



# Organic Cucurbits

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## Introduction

Cucurbits, vegetables in the family Cucurbitaceae, include cucumber, pumpkin, squash, muskmelon and watermelon. Certified organic cucurbits are produced without using synthetic fertilizers and pesticides, according to organic crop production standards regulated by the National Organic Program (NOP). For more information on the exact requirements to be organic certified in Kentucky, please visit the Kentucky Department of Agriculture website at <http://www.kyagr.com/marketing/organic-marketing.html>.

Growers commercially producing cucurbits in Kentucky's climate must manage key insect pests such as cucumber beetle and squash bug as well as economically important diseases such as bacterial wilt, cucurbit yellow vine decline, powdery mildew, and downy mildew. This profile provides an overview of organic cucurbit production in Kentucky, including market demand potential, key production considerations, and baseline economics.

## Marketing and Market Outlook

Direct markets for organic cucurbits in Kentucky include roadside stands, farmers markets, and community supported agriculture (CSA). Local restaurants and grocers may be willing to pay premiums over wholesale prices for locally grown organic produce. There is additional wholesale market potential from chain grocers, produce wholesalers and brokers, and produce auctions.

High consumer demand for organic foods has made organic crop production one of the fastest growing segments of agriculture. Squash is the largest field-grown cucurbit crop, by acreage, with



almost 7,000 acres of organic summer and winter squash harvested in 2016 valued at more than \$48 million. Cantaloupe is the second-largest organic cucurbit crop in the U.S., with more than 1,400 acres grown in 2016 valued at more than \$14.5 million, according to the Certified Organic Survey 2016 Summary report by the USDA's National Agricultural Statistics Service.

Because organic crop production standards are regulated by the National Organic Program, growers producing and selling cucurbits labeled "organic" must be certified by a USDA-approved state or private agency. While there are benefits to using the Kentucky Department of Agriculture (KDA) for the certification process, Kentucky residents can be certified by any approved agency operating in the Commonwealth.

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## Production Considerations

### *Cultivar selection*

Informed cultivar selection is an important first step to a successful organic cucurbit harvest. Select cultivars that are

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resistant or tolerant to Fusarium wilt, downy mildew, and/or powdery mildew. Availability of resistant cultivars will vary by crop. For example, Fusarium resistance can be more commonly available in watermelon cultivars. Fusarium, downy mildew, and powdery mildew resistance will vary between squash, cucumber, and muskmelon varieties. Producers will likely face higher seed costs for organic seed for the most desirable cultivars. Growers should also select cultivars based on their future market. For example, certain squash cultivars do well at farmers markets or CSAs, but can be challenging to produce large quantities uniformly and, therefore, may not be suitable for wholesale markets.

#### *Site selection, planting, and maintenance*

Avoid soils recently planted in cucurbit or solanaceous crops; crop rotation helps greatly in managing cucurbit disease and insect pressure. Cucurbits thrive on well-drained soils that are fairly high in organic matter (2 percent for a sandy soil, 6 percent for a soil with close to 50 percent clay<sup>1</sup>). Land must be certified for organic production. There is a three-year transition period needed for land not previously certified.

Cucurbits are cold sensitive and should be planted after the danger of frost. Cucurbits are often grown from transplants planted into raised beds with black plastic mulch and drip irrigation. Black plastic mulch can help soil warm faster in spring and allow earlier times to market. However, some cucurbits are often direct seeded, such as squash and pumpkins. If direct seeding, over-seeding is recommended. This means planting at 2-3 seeds per planting hole and then thinning down to one plant once seedlings have formed their first true leaves. Mulching also aids in soil moisture retention, nutrient uptake, and weed control, and can have favorable impacts on insect pest populations. Trickle irrigation helps discourage disease spread while increasing fruit quality and quantity. Overhead irrigation is not recommended.

Cucurbit vines, such as those on pumpkins and water-

melon, should be trained to run lengthwise within the row. This protects plants during harvest and makes for easier hand harvesting. Trellising cucumbers can also improve ease of harvest and aid in disease control.

Adequate pollination is important in cucurbits. The use of one to two strong beehives per acre is recommended, depending on crop intensity and pollinator presence. Pollinators will need to be added under row covers, which are commonly used in organic cucurbit systems to help manage pest pressure.

#### *Pest management*

Organic cucurbits face pressure from multiple insects and diseases. Bacterial wilt, a disease vectored by the cucumber beetle, and cucurbit yellow vine decline (CYVD), vectored by squash bug, underscores the importance of insect management for disease control. The risk from wilt and CYVD is so great that many commercial organic cucurbit plantings use row covers to create a physical insect barrier. Traditional organic production has used spunbound row covers removed when the cucurbit starts to bloom, followed by a weekly application of py-



rethroid insecticides. Replicated research in Kentucky and Iowa during 2016 showed favorable marketable yield differences for muskmelons and acorn squash in 3.5-foot-tall “mesotunnels” used in triple row blocks under nylon mesh row covers that remain in place for the entire growing season. Purchased bumblebee colonies are placed inside the mesotunnels for pollination, and no insecticides are used. Seed treatments, like *Bacillus subtilis*, have been shown to impart some level of resistance to bacterial wilt in some melons.

In addition to insect-vectored diseases, many other diseases and viruses affect cucurbits. Gummy stem blight and anthracnose are the most commonly reported watermelon diseases in Kentucky. Summer squash is usually most threatened from *Choanephora* fruit rot, scab, powdery mildew, and *Phytophthora* blight. Late-season cucurbits – such as pumpkins and winter squash – are most susceptible to disease pressure from black rot, downy mildew, and powdery mildew.

**Table 1.**

Crop	Harvest Stage	Postharvest and Storage
Muskmelons	Full-slip (local sale); ¼-slip or ½-slip (advance harvest)	Benefit from field heat removal as soon as possible. Short-term storage at 36F to 41F and a relative humidity of 95 percent.
Watermelons	Full maturity	Benefit from field heat removal as soon as possible. Store up to one month at proper temperatures and relative humidity. Avoid exposure to ethylene during storage.
Cucumbers	Full maturity (slicers); immature (pickling)	Cool after harvest to extend shelf life. Store up to two weeks at proper temperatures (45F to 50F) and relative humidity (95 percent).
Summer Squash	Harvest at size preferred by buyer (usually 6 to 8 inches long), before skin becomes tough and hard. Fruit ready for harvest two to five days after flowers have fully opened.	Sell as soon after harvest as possible.
Winter Squash, Pumpkins	Harvest when rind becomes hard and color deepens. Handle carefully to prevent injury.	Pumpkins will store 2 to 3 months at 50F to 55F and relative humidity of 50 to 70 percent. Curing is not recommended for acorn squash. Properly cured, some winter squash may be stored up to 4 months at proper temperatures and humidity.

Fusarium wilt is a concern across most cucurbits, as is disease pressure from Phytophthora fruit rot, Alternaria leaf spot, Cercospora leaf spot, Plectosporium, belly rot, and numerous viruses. The main option for chemical control is through the use of copper-containing fungicides.

In addition to cucumber beetles and squash bugs, there are other insects such as squash vine borers, spider mites, leafhoppers, and aphids that may become economically important when not managed. Aphids may impact crops by vectoring viruses and producing aphid honeydew, which can attract ants and other problematic insects.

Crop scouting and observation, including insect trapping, is a necessary part of managing pests using organic means. Beneficial and predatory insects and other organisms, including parasitic wasps, may also be utilized to reduce insect pests in organic cucurbits. There are also products approved for certified organic production that may be sprayed on organic cucurbits,

but these products often also reduce beneficial insect populations.

#### *Harvest and storage*

Harvest and storage requirements for cucurbits vary according to plant species and desired market. These are summarized in Table 1. Summer squash tend to have the most variable harvest requirements, as market preferences can determine the maturity stage at which fruit are picked. For cucumbers, picking the first harvestable cucumbers is very important to ensure continued production throughout the season. Cooling cucumbers and squash soon after harvest helps maintain quality and extend shelf life. Melons should be picked at full maturity, with some variations in muskmelons according to market locations. Pumpkins and winter squash may be picked at full maturity and can be stored the longest of any of the major cucurbit crops. It is recommended to wear gloves during harvest for some cucurbits, such as squash and cucumber, to avoid scratching or damaging fruit.



### Labor requirements

Labor needs for organic cucurbit production will vary greatly depending on the type of cucurbit crop, the producer scale, and the production systems. Harvest methods and packing lines will also affect total labor requirements. University of Kentucky labor estimates for conventional cucurbits are listed in Table 2. Generally, organic production will require more labor during production, such as that needed for more machine operator or hand weeding labor. Harvest and postharvest labor needs will be similar. An additional 10 hours per acre is needed for plastic mulch removal.

**Table 2.**

Crop	Labor Hours Per Acre
Muskmelons	Production: >20 hours Harvest & Grading: ≈80 to 120 hours
Watermelons	Production: >20 hours Harvest & Grading: ≈70 hours
Cucumbers	Production: 20-70 hours (higher for trellised) Harvest & Packing: 250 hours per 500 boxes (60-70 pounds per hour)
Summer Squash	Production: >25 hours Harvest & Packing: 200-250 hours
Winter Squash, Pumpkins	Production: ≈25-50 hours Harvest & Packing: 70-100 hours

### Economic Considerations

Initial investments for organic cucurbit production include land preparation, organic certification, and the purchase and/or production of seed and transplants. Additional costs may include installing an irrigation system, row covers, mulch and weed control, and certified organic fertilizers and other inputs.

The value of labor is an important consideration when evaluating the financial feasibility of certified organic production. Many organic producers substitute operator and family labor, such as hand weeding and hoeing, in place of purchased inputs. Certified organic production, especially at smaller scales, also typically involves time-intensive pest control, including crop scouting and recordkeeping. It is important to estimate the time that will be involved in production and evaluate the financial payback returned on the farm operator's time.



In addition to the value of producer labor, a producer should evaluate many other economic factors when he or she is deciding whether to produce organic cucurbits. These include production risk, producer experience, market demand, and even crop varieties and crop rotations. For example, past UK research has demonstrated that organic pumpkins are probably not profitable in Kentucky, especially on sites where cucurbits have been commonly grown.

Market price and yield differentials are also important considerations for organic cucurbits, as for any vegetable crop. It is important to understand the total potential yield range from a certain field area, the expected market price for that yield, and the cost of getting the crop to market for sale. Producers should estimate their costs and returns for crop production before purchasing seed and transplants using a production budget customized for an individual farm's production plans. Tools available for this planning include the Center for Crop Diversification's large- and small-scale vegetable production budgets, spreadsheets that can be modified by users to reflect different production assumptions and scenarios.

<sup>1</sup>Magdoff, F., and van Es, H. (2009). Amount of Organic Matter in Soils. In *Building Soils for Better Crops, Sustainable Soil Management* (3rd ed., pp. 23-35). College Park, MD: Sustainable Agriculture Research and Education (SARE). <https://www.sare.org/Learning-Center/Books/Building-Soils-for-Better-Crops-3rd-Edition/Text-Version/Amount-of-Organic-Matter-in-Soils/How-Much-Organic-Matter-Is-Enough>

### Selected Resources

- "Growing Organic Demand Provides High-Value

Opportunities for Many Types of Producers” (USDA/ERS Amber Waves, 2017)

<https://www.ers.usda.gov/amber-waves/2017/januaryfebruary/growing-organic-demand-provides-high-value-opportunities-for-many-types-of-producers/>

- 2017 Vegetable and Melon Budgets (University of Kentucky Center for Crop Diversification)

<http://www.uky.edu/ccd/tools/budgets>

- “Development of Organic Melon Production Methods to Control Bacterial Wilt” (2010 UK Fruit and Vegetable Crop Research Report, UK PR-608, p. 44) <http://www.ca.uky.edu/agc/pubs/pr/pr608/pr608.pdf>

- Cucumber Beetles: Organic and Biorational Integrated Pest Management (ATTRA, 2008) <https://attra.ncat.org/attra-pub/summaries/summary.php?pub=133>

- “Producing No-Till Pumpkins with a Rye/Vetch Cover Crop in Kentucky with Conventional, Low-Input, and Organic Practices” (2008 Fruit and Vegetable Research Report UK PR-572, p. 51) <http://www2.ca.uky.edu/agcomm/pubs/pr/pr572/pr572.pdf>

- Reinventing Sustainable Protection Systems for Cucurbit Protection <https://portal.nifa.usda.gov/web/crisprojectpages/1007167-reinventing-sustainable-protection-systems-for-cucurbit-production.html>

- Biology and Management of Aphids in Organic Cucurbit Production Systems (eXtension, 2014)

<https://articles.extension.org/pages/60000/biology-and-management-of-aphids-in-organic-cucurbit-production-systems>

- Weed Management Strategies for Organic Cucurbit Crops in the Southern United States (eXtension, 2015) <http://articles.extension.org/pages/60198/weed-management-strategies-for-organic-cucurbit-crops-in-the-southern-united-states>

- “Characteristics of U.S. Organic Fresh Produce Consumers: A Double Hurdle Model Approach,” Bo Chen and Sayed Saghaian (UK Department of Agricultural Economics) Selected Paper Prepared for Presentation at the South Agricultural Economics Association Meeting, Feb. 2017 <http://ageconsearch.umn.edu/record/229980/files/Characteristics%20of%20U.S.%20Organic%20Fresh%20Produce%20Consumers.pdf>

#### **Suggested Citation:**

Ernst, M. (2018). *Organic Cucurbits*. CCD-CP-136. Lexington, KY: Center for Crop Diversification, University of Kentucky College of Agriculture, Food and Environment. Available: <http://www.uky.edu/ccd/sites/www.uky.edu/ccd/files/organiccucurbits.pdf>

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**December 2018**

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