
Spinach	'Space' 'Unipak' 'Emperor'	'Bloomsdale'	
Squash	'Gentry' 'Gold Star' 'Enterprise' 'Scallopini'		
Sweet Corn	'Silver Queen' *(White, Su)* 'Obsession' *(Bicolor, Sh_2)* 'Awesome XR' *(Bicolor, Sh_2)* 'Summer Sweet 7210R' *(Yellow, Sh_2)* 'Passion' *(Yellow, Sh_2)*		'Golden Bantam' *(Yellow, Su)* 'Country Gentleman' *(White, Su)*

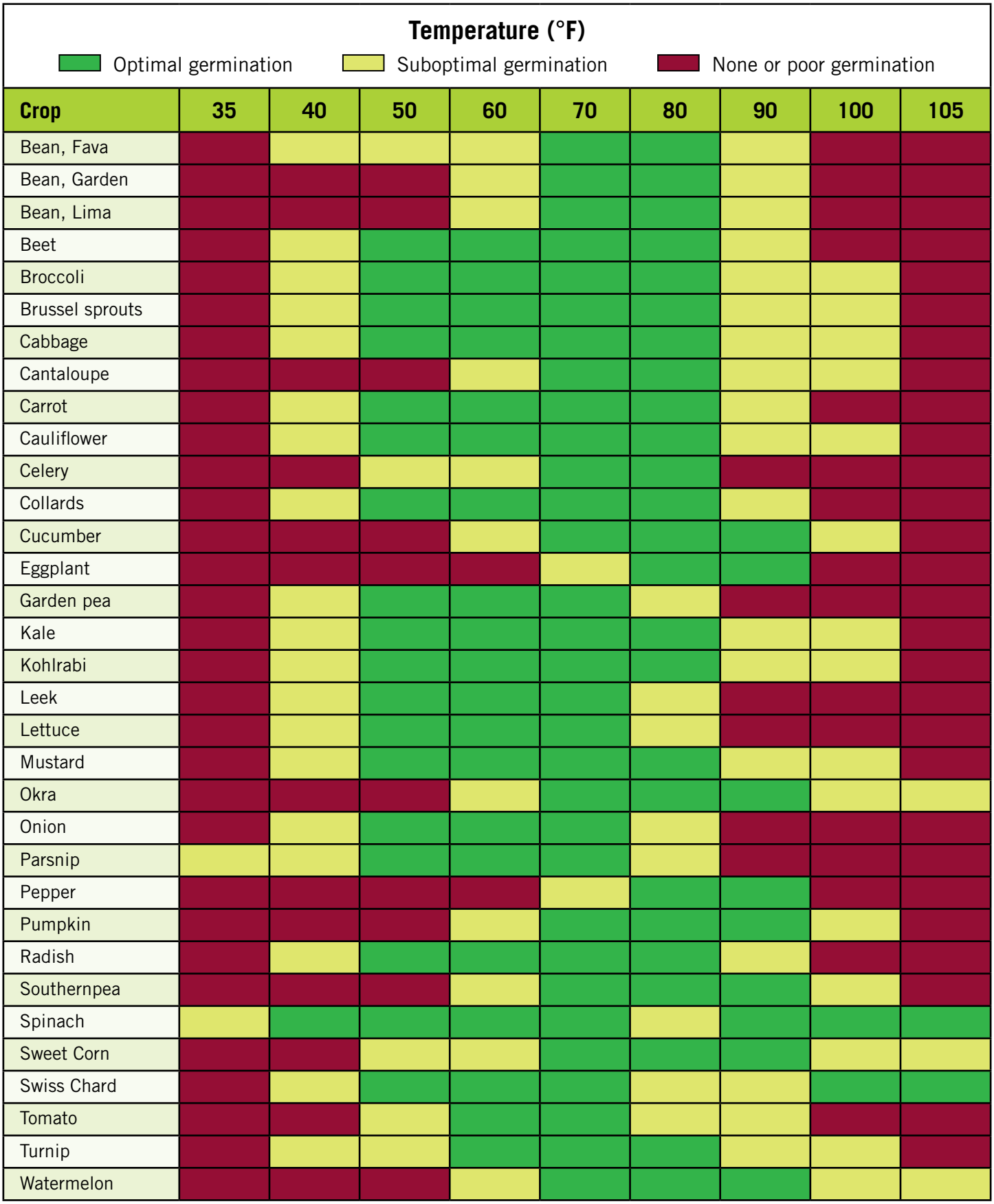
*The listed varieties are suggested varieties for organic production. This list should not be considered to exclude other varieties that may be suitable for production.

Table 4. Selection of varieties suitable for organic production in Georgia *(continued).**

Variety	F_1 Hybrids	Open-Pollinated	Heirloom
Sweet Potato		'Beauregard' 'Covington' 'Evangeline' 'Burgundy' 'Bellevue'	
Swiss Chard	'Bright Lights' 'Bright Yellow' 'Oriole' 'Fordhook Giant'		
Tomato	'BHN 602' 'Red Bounty' 'Celebrity' 'Amelia' 'Plum Regal' *(Roma)* 'Trust' *(Indeterminant, greenhouse)*		'Arkansas Traveler' 'German Johnson' 'Ozark Pink' 'Rutgers'
Turnip		'Purple Top White Globe' 'Shogoin' 'Tokyo Cross' 'Hakurei'	
Watermelon	'Fascination' *(Triploid)* '7187 HQ' *(Triploid)* 'Troubadour' 'Top Gun' 'Sangria' '790' 'Yellow Doll'	'AU-Producer' 'Sugar Baby' 'Allsweet' 'Crimson Sweet'	'Moon and Stars' 'Georgia Rattlesnake' 'Cream of Saskatchewan'
Zucchini	'Spineless Beauty' 'Respect' 'Payload'	'Black Beauty'	'Cocozelle Italian'

*The listed varieties are suggested varieties for organic production. This list should not be considered to exclude other varieties that may be suitable for production.

Table 5. Temperature ranges for vegetable seed germination.



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