VEGETABLE PRODUCTION HANDBOOK

FOR

FRESH MARKET GROWERS

UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN · COLLEGE OF AGRICULTURE
COOPERATIVE EXTENSION SERVICE · CIRCULAR 1241
VEGETABLE PRODUCTION HANDBOOK
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FOR
FRESH MARKET GROWERS
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Acknowledgments

Special thanks are due to the following people for helping to review the manuscript: Walter E. Splittstoesser, C. Chris Doll, William L. George, William M. Brooks, and Mary L. Lamberts.
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All Illinois Extension circulars mentioned in this publication may be obtained from the following address: Office of Agricultural Publications, University of Illinois, 47 Mumford Hall, 1301 West Gregory Drive, Urbana, IL 61801.
Introduction

Commercial vegetable production can be a source of additional family income or a full-time occupation. As the cost-price squeeze continues to reduce the profitability of general farming, the production of high-value food crops on a limited scale may gain more appeal among grain farmers, livestock producers, landowners, and gardeners. This handbook has been written to help beginning growers make cultural and marketing decisions as they plan their vegetable business. It may also help established growers choose new crops or review their current practices.

Before the construction of a modern national highway system, fresh market vegetables were produced on a regional basis by the truck farms that surrounded every city. Today, as energy and transportation costs rise, locally grown produce may again become competitive with produce shipped from the South and Far West. Although Texas, Florida, and California are likely to remain major suppliers during the winter months, consumers may become more interested in fresh, high-quality spring, summer, and fall vegetables that are produced by growers close to population centers.

With the changes in economic conditions has also come a renewed interest in fresh foods. After several decades of increasing consumption of processed and packaged foods, there is now an increasing demand for fresh produce. The popularity of salad bars in restaurants and the greater number of pick-your-own operations, farmers' markets, and community markets are further evidence of this trend. In spite of rising prices, the consumption of salad vegetables continues to increase dramatically. This demand is likely to be satisfied, at least in part, by locally grown produce.

Despite these favorable signs, it is not the intention of this booklet to encourage everyone to grow vegetables for income. Those who are unwilling to make major commitments of time and investment capital should not attempt such an enterprise. Day-to-day control of weeds, insects, and diseases and performance of various cultural operations are critical, and too often small plantings are neglected for other work that may be the primary source of income. It is important to remember that neglect and carelessness lead to failure.

Regardless of the size of the vegetable-growing operation, the sale of the final product should reward the manager for his or her ability to grow and market the crop. Once the decision to grow vegetables has been made, this handbook can serve as one of the many available sources of information on vegetable produc-

### Marketing

The marketing process begins long before produce leaves the farm gate — with initial planting decisions based on information obtained from various marketing services, sales outlets, grower organizations, and the Cooperative Extension Service. It is important to consider the potential volume of production, the availability of adequate financing, and your experience as a grower. Which crops you will grow will depend on the length of the growing season, the availability of labor, and the proximity of your site to established markets. Even the selection of varieties and the determination of planting schedules are basic marketing decisions.

Growers can often choose from several sales outlets, and one of their major problems is deciding which outlet or combination of outlets would be most profitable for their situation. The following points will help new growers evaluate existing locations.

**Market gardeners** are located close to their markets and produce crops primarily for roadside stands, pick-your-own operations, farmers' markets, and local food stores. They grow vegetables in labor-intensive cultural systems, generally on small acreages. A wide variety of crops may be grown for local consumption, and production is based on demand. Because market gardeners are close to their outlets, they are often located on
high-value land near metropolitan areas. Although land prices and taxes may be high in those areas, nearness to customers has the highest priority.

**Truck farmers** ship their produce to terminal produce markets or chain stores and so are usually located some distance from their principal outlet. Because of the distance they cover, they can take advantage of suitable soils, climate, and often lower land costs to grow large quantities of vegetables that are favored by the intended market. The vegetables are harvested, graded, and packed according to the requirements of the specific outlet. The packing and grading equipment required by this operation raises production costs.

Truck farmers usually specialize in one or a few crops. In this kind of operation, vegetables can often be rotated with general field crops or grown to supplement animal production.

**Growers of vegetables for processing** supply produce to companies that freeze, can, or otherwise process vegetables. The crops are usually produced according to the terms of a written contract, which may specify variety, planting schedule, pest control practices, acreage, and price. Maximum mechanization is necessary. Processors usually employ fieldmen to help advise the grower on production, and they may provide specialized harvest equipment. The grower must be located within an economical hauling distance of the processing plant. Processors do not usually buy surplus yields from fresh market growers.

Vegetable crops grown for processing in Illinois include sweet corn, peas, pumpkins, kidney and lima beans, snap beans, asparagus, tomatoes, and cucumbers. Individual growers may produce 100 acres or more of these crops.

**Greenhouse vegetable growers** are highly specialized, and their crops are the most intensively grown of all commercial vegetable crops. Investment costs and management levels are very high. The goal is to produce the highest-quality produce for marketing when local outdoor production is out of season. Therefore, this produce brings a premium price and is in demand by specialty produce buyers, restaurants, and roadside markets. Often small greenhouses supplement their income by selling to local markets. Growing vegetable bedding plants for sale to markets and home gardeners can also be profitable. Land units of one acre or less can provide employment for a family, but the capital investment is substantial.

**Seed producers** are involved in a highly specialized and technical business. The vegetable seed industry is located largely in the West, where environmental conditions are favorable for proper curing and disease control. Relatively few growers produce their own seeds. The location (catalog mailing address) of a seed company has no bearing on the suitability of its varieties and seeds for growers in Illinois.

**Home gardeners** grow vegetables for home use, storage, and freezing. Gardening is a leading hobby activity, and over half the households in the Midwest grow some vegetables. The home vegetable garden can be valuable to a family, although relatively few become involved on a commercial basis. Home gardeners usually do not compete with commercial growers and are actually among the best customers for top-quality vegetables.

**Common Illinois Markets**

Illinois growers usually choose one or more of the following sales outlets for their fresh vegetables: (1) direct markets, (2) retailers, (3) local shippers or truckers, and (4) terminal produce markets. The suitability of the different sales outlets varies considerably, depending upon the location of the farm, the volume produced, the crops grown, and the marketing ability of the grower. Generally, smaller quantities of an assortment of vegetables are most profitably sold in local markets through direct marketing. Larger quantities of vegetables are needed by wholesale buyers.

**Direct markets.** Selling directly to the consumer has become much more common in Illinois in recent years. Direct market crops are sold in pick-your-own operations, roadside stands, and farmers’ markets.

- Pick-your-own is a popular method of selling strawberries, other berries and fruits, and selected vegetables. Vegetables such as sweet corn, melons, and pumpkins are often harvested by the farm crew and brought to a convenient location. Customers then select their own produce while visiting the farm or farm stand.
- Roadside stands and on-farm markets are popular for selling fruits and vegetables. Some growers develop a reputation for specific crops, such as apples, cider, sweet corn, pumpkins, tomatoes, and fruit baskets. Usually grower-operated roadside stands are open only during the growing season. Location on a busily traveled road is probably the single most important factor in a successful operation.
- Many cities in Illinois now have farmers’ markets that are open one or two days a week. It is distinctly advantageous to have more than one opportunity during the week to sell vegetables. The market should also be within convenient driving distance of the farm. For the location of current markets, see the *Directory of Illinois Fresh Fruit and Vegetable Markets*, available from the Illinois Department of Agriculture, Division of Marketing, State Fairgrounds, Springfield, IL 62708.
Prices received in direct markets are generally 10 to 20 percent lower than those received in local retail stores. This reduction represents a savings for the consumer, who will develop a loyalty to a particular farm or market if that market also serves other needs. Since consumers care most about quality, freshness, and personal service, direct market growers should not advertise price savings alone. In some areas, direct customers. Location and accessibility by improved icing directly to the consumer must also have the ability vegetables shipped from distant growing areas. Higher market produce is even priced higher than fruits and prices are usually a reflection of superior quality.

Direct market growers must be located close to their customers. Location and accessibility by improved roads are both important considerations. Growers selling directly to the consumer must also have the ability and personality to deal with the public. Success depends upon building repeat sales by meeting the consumer's expectations of price, quality, freshness, courtesy, and honesty.

An overview of laws and regulations affecting direct market growers is given in Illinois Extension Circular 1195, *Direct Marketing By Farmers To Consumers: Some Legal Implications.*

**Retailers.** Retailers provide an excellent outlet for growers who are fortunate enough to have wholesale farmers’ markets or suitable grocery stores nearby (within 25 to 30 miles). These outlets sometimes cater to smaller growers, and the advantages are usually cash sales and repeat business. Unfortunately, there are no large wholesale farmers’ markets in Illinois, and many large grocery stores prefer the dependable supply of a uniform product that is shipped over a long season from growing points in California, Florida, Michigan, or elsewhere. Some chain stores are now emphasizing Illinois vegetables and the advantages of locally grown, high-quality produce. The Illinois Vegetable Growers Association also promotes home-grown produce with brochures and “August is vegetable month” advertising.

Generally, it is the larger growers and cooperative marketing groups that can best take advantage of selling directly to the retailer. They can promise uniformly packaged, high-quality produce, provide precooling and icing, and ship on schedule to chain stores or warehouses.

**Local shippers and truckers.** These customers may buy from growers at growing and shipping points. They buy for cash and are a good outlet for small growers in truck-farming areas. Sales often result in higher net returns because the grower does not have to pay shipping costs, commission charges, and dockage fees. Local shippers and truckers combine small lots and sell in distant markets when the supply and prices are favorable. Some local shippers buy ungraded vegetables for grading and packing under their own brand.

**Types of Direct Markets**

<table>
<thead>
<tr>
<th>Type of Market</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Customer pick-your-own operations</strong></td>
<td>Customers travel 10 to 20 miles to market and usually pick one crop in amounts sufficient for processing at home. Visits are few and highly seasonal and are often used as family outings.</td>
</tr>
<tr>
<td><strong>Roadside farm stands</strong></td>
<td>Customers travel 6 to 10 miles to market and visit every week or more often. Purchases are usually small and varied, unless the vegetables are to be canned or frozen.</td>
</tr>
<tr>
<td><strong>Downtown community farmers’ markets</strong></td>
<td>Customers travel 1 to 5 miles to market. Markets are usually open one day per week. Purchases are small and varied.</td>
</tr>
</tbody>
</table>

**Horticultural Crops Sold in Direct Markets in Illinois, in Order of Economic Importance**

<table>
<thead>
<tr>
<th>Crop</th>
<th>Annual production for fresh sales</th>
<th>Estimated percentage sold in direct markets</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strawberries, 1,000 lb</td>
<td>7,000-10,000</td>
<td>95</td>
</tr>
<tr>
<td>Apples, 1,000 lb</td>
<td>90,000-100,000</td>
<td>15-20</td>
</tr>
<tr>
<td>Tomatoes, 1,000 lb</td>
<td>18,000</td>
<td>20-30</td>
</tr>
<tr>
<td>Sweet corn, doz</td>
<td>5,000,000</td>
<td>20-25</td>
</tr>
<tr>
<td>Peaches, 1,000 lb</td>
<td>20,000</td>
<td>25-35</td>
</tr>
<tr>
<td>Melons, 1,000 lb</td>
<td>30,000</td>
<td>40-50</td>
</tr>
<tr>
<td>Pumpkins, 1,000 lb</td>
<td>15,000</td>
<td>40-50</td>
</tr>
<tr>
<td>Beans, 1,000 lb</td>
<td>5,000</td>
<td>20-25</td>
</tr>
<tr>
<td>Squash, 1,000 lb</td>
<td>4,000</td>
<td>25-35</td>
</tr>
<tr>
<td>Peppers, 1,000 lb</td>
<td>6,000</td>
<td>5-10</td>
</tr>
<tr>
<td>Blueberries, 1,000 lb</td>
<td>250-300</td>
<td>90-95</td>
</tr>
<tr>
<td>Raspberries, blackberries, 1,000 lb</td>
<td>100-150</td>
<td>90-95</td>
</tr>
<tr>
<td>Cucumbers, pickles, 1,000 lb</td>
<td>8,000</td>
<td>5-10</td>
</tr>
<tr>
<td>Greens, 1,000 lb</td>
<td>3,000</td>
<td>25-30</td>
</tr>
<tr>
<td>Plums, pears, cherries, 1,000 lb</td>
<td>100-150</td>
<td>70-75</td>
</tr>
<tr>
<td>Cabbage, 1,000 lb</td>
<td>17,000</td>
<td>1-2</td>
</tr>
<tr>
<td>Grapes, 1,000 lb</td>
<td>400-600</td>
<td>10-20</td>
</tr>
</tbody>
</table>

*Includes roadside or on-farm markets, community farmers’ markets, and pick-your-own operations.

*A significant acreage of these crops is also grown for processing.*
Terminal produce markets. Some of these markets are located in St. Louis, Chicago, and Benton Harbor, Michigan. Shippers, truckers, and large-scale growers may deal directly with one of several commission houses that often specialize in a limited number of fruits or vegetables. They usually buy in car lots or truck lots and then sell in smaller quantities to produce buyers from chain stores, grocery stores, hotels, restaurants, produce markets, and peddlers. Some commission houses sell to jobbers who specialize in certain kinds of produce for their clientele.

Vegetables packed for wholesale sales to chain stores, shippers, or terminal produce markets must be packaged, graded, and labeled according to the Illinois Weights and Measures Act. For questions regarding grading, labeling, and weight and measure standards, write to the Illinois Department of Agriculture, Division of Agricultural Industry Regulations, Emmerson Building, State Fairgrounds, Springfield, IL 62708.

Information on wholesale prices may be obtained from various market reports published by the USDA Market News Service. Contact the Fruit and Vegetable Division, Market News Branch, USDA, 610 South Canal Street, Room 1060, Chicago, IL 60607; or 208 North Broadway, Room 1010, Federal Building, St. Louis, MO 63102. The national weekly newspaper of the fruit and vegetable industry, The Packer, provides insights into current crop, marketing, and pricing situations. Under a new system called ProNet, daily price information can also be obtained through a computer hookup. For information, write to The Packer, 7950 College Boulevard, Box 2939, Shawnee Mission, KS 66201.

Sources of Additional Information
Publications available from the Department of Horticulture, University of Illinois, 124 Mumford Hall, 1301 West Gregory Drive, Urbana, IL 61801:
HM-1-79: Pick-Your-Own Marketing of Fruits and Vegetables
HM-2-79: Liability and Insurance for U-Pick Operations
HM-3-79: Net Weights and Processed Yields of Fruits and Vegetables in Common Retail Units
HM-4-80: Establishing a Community Farmers' Market
HM-5-82: Yields of Commercial Food Crops in Illinois
HM-6-82: Estimating the Trade Area and Potential Sales for a Pick-Your-Own Strawberry Farm

Other publications (write to the addresses given):
Ohio Crop Enterprise Budgets. MM-389. Office of Information, Ohio Cooperative Extension Service, 2120 Fyffe Road, Columbus, OH 43210.
Point-of-purchase brochures may be obtained from the Illinois State Vegetable Growers Association, 17510 Garden Valley Road, Woodstock, IL 60098.
Crop Selection

The most recent trend in commercial vegetable production is toward increased size, specialization in one or a few crops, and mechanization in culture, harvesting, and packing. Many growers have become specialists at producing relatively large amounts of crops. This practice has enabled them to use large machinery efficiently and to take advantage of wholesale marketing.

Other growers have diversified. By growing small plantings of a relatively large number of vegetables, a farmer can supply high-quality produce to farm stands, roadside markets, and farmers' markets that operate throughout the season. Today, these growers are called "market gardeners." Growers who operate farm stands produce a wide range of vegetables to provide their customers with an attractive selection of fresh produce. However, even market gardeners may specialize in melons, sweet corn, or other popular produce items.

Part-time farmers may choose to grow and harvest a single crop for a specific market. Growers with limited experience or a limited labor supply often prefer this approach. However, these growers must be certain that a market exists for their specialty and that they do not overproduce their single commodity.

When deciding which crops to grow, it is advisable to first investigate potential markets to determine how much of each vegetable might be sold and at what price. This information will help you estimate an average gross return (see table, this page). Be sure to account for the intensive labor and management inputs required to grow your vegetable crops.

The availability of labor will have a direct effect on which crops are produced and how they are marketed. Crops with multiple harvests, such as cucumbers and tomatoes, require much more labor than crops picked only once or twice, such as beets, cabbage, and corn. For this reason some growers find it advantageous to produce higher-value, labor-intensive crops and to sell them on a pick-your-own basis.

Vegetables also require varying numbers of pesticide applications or mechanical cultivations. In some years, for example, early sweet corn may not need insecticide applications in northern Illinois. Varieties with multiple disease resistance are also available that may eliminate or change the need for routine fungicide application. Melon crops, on the other hand, may require a large number of insecticide and fungicide applications as well as mechanical cultivation. Experimenting with crops on a limited scale helps new growers decide which crops best fit their ability, labor supply, and market.

When choosing crops, you also need to consider the following:

- The hardness of the vegetable
- The length of the growing season and the time required for the vegetable to reach maturity
- The adaptability of the crop to the soil, temperatures, rainfall, and day length of the area

The charts on the following pages should help you determine when an individual vegetable may be planted in your region and when it will reach a marketable stage. More information on specific vegetables may be obtained from the individual crop sections of this handbook. What can be grown will be determined largely by environment, and what should be grown will be decided by the marketplace and available resources.

### Estimated Yields and Values of Selected Agronomic and Horticultural Food Crops

<table>
<thead>
<tr>
<th>Crop</th>
<th>Yield per acre</th>
<th>Unit price ($)</th>
<th>Potential gross return ($ per acre)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Winter wheat</td>
<td>50 bushels</td>
<td>3.00</td>
<td>150</td>
</tr>
<tr>
<td>Hay (all types)</td>
<td>4 tons</td>
<td>50.00</td>
<td>200</td>
</tr>
<tr>
<td>Corn for grain</td>
<td>130 bushels</td>
<td>3.00</td>
<td>390</td>
</tr>
<tr>
<td>Soybeans</td>
<td>40 bushels</td>
<td>7.00</td>
<td>280</td>
</tr>
<tr>
<td>Sweet corn</td>
<td>1,000 dozen</td>
<td>1.00</td>
<td>1,000</td>
</tr>
<tr>
<td>Watermelon</td>
<td>1,000</td>
<td>1.00</td>
<td>1,000</td>
</tr>
<tr>
<td>Muskemelon</td>
<td>2,500</td>
<td>0.50</td>
<td>1,250</td>
</tr>
<tr>
<td>Cucumbers</td>
<td>250 bushels</td>
<td>7.00</td>
<td>1,750</td>
</tr>
<tr>
<td>Cabbage</td>
<td>250 cwt</td>
<td>7.00</td>
<td>1,750</td>
</tr>
<tr>
<td>Peppers</td>
<td>300 bushels</td>
<td>7.00</td>
<td>2,100</td>
</tr>
<tr>
<td>Tomatoes, fresh</td>
<td>15,000 pounds</td>
<td>0.30</td>
<td>4,500</td>
</tr>
</tbody>
</table>

Note: Productivity and price will fluctuate.
Crop Selection

Early Planting Dates for Summer Crops

- **Very hardy vegetables**
  (plant 4 to 6 weeks before average frost-free date)
  - Southern Illinois: March 10–25
  - Central Illinois: March 25–April 10
  - Northern Illinois: April 10–25
  - **Seed**
    - Kale
    - Kohlrabi
    - Leaf lettuce
    - Onion
    - Pea
    - Rutabaga
    - Salsify
    - Spinach
    - Turnip
  - **Transplants**
    - Asparagus (crown)
    - Broccoli
    - Brussels sprout
    - Cabbage
    - Horseradish (root)
    - Onion (set or plant)
    - Parsley
    - Potato
    - Rhubarb (root)

- **Frost-tolerant vegetables**
  (plant 2 to 3 weeks before average frost-free date)
  - Southern Illinois: March 25–April 10
  - Central Illinois: April 10–25
  - Northern Illinois: April 25–May 10
  - **Seed**
    - Beet
    - Carrot
    - Chard
    - Herbs
    - Mustard
    - Parsnip
    - Radish
  - **Transplants**
    - Chinese cabbage
    - Herbs

- **Tender vegetables**
  (plant on average frost-free date)
  - **Seed**
    - Bean, snap
    - Corn, sweet
    - New Zealand spinach
    - Squash, summer
  - **Transplants**
    - Tomato

- **Warm-loving vegetables**
  (plant 1 to 2 weeks after average frost-free date)
  - **Seed**
    - Bean, lima
    - Cucumber
    - Muskmelon
    - Okra
    - Pumpkin
    - Squash, winter
    - Watermelon
  - **Transplants**
    - Eggplant
    - Pepper
    - Potato, sweet

Last Planting Dates for Fall Crops

- **Long-season vegetables**
  (require over 90 days to harvest)
  - Southern Illinois: June 1–July 15
  - Central Illinois: June 1–June 15
  - Northern Illinois: June 1–June 15
  - **Seed**
    - Cabbage
    - Collard
    - Kale
    - Kohlrabi
    - Squash, summer
  - **Transplants**
    - Cabbage
    - Potato, Irish
    - Sweet corn
    - Tomato

- **Medium-season vegetables**
  (require 60 to 90 days to harvest)
  - Southern Illinois: July 15–August 1
  - Central Illinois: July 10–July 20
  - Northern Illinois: June 25–July 5
  - **Seed**
    - Bean, snap
    - Beet
    - Carrot
    - Cucumber
    - Endive
    - Okra
    - Rutabaga
  - **Transplants**
    - Broccoli
    - Cabbage
    - Cauliflower

- **Short-season vegetables**
  (require 30 to 50 days to harvest)
  - Southern Illinois: August 15–August 25
  - Central Illinois: August 1–August 10
  - Northern Illinois: July 15–July 25
  - **Seed**
    - Kohlrabi
    - Mustard green
    - Radish
    - Spinach
    - Turnip
  - **Transplants**
    - Chinese cabbage
    - Lettuce, leaf
Freeze Dates and Number of Frost-free Days in Illinois

<table>
<thead>
<tr>
<th>Months</th>
<th>Dates</th>
<th>Number of Days</th>
</tr>
</thead>
<tbody>
<tr>
<td>May</td>
<td>May 5</td>
<td>160</td>
</tr>
<tr>
<td>April</td>
<td>April 10</td>
<td>170</td>
</tr>
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<td>April 30</td>
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<td>October</td>
<td>October 5</td>
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<tr>
<td></td>
<td>October 10</td>
<td>200</td>
</tr>
<tr>
<td></td>
<td>October 15</td>
<td>200</td>
</tr>
<tr>
<td></td>
<td>October 20</td>
<td>200</td>
</tr>
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<td>October 25</td>
<td>200</td>
</tr>
<tr>
<td></td>
<td>October 30</td>
<td>200</td>
</tr>
</tbody>
</table>

A
Average dates of the last 32° F. freeze in the spring. There is a 50-percent chance that a freeze will occur on the dates shown.

B
Average dates of the first 32° F. freeze in the fall. There is a 50-percent chance that a freeze will occur on the dates shown.

C
Number of frost-free days in Illinois. The growing period may be extended if the garden plants are protected, or if they are frost-hardy.
## Approximate Number of Days from Planting to Market Maturity for Vegetables Grown under Optimum Growing Conditions

<table>
<thead>
<tr>
<th>Vegetable</th>
<th>Early variety</th>
<th>Late variety</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bean, broad</td>
<td>56</td>
<td>120</td>
</tr>
<tr>
<td>Bean, green</td>
<td>65</td>
<td>78</td>
</tr>
<tr>
<td>Bean, lima</td>
<td>56</td>
<td>70</td>
</tr>
<tr>
<td>Beet</td>
<td>55</td>
<td>78</td>
</tr>
<tr>
<td>Broccoli*</td>
<td>50</td>
<td>90</td>
</tr>
<tr>
<td>Brussels sprouts*</td>
<td>62</td>
<td>120</td>
</tr>
<tr>
<td>Cabbage</td>
<td>50</td>
<td>95</td>
</tr>
<tr>
<td>Carrot</td>
<td>70</td>
<td>85</td>
</tr>
<tr>
<td>Chinese cabbage</td>
<td>70</td>
<td>80</td>
</tr>
<tr>
<td>Collard</td>
<td>70</td>
<td>85</td>
</tr>
<tr>
<td>Corn, sweet</td>
<td>64</td>
<td>95</td>
</tr>
<tr>
<td>Cucumber, pickling</td>
<td>48</td>
<td>58</td>
</tr>
<tr>
<td>Cucumber, slicing</td>
<td>62</td>
<td>72</td>
</tr>
<tr>
<td>Eggplant*</td>
<td>50</td>
<td>80</td>
</tr>
<tr>
<td>Endive</td>
<td>85</td>
<td>100</td>
</tr>
<tr>
<td>Kale</td>
<td>50</td>
<td>60</td>
</tr>
<tr>
<td>Kohlrabi</td>
<td>50</td>
<td>60</td>
</tr>
<tr>
<td>Lettuce, butterhead</td>
<td>55</td>
<td>70</td>
</tr>
<tr>
<td>Lettuce, leaf</td>
<td>40</td>
<td>50</td>
</tr>
<tr>
<td>Melon, honeydew</td>
<td>110</td>
<td></td>
</tr>
<tr>
<td>Musk melon</td>
<td>85</td>
<td>95</td>
</tr>
<tr>
<td>Mustard</td>
<td>35</td>
<td>55</td>
</tr>
<tr>
<td>Okra</td>
<td>50</td>
<td>60</td>
</tr>
<tr>
<td>Onion, dry</td>
<td>90</td>
<td>150</td>
</tr>
<tr>
<td>Onion, green</td>
<td>45</td>
<td>60</td>
</tr>
<tr>
<td>Parsley</td>
<td>70</td>
<td>80</td>
</tr>
<tr>
<td>Parsnip</td>
<td>120</td>
<td></td>
</tr>
<tr>
<td>Pea</td>
<td>56</td>
<td>75</td>
</tr>
<tr>
<td>Pea, edible-podded</td>
<td>60</td>
<td>70</td>
</tr>
<tr>
<td>Pea, Southern</td>
<td>65</td>
<td>85</td>
</tr>
<tr>
<td>Pepper*</td>
<td>65</td>
<td>80</td>
</tr>
<tr>
<td>Potato</td>
<td>90</td>
<td>120</td>
</tr>
<tr>
<td>Pumpkin</td>
<td>100</td>
<td>120</td>
</tr>
<tr>
<td>Radish</td>
<td>22</td>
<td>30</td>
</tr>
<tr>
<td>Rutabaga</td>
<td>90</td>
<td></td>
</tr>
<tr>
<td>Spinach</td>
<td>37</td>
<td>45</td>
</tr>
<tr>
<td>Squash, summer</td>
<td>40</td>
<td>50</td>
</tr>
<tr>
<td>Squash, winter</td>
<td>85</td>
<td>110</td>
</tr>
<tr>
<td>Sweet potato</td>
<td>120</td>
<td>150</td>
</tr>
<tr>
<td>Tomato*</td>
<td>60</td>
<td>90</td>
</tr>
<tr>
<td>Turnip</td>
<td>40</td>
<td>75</td>
</tr>
<tr>
<td>Watermelon</td>
<td>75</td>
<td>95</td>
</tr>
</tbody>
</table>


*Additional time is required for growing transplants.

---

## Approximate Number of Days from Pollination to Market Maturity for Vegetables Grown under Warm Growing Conditions

<table>
<thead>
<tr>
<th>Vegetable</th>
<th>Early variety</th>
<th>Late variety</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bean</td>
<td>7-10</td>
<td></td>
</tr>
<tr>
<td>Corn</td>
<td>18-23</td>
<td></td>
</tr>
<tr>
<td>Cucumber</td>
<td>4-5</td>
<td></td>
</tr>
<tr>
<td>Eggplant</td>
<td>25-40</td>
<td></td>
</tr>
<tr>
<td>Muskmelon</td>
<td>42-46</td>
<td></td>
</tr>
<tr>
<td>Okra</td>
<td>4-6</td>
<td></td>
</tr>
<tr>
<td>Pepper</td>
<td>45-55</td>
<td></td>
</tr>
<tr>
<td>Pumpkin</td>
<td>80-90</td>
<td></td>
</tr>
<tr>
<td>Squash, summer</td>
<td>5-6b</td>
<td></td>
</tr>
<tr>
<td>Squash, winter</td>
<td>3-4b</td>
<td></td>
</tr>
<tr>
<td>Tomato</td>
<td>35-45</td>
<td></td>
</tr>
<tr>
<td>Watermelon</td>
<td>42-45</td>
<td></td>
</tr>
</tbody>
</table>


*From 50 percent silking.

b For a weight of ¼ to ½ pound.
Variety Selection

Varieties perform according to their genetic potential and the environmental conditions and cultural practices to which they are exposed. Choosing the best varieties for an individual situation is difficult, partly because a large number of varieties exist and partly because environmental conditions can vary considerably. A variety that performs well during a year of adequate rainfall may perform poorly during an excessively wet or dry season. Good varieties perform well under a range of environmental conditions. Those recommended by the University of Illinois have been tested over many years at several locations or have been observed for their performance in commercial production.

In selecting varieties for your operation, you should take into account the preference of your particular market, the times at which the varieties can be expected to mature, your method of culture, disease problems that you are likely to encounter, and the adaptability of the varieties to your soil and climate. It is advisable to test new varieties and hybrids on a limited scale to judge their potential for your area, use, and market. Some factors that influence the performance of a variety or hybrid are climate (temperatures, rainfall, humidity); soil type, fertility, and drainage; cropping season (spring, summer, or fall); culture (planting distances, training methods, mulching, and fertilizer treatment); method of harvest; and intended use (fresh, storage, processing, or marketing). These factors will vary in importance in different locations in the state.

Commercial growers often find that hybrids are superior to older, open-pollinated varieties because they have several desirable characteristics, such as uniformity of plant and fruit type, uniform maturity, disease resistance, quality, and vigor. A hybrid is the result of crossbreeding two parental lines (or varieties) that are different in at least one but usually several important characteristics. The resulting plant grows more vigorously and gives higher yields. Hybrid seed is usually more expensive than seed from an open-pollinated variety. However, the fact that seed is labeled "hybrid" does not necessarily make it superior to established varieties. Resistance to diseases and insects and other factors should be considered when planting any new variety.

Do not depend entirely on a local garden center for varieties that are suitable for your area. Use the winter months to study variety trial results, recommendation lists, and seed catalogs. No one seed company can provide all the best varieties for each individual operation, so you may have to check several sources. For a list of seed companies and distributors, see Horticulture Facts VC-10-80, Sources of Vegetable Seeds, available from the Department of Horticulture, University of Illinois, 124 Mumford Hall, 1301 West Gregory Drive, Urbana, IL 61801.

Many of the vegetable varieties that show promise for Illinois have only recently been introduced and are being compared to the standard varieties in field tests before being included in the University of Illinois's list of recommendations. The latest results of the annual vegetable trials are published annually in the Illinois Vegetable Research Report, available from the Department of Horticulture, University of Illinois, 124 Mumford Hall, 1301 West Gregory Drive, Urbana, IL 61801.

For a description of currently recommended vegetable varieties for commercial growers, see Illinois Extension Circular 1174, Vegetable Varieties for Commercial Growers, available from the Office of Agricultural Publications, University of Illinois, 47 Mumford Hall, 1301 West Gregory Drive, Urbana, IL 61801.

Sites and Soils

Part-time farmers often have a limited selection of suitable sites. In some situations, it may be better not to grow a crop at all than to risk failure by using an unacceptable site. When alternative sites are available, consider their location in relation to the market, topography, water supply, and soil type of your area.

Location

Although a fertile, well-drained soil improves production, location near a market may be just as important a consideration. For a pick-your-own operation or roadside market, accessibility is critical. Before you begin growing vegetables, therefore, first determine how and where you will sell your produce. If you grow vegetables near a small city, you may draw enough buyers and also avoid the high price of land or the taxes that exist around a major metropolitan area.

Road quality must also be considered. Hard-surfaced roads close to the farm are almost a necessity for either shipping or direct marketing. Unimproved roads may prevent deliveries during rainy periods. Moreover, produce is more subject to injury when it is trucked on bumpy roads.

Topography

Southern or southeastern exposures on a gentle slope are preferred for early spring vegetables and fall crops. A sunny slope dries and warms earlier in the spring than a northern exposure. Since a sloped site generally has good air drainage, there is less likelihood of an early autumn frost. Good air and water drainage will also help reduce disease problems.
Water Supply

It is best to consider irrigation as insurance against even short periods of drought. If you do decide to irrigate, you will need an abundant, dependable supply of inexpensive water. A well or stream should be capable of supplying at least 10 gallons of water per minute per acre. A pond with at least 2 acre feet of water can be used for an acre of vegetables.

Additional information on irrigation may be found in *Irrigation Guide for Illinois*, AEng-866, available from the Department of Agricultural Engineering, University of Illinois, 332H Agricultural Engineering Sciences Building, 1304 West Pennsylvania, Urbana, IL 61801. Information on trickle or drip irrigation is provided in *Horticulture Facts VC-23-82, The Basics of Trickle Irrigation*, available from the Department of Horticulture, University of Illinois, 124 Mumford Hall, 1301 West Gregory Drive, Urbana, IL 61801. See page 14 for a further discussion of irrigation.

Soil Type

Vegetables must be grown in well-drained soil. Waterlogged soil in the spring delays planting, and poor drainage during the season substantially reduces yields. A sandy loam is usually ideal because it provides drainage and is also relatively fertile. Excessively drained sands require expensive irrigation systems and more fertilizer but are still preferable to heavy clay soils. It is easier to correct a fertility problem than to improve drainage. Gently sloping or flat soils are also preferred because they prevent uneven soil moisture and runoff.

The ideal soil for vegetable production will

- provide plant nutrients for good yields
- provide soil moisture
- warm in spring for early crops
- provide good drainage
- have a pH of 6.0 to 7.0 (for most vegetables)

This list generally describes a sandy loam with the preferred pH. Only a few growers will be lucky enough to own this type of soil. However, with proper management, many soil types may be used. Nutrients can be supplied with fertilizer, plastic mulches can be used to improve the soil's water-holding capacity and to promote soil warming, irrigation can supply additional moisture, and pH can be adjusted with lime. The only characteristic that is difficult to change is the soil's physical condition or structure. Additions of organic materials over many years will help somewhat, but soils that tend to stay wet because of a high clay content will never be suitable for vegetables.

Soil Fertility

Most vegetables grow best in a slightly acid soil that has a balanced supply of plant nutrients. Problems occur when the amount of nutrients or the pH are either too low or too high. The preferred soil test levels for most vegetables are given below (soil analysis according to methods described in *Recommended Chemical Soil Test Procedures for the North Central Region*, North Dakota Agricultural Experiment Station Bulletin 499, North Dakota State University, Fargo, North Dakota):

- **Phosphorus (P):** 50–75 lb/acre
- **Potassium:** 300–400 lb/acre
- **Calcium:** 1,000–3,000 lb/acre
- **Magnesium:** 250 lb/acre
- **pH:** 6.0–6.8

The general soil types that exist in Illinois are described below.

- **Prairie soils** extend over the northern two-thirds of the state. They are deep, dark colored, level to gently sloping, and generally very productive where drainage is good.
- **Claypan soils** are common throughout the southern one-third of Illinois. They are level to gently sloping, tend to be more drouthy, and are less productive than prairie soils. Ponds are often the only source of irrigation water.
- **Woodland soils** occur in extensive areas in extreme southern and northwestern Illinois. They are generally sloping and subject to erosion.
- **Alluvial soils** occur along major rivers and streams. They are usually deep and very productive. They may be subject to flooding. Irrigation water may be readily available from the river or deep wells.
- **Sandy soils** occur extensively in Iroquois, Kankakee, Tazewell, Cass, Henderson, Whiteside, Mason, Lawrence, and White Counties. They have a low water-holding capacity and are generally low in fertility. With irrigation and proper management, vegetables can be grown to advantage. Wells can furnish water in most areas.

Sources of Additional Information


Soil reports for individual counties are available from county Extension offices.
Soil Testing

Market gardeners should have their soils tested for pH, phosphorus, and potassium every year. Other soil tests — such as those for organic matter, soluble salts, magnesium, calcium, the cation-exchange capacity, and the percentage base saturation — are more expensive but may be useful when the tests for pH, phosphorus, and potassium show a very high level of soil fertility. Tests for micronutrients are usually too unreliable to be of much help in making fertilizer recommendations. However, soil tests can often identify a potential micronutrient problem.

Samples for soil tests should be collected in late fall while the soil is still relatively dry and unfrozen. A separate test must be done on each area with a different color, slope, or drainage, fertilization, and cropping history. Since fertility may vary considerably on acreage that is used for a wide variety of intensively grown vegetables, a separate sample should be taken for each uniform field (but no more than 4 acres per sample). Each sample should consist of a composite of subsamples collected at random throughout the field.

Required Nutrients

Vegetable crops should be fertilized on the basis of annual soil tests, the soil type, the requirements of the crop, and the history of the field. Judgements should be based on experience. Although the rising costs of fertilizers makes efficiency imperative, commercial vegetable growers cannot afford to sacrifice yield or quality to save money on fertilizer. University recommendations try to insure that no shortage of nutrients will exist.

Although living plants require 16 plant food elements to survive, only nitrogen, phosphorus, and potassium are likely to be deficient in most Illinois soils. A yield response to other nutrients should not be expected in Illinois except on soils that are sandy, eroded, or calcareous. On most soils, Illinois research trials to date have not shown yield increases from additions of calcium, magnesium, sulfur, or any micronutrients. Should you decide to apply any of those nutrients, leave a small portion of your field untreated for comparison purposes at harvesttime.

Micronutrients, as the name implies, are essential nutrients that are needed in small amounts. Moreover, the amounts assimilated by vegetables are small in comparison to the total quantity that may be present in the soil. The availability of micronutrients is influenced by soil conditions such as pH, moisture content, aeration, and the presence and amounts of other elements. Therefore, it is extremely difficult for an individual grower to interpret micronutrient soil tests.

Deficiencies of most micronutrients in Illinois are rare. When they do occur, they are usually caused by overliming, underliming, or other poor management practices. Boron is the most widely deficient micronutrient in vegetable crop soils. Deficiencies of that element are most likely to be found in asparagus, cole crops, tomatoes, and most bulb and root crops. However, excess boron can be very toxic to plant growth. Contact your county Extension adviser in agriculture if you think you have a micronutrient deficiency.

Application Methods

Broadcasting. Most fertilizer is broadcast on the soil surface, either by hand or by machine, and then incorporated with a plow, disk, or power tiller. Broadcasting fertilizer much before planting time can result in a considerable loss of nitrogen and potassium, especially on sandy soils. Broadcasting phosphorus on alkaline soils will result in poor availability. However, for soils that require buildup applications of phosphorus and potassium, a broadcast application is preferred.

Banding. Although broadcasting is necessary when soil tests call for large amounts of fertilizer, small amounts can be applied more efficiently in a band. In banding, fertilizer is placed 2 inches to the side and 2 inches below the level of the seed in a row at planting time. This method is especially effective when placing phosphorus in either cold or calcareous soils. In addition, since banding places the fertilizer close to the plant roots, where it is needed, smaller amounts of nitrogen and potassium are likely to be lost through leaching.

Sidedressing. Although fertilizer is needed for early growth, the greatest quantities are taken up during the second half of the growing season. For this reason, much of the fertilizer applied at planting time may be leached out of sandy soils before it can be used by the plants. To correct this problem, a sidedressing of fertilizer (usually nitrogen) can be applied 4 to 8 weeks after planting and 6 to 10 inches from the base of the plant, and then lightly incorporated into the soil.

Using a starter solution. Transplanted crops produce little aboveground growth during the first two weeks after planting, often because they undergo shock at transplanting and also have a limited root system. An application of starter solution will provide phosphorus as well as some nitrogen and potassium directly to the plant roots. This application encourages early growth and may increase the early yield, although it rarely affects the total yield. A typical starter solution is 8-3-16, 10-52-8, or 10-52-17, but any water-soluble fertilizer with a high phosphorus content will work. Mix 4 pounds of a water-soluble, high-phosphate material
Soil Fertility

(such as 10-52-17) in 50 gallons of water (or 1 ounce per gallon) and apply about 1/2 cup per plant.

Recommended Fertilizer Rates

The recommendations given below are based on the best current information and are subject to change as new information becomes available. The recommendations for phosphorus and potassium provide enough fertilizer to build soil test readings to the desired levels over several years. Nitrogen recommendations are outlined in the fertility sections of individual crop chapters. One-third (for high rates) to one-half (for low rates) of the phosphorus may be banded to increase early yields in cold soils. All the potassium may be applied and incorporated before planting.

On sandy soils, one-third of the potassium should be sidedressed along with nitrogen 4 to 6 weeks after planting.

**Phosphorus Applications Based on Soil Test Results**

<table>
<thead>
<tr>
<th>Soil test result (lb/A)</th>
<th>P2O5 required (lb/1,000 sq ft)</th>
<th>Triple superphosphate required (0-44-0) (lb/A)</th>
<th>(lb/1,000 sq ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-20</td>
<td>260 6.0</td>
<td>600 13</td>
<td></td>
</tr>
<tr>
<td>21-40</td>
<td>220 5.0</td>
<td>500 11</td>
<td></td>
</tr>
<tr>
<td>41-50</td>
<td>150 3.5</td>
<td>350 8</td>
<td></td>
</tr>
<tr>
<td>Over 50</td>
<td>50 1.0</td>
<td>100 2</td>
<td></td>
</tr>
</tbody>
</table>

Note: Soil test according to Bray P1 test as described in Recommended Chemical Soil Test Procedures for the North Central Region, North Dakota Agricultural Experiment Station Bulletin 499, North Dakota State University, Fargo, North Dakota.

**Potassium Applications Based on Soil Test Results**

<table>
<thead>
<tr>
<th>Soil test result (lb/A)</th>
<th>K2O required (lb/1,000 sq ft)</th>
<th>Murate of potash required (0-0-60) (lb/A)</th>
<th>(lb/1,000 sq ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-60</td>
<td>260 6</td>
<td>425 12</td>
<td></td>
</tr>
<tr>
<td>61-100</td>
<td>220 5</td>
<td>350 10</td>
<td></td>
</tr>
<tr>
<td>101-200</td>
<td>180 4</td>
<td>300 8</td>
<td></td>
</tr>
<tr>
<td>201-250</td>
<td>120 3</td>
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<td>251-300</td>
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<td>125 4</td>
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<tr>
<td>Over 300</td>
<td>50 1</td>
<td>75 2</td>
<td></td>
</tr>
</tbody>
</table>

Note: Soil test according to recommended procedures for Illinois; see note, preceding table.

**Soil Reaction (pH)**

The soil reaction, or pH, is a measure of the acidity or alkalinity of a soil. The pH is very important for vegetable growers because it regulates the availability of most nutrients. Both applied fertilizers and soil nutrients are most readily available when the pH ranges from 6.0 to 6.8 — that is, when the soil is slightly acidic. This is also the best range for growing most vegetables. Potatoes can be grown in soil with a pH of less than 5.5 to avoid potato scab; however, scab-resistant varieties are available, and a slightly higher pH would be desirable for northern crops. Cabbage grown on soil with a pH slightly above 7.0 will be less damaged by the club root disease, but this pH should be used only where club root infestations exist.

Lime should be added to soils with pH values lower than 5.8 to raise the pH. Do not attempt to raise the pH from very low values to 6.5 in one year. Apply the amount suggested and have the pH checked annually. For more information, see Horticulture Facts VC-18-82, Liming Vegetable Crops, available from the Department of Horticulture, University of Illinois, 124 Mumford Hall, 1301 West Gregory Drive, Urbana, IL 61801.

**Tons of Standard Limestone Required per Acre in Four Soil Types**

<table>
<thead>
<tr>
<th>pH</th>
<th>Soil typea</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td>Below 4.5</td>
<td>8</td>
</tr>
<tr>
<td>4.6–4.9</td>
<td>8</td>
</tr>
<tr>
<td>5.0–5.3</td>
<td>7</td>
</tr>
<tr>
<td>5.4–5.7</td>
<td>4</td>
</tr>
<tr>
<td>5.8–6.1</td>
<td>2</td>
</tr>
<tr>
<td>6.2–6.5</td>
<td>2</td>
</tr>
</tbody>
</table>

a A = dark-colored silt and clay soils.
B = light-colored silt and clay soils.
C = loams and dark sandy loams.
D = light sandy loams and sand.

**Relative Tolerance of Vegetable Crops to Soil Acidity**

<table>
<thead>
<tr>
<th>Slightly tolerant (pH 6.0–6.8)</th>
<th>Moderately tolerant (pH 5.5–6.8)</th>
<th>Very tolerant (pH 5.0–6.8)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asparagus</td>
<td>Bean</td>
<td>Endive</td>
</tr>
<tr>
<td>Beet</td>
<td>Bean, lima</td>
<td>Potato</td>
</tr>
<tr>
<td>Broccoli</td>
<td>Brussels sprout</td>
<td>Rhubarb</td>
</tr>
<tr>
<td>Cabbage</td>
<td>Collard</td>
<td>Shallot</td>
</tr>
<tr>
<td>Cauliflower</td>
<td>Corn</td>
<td>Sweet potato</td>
</tr>
<tr>
<td>Chard, Swiss</td>
<td>Cucumber</td>
<td>Watermelon</td>
</tr>
<tr>
<td>Chinese cabbage</td>
<td>Eggplant</td>
<td></td>
</tr>
<tr>
<td>Leek</td>
<td>Garlic</td>
<td></td>
</tr>
<tr>
<td>Muskmelon</td>
<td>Horseradish</td>
<td></td>
</tr>
<tr>
<td>New Zealand spinach</td>
<td>Kale</td>
<td></td>
</tr>
<tr>
<td>Okra</td>
<td>Mustard</td>
<td></td>
</tr>
<tr>
<td>Onion</td>
<td>Parsley</td>
<td></td>
</tr>
<tr>
<td>Parsnip</td>
<td>Pea</td>
<td></td>
</tr>
<tr>
<td>Salsify</td>
<td>Pepper</td>
<td></td>
</tr>
<tr>
<td>Soybean</td>
<td>Pumpkin</td>
<td></td>
</tr>
<tr>
<td>Spinach</td>
<td>Rutabaga</td>
<td></td>
</tr>
<tr>
<td>Watercress</td>
<td>Squash</td>
<td></td>
</tr>
<tr>
<td>Tomato</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Turnip</td>
<td></td>
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</tr>
</tbody>
</table>
Sources of Additional Information


Recommended Chemical Soil Test Procedures for the North Central Region. Bulletin No. 499. North Dakota Agricultural Experiment Station, Fargo, ND 58102.

Direct Seeding

Placing vegetable seeds into an environment that is suitable for proper germination and growth is often more difficult than it sounds. Cold soils, crusted soils, planting too deep or shallow, and using nonviable seed can all result in poor germination and an uneven stand. A poor stand not only results in lower yields but also wastes fertilizer, pesticides, and time. Using viable seed, preparing a good seedbed, and placing seed at the proper depth will help you avoid uneven stands. Direct seeding may result in lower disease losses where seedborne diseases are involved because it avoids the crowding that occurs in transplant beds.

Commercial growers cannot afford to try to save money on seed. Buy seed fresh each year. Although it may seem wasteful to dump unused seed, it is more economical in the long run. Seed storage can be tricky and is generally not worth the effort.

It is not difficult to prepare a seedbed. Often what you don’t do to the soil is more important than what you do. Do not plow, disc, or rototill wet ground. If possible, do not drive machinery or trucks across a wet field or even walk across it. Working wet soil destroys the soil structure and promotes crusting after the first heavy rain. The soil should be moist enough to form a ball in your fist but dry enough so that you can crumble it between two fingers.

Several vegetable planters are available for use on small acreages. Most of them can be divided into seed drills and precision planters.

- A seed drill opens a small furrow, allows seed to flow through a hole to a specified depth, and then closes the furrow. The standard Planet Jr. planter is an example of a drill that can be pushed by hand or mounted on a tractor tool bar. It can be fitted with a regular single-row shoe or mounted with a scatter shoe to spread seed within a narrow band. Plates with holes of various sizes are available for most vegetables.

- Precision planters are generally more expensive than seed drills but may reduce or eliminate the need for thinning. They place the seed not only at the desired depth but also at the specified spacing within the row. They are available in one-row, hand-push models, or they can be mounted on a tool bar. Old plate planters used for corn can often be adapted for vegetable seeds if the proper-size plate can be obtained. Precision planters work well when the seedbed is properly prepared, and can reduce or entirely eliminate the costly operation of thinning.

General Culture

Tractors and Tillage Implements

Except when plowing, you may not need a large tractor for many vegetable operations. A small tractor with 25 to 45 horsepower can handle most of the routine tasks on the farm. The tractor should have a high clearance of 20 inches or more to allow for spraying and cultivating. Plowing and initial discing can often be arranged with neighbors or contracted with a custom plowing firm. Final seedbed preparation can be accomplished with a small (5- to 6-foot-wide) disc or rototiller.

A large tractor may also be required if vegetables are planted on raised beds. A power bedder can be used to make the bed in one operation; however, a set of disc tillers followed by a bed shaper also does the job and requires less power.
Transplanting
Vegetables are transplanted to insure an earlier harvest and a good stand. As direct seeding technology is improved, only the early crops of most vegetables are likely to be transplanted. You can grow your own plants or obtain them from southern transplant growers or local greenhouses. Home-grown or locally produced plants are generally superior but also more expensive. Southern field-grown plants are usually shipped as bare-root stock and are more likely to carry disease organisms. You can minimize the risk of disease by purchasing certified plants that have been inspected for diseases and that have been grown under conditions that minimize disease potential. You may have to grow your own plants or make local arrangements to obtain the variety you want. For information on how to grow plants, see Illinois Extension Circular 884, Growing Vegetable Transplants.

Moderately expensive single- and multiple-row mechanical transplanters are available that will set bare-root plants, rooted plants, or plants in peat pots. The single-row unit can be drawn behind most small tractors. Two people and a tractor driver can plant several acres in a single day. Transplanters are also available that will punch a hole through plastic mulch and set plants. Since timeliness is an important concern of fresh market growers, a transplanter may be a worthwhile investment. Another advantage of transplanters is that starter solution is applied to each plant immediately after setting.

Plastic Mulch and Row Covers
Mulch traps heat from the sun’s rays and warms the soil earlier than usual, thus increasing the chances of an early harvest. Although mulch is expensive, it is sometimes worth the cost because early vegetables command the highest prices. In northern Illinois, mulching is necessary for growing a crop of muskmelons or watermelons before frost. Mulching with black plastic is also an effective method of weed control, especially on crops for which no good herbicides are available. Generally, plastic mulch will benefit muskmelons, watermelons, and early crops of cucumbers, summer squash, peppers, tomatoes, and sweet corn. If you use more than one acre of plastic mulch, you should probably purchase a mechanical mulch layer.

Mulching can be done with either black or clear plastic. Clear plastic warms the soil best but also allows for weed growth, thus necessitating the additional use of herbicides. Since some herbicides cause injury under these altered environmental conditions, black or opaque plastic is usually preferred. Keep the area between the plastic free of weeds with labeled herbicides or cultivation. Clear plastic row tunnels not only warm the soil but also protect the plant from hail or wind injury. Although they are expensive, they can be used on limited acreage for a very early harvest, either with or without black plastic on the ground. The tunnel is supported by oval hoops made of 16-gauge wire. Two separate sheets of clear plastic are laid down the row on either side of the plants and clipped in the middle above the plants. One side can be pulled down on sunny days for ventilation. A new Prevented Single sheet is now available that does not have to be opened during the day and closed at night.

A new type of floating cover is also being used with success on cucurbits and seeded crops of carrots, beans, lettuce, and other vegetables. The new material is a spun-bonded fabric that allows gas exchange and water percolation. It does not require hoops because it lies directly on top of the developing plants.

Mulches can significantly reduce weed populations, especially of annual grasses and broadleaf weeds; however, they cannot control perennial weeds. For most vegetable crops, with the definite exception of sweet corn, there is no sustained-action, broad-spectrum herbicide that can be used to control weeds under clear plastic. Black polyethylene mulches do exclude sunlight from germinating weed seedlings and so stop their growth. In general, however, it is usually most economical to use herbicides for weed control even when black plastic mulch is used.

Irrigation
Vegetables require a constant supply of soil moisture throughout the growing season. Even brief periods of drought can reduce crop yield and quality. Dry periods early in the growing season can delay harvest and reduce yields. Shortages of moisture later in the season, especially during the maturation period, can severely influence quality. Irrigation may also be needed to establish seedlings or to insure good germination and emergence.

Critical Water-Use Periods for Vegetable Crops

<table>
<thead>
<tr>
<th>Vegetable</th>
<th>Water-Use Period</th>
</tr>
</thead>
<tbody>
<tr>
<td>Broccoli, cabbage, cauliflower, lettuce</td>
<td>Head development</td>
</tr>
<tr>
<td>Carrot, radish, beet, turnip</td>
<td>Root enlargement</td>
</tr>
<tr>
<td>Sweet corn</td>
<td>Tasseling and ear development</td>
</tr>
<tr>
<td>Cucumber, eggplant, pepper, melon, tomato</td>
<td>Flowering, fruit set, and fruit enlargement</td>
</tr>
<tr>
<td>Bean, pea</td>
<td>Flowering and pod development</td>
</tr>
<tr>
<td>Onion</td>
<td>Bulb development</td>
</tr>
<tr>
<td>Potato</td>
<td>Tuber initiation and development</td>
</tr>
</tbody>
</table>
Shallow-rooted crops should not be allowed to experience more than 10 continuous days without water throughout the season. Other crops must receive adequate moisture, especially during critical periods in their development. Most vegetables require from 1.0 to 1.5 inches of water per week during their peak growing period. Apply no more than 0.25 inch per hour to insure good soaking and to prevent runoff. Trying to cover too much acreage in a given amount of time will result in poor uniformity.

Although irrigation equipment and an adequate water source are expensive investments, irrigation may pay for itself in one year of low rainfall. Fresh market growers are encouraged to consider this investment. The type of equipment used will depend on the crop being grown and its potential value, as well as on soil drainage, topography, source water availability, and your financial resources. The most common irrigation system used on medium to small vegetable farms is a portable pipe system with risers and sprinkler heads. Recently, traveling guns with flexible or rigid hoses have come into favor among many producers. Large operations may choose center-pivot systems, and smaller growers may prefer trickle systems. You should work with your local irrigation distributor or manufacturer to design a system suitable for your farm.

Sources of Additional Information


Pest Management

Successful vegetable production depends on the ability of the grower to minimize losses from diseases, insects, and weeds. These pests can significantly affect yields and quality — and therefore profits — if they are not controlled. Economic returns can also be reduced by the unexpected expense of the extra labor involved in harvesting and grading weedy or pest-damaged fields.

Agricultural scientists and growers generally agree that pests can cause excessive yield and quality losses, and large commercial growers can rarely rely exclusively upon nonpesticide methods of control. However, growers can improve the efficiency of pesticides by paying close attention to pest populations and by timing applications correctly. Integrated Pest Management (IPM) is a system that uses all suitable pest control techniques and methods to keep pest populations below economically injurious levels. With IPM, each pest management technique should be environmentally sound, compatible with other production practices, and effective.

Organic farmers have chosen not to use manufactured pesticides in their pest management plans. They often sell their vegetables at markets specializing in produce that is grown without pesticides. The higher per-unit price that these vegetables receive often compensates for the normally reduced yields. As long as a market exists and prices are high, organic farmers may be able to afford nonchemical means of pest suppression. Organic farming will most likely be possible only in small plantings and where markets exist for visually blighted or imperfect produce.

Pesticide Legislation

Growers have nothing to fear from the law as long as they use pesticides according to the current label: only on the crops specified, in the amounts specified, and at the times specified. You should keep a record of the products and trade names used, the percentage of active ingredients, the dilutions, the rates of application per acre, and the dates of application. By following label directions, you can be sure that your vegetables will have no excessive pesticide residues. Vegetables marketed with residues exceeding the Federal Drug Administration tolerances may be injurious to consumers and may be confiscated. Growers who misuse chemicals may also be brought to court.

Chemical manufacturers are hesitant to recommend and sell a pesticide for a vegetable unless there is a high human tolerance to the pesticide. Some lawsuits have forced manufacturers to withdraw pesticides for some crops from the market. Never use a pesticide on...
a crop for which it is not labeled. If you do, you can injure the crop—or worse, the consumer. Pesticides are classified for GENERAL USE or RESTRICTED USE by the U.S. Environmental Protection Agency. A person wishing to use a pesticide classified for restricted use must be certified as a private or commercial pesticide applicator by the Illinois Department of Agriculture. Only a few pesticides have been classified as restricted at this time. Contact your county Extension adviser for details about this program.

Pesticides should be stored in dry, well-ventilated areas that are locked to deny access by children, animals, and irresponsible people. Adequate protection and application precautions as printed on container labels should be followed. Empty containers should be disposed of according to label instructions. NEVER PUT THEM INTO A SEWAGE DISPOSAL SYSTEM.

Pesticides are classified as having high, moderate, low, or slight toxicity. Labels for highly toxic pesticides display a drawing of a skull and crossbones and the words "Danger-Poison." Labels for moderately toxic pesticides display the word "Warning," and labels for pesticides with low and slight toxicity display the word "Caution."

Weed Control

Whether to use herbicides or other means of weed control depends in part on the severity of past weed infestations. In some instances mechanical control is sufficient or may be needed to supplement herbicide use. Several herbicides may be needed for some crops. See page 14 for the use of black plastic mulch.

The most commonly used herbicide application methods are broadcast soil application (uniform application over an entire specific area), foliar application (application to the leaves and/or stems), and preplant soil incorporation (using tillage equipment or irrigation to mix the herbicide with the surface soil). Less commonly used methods are band application (application to a strip or band parallel to a crop row) and directed application (aiming the herbicide at a portion of the plant).

Most herbicides are applied preemergence or are preplant incorporated. Preemergence refers to the use of a herbicide before the crop or weeds emerge, or after the crop emerges but before the weeds appear above the soil surface. Preplant incorporated refers to the use of a herbicide before the crop is planted. The advantage of preplant-incorporated herbicides is that they are in contact with soil moisture and usually do not require immediate rain or irrigation water to become activated. Preemergence applications usually need at least a small amount of moisture to cause weed kill.

There are usually several choices of herbicides for preplant incorporation or preemergence application, depending on the crop species, soil type, climate, and weed species. Most herbicides have selective action and therefore control only certain weeds. In some situations herbicide combinations may be used to increase the control spectrum. Individual growers must make the final choice on the basis of the soil type, the crop grown, and the weed history of the specific field.

To apply preemergence and postemergence herbicides safely, it is important to select the right equipment and nozzles and to adjust the spray pressure correctly. Carefully monitor the pattern and amount delivered by the sprayer before and during application.

Cultivation is an accepted weed control practice, and its benefits are well known. Some generally accepted advantages are that it physically destroys weeds and increases soil aeration. Shallow cultivation is the ideal practice because deep cultivation causes root pruning and injures the crop. Several "rolling" types of cultivators are available besides the standard shovel-type cultivator that is mounted on or pulled by a tractor.

<table>
<thead>
<tr>
<th>Toxicity rating</th>
<th>Label signal words</th>
<th>Oral $LD_{50}$ (mg/kg)</th>
<th>Dermal $LD_{50}$ (mg/kg)</th>
<th>Inhalation $LD_{50}$ (mg/liter or ppm)</th>
<th>Lethal oral dose for a 150-lb person</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>Danger-Poison</td>
<td>0–50</td>
<td>0–200</td>
<td>0–2,000</td>
<td>Few drops to 1 teaspoon</td>
</tr>
<tr>
<td>Moderate</td>
<td>Warning</td>
<td>50–500</td>
<td>200–2,000</td>
<td>2,000–20,000</td>
<td>1 teaspoon to 1 tablespoon</td>
</tr>
<tr>
<td>Low</td>
<td>Caution</td>
<td>500–5,000</td>
<td>2,000–20,000</td>
<td>20,000+</td>
<td>1 tablespoon to 1 pint</td>
</tr>
<tr>
<td>Slight</td>
<td>Caution</td>
<td>5,000+</td>
<td>20,000+</td>
<td>20,000+</td>
<td>Over 1 pint</td>
</tr>
</tbody>
</table>
Insect Control

Commercial vegetable growers find it impossible to produce vegetables profitably unless they control insects with maximum effectiveness and minimum cost. Today's consumer will not accept unsightly, wormy vegetables. The vegetables are unappetizing, and the waste from trimming increases food costs. Therefore the commercial vegetable grower must produce a quality product that is acceptable and safe to the consumer. Careful use of the right insecticides will help make this possible.

Vegetable insect pests can be divided into the following groups:

- Caterpillars or worms that feed on foliage and sometimes on fruit
- Aphids, or plant lice, in large numbers that suck plant juices from new foliage
- Beetles that chew holes in plant foliage
- Adult and immature plant bugs that suck plant juices from foliage and fruit
- Cutworms, earworms, and borers that tunnel into corn ear tips, tomato fruit, and bean pods
- Seed and soil maggots that feed inside newly planted seed and on plant roots

Insect pests can completely destroy a vegetable crop, damage the edible parts and render them unsalable, or contaminate the vegetable as it is being processed. They can reduce plant vigor by sucking juices from the leaves, stems, and fruit. Some insects may carry and transmit diseases to specific vegetables or from plant to plant, thereby causing crop losses.

Cultural practices that reduce pest populations should be combined with an appropriate chemical means for effectively controlling plant-damaging insects. Sanitation and crop rotation are among the most effective means of reducing insect populations in vegetable crops. Plowing to eliminate or reduce crop residues in the field after harvest is one effective sanitation method that will reduce populations of the following insects:

- Stalk borers, such as European corn borers, that overwinter as larvae by boring inside corn stalks
- Cucumber, bean, and flea beetles, which often overwinter as adults in crop residue
- Defoliating caterpillars, such as tomato hornworms and cabbage worms, that overwinter as pupae on or near the soil surface

Squash bugs and other plant bugs that overwinter as adults in crop residue

Alternating vegetable crops in one field or alternating vegetables with unrelated crops can reduce insect populations the following season. For example, the corn rootworm, a root-feeding insect, can seriously attack sweet corn roots and reduce yields. Growing sweet corn one year and an unrelated crop the following year will help solve this problem. In general, a vegetable should be grown in a field for only one out of every three years.

Insects can also be controlled biologically. There are two recognized forms of control: that which occurs naturally and that which is applied. Nonapplied, or naturally occurring, biological insect controls that limit insect pest populations include the following:

- Parasites, including the larvae of certain wasps and flies
- Predator insects, including ladybird beetles, aphid lions, and stinkbugs
- Birds and other predatory animals
- Naturally occurring viruses, bacteria, and fungi

Some of these controls are applied to field vegetables on a small scale and can be quite effective on a greenhouse crop. The bacterial agent *Bacillus thuringiensis* (BT) is currently applied to control caterpillars in cabbage and related crops and also in tomatoes. When ingested, *Bacillus thuringiensis* spores effectively kill susceptible caterpillars by destroying their gut. Additional applications are made every 5 to 7 days.

Predator and parasitic insects are also available from biological supply firms and may be purchased to control other insects. However, the success of this practice is questionable. Introduced parasites and predators always require a dependable source of food, and some predators and most parasites are specific to certain insect species. It is not easy to meet all these needs in field situations.

Disease Control

To control diseases economically, you must have an overall management system for the entire farm. You should also keep records on what crops have been planted, what problems have occurred, and what pesticides have been used.

The use of resistant varieties is the simplest and most effective method of controlling diseases. A variety may be completely immune to a disease or may be able to tolerate it while suffering reduced damage. The immunity type of resistance exists for the control of many
vegetable diseases and is often present in new hybrids and horticulturally superior varieties. Since varieties with this type of resistance are resistant to only specific races or biotypes of pathogens, they should be carefully observed for the presence of new races or biotypes.

Tolerant cultivars are not immune to a disease. Therefore, it is often important to minimize disease development by carefully choosing the planting time and site and by being equally careful with other cultural decisions. Tolerant cultivars that have some resistance may be used in combination with a fungicide program. For example, potato cultivars with field tolerance to late blight can be damaged if they receive no fungicidal protection but suffer only minor losses when they receive reduced amounts of fungicide.

It is also important to remember that tolerant cultivars can be carriers of disease. Serious Verticillium wilt problems have been traced to the potato cultivar ‘Kennebec’. Under certain environmental conditions, yield losses are very low and aboveground symptoms do not develop. However, the disease is moved through seed tubers to other areas, infesting previously unin­fested soil and damaging susceptible varieties.

Disease-free planting materials (seeds, tubers, transplants, bulbs) have been widely used in the control of vegetable diseases and are perhaps the most funda­mental part of an integrated disease management program. One approach is to produce one’s own trans­plants or to buy healthy, certified disease-free transplants. This is the cheapest insurance for the vegetable grower and is an important initial step that will often prevent serious epidemics. Another approach is to treat prop­agative units to remove infected or infested units or to free them of pathogenic organisms. Hot water soaks have been used on crucifer seed to eradicate seedborne fungi or bacteria, protect seeds and seedlings from decay or seedling blight organisms, and disinfect storage areas and packing cases. Foliar applications of fungicides or bactericides break down and must be repeated regularly to protect new plant growth.

Insectic平es are often used to control insects that transmit disease-causing organisms. For example, in­secticides are used to control cucumber beetles, which carry the bacterium that causes bacterial wilt disease of vine crops. Insecticides are also used to kill aphids, which carry virus diseases of pepper and potatoes.

Herbicides are used in disease control programs to control weed hosts of various plant disease agents. For example, control of johnsongrass is critical in control­ling the maize dwarf mosaic virus, which overwinters in the johnsongrass host.

In greenhouse situations, the environment (temper­ature, relative humidity, light, and other factors) can be modified to prevent infections from occurring. In the field, knowledge of environmental factors such as soil temperature, drainage, prevailing winds, and blow­ing soil can help the grower avoid certain disease problems. Following proper cultural techniques (planting at the proper time, handling plants carefully, and using biological controls) also helps prevent disease.

Pest Control Equipment

Vegetable growers generally need two sprayers, one to apply herbicides and the other to apply insecticides and fungicides. If only one is to be used, be sure to clean the sprayer and tank thoroughly between appli­cations. Even with specialized cleaning solutions, there is always a risk of contamination and damage to the crop.

Herbicides may be applied with sprayers capable of producing pressures of 30 to 40 pounds per square inch. Fungicides and insecticides must be thoroughly
applied and require a positive displacement pump that can produce pressures of up to 200 pounds per square inch. Although piston pumps are often more expensive than roller pumps of similar size, they can be used for both liquid formulations and wettable powders. All pumps and sprayers should be fitted with mechanical agitators to keep formulations in suspension.

Sources of Additional Information

For fact sheets on specific pests, consult Horticulture Facts VC-12-80, Publications About Vegetable Crop Production, available from the Department of Horticulture, University of Illinois, 124 Mumford Hall, 1301 West Gregory Drive, Urbana, IL 61801.


Calibration of Field Sprayers. Agricultural Engineering Tips, Tractors and Machinery No. 25. Department of Agricultural Engineering, University of Illinois, 338 Agricultural Engineering Sciences Building, 1304 West Pennsylvania Avenue, Urbana, IL 61801.

Damping-off and Seedling Blight of Vegetables. Report on Plant Diseases No. 916. Department of Plant Pathology, University of Illinois, N533 Turner Hall, 1102 South Goodwin Avenue, Urbana, IL 61801.


Fungicides, Disinfectants, Grain Preservatives, Surfactants, and Soil-Disinfesting Chemicals. Report on Plant Diseases No. 1002. Department of Plant Pathology, University of Illinois, N533 Turner Hall, 1102 South Goodwin Avenue, Urbana, IL 61801.

Identifying Diseases of Vegetables. Department of Plant Pathology, University of Illinois, N533 Turner Hall, 1102 South Goodwin Avenue, Urbana, IL 61801. $7.50.


Vegetable Seed Treatment. Report on Plant Diseases No. 915. Department of Plant Pathology, University of Illinois, N533 Turner Hall, 1102 South Goodwin Avenue, Urbana, IL 61801.

Slitted Row Cover

Mulch Layer
- Opening disk
- Plastic mulch
- Closing disk

Bed Shaper
- Shaper blades

Slits in polyethylene for ventilation
- 5 inches long
- ¾ inch apart

Wire hoop
- #8 or #9 galvanized wire
- 63 inches long
- Center height: 14 to 16 inches
- 5 feet between hoops
MAJOR VEGETABLES
Asparagus is a perennial plant that can produce for 15 years or more if it is properly maintained. Although Illinois has traditionally been a major producer of asparagus for processing, increases in production costs and soilborne diseases have reduced the acreage planted to this crop. However, asparagus remains an important crop in home gardens and could be a fresh market vegetable in Illinois. In Michigan, the acreage of asparagus planted for fresh market has increased rapidly in recent years.

Asparagus can be marketed on a pick-your-own basis to reduce labor costs, especially in regions where pick-your-own strawberry markets have been successful. Average asparagus yields may exceed 3,000 pounds per acre.

Varieties

Although new varieties and several hybrids have outyielded the older types in several years of testing, none have been shown to be superior over 15 to 20 years of production. Promising hybrids such as ‘Jersey Centennial’ have developed problems after 8 to 10 years. The following varieties are recommended for Illinois:

Mary Washington: Early, large, dark green spears with purplish tips; tolerant of rust. Mary Washington 500 has less of a purple tinge on the tip.

Waltham Washington: Productive, dark green spears with purplish tips; tolerant of rust.

Viking KB3: New, uniform variety worthy of trial in Illinois; tolerant of rust.

Soils and Fertility

Since an asparagus bed will be in production for many years, it is important to choose a good site. Asparagus does not tolerate poorly drained, wet soils. Locations susceptible to late spring freezes should also be avoided because freezes delay harvest and may reduce yields. For best results, choose a well-drained, deep, stone-free, sandy loam, preferably one that has never been used for asparagus in the past.

Select your asparagus site at least one year before establishing the crop so that you can adjust pH, improve fertility, add organic matter, and eliminate perennial weeds. Broadcast and plow down enough ground limestone and fertilizer to produce a pH of 6.8 to 7.0, a soil test phosphorus level (P₂) of 100 pounds per acre, and a potassium level of 500 pounds per acre. This initial application is important because it will be difficult to supply slowly soluble nutrients once the crop has been established. A green manure crop should be plowed down along with the fertilizer during the fall before spring planting. Place an additional 75 pounds per acre of phosphate in the bottom of the furrow at planting before setting the plants.

Biannual soil tests will indicate the need for additional potassium. Potash fertilizers may be broadcast and discd in during the spring before the spears appear. Apply 75 pounds per acre of nitrogen each year after the harvest season. See Illinois Extension Circular 1185, Fertilizer Guide for Commercial Vegetable Growers, for more information.

Planting

New asparagus beds are usually started with one-year-old crowns purchased from a nursery. Purchasing crowns is especially recommended for new growers. Approximately 10,000 crowns are needed to plant an acre if they are spaced 1 foot apart in rows 4 to 5 feet apart. The crowns should be set in the bottom of a furrow 8 to 10 inches deep. The furrows may be dug either on flat ground or in the middle of raised beds for increased drainage. Cover each crown with 2 inches of soil, and gradually fill in the furrow to ground (or bed) level as soon as the fern begins to grow. Do not cover the fern.

Growers with larger acreages usually choose to grow their own crowns. An outdoor crown nursery may be established by drilling 4 to 6 seeds per foot in rows 18 to 24 inches apart. Drill the seeds 1 inch deep. One pound of seed will produce 8,000 to 10,000 crowns, depending on germination. Apply 50 pounds per acre of nitrogen when the seedlings are 4 to 6 inches tall. Dig them out as early as possible the following spring and set them in the production field while they are still dormant.
Some commercial producers have turned to direct field seeding or the use of greenhouse-grown transplants. Direct seeding requires a high level of management and should not be attempted by new growers. The use of transplants (10- to 12-week-old seedlings) is possible, however, and can reduce initial planting costs. For more information on these techniques, see the University of California publications listed at the end of this chapter.

Irrigation

The soil around a newly planted crown or seedling should not be allowed to become dry. After the planting is established, however, irrigation will probably be unnecessary except on sandy soils. Asparagus develops a deep and extensive root system that is usually capable of finding water. In the Midwest, excess water is usually a greater problem than inadequate water.

Harvest and Handling

Asparagus should not be harvested during the first two seasons after it has been set in the field. During the third season, you may pick the spears for 2 to 3 weeks. Then allow the ferns to grow. The first few years are critical in the establishment of a permanent bed. Excessive cutting at this time may reduce vigor and productivity in following years. In the fourth year after field setting and in following years, the harvest period can be 6 to 8 weeks long. The typical harvest period in Illinois extends from mid-April to early July, and production is heaviest during May and June. A straw mulch layer 4 to 6 inches deep on the soil late in the spring can delay the appearance of the spears by preventing the soil from warming early. This delay can be used to coordinate the asparagus harvest with the strawberry harvest in a pick-your-own operation.

When harvesting asparagus, snap the spears at ground level or cut them slightly below the soil when they are 8 to 10 inches tall. Do not allow the leaf scales around the tip to separate and open or you will have poor-quality spears. Asparagus is most tender and succulent when temperatures before harvest range from 55° to 65°F at night and 65° to 80°F during the day. Cold temperatures retard growth, causing excessive toughness and giving the plants a purple tinge. During warm weather, spears must be cut daily or they will quickly pass the marketable stage.

After cutting, asparagus spears are usually washed, trimmed to a uniform length of 6 to 8 inches, and bunched in 1- or 2-pound packages for fresh market sales. Roadside stands may sell loose spears from boxes or baskets; however, quality will decline rapidly during warm weather. Standing the spears in a shallow pan of water at cool temperatures helps maintain quality. The spears may also be held for several days at 40° to 50°F and at 90 to 95 percent relative humidity.

Allow the plants to grow after the harvest period until they are killed by frost. As long as the plant is green, it will produce carbohydrates, which are then translocated to the roots for storage. This stored material will produce next year's crop. Once the tops are dead, they should be cut and removed to reduce insect and disease problems the following year.

Weeds

Since asparagus occupies the same soil area for a number of years, there is a tendency for bindweed, common milkweed, and several other perennial weeds to become severe problems. Cultivation and the use of herbicides can help control perennial weeds. Annual, biennial, and perennial weeds are all problems in asparagus, and the most satisfactory control systems combine a grass-active herbicide with a herbicide for broadleaf control.

The choices for effective weed control in direct-seeded asparagus are limited. However, since seeds are likely to germinate slowly, a contact herbicide may be used to burn off small weed seedlings before the asparagus emerges. A contact herbicide may also be used later if the young ferns are shielded from the spray material. Mechanized cultivation will probably be required while the beds are becoming established, regardless of the planting procedure. See Illinois Extension Circular 907, Weed Management Guide for Commercial Vegetable Growers.

Insects

When growing asparagus continuously, you must take care to avoid serious pest problems. Only a few insects cause trouble on asparagus, and they are easily managed if you periodically scout your fields and use appropriate insecticides.

Cutworms may appear early in the spring and feed on emerging spears. However, you are most likely to find two species of beetles. The common asparagus beetle is a shiny blue to black insect with orange to yellow markings. The spotted asparagus beetle usually has 12 black spots on its red-orange back. Both species overwinter in old ferns. The common beetle appears in the spring to lay eggs on emerging spears. Removing dead ferns and cutting at the right time during the season will reduce beetle damage. Spotted beetles appear later in the season, and their larvae feed on mature ferns. High populations of beetles can defoliate plants,

**Diseases**

**Rust** is one of the major disease problems encountered on asparagus. Infection by the rust fungus is obvious as red-brown to black rust pustules on fern growth or on spears. The fungus causes damage primarily by reducing the fern’s food production, thus reducing yields the following spring. Most of today’s commercially used varieties are resistant to the common races of rust; however, if rust damage does appear, fungicide applications will be needed to protect the fern. For specific recommendations, see Illinois Extension Circular 1184, *Disease Management Guide for Commercial Vegetable Growers*.

**Fusarium wilt and root rot**, the other major disease problem, is caused by a fungus that survives in the soil for many years. Replanting in old asparagus fields is not advised for this reason. Affected plants become wilted, dwarfed, and yellowish to brown in color. Although occasionally entire plantings are affected, diseased plants are usually scattered throughout the field. Plants weakened by overcutting, nutrient deficiencies, rust, insect damage, flooding, or drought are most likely to be damaged. No asparagus varieties are truly resistant to this disorder. Proper cultural operations and the use of healthy plants are the best defenses against this disease.

**Sources of Additional Information**


*Direct Seeding of Asparagus.* Leaflet 2776. Agricultural Information, University of California, Davis CA 95616.

*Establishing the Commercial Asparagus Plantation.* Leaflet 21165. Agricultural Information, University of California, Davis, CA 95616.

Beans

Snap beans, lima beans, and dry beans are major vegetables grown for processing in Illinois. Economical production requires the use of mechanized harvesting and handling equipment. If you are not ready to consider this major financial investment, you should plan to sell your beans on a pick-your-own basis.

Snap beans are a relatively-short-season crop that do best in warm weather. They are not tolerant of extreme temperatures or moisture conditions. Lima beans and dry beans require a longer growing season, primarily because the seed is harvested, not the immature pod as in snap beans.

A good yield of snap beans for market is 150 bushels (4,500 pounds) per acre. Limas should produce 100 bushels (3,000 pounds) of shelled beans per acre. Dry beans may yield between 2,500 to 3,500 pounds per acre, depending on the type. These yields are rare for red kidney beans, which are much more likely to yield 2,000 to 2,500 pounds per acre.

Varieties

Scores of varieties are available of fresh market snap beans, and deciding on one is often difficult. Snap beans are not marketed by variety but by type, such as round green, flat green, or yellow wax. The main type used is the round green, and most are stringless. Many processors use their own strains for canning and freezing. Local marketers often prefer strains of 'Bush Blue Lake', but a number of excellent cultivars are available for fresh use.

Lima beans are divided into large limas and baby limas. In the Midwest, the standard baby lima used is 'Henderson Bush' and the standard large lima or butterbean used is 'Fordhook'. Wherever possible, use only varieties with resistance to the bean common mosaic virus, the New York strain 15 of the bean common mosaic virus, and the bean yellow mosaic virus.

Certain lima and snap bean varieties are preferred for freezing and canning. These varieties usually retain good color when processed at home or commercially. Most varieties grown commercially are bush rather than pole beans; however, pole beans are popular in some pick-your-own operations.

Dry beans are also separated into types. The main dry beans grown for local sales are red kidney, navy, pinto, and black turtle soup. Processors choose their own varieties.

A complete list of recommended varieties is available in Illinois Extension Circular 1174, Vegetable Varieties for Commercial Growers.

Soils and Fertility

Beans will grow on a wide range of soil types as long as the soils are well drained. Heavy, wet soils may restrict roots and reduce yields. Coarse-textured, sandy soils are preferred for early market production because they warm up more quickly in the spring.

Phosphorus and potassium fertilizers should be applied on the basis of soil test results. Most of this fertilizer may be plowed down before planting; however, 20 to 40 pounds per acre of each should be banded with the seed at planting. The band should be placed 2 inches to one side and 2 inches below the depth of the seed. Include 40 pounds of nitrogen fertilizer in the application. In sandy soils or following a period of heavy spring rains, an additional 25 pounds per acre of nitrogen may be sidedressed when the plants have 2 to 3 true leaves. Later applications, especially on snap beans, will be less effective. Inoculating snap, lima, or dry beans with rhizobium has generally not proven as effective as with soybeans. For more information, see Illinois Extension Circular 1185, Fertilizer Guide for Commercial Vegetable Growers.

Beans have a relatively narrow range of tolerance to acidity or alkalinity. Soil pH values above 6.7 or below 6.0 may result in poor growth and reduced yield. If the pH falls below 6.0, apply ground limestone to bring it to 6.5. Beans are especially susceptible to zinc and manganese deficiencies in calcareous soils. If the pH exceeds 6.7, apply 5 pounds of zinc and 3 pounds of manganese per acre with the broadcast application of fertilizer. Foliar treatments are also effective if applied before deficiency symptoms appear.
Planting

Snap and dry beans are direct-seeded after soil temperatures at 3 inches reach 60°F; limas are direct-seeded when soil temperatures reach 70°F at 3 inches. Seeds planted in cold, wet soil will germinate poorly and lack vigor. They are usually planted after May 1 in southern Illinois and after June 1 in extreme northern Illinois. Planting snap beans every 2 to 3 weeks from May through July will produce a continuous supply of beans all summer.

Plant bean seeds from 1 inch deep (in heavy soils) to 2 to 3 inches deep (in sandy soils). Shallow planting improves germination if soil moisture is available. Snap bean rows may be 18 to 40 inches apart; the wide spacing is preferred for pick-your-own operations. Snap beans should be planted with 5 to 7 seeds per foot, which requires 90 pounds of seeds per acre at the closer row spacing. Limas are seeded with 3 to 4 seeds per foot in rows 24 to 40 inches apart; this spacing requires 50 to 60 pounds of seed per acre. Dry beans are usually planted about 3 inches apart in rows 30 to 36 inches apart; this spacing requires 60 pounds of seed per acre.

Irrigation

Moisture must be present in the top 2 inches of soil for good germination and effective herbicidal activity. Once the plants are established, they probably will not need irrigation until they flower, except on sandy soils or during extremely dry years. Moisture stress or high temperatures during flowering may cause blossom abortion, a split pod set, and reduced yields. Inadequate moisture during pod development will result in poor-quality beans. Beans require at least 1 inch of water per week from planting to flowering and 1.5 inches per week from flowering to harvest.

Harvest and Handling

Almost all fresh market beans and all beans grown for processing are harvested with mechanical pickers. These machines produce many off-size and broken pods, which can be costly because most markets require that beans are graded and free of culls. However, these losses are usually offset by the cost of handpicking. Small acreages can be marketed effectively on a pick-your-own basis, and if the operation expands, a one- or two-row picker can then be purchased.

Because they have been bred for a single harvest, most snap bean varieties can be picked two weeks after the appearance of the first flowers. Multiple harvests may result in a higher total yield but will also give a lower net return because of the increased labor cost. Pick-your-own market growers may prefer varieties that set over a longer period of time. All lima bean varieties should be picked several times for fresh market use. Dry beans are usually cut, windrowed, and then threshed with a combine equipped with a pickup attachment. Reduce the cylinder speed of the combine to avoid splitting or cracking the seed coat.

Pick-your-own growers may wish to grow both pole and bush beans, since both types have advantages and disadvantages at harvesttime. More beans per foot of row can be picked from bush beans, but some customers may prefer to stand and pick erect pole beans.

Beans that are stored for several days must be kept cool and moist. Temperatures should range from 40° to 45°F for snap beans and from 32° to 34°F for limas, with a relative humidity of 90 to 95 percent. Warm beans quickly lose moisture and become flabby. Excessively cold temperatures will result in spotting and poor color. Dry beans are easily stored as long as they are kept dry.

Weeds

Snap beans are a short-season crop (60 to 70 days). For effective weed control, use a preplant-incorporated or preemergence herbicide that will prevent weeds from competing with the young bean seedlings. Annual grass weeds are the main problem with beans that are planted early in the growing season on sandy soils; in beans that are planted later, broadleaf weeds become more important and must be controlled with a broadleaf-active herbicide.

Lima and dry beans have a longer growth period (70 to 100 days), so weeds on these crops must be controlled throughout the entire season. Often a preplant-incorporated treatment of a dinitroaniline herbicide is combined with a preemergence or overlay treatment of a broad-spectrum herbicide. Broadleaf weeds may develop later in the growing season, much as in soybean culture, and a postemergence herbicide can then be used to facilitate control.


Insects

Many individual insects can affect beans, and only the major bean pests are described in this handbook. Often pesticides and cultural techniques used to control major pests also prevent damage by others. More specific information and often color pictures may be found in the publications listed at the end of this chapter.

Seed corn maggots can cause major problems in beans by attacking the sprouting seed before it emerges.
These insects are especially troublesome in cool, wet soils. Damage can be prevented by using chemical seed treatments; it can also be reduced considerably by planting later in warm soil.

Aphids, leafhoppers, and beetles are often found feeding on bean foliage. Aphids suck plant juices from leaves, causing them to curl and turn yellow. The potato leafhopper migrates into Illinois from the South in early summer. As it feeds, it causes leaves to curl and turn yellow or brown at the edges. In severe cases, it causes general stunting and scorching of leaves, called “hopper burn.” The bean leaf beetle looks somewhat like a ladybird beetle. It overwinters in the soil or in debris from previous crops and lays eggs in the spring on emerging seedlings. The first generation can skeletonize the foliage until fall. All three of these foliage pests can be controlled with appropriate insecticides.

Both the European corn borer and the corn earworm can infest bean pods in late summer. These insects tunnel into the pods, making chemical control difficult; insecticides should therefore be used as soon as pods appear. Specific chemical recommendations are presented in Illinois Extension Circular 897, Insect Pest Management Guide for Commercial Vegetable Crops and Greenhouse Vegetables.

Diseases

Only the major bean diseases are described here. More specific information and often color illustrations may be found in the publications listed at the end of this chapter.

Since bean diseases can seriously reduce yields and quality, disease resistance should be a consideration in variety selection. Where possible, select only varieties resistant to the bean common mosaic virus and the New York strain 15 of the bean common mosaic virus, since there are no other effective controls for these diseases. Rust-resistant varieties are also available.

Crop rotation is critical in bean production if serious diseases such as common bacterial blight, halo blight, bacterial brown spot, anthracnose, and rust are to be controlled. The pathogens of these diseases survive on crop residues, and rotations of 2 to 4 years are necessary for the residues to decay to the point that the pathogens die out. Crop rotation programs will also help you avoid several root rot disease problems.

Only seed grown in the dry conditions of the West should be purchased, since seed produced in the Midwest will probably be infected with the bacteria that cause halo blight, common bacterial blight, or bacterial brown spot. Avoid cultivating or picking beans when the plants are wet, since these diseases can be spread under wet conditions.

Fungicide seed treatments are usually recommended, especially where soils are cold or where root rot disease problems are likely to occur. Foliar applications of fungicides or bactericides are commonly used for control of Sclerotinia white mold, Botrytis grey mold, rust, downy mildew, anthracnose, and the bacterial blight diseases.

Root rot diseases are the most important bean diseases wherever beans are grown intensively. Affected plants are stunted and yellowed and yield poorly. Root rot problems are caused by a complex of common soil-inhabiting fungi, including Pythium spp., Fusarium solani, Rhizoctonia solani, Thielaviopsis basicola, and Aphanomyces sp. These fungi will build to damaging levels in the soil wherever rotations are not used. Rotations of 3 to 5 years will help keep root rot problems to a minimum if the fungi have not reached damaging levels before the rotations are begun.

Planting in well-drained, fertile soils that are 60°F or warmer and using fungicide seed treatments and furrow fungicide sprays will also help control these diseases. Although no resistant varieties are available, breeders have developed some promising lines. Some herbicides have also shown promise for root rot suppression.

Bacterial blights damage leaves and pods. Leaf lesions are typically yellow to brown. Pod lesions are brown, and infected pods are often distorted. Common bacterial blight (Fuscosus blight), halo blight, and bacterial brown spot (Syringe blight) are all bacterial blight diseases. Development of all three is favored by warm, wet weather. Besides using the control measures previously mentioned, you can apply copper bactericides for control. There are no commercial varieties resistant to these diseases. All types of beans are susceptible.

Anthracnose is favored by cool, wet weather and appears as black, sunken lesions on pods and stems. The causal fungus can survive on or in infected bean residues for 1 to 2 years and is spread primarily by equipment or wind-driven rain. Where crops are rotated every 3 or more years and western-grown seed is planted, anthracnose is of no economic importance.

Sclerotinia white mold is characterized by a white, cottony mold growth and soft rot of pods and stems. Usually small black bodies (sclerotia) are found in the mold growth or inside infected pods and stems. The causal fungus can survive on or in infected bean residues for 1 to 2 years and is spread primarily by equipment or wind-driven rain. Where crops are rotated every 3 or more years and western-grown seed is planted, anthracnose is of no economic importance.

This disease is best controlled by using fungicide sprays during the bloom period and by storing harvested
Beans at 40° to 45°F without free water on the beans and at a relative humidity of 90 to 95 percent.

**Common rust** is characterized by reddish, dusty pustules on the leaves. The pustules are surrounded by a yellow halo. The disease is favored by warm, wet weather and is best controlled by growing resistant varieties. Fungicide sprays are also effective in controlling rust.

**Virus mosaic** diseases are characterized by stunting of plants, mottling or puckering of leaves, dieback of shoot tips, and distortion, stunting, or absence of pods. Several viruses may be involved. The most common in Illinois are the common bean mosaic virus and the bean yellow mosaic virus. They are usually spread by aphids and are controlled only by growing resistant varieties.

For specific control procedures, see Illinois Extension Circular 1184, *Disease Management Guide for Commercial Vegetable Growers*.

**Sources of Additional Information**


*Edible Beans.* B-671. Horticulture Department, South Dakota State University, Brookings, SD 57007. 35¢.


Red beets are grown and shipped from California and Texas throughout the year. In the Midwest, a fresh market grower can produce enough beets in successive plantings to supply a roadside stand from June through December. Although only relatively small quantities will probably be sold, beets will add variety and color to a market.

To reach optimum quality, beets need cool growing conditions. If they are grown during hot weather, they may lack a deep red color or may have alternating concentric zones of red and pink. However, color may not be as important for direct sales as for processing, and beets can be grown throughout the summer if adequate water is available. Temperatures below 50°F for 2 to 3 weeks after the plants have several true leaves may initiate seed stalks, which will then appear when the weather becomes warm. Fresh market growers can expect yields of 7 to 12 tons per acre.

**Varieties**

The two main varieties of red table beet are 'Ruby Queen' and 'Detroit Dark Red'. Both are globe-shaped, high-quality, dark-colored beets. The old flat Egyptian types, such as 'Crosby Egyptian', have largely been replaced by early globe-shaped varieties such as 'Firechief'. 'Crosby Green Top' is the standard variety used for bunching because its erect green foliage is easier to tie. However, the roots may be slightly flattened on the top.

Several novelty beets are also available that produce either white or golden orange roots. These may be used to add variety to a produce display. The new monogerm varieties or hybrid beets have not gained wide acceptance.

**Soils and Fertility**

Although beets will grow in most soils, germination and emergence may be poor in heavy clays that crust. Well-drained sandy loams or silt loams are preferred. Avoid tillage practices that promote crusting.

Phosphorus and potassium should be broadcast in the spring on the basis of soil test results. Apply 50 pounds of nitrogen on dark soils and 100 pounds on light sandy soils. If possible, split the nitrogen and apply two-thirds before seeding and one-third as a sidedressing 4 to 6 weeks after seeding. Boron deficiency is a common problem, especially on alkaline soils. For more information, see Illinois Extension Circular 1185, Fertilizer Guide for Commercial Vegetable Growers.

**Planting**

Beets are usually direct-seeded but can be transplanted for an early market. Planting can begin in April in southern Illinois and in early May in northern Illinois. Rows should be from 12 to 24 inches apart, and there should be 10 to 12 plants per foot of row; this spacing requires 10 to 12 pounds of seed per acre, or 1 ounce per 100 feet. Since beet seed balls actually contain several seeds, do not overplant. Crowding may result in flat sides, and hand-thinning to avoid this problem is expensive and rarely economical. Planting every 2 to 3 weeks will result in continuous production throughout the season.

**Weeds**

Beets do not compete well with weeds. A combination of herbicides is suggested for improving the competitive ability of young seedlings. An annual grass herbicide applied to the soil and preplant incorporated should be combined with a herbicide that is effective against annual broadleaf weeds. Specific recommendations may be found in Illinois Extension Circular 907, Weed Management Guide for Commercial Vegetable Growers.

**Insects**

Insects do not cause major problems in beets. Occasionally minor damage is caused by flea beetles chewing small holes in the leaves or by leaf miners tunneling and leaving trails between the leaf surfaces. Chemical control is usually unnecessary unless the beets are going to be sold in bunches and must have attractive foliage.
Diseases

The major disease problem in beets occurs in the seed and seedling stage, when the plants are susceptible to dampening-off. Damping-off diseases are caused by soilborne fungi that thrive in cool, moist soils. Fungicide seed treatments and a well-drained seedbed will reduce dampening-off.

The root rot complex is caused by either of two common soil fungi, *Pythium* or *Rhizoctonia*, or by the fungus *Phoma betae*. Symptoms include preemergence and postemergence dampening-off, root rot, stem rot, and external or internal dry rot of fleshy roots. Root rot is most prevalent in cool, wet soil, in fields that are planted yearly to beets, and in plantings that exhibit poor vigor.

*Cercospora leaf spot* is a common leaf disease that causes brown to grey leaf spots with reddish to purple borders. Under warm, wet conditions, this disease can cause rapid defoliation and require fungicide control.

Specific control recommendations for these diseases are given in Illinois Extension Circular 1184, *Disease Management Guide for Commercial Vegetable Growers*. 
Carrots are grown in Illinois primarily for fresh market and are sold through local retail stores and roadside stands. Because California and Texas ship carrots throughout the year, prices tend to be fairly stable. High-quality carrots are not forked, rough, cracked, or flabby. Unlike carrots grown for processing, fresh-market carrots are harvested before they reach full maturity. The smaller carrots are more tender, milder in flavor, and brighter in color than the larger carrots that are grown for soup or baby food.

Carrot production requires relatively long periods of mild weather with day temperatures between 60° and 70°F. Extreme temperatures and too little or too much water will result in low yields and poor quality. The soil must be in excellent condition if the roots are to be well shaped and the plants are to germinate properly. Deep, sandy loams produce well-shaped roots and facilitate harvesting. Short-root varieties can be grown on heavier soils that are deeply plowed and free of stones. Over 10 tons of carrots may be produced per acre.

Varieties

Most fresh market varieties are the long, slim, tapered Emperor types. Several new hybrids are more uniform than the standard open-pollinated variety 'Gold Pack'.

Processing carrots are either long and cylindrical for slicing, such as the Nantes types, or very large for dicing and baby food, such as the Chantenay and Danvers types.

For specific recommendations, see Illinois Extension Circular 1174, Vegetable Varieties for Commercial Growers.

Soils and Fertility

Although organic matter and animal manures are useful in creating a well-structured, fertile soil, applying them before planting may result in forked roots. Apply all organic additions to carrots in the fall. Fertilize with phosphorus and potassium on the basis of soil test results. Nitrogen is required throughout the growing season to maintain adequate foliage, which may be reduced by leaf blights. An initial broadcast application of nitrogen should be followed by one or more side-dressings as the season progresses. See Illinois Extension Circular 1185, Fertilizer Guide for Commercial Vegetable Growers.

Micronutrient deficiencies can be troublesome with carrots grown on muck soils. However, only boron is likely to be limiting on mineral soils, especially on soils with a pH greater than 7.0.

Planting

Since spacing affects carrot shape and development and thinning is not economically feasible, proper stand establishment and initial seed placement are critical. Where chemical weed control is effective, a standard vegetable planter with a scatter shoe can be used to distribute seed in a 3- to 4-inch band. This wide spacing will result in more marketable roots per foot of row. Consider the germination rate and plant enough seed to produce 24 plants per foot of row. Rows are usually 15 to 20 inches apart. This spacing requires 2 to 4 pounds of seed, depending on the size of the seed. Precision seeding of coated seed can also be employed to obtain a good stand. When precision-seeding, place 10 to 12 seeds per foot and make the rows 12 to 14 inches apart. See page 13.

Seeds should be placed as shallow as possible yet deep enough so that they still receive adequate moisture for germination. On heavy soils or in areas where irrigation is available, plant seeds ½ to ¼ inch deep. On lighter soils, seeds may be planted up to ½ inch deep. Carrots may be seeded from early April in southern Illinois to late April in northern Illinois.

Irrigation

Irrigation following seeding greatly improves germination, especially on lighter soils. Even in humid regions, yields are often increased when supplemental irrigation is available throughout the growing season. Carrots generally require a total of 10 to 14 inches of water from both rainfall and irrigation during a complete growing season. Uneven water distribution may result in misshapen or cracked roots. An abundant, continuous supply is required for good yields and quality.
Harvest and Handling

Harvest can begin when the carrots reach a salable size; however, maximum marketable yield is reached when 20 percent of the roots are over 1 1/2 inches in diameter at the top. Mechanical harvesters undercut roots and lift them up by their tops. When a lifter is not available, the soil can be loosened with a plow before the roots are pulled.

Carrots can be bunched with their tops attached, bagged in cell-paks, or placed in bushels for direct sales. Although bunched carrots may be attractive, they must be marketed rapidly or the attached tops may cause the roots to shrink from loss of water. Removing tops in the field reduces storage losses.

Carrots can be stored for 4 to 6 weeks at 32°F and 95 to 99 percent relative humidity. Apples, pears, or other fruit stored in the same room may give carrots a bitter flavor. Only washed, unbruised, whole roots with their tops removed should be placed in storage.

Insects and Diseases

Aster yellows, the major disease of carrots, is spread by the only serious carrot insect pest, the aster or six-spotted leafhopper. This leafhopper transmits a mycoplasma to the plant as it feeds on the foliage. The symptoms of the disease become visible a few weeks after the leafhoppers appear. Infected plants have pale yellow leaves and fine rootlets on the taproot. Infected roots have a bitter taste. The mycoplasma can be transmitted to many plants, including vegetables such as lettuce, celery, parsnips, and parsley. You can control this problem by detecting leafhoppers early and by following a spray program. Specific control measures are outlined in Illinois Extension Circular 897, Insect Pest Management Guide for Commercial Vegetable Crops and Greenhouse Vegetables.

Leaf spot diseases caused by the Alternaria and Cercospora fungi can reduce yields and should be controlled with fungicides. Bacterial leaf blight caused by Xanthomonas carotae can be a problem, particularly on the ‘Spartan Sweet’ varieties. Seed treatment, rotation, and copper applications will reduce the incidence of these diseases. They can be controlled with the periodic fungicide treatments listed in Illinois Extension Circular 1184, Disease Management Guide for Commercial Vegetable Growers.

The root knot nematode causes galling and forking of carrot roots. It can be controlled by fumigating the soil or by rotating with a member of the grass family for 2 or more years.

Sources of Additional Information

Cauliflower, cabbage, and broccoli are grown in Illinois for direct marketing. Cabbage and broccoli can be grown and harvested throughout the summer in northern Illinois. Cauliflower is more sensitive to extreme heat and is best grown as either a spring or fall crop. Fall-harvested broccoli and cauliflower usually yield a superior product because the heads mature during cool weather.

A good cabbage crop yields over 7,000 three-pound heads per acre. Cauliflower will yield 6,000 one- to two-pound heads per acre, and broccoli should produce a total of 9,000 to 10,000 pounds of center heads and side shoots.

Varieties

A large number of cabbage, cauliflower, and broccoli varieties are available to commercial growers. Recommended varieties are listed in Illinois Extension Circular 1174, Vegetable Varieties for Commercial Growers.

In commercial production, the older cabbage varieties have largely been replaced by uniform hybrids. Only cabbage varieties with resistance to Fusarium yellows should be selected. The uniform head type and maturity of the new hybrids facilitate the harvest operation. In a direct marketing operation, however, uniform maturity may not be essential, and a grower may reduce seed costs with an open-pollinated variety. The savoy (crinkled leaf) cabbage varieties are attractive and may be popular at roadside stands.

Two primary differences among cauliflower varieties are the number of days to harvest and the degree to which the leaves protect the curd from sunlight. Self-blanching types have more upright leaves that shade the curd and keep it from turning yellow. Otherwise cauliflower leaves are usually tied to keep the curd from becoming discolored.

Broccoli varieties differ in their average maturity dates and their ability to produce side shoots. New hybrids are available that have a strong tendency to produce a single, large, main head. This type can be planted close together and is ideal for a once-over hand harvest or mechanical harvest. Pick-your-own and roadside market operators prefer types that continue to produce side shoots over several weeks.

Soils and Fertility

Cabbage, cauliflower, and broccoli will grow in most soils that have adequate moisture and good fertility. Apply phosphorus and potassium on the basis of soil test results. In cabbage, excessive potash applications may result in poor internal head quality. Early transplants in cold soils should receive a high-phosphorus starter solution to encourage root growth. All these crops require 75 to 100 pounds per acre of nitrogen before planting and an additional 50 pounds side-dressed 4 to 5 weeks later. See Illinois Extension Circular 1185, Fertilizer Guide for Commercial Vegetable Growers.

Although these crops will grow in slightly acid soils, alkaline conditions are preferred to avoid the clubroot disease. Soil pH values above 7.0 will prevent clubroot but will also encourage a boron deficiency. Apply 2 to 3 pounds per acre of boron to heavy soils and 1 pound per acre to sandy soils if the pH exceeds 7.0.

Planting

An early cabbage crop can be transplanted as soon as the danger of a hard freeze has passed. The first plantings may be made as early as March 1 in southern Illinois and April 1 in northern Illinois. The transplants should be set 9 to 14 inches apart in rows spaced 2 to 3 feet apart. Later-maturing cabbage varieties may require wider spacing. Often the head size can be controlled by the in-row spacing (more space allows for larger heads).

The spring crop of cauliflower or broccoli must be transplanted early enough so that the crop matures before hot weather arrives, especially in southern Illinois. Rows should be 3 feet apart, and plants should be set 18 to 36 inches apart in each row, depending upon their eventual size. Early cauliflower and single-head broccoli can be set at the closer spacings. Do not set the plants until the danger of a hard freeze has passed. The last hard freeze will occur from late March in southern Illinois to late April in northern Illi-
nois. For early planting, use small transplants that are 4 to 6 weeks old and have 4 to 5 true leaves. Older, larger transplants are likely to button (produce small, premature heads) after they are exposed to cold temperatures.

All three crops can be direct-seeded 1/4 to 1/2 inch deep for later harvests. As the seedlings grow, they must be thinned to the final desired spacing, unless they are sown with a precision planter. These planters place pelleted or raw seed at desired intervals and so spare you the costly process of thinning. See page 13.

Irrigation

Supplemental irrigation will increase yields and improve quality in dry weather and is needed for establishing the fall crop. Even relatively short periods of dry weather may injure the plant and reduce yields if they occur during head development.

Harvest and Handling

Cabbage for fresh market must be harvested before it becomes too large. Consumers usually prefer a medium-size head to an excessively large head. Moreover, the danger of split heads increases as the cabbage becomes larger.

Most consumers prefer cauliflower that is snowy white rather than yellow at harvest. Using self-blanching varieties or tying leaves over the curd will improve color. The most desirable size is about 6 to 8 inches in diameter. Heads are usually cut with one or more whorls of leaves left around the curd for protection. They must be cut while the curd is still compact; once the curd begins to separate or become ricey in appearance, it is no longer marketable.

Broccoli is cut when the main heads are 3 to 6 inches in diameter and before the flower buds begin to open and show yellow. On some varieties, side shoots 1 to 3 inches in diameter will develop after the main head is harvested. Broccoli is usually cut 8 to 10 inches down the stem and tied in 1- or 2-pound bunches.

Cauliflower and broccoli should be sold immediately because they deteriorate rapidly in warm temperatures. All three crops may be held in storage for up to two weeks at 32°F and 90 to 95 percent relative humidity.

Weeds

Early weed control for direct-seeded crops is very important because young seedlings do not compete well with weeds. Preplant-incorporated or preemergence herbicides can be effective in direct-seeded cabbage and also in transplants. Broadleaf weeds may become a problem as the season progresses. When available, a broadleaf herbicide should be used. Cultivation will probably be required on all three vegetables. Chemical control procedures are described in Illinois Extension Circular 907, Weed Management Guide for Commercial Vegetable Growers.

Insects

Cole crops are very susceptible to feeding damage by three species of caterpillars: the cabbage looper, the imported cabbage worm, and the larvae of the diamondback moth. Cabbage loopers are striped, light green worms that move in a looping or "measuring" motion. Imported cabbage worms are velvety green, slow-moving worms. Diamondback moth larvae are small, green caterpillars that move rapidly when disturbed. All three species of worms chew holes in the leaves and forming heads. Visible damage may be done by one, two, or even all three at one time. The most serious pest is the cabbage looper, since it is difficult to control with many of the common insecticides.

Control begins with the destruction or plowing under of cole crop residues after harvest is completed. Chemical control consists of following a regular spray program after feeding damage is observed.

Occasionally cabbage aphids or thrips will be found feeding on leaves. These insects must be controlled with insecticides before the plant leaves begin to show injury. Maggots often cause problems on early crops that are planted in cool, wet soils. These are larvae of flies that lay their eggs near the base of transplants. The larvae hatch out and feed on developing roots, causing the plant to wilt or die. A preplant, broadcast application of an insecticide or a transplant drench will control maggots.

Specific chemical control methods for these insects are described in Illinois Extension Circular 897, Insect Pest Management Guide for Commercial Vegetable Crops and Greenhouse Vegetables.

Diseases

Many diseases can damage cabbage, cauliflower, and broccoli. Most are easily prevented by the use of resistant varieties, seed that has been treated with hot water, periodic fungicide treatments, and disease-free transplants. Purchasing seed that has been treated with hot water is the only sure way of avoiding seed transmission of blackrot and blackleg.

Wirestem, bottom rot, and head rot. These diseases are caused by the same fungus that causes damping-off. Wirestem is characterized by stems that are darkened and girdled near the soil line. Affected plants are weak, produce small heads, and sometimes wilt and die. Bottom rot develops on plants after they have been transplanted to the field. Dark, slightly sunken spots
Cole Crops

develop on basal leaves near the soil. In moist conditions and in storage, rot spreads to adjacent leaves and causes a head rot. The causal fungus is present in all field soil. Disease is promoted by moist conditions.

Blackleg. Symptoms of blackleg begin as dark, sunken cankers at the base of the stem and as light brown, circular leaf spots. The stem cankers enlarge and girdle the stem, causing the plants to wilt. The fungus overwinters on seed and in residue from diseased plants, and can persist in residue for 2 to 3 years. It can be carried on seed and on transplants or spread within fields when diseased and healthy plants are dipped in the same water, when workers and implements move through fields that have diseased plants, and by splashing contaminated water.

Alternaria leaf spot. Alternaria leaf spot is caused by a fungus and is characterized by distinct spots with concentric rings on the lower leaves. A dark, dusty fungus growth develops on these spots during moist periods. During storage, the spots enlarge. Soft rot bacteria may enter through dead leaf spots or damaged cauliflower curd tissue. The Alternaria fungus also attacks cauliflower curds, causing unsightly brown to black spots. The fungus overwinters in seed and in residue from diseased plants. Wet conditions promote disease development.

Blackrot. This disease is caused by a bacterium that affects young as well as mature plants. Affected seedlings turn yellow and die. On older plants, yellow V-shaped areas appear at the leaf margins and expand toward the center of the leaf. Affected areas later turn brown and die, and veins turn black in affected areas. The discoloration moves from the leaf margins toward the base of the plant. Heads are dwarfed, and lower leaves fall off. Frequently symptoms are most severe on one side of the head, and soft rot often develops on affected heads. The blackrot bacterium overwinters on seed and in residue from diseased plants, and persists in residue for 1 to 2 years. Like the blackleg fungus, the blackrot bacterium is seedborne and is spread by seedlings and by the movement of contaminated water.

Fusarium yellows. Fusarium yellows is most severe on susceptible cabbage varieties, but it also affects other crucifers. Plants have a sickly, dwarfed, yellow appearance. In affected leaves, edges frequently become purple and bases become brown. Lower leaves drop one by one, and the vascular tissue in the veins turns dark brown in leaves or stems. This discoloration moves from the base of the plant toward the leaf margins. The causal fungus of Fusarium yellows can persist in soil for many years, and development is promoted by high soil temperatures. This disease is best controlled by planting resistant varieties.

Clubroot. Clubroot is caused by a fungus that causes wilting and yellowing of aboveground parts. The diagnostic symptom is the presence of large, spindle-shaped galls on the roots. The causal fungus is soilborne and persists in soil for at least 7 years.

Specific control procedures for these diseases are described in Illinois Extension Circular 1184, Disease Management Guide for Commercial Vegetable Growers.

Sources of Additional Information


Cucumbers grown for fresh market in Illinois are either pickling cucumbers or "slicers." Slicing varieties produce 6- to 8-inch-long dark green fruit that must be picked by hand every 2 to 3 days. Yields range from 10,000 to 20,000 pounds (200 to 400 bushels) per acre. Pickling cucumbers may be grown for sale to customers who wish to pack their own pickles. They may have either black or white spines, but the black-spined varieties tend to turn yellow-orange as they mature. Yields range from 8,000 to 20,000 pounds (160 to 400 bushels) per acre. A bushel will produce 24 quarts of dill pickles.

Varieties

Since some cucumber varieties have good disease resistance, it is advisable to use variety selection as a basic tool in disease control programs.

A number of new gynoecious varieties (having all female flowers) are early crops and can be harvested over a relatively short period of time. Seeds of these varieties contain 10 to 15 percent monoecious plants (having male and female flowers) for pollination. Where a long picking season is desired, it may be advantageous to grow long-season varieties. See Illinois Extension Circular 1174, Vegetable Varieties for Commercial Growers, for specific recommendations.

Soils and Fertility

Light, well-drained soils with high organic matter content are preferred for early production. A previous crop of alfalfa or a legume cover crop will increase the organic matter content of the soil. Cucumbers should not be grown in soil with a pH below 5.5; a pH of 6.0 to 6.5 is preferred.

To fertilize, broadcast phosphorus and potassium on the basis of soil test results and apply 50 pounds of each in a band 2 inches to the side and 2 inches below the seed at planting. In addition, broadcast 50 to 75 pounds of nitrogen before planting and sidedress with an additional 25 pounds after the vines start to run. In sandy soils or during especially rainy weather, a sidedressing may be required if the leaves begin to appear light green or yellow. Up to 20 pounds of nitrogen per acre may be applied through an irrigation system rather than through sidedressing. For more information, see Illinois Extension Circular 1185, Fertilizer Guide for Commercial Vegetable Growers.

Planting

Cucumbers may be direct-seeded when soil temperatures exceed 60°F. Plantings in cool soils will germinate slowly or not at all. Place seed 10 to 12 inches apart in rows 5 to 6 feet apart. This spacing will require about 1½ pounds of seed per acre.

Cucumbers are sometimes transplanted for early production. Transplants should be no more than 3 weeks old when set in the ground. Since they are grown in containers, great care must be taken not to disturb the roots during the transplanting operation. Any disturbance will delay crop development. Early plantings may be made from late April in southern Illinois to late May in northern Illinois.

Irrigation

Cucumbers should not be allowed to wilt at any time during the season, and especially not during fruit development, since dry periods at this time result in poorly shaped fruit. An even moisture supply improves fruit quality and may be achieved with weekly applications of water and the use of plastic mulch. Equipment should be available to apply at least 1 inch of water per week. Sandy soils may require more frequent irrigation.

Pollination

Monoecious cucumber varieties normally produce male flowers first and then both male and female flowers. The female flowers are easily recognized by their tiny, cucumber-shaped ovaries. Bees carry pollen from the male flowers to the female flowers. Usually natural bee populations are sufficient for pollination; in some areas, however, one healthy hive per acre is set in the field 5 days after the first bloom. Insecticides should be applied in the evening when bee activity is at its lowest point.
Harvest and Handling

Slicers should be picked every 2 to 3 days to prevent oversized fruit from developing and to encourage further fruiting. You can remove them from the vine by twisting and snapping them off. Then they are often washed and waxed to prevent water loss before they are marketed.

Pickles can be harvested in a once-over destructive harvest by machine, but most small growers handpick several times. Pickers often skip over the small fruits (¾ to 2 inches long), not realizing that these often sell for a higher price and that removing young fruit keeps the plant productive. Never allow pickling cucumber fruit to mature on the plant, even if it is not marketable. Daily picking is recommended, since fruit can increase in size by 40 percent in one day.

Cucumbers can be stored for up to 2 weeks at 45° to 50°F and 95 percent relative humidity. Lower temperatures cause chilling damage, and higher temperatures encourage yellowing. Cucumbers will also turn yellow more quickly if they are stored in a room with tomatoes or apples.

Weeds

The production of cucumbers in wide rows lends itself to the use of a preplant-incorporated or pre-emergence herbicide early and cultivation of row middles before extensive vining occurs. Herbicides are available that control annual grasses and broadleaf weeds. Since cucumbers are extremely sensitive to injury from many herbicides, however, you should choose your chemicals carefully.

As an alternative to herbicides where earliness is desired, black polyethylene mulch can be used to control annual weeds, conserve moisture, and increase early spring soil temperatures. For specific control recommendations, see Illinois Extension Circular 907, Weed Management Guide for Commercial Vegetable Growers.

Insects and Diseases

A host of different insect pests can infect cucumbers, and periodic pesticide sprays are required to prevent serious damage, especially during wet weather. The most evident insect is the cucumber beetle, which overwinters as an adult and begins feeding on young seedlings as soon as they emerge. Two different cucumber beetles can attack cucumbers, the striped cucumber beetle and the spotted cucumber beetle (also called the southern corn rootworm beetle). You must control these pests early in the season with pesticides to prevent serious feeding damage and transmission of the bacterial wilt disease, which is characterized initially by wilted vines. These wilted parts may appear to recover at night but will wilt on successive sunny days and finally die. Solid, nonvented row tunnels prevent feeding by beetles when plants are young, but insecticide protection will still be necessary after the covers are removed.

A number of virus diseases can also be transmitted by insects, usually by aphids. Vines on infected plants are stunted, and new leaves are dwarfed, mottled, and sometimes distorted. Insecticides provide poor control. To protect your crops, plant resistant varieties and control broadleaf weeds in noncropland areas where these viruses can survive over the winter.

Several foliar diseases are common on cucumbers. Powdery mildew appears as a white powdery growth on leaves. Crown leaves are affected first and may wither and die. Cool nights and warm days favor powdery mildew development. Downy mildew is more prevalent under cool, moist conditions. Irregular yellow to brown spots appear on the upper sides of the leaves and during wet weather, and a purplish mildew develops on the underside of the spots. The symptoms usually begin near the crown and spread outward. Although fungicide sprays are available to help prevent these problems, you should select varieties that are resistant to powdery and downy mildew.

Alternaria leaf spot generally occurs as large brown spots on crown leaves shortly after the initiation of fruit set. This disease is favored by nitrogen deficiency and warm days with cool nights. It is controlled by the use of resistant varieties, fungicide sprays, rotation, and adequate nitrogen fertilization.

Angular leaf spot is a bacterial disease that is spread by splashing water, wind-driven rain, and the movement of pickers or machinery through the field. Leaf spots are angular and irregular in shape and size. They are first water-soaked in appearance, then turn gray or tan, and finally drop out, leaving ragged holes. The use of resistant varieties and 3- to 4-year rotations will reduce the incidence of this disease. The use of maneb or mancozeb plus copper sprays will control it.

The anthracnose fungus can cause problems on both leaves and fruit. Leaf spots begin as yellowish, water-soaked areas that enlarge, turn brown, and shatter to form a ragged hole within the spot. Fruit usually develop depressed, dark-bordered cankers with creamy, pink-colored ooze in the center. Humid weather and frequent rains promote the development and spread of the disease. Although fungicides are available, you can control anthracnose most effectively by using resistant varieties.
The gummy stem blight disease causes wilting of vines, leaf spots, and fruit rot, and is favored by warm, wet weather. This disease can be controlled by planting resistant varieties, using fungicide sprays, and rotating crops.

Most cucumber varieties are now resistant to scab, which used to cause severe problems on cucumber fruit. Belly rot, however, remains a problem, especially when temperatures are above 82°F and the weather is humid. This disease causes a yellowish brown discoloration that develops into sunken, irregular spots on the underside of the fruits. Fungicide sprays may be used for control.


Sources of Additional Information


Evaluating Honey Bee Colonies for Pollination. Bee Facts E-5. Extension Entomology, University of Illinois, 172 Natural Resources Building, 607 East Peabody Drive, Champaign, IL 61820.

Growing Pickling Cucumbers for Mechanical Harvesting. Leaflet 2677. Agricultural Information, University of California, Davis, CA 95616.

Managing Honey Bees for Pollination. Bee Facts E-1. Extension Entomology, University of Illinois, 172 Natural Resources Building, 607 East Peabody Drive, Champaign, IL 61820.


Pollination of Fresh Vegetable and Canning Crops. Bee Facts E-2. Extension Entomology, University of Illinois, 172 Natural Resources Building, 607 East Peabody Drive, Champaign, IL 61820.
A limited eggplant market exists in Illinois, primarily near metropolitan areas during July and August. Roadside marketers and pick-your-own operators are advised to offer a wide variety of crops and to grow a small amount of eggplant as an added attraction, since it is easy to flood a local market with too many eggplants. Excellent fruit and good merchandising will allow you to sell a few eggplants. Do not overplant, since an acre should yield over 10,000 fruit.

**Varieties**

Eggplants differ greatly in size and shape. 'Black Magic' is the earliest of the large oval fruit and is often used for stuffing. 'Dusky' is a smaller fruit that may be preferred by small families. The long, slender varieties are excellent for slicing and drying and may do well in select local markets. The varieties with a green calyx (hard, leaflike cap on the stem end) appear fresher at the market. A purple calyx may make the fruit appear older and should not be grown for direct sales. For specific variety recommendations, see Illinois Extension Circular 1174, *Vegetable Varieties for Commercial Growers*.

**Soils and Fertility**

Eggplant is a heavy feeder and requires a rich, fertile soil with adequate drainage. For rapid, uninterrupted growth, broadcast 75 pounds of nitrogen before planting and sidedress with 25 pounds of nitrogen 4 and 8 weeks after planting. Phosphorus and potassium should be broadcast before planting at rates based on your soil test results. For more specific recommendations, see Illinois Extension Circular 1185, *Fertilizer Guide for Commercial Vegetable Growers*.

Do not plant eggplants in soils that have produced eggplants, tomatoes, potatoes, or strawberries within the previous 5 and preferably 10 years, since these crops are very susceptible to Verticillium wilt. Soil fumigation can also be used to control Verticillium wilt.

**Planting**

Eggplants germinate slowly and require a long season; therefore, they are usually grown from transplants. The plants are usually 6 to 8 weeks old when they are set out. They must be planted after all danger of frost has passed, which is usually in early May in southern Illinois and late May in northern Illinois, when the soil is warm. Set them 2 to 3 feet apart in rows 3 to 4 feet apart.

**Irrigation**

Irrigation will probably not be required except on sandy soils or during excessively dry periods. Eggplants, like tomatoes and peppers, are somewhat susceptible to blossom end rot, which is caused by uneven watering. Peaks of very wet or dry periods can be reduced with the use of plastic mulch. Mulch may also increase yields.

**Harvest and Handling**

Eggplant fruit can be harvested after they are one-third grown and until they reach full size. After reaching marketable size, they are cut from the plant with a short piece of the stem attached. Pulling the fruit off will damage it or break the plant.

Eggplants must be harvested at an immature stage. It is better to pick fruit that is too young than too old. Mature fruit will have tough flesh and dark, hard seeds. Old fruit are dull and washed out in color. It may be necessary to pick twice a week to insure quality throughout the season.

Eggplants should not be stored for more than one week. They retain the best market quality in storage at 50°F with a relative humidity near 90 percent.

**Weeds**

Herbicide selections for eggplant are limited because several herbicides that are safe for tomatoes and peppers injure eggplant. Although annual grasses may be controlled with herbicides, cultivation during the middle
part of the growing season is an essential part of weed control in eggplant production. For recommendations, see Illinois Extension Circular 907, Weed Management Guide for Commercial Vegetable Growers.

As an alternative to herbicides where earliness is desired, black polyethylene mulch may be used to control annual weeds, conserve moisture, and increase early spring soil temperatures. Mulch may also aid in reducing losses from Verticillium wilt.

**Insects and Diseases**

The major insect pest found on eggplant is the **flea beetle**, which chews small holes in the leaves, giving them a sievelike appearance. These tiny, black, hopping beetles can be controlled with the pesticides listed in Illinois Extension Circular 897, Insect Pest Management Guide for Commercial Vegetable Crops and Greenhouse Vegetables.

The most destructive disease in eggplants is **Verticillium wilt**, which stunts plants and causes leaves to turn yellow between the veins, wilt, and die. The disease can persist in the soil for many years and also affects tomatoes, potatoes, strawberries, and brambles. The use of black plastic mulch has been shown to reduce its severity. Soil fumigation is a reliable control tool and is used by many producers in the eastern United States.

Two leaf blight diseases, **Phomopsis blight** and **Alternaria leaf blight**, as well as **anthracnose fruit rot**, are easily avoided by using periodic sprays of appropriate fungicides. Specific treatments are described in Illinois Extension Circular 1184, Disease Management Guide for Commercial Vegetable Growers.

**Sources of Additional Information**

Cool weather is required for the production of good lettuce. Head lettuce is seldom grown in Illinois because temperatures above 70°F promote poor head formation and seed stalk development. However, leaf lettuce grows well in this state, and varieties are available that will produce throughout the season if given adequate water. Leaf lettuce is usually marketed locally because most field-grown varieties do not handle or ship well.

Varieties

Leaf lettuce varieties may be grouped into three main types: butterhead or Bibb, cos or romaine, and loose-leaf. The butterhead types have smooth, tender leaves that overlap to form a small, loose head. The head is surrounded by spreading, loose leaves and is characterized by its sweet, buttery flavor. Cos or romaine lettuce is upright and has long, narrow leaves and a loaf-shaped, soft head. If picked at the proper stage, it is sweet and lacks bitterness. The leaves of loose-leaf lettuce are clustered together but do not overlap to form a head. Recommended varieties are listed in Illinois Extension Circular 1174, Vegetable Varieties for Commercial Growers.

Soils and Fertility

Although the lettuce plant does not remove excessive amounts of nutrients from the soil, it needs a fertile soil because it has a small root system. Apply 80 pounds of nitrogen per acre before planting and an additional 40 to 60 pounds 3 to 5 weeks after planting. Use the higher rate on sandy soils or during excessively wet seasons. Phosphorus and potassium should be applied on the basis of soil test results as described in Illinois Extension Circular 1185, Fertilizer Guide for Commercial Vegetable Growers.

Since lettuce is not tolerant of acid soils, the pH must be maintained above 5.8, preferably between 6.0 and 6.5.

Planting

Lettuce may be either direct-seeded or transplanted for an early spring crop. When the crop is direct-seeded, the seedbed must be well prepared and must also contain adequate moisture for germination. It should be level and free of clods and trash. Precision planters reduce the need for thinning.

Lettuce should be planted in rows 1 to 2 feet apart; the wider spacing is preferred in a pick-your-own operation. Set plants or thin seedlings to achieve a final in-row spacing of 10 to 16 inches, depending on the variety. Romaine types require less space than the spreading butterhead or loose-leaf varieties. Lettuce may be seeded from late March in southern Illinois to mid-April in northern Illinois.

Irrigation

To produce a successful lettuce crop, growers must maintain a uniform soil moisture level. Fluctuations in moisture reduce yield and quality.

Irrigation may be required at seeding to insure germination. During the growth period, do not allow the crop to go for more than 10 days without at least 1 inch of rain or irrigation water. More will be required on sands or during warm weather. Frequent light irrigations may improve quality by causing evaporative cooling during hot weather.

Harvest and Handling

Lettuce heads should be cut just above the soil when they reach a marketable size. The plants may be washed to remove soil and to help prevent rapid wilting. They should be stored and displayed in cool conditions. If refrigeration is not available, such as at a farm stand, moist paper towels in the bottom of a bushel basket or box can be used to raise the humidity around the leaves. Never display leaf lettuce in full sun, since wilted plants are unattractive.

Lettuce may be stored for a few days at 32° to 34°F and high humidity. Higher temperatures or storage near apples encourages russet spotting.
Weeds

Although leaf lettuce is a short-season crop, young seedlings are susceptible to competition from weeds. Grass-active herbicides are available, but cultivation, hand-weeding, and hoeing may also be required. See Illinois Extension Circular 907, Weed Management Guide for Commercial Vegetable Growers.

Insects and Diseases

Few insects cause problems on lettuce grown in Illinois. Because lettuce requires high moisture, slugs may be a problem. Slug baits are available but are not always effective. Various caterpillars also feed on lettuce, but control measures may be limited because there is a lack of registered chemicals. The bacterial agent Bacillus thuringiensis, however, will safely control most worms. Aphids and leafhoppers must also be controlled because their feeding may introduce diseases. See Illinois Extension Circular 897, Insect Pest Management Guide for Commercial Vegetable Crops and Greenhouse Vegetables.

Aster yellows is a lettuce disease that is characterized by yellowing and curling of the youngest leaves. The causal mycoplasma overwinters in weeds on the borders of fields and is spread by leafhoppers while they feed. Similar symptoms can be caused by several viruses that are spread by aphids. Controlling aphids and leafhoppers will prevent these diseases.

Although water is required for lettuce production, excessive moisture may cause several fungus diseases. Regular fungicide applications and well-drained soils will reduce problems caused by downy mildew, Rhi­zoctonia bottom rot, Sclerotinia drop, and Botrytis gray mold. See Illinois Extension Circular 1184, Disease Management Guide for Commercial Vegetable Growers.

Sources of Additional Information


Melons are grown in Illinois for local or regional markets. Local growers can supply consumers with muskmelons that are far superior to melons shipped long distances. Watermelons can be grown and sold to retail markets at a more competitive price because of the high cost of shipping from the South.

Muskmelons and watermelons require a relatively long, warm season for optimum production. Plastic mulch and row covers often improve marketable yields and promote earliness. If you have light-textured soils and if you provide adequate fertility and irrigation, you may expect muskmelon yields of over 20,000 pounds (or 4,000 six-pound melons) per acre. Watermelon yields may exceed 20,000 pounds (1,000 twenty-pound fruits) per acre. Yields of both melons will be lower in northern Illinois because of the shorter growing season. Heavy soils generally produce lower yields and smaller fruit.

Varieties

Most muskmelons that are grown for local markets are heavily netted and deeply ribbed, whereas shipping melons are usually lightly netted and have shallow ribs. Melons shipped from Texas and California are picked before they are fully mature and so are inferior to local melons. Because these melons also happen to be light ribbed, growers often mistakenly associate light ribbing with poor flavor; however, the finely netted ‘Saticoy’ melon has excellent flavor when picked at the proper stage. Honeydew melons are difficult to grow in Illinois because they require a long growing season and are not resistant to disease.

Watermelon varieties differ widely in size and flesh color. The large ‘Charleston Gray’ may be too big for consumers who prefer a smaller melon such as ‘Crimson Sweet’. ‘Yellow Baby’ is a yellow-fleshed, early melon that can be marketed as a specialty item. For a complete description of melon varieties, see Illinois Extension Circular 1174, Vegetable Varieties for Commercial Growers.

Soils and Fertility

Melons can be grown on a wide variety of soil types, but well-drained, sandy loams are preferred for earliness and highest quality. Light, sandy soils are also used for early production but require better management and additional inputs of water and fertilizer. Avoid growing melons on poorly drained soils.

Fertilize with phosphorus and potassium on the basis of soil test results, and apply lime if needed to maintain a pH between 6.0 and 6.8. Watermelons can be grown on more acidic soils with a pH of 5.5 to 6.8. A high level of magnesium is believed to be important for melon crops. Unless soil test magnesium levels exceed 300 pounds per acre, an application of 50 pounds of magnesium may be required. Magnesium sulfate or Epsom salts is the standard material, but dolomitic limestone (containing magnesium) may also be used if lime is required.

Melons may receive from 80 to 100 pounds of nitrogen per acre. Use the higher rate on sandy soils. When plastic mulch is used, all of the nitrogen may be applied at planting. When mulch is not used, two-thirds should be applied at planting and one-third before the vines begin to spread. See Illinois Extension Circular 1185, Fertilizer Guide for Commercial Vegetable Growers.

Planting

Vine crops can be either seeded directly in the field or transplanted for an early harvest. Transplants should be 2 to 3 weeks old when set in the fields. You may cover them with hot caps or plastic row tunnels to prevent injury from late frosts and to encourage early growth. Plants may be set as early as April 15 in southern Illinois and May 15 in northern Illinois if they are protected. For early melons, use large transplants grown in 3-inch peat pots, black plastic mulch, and clear plastic or spunbonded row covers. Remove the row covers when the plants begin producing flowers to allow for pollination by bees.

Two to four pounds of seed will be required to plant an acre. Rows should be spaced 6 to 8 feet apart with single plants 2 to 3 feet apart in a row. Hills of 2 plants
each may also be made 4 to 5 feet apart in the row for cross cultivation. In either case, seeds should be covered with 1/2 inch of soil. Early plantings may germinate slowly or not at all if soil temperatures fall below 60°F. Seeds should emerge within 5 days if the soil temperature is 75°F.

Seedless watermelons must be transplanted because their seed has very poor vigor and does not germinate well. To improve the chance of success, follow these steps:

- Soak Jiffy 7s or another peat-lite mix 24 hours before planting.
- Plant two seeds per pellet or cell-pak 1/2 inch deep. Insert the seed with the pointed end up so that the seed coat will be shed easily upon emergence.
- Maintain a constant temperature of 85°F for 2 days. Do not allow the soil to dry out or become excessively wet.
- Grow the plants for 2 to 3 weeks in full sun at 75°F.
- Transplant into the field carefully, remembering to seed a pollinator variety in every third row ('Sugar Baby' is often used).

Irrigation

Rainfall usually supplies sufficient moisture to melons once the crop has been established. When water is required before the fruiting period, heavy, less frequent applications are more beneficial. Excessive watering during fruiting may result in splitting, especially following a long dry period; therefore less frequent, lighter applications at this time are preferred. Plastic mulch helps maintain a uniform water supply.

Pollination

Melons must be pollinated by bees. Supply one healthy bee colony per acre of melons in large fields that do not contain a sufficient number of wild bees. Apply pesticides in the evenings when bees are inactive.

Harvest and Handling

Muskmelons should be picked every two days and only at full slip — that is, when the vine detaches easily from the fruit when you lift the vine off the ground. Do not pull hard or break the vine from the fruit, since maximum sugar content will not be developed until the vine slips easily. Fruit held for 1 to 2 days after full slip at 70°F will have the best flavor. For longer storage, muskmelons should be cooled to 50° to 55°F.

When mature, watermelons should be cut, not pulled, from the vine. Most varieties are mature when the underside turns from white to pale or dark yellow. Experienced pickers may also be able to pick a melon by thumping. A metallic, hard sound indicates that the melon is not yet ripe; a muffled, hollow sound indicates that it is. Dried tendrils near the melon and the leaf nodes on either side of the melon may also indicate maturity. Watermelons can be held as long as two weeks at 40°F to 50°F. Cooler temperatures cause pitting, and warmer temperatures allow for decay.

Weeds

A combination of a grass herbicide and a broadleaf herbicide is recommended for melon production. Because muskmelons and watermelons are grown in wide-row culture, it is often possible to control weeds in the middle of the rows by cultivation. As an alternative to herbicides where earliness is desired, black polyethylene mulch can be used to control annual weeds, conserve moisture, and increase early spring soil temperatures and yields. See Illinois Extension Circular 907, Weed Management Guide for Commercial Vegetable Growers.

Insects

As with cucumbers, the most serious insect pests of muskmelons are the striped cucumber beetle and the spotted cucumber beetle. These beetles can injure plants by their feeding. They also transmit the bacterial wilt organism, which can cause a total crop loss. Since this disease can become severe just before harvest, growers can suffer serious financial losses if they do not use season-long control programs. Although watermelons are not susceptible to bacterial wilt, beetle feeding must be prevented to allow for maximum productivity. Nonvented, spun-bonded row tunnels can be used to prevent early feeding.

Various caterpillars can damage vine crops. Sprays and baits are available that will offer control if growers carefully scout their fields. The squash bug, however, is more difficult to control. This brownish black insect (usually 5/8 inch long when grown) can suck plant juices from the foliage and cause it to wilt, turn brown, and die. Rotating vine crops with other noncucurbit crops will reduce bug populations. For control measures for insects, see Illinois Extension Circular 897, Insect Pest Management Guide for Commercial Vegetable Crops and Greenhouse Vegetables.

Diseases

Some foliar diseases that affect cucumbers also affect melons. These diseases include downy mildew, powdery
mildew, Alternaria leaf spot, gummy stem blight, anthracnose, angular leaf spot, and mosaic virus. See the chapter on cucumbers for details.

**Fusarium wilt** is another disease of melons that can be serious. Infected vines become stunted, yellow, and wilted, and finally die. The fungus that causes this disease persists in the soil for many years. Resistant varieties should be used wherever vine crops have been grown before.

A disease that is particular to muskmelons, called **late collapse** or **sudden wilt**, can be very damaging. Plants collapse on bright, sunny days late in the season after heavy rains and cold nights — conditions that lower soil temperatures. Soil temperatures less than 60°F at the 4-inch soil depth are thought to be correlated with the disease. There are no controls.

The **root knot nematode** can reduce growth and yields by disrupting root functions. Galls ¼ to 1 inch in diameter form on the roots. Infected plants wilt during hot, dry days and recover at night. The use of nematicides, soil fumigants, or rotation will provide control.

For more information on disease prevention, see Circular 1184, *Disease Management Guide for Commercial Vegetable Growers*.

### Sources of Additional Information


*Evaluating Honey Bee Colonies for Pollination.* Bee Facts E-5. Extension Entomology, University of Illinois, 172 Natural Resources Building, 607 East Peabody Drive, Champaign, IL 61820.

*Managing Honey Bees for Pollination.* Bee Facts E-1. Extension Entomology, University of Illinois, 172 Natural Resources Building, 607 East Peabody Drive, Champaign, IL 61820.

*Pollination of Fresh Vegetable and Canning Crops.* Bee Facts E-2. Extension Entomology, University of Illinois, 172 Natural Resources Building, 607 East Peabody Drive, Champaign, IL 61820.
Onions are grown in Illinois primarily for fresh market and for sale as onion sets. Early crops can often be sold at a premium price because Texas and California harvests decline after a May-through-July peak. Onions harvested in September and into October are usually stored for shipment at a later date. Growers should expect to produce 17,000 to 25,000 pounds of onions (350 to 500 fifty-pound bags) per acre.

Large, mature bulbs can be produced for early market from sets or transplants. Storage onions are usually direct-seeded. The best yields are achieved when the early growing season is relatively cool (65° to 68°F) and sunny. Extensive root and foliage growth before the onset of bulbing will result in larger bulbs; for this reason, early planting is essential. The long days and warm temperatures of late June trigger the bulbing process, and warm weather in late summer and early fall is required for rapid bulb maturation.

Begin harvesting onions when most of the tops have fallen over and the necks have begun to dry. After the tops are removed, onions can be dried further in pallet boxes in the field or artificially in storage.

**Varieties**

Dry bulb onion varieties can be classified according to type. Shapes range from globe to flattened, and pungency varies from mild to very strong. Onions come in colors such as white, red, or the standard yellow-brown. The type of onion grown will depend on your market. Recommended varieties are listed in Illinois Extension Circular 1174, *Vegetable Varieties for Commercial Growers*.

Although bulbing types can be used to produce green onions, special varieties that do not form bulbs are usually preferred. Varieties with a white base are required for market. ‘Southport White Globe’ is probably the most widely used variety for an early crop, and ‘Lisbon White Bunching’ is used for later harvests.

**Soils and Fertility**

When mineral soils are to be used for onion production, they should be medium to light loams with excellent drainage. The pH should be between 6.2 and 6.8, and the soil test for phosphorus (P₄) should be above 75 pounds per acre. Since onions are highly sensitive to acid soils, the pH should not fall below 6.0. Lower yields in acid soils are thought to be caused by aluminum toxicity. High soil phosphorus levels also help reduce soluble aluminum.

Apply phosphorus and potassium on the basis of soil test results. Seventy-five pounds of nitrogen per acre should be broadcast before planting, and an additional 25 pounds should be sidedressed 4 to 5 weeks after planting. Green onions must receive 25 pounds of nitrogen 4 to 5 weeks before harvest to maintain good color.

Excess nitrogen has not been shown to delay bulb development or neck drying, as is generally assumed. However, excess water will delay maturity and increase the need for nitrogen. During wet seasons a second sidedressing of nitrogen may be required to optimize yields. In that case, maturation will probably be delayed whether nitrogen is applied or not; nevertheless, yields will be higher with the additional nitrogen. See Illinois Extension Circular 1185, *Fertilizer Guide for Commercial Vegetable Growers*.

**Planting**

The highest yields of bulb onions over 2 inches in diameter can be obtained with 12- to 16-inch rows and direct seeding of 3.5 to 4.0 pounds of seed per acre. This spacing will result in 6 to 8 plants per foot of row if germination is good. When transplanting large onions such as ‘Yellow Sweet Spanish’, allow only 4 plants per foot of row (or 120,000 to 140,000 plants per acre). Onion sets planted for early market may also be spaced 2 to 4 inches apart. Approximately 25 bushels (800 pounds) of sets less than 1 inch in diameter are needed per acre. Sets of onions larger than ½ inch in diameter are more subject to bolting.

Green onions are seeded and thinned, transplanted, or grown from sets to produce a population with plants about 1 inch apart.
Irrigation

Supplemental irrigation is usually required for maximum onion production. During the seedling and foliage growth stages, from 1 to 1.5 inches of rainfall or irrigation water will be needed per week. Although water is required as the bulbs enlarge and mature, too much at this time will delay drying.

Harvest and Handling

The timing of the harvest operation has a dramatic effect on onion storage. To hasten drying, onions are usually undercut just below the bulb 5 to 7 days before lifting. In regions where the fall is generally dry, harvest may be delayed until all the tops have fallen over. In Illinois these delays may result in renewed root growth during humid weather.

After lifting, onions for storage can be cured either in the field or inside. If left in the field, they must be sheltered from rain. Curing will be complete in 2 to 3 weeks if temperatures are between 75° and 80°F and if the relative humidity ranges from 60 to 70 percent. Onions that are stored in bulk are usually cured in storage facilities. Temperatures are maintained at 85° to 90°F for rapid drying, and air is forced through the onions for 4 to 5 days until the necks are dried and tight.

After curing, temperatures are reduced gradually as the outside temperature drops. Ventilation is required to prevent storage decay. Temperatures between 32° and 34°F will be necessary for long-term storage. It is usually best to sell the crop before March, since this is when Texas onions appear on the market.

For long-term storage, maleic hydrazide (MH-30) may be applied to plants in the field 1 to 2 weeks before harvest. The timing of the spray is critical because early applications may result in storage losses and late spraying will be ineffective. Apply 1/2 gallon in 100 gallons of water when 50 percent of the tops are down. Several green leaves per plant must be present to absorb the material. MH-30 extends the dormancy of varieties that are already known to store well.

For more information on onion storage, read Storage Recommendations for Northern Grown Onions, Information Bulletin 148, available for $1.00 from the Mailing Room, 7 Research Park, Cornell University, Ithaca, NY 14853; and Horticulture Facts VC-4-79, Inhibiting Sprouts in Onions and Potatoes That Are To Be Stored, available from Department of Horticulture, University of Illinois, 124 Mumford Hall, 1301 West Gregory Drive, Urbana, IL 61801.

Weeds

Since onion seedlings are susceptible to weed competition and the cost of hand-hoeing and hand-pulling weeds is likely to be excessive, a combination program using a preemergence grass killer and a postemergence broadleaf weed killer is recommended. It may be necessary to rely on cultivation between rows later in the growing season if a postemergence herbicide is not used. Onion seedlings are extremely susceptible to injury by some herbicides early in their growing period, especially in the flag stage through the 3-true-leaf stages; therefore, application should be avoided during these stages. See Illinois Extension Circular 907, Weed Management Guide for Commercial Vegetable Growers.

Insects

The onion maggot can be a serious insect pest if it is not controlled. Small flies lay eggs near the seed or set. The maggots emerge and burrow into young bulbs, causing decay and eventually death. A granular insecticide applied in the seed furrow at planting, followed by a foliar spray when adult flies emerge, will prevent maggot damage.

Middle- and late-season injury from thrips may result in a blanched, unhealthy appearance at the base of the leaves. Thrips are usually more prevalent during dry weather. Foliar sprays are effective against them. See Illinois Extension Circular 897, Insect Pest Management Guide for Commercial Vegetable Crops and Greenhouse Vegetables.

Diseases

Smut is the most destructive onion disease in Illinois and appears when land has been cropped with onions for several years. The fungus attacks young seedlings, producing small black pustules that break open and release powdery masses of spores. The first leaf to emerge is susceptible, but if it reaches full growth, it will continue to be free from the disease. Smut is best controlled by using sets or fungicide-treated seed.

Botrytis blast, Alternaria purple blotch, and downy mildew are other common leaf diseases. They must be controlled by regular fungicide applications if neck rot losses are to be controlled. This is a disease of storage onions that have been diseased or injured in some way. Early harvesting and topping may open wounds for infection by the fungus. Dry sunken areas may appear on the bulb, especially near the neck. The disease can be avoided by allowing onions to dry completely before topping, using regular foliar fungicide sprays to control leaf diseases, and providing adequate ventilation in storage. Cull onions that are dumped outside storage facilities or in the field provide inoculum for the disease.

For more specific control recommendations, see Illinois Extension Circular 1184, Disease Management Guide for Commercial Vegetable Growers.
Sources of Additional Information


Onion Production in California. (4097). Agricultural Communications, University of California, Davis, CA 95616. $5.00.


The standard garden pea, Southern pea, snow pea, and new snap pea can all be grown for local fresh market sales in Illinois. These crops can be sold at both roadside stands and pick-your-own operations; because hand-harvesting is costly, however, most growers prefer the pick-your-own operation. Garden peas require a relatively cool season and produce better in northern Illinois. The fast-growing snap pea and snow pea can be grown as spring crops throughout the state. Growers should consider double-cropping by following peas with a fall crop of broccoli or cauliflower. Southern peas will withstand warmer temperatures and can be grown throughout the summer.

Average yields of unshelled garden peas often exceed 4,000 pounds (almost 150 bushels) per acre. Yields of Southern peas will range from 500 to 1,000 pounds per acre of dry peas and from 700 to 1,000 pounds per acre of green peas.

Varieties

Several good garden pea varieties are described in Illinois Extension Circular 1174, Vegetable Varieties for Commercial Growers. Although a number of new snap pea varieties have been developed, none have proved consistently superior to the original variety 'Sugar Snap.' 'Mammoth Melting Sugar' is the standard snow pea variety grown, but several other good varieties are available.

Southern peas are also known as field peas, cowpeas, black-eyed peas, and crowder peas. The varieties can be distinguished by pod color and seed type. 'California Blackeye' is probably the leading black-eyed pea grown. Two standard crowder peas are 'Colossal' and 'Mississippi Silver'. A leading purple hull pea is 'Pink Purple Hull', and a standard cream-colored Southern pea is 'Texas Cream 40'. Many other varieties may perform well in the Midwest.

Soils and Fertility

Well-drained soils are required for early planting. Although pea seed (except Southern pea seed) will stand cool temperatures, wet soil may result in poor germination. Late-planted garden peas do not yield as well, and quality deteriorates rapidly in warm weather. Light, sandy soils may require irrigation during the pod-filling stage.

Peas are especially sensitive to residues from atrazine herbicides. If they are to follow atrazine-treated corn, therefore, no more than 1.0 pound active ingredient of atrazine should be used. To avoid the buildup of root rot pathogens, do not plant peas in the same field more than once every 4 years.

Peas respond well to adequate fertility. Since early planting is desirable, phosphorus and potassium should be broadcast during the preceding fall. To encourage early growth, especially in cold soils, a band application of a complete fertilizer should then be applied at seeding 2 inches to the side and 2 inches lower than the seed. This application should contain 50 pounds of nitrogen, 50 pounds of phosphorus, and 50 pounds of potassium. A second nitrogen application of 25 pounds per acre may be needed when the peas are 4 to 6 inches tall, especially if they are later varieties growing in sandy soil or if the spring has been rainy. See Illinois Extension Circular 1185, Fertilizer Guide for Commercial Vegetable Growers.

Peas do not produce well on acid soils. Apply lime to achieve a pH of 5.8 to 6.5. On rented land, 300 to 400 pounds per acre of dolomitic limestone may be mixed with seed to raise the pH near the seed.

Planting

Since peas will germinate in cool soils, they are planted as early as possible — in early to mid-April in northern Illinois and in late March farther south. Southern peas require soil temperatures above 65°F.

All peas except Southern peas are drilled in rows 2 to 3 feet apart with seeds 2 inches apart in the row. This spacing will require between 100 to 150 pounds of seed per acre, depending on the variety. Place the seed 1 inch deep in heavy soil and 2 inches deep in lighter soils. Southern peas should be planted in 36- to 42-inch rows with seeds 3 to 4 inches apart. This spacing will require 30 to 40 pounds of seed per acre.

Snap peas and peas for fresh market give better yields and can be picked more easily if they are allowed to
climb. Light poultry fencing with stakes at 20-foot intervals provides adequate support.

Harvest and Handling

Fresh market peas are picked by hand several times during the season. Handpicking is the most expensive operation in pea production. Some growers try to reduce expenses by allowing the vines to grow on the ground; then they pull the vines and strip the pods in a single destructive harvest. This method reduces costs but also results in poorer peas, since some of the pods will be too young and others will be well past maturity.

Southern peas can be harvested as dry peas, green mature peas, or green pods. Dry peas are usually combined after 35 to 40 percent of the pods are dry. Green snap or green mature peas can be mechanically harvested with a snap bean harvester. Most farmers in the Midwest, however, grow Southern peas for pick-your-own operations.

Peas may be stored for 2 weeks at 32° to 34°F and 90 to 95 percent relative humidity.

Weeds

Peas produced commercially for processing are planted at high populations and in narrow rows. This system provides competition to weeds, reducing the number of weed seedlings that are able to survive. Since the peas are planted early in the spring, they are able to produce significant growth before many weeds germinate and grow. Their relatively short growing season also enables them to escape some weed flushes. Growers who plant in wider rows for pick-your-own operations can expect more weed competition.

Despite the advantages peas have over weeds, some problems can still occur that will reduce economic and actual yields. A preplant-incorporated or preemergence herbicide should be used to reduce heavy weed populations that might reduce yields. Control of Canada thistle is critical in processing peas because the thistle seed ball is difficult to separate from the peas during harvest. Quackgrass may also be a problem and should be controlled. Refer to Illinois Extension Circular 907, Weed Management for Commercial Vegetable Growers, for recommendations.

Insects and Diseases

The major insect pests of peas are aphids and caterpillars. The pea aphid is a large, pale green aphid. Both it and the caterpillars can be controlled with insecticides described in Illinois Extension Circular 897, Insect Pest Management Guide for Commercial Vegetable Crops and Greenhouse Vegetables.

Long rotations and the use of resistant varieties will help reduce root rot and wilt diseases of peas. Several fungi cause pea root rots. Symptoms may include a water-soaked appearance of the lower stem or roots. Red, brown, or purple discoloration may also be evident near the soil line. Fusarium wilt and near-wilt are caused by similar fungi and are controlled by planting resistant varieties. In areas where wilt symptoms have appeared, only resistant varieties should be used. Some herbicides have been shown to suppress the pea root-rot complex. Powdery mildew and bacterial blight are occasional problems and are best controlled by applying fungicides or copper. For more general information, see Illinois Extension Circular 1184, Disease Management Guide for Commercial Vegetable Growers.

Sources of Additional Information


Insects of Peas. PNW-150. Department of Horticulture, Washington State University, Pullman, WA 99163.

Bell peppers are sold in limited quantities at roadside stands in Illinois. Most are harvested green after they have reached full size and their walls have thickened. Red bell peppers take longer to mature and reduce the total fruit output of a plant, but they can be sold in limited quantities at a higher price. Most consumers prefer a large, blocky, four-lobed, green bell pepper. Fresh market peppers should yield 10,000 pounds (400 bushels) per acre.

Varieties

It is advisable to grow two or more varieties of bell pepper as insurance against losses, since varieties often differ widely in their ability to set fruit under various environmental conditions. Unusually hot or prolonged cool weather, with night temperatures below 60°F or above 75°F, may cause flowers to drop prematurely. Hot, dry winds may also cause flowers to abort. Although the plant itself is not adversely affected by these conditions, yields will suffer. Varieties such as 'Ace', 'New Ace', 'Super Set', 'Early Prolific', and 'Stokes Early Hybrid' do not produce large, blocky fruit but do set better under adverse conditions.

Recommended varieties are listed in Illinois Extension Circular 1174, Vegetable Varieties for Commercial Growers.

Soils and Fertility

Peppers will grow well in a wide range of soil types as long as drainage is good. Apply phosphorus and potassium on the basis of soil test results. See Illinois Extension Circular 1185, Fertilizer Guide for Commercial Vegetable Growers. Nitrogen will be required before planting and several times during the season. Broadcast 75 pounds of nitrogen before planting and sidedress with an additional 50 pounds 3 to 4 weeks after the first fruit set. In sandy soils or after periods of heavy rain, an additional 50 pounds may be required.

Planting

Peppers require warm weather, and little is gained by early planting. Wait until average temperatures are between 65° and 70°F, since peppers recover very slowly from severe shocks such as cold soils or frost. Because they germinate slowly, peppers are rarely direct-seeded. Transplants may usually be set out from late April in southern Illinois to late May in northern Illinois. They will benefit from an application of a high-phosphorus starter solution. Plants should be set 18 to 24 inches apart in rows that are 3 to 4 feet apart. If irrigation is not available, wider in-row spacing is preferred.

Irrigation

Transplants should be irrigated shortly after they are set in the ground. After they are established, irrigation may be required if dry weather persists. Do not let the plants go for more than 10 days without at least 1 inch of rain or irrigation water, especially during fruit set and development. Dry conditions during fruit development may result in blossom end rot later.

Harvest and Handling

Peppers are broken from the plants with their stems attached. Green peppers are ready to pick when they are 3 to 4 inches long and firm to the touch. Immature peppers will be soft, and although they can be consumed, picking them will result in yield losses. Peppers require 2 to 3 weeks longer to turn red, and then they are subject to bruising and deterioration.

Peppers may be stored for only a few days. The storage temperature must be between 45° and 50°F, and the relative humidity must be 85 to 95 percent. Temperatures below 45°F will result in chilling injury, and temperatures above 50°F will promote ripening and deterioration.

Weeds

Bell peppers have a slow initial growth rate and do not compete well with heavy weed infestations. Where significant weed populations are present, preplant-incorporated or preemergence herbicides should be used to give pepper plants a competitive advantage. DO NOT use metribuzin in pepper production. Because peppers are a long-season crop, cultivation should be done later in the growing season.
For specific control recommendations, see Illinois Extension Circular 907, *Weed Management Guide for Commercial Vegetable Growers*.

As an alternative to herbicides where earliness is desired, black polyethylene mulch can be used to control annual weeds, conserve moisture, and increase early spring soil temperatures and yields.

**Insects**

During most years, the best insect control for peppers will be *NONE AT ALL*. Natural predators often keep pest populations low, and applying the wrong insecticides will increase rather than decrease populations. The only two serious insect pests found on peppers are the **green peach aphid** and the **European corn borer**. An insecticide is available that will control the green peach aphid if its numbers increase, but the aphid is resistant to many insecticides. When green corn plants are not nearby, green peppers may attract moths of the European corn borer. Insecticides are available that will control this pest.

**Diseases**

**Virus diseases** are spread by aphids and can be very serious on peppers because they are difficult to control. The symptoms generally appear as leaf mottling, puckering, or curling, as well as rough, deformed, or spotted fruit. Often plants will be stunted, and blossoms or fruit may fall off. Growers should plant one of the many pepper varieties with tobacco mosaic resistance; some varieties are also resistant to other viruses.

**Bacterial spot** is also serious on peppers. The bacteria that cause this disease are spread by splashing rain and movement of equipment through the field. Infected plants, crop residue, and seeds are the primary sources of inoculum, but the bacterial spot organism may also overwinter on weeds. Bacterial spot first appears on the lower leaf surfaces as small, irregular, water-soaked areas. The spots enlarge and become purplish gray with black centers. Leaves may eventually turn yellow and fall off. Warm, wet, rainy weather promotes the disease, and wind damage to leaves makes the plants more susceptible. The use of windbreaks, crop rotations, bleach seed soaks, and clean transplants should help prevent bacterial spot. Applying a combination of copper plus maneb or mancozeb will also help control this disease.

Two fungal diseases, **Cercospora leaf spot** and **anthracnose**, can also cause problems in peppers, especially in rainy weather. Fungicide treatments for these diseases are described in Illinois Extension Circular 1184, *Disease Management Guide for Commercial Vegetable Growers*.

**Sources of Additional Information**

*Growing Peppers in California.* Leaflet 2676. Agricultural Information, University of California, Davis, CA 95616.

Pumpkins for jack-o'-lanterns are relatively easy to grow and sell but require a large amount of space. Winter squash often sells well just before Halloween because people also buy pumpkins at this time. Picking pumpkins and gourds has recently become a popular family activity in the fall, and roadside marketers can also sell ornamental corn and gourds at this time of year. Growers have achieved yields of over 15 tons per acre of large winter squash and pumpkins.

Varieties

While all members of the genus Cucurbita may be called squash, the round, orange fruits used for pies or jack-o'-lanterns are generally called pumpkins. The small, ornamental types with hard rinds are usually called gourds. The primary practical difference between pumpkins and squash is that squash is cooked and consumed as a vegetable dish. However, several winter squashes can be used to make pumpkin pie, and the major pie pumpkin used for canning, ‘Dickinson Field’, is botanically considered a squash.

Most jack-o'-lantern growers plant several varieties of pumpkin, from the small 4- to 6-pound ‘Spookie’, to the larger 8- to 15-pound ‘Young’s Beauty’, to the large, 15- to 25-pound ‘Howden’s Field’ or ‘Connecticut Field’. For larger pumpkins, growers may use a squash variety called ‘Big Max’.

Many different types of winter squash are available. Of the standard types such as acorn and butternut, there are several acceptable varieties. Fewer varieties are generally available for the buttercup, Hubbard, and other less common squash types. The novelty squash ‘Vegetable Spaghetti’ has consumer appeal and may sell well at the farm stand.

For a complete list of recommended varieties, see Illinois Extension Circular 1174, Vegetable Varieties for Commercial Growers.

Soils and Fertility

Pumpkins and squash will grow well in any well-drained soil; they will not tolerate excessively wet soil or standing water. They also grow well at a pH of 5.5 to 6.5. More acidic soils should be limed, preferably with a dolomitic limestone.

Pumpkins and large squash are heavy potassium feeders and should receive at least 200 pounds of potassium per acre before planting. Apply only 75 to 100 pounds of nitrogen per acre for jack-o'-lantern pumpkins, since excessive nitrogen may increase rapid growth and produce a flat side. Except on sandy soils, nitrogen need not be sidedressed. See Illinois Extension Circular 1185, Fertilizer Guide for Commercial Vegetable Growers.

Planting

Pumpkins and squash are direct-seeded after the danger of the last frost has passed, usually from mid-April in southern Illinois to mid-May in northern Illinois. Pumpkins for Halloween should be planted in early June. Rows are 6 to 12 feet apart, depending on the variety grown. Seeds may be drilled with 1 seed every 12 inches or placed in hills of 2 to 4 seeds at 4- to 6-foot intervals. They should be placed no deeper than 1 inch, except in very light-textured soils. Two to 4 pounds of seed will be required to plant an acre, depending on the variety.

Harvest and Handling

Pumpkins and winter squash are harvested when the vines die and the skins of the fruit are hard enough to resist denting from thumbnail pressure. Fruit should not be left in the field when there is a danger of a hard frost. Pumpkins that have begun to turn color may be ripened at room temperature; however, extreme care must be taken when handling them. Breaks in the skin or bruises may provide an entrance for disease organisms.

When harvesting pumpkins and winter squash, cut the fruit from the stem so that a short stub remains. If the stem is pulled off, the pumpkin will decay rapidly and have a shorter storage life.

Some winter squash varieties can be held for several months if they are properly cured. They should be stored at 80° to 85°F and 80 percent relative humidity for 10 days and then transferred and held at 50° to 55°F and 50 to 75 percent relative humidity. The initial
warm temperatures help heal surface wounds but may not be required if the fruit is already hard when picked. Prolonged storage at warm temperatures and high humidity will promote decay.

Acorn squash can be stored for 30 to 50 days, butternut varieties for up to 50 days, and Hubbard varieties for as long as 6 months. Pumpkins can be stored for 2 to 3 months under the proper conditions. Poor prestorage handling may often reduce storage life more than actual storage temperatures.

Weeds

Pumpkins and winter squash are grown in wide-row culture and are planted in warm soil. The use of a herbicide is recommended to maintain the competitive advantage over fast-growing weeds. On sandy soils a herbicide that will not rapidly leach from the soil is preferred. Once established, pumpkin and squash vines cover the soil area and tend to suppress young weed seedlings. The row middles in wide-row culture can be weeded by cultivation or diskng until complete vining has occurred. For specific control recommendations, see Illinois Extension Circular 907, Weed Management Guide for Commercial Vegetable Growers.

Insects

Many of the same pests that appear on cucumbers and melons affect squash and pumpkins. The most serious insect problem is the squash bug, since until recently no chemicals have been available that could control this pest. Today at least one of the synthetic pyrethrins is labeled for winter squash and pumpkins and provides good control. The squash bug sucks plant juices from foliage, causing the plant to wilt and turn brown. Adults overwinter in fencerows, and populations build up during the growing season if they are not controlled.

Squash plants, especially the Hubbard and acorn varieties, are very susceptible to vine borer attack. Eggs are deposited at the base of leaf stems, and the borer larvae tunnel into the stalk or in the leaf stems. Symptoms include frass pushed from the side of the stalk and wilting of plants. The borer larva is a white worm with a brown head and is about 1 inch long when fully grown. Rotating squash plantings with other crops may reduce borer activity, since this insect overwinters as a pupa in the soil beneath old squash plants. Control with insecticides should begin when adult moths are observed flying about the squash plantings. The adult moth has a red body and clear wings.

For specific control recommendations, see Illinois Extension Circular 897, Insect Pest Management Guide for Commercial Vegetable Crops and Greenhouse Vegetables.

Diseases

Although bacterial wilt is not generally as severe a problem on squash or pumpkins as on cucumber or melons, cucumber beetles should be controlled to reduce plant damage from feeding. These insects are discussed under cucumbers and melons.

The major disease problems of pumpkins and squash are black rot (gummy stem blight), powdery mildew, and angular leaf spot. See the chapter on cucumbers for details. These diseases are controlled by rotations with nonvine crops and application of fungicides or bactericides. See Illinois Extension Circular 1184, Disease Management Guide for Commercial Vegetable Growers, for further information.

Sources of Additional Information


Sweet corn is a major processing crop grown in Illinois and is also an important fresh market vegetable. A steady supply of sweet corn from July 1 until the first frost is a must for roadside marketers because sweet corn attracts customers who will then purchase other items. Quality is the key to successful sales. Customers will return for tender, fresh-picked ears that are free of insects. Yields of 750 to 1,500 dozen salable ears per acre should be expected.

Varieties

There are more varieties of sweet corn available to the commercial grower than of any other vegetable crop. Some varieties may be available for only a few years and are then replaced by newer and better ones. Varieties can be divided into several types: early yellow corn, main-season yellow corn, bicolors, high-sugar corn, and white corn.

Early corn varieties generally develop rapidly after seeding and produce a small but marketable ear. Yellow main-season varieties offer excellent quality over a wide range of maturity dates. ‘Gold Cup’ and ‘NK 199’ are high-yielding, main-season varieties with good quality. As specialty corns, the bicolors and white corn sell better than yellow corn in some Illinois markets. The white corn ‘Silver Queen’ is unsurpassed in quality but requires a long growing season. High-sugar (“super sweet”) corns retain sugars better after harvest but may germinate poorly, especially in cold soil. For a complete list of recommended varieties, see Illinois Extension Circular 1174, Vegetable Varieties for Commercial Growers.

Soils and Fertility

Fertile, easily worked soils of good tilth are best for sweet corn production. Although corn requires good soil moisture, standing water caused by poor drainage will injure the crop. Heavy clay soils may produce low yields. Grow early crops on well-drained soils that warm rapidly in the spring.

Apply phosphorus, potassium, and lime (if required) on the basis of soil test results. Early plantings may benefit from a band application of phosphorus. Nitrogen applications should be split between a preplant broadcast application and one or more sidedressings, depending on soil and rainfall. A total of 100 to 130 pounds of nitrogen may be applied, with two-thirds broadcast and one-third sidedressed when the plants are 8 to 10 inches tall. See also Illinois Extension Circular 1185, Fertilizer Guide for Commerical Vegetable Growers.

Planting

Sweet corn is direct-seeded in rows 30 to 36 inches apart or according to planter and cultivator allowances. Seed should be spaced 8 to 12 inches apart in the row and placed no deeper than 2 inches. Shallow planting in the spring may be desirable because corn emerges slowly from cool, wet soil. The first plantings may be 1/2 inch deep, and later plantings may be 1 to 2 inches deep, depending on the soil type. Shallower planting may result in faster emergence if adequate moisture is available. Certain high-sugar varieties may emerge better if planted at 1 inch, especially in cold soils.

Use a closer spacing (18,000 to 20,000 plants per acre) for early corn and a wider spacing (13,000 to 15,000 plants per acre) for later plantings. Individual varieties should be planted in blocks 4 to 8 rows wide to insure pollination.

All white sweet corn varieties and some high-sugar varieties should be isolated from yellow sweet corn by at least 300 feet. White corn pollinated by yellow corn will appear bicolored, and some high-sugar cultivars will taste like field corn if they are not isolated. All sweet corn varieties must be isolated from popcorn and field corn.

Plantings of a single variety 10 days apart will usually result in harvest dates 5 to 7 days apart. Early varieties are normally planted from early April in southern Illinois to late April in northern Illinois. Main-season plantings will extend from May through early July in most parts of Illinois.

Irrigation

In areas where rainfall from April through September exceeds 20 inches, irrigation usually is not required.
However, the period from tasseling through harvest is critical, and moisture stress during this time can lower yields and quality. Either supplemental irrigation or rainfall totaling at least 1 inch per week will be required during this period.

**Harvest and Handling**

The stage at which sweet corn is harvested is critical for good quality. When sweet corn is ready, the juice inside the kernel appears milky and spurts out as you press it with your thumbnail. Kernels of young ears are watery, and those on old ears are tough and doughy. Dry, brown silks and full ears that are firm to the touch also signal maturity.

Sweet corn should be picked daily for local marketing. It is usually picked in the morning and then cooled immediately by being placed in a cooler or by being wet down and put in the shade. When handpicking, grasp the ear near the base and sharply twist it downward while rotating your wrist.

Sweet corn should be used as soon as harvest as possible. Fifty percent of the sweetness will be lost within 12 hours after picking if the corn is kept at room temperature. Sweet corn can be held at 32°F and 90 percent relative humidity for several days, but there will be some loss in quality. High-sugar varieties maintain quality longer and may be preferred for this reason.

**Weeds**

Triazine herbicides can be used safely and effectively in sweet corn; however, some may persist in the soil and injure subsequent vegetable crops. Triazines with shorter soil life can be used, but some varieties may be sensitive to the rates needed for good weed control. It is usually best to combine other preplant-incorporated herbicides or preemergence herbicides with a triazine used at a lower rate. The use of two herbicides causes less soil carryover to sensitive crops and broadens the weed control spectrum.

Postemergence herbicides are available to control weeds such as nutsedge and Canada thistle. Perennial grasses such as quackgrass and johnsongrass can be controlled with herbicides used after the growing season. Weeds that have escaped a herbicide can often be controlled later in the growing season by cultivation.


**Insects**

A number of insects can damage sweet corn, including rootworms, leaf aphids, the fall armyworm, the seed maggot, and flea beetles. However, the two most serious pests are the European corn borer and the corn earworm.

The *first-generation corn borer* is especially troublesome in fresh market corn that has been planted very early; the *second-generation borer* is a problem during silking and ear fill in July, August, and September. Corn borers overwinter in the stalks of corn and the stems of plants such as giant ragweed. In May and June, moths emerge to lay eggs on corn plants in the tallest fields or those that were planted earliest. The new borers feed in the whorls and may bore into the stalk or move down the stalk to bore into the ears. Second-generation borer adults hatch about six weeks later and deposit eggs on the foliage of late-planted fields. The hatching borers enter the ears through the silk channel, the side of the ear, or the ear shank.

Most *corn earworms* migrate into the state each year from the Gulf states. One exception is a strain of earworm located in Madison and St. Clair Counties that successfully overwinters and appears as an adult moth in June when early-planted corn is in the silk stage. Most earworm moths begin to migrate into Illinois in late July or even as late as mid-August, and moderate to high populations are observed from August through early October. They are brownish green, striped worms with brown heads, and they feed on the ear tips.

Corn in silk must be sprayed every 2 to 3 days when earworm moths are present. This spray program, when used from silk emergence until two weeks later, will usually control both earworms and borers. For insecticide recommendations, see Illinois Extension Circular 897, *Insect Pest Management Guide for Commercial Vegetable Crops and Greenhouse Vegetables*.

**Diseases**

Warm winters favor the overwintering of flea beetles, which carry the *Stewart's bacterial wilt* organism to young corn plants. This disease causes pale green to yellow streaks, which may turn brown. The interior pith tissue near the crown decays, and seedlings wilt and die. To control this disease, use resistant varieties or insecticides that control flea beetles while plants are young.

Foliar diseases such as *rust, northern corn leaf blight*, and *southern corn leaf blight* are generally of economic importance only in late plantings. Warm, wet weather or heavy dews favor the development of these diseases. Fungicide controls are generally needed only on mid-season to late plantings. Some disease-resistant varieties are available.

*Maize dwarf mosaic* is another disease that causes losses. The infection causes stunting, and leaves are a mottled chlorotic yellow. Sterility usually occurs near
the base of the cob and can create serious marketing problems. This disease is best controlled by planting resistant or tolerant varieties and by controlling johnsongrass in and near the fields. The virus overwinters in johnsongrass and is carried to the field by aphids. Insecticides are not useful for control.

For more information on corn diseases, see the references listed at the end of this chapter, as well as Illinois Extension Circular 1184, *Disease Management Guide for Commercial Vegetable Growers*.

**Sources of Additional Information**

_Corn Diseases: An Aid to Identification and Control._ Clemson University Cooperative Extension Service, Clemson, SC 29631.

_Corn Insects._ Clemson University Cooperative Extension Service, Clemson, SC 29631.

_Corn Insects: Above Ground._ NHE-120. Department of Agricultural Entomology, University of Illinois, 172 Natural Resources Building, 607 East Peabody Drive, Champaign, IL 61820.


_Sweet Corn: Bird, Insect and Disease Control._ A-2353. University of Wisconsin, Agricultural Bulletin Building, 1535 Observatory Drive, Madison, WI 53706. 15¢.
Fresh, locally grown tomatoes are in demand in markets throughout the year in Illinois. Growers can satisfy part of this demand during their production season. Effective marketing and good quality will allow a grower to sell tomatoes even when garden tomatoes are plentiful. It is also important to make produce easily accessible. Pick-your-own operations in rural areas will not be as successful as a roadside market on a busy country road or a farmers' market in the downtown square.

Although tomatoes are relatively easy to grow in the garden, a profitable commercial operation requires special production and marketing skills. Tomato yields in Illinois should exceed 15,000 pounds (300 bushels) per acre for the main-season crop.

Varieties

Most markets in Illinois require a firm, medium to large fruit (5 to 10 ounces) that has uniform color and is free of cracks or blemishes. A number of varieties are available that will produce high-quality fruit for either the early-market or the main-season crop. The varieties listed in Illinois Extension Circular 1174, *Vegetable Varieties for Commercial Growers*, are among the large number tested in Illinois and found to be acceptable. Most growers have individual preferences. Although it is wise to use a variety that has performed well in the past, new varieties may be planted on a trial basis. Two of the standard varieties grown in Illinois are ‘Pik-Red’ and ‘Jet Star’. Both are suitable for ground or cage culture.

Soils and Fertility

Most soils with good drainage can be used for tomato production. Apply phosphorus and potassium on the basis of soil test results. Nitrogen should be broadcast in the spring and sidedressed once or twice during the season to supply a total of 125 to 150 pounds per acre. Apply 75 to 100 pounds before planting, and sidedress with 25 to 50 pounds per acre after the first fruit have set. A second sidedressing may be applied if the rainfall was heavy during the spring or if the soil is sandy. Tomatoes grown on sandy soils may benefit from a potassium application along with the second nitrogen sidedressing. Early crops or main-season tomatoes grown on heavier soils may not require sidedressings. See Illinois Extension Circular 1185, *Fertilizer Guide for Commercial Vegetable Growers*.

Planting

Although a fall crop of tomatoes may be seeded directly in the field, most growers choose to use transplants for both early and later plantings. Transplants may be purchased or grown at home, but it is usually necessary to grow your own plants if you want to use new or special varieties (see Illinois Extension Circular 884, *Growing Vegetable Transplants*). Direct seeding is often used for processing crops because high populations are preferred for a once-over harvest.

Market growers are encouraged to grow transplants and to use wire cages for support (see Horticulture Facts VC-22-82, *Training Tomato Plants*, available from the Department of Horticulture, University of Illinois, 124 Mumford Hall, 1301 West Gregory Drive, Urbana, IL 61801). Cages are set in the ground at a 2½-foot spacing (center to center) in rows 5 feet apart.

When grown without stakes or cages, tomatoes may be planted closer together within the row. Large-vined, indeterminate types may be direct-seeded or transplanted 24 inches apart in rows 5 to 6 feet apart. Small-vined, determinate types may be planted 12 to 18 inches apart in rows 3 to 5 feet apart. Between-row spacing is usually determined by the cultivation method used and the spray equipment that is available. Transplants will benefit from a starter solution application at planting, especially early in the season when soils are cold.

Tomatoes for the main crop should be transplanted in Illinois after all danger of frost has passed. Plants for an early harvest may be set out earlier. To reduce the risk involved in early planting, you may consider using hot caps or row tunnels. Light, sandy soils with a slightly southern exposure and protection from wind will also help. Black plastic mulch may encourage earliness, and mechanical transplanters are available that will plant through a mulch. Mulches are also helpful in avoiding problems with blossom end rot.
Irrigation

Tomatoes require a constant supply of water throughout the season. The demand may be satisfied by rainfall, but you should consider investing in irrigation as insurance. During dry periods, apply enough water to soak the entire root zone. Drought after planting or during fruit set and development is especially harmful.

Harvest and Handling

Tomatoes for market are handpicked and packed in boxes or baskets. It is better to pack them in shallow boxes than in bushel baskets. Tomatoes for local market may be picked after they begin turning color and are 10 to 30 percent pink or red. If the weather is warm or if the fruit will be held for more than two days, pick the fruit slightly before this stage. Pink fruit are more easily damaged than green fruit. Tomatoes ripen to maximum firmness at 55°F. In hot weather they should be harvested daily before they turn red and soften. It is best to pick them in the early morning while they are still cool.

Weeds

Since direct-seeded tomatoes cannot compete with heavy weed infestations, a preemergence application of an appropriate herbicide is required. Effective herbicides are also available for transplanted tomatoes. Postemergence herbicides can be added to the program to control broadleaf weeds. As an alternative to herbicides where earliness is desired, black polyethylene mulch can be used to control annual weeds, conserve moisture, and increase early spring soil temperatures and yields. For details on tomato herbicides, refer to Circular 907, Weed Management Guide for Commercial Vegetable Growers.

Insects

Few major insects are serious problems on tomatoes because they are easily controlled by safe and effective insecticides. Weekly foliar sprays will prevent leaf feeding by tomato hornworms and cabbage loopers and will also reduce fruit feeding by tomato fruitworms. Watch the undersides of leaves for tiny reddish aphids, which should also be controlled with insecticides. For specific recommendations, see Illinois Extension Circular 897, Insect Pest Management Guide for Commercial Vegetable Crops and Greenhouse Vegetables.

Diseases

Disease problems are very serious on tomatoes, and weekly fungicide applications are usually required. Specific recommendations are given in Illinois Extension Circular 1184, Disease Management Guide for Commercial Vegetable Growers. Early blight, late blight, and Septoria leaf spot are the common foliar diseases that can be prevented by using periodic fungicide applications. Bacterial spot is a foliar disease of tomatoes that causes a small, dark, greasy-looking spot on the leaves and fruit. The disease is more prevalent in wet weather because bacteria are spread by driving rain. You can avoid this disease by rotating crops after 2 or 3 years.

Fruit spots and rots are more serious than bacterial spot because they affect the marketable portion of the plant. Again, weekly sprays will reduce problems caused by anthracnose, bacterial speck, bacterial spot, and buckeye rot. These diseases are generally worse during periods of wet weather. Foliar diseases such as early blight and Septoria leaf spot must be controlled. Mulching, staking, or caging fruit often reduces the incidence of these diseases by limiting fruit contact with the soil. Bacterial diseases can be minimized by using bleach seed soaks.

Two virus diseases of tomatoes are common in Illinois. Symptoms of the tobacco mosaic virus are mottled foliage and curling and slightly malformed leaflets. Often the plants are stunted and have poor yields and misshapen fruit. The virus may be spread by using tobacco products while working with tomato plants. Damage is most severe when young plants are infected. The cucumber mosaic virus is usually spread by aphid feeding. Infected plants appear stunted, and leaves are typically very narrow, exhibiting the “shoestring” symptom. You can reduce the spread of this disease by controlling aphids.

There are also several important physiological (nonpathogenic) disorders of tomatoes. Blossom end rot, caused by insufficient calcium when fruit are forming, is characterized by a large, dry, brown to black, often depressed, leathery area at the blossom end of the fruit. Calcium deficiency can result from excessive nitrogen fertilization, rapid plant growth, and drastic fluctuations in moisture caused by heavy rainfall, drought, and root pruning during cultivation. Mulching helps reduce the incidence of this disorder.

Catfacing, another nonpathogenic disorder, is caused by several factors that seriously disturb initial fruit development during blossoming. Symptoms are extreme malformation and scarring, frequently at the blossom end. Two specific factors that may cause catfacing are cool weather during fruit set and injury from 2,4-D herbicide.

Sunscald, yet another nonpathogenic disorder, is caused by sudden exposure of fruit to direct sunlight, particularly during hot, dry weather. Leaf blights and
loss of foliage during picking often provide conditions favorable for this injury. Sunscald is most prevalent on green fruit and appears as a whitish or yellowish patch on the side of the fruit that is toward the sun. When sunscald is severe, the affected area shrinks and forms a large, flattened, grayish white spot with a papery surface.

Sources of Additional Information

Common Diseases of Tomatoes. Cooperative Extension Service, Oklahoma State University, Stillwater, OK 74074.

Part I. Diseases Caused by Fungi (No. 7625)

Part II. Diseases Caused by Bacteria, Viruses and Nematodes (No. 7626)

Part III. Diseases Not Caused by Plant Pathogens (No. 7627)

Sources of General Information and Materials

University Publications


*Estimated Costs and Returns for Production of Various Crops and Livestock in Kentucky.* Agricultural Economics Extension Series No. 16. Department of Agricultural Economics, University of Kentucky, Lexington, KY 40506.


*Getting Started in Farming.* North Central Regional Extension Publication 81. Extension Information, University of Missouri, Columbia, MO 65211.

*Getting Started in Farming: Mostly on Your Own.* North Central Regional Extension Publication 82.

*Getting Started in Farming: Part-Time or Small Farms.* North Central Regional Extension Publication 83.

*Getting Started in Farming: Via the Home Farm.* North Central Regional Extension Publication 84.

*Getting Started in Farming: So You Have Inherited a Farm.* North Central Regional Extension Publication 85.


*Part-Time Vegetable Farming.* Publication No. 120. University of Massachusetts, Amherst, MA 01002.

*Proceedings of the Illinois Vegetable Growers Schools.* Department of Horticulture, University of Illinois, 124 Mumford Hall, 1301 West Gregory Drive, Urbana, IL 61801. Annual, $5.00 each.

*Publications About Vegetable Crop Production.* Horticulture Facts VC-12-80, Department of Horticulture, University of Illinois, 124 Mumford Hall, 1301 West Gregory Drive, Urbana, IL 61801.

*Publications from the College of Agriculture, University of Illinois at Urbana-Champaign.* Agricultural Publications, 47 Mumford Hall, 1301 West Gregory Drive, Urbana, IL 61801. Lists Extension circulars, *Illinois Research* reprints, county Extension addresses, research bulletins, and county soil reports.


Periodicals

*Ameri can Vegetable Grower.* Available at $10 per year from Meister Publishing Company, 37841 Euclid Avenue, Willoughby, OH 44094. The July issue is a valuable buyers’ guide that is free to members of the Illinois Vegetable Growers Association.

*The Great Lakes Vegetable Growers News.* Monthly. For information, write GLVGN, Inc., P.O. Box 128, Sparta, MI 49345.

*Illinois Vegetable Farmers Letter.* Available free of charge from John M. Gerber, University of Illinois, 208 Vegetable Crops Building, 1103 West Dorner Drive, Urbana, IL 61801.

*The Packer: The National Weekly Business Newspaper of the Fruit and Vegetable Industry.* Available at $35 per year from 7950 College Boulevard, P.O. Box 2939, Shawnee Mission, KS 66201.

Books


Organizations

Illinois Vegetable Growers Association. For information and the newsletter, contact Mr. Henry Boi, 17510 Garden Valley Road, Woodstock, IL 60098.

Cook County Truck Gardeners and Farmers Association. For information, contact Mr. Jerry Vos, 16301 South Surrey Drive, Tinley Park, IL 60477.

Madison, St. Clair, Monroe County Vegetable Growers.
For information, contact Don Willaredt, Route 3, Box 840, Collinsville, IL 62234.

Meetings
State and regional vegetable schools and summer field days are announced in the Illinois Vegetable Farmers Letter (see Periodicals). The annual Illinois Fruit and Vegetable Growers Convention and Trade Show is held in January each year.

Extension Specialists
The following individuals are available to answer questions:

Direct marketing and culture: J.W (Bill) Courter, Dixon Springs Agricultural Center, Simpson, IL 62985, 618/695-2441.

General culture: C. Chris Doll, 132 North Kansas, Box 645, Edwardsville, IL 62025, 618/656-9227.

Fertility, varieties, and culture: John M. Gerber, University of Illinois, 208 Vegetable Crops Building, 1103 West Dorner Drive, Urbana, IL 61801, 217/333-1969.

Disease problems: Barry J. Jacobsen, University of Illinois, N-533 Turner Hall, 1102 South Goodwin Avenue, Urbana, IL 61801, 217/333-1969.

Weed control and culture: Extension weed specialist, University of Illinois, 206C Vegetable Crops Building, 1103 West Dorner Drive, Urbana, IL 61801, 217/333-1845.

Insect problems: Roscoe Randell, University of Illinois, 165 Natural Resources Building, 607 East Peabody Drive, Champaign, IL 61801, 217/333-6650.

University Vegetable Research Farms
Vegetable Research Farm, Urbana, IL.

Dixon Springs Agricultural Center, Simpson, IL.

Kankakee River Valley Vegetable Research Field, Wichert, IL.

St. Charles Horticultural Research Center, St. Charles, IL.

Field meetings are held periodically at each of these locations. Watch the Illinois Vegetable Farmers Letter (see Periodicals) for more information. You are welcome to visit at any time, but call ahead if you would like to speak with a specialist.

Information on Legal and Legislative Matters
Unemployment compensation, child labor laws, minimum wage, maximum hours: Illinois Department of Labor, 910 South Michigan Avenue, 19th Floor, Chicago, IL 60605.

Sales taxes: Illinois Department of Revenue (your local office) or call 800/785-4265.

Health and safety regulations, occupational injuries and diseases: Illinois Industrial Commission, 160 North LaSalle Street, Chicago, IL 60601.

Social security, income taxes: Internal Revenue Service (your local office).

Product liability, labeling standards: Illinois Department of Health, Division of Food and Drugs, 535 West Jefferson Street, Room 350, Springfield, IL 62700.

Grading and inspection, weights and measures, marketing and advertising, directories of produce sellers: Illinois Department of Agriculture, Emmerson Building, Illinois State Fairgrounds, Springfield, IL 27000.

Information on Product Pricing
Fruit and Vegetable Terminal Market Report, Unit 97 — Produce Row, Room 203, St. Louis, MO 63100, 314/425-4520.

Fruit and Vegetable Terminal Market Report, U.S. Custom House, Room 1060, 610 South Canal Street, Chicago, IL 60600, 312/363-0111.

Seeds
See Horticulture Facts VC-10-80, Sources of Vegetable Seeds, available from University of Illinois, 101 Vegetable Crops Building, 1103 West Dorner Drive, Urbana, IL 61801.

Plants
Bonnie Plant Farms, Union Springs, AL 36089, 205/738-3104.

Brown’s Omaha Plant Farms, P.O. Box 787, Omaha, TX 75571.

Brownlee Plant Company, Tifton, GA 31794, 912/382-7098.

Bryan & Sons, Tifton, GA 31794, 912/382-3762.

Dixie Plant Farms, Inc., Tifton, GA 31794, 912/382-9390.
H. C. Dodson Farms, Tifton, GA 31794, 912/382-3872.
Durrence Plant Company, Claxton, GA 30417, 912/739-4849.
Four Way Plant Farms, Union Springs, AL 36089, 205/738-4949.
Fulwood Farms, Tifton, GA 31794, 912/382-6090.
Fly Farms, Milan, TN 38358, 901/686-0246.
Irrigated Plant Farms, Thorndale, TX 76577.
Lewis Taylor Farms, Route 1, Tifton, GA 31794, 912/382-4454.
Mobley Plant Company, Moultrie, GA 31768, 912/985-5544.
Mullins Plant Farm, 410 Brookfield Avenue, Chattanooga, TN 37411.
Plants of Ruskin, Inc., P.O. Box 994, Ruskin, FL 33570, 813/645-2528.
Pond-O-Gold, Omega, GA 31775, 912/528-6767.
Ponder Plant Company, Omega, GA 31775, 912/528-4261.
Service Plant Company, Omega, GA 31775.
Shaw Plant Farm, P.O. Box 1009, Immokalee, FL 33934.
Speedling, Inc., P.O. Box 98, Sun City, FL 33586.
Steele Plant Company, Gleason, TN 38229.
Texas Plant Farms, Jacksonville, TX 75766.
Thornhill Plant Company, Tifton, GA 31794, 912/382-1474.
Tifton Plant Company, Sylvester, GA 31791, 912/776-4876.
Ralph Veazey, Tifton, GA 31794, 912/382-6443.

**Irrigation Equipment**

Alton Irrigation Company, 8096 Luther Road, Rock Falls, IL 61071, 815/438-2730.
Amko Agri-Products/Rain Control, Inc., 123 West Main, Hudson, MI 49247, 517/448-3651.
Century Rain Aid Supply, 341 Lively Boulevard, Elk Grove Village, IL 60007.
Chapin Watermatics, 368 North Colorado Avenue, Watertown, NY 13601.
Eckmann Irrigation and Equipment, 3600 Fairmont Avenue, Collinsville, IL 62234, 618/344-4134.
Indiana Irrigation Company, Box 20, Onward, IN 46967, 219/626-2541.
Williamstown Irrigation, Inc., Williamstown, NY 13493, 315/964-2214.

**Tillage Equipment and Bedders**

Ahrens Nursery, R.R. 1, Huntington, IN 47542, 812/683-3055.
A.M.T.I., 1015A South San Gabriel Boulevard, San Gabriel, CA 91776, 213/285-7287.
Befco, Inc., P.O. Box 6036, Rocky Mount, NC 27801, 919/977-9920.
George F. Ackerman Company, P.O. Box 157, 3000 Mill Street, Curtice, OH 43412, 419/836-7735.
Guy Farm Equipment Company, Inc., 15219 Highway 14, P.O. Box 5, Woodstock, IL 60098, 815/338-0600.
Howard Rotavator Company, Inc., 102 Howard Avenue, P.O. Box 7, Muscoda, WI 53573, 608/739-3106.
Kennco Manufacturing, Inc., P.O. Box 1158, Ruskin, FL 33570, 813/645-2591.
Larchmont Engineering & Irrigation, Inc., 11 Larchmont Lane, Lexington, MA, 02173, 617/862-2550.
Lely Corporation, Box 1060, Wilson, NC 27893, 919/261-7050.
**Sources**

**Seeding Equipment**

Bob Dickey Sales, Auburn, IL 62615, 217/438-6135 (Heath Planter).

Cnockaert Farming Enterprises, Inc., St. Thomas, R.R. 7, Ontario, N5P 3T2 (Webb Precision Seeder).

Cole Manufacturing Company, Box 9216, Charlotte, NC 28299 (Planet Jr. Seed Drill).

Earthway Products, Inc., P.O. Box 547, Bristol, IN 46507 (garden planters).

George F. Ackerman Company, P.O. Box 157, 300 Mill Street, Curtice, OH 43412, 419/836-7735.


Laporte — U.S., 411 Hackensack Avenue, Hackensack, NY 07601 (fluid drill).

Triangle M Tractors, Old 41 North, Morocco, IN 47963, 219/285-2377 (Mahan System Planter, Stanhay Precision Seed Drill).

Winslow Pacific Company, 6100 Avenida Encinas, Carlsbed, CA 92008 (Centra-Flo Precision Planter).

**Transplanting Equipment**

Ellis Manufacturing Company, P.O. Box 246, Verona, WI 53593.

Holland Transplanter Company, 510 E. 16th Street, Holland, MI 49423.

Mechanical Transplanter Company, Box 1008B, Holland, MI 49423.

Powell Manufacturing Company, P.O. Drawer 707, Bennettsville, SC 29512.

Speedling Manufacturing Company, P.O. Box 283, Sun City, FL 33586.

**Containers and Packaging**

Aargus Poly Bag Company, 1415 Redeker Road, Des Plaines, IL 60016, 312/356-3341.

Agri-Pack Division, Liberty Carton Company, 870 Louisiana Avenue, Minneapolis, MN 55426, 612/540-9615.

Allied Fastener Corporation, 133 North 25th Avenue, Melrose Park, IL 60521, 312/345-0063.

Alton Packaging Corporation, 401 Alton Street, Alton, IL 62002, 618/466-6552.

Anderson Box Company, Park Fletcher Station, P.O. Box 41264, Indianapolis, IN 46241, 317/248-8086.

Cordage Packaging, 8112 West Thomas Street, Apt. 3, Justice, IL 60458, 312/496-3152.

International Paper Company, 635 Northwest Avenue, Northlake, IL 60164, 312/562-6900.

Package Research Laboratory, 2406 Shooting Park Road, Peru, IL 61354, 815/223-7700.

Packaging Corporation of America, 1603 Orrington, Evanston, IL 60204, 312/492-6956.

**Specialized Sprayer Equipment**

Ag Tec Crop Sprayer, 4900 Viking Drive, Minneapolis, MN 55435.

Agrotec, Inc., Box 215, Salisbury, MD 21801.

Broyhill Company, North Market Square, Dakota City, NB 68731.

Electro-Spray Manufacturing, Inc., 6500 N.W. 42nd Street, Lincoln, NE 68524, 402/470-2685.

Grower Equipment and Supply Company, Route 1, Box 7, Grayslake, IL 60030.

Lee Blacksmith, Inc., Route 51 South, Box 27, Rochelle, IL 61068.

Reeser Rope-Wicks, Route 1, Box 79, Weldon, IL 61882, 217/736-2271.

William Moran Orchard Equipment, Route 2, Toledo, IL 62468.

**General Suppliers**

In addition to the sources indicated below, you may also contact your FS dealer and other local fertilizer dealers. Many distributors and major manufacturers of specialized equipment display at the Illinois Fruit and Vegetable Growers Convention and Trade Show, which is held each year in January.

The July issue of the *American Vegetable Grower* is a valuable buyers' guide and lists major supply companies and manufacturers. Also check the classified section of *American Vegetable Grower* (periodical), *The Great Lakes Vegetable Growers News* (periodical), and your local paper for used equipment.

ADI Distributors, Inc., P.O. Box 643, 430 West Carmel Drive, Carmel, IN 46032, 317/844-8221.

Ahrens Strawberry Nursery, R.R. 1, Huntingburg, IN 47542, 811/683-3055.

Ball Seed Company, Box 335, West Chicago, IL 60185, 312/231-3500.
P.A. Bonvallet's Sons, Inc., R.R. 3, Box 481, St. Anne, IL 60964, 815/427-8222.

Carlin Sales Corporation, 8964 North 51st Street, Milwaukee, WI 53223, 414/355-2300.

Ceramo Company, Inc., P.O. Box 384, Jackson, MO 63755, 314/243-3138.

The DAO Corporation, P.O. Box 659, Terre Haute, IN 47808, 812/466-4242.

Florists Products, Inc., 2242 North Palmer Drive, Schaumberg, IL 60095, 312/885-2242.

Grower Equipment and Supply Company, Rt. 1, Grayslake, IL 60030, 312/223-3100.

A.H. Hummert, 2746 Chouteau Avenue, St. Louis, MO 63103, 800/325-3055.

Illinois Fruit Growers Exchange, P.O. Box 438, Cobden, IL 62920, 618/893-2194.

K.P.R. Sales, Inc., P.O. Box 163, LaCrosse, IN 46348, 312-331-1606.


Mellingers, 2310 West South Range Road, North Lima, OH 44452, 216/549-9861.

Michigan Orchard Supply Company, P.O. Box 321, South Haven, MI 49090, 616/637-1111.

Nasco, 901 Janesville Avenue, Fort Atkinson, WI 53538, 414/563-2446.

Paarlberg Chemicals, 1840 East 172nd Street, South Holland, IL 60473, 312/474-3086.

Martin Rispens & Sons, P.O. Box 5, 3332 Ridge Road, Lansing, IL 60438, 312/477-0241.

R.H. Shumway, 628 Cedar Street, P.O. Box 777, Rockford, IL 61105, 800/528-6050 (Extension 517).

Stuppy, P.O. Box 12456, North Kansas City, MO 64116, 800/821-2132.