Vegetable Gardening

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Learning Objectives

1. Be able to successfully prepare a site for a vegetable garden.
2. Understand the techniques used to establish a vegetable garden.
3. Be able to successfully extend the vegetable season through modified gardening techniques.
Vegetable Gardening

Vegetable gardening is the best of all possible worlds. You can have a beautiful garden that is an asset to your landscape, enjoy the out-of-doors and a relaxing hobby, while saving money and exerting some control over the quality of your food. A variety of fresh, nutritious produce for your family, treated with a minimum of pesticides and fertilizers, can be practically at your doorstep. A vegetable garden takes a little work, but there are abundant rewards.

Planning

The key to any good garden is Planning. It will affect your results and even your ability to care for the garden properly. The garden should be planted, maintained and harvested in your head, before you ever lift a spade of soil.

Choose a Garden Location.

- It should get at least 6 hours of direct sunlight. Note shading patterns that will occur throughout the day.

- Avoid planting near trees. They not only shade the crops, but will compete for water and nutrients.

- The soil should be well-drained. Trenching can help if your soil is heavy, but cannot overcome serious flooding.

- If the area is not level, use contour rows or terraces to avoid erosion.

- Avoid windy locations.

- Make sure a source of water is readily available.

Start Small

Put stakes at the corners of your garden area and then run string between them to help you visualize the size of the area. Ask yourself honestly--will I be able to maintain it?

What Are Your Family’s Likes and Dislikes?

If everyone hates eggplant but you, plant only a few plants. The "cardinal sin" of vegetable gardening is to let something go to waste.
**Draw a Picture**

Draw a picture to scale if you can. Write in what will replace early crops after they are harvested. Use the "Planting Chart for Vegetables" to figure out when to plant and how much space plants will need to grow well.

- Put perennial crops like asparagus and rhubarb together along one side of the garden so you will not accidently dig them up when you till the garden.

- Plan to make the most of your space. Plant early crops together, so that later fall crops can be planted in these areas after the spring crops mature.

- Increase the planting sizes to allow for canning, freezing or storage.

- Many crops can be planted at intervals over an extended period to be harvested throughout the season. Plant sweet corn every two weeks for continuous harvest.

- Plant small plants such as lettuce in beds, to get more for your space.

- Use recommended varieties for the bulk of the garden for best results, but also try something new. You may discover something wonderful and it's part of the adventure. All-American Selections or Seed Savers offer new widely-adapted varieties or heirloom open-pollinated varieties respectively.

**Order Seeds Early.**

Will you be growing your own transplants? Cabbage can be started indoors in February.

Choosing and purchasing vegetable seeds is an enjoyable gardening pastime for many. Thumbing through colorful catalogs and dreaming of the season's harvest is one way to make the winter seem shorter. Seed purchased from a dependable seed company will provide a good start toward realizing that vision of bounty. Keep a notebook about the seeds you purchase--make notes about their germination, the vigor of plants, tendencies toward insects and disease, etc. From this information you can determine whether the seed company is meeting your needs, and whether the varieties you have chosen are suitable for your area or gardening style. For example, if powdery mildew is a big problem on squash family plants in your area, the next year you may want to look for mildew-resistant varieties.

**Saving Seed**

If you want to save your own seed, keep in mind:
• Do not save seed from hybrid varieties. They will not be the same as the parent plants. Only open-pollinated varieties should be used for home seed production. Some seed dealers have responded to the increasing interest in seed-saving by clearly marking open-pollinated varieties in their catalogs.

• There is the possibility of carrying seed-borne diseases into the next year’s crop. Many commercially grown seeds are grown in dry areas unsuitable to fungal, viral and bacterial diseases that may be present in your region. Take care to control diseases that can be carried in seed.

• Another weather-related factor is the speed of seed drying. Frequent rains and/or high humidity can cause seeds to rot.

• If you’ve ever saved squash seed during a season in which you had more than one type of squash planted, you have probably seen the weird results of cross-pollination! Saving seeds from cross-pollinated crops is not generally recommended for the novice because of problems with selection, requirements for hand pollination and isolation, biennial habits, and genetic variability.

Some common self-pollinated annual plants from which seed may be saved include lettuce, beans, herbs, and tomatoes. Tips on saving these seeds include:

• Saving bean seed: Allow seed pods to turn brown on the plant. Harvest the whole pods, dry for 1-2 weeks, shell, and then store in a cool (below 50°F), dry environment in a paper bag.

• Saving lettuce seed: Cut off seed stalks when fluffy in appearance, just before all the seeds are completely dried. Seeds will fall off the stalk, and be lost if allowed to mature on the plant. Dry the harvested seed stalk further, shake seeds off, and then store in a cool, dry environment in an envelope or small glass jar.

• Saving herb seeds: Herbs vary in the way their seeds are produced. In general, allow herb seeds to dry on the plants until they are almost completely dry. Some seed heads, such as dill, will shatter and drop their seeds as soon as they are dry. Watch the early-ripening seeds; if they tend to fall off, harvest the other seed heads before they get to that point, leaving several inches of stem attached. Hang several stems upside down, covered with a paper bag to catch falling seed, in a warm, dry place until the drying is complete. Remove seeds from the seed heads and store in envelopes or small glass jars. Some herb seeds--dill, celery, anise, cumin, and others--are used for flavoring and are ready to use once dry.

• Saving tomato seeds: Pick fruit from desirable plants when ripe. Cut fruit and squeeze out the pulp into a container. Add a little water, then let the seeds ferment 2-
4 days at room temperature, stirring occasionally, when seeds settle out, pour off pulp and spread the seeds thinly to dry thoroughly. Store in an envelope or glass jar in a cool dry place.

For all kinds of saved seeds, be sure to mark the storage containers clearly with permanent ink, indicating the variety and date saved. Store in a glass jar with a tight lid in the bottom of the refrigerator. Put a small packet of powdered milk wrapped in a paper towel in a jar with the seed to act as a desiccant. Seeds should remain viable until next spring.

To test seed germination, roll seeds between moist paper towels and check frequently for signs of sprouting. Keep moist. If germination is low, either discard the seed or plant enough extra seeds to give the desired number of plants. Most seeds remain viable for several years (Table 1).

**Get Your Tools Together**

You will need minimum:

- shovel and/or tiller
- garden rake
- sprayer
- hoe
- trowel
- bucket and/or hose

When you purchase tools, buy for quality rather than quantity. Your tools will be in frequent use throughout the garden season. Cheap tools tend to break or dull easily and may end up making a job unnecessarily difficult and frustrating. Quality tools will last if well-kept. Tools should be lightweight for easy handling, but heavy enough to do the job properly. Metal parts should be of steel, which will stay sharp and keep their shape.

Keeping a tool clean and in good condition will increase its usefulness and lengthen its life. Learn the techniques for sharpening tools and practice them frequently. Professional gardeners often carry sharpening stone or files while working and sharpen tools as needed. Clean your tools after each use. Keep a small, deep box in your tool shed. Fill the box with sand and add used motor oil. At the end of the gardening day, remove clinging dirt from tools by sinking them into the oily sand several times. This will keep the tools cleaned and oiled, and will help prevent rusting. Keep tools in a dry place to prevent corrosion.

**Soil Testing and Amendments**

**Take a Soil Test.**

pH kits are available from your local Cooperative Extension Service Office. Complete soil
analysis from laboratory tests are superior to home tests in that you receive recommendations for fertilizer and lime based on accurate test results. Check soil pH by having your soil tested at least once every three years.

For best results follow instructions carefully for taking the test. If you take the soil from one hole, we can tell you how much fertilizer and lime to put in that hole but not in the whole garden. Take soil from 10-20 places in the garden. Be sure to get soil from the surface to 8 inches in depth. Mix all the samples together and take out about two cups. This gives you an average of what the soil in the whole garden is like. If there are any very low or unusual areas—take a separate sample. Air dry the soil before sending it to the lab. Do not keep it wet in a tightly sealed plastic bag and do not heat it as this could change the chemistry.

**pH**

Soil pH measures the degree of acidity or alkalinity of the soil. Vegetables vary to some extent in their requirements, but most garden crops will do well with a soil pH of 6.2-6.8. This is a little below neutral or slightly acid. If acid pH is too high or low, crops will suffer due to the effects of pH on the availability of nutrients to plants.

Ground limestone adds calcium as it raises pH. Dolomitic limestone adds calcium and magnesium as it increases pH. Hydrated and burnt limestone at lower rates have also been used as soil amendments, but they are not generally recommended.

Wood ashes are sometimes used as a soil amendment. They contain potash (potassium), phosphate, boron, and other elements. Wood ashes can be used to raise soil pH with twice as much ash applied as limestone for the same effect. Ashes should not come into contact with germinating seedlings or plant roots as they may cause root burn. Spread the ashes in a thin layer over the soil and incorporate them into the soil; check pH yearly if you use wood ashes. Never use coal ashes or large amounts of wood ash (no more than 20 lbs. per 1000 square feet), as toxicity problems may occur.

**Fertility**

On many New York soils, the yield and quality of vegetables will be improved by the use of commercial fertilizer, even if you make generous applications of manure or other organic matter. Organic materials contain comparatively small amounts of nutrients. If you wish to fertilize your garden organically, it will take special care and preparation. Organic materials are very variable in their nutrient content, so soil testing should be done every year to ensure adequate levels. Most organic materials must degrade before they release nutrients and will do so at different rates depending on conditions. This slow release may be an advantage in some cases and it must be taken into consideration to be sure that plants have adequate supplies of nutrients when they need them.

Commercial fertilizers are usually made up of materials containing nitrogen, phosphorus and
potassium. Common analyses for home gardens would be 5-10-10, 10-10-10, and 10-6-4. The first number in the analysis refers to the percentage of available nitrogen, the second, phosphorus expressed as \( P_2O_5 \) and the third to potassium expressed as \( K_2O \). As a general guide, most vegetables will need about 30-40 pounds per 1000 square feet of fertilizer containing 5% nitrogen or 15-20 pounds per 1000 square feet of fertilizer containing 10% nitrogen. Apply 2/3 of the fertilizer to the soil and till in. Use the remainder for a banded application at planting or as sidedressing after planting. All fertilizer should be cultivated in lightly.

Get Your Materials Together.

Find source for:

- fertilizer
- mulch
- Limestone
- pesticides
- organic materials

Soil Preparation

Good soil preparation is the most labor-intensive part of vegetable gardening, but it is very important as it lays the groundwork for the rest of the season.

- In new garden spots, unless you are using a very powerful tiller, remove sod with a spade and put it in a compost pile to decay. Or, if you are planning ahead, spray the future garden site with glyphosate the fall before you want to plant. Then till the dead sod.

- Plow, spade, or rotary till the soil to a depth of about 6-8 inches.

- Working the soil in fall has several advantages over the traditional spring plowing. It allows for earlier spring planting, since the basic soil preparation is already done when spring arrives. Turning under large amounts of organic matter is likely to result in better decomposition when done in the fall, since autumn temperatures are higher than those of early spring, and there is more time for the process to take place. Insects, disease organisms and perennial weeds may be reduced by killing or inactivating them through burial or exposure to harsh winter weather. The physical condition of heavy clay soils may be improved by the alternate freezing and thawing, which breaks up tightly aggregated particles. Also, snow is trapped between the hills of roughly plowed soil, so more moisture is retained than on flat, bare ground. Incorporation of limestone in the fall gives it time to break down and begin doing its job by spring. Areas that are subject to erosion should be covered by mulch or a cover crop if fall plowed.

- Work the soil only when the soil moisture conditions are right. To test, pick up a handful of soil and squeeze it. If it stays in a mud-ball it is too wet. If it crumbles
freely it should be about right. Soil that is too dry is powdery and clumpy and may be difficult to work. Working excessively wet soils can destroy the soil structure, which may take years to rebuild. It may also encourage the formation of a compaction layer just below the tilled layer.

- Add large amounts of organic materials, such as compost, manure, leaf mold, sawdust (or even peat moss—but it’s expensive)—at least 2-3 cubic yards per 1,000 square feet. In heavy fill soils, that are often subsoil, more is better, as you are attempting to rebuild the top soil. Addition of organic materials can markedly improve a soil in even a few years.

Purchasing top soil is risky as it may not be any better than what you have, even if it is dark in color, or worse yet, contaminated with heavy metals or high in soluble salts. It is usually better to use organics from known sources.

Animal manures are commonly used directly as a garden soil amendment. Fresh horse, sheep, rabbit, and poultry manures are quite high in nitrogen and may even burn plants if applied directly to a growing garden. They are best applied in the fall and tilled under. Unfortunately, manures also may be a source of weed seeds, especially if they contain straw bedding material.

Organic materials are decomposed in the soil by microorganisms. Various factors such as moisture, temperature, and nitrogen availability determine the rate of decomposition. Adequate water must be present, and warm temperatures will increase the rate at which the microbes work. The proper balance of carbon and nitrogen in the material is needed to insure adequate nutrient availability both to growing plants and decomposing organisms. **Adding nitrogen (usually as additional fertilizer) may be necessary** if large amounts of undecomposed leaves, straw, sawdust or other high-carbon substances are used. Nitrogen is used by the decayers to make proteins for their own bodies, and if it is not present in sufficient amounts, the microbes will take nitrogen before the plants can use it resulting in nitrogen deficiencies. Generally, fresh green wastes, such as grass clippings, are higher in nitrogen than dry material.

Another source of inexpensive soil improvement that should not be underestimated is a cover crop. A tiller is usually required to use this method. Green manures, or cover crops, such as annual rye, ryegrass, and oats are planted in the garden in the fall for incorporation in the spring. For best results, seed should be sown a month before the first killing frost. In a fall garden, plant cover crops between the rows and in any cleared areas. Cover cropping provides additional organic matter, holds nutrients that might have been lost over the winter, and helps reduce erosion and loss of topsoil.
Legume cover crops can increase the amount of nitrogen in the soil and reduce fertilizer needs but need to be planted earlier in the fall. A deep-rooted cover crop allowed to grow for a season in problem soil can help break up a hardpan and greatly improve tilth. Incorporate green manures at least two weeks before planting vegetables. They should not be allowed to go to seed.

- Add fertilizer and limestone according to soil test results.
- Just prior to planting, break up large clods of soil and rake the planting beds level. Do not rake the entire garden smooth. Rake clods and pebbles into the path areas to help inhibit weed germination.

Growing Your Own Transplants

Get a head start on the growing season and a larger harvest by planting some vegetables as transplants. Transplants are easy to grow, but you must provide the right conditions and care. Find a place where the plants will get:

- Bright sunlight or a source of 14-16 hours of artificial light. Two 40 watt cool white fluorescent tubes placed no more than 12 inches above the plants can be used. More homegrown seedlings are probably lost to low light than to any other factor. Vegetable seedlings grown under low-light conditions will most likely be leggy and weak, and many will fall over under their own weight after they are 3-4" tall. If you do not have a sunny room or back porch with a southern exposure, you will probably need supplemental lights.

- Provide a growing temperature between 65-70°F. Plants grown within these temperatures will be more stocky and robust than plants grown in higher temperatures and will be further along compared to plants grown under cooler conditions.

- Adequate water is important to ensure rapid, healthy plant growth.

To grow transplants successfully at home, you will need these supplies:

- "Sterile" potting soil or seed starting medium. It is probably easiest to use a soilless or peat-lite mix to start seedlings, since garden soil has disease organisms which can kill small plants. You can sterilize soil by baking it at 200°F in the oven until the interenal soil temperatures is 180°F. It should be held at that temperature (180°F) for 30 minutes. This is a smelly process and hardly worth the trouble since you can purchase sterile media cheaply at most garden centers. You can make your own peat-like mix by mixing 50% vermiculite or perlite with 50% fine sphagnum peat moss.

- Fresh seed.
Clean pots, flats or other containers with adequate drainage.

A cover sheet of plastic, paper or cloth.

Water soluble fertilizer.

It takes 6-8 weeks to produce a good transplant from seed. The exceptions to this rule are cucumbers, melon and squash, that should be no older than three weeks when transplanted to reduce seedling shock. (Table 2)

Fill clean containers with moist, sterile potting medium. Remove any large chunks.

Sow seeds thinly- 2 or 3 per pot, or sow seeds in a flat. After seedlings have germinated they can either be thinned or moved into additional containers after they develop their first leaves.

Cover lightly with a thin layer of soil mix.

Water well, with a fine spray.

Cover the containers with the sheet of plastic, paper or cloth to hold in moisture.

Put in a warm place, out of drafts.

Check under the cover every day and remove it as soon as the first seedling comes up. Then place the containers in bright light.

Keep the seedlings watered. Allow the top of the soil mix to dry out slightly between waterings to help prevent "damping-off", a fungal disease that rots off small seedlings at ground level.

When the seedlings develop their first "true" leaves that look like normal leaves for the plant, they should be fertilized. (These are actually the second set of leaves to develop, but the first are "seed" leaves or cotyledons.) Follow the fertilizer label directions for seedlings or use one-half the amount of fertilizer recommended for mature plants. Repeat every three weeks.

There is only enough room in a 2-3 inch container for one plant to grow. If there is more than one plant in each pot you must choose the strongest and pinch off or transplant the others.

Soon your plants will be 5-6 inches tall, with strong stems, a healthy green color and 5-6 leaves- almost ready for garden planting. (If you purchase transplants, this is the best size to buy. They will suffer less from transplant shock and will begin to grow rapidly. They
should be young plants, and not so hardened that they are woody and yellow.)

If you move cool weather crop transplants like cabbage from your warm home into an April garden they will probably die. You must first "harden" them to the tough conditions out-of-doors.

Start the "hardening off" process 7-10 days before planting in the garden. Put the plants outside on sunny days in a protected place. Bring them in at night for the first week and when frost is expected. Withhold water so that plants will be less succulent and water them only when they begin to wilt slightly.

Now the transplants are ready to go into the garden.

**Planting**

**Planting Transplants**

Try to choose a time for planting that is:

- On or after the safe planting date.
- Overcast.
- Calm, not windy.
- Late in the afternoon.

You will need:

- The garden soil properly prepared.
- A trowel.
- Starter solution- you can purchase special water soluble starter fertilizer.

To plant:

- Dig a hole slightly larger than the transplant pot or root ball.
- Fill it with water. Let it drain.
- Tip the transplant out of the pot or cell tray and gently pull apart the root system a little bit (except cucumbers, melons and squash - their roots should not be disturbed
as they are very susceptible to transplant shock) or, tear the top edge and bottom from peat pots.

- Place the transplant in the hole slightly deeper than it was in the pot. (Tomatoes can be planted deeply up to their first leaves as they will produce roots from their stems. Melons should be planted to their cotyledon leaves.) Other types of transplants may rot if planted too deeply.

- Fill soil in around the roots and firm gently.

- Water with at least 1 cup of starter fertilizer solution to moisten and settle the soil around the roots.

- Put a little soil over the wet area to hold in moisture.

**Planting Seed**

Some vegetable seeds may be sown directly in the garden.

Straight rows and beds make the garden appear much more attractive and makes cultivation easier and more efficient. Make straight rows by tying a string tightly between stakes at each end of the row.

Plant most seeds shallowly. Seeds planted too deeply may not be able to germinate or emerge properly. Seeds such as lettuce which require light for germination and very tiny seeds like collards should not be covered more than 1/4 inch. For rows, make a shallow trench at the proper depth for planting with a hoe. Sow the seeds thinly and uniformly by shaking them out of the seed envelope or dropping them with the fingers. It may help to mix very small seed with coarse sand to distribute the seeds more evenly. Cover the seeds carefully using the corner of the hoe. Seedlings can emerge quite easily from a sandy or organic soil. However, if your garden soil is heavy with a high silt and/or clay content, it may be helpful to apply a band of sand, fine compost, or vermiculite over the seeds after planting. This will help retain moisture, reduce crusting, and will make it easier for seedlings to push through the soil surface. Firming soil over seeds improves uptake of soil moisture, and hastens germination. Water the seeds in to improve soil/seed contact. You may need to water them each day to promote germination. When plants have grown to about 1-2 inches tall, thin them according to seed packet instructions to provide adequate room for growth. Each seed must also have the proper soil temperature for germination. (Table 2)

**Perennial Plants**

When buying perennial crowns such as asparagus, order early to buy from reliable local outlets. Dormant bareroot plants and one or two-year-old crowns are preferred. Look for roots that are full, slightly moist, and have good color. Roots that are dry, brown or soggy
black will probably not give good results. Check crowns for signs of viable buds. Inspect plants for signs of insects or disease. If you receive plants by mail which are not satisfactory, do not hesitate to write or call the dealer.

Once you have the plants, do not allow the roots to shrivel and dry out. Keep the roots moist, but not soaking wet. Do not allow them to freeze or be exposed to high temperatures. If it is necessary to keep the crowns for more than a few days, place in cold storage (not freezing) or heel in a trench of moist soil in a shaded location. Pack soil firmly against roots to eliminate any air pockets.

Transplant crowns by digging holes or trenches that are large enough to give the roots plenty of room to spread. Remove any roots which are discolored or dried out. Mix compost into the bottom of the hole. See the Extension publications on individual plants for more details.

Once transplanted, water when needed. Extra care at the beginning of their growth will result in more productive, healthier plants.

**Rows, Beds or Hill**

**Wide Row Planting**

Many crops may be sown or transplanted into wide rows or beds instead of single rows. This allows more efficient use of space for crop production. As plants grow, they fill the space and their canopy cover reduces weed growth and retains soil moisture. Greens and root crops such as spinach, beets, lettuce and carrots are especially suited to this type of culture. Seed should be sown evenly over the area, then gently raked in. Firm the soil over the seeds. Thin when the plants are still small to allow room for growth by dragging a garden rake over the bed.

**Hill Planting**

Vegetables such as melons, squash, and cucumbers may be planted in hills. The soil is mounded to a foot or so in diameter and 6 inches higher than the surrounding grade. Plant 4-6 seeds per hill, firming the soil well. Thin the seedlings to 3-5 plants per hill.

**Irrigation**

**An Overview**

Adequate soil moisture is essential for good vegetable production and quality. A healthy plant is composed of 75-90% water, which is used for the plant's vital functions, including photosynthesis, support (rigidity), and transportation of nutrients and sugars to various parts of the plant.
Vegetable crops need about an inch of water per week in the form of rainwater, irrigation water, or both. It is helpful (and interesting) to keep a rain gauge near your garden or check with the local weather bureau for rainfall amounts, then supplement rainfall with irrigation water if needed. During dry periods, one thorough watering each week of one to two inches of moisture (65 to 130 gallons per 100 square feet) is usually enough for most soils. The soil should be wet to a depth of 5-6 inches each time you water and not watered again until the top few inches begin to dry out. It is usually necessary to set up a sprinkler, or other irrigation system to apply enough water as it usually takes 45 minutes, or more.

There are ways to reduce the amount of water that needs to be applied.

- The addition of organic matter to your soil is the first step in improving the moisture holding capacity of your garden. Clay soils hold soil moisture tightly. The addition of organic matter can make more water available to the plants by causing clay particles to aggregate (stick together), adding air spaces which allow moisture to drain to lower levels as a reserve, instead of puddling and running off the top of the soil.

- In sandy soil, organic matter will hold water until it is needed by plants.

- Mulching can significantly decrease the amount of water that must be added to the soil by suppressing weeds (that take up and transpire moisture) and by reducing evaporation of moisture directly from the soil. Organic mulches themselves hold some water. Black plastic mulch also conserves moisture and raises the air temperature. Other mulches should be spread over black plastic in mid summer to reduce heat buildup around plants.

- Shading and the use of windbreaks are other moisture-conserving techniques. Plants that wilt in very sunny areas can benefit from partial shade during the afternoon in summer. Small plants, in particular, should be protected. Air moving across a plant carries away the moisture on the leaf surfaces, causing more water to be needed by the plant. In very windy areas the roots often cannot keep up with leaf demands, and plants wilt.

There are two basic rules for watering:白天 and deeply.

**Daytime:** Morning watering is preferred. In any case, the foliage should dry before dark. Cool, dark and wet conditions that will exist overnight can encourage fungal disease. Even if you do not wet the foliage, you raise the humidity.

**Deeply:** Water enough to soak the soil to a depth of 5-6 inches. It takes approximately 2/3 gallon of water for each square foot or about 65-130 gallons for 100 square feet of garden area. This varies with the nature of your soil. Frequent, light waterings will encourage shallow rooting and cause plants to suffer more quickly during drought periods or blow over.
in a storm. On the other hand, too much water, especially in poorly drained soils, can be as damaging to plant growth as too little water. Adjust the flow or rate of water application to avoid run-off. To determine when you have added enough water, place small containers at various places within the sprinkler's reach and check the level of water in the cans frequently.

For best results, vegetable crops should receive adequate water at all times to keep them in active growth. However, there are some critical watering periods. This can be important, especially where water supplies are limited. In general water is needed most during the first few weeks of development, immediately after transplanting, and during the development of the edible portion of the fruit or vegetable. (Table 3)

**Irrigation Methods**

The type of watering equipment you will need depends upon available water facilities, water supply, climate, and garden practices. If there is no water supply near the garden, the expense of having one installed may be greater than the benefits gained except in very drought-prone areas or when you are dependent on the season's product. Where rainfall is adequate except for brief periods in the summer, it is wise to keep watering equipment simple. When using the oscillating type of lawn sprinklers place the sprinkler on a platform higher than the crop and try to keep the watering pattern even by frequently moving the sprinkler and overlapping about 1/2 of each pattern.

Overhead sprinklers waste a lot of water, so a drip irrigation system may be in order. Drip irrigation puts water right at the roots and doesn't wet plant leaves, helping to control disease.

Several types of drip or trickle equipment are available. The soaker hose is probably the least expensive and easiest to use. It is a fibrous hose that allows water to seep out all along its length at a slow rate. There are also hoses with holes in them that do basically the same thing. A flow regulator is usually included with the system so that the water can reach the end of the hose, yet not be sprayed out at full force. A special double-wall type of irrigation hose has also been developed which helps to maintain a more even flow. Perforated plastic hoses or soaker hoses should be placed, with holes down (if there are holes), along one side of the crop row, or underneath mulch. The water is allowed to soak or seep into the soil slowly.

Finally, there is the emitter type trickle irrigation system, in which short tubes, or emitters, come off of a main water supply hose. Emitters put water right at the roots of the desired plants. This is generally the most expensive form of irrigation and the most complex to set up, but it has the advantage that the weeds in the area are not watered and evaporation from the soil is minimized. This type of system is best used in combination with a coarse mulch or black plastic. Drip systems generally have some problems with clogging from soil
particles and/or mineral salts from water taken from springs or wells. Algae can clog emitters. Whenever surface waters such as ponds are used, an excellent filtration must be installed. New designs take into consideration the clogging problem and include filters and self-flushing emitters. It is wise to make a complete investigation and comparison before purchasing a drip irrigation system.

Pest Management

Principals

Insects, diseases and weeds can be major problems in the garden. Good garden management will help you solve many problems and be prepared to deal with others as they come up.

Use the principles of IPM. That stands for Integrated Pest Management, a technique now being used by farmers to make good decisions about pest control. Fields are checked regularly for pest problems using scientific sampling techniques and this information, combined with information on crop growth stage, weather and beneficial insect populations, is used to make decisions as to whether pest controls are needed, and if so, the best method.

1. Check your garden on a regular basis. Look under leaves for insects. Anticipate common problems. For example, time preventative treatments for squash vine borers before they infest your plants.

2. If you think you have found a pest problem, identify it correctly. Are beneficial insects, like ladybugs present? Every spot is not caused by disease.

3. Is the pest really a problem? Some insects do little damage and are just nuisances. If you wait, they will go away. Don’t kill them just because they are bugs.

4. What are your choices for control? Weeds may be controlled by herbicides or by hoeing. Are biological pesticides available? Will a soap spray do the job?

5. If you are going to use a chemical, have you chosen the right one and can you use it in the right way, at the right time? ALWAYS READ AND FOLLOW LABEL DIRECTIONS.

6. What can you do to prevent the problem in the future? Choose resistant varieties. Dispose of old crop residues that might carry pests over the winter. Keep plants healthy and vigorous through proper culture.

These simple IPM steps can help you to understand and deal with the pests that invade your garden, while avoiding unnecessary pesticide use for yourself and the environment.
Weed Control

A weed is simply a plant out of place. However, since most are well adapted for survival, take water, nutrients, sunlight and space from our vegetable plants, we increase our crop yields and/or quality by controlling them.

Weeds are easiest to control when they are small. If allowed to get large, weeds will be difficult to remove and the crop roots will be more likely injured in the process. If allowed to go to seed, there’s an old saying, "One year’s weed--seven years of seed." Every seed does not remain viable for 7 years but some do for even longer. Weeds that go to seed, provide plenty of misery.

Cultivation

One tried and true method of weed control is cultivation. Done when weeds are small, shallow cultivation will control weeds and not injure crop roots.

Hand-pulling and digging are okay for small gardens and raised beds. Gardeners with larger areas usually prefer at least a hoe. There are manual-powered rotary cultivators that do a good job on long rows and pathways as long as the soil is not too wet or dry and the weeds are small. In large gardens, a rotary tiller of appropriate size makes the work easy and fast, but may be unpleasant on a hot August day. The manual and powered rotary cultivators are usually unable to turn under weeds very close to vegetable plants without damaging the vegetables. Hand-pulling or hoeing with a light touch are best for removing weeds near vegetable plants. Any deep cultivation is likely to damage roots of crop plants.

Weeds (except for rhizomatous grasses) that have not gone to seed should be composted. If allowed to lay in the garden, some weeds may survive. If weeds have started to go to seed, composting may not destroy the seeds if the pile doesn’t heat up enough after the weeds are added. Grasses that spread by rhizomes or stolons also present a problem is not completely dried up. Reducing weed growth around the garden by mowing or other means will also help prevent the spread of weeds and seeds to the garden area.

Cultivation is best done when the soil is somewhat moist, but not wet. When soil is too dry, weeds are difficult to pull and hoeing is also harder. A day or two after a rain or irrigation is probably the best time to cultivate.

Mulching

The use of mulch helps control weeds, regulates the soil temperature, conserves moisture and keeps vegetables clean. Materials such as clean straw (no seed), leaves, rotted sawdust, dry grass clippings, wood shavings, newspaper, black plastic and weed barriers can be used.

Do not add organic mulching materials for warm-season crops until the soil has warmed,
usually around July 1 - 15 and after clean cultivation. Spread the materials uniformly around
the plants and between rows. Spread straw and leaves 3-4 inches deep, sawdust and wood
chips 2 inches thick, or put down newspaper 6 sheets thick and anchor with boards or stones.
A light rain or irrigation after mulching will help stabilize the straw or leaf mulch,
preventing it from blowing in the next strong wind.

Organic mulches require nitrogen for decomposition and will compete with crops for
nitrogen. Be sure to fertilize your vegetables adequately.

Lay plastic mulch or weed barriers over well prepared, moist soil. Unroll over the row and
place the edges in furrows. Backfill the furrows to anchor the edges in place. Cut "X's" in
the mulch and plant transplants through them or cut slits for seeding. Alternatively, a bulb
planter makes a good transplanting hole. Black plastic mulch can encourage rapid early
growth of crops by increasing air temperatures around plants. However, as the weather gets
warmer, temperatures can get too high and scorching of leaves can occur if the plastic is not
completely shaded by the plant. Cover the plastic with newspaper or other organic mulch as
the weather gets hot to solve this problem.

Other Practices

Some gardeners are experimenting with no-till gardening to reduce weed problems, prevent
erosion and moisture loss. The technique involves sowing a fall cover crop and then killing
it with a herbicide in the spring. The residue mulches the ground reducing moisture
evaporation and weed germination. When the cover crop is a legume, nitrogen is an added
benefit. Transplants in the squash or tomato family do well when planted in the residue.

Killing the cover crop for a no-till garden around the home can be complex. Pesticide use
near the home raises the risk of exposure to family members and pets. Extreme caution is
always the rule of the day. Systemic contact herbicides are most effective. Check the labels
to be certain that those products are labeled for home vegetable use.

If you want to experiment, add fertilizer and lime over weeds, then cover them with black
plastic. Wait about 2 weeks for the weeds to smother, then plant transplants through the
mulch.

Herbicides

Herbicides may be used in and around the home garden. Special precautions are necessary
when pesticides are used near homes, landscape plants, water supplies and children. These
chemicals are specific in their action on certain types of plants and must be used carefully to
prevent injury to the desired vegetables being grown. With proper planning, other weed
control methods should be adequate for most gardener's needs. If really necessary,
herbicides should always be used according to label instructions and only for crops listed on
the label. Drift and residues from herbicide sprays used in the garden, on the lawn or in
areas surrounding the garden can cause damage to vegetable plants, so take care to apply on windless days and erect barriers to protect plants if necessary. Never use an herbicide in the same sprayer you use for insect and disease control - keep a separate one for herbicides only.

Harvesting

Harvest vegetables at the peak of quality or at the particular stage of maturity that your family likes. Some crops, like sweet corn, lose their quality within a day or two. Others, such as cabbage and beets will hold their quality over a long period of time. Summer squash and snap beans should be harvested when they are young and tender, while melons and pumpkins should be mature (Table 4). If you are not sure, try harvesting when maturity is similar to produce offered in supermarkets.

Intensive Gardening Methods

Raised Beds

Raised beds can offer several advantages to the gardener, including:

- improved drainage.
- improved soil warming in the spring.
- a deeper layer of prepared soil for root crops.
- wide row planting.
- less compaction from foot traffic.

Beds are generally 2-4 feet wide (so you can reach into the center from either side) and as long as you want, but remember you have to walk around it. Raised beds can be easily built once good basic soil preparation is done (with the addition of plenty of organic materials) and can be rebuilt each year, or they can become permanent garden fixtures where only the soil in the beds is prepared each year. Some people take their raised beds quite seriously and will double-dig and use other very labor intensive techniques to develop them. Their results are probably a little better than those people who use the quick and dirty method. Is it worth it? You'll have to be the judge.

If you want to double-dig, here's how:

If your soil is not deep, double-digging the beds may be of benefit. Remove the top twelve inches of soil from the bed. Insert a spade or spading fork into the next 10"-12" of soil and wiggle the handle back and forth to break up compacted layers. Do this every 6"-8" in the bed. Mix the top soil with a generous amount of compost or manure, and return the mixture to the bed. It should be somewhat fluffy and may be raised a bit. Take topsoil from the neighboring pathways and mix it in as well.
**Vertical Gardening**

Use trellises, nets, strings, cages or poles to support the growing plant. It saves space and makes maintenance and harvesting easier. It also keeps the vegetables clean and helps prevent some disease. Vining and sprawling plants, such as cucumbers, tomatoes, melons and pole beans are obvious candidates for this. Make trellises from stakes and string, tepees made of poles, or tie plants on fences. Permanent structures can be built but limit your flexibility. Some plants entwine themselves around the support, while others may need to be tied. When tying up plants, be sure to use ties that will not cut the stems such as old pantyhose or soft cloth.

**Interplanting**

Growing two or more types of vegetables in alternating rows in the same bed at the same time is known as interplanting and allows you to get more for your space. The proportioned pest control benefits of this method are not supported by research findings.

Proper planning is essential to obtain higher production and increased quality of the crops planted. To successfully plan an interplanted garden the following factors must be taken into account for each plant: the length of the plant's growth period, its growth pattern (tall, short, below or above ground), possible negative effects on other plants (such as the allopatic effects onions can have on beans- the chemicals the onions put out into the soil may inhibit the growth of beans), preferred season, light, nutrient and moisture requirements. Interplanting can be accomplished by alternating rows within a bed (plant a row of peppers next to a row of onions), by mixing plants within a row, or by distributing various species throughout the bed. For those without experience in this technique, alternating rows may be the easiest to manage at first.

Long season (slow maturing) and short season (quick maturing) plants like carrots and radishes, respectively, can be planted at the same time. The radishes are harvested before they begin to crowd the carrots. An example of combining growth patterns is planting smaller plants close to larger plants, (radishes at the base of beans or broccoli). Shade tolerant species like lettuce and spinach may be planted in the shadow of taller crops, which may actually keep the greens cooler and slow the process of going to seed in hot weather.

There are some disadvantages to interplanted crops. They may be difficult to keep weeded due to differences in growth habit. When it is necessary to control pests, it's harder to be sure that all plants are protected adequately since they are susceptible to different pest problems.

**Succession Planting**

Secession planting is an excellent way to make good use of your space. To obtain a succession of crops, plant something new in the spots vacated by harvested plants. Corn
planted after peas is a type of succession planting.

Relaying is another common practice, consisting of overlapping blocks of one vegetable grown over a period of time - a new block is planted before the old one is removed. For instance, sweet corn may be planted at two-week intervals for a continuous harvest. This requires some care, though, since crops planted very early are likely to get a slower start because of low temperatures. In the case of supersweet corn, it can be disastrous to have two varieties pollinating at the same time, as the quality of the kernels may be affected. Give early planted corn extra time to get started for best results. Another way to achieve the same result is to plant varieties of the same vegetable with different maturation times. For example, if you plant an early-, a mid-, and a late-season corn at the same time you will extend your harvest season over several weeks.

Planting a spring, summer, and fall garden is another form of succession planting. Cool season crops (broccoli, lettuce, peas) are followed by warm season crops (beans, tomatoes, peppers), and, where possible, these may be followed by more cool-season plants, or even a winter cover crop. Always prepare the soil before planting the next crop.

**Extending the Harvest**

**Some Techniques**

Another way to get more from your garden is to use methods to extend the growing season. Transplanting is one way this is done, but other methods can also be used.

Early plantings can often be made with hotcaps, row covers, plastic tunnels and even clean plastic mulch to warm the soil.

Harvest can be extended by several weeks in the fall if warm weather crops like tomatoes can be protected from encroaching frost by covering them with plastic bags or sheets at nightfall. Kale, spinach, lettuce, parsley, parsnips, carrots and salsify are examples of crops that may survive all winter in the garden. Late plantings of these cool weather crops can be banked with about 8 inches of mulch to prevent heaving of the soil. They can be dug or picked as needed throughout the winter or in early spring in the warmer areas of New York. You could also try enclosing overwintering vegetables in a small cold frame made from bales of straw and an old window sash. Results will vary with the micro-climate of your particular garden, air movement patterns, exposure and other factors. It is usually warmer in urban areas than in more rural ones.

Don’t forget that vegetables can also be grown in containers. Have a winter window box salad with leaf lettuce and radishes.
Cold Frames and Hot Beds

Cold frames and hot beds are relatively inexpensive, simple structures that provide a favorable environment for growing cool-weather crops in the early spring, the fall, and even into the winter months.

Cold frames have no outside energy requirements, relying on the sun for their source of heat. Hot beds are usually heated by soil heating cables. Heat is collected by all these frames when the sun’s rays penetrate through the sash (made of clear plastic, glass, or fiberglass). The ideal location for a cold frame is a south-facing or southeastern exposure with a slight slope to insure good drainage and maximum solar absorption. A sheltered spot with a wall or hedge to the north will provide protection against winter winds. Sinking the frame into the ground somewhat will also provide added insulation.

New designs in cold frames include passive solar energy storage. For example, barrels painted black and filled with water absorb heat during the day and then release it slowly at night. Other new cold frames are insulated very well and are built with a very high back and a steep glass slope. These designs may include movable insulation that is folded up during the day and down at night or used during extremely cold weather to cover growing plants.

In early spring a cold frame is useful for hardening off seedlings which were started indoors or in a greenhouse. This hardening off period is important, as seedlings can suffer serious setback if they are moved directly from the warmth and protection of the house to the garden. The cold frame provides a transition period of gradual adjustment to the outdoor weather. It is also possible to start cool-weather crops in the cold frame and either transplant them to the garden or grow them to maturity in the frame.

Spring and summer uses of the cold frame center around plant propagation. Young seedlings of hardy and half-hardy annuals can be started in a frame many weeks before they can be started in the open. The soil in a portion of the bed can be replaced with sand, peat moss or another medium suitable for rooting cuttings and for starting sweet potato slips.

Fall is also a good time for sowing some cool-weather crops in cold frames. If provided with adequate moisture and fertilization, most cool-season crops will continue to grow through early winter in the protected environment of the cold frame. Depending on the harshness of the winter and whether or not additional heating is used, your frame may continue to provide you with fresh greens, herbs, and root crops throughout the cold winter months.

Growing frames can be built from a variety of materials, but wood and cinder blocks are the most common. Use pressure-treated wood. Never use creosote-treated wood or wood treated with pentachlorophenol, since these substances are harmful to growing plants. Kits may be purchased and easily assembled and some kits even contain automatic ventilation
equipment.

There is no standard sized cold frame. The dimensions of your frame will depend on your situation, amount of available space, desired crops, size of available window sash, and permanency of the structure. Since standard lumber is sold in 4' lengths from 8' upward, lumber use is most effective if coldframes are built in 4' increments. Do not make the structure too wide for weeding and harvesting; 4 to 5 feet is about as wide as is convenient to reach across. The sash of the frame should be sloped to the south to allow maximum exposure to the sun's rays.

Insulation may be necessary when a sudden cold snap is expected. A simple method is to throw burlap sacks filled with leaves over the sash on the frame at night to protect against freezing. Bales of straw or hay may also be stacked against the frame for insulation.

Ventilation is most critical in late winter, early spring, and early fall on clear, sunny days when temperatures rise above 45 degrees. The sash should be raised partially to removed to prevent the buildup of extreme temperatures inside the frame. Lower or replace the sash early enough in the day to conserve some of the accumulated heat for the evening.

In summer, extreme heat and intense sunlight can damage plants. This can be avoided by shading with lath sashes or old bamboo window blinds. Watering should be done early in the day so that plants dry before dark to help reduce disease problems.

You may also convert your cold frame into a hotbed. To build an electric heated bed, dig out an area 8" or 9" deep and lay down a thermostatically controlled electric cable. Evenly space the cable but never allow it to cross over itself. Cover the cable with 2" of sand or soil. Hardware cloth laid over will protect the heating cable. Finally cover the cable with 4-6" of good soil.

Cloches

The cloche (pronounced kloosh) was originally a bell-shaped glass jar set over delicate plants to protect them from the elements. The definition has expanded, however to include many types of portable structures which shelter plants from drying winds and cold air.

The idea is to provide a greenhouse-like atmosphere for seeds and small plants in order to get an early start on the season, or to extend the fall garden as long as possible. Cloches are set out over individual plants or are made into tunnels for whole rows. They trap solar radiation and moisture evaporating from the soil and plants. The hotcap and the cut-off plastic jug are simple forms of cloches. More elaborate designs include fiberglass tunnels, special plastic row covers with slits in them for some aeration, and panes of glass connected by specially designed hinges to form a tent.
Cloches are generally lightweight, portable and reusable. It is preferable to have a design which can be closed completely at night to prevent frost damage and opened or completely removed during the day for good air circulation. Cloches should be anchored or heavy enough that they don’t blow away.

**Greenhouses**

There is an almost overwhelming selection of greenhouses on the market, and plans for building even more types are available. If you intend to purchase or build a greenhouse, it is wise to investigate the alternatives thoroughly, preferably visiting as many operating home greenhouses as possible. List your needs and wants ahead of time and determine the kinds of plants you want to grow in your greenhouse. Many companies will send free specifications and descriptions of the greenhouses they offer.

**Fall Planting**

By planning and planting a fall vegetable garden it is possible to have fresh vegetables up to and even past the first frosts. At the time when retail vegetable prices are on the rise, you can be reaping harvests from your still-productive garden site.

Many types of vegetables can be planted in mid- to late summer for fall harvests. Succession plantings of warm season crops (such as corn and beans) can be harvested up until the first killing frost. Cool season crops (such as kale, turnips, mustard, broccoli, cabbage, etc.) grow well during the cool fall weather and withstand light frosts. Fall transplants can be started in a small nursery bed at the side of the garden about 4-6 weeks prior to planting. Timely planting is the key to a successful fall garden.

To determine the time to plant a particular vegetable for the latest harvest in your area, you need to know the average date of the first killing frost and the number of days to maturity for the variety you are growing (check the seed catalogue). Choose early maturing varieties for late fall plantings.

**Putting The Garden To Bed**

Garden clean up and winter preparation are important to ensure good sanitation and reduce future pest and disease problems, as well as to keep the garden looking nicer.

Prepare perennial vegetables for winter by adding a layer of mulch to reduce damage from freezing and thawing. Cut dead leaf stalks of perennial vegetables such as asparagus and rhubarb to the ground after their tops are killed by frost. When your tender crops have been harvested and the overwintering crops are cared for, pull up all the stakes and trellises in the
garden except those stakes that are clearly marking the sites of overwintering plants. Clean the stakes by hosing them down and allow them to dry. Tie stakes in bundles and stack them so that they won't get lost over the winter. If you leave this infested plant material in your garden, you are leaving overwintering disease and insect pests that may begin to reproduce in the spring.

Add organic matter to the garden to improve the soil. Do not overlook the excellent and free sources of organic material available during the fall. Leaves are abundant, and neighbors will usually be glad to give their leaves to you. Put some on the garden now and store some for next year's mulch. Leaves will mat if put on too thickly and will not decompose quickly. You can help leaves break down more easily by using a lawn mower to shred them into smaller pieces. Also compost shredded leaves. Sawdust and wood chips are easy to obtain from sawmills. Many farms and stables want to get rid of manure piles before winter.

Consider a cover crop to decrease soil erosion during the winter. Cover crops also add organic material when they are incorporated in the spring. In addition cover crops improve soil tilth and porosity, add nutrients (Table 5). Winter cover crops can be planted as early as August 1 but should be planted no later than November 1. They should make some growth before hard frost kills them. Where you have fall crops growing, you can sow cover crop seed between rows a month or less before expected harvest. This way, the cover crop gets a good start but will not interfere with vegetable plant growth. Mixtures of legumes and non-legumes make good cover crops.

Before winter sets in, sharpen tools, coat metal parts lightly with oil and rub wooden handles with linseed oil. Winterize power tools according to manufacturers' directions. Obtain filters, mufflers, and tune-up parts so that a fall or late-winter tuning can get the machine ready for early spring jobs. Have maintenance done, if needed, over the winter, when the demand for the tool is the lowest.

If you can grow petunias, you can grow pumpkins.
If you can grow tulips, you can grow tomatoes.
If you can grow roses, you can grow anything.

Grow flowers and vegetables together, for a garden that is ornamental and productive - and enjoy the "fruits" of your labor.
Table 1

**Viability of Vegetable Seeds**  
(Average No. of Years Seeds May be Saved)

<table>
<thead>
<tr>
<th>Vegetable</th>
<th>Years</th>
<th>Vegetable</th>
<th>Years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asparagus</td>
<td>3</td>
<td>Leek</td>
<td>1</td>
</tr>
<tr>
<td>Bean</td>
<td>3</td>
<td>Lettuce</td>
<td>5</td>
</tr>
<tr>
<td>Beet</td>
<td>4</td>
<td>Muskmelon</td>
<td>5</td>
</tr>
<tr>
<td>Broccoli</td>
<td>5</td>
<td>Mustard</td>
<td>4</td>
</tr>
<tr>
<td>Brussels Sprouts</td>
<td>5</td>
<td>Okra</td>
<td>2</td>
</tr>
<tr>
<td>Cabbage</td>
<td>5</td>
<td>Onion</td>
<td>1</td>
</tr>
<tr>
<td>Carrot</td>
<td>3</td>
<td>Parsley</td>
<td>2</td>
</tr>
<tr>
<td>Cauliflower</td>
<td>5</td>
<td>Parsnip</td>
<td>1</td>
</tr>
<tr>
<td>Celery</td>
<td>5</td>
<td>Pea</td>
<td>3</td>
</tr>
<tr>
<td>Chinese Cabbage</td>
<td>5</td>
<td>Pepper</td>
<td>4</td>
</tr>
<tr>
<td>Collard</td>
<td>5</td>
<td>Pumpkin</td>
<td>4</td>
</tr>
<tr>
<td>Cucumber</td>
<td>5</td>
<td>Radish</td>
<td>5</td>
</tr>
<tr>
<td>Eggplant</td>
<td>5</td>
<td>Rutabaga</td>
<td>5</td>
</tr>
<tr>
<td>Endive</td>
<td>5</td>
<td>Spinach</td>
<td>5</td>
</tr>
<tr>
<td>Kale</td>
<td>5</td>
<td>Squash</td>
<td>5</td>
</tr>
<tr>
<td>Kohlrabi</td>
<td>5</td>
<td>Sweet Corn</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Tomato</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Turnip</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Watermelon</td>
<td>5</td>
</tr>
</tbody>
</table>
Bolting Vegetables

Many gardeners have encountered problems with bolting, or premature flowering, in their vegetables. Bolting response differs according to species and variety. Environmental stimuli—usually temperature, day length and growth stage—also play a role.

Vegetables in the mustard family, including many cole crops and greens, initiate flowers when plants are exposed to prolonged cold temperatures. When warm weather returns, they bolt without producing harvestable plant parts. This cold-induced flower initiation is called vernalization. Cabbage will initiate flower stalks when plants are exposed to temperatures less than 50°F for 5 to 6 weeks. However, if cabbage plants are in the juvenile (seedling) stage they will not be vernalized. Mustard, turnips, kale, and collards are also induced to flower by cold temperatures. This is why overwintered greens and cabbage generally bolt quickly in the spring.

Flowering in onions can be induced by temperatures below 50°F. This is why some varieties or types of onions bolt when overwintered. Cold exposure will not vernalize onion seedlings or onion sets of less than 5/8" diameter, so spring planted onions normally do not bolt. Crops in other families that can be induced to flower by cold exposure include beets and carrots. Normally this is not a problem because they are not overwintered.

Spring planted mustard and Chinese cabbage are difficult to grow because seedlings bolt easily with even slight spring cold snaps. Some types are also day-length sensitive and will flower under long days. In contrast, spring planted cabbage does not usually bolt because the juvenile (seedling) forms are not vernalized during cold snaps.

In the case of broccoli, gardeners, often have problems with heads (flower buds and stems) going to flower before they can be cut. Spring planted broccoli that matures in hot weather will develop from bud to flower stage quickly. Therefore, it must be cut without delay as the spring gets warmer. In comparison, summer planted, fall maturing broccoli develops much more slowly and will keep longer in the garden.

Spinach flower when it receives long daylengths and warm temperatures. The most rapid bolting occurs when plants are exposed to cold followed by high temperatures and long days. Older plants and crowded plants bolt more quickly. There is considerable variation in bolting response among spinach varieties; some require much longer day lengths to flower than others. Therefore, varieties should be selected according to when they will be planted and harvested. Only slow bolting varieties should be used for overwintering or spring planting.

High temperature is the most important factor in lettuce bolting. Iceberg types are the most sensitive to warm temperatures; heading is prevented and seed stalks form when temperature reaches 79°F. Romaine and bibb types are intermediate in temperature effects on flowering.
Butterhead, leaf and summer crisp lettuces are the slowest to bolt in hot weather. Even young lettuce plants will initiate flowers when exposed to high temperatures, so it is important to choose heat tolerant, slow-bolting varieties for later plantings.

**Pollination**

Poor fruit set in many vegetables and fruits is often due to pollination problems. Aborted, misshapen, or deformed fruit can also be a result of poor pollination. Cucurbit vegetables, including cucumbers, melons, squashes, gourds and pumpkins all require insects for pollination. Honey bees are important pollinators in our part of the country.

If there are few bees or if conditions too rainy or cold for bees to fly, good pollination can't happen. Some cucumber hybrids are gynoecious, meaning that they have only female flowers. These types require planting a pollinator with male flowers nearby. Seedless watermelons also require a "normal" variety to be planted nearby to provide pollen.

Fruit set in vegetables such as tomatoes and peppers is affected by extremes of temperature and humidity. In tomatoes, poor fruit set will occur if maximum day temperature is above 100°F, if the minimum night temperature is greater than 80°F, if there are hot drying winds, or if temperatures fall below 50°F. In peppers, fruit set does not occur below 60°F, above 90°F, or if humidity is very low.
Table 2

Seed Germination Chart

<table>
<thead>
<tr>
<th>Crop</th>
<th>Mean Days to Emergence</th>
<th>Mean Days to From Seeding</th>
<th>Optimum Germination</th>
<th>Optimum Soil Temp. Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beans, Lima</td>
<td>5-10</td>
<td></td>
<td>70°-85°</td>
<td></td>
</tr>
<tr>
<td>Beans, Snap</td>
<td>5-10</td>
<td></td>
<td>65°-85°</td>
<td></td>
</tr>
<tr>
<td>Beets</td>
<td>7-10</td>
<td></td>
<td>50°-85°</td>
<td></td>
</tr>
<tr>
<td>Broccoli</td>
<td>3-10</td>
<td></td>
<td>50°-85°</td>
<td></td>
</tr>
<tr>
<td>Cabbage</td>
<td>4-15</td>
<td></td>
<td>50°-85°</td>
<td></td>
</tr>
<tr>
<td>Carrots</td>
<td>6-18</td>
<td></td>
<td>50°-85°</td>
<td></td>
</tr>
<tr>
<td>Cauliflower</td>
<td>4-20</td>
<td></td>
<td>50°-85°</td>
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</tr>
<tr>
<td>Celery</td>
<td>9-16</td>
<td></td>
<td>50°-65°</td>
<td></td>
</tr>
<tr>
<td>Chard, Swiss</td>
<td>7-10</td>
<td></td>
<td>65°-85°</td>
<td></td>
</tr>
<tr>
<td>Corn, Sweet</td>
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<td>65°-85°</td>
<td></td>
</tr>
<tr>
<td>Cucumber</td>
<td>4-6</td>
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<td>65°-85°</td>
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<td>Eggplant</td>
<td>6-13</td>
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<td>65°-85°</td>
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<tr>
<td>Lettuce</td>
<td>6-8</td>
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<td>Melons</td>
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<td>Okra</td>
<td>7-17</td>
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<td>65°-85°</td>
<td></td>
</tr>
<tr>
<td>Onion</td>
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<td>65°-85°</td>
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<td>Parsley</td>
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<td>Peas</td>
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</tr>
<tr>
<td>Pepper</td>
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<td>65°-85°</td>
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</tr>
<tr>
<td>Potatoes, Sweet (slips)</td>
<td>5-11</td>
<td></td>
<td>65°-85°</td>
<td></td>
</tr>
<tr>
<td>Radish</td>
<td>5-11</td>
<td></td>
<td>50°-65°</td>
<td></td>
</tr>
<tr>
<td>Spinach</td>
<td>7-12</td>
<td></td>
<td>50°-65°</td>
<td></td>
</tr>
<tr>
<td>Squashes</td>
<td>3-8</td>
<td></td>
<td>65°-85°</td>
<td></td>
</tr>
<tr>
<td>Tomatoes</td>
<td>6-12</td>
<td></td>
<td>65°-85°</td>
<td></td>
</tr>
<tr>
<td>Turnip</td>
<td>2-6</td>
<td></td>
<td>50°-65°</td>
<td></td>
</tr>
</tbody>
</table>
Table 3

Critical Periods for Watering

<table>
<thead>
<tr>
<th>Crop</th>
<th>Critical Periods</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asparagus</td>
<td>Spear production, fern development</td>
</tr>
<tr>
<td>Broccoli, Cabbage, Cauliflower</td>
<td>Head development</td>
</tr>
<tr>
<td>Beans, peas</td>
<td>Pod filling</td>
</tr>
<tr>
<td>Carrot</td>
<td>Seed emergence, root development</td>
</tr>
<tr>
<td>Corn</td>
<td>Silking, tasseling, ear development</td>
</tr>
<tr>
<td>Cucumber</td>
<td>Flowering, fruit development</td>
</tr>
<tr>
<td>Eggplant, Tomato</td>
<td>Flowering, fruiting</td>
</tr>
<tr>
<td>Lettuce</td>
<td>Head development; moisture should be constant</td>
</tr>
<tr>
<td>Melons</td>
<td>Flowering, fruit development</td>
</tr>
</tbody>
</table>
Table 4

Harvest at Just the Right Time

**Asparagus** - (2 yrs from planting to harvest).
Wait 2 years from planting. Snap off spears 7-10 inches long with tight heads, leaving the tough stub on the plant. Harvest all spears that come up during the harvest season. The harvest season is 2 weeks the third year, 4 weeks the fourth year, and 8 weeks the fifth and following years.

**Beans** - (Lima) - (65 - 80 days from planting to harvest).
Pick when the outlines of fully formed beans are plainly seen on pods, but before they begin to yellow.
(Snap) - (45 - 60 days from planting to harvest).
Pick when pods are 2 inches long or longer, when they snap easily, and before large beans form in the pod.

**Broccoli** - (60 -80 days from planting to harvest).
Cut stem below head when head is 5-10 inches across while buds are still green and tight, before the buds begin to separate, show yellow color or the flowers open.

**Brussels Sprouts** - (90' - 100 days from planting to harvest).
Harvest sprouts when they are 1 - 1 1/2 inches in diameter. Remove the leaf beneath the sprout. Then break it off.

**Cabbage** - (60 -90 days from planting to harvest).
Cut head when it is firm and heavy, before it splits. Leave the cut stem in the ground and small heads may develop that can be used.

**Cantaloupe** - (85 - 100 days from planting to harvest).
Fruit will 'slip' - crack will develop around the stem where it attaches to the fruit and the fruit will break easily from the stem with gentle thumb pressure. If the stem must be forcibly broken the fruit is not ready.

**Cauliflower** - (70 -90 days from planting to harvest).
Cut when 5-10 inches across, before the curd begins to separate or become 'ricey'.

**Corn (Sweet)** - (70-90 days from planting to harvest).
Harvest as soon as silks have dried, husk tightens and the ear is filled to the tip (feel through the husk). The kernels should be bright, plump and have
'milky' juice.

**Cucumber** - (50 - 70 days from planting to harvest). Pick when medium to full length (4-10 inches) before seeds develop inside.

**Greens** - (50 - 80 days from planting to harvest). Pick outer leaves starting when plants are half grown. Center leaves will continue to form.

**Okra** - (55 - 65 days from planting to harvest). Harvest pods when they are 2-4 inches long, crisp and easily punctured.

**Onions** - (80 - 120 days from planting to harvest). Harvest anytime for green onions. For mature, dry onions wait until at least half the tops have broken over naturally at the neck, then pull. When the tops have wilted cut them off 1 inch above the bulbs and rub clean with your hands. Cure in a mesh bag in a warm dry area for a few weeks then store in a cool, dry place.

**Peas** - (55 - 90 days from planting to harvest). Pick when pods are bright green and well filled. Yellowish, hard pods are too old.

**Potatoes** - (75 - 120 days from planting to harvest). Dig in September when most of the tops have died. Cure potatoes by holding at 50° to 60° F. for 10 - 14 days. Then store at 38° to 40° F. until use. Small potatoes can be dug in August to use immediately.

**Squash (winter)** - (85 - 100 days from planting to harvest). and **Pumpkins** Harvest before frost when the color is even and the vines have dried back to ground. Leave a piece of stem attached.

**Squash (summer)** (50 - 60 days from planting to harvest). Pick when medium sized, while the outer skin is still tender, and before large seeds develop inside.

**Root Crops** - (40 - 80 days from planting to harvest). When ready to harvest, the tops get large and often the shoulders of the roots push above the soil. Pull the largest one to see if they are ready. The roots should be medium size and firm.

**Tomatoes** - (70 - 90 days from planting to harvest). Pick when the fruit is even colored, plump and slightly soft.
**Green Peppers** - (60 - 90 days from planting to harvest).
Pick when full size and green. Allow some to turn mature red toward the end of the season.

**Watermelon** - (80 - 100 days from planting to harvest).
Rap the melon sharply with your knuckles - a dull, flat sound indicates ripeness. Also the lighter spot that laid on the ground changes from white to a light yellow. When the first tendril out of the watermelon is dead, then harvest.
Table 5

Cover Crops

<table>
<thead>
<tr>
<th>Legume/Non-Legume</th>
<th>Amount to Sow per 100 sq.ft (oz.)</th>
<th>When to Sow</th>
<th>When to Turn Under</th>
<th>Effects</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Buckwheat N</td>
<td>2-1/2</td>
<td>Spring</td>
<td>Summer</td>
<td>Mellows soil; rich in potassium.</td>
<td>Must leave part of garden in cover during season. Grows quickly. Not hardy.</td>
</tr>
<tr>
<td>Fava beans L</td>
<td>Plant 8&quot; apart.</td>
<td>Early spring</td>
<td>Early summer</td>
<td>Some types fix 70-100 lbs.</td>
<td>Will grow on many soil types. Medium in drought tolerance. Likes cool growing weather. Good for mountain areas. If planted in early spring can grow late vegetables. Inoculate with same bacteria as for hairy vetch.</td>
</tr>
<tr>
<td>Oats N</td>
<td>4</td>
<td>Spring</td>
<td>Summer</td>
<td>Adds organic matter; improves soil aggregation.</td>
<td>Needs adequate manganese. Not hardy; tolerates low pH.</td>
</tr>
<tr>
<td>Rye, winter N</td>
<td>3-1/2</td>
<td>Fall</td>
<td>Spring</td>
<td>Adds organic matter; improves soil aggregation.</td>
<td>Very hardy. Can plant till late October.</td>
</tr>
<tr>
<td>Vetch, hairy L</td>
<td>2-1/2</td>
<td>Early fall</td>
<td>Spring</td>
<td>Fixes 80-100 lbs. N/acre/year.</td>
<td>Inoculate; slow to establish. Fairly hardy. Till under before it seeds; can become a weed.</td>
</tr>
<tr>
<td>Wheat, winter N</td>
<td>4</td>
<td>Fall</td>
<td>Spring</td>
<td>Add organic matter; improves soil aggregation.</td>
<td>Same as barley.</td>
</tr>
</tbody>
</table>
Review Questions:

1. Outline the "best" transplanting techniques for vegetable plants to a novice gardener.

2. What type of vegetable plants should be planted in the hill system?

3. List 3 ways to reduce the amount of irrigation water required by the garden.

4. What is the relative advantage of drip irrigation vs. overhead irrigation?

5. Define IPM.

6. A gardener new to raising vegetables wants to know what are the advantages of using raise beds. How do you answer?

7. Exactly, what is interplanting?

8. Can you save the seeds of hybrid varieties? What will happen if you do?
Resources:


15. Vegetable Gardening in Maryland. Bulletin 220

Related Resources

**Vegetables**

<table>
<thead>
<tr>
<th>Title</th>
<th>Item Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Garden in the City</td>
<td>141L78</td>
</tr>
<tr>
<td>Grow with the Flow: Hydroponics</td>
<td>141M7</td>
</tr>
<tr>
<td>Vegetable Production Handbook (commercially oriented)</td>
<td>142VPH</td>
</tr>
<tr>
<td>Weed Control For The Home Vegetable Garden</td>
<td>161IB216</td>
</tr>
<tr>
<td>The Home Vegetable Garden</td>
<td>161IB101</td>
</tr>
<tr>
<td>The Heirloom Vegetable Garden</td>
<td>161IB177</td>
</tr>
<tr>
<td>Cover Crops for Vegetable Production in the Northeast</td>
<td>142IB244</td>
</tr>
<tr>
<td>Pest Management Around the Home Parts 1 &amp; 2</td>
<td>139S74</td>
</tr>
<tr>
<td>Natural Enemies of Vegetable Insect Pests</td>
<td>139NVP</td>
</tr>
<tr>
<td>Tomato Disease and Pest Identification (Fact Sheet Set)</td>
<td>VFSTOMA</td>
</tr>
<tr>
<td>Pepper Disease and Pest Identification (Fact Sheet Set)</td>
<td>VFSPLVVP</td>
</tr>
</tbody>
</table>

These titles are available for review and sale at The Resource Center's online bookstore:

[www.cce.cornell.edu/store](http://www.cce.cornell.edu/store)

You may also order titles or a catalog by:
Phone: 607-255-2080
Fax: 607-255-9946
E-Mail: resctr@cornell.edu

Or write:
The Resource Center
Cornell University
PO Box 3884
Ithaca, NY 14852-3884

These titles are also usually available through your local Cooperative Extension association office.
Cornell Website information on Vegetables

All Cornell website information on gardening is accessible through the Cornell Gardening Resources Website www.gardening.cornell.edu

The following are specific sections of the Cornell Gardening Resources Website as of Dec.15, 2004. New web pages are added regularly. Please check www.gardening.cornell.edu periodically for updates and new information.

http://www.gardening.cornell.edu/vegetables/index.html

http://www.hort.cornell.edu/extension/commercial/vegetables/ (commercially oriented)

http://www.nysipm.cornell.edu/vegetables.html

http://www.entomology.cornell.edu/Extension/DiagnosticLab/IDLFS/index.html

Cornell Visual Presentation Resources in Vegetables
Master Gardeners may borrow resources from the Department of Horticulture’s Home Grounds and Community Horticulture Resource Library in Ithaca, NY. MG’s should discuss it with their county MG Coordinator and reserve a resource through that staff person. Resources in this library are slides, powerpoint CD-ROM’s and videos. They are generally used by Master Gardeners to make presentations to community groups as part of the county CCE’s educational mission. The ✿ symbol means that it is appropriate for the Core Qualifying Course for Master Gardeners. The number preceding each resource is its library code number in Ithaca.

VEGETABLES
68. Home Storage of Fruits & Vegetables Slide Set (64 slides & script) NRAES, Cornell University
122. ✿ Growing Vegetables in the Home Garden Slide Set (176 slides & script) M. Eames-Sheavly, Cornell University
130. Natural Enemies of Vegetable Insect Pests Slide Set (91 slides & script) M. Hoffman & A. Frodsham, Cornell University
134. Late Blight: A Serious Disease of Potatoes and Tomatoes Slide Set (16 slides & script) D. Karasevicz, Cornell University
136. Heirloom Vegetables Slide Set (77 slides & script) B. Becker, Cornell University
157. ✿ Organic Gardening Slide Set (80 slides & script) K. Hennigan, C. Mazza, S. Cunningham, Cornell University, 2001
CD-5 ✿ Organic Gardening CD-powerpoint -- 80 frames (images and/or text) & script – K. Hennigan, C. Mazza, S. Cunningham, Cornell University, 2001