# CHAPTER 10

## The Vegetable Garden

Edited and revised by by Dr. Otho Wells, University of New Hampshire Cooperative Extension

When planning your garden, it is important to ask a few basic questions:

Who will be doing the work? Will the garden be a group project with family members or friends who will work willingly through the season to a fall harvest, or will you be handling the hoe alone, in between camping and swimming? Remember, a small weed-free garden will produce more than a large weedy mess.

What do you and your family like to eat? Although the pictures in the garden catalog look delicious, there is no value in taking up gardening space with vegetables that no one eats. Make a list of your family's favorite vegetables, ranked in order of preference. This will make a useful guide in deciding how much to plant of each. Successive plantings of certain crops, such as beans, will give a longer harvest period and increase your yield. List recommended varieties and planting dates.

How do you plan to use the produce from your garden? If you plan to can, freeze, dry, or store part of the produce, this will be a factor not only in planning the size of the garden but also in selecting the varieties grown. Some varieties have much better keeping quality than others. Care should be used in choosing the seeds, making sure the varieties you select are adapted to your area and intended use.

How much space is available? That is, how much area can be converted into usable garden space, not simply how much empty ground is available.

### Some Planning Hints

- Plan the garden on paper first. Draw a map showing arrangement and spacing of crops. If you wish to keep the garden growing all season, you may need a spring, summer, and fall garden plan.
- Plan the garden and order seeds by January or February. Some plants may be started indoors as early as late-February.
- In your plan, place tall and trellised crops on the north side of the garden so they won't shade the shorter vegetables.
- Group plants by length of growing period. Plant spring crops together so that later crops can be planted in these areas when the early crops mature. Consider length of harvest as well as time to maturity. Place perennial crops to the side of the garden where they will not be disturbed by annual tillage.

## Locating the Garden

- Vegetables grow best in a level area with loose, well-drained soil, and at least 6 hours of sun (8 to 10 hours is ideal).
- Use contour rows or terraces on sloped or hillside sites to avoid erosion. South-facing slopes are warmer and less subject to damaging frosts.
- Avoid placing the garden in low spots, at the base of a hill, or at the foot of a slope bordered by a solid fence. Such areas are slow to warm up in the spring, and frost settles in these places, since cold air naturally drains into low areas.
- Avoid windy locations; if you must plant in a windy spot, build or grow a windbreak.
- Locate near a good and easily accessible supply of water if possible.
- Choose a spot near your home so it is convenient to work in the garden when you have a few minutes.
- Avoid planting near trees and shrubs; they compete for nutrients and water, and may cause excessive shading.
- Sites too near buildings may result in plants not receiving enough sunlight. Observe shading patterns through the growing season; if possible, before starting the garden. If you have a shaded area you wish to use anyway, plant shade-tolerant crops.
- Try not to plant related vegetables in exactly the same location in the garden more often than once in 3 years. Rotation prevents the buildup of insects and disease. Use old plans as guides for rotating crops.
- Avoid locating the garden on a site where buildings with lead paint have stood; soil lead may be present in toxic amounts. If you are unsure about your chosen location, have the soil tested for lead content, or have tissue analyses done on some leafy vegetables.

# Soil Preparation

The ideal vegetable garden soil is deep, friable, well-drained, and has high organic matter content. Proper soil preparation provides the basis for good seed germination and subsequent growth of garden crops. Careful use of various soil amendments can improve garden soil and provide the best possible starting ground for your crops.

## Soil Testing

Check soil fertility and pH by having your soil analyzed at least once every 3 years. 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 to 6.8. This is a little below neutral, or slightly acid (sour). If soil pH is too high or low, poor crop growth will result, largely due to the effects of pH on the availability of nutrients to plants. A soil test will also give you a relative idea of the nutrient level in the soil.

Soil test kits are available for checking soil at home. Soil samples may also be sent to your local Extension office for testing. Extension will mail results to you with recommendations for correcting any deficiencies or other problems that may exist. For best results, carefully follow the instructions for taking the soil sample.

Make basic nutrients and pH adjustments to the soil by adding required fertilizers and lime (or acidifiers). In new garden spots, remove sod with a spade and put it in a compost pile to decay. Plow, spade, or rotary till the soil. Work only when soil moisture conditions are right. To test, pick up a handful of soil and squeeze it. If it stays in a ball it is too wet. If it crumbles freely, it should be about right. Excessively dry soil is powdery and clumpy and may be difficult to work. If soil sticks to a shovel, or if when spading, the turned surface is shiny and smooth, it is still too wet. Working soils when excessively wet can destroy soil structure, which may take years to rebuild. Plowing with a tractor when the soil is wet is especially damaging, causing the formation of a compaction layer that will inhibit root growth. Soils with adequate humus levels generally allow more leeway because of their improved structural qualities.

Just prior to planting, break up large clods of soil and rake the bed level. Small-seeded vegetables germinate best in smooth, fine-surfaced soil. Do not pulverize the seedbed soil. This destroys the structure and promotes crusting and erosion problems.

## Equipment

The type of equipment used to prepare your garden will depend on the size of the garden, your physical ability, time, and budget. Options include hand-digging with a spade or shovel, tilling with a power rotary tiller, using a small garden tractor, or a full-sized farm tractor.

## Tilling the Soil

It was once assumed that gardens should be turned yearly with a moldboard plow, mostly for weed and pest control. While garden plowing is still a common practice, turning the soil completely over has been found to be detrimental in some cases, causing soil compaction, upsetting balances of microorganisms, and often causing layers of coarse organic material to be buried below the influence of insects and microbes which would otherwise cause breakdown of the material. Chisel plowing, which does not have this disruptive effect, is one alternative, but it is limited to sandy or loamy soils and many farmers who work gardens do not have chisel plows. In addition, gardeners in other-than-rural areas have trouble finding a farmer who will come to plow and disk the garden for a reasonable price (or at all). Roto-tilling most home gardens is sufficient, as long as plant debris accumulation is not out of hand. Rotary tilling mixes the upper layers of soil rather than completely turning the soil over, and the effects produced are generally desirable. One possible harmful effect of roto-tilling is the formation of a compaction layer just beyond the reach of the tines. This also occurs when a moldboard plow is used to the same depth every year, but at a somewhat deeper level. Use of deep-rooted cover crops or double-digging can do much to prevent or alleviate this problem when it exists. Small gardens can be designed using raised beds which may be worked entirely by hand if the area is small enough.

Gardeners often wonder whether to plow/till in the spring or fall. Working the soil in fall has several advantages over the traditional spring plowing. It allows 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 or rock fertilizers in the fall gives them time to become integrated with the soil and influence spring plant growth.

Fall plowing alone is not recommended for hillside or steep garden plots, since soil is left exposed all winter, subject to erosion when spring rains come. If a winter cover crop is grown to improve soil and prevent erosion, the ground will have to be tilled in the fall to prepare the soil for seed, and again in spring to turn under the green manure. Spring plowing is better for sandy soils and those where shallow tilling is practiced. Generally, most gardens must be disked or rotary-tilled in the spring to smooth the soil for planting.

## Soil Amendments

Any addition to the soil which improves its physical or chemical condition is considered a soil amendment. Many types of amendments are available to the home gardener.

**Amendments to Change pH and Nutrient Levels:**

Lime and sulfur are common amendments used to change soil pH. The correct soil pH is essential for optimum plant growth. Dolomitic limestone adds calcium and magnesium as it increases pH. Sulfur itself may acidify alkaline soil. The amount to add depends on the current and desired pH, one good reason to have garden soil checked periodically.

Wood ashes are often 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 in a thin layer over the winter, and incorporate 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.

Other amendments are added specifically to improve soil nutrient levels. Greensand is a source of potassium. Greensand is relatively low in potassium which is readily dissolved. Other nutritional amendments that can be purchased for garden use include cottonseed meal and kelp meal as well as an array of synthetic fertilizers. The organic amendments are particularly useful where a trace element deficiency exists, while synthetic fertilizers are generally more available, less expensive, and have quicker results.

**Amendments to Improve Soil Qualities:**
In special cases, coarse sand, peat, vermiculite, and perlite are sometimes added to heavy clays to help improve soil texture (the ratio of sand:silt:clay) or structure. However, these inert materials can be expensive and large quantities are needed to do any good. Compost, manures, and other amendments usually serve the purpose more economically and just as well.

Organic matter is a great soil improver for both clay and sandy soils. Good sources of organic matter include manures, leafmold, sawdust, straw, and others. These materials are decomposed in the soil by soil organisms. Various factors, such as moisture, temperature, and nitrogen availability determine the rate of decomposition through their effects on these organisms. 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 ensure adequate nutrient availability both to growing plants and decomposing organisms. Adding nitrogen 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 have no qualms about stealing the plants' share.

The use of compost is one way to get around the decomposition problem. Compost is usually made by the gardener from plant and/or animal wastes. Correct composting is an art which can result in a valuable nutrient and humus source for any garden. The basis of the process is the microbial decomposition of mixed raw organic materials to a dark, fluffy product resembling rich soil, which is then spread and worked into the garden soil.

Animal manures are commonly used as a garden soil amendment. The value of manure in terms of the nutrients it contains varies. 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. Manure usually has fewer total nutrients than synthetic fertilizers in terms of N, P, & K, but is a valuable soil-builder. Unfortunately, manures may be a source of weed seeds; if this is a problem, composting in a hot pile may help. In urban areas, manure may be hard to come by, but country dwellers usually find it plentiful.

Another source of inexpensive soil improvement that should not be underestimated is the cover crop. 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. A deep-rooted cover crop allowed to grow for a season in problem soil can help break up hardpan and greatly improve tilth. Incorporate green manures at least 2 weeks before planting vegetables; they should not be allowed to go to seed before incorporation.

The regular addition of manure, compost, cover crops, and other organic materials can raise the soil nutrient and physical level to a point at which the addition of synthetic fertilizers is no longer needed, or is at least greatly reduced. This comes about not only through the intrinsic fertilizing value of the amendment, but also through the increased action of microorganisms on soil and humus particles; humic acid (and other acids) helps to release previously locked-up nutrients naturally present in the soil, and the extra surface area provided by humus serves as a reserve, holding nutrient elements until they are needed by plants. This highly desirable soil quality does not come about with a single or even several additions of organic material, but rather requires a serious, long-term, soil-building program. Information is widely available in books and magazine articles on this subject.

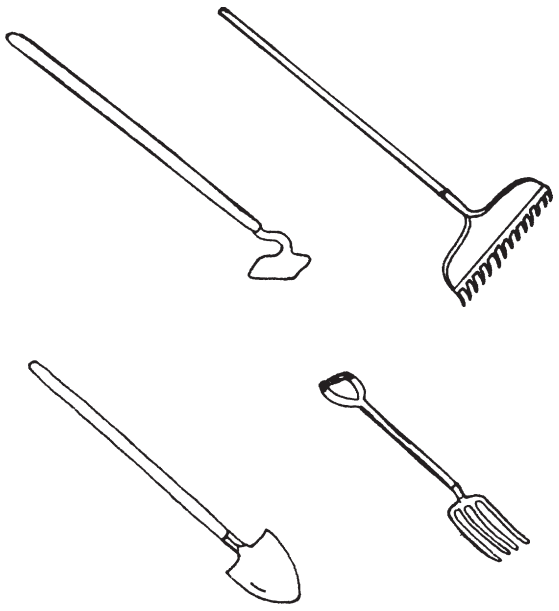
Remember, your soil is alive and constantly changing. By keeping it fertile and rich, many gardening problems may be diminished. Soil is the base for plant growth, and much attention should be paid to getting and keeping it in the best condition.

## Selecting Gardening Equipment

Garden catalogs and stores are full of gardening tools, many highly specialized; some are very useful, others are nice but not necessary, and some are gimmicks. The gardening equipment you need depends on the size of your garden, your age and strength, and whether you want to get the job done in a hurry or prefer to take your time. The minimum equipment needed by most gardeners includes a shovel or spade, a hoe, a rake, and a trowel. A wide selection of styles is available in each of these tools, and the choice is really one of personal preference and price range. You can get the best value for the price range you choose by knowing each tool's uses and particular qualities to look for when comparison shopping.

### Hand Tools for Cultivating

A garden **shovel** with a pointed blade is lighter and smaller than most other shovels and is well suited for use in the garden. Shovels are earth movers with dish-shaped blades mounted to the handle at an angle. A **spade** has a flat blade and is designed for cutting rather than lifting or moving soil. Spades are excellent for shaping straight-sided trenches and for edging beds. For general purpose digging, lifting and moving, a long-handled shovel is ideal. Both shovels and spades come with long or short handles in standard or D-shaped styles. Choice of handle style will depend on personal preference; long handles offer greater leverage and are less tiring to use in many cases. Short handles are often thicker and stronger than long ones.



A **spading fork** is another useful digging tool. It is ideal for breaking and turning heavy soils and for loosening subsoil layers when double digging a bed. Turning coarse compost, spreading mulches, and digging root crops are other jobs suitable for a spading fork.

A **hoe** is essential in any garden for preparing the seed bed, removing weeds, and breaking up encrusted soil. Several different hoe styles are available. The pointed hoe with a heart-shaped blade is lightweight and useful for opening seed furrows and cultivating between plants. The hula, or action hoe, is a type of scuffle hoe which is very lightweight and maneuverable. Pushing and pulling it just under the soil surface eliminates newly emerging weeds and breaks up any crust on the soil surface. This type of hoe is most easily used on soil which is not compacted, since the blade is relatively thin and lacks the clod-breaking capabilities of a heavier hoe; it is also less effective in cases where weeds have gotten a good start. Other types of scuffle hoes are somewhat more sturdy, and are used with a pushing motion rather than pushing and pulling. Probably the most commonly used hoe is the square-bladed hoe, which lends itself well to many garden tasks.

A sturdy **rake** is useful in clearing the garden of rocks and debris. It is also helpful in spreading mulches and smoothing seedbeds. The size of the rake right for you depends on your size and strength and the uses you intend to put it to. As the number of tines increases, the rake weight also increases; avoid choosing a rake so heavy it will tire you after a short period of use. The length of the rake handle is important too; the tip of the handle should come up to your ear when standing upright. A handle that is too short will make your work harder, causing excess bending and back strain.

Especially in the spring, a **trowel** will be in constant use for those many digging jobs that need not be done with full-sized tools. The trowel is perfect for transplanting seedlings and bulbs or digging shallow-rooted weeds. Small hand cultivators, often sold in sets with trowels, are good for weeding in small areas and between closely spaced plants. Another useful small digging tool is appropriately named a digger (a.k.a. weeder, cultivator, asparagus knife). This tool is available from most hardware or discount stores for a few dollars. It is indispensable for digging up weeds with long taproots, such as dandelions or Queen Anne's lace, or for prying out

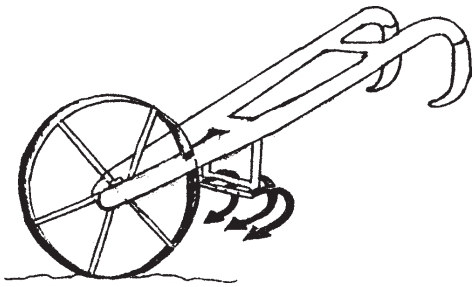
quackgrass rhizomes. It consists of a long (10 to 14 inch) solid metal rod with a two-pronged blade at one end and a handle at the other. This tool is practically indestructible and well worth the small investment of its price.

Some other tools that may have a place in the garden tool shed include the pickaxe, mattock, and wheel cultivator. Pickaxes are used to break up extremely hard-packed or stony soil. Mattocks are for the same purpose, but are equipped with a cutting blade for areas where larger roots need to be removed. A mattock may also be used to chop up debris for composting. A wheel cultivator has a number of attachments for soil preparation and weed control and may prove a good investment for those with larger gardens.

## Power Tools for Cultivating

The power **rotary tiller** is probably the power tool most commonly purchased by gardeners. Whether or not a gardener needs a rototiller depends on the size of the garden, the gardener's capabilities, and the intended uses of the tiller. Tiller selection may be based on the nature of the work to be done, the quality of the machine, and ease of repair, as well as personal preference. The tiller's engine powers rotating blades, or tines, which can make garden soil loose and fluffy, ready for planting. It can also chop up plant debris and mix it into the soil. Incorporating organic matter and manures into the garden is easily accomplished with a tiller, reducing the tendency to procrastinate this necessary chore. The ability of the tiller to do these jobs effectively is a function of its weight, strength, design, type of tines, and type of soil. A heavy, powerful tiller is most effective on stony clay soils, while in a small garden or one with light soil, a smaller tiller is more appropriate. Very lightweight tillers, known as soil blenders, are designed mainly for raised-bed gardening; however, they are not widely available and generally must be mail-ordered.

Roto-tillers are available with front-mounted or rear-mounted times. Rear-tined tillers are generally better able to self-propel on all but the rockiest soils. They travel straight and can produce a footprint-free seedbed. Rear-tined tillers often have a number of attachments available for a variety of uses, such as hilling potatoes, making raised beds, even plowing snow! The price of a rear-tined rototiller is considerably higher, in most cases, than that of the front-tined type; consideration should be given to the payback time necessary for such a large investment.



If gardening is simply a hobby, or if the garden is small, a front-tined tiller may be suitable. Front-tined tillers are usually light in weight, but may require considerable strength to guide them through the soil. Operating this type of tiller is comparable to handling a large floor polisher such as those used in schools and hospitals; mainly, leverage is required for control. New gardeners are sometimes scared away from these tillers because of the initial experience of having a tiller run away with them. The front-tined tiller may not make as straight a pass as the heavier rear-tined type, but it is much easier to turn. Due to this increased maneuverability, the front-tined tiller is easy to use in small gardens and in corner areas.

The purchase of a tiller is a major investment as garden tools go. Features to look for include heavy cast-iron, steel plate and tubing, heavy bearings, strong welds used in construction, and easily operable controls. Ask to look at the operator's manual and try to determine how simply a tune-up

can be performed; you may save yourself a great deal of trouble and money if you can replace plugs and points yourself, particularly if you have no truck on which to load the tiller. Also consider the locations of service centers and parts dealers.

Careful attention to your needs, abilities, and price range is important. Talk to people who have the types of tillers you are interested in. If possible, borrow or rent various types of machines and send for information before buying.

If you are considering the purchase of a used rototiller, plan to do so well ahead of time so you will not be rushed into a purchase. If you do not know much about such equipment, it might be helpful to have a mechanically-minded friend look over the machines you are considering. Above all, test each tiller for ease of starting and operation. An engine that smokes or runs roughly may require a lot of work. Tines should operate smoothly and freely. Check the welds in the handles to see that they are strong; re-welding may mean that the handles have broken at some time, a common problem in older tillers. Look at the dipstick if there is one; low oil or very sludgy oil may mean that the tiller has been maintained poorly. The oil and other fluids may also be checked by opening the drain plugs. Look for excessive dirt around the engine or in the air filter. This may also mean bad maintenance habits. Ask the owner for an operator's manual and ask where the machine has been serviced in the past. A good tiller is a long-term investment, so plan carefully before you buy.

## Other Power Tools

There are few other power tools needed in the vegetable garden. Cordless tools come with various cultivating attachments. Most are rechargeable and can make garden chores more pleasurable; these tools are especially useful to those with physical disabilities which limit strength.

A garden shredder is nice to have for a large garden with a lot of plant wastes. There are hand-operated shredders which are slow but useful if wastes become available in small quantities and are not too coarse. Gasoline shredders are quite expensive, and may be disappointing to the gardener who wants to chip branches and other large materials. They are best used for shredding leaves, small branches, and other plant wastes (though sunflower stalks would probably be too much for one). A chipper, on the other hand, will chip large branches and other coarse material, but the cost of $1000 or more makes the chipper uneconomical for the home gardener.

## Carts/Wheelbarrows

A wheelbarrow or cart is very handy to have in and around the garden area. It should be easy to handle when full, with good maneuverability. Durable construction is well worth paying for to ensure a long, useful life. Be sure to choose the size appropriate for your physical abilities and garden needs. A wheelbarrow generally requires more strength and control than do most garden carts, but many of the small carts generally available are made of relatively flimsy metal and, though inexpensive, are not particularly long-lasting or suitable for heavy items such as rocks. Again, consider your needs. If you plan to haul only light straw, leaves, sawdust, and such materials, then one of the small carts may be suitable. For heavier jobs, you may need a wheelbarrow; or investigate some of the newer garden carts, especially those with bicycle-size tires, which make easy work of hauling. They are made of heavy plywood and metal, but are well-balanced and easy to maneuver. These carts do, however, involve a sizeable investment (up to several hundred dollars) and a large storage space. Therefore, only serious gardeners or those with other uses for such a cart find these carts economical. One alternative is to build your own from one of several plans available from gardening magazines or private companies.

## Watering Equipment

Watering is one garden job that most gardeners must do at least occasionally. An adequate water supply may make a big difference in garden yields. Purchase of watering equipment depends upon available facilities, water supply, climate, and garden practices. If there is no outdoor spigot near the garden, the expense of having one installed may be greater than the benefits gained except in very drought-prone areas or in the case of a gardener who is fully dependent on the season's produce. Where rainfall is adequate except for a few periods in the summer, it is wise to keep watering equipment simple; a rain barrel or a garden hose with a fan-type sprinkler will suffice. A water breaker for small seedlings is a nice extra. But, in areas where there are extended periods of hot weather without precipitation, the local water supply is likely to be short. Overhead sprinklers are wasteful of water, so in this case, a drip irrigation system may be in order. Drip irrigation puts water right at the roots and doesn't wet plant leaves, helping to prevent disease. Timers are available that allow automatic watering with drip and some other systems.

However, this type of system is relatively expensive and may be considered a nuisance by some gardeners because of maintenance and placement requirements. Determine whether cultural practices such as mulching, close plant spacing, shading, or wide bed planting will meet most of your extra water needs. Then purchase watering gadgets accordingly.

## Soil Testing Equipment

Soil test kits can be purchased in various sizes and levels of sophistication. These are handy but not always necessary; soil testing does not have to be done more frequently than once a year for most gardening purposes. If inexpensive garden soil tests are offered through Extension, it is often preferable to have them do the tests, as results are likely to be more accurate. Some gardeners like to monitor the soil quality frequently, though, making a soil test kit a worthwhile purchase. An electronic pH tester is on the market for those who like gadgets.

## Seeding and Planting Tools

Depending on the size of your garden and your physical abilities, you may want to consider a row seeder. Seeders with wheels make easy work of sowing long rows of corn or beans or other vegetables. Seeders are available which make a furrow, drop the seeds properly spaced, and close up the furrow behind the seed, all in one pass. They do not perform quite as well on small-seeded crops, and it is not really worth the effort of setting up a seeder for small areas. A hand-held seeder is probably a better choice for this type of work. Broadcast seeders are available for sowing seeds such as rye or wheat for a cover crop, but are generally not necessary for the average home gardener, since broadcasting is easily done by hand once the proper technique is learned.

## Environmental Monitoring Equipment

Serious gardeners often invest in various types of equipment that allow them to monitor the microclimate around the garden or indoors. A rain gauge is an inexpensive device that helps the gardener determine if enough rain has fallen for garden plants. A maximum-minimum thermometer is a costly, but often useful, device to measure nightly lows and daytime highs within an area; these are especially valuable in a greenhouse. Soil thermometers measure soil temperature and the internal temperature of a compost pile. Light and watering meters can be purchased for indoor plant monitoring.

## Trellises/Cages

Trellises and cages for vining plants save space and keep fruits off the ground, reducing the amount of stooping required for harvest and damage to plants. Look for heavy-duty materials and sturdy design that will stand up to rain, wind, and drying. Wire should be of a heavy gauge and wood should be treated with non-phytotoxic (i.e., not toxic to plants) materials. Metal parts should be rustproof or at least rust-resistant. If you build your own, you will probably save a considerable amount of money and get better quality for the price.

## Composting Equipment

If you wish to make compost regularly, it will be helpful to have compost bins in some form. You can construct two bins out of planks or concrete blocks. Make the bins about 4 feet high, 4 feet wide, and as long as desired, and open at one end for easy access. Leave spaces between blocks or planks for aeration. Plant refuse may be accumulated in one bin while the composting process is taking place in the other. A third bin may be desirable for near-finished or finished compost storage.

A simple, portable compost bin can be made with three or four sturdy, used pallets, which are simply stood on their ends in a square or open square and lashed or otherwise held together. This type of bin can be disassembled for easy turning and emptying and then reassembled around the new pile. A chicken wire cage supported by three or four wooden stakes will also work satisfactorily, but is somewhat less sturdy.

There are also ready-made and kit composters available, including slat-sided cylinders into which refuse is added from above and compost removed at ground level. Rotating barrels for easy turning are also available; gardeners who have physical disabilities may find either of these types easier to deal with than the standard compost bin.

Whichever type of compost maker you use, it's a good idea to make use of the nutrients which will leach out from under the pile. This is easily done by locating the composter in the garden (which also reduces hauling time) or under a large fruit tree. Or, make some provision to catch the run-off from the pile and use it as liquid fertilizer.

## Harvesting Equipment

Harvesting equipment varies depending on the size and type of garden, whether or not food is to be stored, and the way in which it is to be processed. Baskets are useful to most gardeners. They may be purchased at garden or farm supply stores or sometimes may be scrounged from local grocery stores or fruit stands. Berry baskets for small fruits, baskets with handles for carrying vegetables, and peck or bushel baskets for storage are all useful. Fruit pickers are nice and easy to use for tall fruit trees. A sharp knife for cutting vegetables off plants is handy and helps prevent plant damage.

Food processing equipment includes canners, blanchers, dehydrators, and sealers for frozen food packages. There is even a home vacuum-packer available. A food mill is inexpensive and very useful for making sauces and juices; a blender or food processor is also useful to the gardener with extra food. More specialized tools include corn cutters which remove kernels from the cob, bean Frenchers and shellers, cherry pitters, strawberry cappers, apple corers and peelers, jelly strainers and thermometers, and many more. For canning, a large kettle or pot is indispensable for preparing food prior to canning. A jar lifter will prevent burned fingers; a funnel for transferring food to jars reduces messiness. As always, choices depend on individual needs.

## Purchase and Maintenance

When purchasing 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 and tend to increase in value with time 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, keep its shape, and outlast softer metals. Consumers' magazines and gardening publications frequently have articles explaining what to look for in tools and listing alternatives to local hardware stores, which often carry a single line of tools. Several excellent books featuring garden tools have been published and may be available at the library.

Keeping a tool clean and sharp will increase its usefulness and lengthen its life. Learn the techniques of sharpening each tool and practice them frequently. Professional gardeners often carry sharpening stones or files while working and sharpen after every hour or so of use. Clean your tools after each use. One effective method is to keep a five gallon bucket filled with sand and used motor oil in the tool shed. At the end of the gardening day, remove clinging dirt from tools by plunging them into the oily sand several times. This will keep the tools cleaned and oiled, and will help prevent rusting.

The last and perhaps most important step in tool care is to put tools in their proper places. Tools left in the garden will rust and break and can be a safety hazard. Some gardeners paint handles with a bright color to make their tools easy to spot. And, if each tool has its own place in the storage area, it is simple to determine if tools are missing before closing up.

Before winter sets in, sharpen tools, then coat metal parts lightly with oil and rub wooden handles with linseed oil. Drain power tools of gasoline and 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, in the winter, when demand is lowest and you can afford to let the repairer take his or her time.

In fall, any trellises or cages that have been outdoors should be cleaned and stored inside if possible. Traps and other pest control devices should also be stored if the pest season is over. Cold frames and other season extenders should be protected from damage by ice and snow or high winds, and once their job is done, should be repaired if necessary and put away if possible. Tools with wheels like cultivators, seeders, and carts should be oiled and stored. Thoughtfully selected and cared for, your tools will give many years of service. This extra help in the garden will pay for itself in time.

## Seed for the Garden

Choosing and purchasing vegetable seeds is one of the most enjoyable gardening pastimes. Thumbing through colorful catalogs and dreaming of the season's harvest is one way to make winter seem a little warmer. Seed purchased from a dependable seed company will provide a good start toward realizing that vision of bounty. Keep notes about the seeds you purchase - their germination qualities, vigor of plants, tendencies toward insects and disease, etc. From this information you can determine whether one seed company is not meeting your needs, or whether the varieties you have chosen are unsuitable 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

Saving your own vegetable seed is another pleasurable activity. It offers a sense of self-sufficiency and saves money. You can maintain a variety that is not available commercially, which helps to perpetuate a broad genetic base of plant materials. Breeders often search for old-time varieties when attempting to improve commercial plants, since the heirloom vegetables (as they are sometimes called) often have inbred disease- and pest-resistance or cold-hardiness. Participation in a seed-saver's exchange can be a rewarding experience. Extra seeds that you have may be traded for unusual types that are not available through other sources.

There are certain considerations that should be kept in mind when saving seed, however. Hybrid varieties are not likely to be the same as the parent plants; therefore, 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. Another consideration in saving seed 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 which may be present in your region. Take care to control diseases which can be carried in seed. Another weather-related factor is the speed of drying of seeds, which can be adversely affected by frequent rains and/or humidity.

And finally, 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 that may be obtained from 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 and peas, herbs, and tomatoes.

**Saving beans and peas:**

Allow seed pods to turn brown on the plant. Harvest pods, dry for 1 to 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 stay 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, coriander, 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 pulp into a container. Add a little water, then let ferment 2 to 4 days at room temperature, stirring occasionally. When seeds settle out, pour off pulp and spread 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 (preferably waterproof) ink, indicating the variety and date saved. Seeds will remain viable for some time if properly stored. To test for germination, sprout seeds between moist paper towels; if germination is low, either discard the seed or plant enough extra to give the desired number of plants.

## Viability of Vegetable Seeds

(Average number of years seeds may be saved)

| Vegetable | Years |
|---|---|
| Asparagus | 3 |
| Bean | 3 |
| Beet | 4 |
| Broccoli | 5 |
| Brussels sprouts | 5 |
| Cabbage | 5 |
| Carrot | 3 |
| Cauliflower | 5 |
| Celery | 5 |
| Chinese cabbage | 5 |
| Collard | 5 |
| Corn | 5 |
| Cress, water | 5 |
| Cucumber | 5 |
| Eggplant | 5 |
| Endive | 5 |
| Kale | 5 |
| Kohlrabi | 5 |

| Vegetable | Years |
|---|---|
| Leek | 1 |
| Lettuce | 5 |
| Muskmelon | 5 |
| Mustard | 4 |
| Onion | 1 |
| Parsley | 2 |
| Parsnip | 1 |
| Pea | 3 |
| Pepper | 4 |
| Pumpkin | 5 |
| Radish | 5 |
| Rutabaga | 5 |
| Spinach | 5 |
| Squash | 5 |
| Sweet corn | 2 |
| Tomato | 4 |
| Turnip | 5 |
| Watermelon | 5 |

## Depth for Planting Vegetable Seeds

The depth to cover seeds when you plant them depends on a number of factors such as the size of the seed, the type of soil you have, and the season of the year.

As a general rule, vegetable and flower seeds should be covered about 4 to 5 times their lateral diameter or width (not their length). There are exceptions, however; read the packet directions. Some seeds require light for germination and should not be covered at all. These instructions apply to seeds planted both inside and out.

## Starting Seed Indoors

To start seeds indoors, it is important to have enough light. More homegrown seedlings are probably lost to this one factor than to any other. Vegetable seedlings grown under low-light conditions are likely to be leggy and weak, and many will fall over under their own weight after they are 3 to 4 inches tall. If you do not have a sunny room or back porch with a southern exposure, you will probably need supplemental lights. A simple fluorescent shop light with one warm-white and one cool-white bulb (or with grow lights) will suffice.

It is probably easiest to use a soilless or peat-lite mix to start seedlings, since garden soil contains disease organisms which can be highly destructive to small plants. Soil can be sterilized in the oven by baking it at 200° F. until the internal soil temperature is 180° F. It should be held at that temperature for 30 minutes. This is a smelly process, but it works. Garden soil that is high in clay should be conditioned with compost or perlite to prevent excess moisture and/or shrinkage. You can mix your own peat-like mix if you prefer, 50% vermiculite or perlite and 50% fine sphagnum peat is excellent for starting seeds. Fertilizer at half the normal strength may be added to the mixture. Mix well before using.

Many types of containers can be used to start seeds. Flats or other large containers may be used; plant in rows and grow seedlings until they have one or two sets of true leaves, then transplant into other containers for growing to the size to transplant outdoors. Seedlings may also be started in pots, old cans, cut-off milk cartons, margarine tubs, egg cartons, or other throwaways. The pop-out trays found at garden centers are easy to use and reusable. Peat pots are nice, especially for large seeds. Sow one or two large seeds directly in each peat pot.

Thin to one seedling per pot. Peat pots may be planted directly in the garden; do not allow the edges of the pot to stick out above the soil, since they will act as a wick and moisture will evaporate from this exposed surface.

Regardless of the type of container chosen, fill it 3/4 full with seed-starting mixture and sow the seeds. Cover to the specified depth and water the mix. If your home is dry, it may help to cover the containers with plastic wrap to maintain a steadier moisture level. Seeds and seedlings are extremely sensitive to drying out. They should not be kept soaking wet, however, since this condition is conducive to damping-off, a fungus disease deadly to seedlings. Damping-off can be prevented or diminished by sprinkling milled sphagnum moss, which contains a natural fungicide, on top of the soil.

Another option is to use peat pellets or cubes, which are pre-formed and require no additional soil mix. The pellets or cubes are soaked until thoroughly wet, then seeds are planted in the holes provided. The whole pellet or cube may then be planted without disturbing the roots. The only disadvantage to this method is the expense.

## Starting Seed Outdoors

Many seeds may be sown directly in the garden. If garden soil is quite sandy, or is mellow with a high content of organic matter, seeds may be planted deeper. Young seedlings can emerge quite easily from a sandy or organic soil. If garden soil is heavy with a high silt and/or clay content, however, the seeds should be covered only 2 to 3 times their diameter. In such soils, it may be helpful to apply a band of sand, fine compost, or vermiculite 4 inches wide and ¼ inch thick along the row after seeds are planted. This will help retain soil moisture and reduce crusting, making it easier for seedlings to push through the soil surface.

Soil temperature has an effect on the speed of seed germination. In the spring, soil is often cold and seeds of some plants will rot before they have a chance to sprout. The following chart gives optimum soil temperatures.

## Plant Production Data Chart

| Crop | Days to Emergence From Seeding | Optimum Germination Soil Temperature Range | Number of Weeks to Grow Transplants |
|---|---|---|---|
| Beans | 5 - 10 | 65° - 85° | [1] |
| Beets | 7 - 10 | 50° - 85° | [1] |
| Broccoli | 3 - 10 | 50° - 85° | 5 - 7 |
| Cabbage | 4 - 10 | 50° - 85° | 5 - 7 |
| Carrots | 12 - 18 | 50° - 85° | [1] |
| Cauliflower | 4 - 10 | 50° - 85° | 5 - 7 |
| Celery | 9 - 21 | 50° - 65° | 10 - 12 |
| Chard, Swiss | 7 - 10 | 65° - 85° | [1] |
| Corn, Sweet | 5 - 8 | 65° - 85° | [1] |
| Cucumber | 6 - 10 | 65° - 85° | 4 (peat pots) |
| Eggplant | 6 - 10 | 65° - 85° | 6 - 9 |
| Lettuce | 6 - 8 | 50° - 65° | 3 - 5 |
| Melons | 6 - 8 | 65° - 85° | 3 - 4 (peat pots) |
| Onion | 7 - 10 | 65° - 85° | 8 |
| Parsley | 15 - 21 | 50° - 85° | 8 |
| Peas | 6 - 10 | 50° - 65° | [1] |
| Pepper | 9 - 14 | 65° - 85° | 6 - 8 |
| Radish | 3 - 6 | 50° - 65° | [1] |
| Spinach | 7 - 12 | 50° - 65° | [1] |
| Squash | 4 - 6 | 65° - 85° | 3 - 4 (peat pots) |
| Tomato | 6 - 12 | 65° - 85° | 5 - 7 |
| Turnip | 4 - 8 | 50° - 65° | [1] |

[1] transplants not recommended

When planting the fall garden in midsummer, the soil will be warm and dry. Therefore, cover the seeds 6 to 8 times their diameter. They may need to be watered regularly with a sprinkler or a sprinkling can to promote germination. Moisture can also be retained with a shallow mulch or by covering the row with a board until the seeds are up. Pre-sprouting is a useful technique for planting in cold soils, as well. However, seed must be handled very carefully once sprouted to prevent damaging new root tissue.

## Row Planting

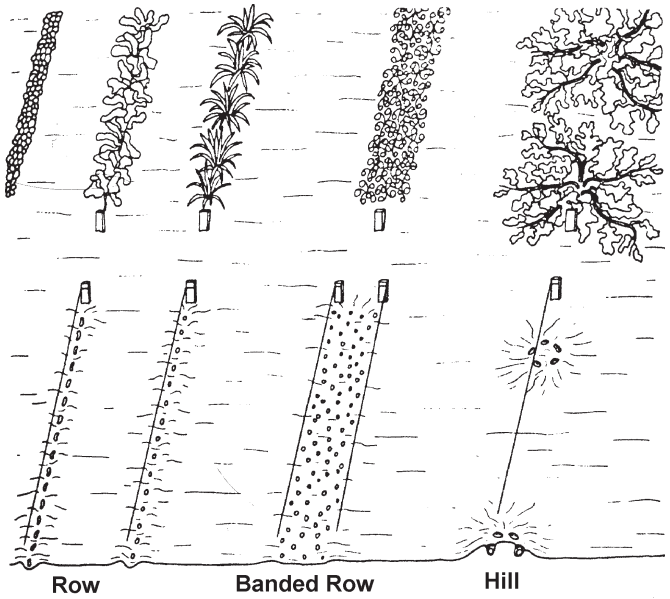
A string stretched between stakes will provide a guide for nice straight rows, if desired. Use a hoe handle, a special furrow hoe, or a grub hoe to make a furrow of the appropriate depth for the seed being planted. Sow seed thinly; it may help to mix very small seed with coarse sand to distribute the seeds more evenly. Draw soil over the seed, removing stones and large clods. Firming soil over seeds improves uptake of soil moisture, hastening germination. Water the seeds in to improve soil/seed contact. When plants have grown to 4 to 6 inches tall, thin according to seed packet instructions to provide adequate room for growth.

## Broadcast Planting

Many crops may be sown in wide rows or beds instead of in long, single rows. Crops such as spinach, beans, peas, beets, lettuce, and carrots are especially suited to this type of culture. Sow seed evenly over the area, then rake it in. Firm soil over the seeds. Thin young plants to allow room for growth.

## Hill Planting

Larger vegetables such as melons, squash, corn, and cucumbers may be planted in hills. Soil is mounded to a foot or so in diameter, at the recommended spacing. Plant 4 to 6 seeds per hill, firming the soil well. Thin the seedlings to 3 to 5 plants per hill.



# Transplants for the Garden

Most gardeners use transplants in the garden at some time or another to give long season plants a chance to grow to maturity under their preferred weather conditions, or just to lengthen the harvest season.

Due to the amount of time, attention and need for controlled growing conditions, many gardeners prefer to purchase plants for their gardens. However, for a larger choice in varieties and the control of plant production from seed to harvest, others choose to start their own.

## Annual Plants

Transplants of annual vegetables and flowers should be stocky, healthy, free from disease, and have good roots. They should not be too small or too mature. Be sure plants have been hardened-off so that they will easily adapt to environmental change, but they should not be so hardened that they are woody and yellow. Successful transplanting is achieved by interrupting plant growth as little as possible. This is one of the advantages of using peat pots or peat pellets, which do not have to be removed when transplanting.

Have garden soil prepared before transplanting. All additives which require time to break down, such as manures, limestone, rock fertilizers, and green manures, should be incorporated several weeks before planting. Quick-acting lime and fertilizers and well-decayed compost may be added just before planting.

Transplant on a shady day, in late afternoon, or in early evening to prevent wilting. It helps to water the plants several hours before transplanting; when using bare-root plants, soak the roots thoroughly an hour or two before setting them out in the garden. They should not be allowed to dry out completely at any time. Handle plants carefully. Avoid disturbing the roots or bruising the stems.

Dig a hole large enough to hold the roots of the plants. Set the plants slightly deeper than previously planted and at recommended intervals. Press soil firmly around the roots of transplants. Pour about a cup of starter solution in the hole around the plant. Use a solution of about half the strength recommended for that type of plant during the normal growing season. Fish emulsion or diluted manure tea may also be used.

For a few days after transplanting, protect the plants from wind and sun by placing newspaper or cardboard on their south sides, or by covering with jugs, baskets, or flower pots. Water the plants once or twice during the next week if there is insufficient rain.

## Perennial Plants

When buying small fruit plants and perennial crowns such as asparagus, order early or buy from reliable local outlets. Discount department stores often allow plants to dry up, so watch for this, especially if you are buying sale plants. Select varieties that will do well in your growing conditions. For perennial plants, it will pay to do some research to find out what the major disease and insect pests are and buy resistant varieties. Dormant, bareroot plants and 1- or 2-year-old crowns are preferred. Look for roots that are full, slightly moist, and have color. Roots that are dry brown or soggy black are indicative of poor storage and 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 send them back.

Once you have the plants, keep the roots moist (but not soaking wet) by misting occasionally, and 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 else heel in a trench of moist soil in a shaded location. Pack soil firmly against roots to eliminate any air pockets.

Transplant crowns according to directions, digging holes large enough to give the roots plenty of room to spread. Remove any roots which are discolored or dried out. Perennial plants appreciate a dose of compost mixed into the bottom of the hole.

Once transplanted, shade the plants if necessary and water when needed. Extra care at the beginning of their growth will result in productive, healthy plants.

### Transplant Production Data

(Ease of transplanting)

| Easily Survive Transplanting | Require Care in the Operation | Not Successfully Transplanted by Usual Methods |
|---|---|---|
| Broccoli | Beets | Beans |
| Cabbage | Carrots (young) | Peas |
| Cauliflower | Celery | |
| Eggplant | Chard | |
| Lettuce | Melon | |
| Chinese cabbage | Squash | |
| Onion | Corn | |
| Tomatoes | | |
| Pepper | | |

## Irrigating the Home Garden

Adequate soil moisture is essential for good crop growth. A healthy plant is composed of 75% to 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. During the first 2 weeks of growth, plants are becoming established and must have water to build their root systems.

While growing, vegetable crops need about an inch of water per week in the form of rainwater, irrigation water, or both, from May to September. Keep a rain gauge near the garden or check with the local weather bureau for rainfall amounts, then supplement rainfall with irrigation water if needed. There are ways, however, to reduce the amount of water you have to add.

During dry periods, one thorough watering each week of 1 to 2 inches of moisture (65 to 130 gallons per 100 square feet) is usually enough for most soils. Soil should be wetted to a depth of 5 to 6 inches each time you water and not watered again until the top few inches begin to dry out. Average garden soil will store about 2 to 4 inches of water per foot of depth.

### Reducing Water Demands

All of this water, however, may not be available to plants, particularly if the soil is a heavy clay. Clay particles hold soil moisture tightly. If, for example, there are 4½ inches of water per foot of this type of soil, there may be as little as 1½ inches available for plants. A relatively high level of humus in the soil, brought about by the addition and breakdown of organic matter, can improve this proportion to some extent. By causing clay particles to form aggregates or large clumps of groups of particles, humus also adds air spaces to tight clays, allowing moisture to drain to lower levels as a reserve, instead of puddling and running off the top of the soil.

The moisture-holding capacity of sandy soils is also improved by the addition of organic matter. Though most soil water in sandy soil is available, it drains so quickly that plants are unable to reach water after even a few days following a rain. Humus in sandy soil gives the water something to cling to until it is needed by plants. Addition of organic matter is the first step in improving moisture conditions in the garden.

Mulching is a cultural practice which can significantly decrease the amount of water that must be added to the soil. A 6 to 8 inch organic mulch can reduce water needs by as much as ½ by smothering weeds (which take up and transpire moisture) and by reducing evaporation of moisture directly from the soil. Organic mulches themselves hold some water and increase the humidity level around the plant. Black plastic mulch also conserves moisture.

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 the plant to need more water. In very windy areas, the roots often cannot keep up with leaf demands, and plants wilt. Temporary or permanent windbreaks can help tremendously.

During those times when cultural practices simply aren't enough, when rainfall is sparse and the sun is hot, watering can benefit the garden with higher yields, or may save the garden altogether in severe drought years.

Irrigation practices, when properly used, can benefit the garden in many ways:

- Aids in seed emergence.
- Reduces soil crusting.
- Improves germination and plant stand.
- Reduces wilting and checking of growth in transplants.
- Increases fruit size of tomato, cucumber, and melon.
- Prevents premature ripening of peas, beans, and sweet corn.
- Maintains uniform growth.
- Improves the quality and yields of most crops.

## Irrigation Methods

The home gardener has several options for applying water to plants - a watering sprinkler can, a garden hose with a fan nozzle or spray attachment, portable lawn sprinklers, a perforated plastic soaker hose, drip or trickle irrigation, or a semi-automatic drip system. Quality equipment will last for a number of years when properly cared for. When deciding on which type of watering equipment to use there are a number of things to consider.

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; water drips out the holes. With the latter type, a flow regulator usually has to be included with the system so that 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 an even flow. Finally, there is the emitter type system, best used for small raised-bed or container gardens, in which short tubes, or emitters, come off 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. New designs take into consideration the clogging problem; some include filters and self-flushing emitters. It is wise to make a complete investigation and comparison before purchasing a drip irrigation system.

### Some basic techniques and principles for watering:

1. Adjust the flow or rate of water application to about ½ inch per hour. Much faster than this will cause run-off, unless the soil has exceptionally good drainage. To determine the rate for a sprinkler, place small tin cans at various places within the sprinkler's reach, and check the level of water in the cans at 15 minute intervals.
2. When using the oscillating type of lawn sprinklers, place the sprinkler on a platform higher than the crop to prevent water from being diverted by plant leaves and try to keep the watering pattern even by frequently moving the sprinkler, overlapping about ½ of each pattern.
3. Do not get foliage wet in the evening; this can encourage diseases. Morning watering is preferred.
4. 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. Water is allowed to soak or seep into the soil slowly.
5. It is best to add enough water to soak the soil to a depth of 5 to 6 inches. It takes approximately 2/3 gallon of water for each square foot or 65 to 130 gallons for 100 square feet of garden area. This varies with the nature of the soil. Frequent, light waterings will only encourage shallow rooting which will cause plants to suffer more quickly during drought periods, especially if mulches are not used. On the other hand, too much water, especially in poorly drained soils, can be as damaging to plant growth as too little water.

6. By knowing the critical watering periods for selected vegetables, you can reduce the amount of supplemental water you add. This can be important where water supplies are limited. In general, water is most needed during the first few weeks of development, immediately after transplant, and during development of edible storage organs.

   Specifically, the critical watering periods for selected vegetables are:

| | |
|---|---|
| Asparagus | Spear production, fern development |
| Broccoli | Head development |
| Cabbage | Head development |
| Cauliflower | Head development |
| Beans | Pod filling |
| Carrot | Seed emergence, root development |
| Corn | Silking, tasseling, ear development |
| Cucumber | Flowering, fruit development |
| Eggplant | Flowering, fruiting |
| Lettuce | Head development; moisture should be constant |
| Melons | Flowering, fruit development |
| Peas | Pod filling |
| Tomato | Flowering, fruiting |

7. In areas prone to repeated drought, look for drought-resistant varieties when buying seed or plants.

# Fertilizing the Garden

The amount of fertilizer to apply to a garden depends on the natural fertility of the soil, the amount of organic matter present, the type of fertilizer used, and the crop being grown. The best way to determine fertilizer needs is to have the soil tested. Soil testing is available through your local Extension agent, and with soil test kits which can be purchased from garden shops and catalogs. Vegetables fall into three main categories according to their fertilizer requirements: heavy feeders, medium feeders, and light feeders. It may be advantageous to group crops in the garden according to their fertilizer requirements to make application easier. For a complete discussion of fertilizers, refer to the Soils chapter.

# Weed Control in the Garden

The old saying, “One year’s weed - seven years’ seed,” contains more truth than myth, as most gardeners soon learn. Weeds (some native and some introduced) are remarkably adapted to conditions in the area where they grow, usually much more so than the imported cultured vegetables we prize so highly for food. Many weeds which would otherwise not be growing in a lawn or natural area appear to spring up as if by magic when the soil is cultivated. Weed seeds may remain viable for those 7 (or more) years when conditions are not right for their growth. Then, brought to the surface by tilling, and uninhibited by sod, shade, or other factors, they germinate and become the pests that take water, nutrients, sunlight, and space from vegetable plants.

## Beneficial Weeds

Many plants considered weeds in the garden have positive attributes. Some, such as morning glory, and even thistles, have flowers that rival those intentionally planted in flower beds. In fact, seeds of some weeds are sold by seed companies as flowering plants.

Other native plants are edible, providing nutritious variety to the regular diet: dandelions, purslane, chickweed, cress, mustards, and lamb’s quarters all offer greens; blackberries produce sweet fruits; Jerusalem artichokes, or sunchokes, are nothing but the tubers of the native sunflower. Before attempting to eat wild plants, be sure that you have properly identified them. A course from a person knowledgeable about wild edibles is probably the best way to learn; books often do not make fine distinctions between edible and non-edible wild plants.

Weeds are often a habitat for various insects, some of which are beneficial to the garden. They provide shelter, pollen, and nectar for such insects as bees and predators of garden pests, such as praying mantis.

Wild plants also have other virtues. Parts of some plants are used in natural dyes and other home-made products. Weeds can be a good source of nitrogenous materials for the compost pile if pulled before flowering. Many have long roots which bring elements from the subsoil into their above-ground tissues; when the weeds are pulled or tilled and allowed to decay in the garden, these elements are made available to other plants. Finally, the presence of some native plants can indicate certain soil problems, e.g., deficiencies, pH changes, soil compaction, etc. A small number of books are available with detailed information on this subject.

## Control Methods

Despite all this goodness, most gardeners won't tolerate weeds in their vegetable plots. Perhaps it is an overreaction to the first garden he or she allowed to go completely to weeds or perhaps it's the unruly appearance of weeds. This may be a sensible approach. If one doesn't have time to ruthlessly destroy morning glory vines after enjoying the first few flowers and before they go to seed, the garden will soon become one glorious display of morning glories and little else.

**Cultivation:**

There are several ways to rid the garden of most problem plants. Since mature weeds extract large quantities of moisture and nutrients from the soil, it is more beneficial (and easier) to remove weeds when they are young and tender. Hand-pulling and digging are okay for small gardens and raised beds. Those with larger spaces 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 it is not the most pleasant chore to get behind a smoky, noisy engine on a hot summer day. 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. Deep cultivation with any instrument is likely to damage roots or stems of crop plants.

Turning under weeds, especially before they flower, provides organic matter to the soil. Hand-pulled weeds, except for rhizomatous grasses, may be laid on top of the soil to dry out and will eventually have the same effect. However, if rain is predicted in the area within a day or two, it's best to collect the weeds and add them to the compost pile; rain will wash soil around the roots and some weeds will survive. If weeds have started to go to seed, leaving them in the garden is not a good idea. Composting may not destroy weed seeds if the pile doesn't heat up enough after the weeds are added. Grasses that spread by rhizomes or stolons for example, quackgrass also present a problem if not completely dried up. In these cases, despite their potential value as organic material, it's better to let the trash collectors take the weeds, or burn them and spread the ashes in the garden (if local ordinances permit). 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. Working wet soil will change the structure, especially of heavy soils. When it is too dry, weeds are difficult to pull and hoeing is also hard. A day or two after a rain or irrigation is probably the best time to cultivate. If you have a choice, remember that the work will be much more pleasant in the cool temperatures of early morning or evening. On hot summer afternoons, you are likely to fatigue more easily, get a sunburn, or suffer from sun poisoning, sunstroke, or worse. Wear protective clothing if you must work when it's sunny, and stop frequently for rest and refreshment. Controlling weeds when they are small will greatly reduce labor.

**Mulching:**

Mulching can be an alternative to weeding if you have a reliable source of mulching materials. Thick layers of organic mulch will not allow most annual weeds to poke through, and those that do are usually easily pulled. Weeds with runners are often not so easily controlled, and black plastic may be a better choice where these prevail. For paths, newspaper, old carpeting, or other such materials, covered with sawdust, will provide excellent weed suppression.

**Close Spacing:**

Once vegetable plants are established, if they have been planted close enough to each other, they will shade the soil and prevent the growth of many weed seedlings. This is the effect achieved by a well-planned raised bed, in which plants are spaced so that the foliage of adjacent plants touches and forms a closed canopy at a mature growth stage.

**Other Practices:**

Some gardeners are experimenting with various types of no-till gardening to reduce weed problems and prevent erosion and moisture loss. The standard farm no-till practice of sowing a fall cover crop and then killing it with a herbicide, and planting vegetables in the dead sod, after a recommended waiting period, is one method. However, there are no herbicides recommended for use in established home vegetable gardens to kill emerged weeds at the present time. Use of weed-killers normally recommended for lawns or other areas is not advised, and until a safe herbicide is available for growing weeds, this type of no-till practice is unsafe for growing vegetables in the home garden. One alternative is the use of a living sod, mowed regularly, which has many of the benefits of no-till and does not necessitate the use of herbicides. This practice works best with raised beds, so that only the paths need to be mowed.

The use of cover crops over several seasons or years in a particularly weedy section can also reduce weed problems. However, this method requires leaving that part uncultivated, reducing gardening space. Cover crops must also be mown or harvested regularly, which can be time-consuming and/or difficult without appropriate tools. Investigate crop rotations thoroughly before using them to control weeds. All of the above techniques are still in the experimental stage for home gardeners. Try them in small sections of the garden to determine their effectiveness.

Vegetable Planting Chart and Recommended Planting Dates

# Planting Guide

The Vegetable Planting Guide can be used to determine the approximate proper amount of crop to plant for the desired yield, the amount of seed or transplants required for that amount of crop, and proper spacing between plants in a row.

In intensive, raised-bed gardens, use the in-row figures between all plants; i.e., use equidistant spacing between plants. Sow seeds to a depth 3 to 5 times the diameter of the seed. For mid-summer plantings, sow up to twice this depth.

## Planting Chart for the Home Garden

| Crop | Suggested feet of row or amount per person[5] | Seeds or plants (P) per 100 ft of row | Planting Distance (Inches) Between Rows | Between Plants or Hills (H) | Depth of Planting (Inches) | Average Planting Date in New Hampshire[4] |
|---|---|---|---|---|---|---|
| Asparagus | 15-20 | 60-70 (P) | 36-48 | 18 | 6-8 | April 20-May 15 |
| Beans | | | | | | |
| Pole | 10 | ½ lb. | 36 | 24 (H) | 1 | May 15-June 15 |
| Snap | 20-30[1] | 3/4 lb. | 24 | 2-4 | 1 | May 15-July 1 |
| Beets | 10-15[1] | 1oz. | 12-18 | 2-3 | ½ | April 25-July 1 |
| Broccoli and Brussel Sprouts | 5 plants | 1/8oz. or 67(P) | 24-36 | 24-30 | 1/4 | May 10- July 1 |
| Cabbage | | | | | | |
| Early | 5 plants | 1/8oz. or 67-100 (P) | 24-36 | 12-18 | 1/4 | May 10 |
| Late | 10 plants | | 24-36 | 18-24 | 1/4 | July 1 |
| Carrots | 50-75[1] | ½oz. | 12-18 | 2-3 | ½ | May 1-July 1 |
| Cauliflower | 5 | 1/8oz. or 67 (P) | 24-36 | 24-30 | 1/4 | May 10-July 1 |
| Swiss Chard | 5 | 1oz. | 18-24 | 6-8 | ½ | May 1-July 1 |
| Sweet Corn | | | | | | |
| Early | 20 | 1/4lb. | 24-36 | 6 | 1 | May 1-July1 |
| Midseason | 20 | | | | 8 | |
| Late | 20 | | | | 9 | |
| Cucumbers | 10-15 | 1/2oz. | 48-72 | 48 (H) | 3/4 | May 25-June 15 |
| Eggplant | 2 plants | 1 pkt. or 67 (P) | 24-36 | 18 | 1/4 | May 25-June 15 |
| Lettuce | | | | | | |
| Head | 5-10[1] | 1/4oz. or 75-100(P) | 12-18 | 15-18 | 1/4 | May 1-July 1 |
| Leaf | 5[1] | 1/4oz. | 12-18 | 6 | 1/4 | May 1-Aug. 1 |
| Melons | | | | | | |
| Muskmelons | 10-25 | 1/2oz. or 60-100(P) | 72-96 | 48 (H) | 3/4 | June 1-June 15 |
| Watermelons | 10-15 | 1oz. or 50-60 (P) | 96-144 | 60 (H) | 3/4 | June 1-June 15 |
| Onions | 10-20 | 1lb. (sets) | 12-18 | 1-3 | ½ | April 20-May 15 |
| Parsnips | 5-10 | 1/2oz. | 18-24 | 2-4 | ½ | May 1-May 15 |

| Crop | Suggested feet of row or amount per person[5] | Seeds or plants (P) per 100 ft of row | Planting Distance (Inches) Between Rows | Between Plants or Hills (H) | Depth of Planting (Inches) | Average Planting Date in New Hampshire[4] |
|---|---|---|---|---|---|---|
| Peas | | | | | | |
| Early & Late | 50-150[1] | 1lb. | 18-36 | 1-2 | 1 | April 15-July 15 |
| Peppers | 2 plants | 1 pkt. or 67 (P) | 18-24 | 18 | 1/4 | May 25-June 20 |
| Pumpkins[2] | 1 hill | 1oz. | 36 | 48 (H) | 1 | May 25-June 10 |
| Radishes | 5[1] | 1oz. | 112-18 | 1 | ½ | April 15-Aug. 15 |
| Rhubarb | 5-10 | 40-50 (P) | 48 | 24-30 | 2-3 | April 20-May 15 |
| Rutabagas | 10-20 | 1/4oz. | 18-24 | 6-8 | ½ | June 1-July 1 |
| Spinach | 25[1] | 1oz. | 12-18 | 3-4 | ½ | April 10-May 10 |
| Squash[2] | | | | | | |
| Summer | 1 hill | 1oz. | 36 | 48 (H) | 1 | May 25-July 1 |
| Winter | 20-30 | 1oz. | 72-96 | 72 (H) | 1 | May 25-June 10 |
| Tomatoes | 15 plants[3] | 1 pkt. or 25-67(P) | 24-48 | 18-36 | 1/4 | May 25-June 10 |

[1] Make two or more plantings or plant early, midseason, and late varieties at same time. Suggested amount is for each planting.

[2] Planting distance is for bush types. If large vine types are planted, allow more space.

[3] If only early varieties are planted, allow 15 plants per person. If main crop varieties are grown, plant 8-10 plants per person.

[4] The exact date may vary with the season, soil type and local planting conditions.

[5] Assuming you freeze, store and can vegetables at home, these are the vegetable needs per person.

## Intensive Gardening Methods

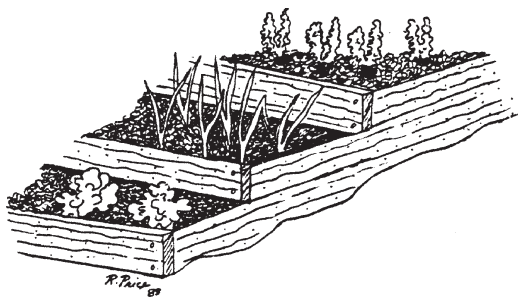
The purpose of an intensively grown garden is to harvest the most produce possible from a given space. More traditional gardens consist of long, single rows of vegetables spaced widely apart. Much of the garden area is taken by the space between the rows. An intensive garden reduces wasted space to a minimum. The practice of intensive gardening is not just for those with limited garden space; rather, an intensive garden concentrates work efforts to create an ideal plant environment, giving better yields with less labor.

Though its benefits are many, the intensive garden may not be for everyone. Some people enjoy the sight of long, straight rows in their gardens. Others prefer machine cultivation to hand weeding; though there is often less weeding to do in intensive plantings because of fewer pathways and closely spaced plants, the weeding that must be done is usually done by hand or with hand tools. Still other gardeners like to get their gardens planted in a very short period of time and have harvests come in all at once. The intensive ideal is to have something growing in every part of the garden at all times during the growing season.

A good intensive garden requires early, thorough planning to make the best use of time and space in the garden. Interrelationships of plants must be considered before planting, including nutrient needs, shade tolerance, above- and below-ground growth patterns, and preferred growing season. Using the techniques described below, anyone can develop a high-yielding intensive garden.

### The Raised Bed

The raised bed or growing bed is the basic unit of an intensive garden. A system of beds allows the gardener to concentrate soil preparation in small areas, resulting in effective use of soil amendments and creating an ideal environment for vegetable growth.



Beds are generally 3 to 4 feet wide and as long as desired. The gardener works from either side of the bed, reducing the incidence of compaction caused by walking on the soil.

Soil preparation is the key to successful intensive gardening. To grow so close together, plants must have adequate nutrients and water. Providing extra synthetic fertilizers and irrigation will help, but there is no substitute for deep, fertile soil high in organic matter. Humus-rich soil will hold extra nutrients, and existing elements that are “locked up” in the soil are released by the actions of earthworms, microorganisms and acids present in a life-filled soil, making them available for plant use.

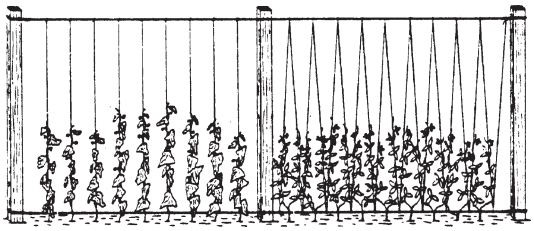
If your soil is not deep, double-dig the beds for best results. Remove the top 12 inches of soil from the bed. Insert a spade or spading fork into the next 10 to 12 inches of soil and wiggle the handle back and forth to break up compacted layers. Do this every 6 to 8 inches in the bed. Mix the top soil with a generous amount of compost or manure, and return the mixture to the bed. It should be somewhat fluffy and may be raised slightly. To create a true raised bed, take topsoil from the neighboring pathways and mix it in as well.

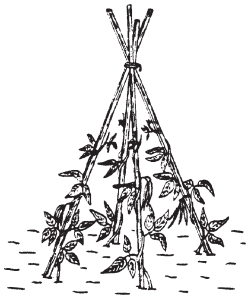
This is a lot of work! Try it in one or two beds for some of your most valuable plants; if you like the results you can proceed to other beds as you have time. One nice thing about raised bed gardening is that it breaks work into units. Instead of gazing desperately at a garden full of weeds, thinking you’ll never have time to clean it up, you can look at each bed and say, “I can do that in half an hour today!” Other chores are accomplished with the same ease.

By their nature, raised beds are a form of wide-bed gardening, a technique by which seeds and transplants are planted in wide bands of several rows or broadcast in a wide strip. In general, the goal is to space plants at equal distances from each other on all sides, such that leaves will touch at maturity. This saves space, and the close plantings reduce moisture loss from surrounding soil.

## Vertical Gardening

The use of trellises, nets, strings, cages, or poles to support growing plants constitutes vertical gardening. This technique is especially suited, but not limited, to gardeners with a small garden space. Vining and sprawling plants, such as cucumbers, tomatoes, melons, and pole beans are obvious candidates for this type of gardening. Some plants entwine themselves onto the support, while others may need to be tied. Remember that a vertical planting will cast a shadow, so beware of shading sun-loving crops, or take advantage of the shade by planting shade-tolerant crops near the vertical ones. Plants grown vertically take up much less space on the ground, and though the yield per plant may be (but is not always) less, the yield per square foot of garden space is much greater. Because vertically growing plants are more exposed, they dry out faster and may need to be watered more frequently than if they were allowed to spread over the ground. This fast drying is also an advantage to those plants susceptible to fungus diseases. A higher rate of fertilization may be needed, and soil should be deep and well-drained to allow roots to extend vertically rather than compete with others at a shallow level.





## Interplanting

Growing two or more types of vegetables in the same place at the same time is known as interplanting. Proper planning is essential to obtain high production and increased quality of the crops planted. This technique has been practiced for thousands of years, but is just now gaining widespread support in this country. To successfully plan an interplanted garden the following factors must be taken into account for each plant: 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 allelopathic effects of sunflowers and Jerusalem artichokes on nearby plants), preferred season, and 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 the beginner, alternating rows may be the easiest to manage at first.

Long-season (slow to mature) and short-season (quick to mature) 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, spinach, and celery may be planted in the shadow of taller crops. Heavy feeders, such as cabbage family crops, should be interplanted with less gluttonous plants.

Interplanting can help keep insect and disease problems under control. Pests are usually fairly crop-specific; that is, they prefer vegetables of one type or family. Mixing families of plants helps to break up large expanses of the pest-preferred crop, helping to contain early pest damage within a small area, thus giving the gardener a little more time to deal with the problem. One disadvantage is that when it does come time to spray for pests, it's hard to be sure that all plants are protected.

## Spacing

Individual plants are closely spaced in a raised bed or interplanted garden. An equidistant spacing pattern calls for plants to be the same distance from each other within the bed; that is, plant so that the center of one plant is the same distance from plants on all sides of it. In beds of more than two rows, this means that the rows should be staggered so that plants in every other row are between the plants in adjacent rows. The distance recommended for plants within the row on a seed packet is the distance from the center of one plant to the center of the next. This results in an efficient use of space and leaves less area to weed and mulch. The close spacing tends to create a nearly solid leaf canopy, acting as a living mulch, decreasing water loss, and keeping weed problems down. However, plants should not be crowded to the point at which disease problems arise or competition causes stunting.

## Succession and Relay Planting

Succession planting is an excellent way to make the most of an intensive garden. To obtain a succession of crops, plant something new in spots vacated by spent plants. Early sweet corn after peas is a type of succession.

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, cucumbers, etc).

Relaying is another common practice, consisting of overlapping plantings of one type of crop. For instance, sweet corn may be planted at 2-week intervals for a continuous harvest. This requires some care, though; crops planted very early are likely to get a slower start because of low temperatures. In the case of 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, at once, various varieties of the same vegetable; for example, you can plant an early-season, a mid-season, and a late-season corn at the same time and have a lengthy harvest.

Starting seeds indoors for transplanting is an important aspect of intensive gardening. To get the most from the garden plot, a new crop should be ready to take the place of the crop being removed. Several weeks may be gained by having 6-inch transplants ready to go into vacated areas. Don't forget to recondition the soil for the new plants.

## Planning an Intensive Garden

Begin planning your garden early. In January or February, when the cold days of winter seem never-ending, pull out last-year's garden records and dig into the new seed catalogs. As with any garden, you must decide what crops you want to grow based on your own likes and dislikes, as well as how much of each you will need. An account of which cultivars were most successful or tasted best is helpful in making crop choices. Use the charts below, and your own experience, to determine which crops are likely combinations.

Good gardening practices such as watering, fertilizing, crop rotation, composting, and sanitation are especially important in an intensive garden. An intensive garden does require more detailed planning, but the time saved in working the garden and the increased yields make it well worthwhile. Use your imagination and have fun!

### Intensive Spacing Guide

Note: To determine spacing for interplanting, add the inches for the two crops to be planted together, and divide the sum by 2. For example, if radishes are planted next to beans, add 2 inches + 4 inches = 6 inches, then divide 6 inches by 2 inches = 3 inches. The radishes should be planted 3 inches from the beans.

| Plant | Inches | Plant | Inches |
|---|---|---|---|
| Asparagus | 15-18 | Lettuce, head | 10-12 |
| Beans, pole | 6-12 | Lettuce, leaf | 4- 6 |
| Beans, bush | 4- 6 | Melons | 18-24 |
| Beets | 2- 4 | Mustard | 6- 9 |
| Broccoli | 12-18 | Onion | 2- 4 |
| Brussels sprouts | 15-18 | Peas | 2- 4 |
| Cabbage | 15-18 | Peppers | 12-15 |
| Cabbage, Chinese | 10-12 | Potatoes | 10-12 |
| Carrots | 2- 3 | Pumpkins | 24-36 |
| Cauliflower | 15-18 | Radishes | 2- 3 |
| Cucumber | 12-18 | Rutabaga | 4- 6 |
| Chard, Swiss | 6- 9 | Spinach | 4- 6 |
| Collards | 12-15 | Squash, summer | 18-24 |
| Endive | 15-18 | Squash, winter | 24-36 |
| Eggplant | 18-24 | Sweet corn | 15-18 |
| Kale | 15-18 | Tomatoes | 18-24 |
| Kohlrabi | 6- 9 | Turnip | 4- 6 |
| Leeks | 3- 6 | | |

**Plants Grouped According to Nutrient Needs**

| Heavy Feeders | Light Feeders | Soil Builders |
|---|---|---|
| Asparagus | Carrot | Alfalfa |
| Beet | Garlic | Beans, broad |
| Broccoli | Leek | Beans, snap |
| Brussels sprouts | Mustard greens | Clover |
| Cabbage | Onion | Peas |
| Cantaloupe | Parsnip | |
| Pepper | Celery | |
| Collard | Rutabaga | |
| Shallot | Cucumber | |
| Eggplant | Turnip | |
| Endive | | |
| Kale | | |
| Kohlrabi | | |
| Lettuce | | |
| Parsley | | |
| Pumpkin | | |
| Rhubarb | | |
| Spinach | | |
| Squash, summer | | |
| Squash, winter | | |
| Strawberry | | |
| Sunflower | | |
| Tomato | | |
| Watermelon | | |

## Economic Value of Crops

It is difficult to evaluate the economic value of crops grown in the vegetable garden due to the different lengths of time they require for maturity and harvest, the availability of varieties and vegetables types not generally found in the marketplace, and the lack of comparison values for vegetables that are not acceptable by commercial standards (cracked tomatoes, crooked cucumbers, etc.), but which are perfectly usable by the gardener. Nevertheless, several studies have attempted to determine which crops bring the most value per square foot of garden space, partly to aid small-space gardeners in making decisions about what to plant. Of course, if no one in the family likes beets, there is no point in growing them just because they are economically valuable, but this list may help you determine which vegetables to plant and which to buy. Perennial crops are not on the list below because each of the studies was on a one-season basis. Asparagus, rhubarb, horseradish, and other perennial crops do also have considerable economic worth. Fruit trees and shrubs are also valuable producers, especially considering the long-term.

### Top 15 Vegetables in Economic Value[1]:

| | |
|---|---|
| Tomatoes | Beets |
| Green bunching onions | Cucumbers |
| Carrots | Peppers |
| Leaf lettuce | Broccoli |
| Swiss Chard | Head Lettuce |
| Summer squash | Turnips (greens&roots) |
| Edible pod peas | Beans (pole, bush) |

Onion storage bulbs

[1] **Values based on pounds produced per square foot, retail value per pound at harvest time, and length of time in the garden.**

### Low-Value Crops:

*(not recommended for small spaces)*

Corn

Squash

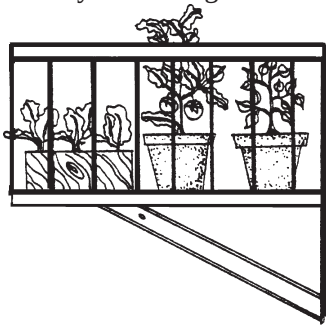
Melons

Pumpkins

Miniature varieties or trellising may increase value per square foot.

## Container Gardening

If you don't have space for a vegetable garden, or if your present site is too small, consider raising fresh, nutritious, homegrown vegetables in containers. A window sill, patio, balcony, or doorstep can provide sufficient space for a productive container garden. Problems with soil-borne diseases, nematodes, or poor soil can also be overcome by switching to container gardening.



Growing vegetables that take up little space, such as carrots, radishes and lettuce, or crops that bear fruits over a period of time, such as tomatoes and peppers, for best use of space and containers. Dwarf or miniature varieties often mature and bear fruit early, but most do not produce as well overall as standard varieties. With increasing interest in container gardening, plant breeders and seed companies are working on vegetables specifically bred for container culture. These varieties are not necessarily miniatures or dwarf and may produce as well as standard types if properly cared for.

The amount of sunlight that your container garden spot receives may determine which crops can be grown. Generally, root crops and leaf crops can tolerate partial shade, but vegetables grown for their fruits generally need at least 8 hours of full, direct sunlight each day, and perform much better with 10 to 12 hours. Available light can be increased somewhat by providing reflective materials around the plants, e.g., aluminum foil, white-painted surfaces, marble chips.

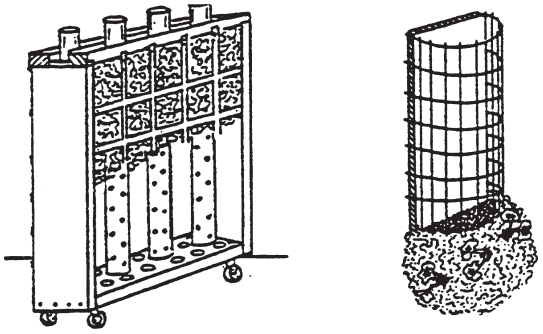
Container gardening lends itself to attractive plantscaping. A dull patio area can be brightened by the addition of baskets of cascading tomatoes or a colorful herb mix. Planter boxes with trellises can be used to create a cool shady place on an apartment balcony. Container gardening presents opportunities for many innovative ideas.

**Containers**

There are many possible containers for gardening. Clay, wood, plastic, metal are some of the suitable materials. Containers for vegetable plants must (1) be big enough to support plants when they are fully grown, (2) hold soil without spilling, (3) have adequate drainage, and (4) never have held products that would be toxic to plants or people. Consider using barrels, cut-off milk and bleach jugs, window boxes, baskets lined with plastic (with drainage holes punched in it), even pieces of drainage pipe or cement block. If you are building a planting box out of wood, you will find redwood and cedar to be the most rot-resistant, but bear in mind that cedar trees are much more plentiful than redwoods. Wood for use around plants should never be treated with creosote or pentachlorophenol (Penta) wood preservatives. These may be toxic to plants and harmful to people as well.

Some gardeners have built vertical planters out of wood lattice lined with black plastic and then filled with a lightweight medium; or out of welded wire, shaped into cylinders, lined with sphagnum moss, and filled with soil mix.

Depending on the size of your vertical planter, 2-inch diameter perforated plastic pipes may be needed inside to aid watering.



Whatever type of container you use, be sure that there are holes in the bottom for drainage so that plant roots do not stand in water. Most plants need containers at least 6 to 8 inches deep for adequate rooting.

As long as the container meets the basic requirements described above it can be used. The imaginative use of discarded items or construction of attractive patio planters is a very enjoyable aspect of container gardening. For ease of care, dollies or platforms with wheels or casters can be used to move the containers from place to place. This is especially useful for apartment or balcony gardening so that plants can be moved to get maximum use of available space and sunlight, and to avoid destruction from particularly nasty weather.

**Media**

A fairly lightweight potting mix is needed for container vegetable gardening. Soil straight from the garden usually cannot be used in a container because it may be too heavy, unless your garden has sandy loam or sandy soil. Clay soil consists of extremely small (microscopic) particles. In a container, the bad qualities of clay are exaggerated. It holds too much moisture when wet, resulting in too little air for the roots, and it pulls away from the sides of the pot when dry. Container medium must be porous in order to support plants, because roots require both air and water. Packaged potting soil available at local garden centers is relatively lightweight and may make a good container medium. Soilless mixes such as peat-lite mix are generally too light for container vegetable gardening, not offering enough support to plant roots. If the container is

also lightweight, a strong wind can blow plants over, resulting in major damage. Also, soilless mixes are sterile and contain few nutrients, so even though major fertilizers are added, no trace elements are available for good plant growth. Add soil or compost if you wish to use a sterile mix. For a large container garden, the expense of prepackaged or soilless mixes may be quite high. Try mixing your own with one part peat moss, one part garden loam, and one part clean, coarse (builder's) sand, and a slow-release fertilizer (14-14-14) according to container size. Lime may also be needed to bring the pH to around 6.5. In any case, a soil test is helpful in determining nutrient and pH needs, just as in a large garden.

**Planting**

Plant container crops at the same time you would if you were planting a regular garden. Fill a clean container to within ½ inch of the top with the slightly damp soil mixture. Peat moss in the mix will absorb water and mix much more readily if soaked with warm water before putting the mix in the container. Sow the seeds or set transplants according to instructions on the seed package. Put a label with the name, variety, and date of planting on or in each container. After planting, gently soak the soil with water, being careful not to wash out or displace seeds. Thin seedlings to obtain proper spacing when the plants have two or three leaves. If cages, stakes, or other supports are needed, provide them when the plants are very small to avoid root damage later.

**Watering**

Pay particular attention to watering container plants. Because the volume of soil is relatively small, containers can dry out very quickly, especially on a concrete patio in full sun. Daily or even twice daily watering may be necessary. Apply water until it runs out the drainage holes. On an upstairs balcony, this may mean neighbor problems, so make provisions for drainage of water. Large trays filled with coarse marble chips work nicely. However, the soil should never be soggy or have water standing on top of it. When the weather is cool, container plants may be subject to root rots if maintained too wet. Clay pots and other porous containers allow additional evaporation from the sides of the pots and watering must be done more often. Small pots also tend to dry out more quickly than larger ones. If the soil appears to be getting excessively dry (plants wilting every day is one sign), group the containers together so that the foliage creates a canopy to help shade the soil and keep it cool.

On a hot patio, you might consider putting containers on pallets or other structures that will allow air movement beneath the pots and prevent direct contact with the cement. Check containers at least once a day, and twice on hot, dry, or windy days. Feel the soil to determine whether or not it is damp. Mulching and windbreaks can help reduce water requirements for containers. If you are away a lot, consider an automatic drip emitter irrigation system.

**Fertilizing**

If you use a soil mix with fertilizer added, then your plants will have enough nutrients for 8 to 10 weeks. If plants are grown longer than this, add a water-soluble fertilizer at the recommended rate. Repeat every 2 to 3 weeks. An occasional dose of fish emulsion or compost will add trace elements to the soil. Do not add more than the recommended rate of any fertilizer, since this may cause fertilizer burn and kill the plants. Container plants do not have the buffer of large volumes of soil and humus to protect them from over-fertilizing or over-liming. Just because a little is good for the plants does not guarantee that a lot will be better.

**General care**

Vegetables grown in containers can be attacked by the various types of insects and diseases that are common to any vegetable garden. Plants should be periodically inspected for the presence of foliage-feeding and fruit-feeding insects as well as the occurrence of diseases. Protect plants from very high heat caused by light reflection from pavement. Move them to a cool spot or shade them during the hottest part of the day. Plants should be moved to a sheltered location during severe rain, hail, or wind storms, and for protection from early fall frosts.

**Indoor container gardening with vegetables**

If you want fresh, home-grown vegetables over the winter, or if you don't have an outdoor space in which you can place containers, it is worth trying some indoor container gardening. Of course you cannot have a full garden in the house, but a bright, sunny window can be the site for growing fresh food all year. Some small-fruited tomatoes and peppers, several types of lettuce, radishes, and many herbs are among the plants you can include in the indoor garden.

Follow directions given above for preparing pots and for watering, fertilizing, etc. However, note that plants will dry out less quickly indoors and

will also grow more slowly, needing less fertilizer. To make watering easy it is wise to set the pots in large trays with an inch or two of decorative stones in them. Not only will this prevent your having to move the plants in order to water them, which may discourage you from watering when you should, but it will also provide humidity, which is a major requirement, especially during winter when the house is warm and dry.

As mentioned before, a sunny window, preferably south-facing, is almost a must for indoor vegetable growing. Fruiting vegetables such as tomatoes and peppers will also need supplemental light, such as a combination warm-white/ cool-white fluorescent fixture, during winter months. Insufficient light will result in tall, spindly plants and failure to flower and set fruit.

Herbs are a first choice for many indoor gardeners. Many are less demanding than vegetable plants, and cooks find it pleasant to be able to snip off a few sprigs of fresh parsley or chop some chives from the windowsill herb garden. Chives grow like small onions with leaves about 6 inches tall. These plants prefer cool conditions with good light, but will grow quite well on a windowsill in the kitchen. One or two pots of chives will provide leaves for seasoning salads and soups. Plant seeds in a 6-inch pot. The plants should be about 1 inch apart over the entire surface area. It will require about 12 weeks from the time seeds are planted until leaves can be cut. For variety, try garlic or Chinese chives, which grow in a similar fashion, but have a mild garlic flavor.

Parsley seeds can be planted directly into 6-inch pots, or young, healthy plants can be transplanted from the garden. One vigorous plant per pot is enough. Standard parsley develops attractive, green, curly leaves about 6 or 8 inches tall. Italian, or flat-leaved, parsley has a slightly stronger flavor and is a favorite for pasta dishes. Leaves can be clipped about 10 to 12 weeks after planting the seeds.

Cilantro, or the leaves of the young coriander plant, can be grown in the windowsill garden. Cilantro is used in Oriental and Mexican dishes, but it is not available in most grocery stores and must be used fresh. Grow cilantro as you would parsley. Thyme and other herbs will also grow well indoors if given the right conditions.

The small-fruited varieties of tomatoes such as Tiny Tim, Small Fry, and the paste tomato, Roma, may be raised quite satisfactorily in the home. They will challenge your gardening ability, and supply fruits which can be eaten whole, cooked, or served with salad. The Tiny Tim tomato grows to a height of about 12 to 15 inches. Small Fry, which is about 3 feet tall, and Roma will need more space and should be located on an enclosed porch or in a sun room. Several varieties have been developed for hanging baskets; they may be worth experimenting with.

Some of the small-fruited peppers may be grown as indoor plants. Like tomatoes, they require warm, bright conditions in order to grow well indoors. Fruits will be ready to harvest from peppers and tomatoes about ten weeks after planting. Whiteflies and aphids may present a problem on indoor tomato and pepper plants. Keep a close watch for these pests so they do not get a good start in your planting. Yellow sticky traps, either purchased or homemade, are effective in trapping whiteflies. Insecticidal soap or other pesticide approved for vegetable plants can be used to control aphids. Fortunately, you will be less likely to experience problems with such outdoor pests as tomato hornworms and early blight than you would if plants were outside.

For a quick-growing crop, try radishes. These must be grown very rapidly if they are to be crisp and succulent. Scatter radish seeds on moist soil in a 6-inch pot. Cover with ¼-inch of soil and place a piece of glass or plastic wrap over the pot to conserve moisture until the seeds germinate. Carrots are slower, but can be grown in the same way; use the small-rooted varieties, such as Little Finger, for best results indoors.

Experiment with various types of lettuce. Leaf lettuce and the miniature Tom Thumb butterhead are some to try. Space them according to package directions. Keep lettuce moist and in a very sunny spot.

If light is limited, an old standby for fresh taste and high food value is sprouted seeds. Almost any seeds can be sprouted: corn, barley, alfalfa, lentils, soybeans, rye, peas, radish, mung beans, sunflowers, etc. Use only special seeds for sprouting available from health food or grocery stores to avoid the possibility of getting seeds treated with pesticides. Use any wide-mouthed container such as a Mason or mayonnaise jar. Soak seeds overnight, drain, and place in the container. Cover with a double cheesecloth layer held with rubber bands, or a sprouting lid. Set the container in a consistently warm spot and rinse and drain seeds two or three times daily. In 3 to 5 days, sprouts will be 1 to 3 inches long and ready for harvesting.

## Information for Growing Vegetables in Containers

| Vegetable[1] | Light Requirements[2] | Minimum Container Size | **Distance (“)** Plants in Containers | Days from Seed to Harvest | Comments |
|---|---|---|---|---|---|
| Beans, bush | FS | 2 gal. | 2-3 | 45-60 | Several plantings, week intervals |
| Beets | FS/PS | ½ gal. | 2-3 | 50-60 | Thin plants when 6-8" tall |
| Carrots | FS/PS | 1 qt. | 2-3 | 65-80 | Several plantings, 2-week intervals |
| Cabbage | FS/PS | 3 gal. | 12-18 | 65-120 | Requires fertile soil |
| Chard, Swiss | FS/PS | ½ gal. | 4-6 | 30-40 | Harvest leaves |
| Cucumbers | FS | 3 gal. | 14-18 | 70-80 | Require hot weather, vining types need support |
| Eggplant | FS | 3 gal. | 1 plant per | 75-100 | Requires fertile soil container |
| Kale | FS/PS | 2 gal. | 10-15 | 55-65 | Harvest leaves |
| Lettuce, leaf | PS | ½ gal. | 4-6 | 30-35 | Harvest leaves |
| Mustard greens | PS | ½ gal. | 4-5 | 35-40 | Several plantings 2-week intervals |
| Onions, green | FS/PS | ½ gal. | 2-3 | 70-100 | Requires lots of moisture |
| Peppers, Bell | FS | 2 gal. | 1 plant per | 110-120 | Require hot weather container |
| Squash, summer | FS | 3 gal. | 1 plant per | 50-60 | Plant only bush type container |
| Tomatoes | FS | 3 gal. | 1 plant per | 55-100 | Stake and prune or cage container |
| Tomatoes, cherry | FS | 1 gal. | 1 plant per | 55-100 | Helps to stake & prune container |
| Turnips | FS/PS | 3 gal. | 2-3 | 30-60 | Harvest roots & leaves |

[1] Consult seed catalogs for varieties adapted to container culture

[2] FS = Full Sun  FS/PS = Full sun; tolerates partial shade  PS = Partial shade

# Vegetable Gardening in the Fall
# Planting for a Fall Harvest

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 large and varied harvests from your still-productive garden site.

Many varieties of vegetables can be planted in midsummer to late summer for fall harvests. Succession plantings of warm season crops, such as corn and beans, can be harvested until the first killing frost. Cool season crops, such as kale, turnips, mustard, broccoli, cabbage, etc., grow well during the cool fall days and withstand light frosts. Timely planting is the key to a successful fall garden. Refer to the planting chart for latest planting dates.

When planting fall crops, prepare the soil by restoring nutrients removed by spring and summer crops. A light layer of compost or aged manure, or a small application of complete chemical fertilizer will boost soil nutrients in preparation for another crop.

Dry soil may make working the soil difficult and inhibit seed germination during the midsummer period. Plant fall vegetables when the soil is moist after a rain, or water the area thoroughly the day before planting. Seeds may be planted in a shallow trench to conserve moisture. Cover the seeds about twice as deeply as you do in the spring. An old-time trick for germinating seeds in midsummer is to plant the seeds, water them in well, and then place a board over the row until the sprouts just reach the soil surface; at that time remove the board. Plastic will also work, but must be completely anchored so the soil does not dry out underneath or the plastic blow away. An organic mulch on top will help keep soil cool. Mulching between rows can also help keep soil cool and decrease soil drying. In severe hot weather a light, open type of mulch, such as loose straw or pine boughs, may be placed over the seeded row. This must be removed as soon as seedlings are up so that they receive full sun. Starting transplants in a shaded cold frame or in a cool indoor area is another possibility.

Once young plants are established, a heavier mulch may be used to hold moisture and control weeds. Irrigate when necessary so the young plants have sufficient moisture. Fall plantings often have few insect problems, as they avoid the peak insect activity period of midsummer. However, some insects, such as cabbageworm and corn earworm, may be even worse late in the year than in summer; vigilance is still required! Avoid some pests and diseases by planting crops of different families than were originally in that section of the garden.

Some of the best quality vegetables are produced during the warm days and cool nights of the fall season. These environmental conditions add sugar to sweet corn and crispness to carrots. Parsnips and rutabagas are examples of crops that are very much improved by a touch of frost.

Protection of vegetable plants during cold periods may extend your season even further. Though in the hot days of summer the last thing you want to think about is planting more crops to take care of, look ahead to the fall garden, which offers its own satisfaction through prolonged harvest of fresh vegetables, savings in food costs, and the knowledge that you're making full use of your gardening space and season.

## Care of Fall Crops

The beginning of fall garden care comes when the weather and the radio station announce the first arrival of frost. Your main concern then should be to harvest all ripe, tender crops. Tomatoes, summer squash, melons, eggplant, cucumbers and peppers are some of the crops that cannot withstand frost and should be picked immediately. Store the vegetables in a place where they can be held until needed for eating or processing. If the frost warning is mild, predicting no lower than a 30° F., try covering tender plants in your garden that still hold an abundance of immature fruit. Baskets, burlap, boxes, row covers, blankets, or buckets help protect them from the frost. Warm days after the frost will still mature some of the fruit as long as the plants have this nightly frost protection. Much will depend on the garden's microclimate. If your spot is low and unsheltered, it is likely to be a frost pocket. Gardens sheltered from winds and on the upper side of a slope are less susceptible to early frost damage.

When using a cold frame to extend the harvest season, be sure to close the top on frosty nights to protect the plants from the cold. When the sun comes out the next morning and the air warms, open the cold frame again; leave it closed if daytime temperatures are low. Spun bonded row covers work well for season extension.

Cool-season crops such as cabbage, cauliflower, broccoli, spinach, and Brussels sprouts can withstand some cold. In fact, their flavor may be enhanced after a frost. They cannot stay in the garden all winter, but do not need to be picked immediately when frost comes. Kale, spinach, evergreen bunching onions, lettuce, parsley, parsnips, carrots, and salsify are some crops that may survive all winter in the garden. Mulch these overwintering vegetables with 8 inches of mulch to prevent heaving of the soil. Most of these vegetables can be dug or picked in early spring.

Now is the time to prepare perennial vegetables for winter, too. Most will benefit from a topdressing of manure or compost and a layer of mulch, which reduces damage from freezing and thawing. Dead leaf stalks of perennial vegetables such as asparagus and rhubarb should be cut to the ground after their tops are killed by frost, though some people prefer to leave asparagus stalks until late winter to hold snow over the bed. Don't forget strawberry beds. Remove weeds that you let grow when you were too busy last summer. You can transplant some of the runner plants if you carefully dig a good-sized ball of soil with the roots. Mulch the bed well with a light material. Old raspberry canes can be cut back at this time or late in the winter.

When tender crops have been harvested and overwintering crops cared for, pull up all stakes and trellises in the garden except those stakes that are clearly marking the sites of overwintering plants. Clean stakes and trellises of remnants of plant materials and soil. Hose them down and allow to dry. Tie stakes in bundles and stack them so that they won't get lost over the winter. If possible, roll up wire trellises and tie them securely. Store these items inside your attic, barn, or shed in an area where they are out of the way, and where rodents and other animals cannot get to them to use as winter nests.

## Preparing Soil for Winter

Pull up all dead and unproductive plants and place this residue on top of the soil to be tilled under, or in the compost heap. Remove any diseased or insect-infested plant material from the garden that may shelter overwintering stages of disease and insect pests. If this plant material is left in the garden, you are leaving an inoculum of diseases and insects which will begin to reproduce the next spring and add to your pest problems.

The best thing to do is to remove infested plant material from the garden or burn it. Burning will kill any diseases or insects that may be in plant wastes. Spread the ashes on the garden to get the benefit of mineral nutrients. Check laws in your area before burning anything; you may need a permit. If you live near a wooded area, burning may be too risky. In this case, haul the diseased material away.

Clean-up also gives you the chance to add compost to the garden. Compost contains highly nutritious, decomposed plant material and beneficial organisms, and is an excellent soil-builder. By spreading compost and other wastes on the soil and plowing them in, you are adding nutrients to the soil for next year's crop. The beneficial insects and microorganisms in the compost will help integrate the compost with the soil, and the added humus will improve soil structure.

Don't overlook other excellent sources of organic material available during the fall. Leaves are abundant, and neighbors will usually be glad to give their leaves away. Put some on the garden now and store some for next year's mulch. Leaves will mat if put on in too thick a layer, and will not decompose quickly. You can help leaves break down more easily by running a lawn mower back and forth over the pile. Put the shredded leaves directly onto the garden or compost them. Sawdust and wood chips are easy to obtain from sawmills and many farms and stables want to get rid of manure piles before winter sets in.

If you wait until spring to add organic material to the garden, it may not have time to decompose and add its valuable nutrients to the soil by the time you are ready to plant, and you may have to delay planting to a later date. Hot (very fresh) manure can also burn young seedlings. By adding these materials in the fall, you give them plenty of time to decompose and blend into the soil before planting time. If you don't have enough organic material for the entire garden, try to cover those areas that you want especially rich for next summer's crop.

If the weather stays dry enough before the ground freezes, you can plow or rototill in the fall. Turning under vegetation in the fall allows earlier planting in the spring and is especially good for heavy soils, since they are exposed to the freezing and thawing

that takes place during the winter. This helps to improve soil structure. If you have a rainy fall, or if the garden is steep and subject to erosion, you may decide you'd rather plant a cover crop for winter garden protection. A cover crop decreases erosion of the soil during the winter, adds organic material when it is incorporated in the spring, improves soil tilth and porosity, and adds valuable nutrients. Winter cover crops can be planted as early as August 1 but should not be planted any later than mid-September. 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.

Prepare the soil for cover crop seed by tilling under plant wastes from the summer. Ask at the seed store what the best type of cover crop for your area is and at what rate (pounds per 100 square feet) to plant it. Broadcast the seed, preferably before a rain, and rake it evenly into the soil. Spring planting may be delayed somewhat by the practice of cover cropping, since time must be allowed for the green manure to break down. If you have crops that need to be planted very early, you may prefer to leave a section of the garden bare or with a stubble mulch.

When time or weather conditions prohibit either tilling or cover cropping, you may wish to let your garden lie under a mulch of compost, plant wastes, or leaves all winter to be plowed or tilled under in the spring. However, if you want to plant early the next spring, a mulch of heavy materials such as whole leaves may keep the soil cold long enough to delay planting. In this case, chop them fine enough that they will break down over the winter. The addition of fertilizer high in nitrogen will also help break down organic matter more quickly.

Some cover crops suitable for winter use are in the table on the next page. Mixtures of legumes and non-legumes are effective as well.

# Cover Crops

| Type | Legume/ Non-Legume | Amount to sow per 100 sq. ft. (Oz.) | When to Sow | When to Turn Under | Effects | Notes |
|---|---|---|---|---|---|---|
| Alfalfa | L | ½ | Spring | Fall | Fixes 150-250 lbs. N/ac./yr.; deep roots break up hard soil, trace elements to surface | Loam, fairly fertile soil; needs warm temps. For germination. Lime if pH is low. Hardy. In mtns sow by Aug. 10. Drought - tolerant. Innoculate |
| | | | Late Summer | Spring | | |
| Barley | N | 4 | Fall | Spring | Adds organic matter; improves soil aggregation. | Prefers medium-rich, loam soil. Lime if pH is low. Not as hardy as rye. Tolerates drought. |
| | | | Spring | Fall | | |
| Buckwheat | N | 2-1/2 | Spring | Summer | Mellows soil; rich in potassium | Must leave part of garden in cover crop during season. Grows quickly. Not hardy. |
| | | | Summer | Fall | | |
| Crimson Clover | L | 1/3 | Spring | Fall | Fixes 100-150 lbs. N/ac/yr. | Not reliably hardy. Sow before mid-Sept in Piedmont and mountains. Not drought-tolerant. Lime if pH is low. White clover somewhat hardier. |
| | | | Fall | Spring | | |
| Fava beans | L | Plant 8" apart | Early spring | Early summer | Some types fix 700-100 lbs. N/acre in as little as 6 wks. | Will grow on many soil types. Medium drought tolerance. Likes cool growing weather. Good for mountain areas. If planted in early spring can grow late vegetables. Innoculate with same bacteria as for hairy vetch. |
| | | | Late summer | Fall | Use small-seeded rather than large-Seed table types. | |
| Oats | N | 4 | Spring | Summer | Adds organic matter; improves soil aggregation | Needs adequate manganese. Not hardy; tolerates low pH. |
| | | | Fall | Spring | | |
| Rye, winter | N | 3-1/2 | Fall | Spring | Adds organic matter; improves soil aggregation. | Very hardy. Can plant till early October |
| Vetch, hairy | L | 2-1/2 | Early fall | Spring | Fixes 80-100 lbs. N/acre/yr. | Innoculate; slow to establish. Fairly hardy. Till under before it seeds; can become a weed. |
| Wheat, winter | N | 4 | Fall | Spring | Add organic matter; improves soil aggregation. | Same as barley. |

## Care of Garden Equipment

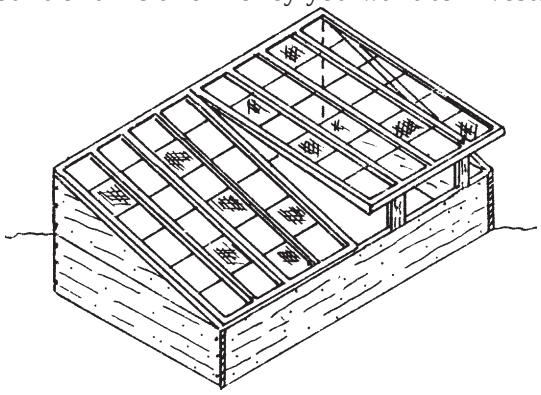
Clean-up of tools and equipment is another important practice related to the garden which should not be ignored in the fall. Proper clean-up of tools now will leave them in top shape and ready to use when spring comes. Clean, oil, and repair all hand tools. Repaint handles or identification marks that have faded over the summer. Sharpen all blades and remove any rust. Power tools should be cleaned of all plant material and dirt. Replace worn spark plugs, oil all necessary parts, and sharpen blades. Store all tools in their proper place indoors, never outdoors where they will rust over the winter.

Unless you are lucky enough to live in a warm area where a cold frame will protect vegetables all winter, you will need to clean up the frame when all vegetables have been harvested. Remove all remaining plant material and spread it on the cold frame soil. Spade the plant refuse and any other organic material into the soil in the cold frame as thoroughly as possible. Do not leave the top on the cold frame over the winter, as the cold air or the weight of snow may crack or break the glass. Remove the top, wash it thoroughly, and store it on its side in a protected indoor area where it will not get broken.

Successful gardening doesn't stop when frost comes, but continues throughout the fall and early winter months. When following good garden care practices during this time, your garden will be ready for the growth of healthy vegetables next spring.

## Season Extenders

To get the most out of a garden, you can extend the growing season by sheltering plants from cold weather both in early spring and during the fall. Very ambitious gardeners harvest greens and other cool-weather crops all winter by providing the right conditions. There are many ways to lengthen the growing season, and your choice depends on the amount of time and money you want to invest.

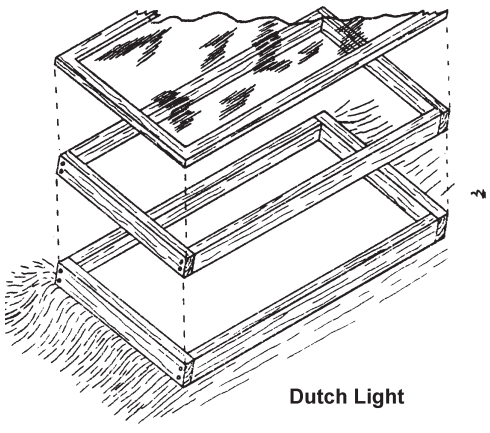


## Cold Frames and Hot Beds

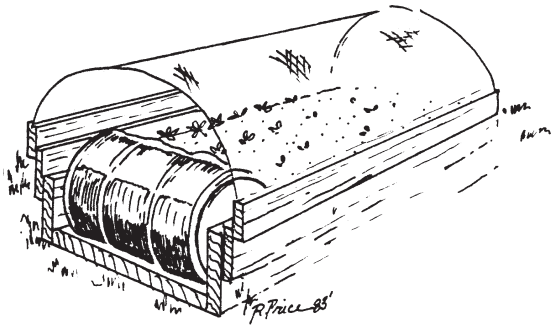
Cold frames, sun boxes, and hot beds are relatively inexpensive, simple structures providing a favorable environment for growing cool-weather crops in the very early spring, the fall, and even into the winter months. Some are elaborate and require a large investment, but are reasonable for those who are serious about having fresh vegetables during the winter.

Cold frames and sun boxes have no outside energy requirements, relying on the sun for their source of heat. Hot beds are heated by soil heating cables, steam-carrying pipes, or fresh strawy manure buried beneath the rooting zones of the plants. Heat is collected by these frames when the sun's rays penetrate the sash, made of clear plastic, glass, or fiberglass. The ideal location for a cold frame is a southern or southeastern exposure with a slight slope to ensure 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 protection, using the earth for insulation. To simplify use of the frame, consider a walkway to the front, adequate space behind the frame to remove the sash, and perhaps weights to make raising and lowering of glass sashes easier. Some gardeners make their cold frames lightweight enough to be moved from one section of the garden to another. Another possibility is the Dutch light, which is a large but portable greenhouse-like structure which is moved around the garden.

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 release it at night. The solar pod, shown on next page, is one design which provides for this type of heat storage. Other new cold frames are built with a very high back and a steep glass slope and insulated very well; these may also include movable insulation that is folded up during the day and down at night or during extremely cold weather.



Dutch Light



**Solar Pod**

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 setbacks if they are moved directly from the warmth and protection of the house to the garden. The cold frame provides a transition period for 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 or peat moss or other medium suitable for rooting cuttings.

Fall is also a good time for sowing some cool-weather crops in 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 fresh greens, herbs, and root crops throughout the cold winter months.

Growing frames can be built from a variety of materials; wood and cement block are the most common. If you use wood, choose wood that will resist decay, such as a good grade of cypress or cedar, or use pressure-treated wood. Never use creosote-treated wood or wood treated with pentachlorophenol, since these substances are harmful to growing plants. Wood frames are not difficult to build. Kits may also be purchased and easily assembled; some kits even contain automatic ventilation equipment.

There is no standard-sized cold frame. The dimensions of the frame will depend on amount of available space, desired crops, size of available window sash, and permanency of the structure. 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. Or, bales of straw or hay may be stacked against the frame.

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

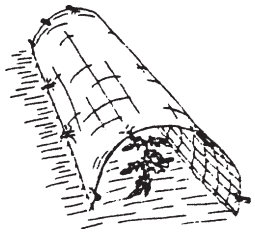
In summer, extreme heat and intensive sunlight can damage plants. This can be avoided by shading with lath or old bamboo window blinds. Watering should be done early so that plants dry before dark, to help reduce disease problems.

You may convert your cold frame to a hotbed. For a manure-heated bed: dig out to 2 feet deep (deeper to add gravel for increased drainage); add an 18-inch layer of strawy horse manure; cover with 6 inches of good soil. For an electric heated bed: dig out area 8 inches deep; lay down thermostatically controlled electric cable in 6 to 8-inch long loops, evenly spacing cable, but never crossing; cover with 2 inches of sand or soil; lay out hardware cloth to protect cable; cover with 4 to 6 inches of good soil.

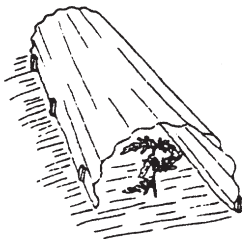
## Cloches and Row Covers

The cloche (pronounced *klosh*) 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.

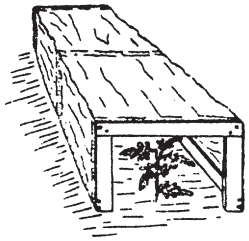
Bend wire frame over plants and secure in soil. Drape clear plastic over wire and fasten with clothpins. Fold plastic back on hot days.



Bend fiberglass panel over the row and secure it with stakes.



Build a wood frame and cover it with clear plastic.



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 hotkap and the cut-off plastic jug are simple forms. More elaborate ones are fiberglass tunnels, special plastic cloches, spunbonded row covers with slits in them to allow some aeration, and panes of glass connected by specially designed hinges to form a tent. There are a variety of forms on the market now, some which work and some which don't, and some are easily constructed from materials around the home.

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 uses you will put your greenhouse to. Then compare on that basis. Many companies will send free specifications and descriptions of the greenhouses they offer; look in gardening magazines for their ads.

The conservation-minded person may find an attached solar greenhouse desirable. The initial cost is generally higher for a solar greenhouse than for the simpler free-standing, uninsulated types, but for maximum use with lower heating bills, one can insulate north and side walls, provide liberal glass area for winter sun-catching, and make use of some type of solar radiation storage. When attached to a house, these greenhouses can be used for supplementary household heating, but there is a trade-off between heating the home and growing plants (especially heat-loving ones) in the greenhouse. Some researchers have concluded that a good compromise is to forget winter tomatoes and grow cool-weather crops during the winter in a solar attached greenhouse.

## Shading

It is not always easy to start seeds or young plants for fall crops in the hot and dry conditions of August. One simple way to provide shade in otherwise exposed conditions is to build a portable shade frame for placing over rows after seeds are sown or transplants are set out. This can be the same type of frame used for starting early seeds, but using lath strips or an old bamboo shade instead of plastic.