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# Vegetable Gardening

South Dakota State Unversity • College of Agriculture and Biological Sciences • South Dakota Cooperative Extension Service

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### Protect yourself from West Nile virus while gardening:

- Garden at times other than at dusk or in early morning.
- Wear loose-fitting, long-sleeved, long-legged clothing.
- Use insect repellents that contain DEET. Wash off when you come back in the house.
- Empty or remove any pots, watering cans, wheelbarrows, or other containers that hold standing water for more than 10 days.
- Check the outside water faucet for drips.



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# Vegetable Gardening

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Gardening provides a useful, profitable form of recreation for the entire family. When children are involved in gardening, their interest in and consumption of nutritious vegetables increases considerably. Vegetables picked and used fresh from the garden also are often superior in quality to those found in stores; grocery store produce often loses quality in the delay from grower to consumer and may have been harvested before fully ripe.

## Factors affecting plant growth

Flavorful, tender, attractive vegetables are the goal of every gardener. Two groups of factors ultimately determine the quality of the vegetable when it is prepared for table use:

- conditions affecting the crop while it is growing, and
- conditions under which the vegetables are kept between harvest and use. Reducing the time from garden to table often means fresher tasting and more nutritious produce.

To grow quality vegetables, consider the following—water, light, temperature, nutrients, pH, diseases, and insects.

### Water

Water is one of the most essential factors for plant growth since it is the major component of vegetables in their fresh state. Vegetables typically need 1 to 1 1/2 inches of water per week for good growth. Productivity and quality may both be reduced before wilting is apparent. Supplemental watering often is necessary for maximum production when rainfall is scarce.

### Light

Light is necessary for photosynthesis, the process by which the plant collects energy and produces the carbohydrates needed to grow. Most vegetable plants require at least 6 hours of full sunlight per day for best growth. Leafy vegetables, like lettuce and spinach, can tolerate less sunlight than vegetables that produce a fruit, such as tomatoes, peppers, sweet corn, or squash.

### Temperature

Different vegetables have different temperature requirements for germination, growth, and production. This is one reason all vegetables do not respond in the same way to the same weather conditions. Vegetables are either cool- or warm-season types, depending on their temperature requirements.

### Nutrients

The three most important elements essential for the plant growth are nitrogen, phosphorus, and potassium. These are considered the major elements and are required in relatively large amounts by plants. Calcium, iron, sulfur, magnesium, manganese, zinc, boron, copper, and molybdenum are the minor or trace elements. These are required in relatively small amounts. In South Dakota, most gardens require only nitrogen, sometimes phosphorus, and only rarely potassium. For maximum production, have an initial soil test to deter-

mine nutrient needs. Contact your local county Extension office for soil testing information.

### pH

Most vegetables prefer a soil that is slightly acidic (pH 6.5-7.0). If the soil is too acid or too alkaline, certain nutrients become unavailable to the plant and poor growth or death of the plant results.

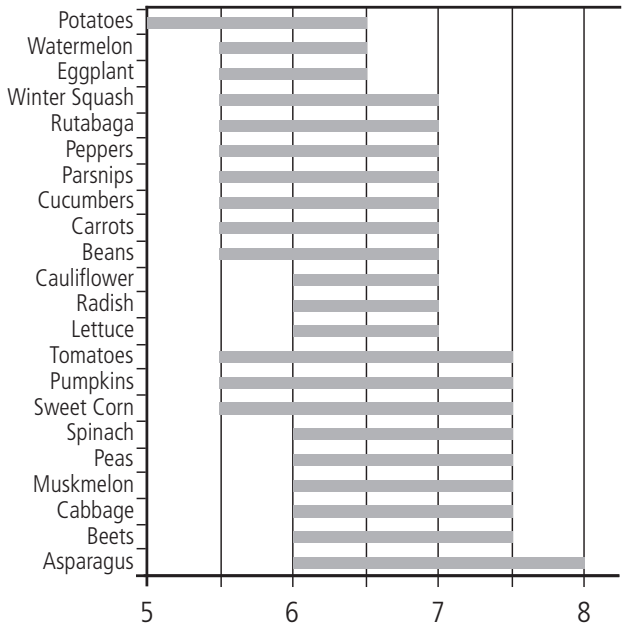



**Figure 1. Ideal Soil pH ranges for common vegetables.**

The pH of the soil can be learned from a soil test. The soil pH scale ranges from 1 to 14; a pH of 7 is neutral, below 7 is acid, and above 7 is alkaline. Most South Dakota garden soils range from about 6.5 to 7.5, making them suitable for vegetable production. However, pH may reach 8 to 8.5 or even higher in some parts of the state, especially West River, making some vegetables difficult to grow.

There are ways to alter soil pH. The most common, lime, is used to raise the pH when it is too low, or acidic. However, since most of our soils have a pH that is either acceptable or too high, lime should not be applied to garden soils in South Dakota unless a soil test has indicated that it is needed. Similarly, wood ashes should not be applied to our soils, as they will raise the soil pH.

Acidifying the soil is often more difficult than raising the pH. Elemental sulfur is the most effective material for lowering soil pH. Apply 2 to 4 lb per 100 sq ft in the fall and work into the soil to lower pH if it is above 7.5. Additional applications will be needed to help maintain desired pH.

Organic matter, added to the soil, can help decrease pH, especially if peat moss or pine needles are used. Most forms of organic matter have a neutral pH.

### Diseases and insects

Damaged plants cannot function efficiently and, as a result, the crop may be ruined. Take precautions to prevent diseases and restrict harmful insects before serious damage occurs.

## Selecting the garden site

### Location

The most convenient location for a garden is near the house, where you can easily monitor the garden's progress, and provide the needed care. Water is usually more accessible near the house as well. Sometimes, however, it may be advisable to locate the garden plot in another area because of poor soil, poor drainage, shade, or lack of space.

The site must receive adequate (6–8 hours per day) sunlight. Heavily shaded gardens often fail to be productive. Nearby trees and shrubs also compete with garden plants for soil moisture and nutrients. The root system of a tree often extends out at least as far as the tree is tall, and will regrow quickly if attempts are made to remove roots by tillage. Applying additional water and fertilizer can compensate somewhat for competition but full sunlight is still needed.

If space is limited, vegetables requiring a small amount of room could be planted near the house, while those requiring a larger space could be planted where more room is available. Vining plants such as cucumbers can be trellised against a wall, and most bush types of vegetables can be grown in containers.

### Soil

The soil for a good garden should be fertile, easy to work, at least 6 to 8 inches deep, well drained, and not too alkaline or acid. A sandy loam or silt loam is often the best type of soil for a garden. However, sandy or clay type soils can also support a good garden if the garden is managed properly (see section on soil preparation).

### Protection

In South Dakota, it is usually advantageous to provide some sort of windbreak if the garden is in an exposed area. Trees and shrubs are most effective and are good for a large area. Locate the garden at least 50 feet from a tree windbreak.

Other desirable windbreak materials, especially for smaller areas, are snow fences or three to four rows of sweet corn, millet, or sunflowers. A single or double row of Sudan grass, planted along the windward side of the garden, makes another effective windbreak. Sweet corn can act as a windbreak if planted along the west or south side of the garden, but it may shade some smaller crops.

Rabbits, raccoons, woodchucks, gophers, deer, and livestock can cause significant damage to a garden. Although some chemical deterrents are available and are somewhat effective, often the best protection is to fence the entire garden with woven wire or chicken wire to keep animals out.

## Planning the garden

### Plan

A plan is one of the most important steps for efficient use of garden space. Sketch the plan, preferably to scale, well ahead of spring planting. The plan should outline what, when, and how much to plant.

Good records of what and where each vegetable was planted will make it easier to design next year's garden. They also will aid in planning proper rotation of the vegetables. It can be very helpful to record notes about those vegetables that may have performed well or had particular problems.

### Size

Garden size is influenced by family size, product use, and time available for gardening. Plant more of vegetables that will be canned, frozen, or dried, but never plant more than can easily be tended. A small garden, given good care, is far better than a large one that becomes neglected and overgrown with weeds. Good care affects the appearance of the garden as well as the quality and quantity of the vegetables it will produce.

### Arrangement

It is generally a good idea to divide the garden into three areas containing the following groups of crops:

**Perennial crops** (asparagus and rhubarb). Plant on one side (or end) of the garden so they will not be disturbed from year to year.

**Short-season, early planted crops.** Plant at one end of the garden to make it easier to replant after these crops are harvested. Short-season crops include peas, spinach, lettuce, beets, kohlrabi, radishes, onions for bunching, cabbage, cauliflower, and broccoli. Alternatively, interplant short-season with long-season crops.

**Long-season crops.** These are usually warm-season vegetables that require most of the growing season to mature and be productive. Examples of long-season vegetables are tomatoes, peppers, potatoes, vine crops, and sweet corn.

**Figure 2. Straight long rows are easier to cultivate.**

Plant tall-growing vegetables far enough away from low-growing vegetables so they don't shade them. Planting tall vegetables on the north or east side of the garden also will reduce the shading of shorter crops. (Lettuce and similar greens may be grown in partial shade in mid-summer.)

Save space by intercropping. For example, early peas could be planted between rows where tomatoes or cucumbers are planted later. Radishes or lettuce can also be grown between tomatoes, peppers, or vine crops since they will be removed by the time these crops need the space.

Change the location of the garden or that of the individual crops within the garden from year to year to help reduce insect and disease problems and to make better use of fertilizer in the soil. Because they are closely related and can carry the same diseases, do not plant potatoes, eggplant, peppers, or tomatoes where any of the four were the previous year. The same principle follows for members of the cole crop group (broccoli, cauliflower, cabbage, etc.) and the cucurbit group (melons, pumpkins, squash, gourds, cucumbers.)

Long rows are easier to cultivate with wheeled equipment than are short rows (Fig 2). North-south rows may reduce the shading of adjacent rows by taller plants.

Planting in a block, however, can save space and make it easier to meet crop needs (Fig 3). Block planting is also recommended for optimal pollination of wind-pollinated crops such as sweet corn.

**Figure 3. Cabbage planted in a block.**

Mark each variety with a stake or label. Those that perform well can be easily identified for future reference.

Do not plant large amounts of one variety of vegetable at a time unless you need large quantities for canning or freezing. Instead, plant small amounts of seed at 7 to 10 day intervals to provide a longer harvest period.

### Color your garden healthy

Plant a variety of colors for a nutritious garden. By eating vegetables and fruit from each color group, you will benefit from the unique array of phytochemicals, as well as essential vitamins, minerals, and fiber that each color group has to offer alone and in combination. The best source of vitamins, antioxidants, minerals, and phytochemicals for prevention of cancer and heart disease are from food, not dietary supplements.

Consider including the following colors to your garden:

**Reds and pink:** tomatoes, watermelons, red peppers, kidney beans, red cabbage, radishes, beets.

**Green:** asparagus, kale, cabbage, brussels sprouts, green beans, lettuce and other leafy greens, spinach, broccoli, peas, honeydew melons, rutabagas, turnip greens, zucchini, green peppers.

**Deep orange and bright yellow:** sweet potatoes, carrots, yellow sweet corn, pumpkins, muskmelons, butternut squash, yellow peppers, tomatoes.

**Purple and blue:** eggplant, purple peppers, blue or purple potatoes.

**White:** cauliflower, kohlrabi, garlic, chives, scallions, leeks, onions, turnips, white potatoes.

### Succession planting

Every gardener would like to achieve maximum production from the garden space available, because much labor and expense are involved. One way to do this is to use succession planting for some crops. Succession planting means planting one crop over a 1 to 2 week interval. For example, three or four plantings of beans could be seeded 7 to 10 days apart.

Another means of succession planting is to plant another crop into an area where one has already been harvested. Snap beans can be planted in the rows from which peas have been harvested.

There are several reasons for using succession planting. Many vegetables are at their prime edible stage for only a short time. Thus, a single planting of beets, corn, or snap beans would mature and be of good eating quality for less than 2 weeks. If two or three plantings were made 1 to 2 weeks apart, the vegetables would be available for a longer time. Three 5-foot rows of beets, planted at three different dates, will have a greater chance of being used than a 15-foot row planted at once.

When peas have quit bearing, dig them up and plant another crop. This way there will not be any non-productive open spaces and weed control will be easier. Since time, money, and effort are spent in gardening, you will get maximum benefit by having a crop growing and producing all the time.

Crops suitable for succession planting (every 1 to 2 weeks) are given below:

| | | |
|---|---|---|
| beets | carrots | kohlrabi |
| leaf lettuce | onions | peas |
| radishes | snap beans | sweet corn |
| turnips | | |

### Fall garden

A fall garden is planted in mid-summer and harvested in late summer or early fall when the weather is cooler. Because fall garden vegetables start their growth during hot, dry weather, make certain water is available. Vegetables that will succeed in a fall garden are listed below.

Plant from June to August:

| | | |
|---|---|---|
| beets | broccoli* | cabbage* |
| carrots | cauliflower* | kale |
| kohlrabi | leaf lettuce | onions |
| parsnips | rutabagas | snap beans** |
| spinach | turnips | |

*generally planted as transplants
**not frost tolerant

Vegetables for the fall garden can be planted in the area vacated by early-maturing crops or between rows of early-maturing crops. In South Dakota, the fall garden is planted from late June to August, depending upon the days to maturity of the crop and when heavy frost occurs in the fall. Except for snap beans, the crops can withstand light frost.

## Equipment

Garden work can be much more enjoyable if you use high-quality tools and give them proper maintenance. Many time- and labor-saving pieces of equipment are available which will promote better garden care and reduce labor. Adaptive tools for arthritic gardeners are available as well.

Indispensable hand tools include a trowel, hoe, steel rake, spade, spading fork, bucket or watering can, garden hose, liquid measurer, stout garden line, hand duster or sprayer, and stakes. For larger gardens, equipment such as a wheel hoe cultivator, rototiller, or a small garden tractor with attachments is highly desirable.

A power garden tractor may even pay for itself in rental to neighbors.

Other miscellaneous items that may be useful, especially on larger gardens, are wheel-type fertilizer and insecticide distributor, wheelbarrow-type compressed air sprayer, hose-end sprayer, hand or drill seeder and row marker, and soaker hoses and other types of irrigation equipment.

## Soil Preparation

### Tillage

Good soil preparation is essential for growing vegetable crops. Plow or spade, depending on available equipment and garden size, in either the fall or spring. Work the soil about 8 inches deep. Avoid working the soil when it is too wet since this will cause compaction and clods.

Before planting, work the soil to a reasonably fine condition with a disk or harrow and a drag, with a wheel cultivator and rake, or a rototiller.

### Organic matter

Almost all South Dakota soils can produce better crops if quality organic matter (OM) is added. OM supports valuable soil organisms, improves soil texture, increases water-holding capacity, provides aeration and better drainage, and makes fertilizer more effective. A soil organic matter content of 5% is generally considered ideal. Sources include animal manure, green manure, compost, peat moss, and others.

**Animal manure** provides organic matter and many nutrients. Apply in the fall and work the manure into the soil. Since fresh animal manures can damage plants and may also contain potentially harmful pathogens or weed seeds, it is best to use old, well-rotted manure or prepackaged or composted manures. Pet waste is not recommended.

*If you apply manure, be sure it has been aged at least six months at warm (growing season) temperatures.* This aging process will help eliminate most or all of potential human pathogens that may be transmitted through animal feces. The aging process will also help decrease potentially high salt levels in the manure, so you are less likely to observe 'burning" or other salt damage on your plants. Aging the manure also will decrease the number of remaining viable weed seeds.

**Green manure** refers to cover crops such as rye grass, vetch, alfalfa, etc. that are turned under to decompose. With non-leguminous crops such as rye or oats, nitrogen must be added at plowing time to help decompose the material and prevent nitrogen starvation in the succeeding crop.

Cover crops generally are planted near the final harvest. If enough growth takes place, the cover crop can be plowed down in the fall; however, this may also be done in the spring. One advantage of waiting until spring is that the cover crop can hold additional snow during the winter months.

**Compost** consists of plant refuse placed in a pile with soil and fertilizer to decompose. Compost makes a good substitute for animal manure for improving nutrient content, soil structure and water holding capacity. (See comments on organic mulch in the section on weed control, page 9.)

## Fertilizing

Vegetables need a well-balanced diet. For best growth, nitrogen, phosphorus, and potassium and other micronutrients in adequate amounts must be available for uptake by the plants. It is often necessary to rely on fertilizer to provide at least part of the nutrient requirements of garden plants. Proper fertilizer applications to vegetable crops may return more money for less cost than any other expenditure.

Organic fertilizers such as fish emulsion, manures, and blood meal are alternatives to chemical-based fertilizers. Except for manures and fish fertilizers, organic materials tend to be low in phosphorus.

Materials such as decomposed straw, leaves, or grass clippings will not provide a sufficient balance of plant nutrients. Also, as fresh organic matter initially breaks down, it may temporarily deplete the soil of available nitrogen.

If you purchase fertilizer, check the label. Some are applied as granules, and others are dissolved in water prior to application. By law, all commercial fertilizers must list the contents expressed as a percent of each nutrient in the material. For example, an 8-32-16 NPK fertilizer will have:


Nitrogen (N) =8%
Phosphate ($P_2O_5$) = 32%
Potash ($K_2O$) = 16%

Certain nutrients are needed in all vegetable plantings, but fertilizers should be used according to the needs of each plant. Improper or excessive fertilization, especially with nitrogen, can cause excessive vegetative growth and reduce yields of fruiting vegetables. Call your local Extension office for information on taking a soil test to determine proper application rates.

The best time to fertilize the entire garden is before planting, so that nutrients can be worked in to the soil.

Once vegetables are up and growing, they may be side-dressed with a nitrogen fertilizer if a soil test indicates a need. A good lawn fertilizer that contains 20 to 30% nitrogen will work well. *Be sure not to use any products such as "Weed and Feed," that contain a broadleaf weed killer or seed germination inhibitor!* Stay 6 to 8 inches away from

the main stem in the case of tomatoes and 3 to 4 inches away from onions.

Leafy crops such as lettuce, spinach, cabbage and sweet corn may be side-dressed after they have developed three to five true leaves. Use about 1 cup for each 25 feet of row, worked into the top 2 inches of soil, along each side of the row.

Do not side-dress fruiting vegetables such as tomatoes, peppers, eggplant, squash, pumpkin, or cucumbers until after the plants have begun to set fruit. Fertilizing too early can reduce or even prevent fruit set.

# Planting the garden

## Time of planting and crop classification

Planting dates vary depending on the type of vegetables grown and the local climate. Vegetables can be grouped into two general classes: cool-season and warm-season crops. The former grow best at cool temperatures and will tolerate frost; the latter grow best at warm temperatures and will not tolerate frost.

Planting periods for each cool and warm season crop are given in Table 1. Personal experience and the advice of experienced gardeners will help, particularly in the Black Hills areas because of variations in elevation and climate.

Use the maps on the inside cover to determine the average date of the last spring frost and first fall frost for your location. These dates should help you determine spring and summer planting dates, as well as the average length of the growing season in your area. For example, much of the southeast part of the state is frost-free between May 1 and September 24, for a total of 147 frost-free days.

**Table 1. Temperature requirement and time of planting for annual vegetable crops.**

**COOL SEASON CROPS**

**Group A.** Plant in April or early May: will not grow well in hot weather. Minimum soil temperature: 40 to 45°F, optimum 60 to 65°F.

| | | |
|---|---|---|
| spinach | peas | radishes |
| cauliflower* | head lettuce* | |

**Group B.** Plant as early as Group A or shortly afterwards; these will tolerate some hot weather. Minimum soil temperature: 40 to 45°F, optimum 60 to 65°F.

| | | |
|---|---|---|
| broccoli* | onions | cabbage* |
| chard | leaf lettuce | irish potato |
| carrots | turnips | beets |
| celery (in May) | kohlrabi | |

**WARM SEASON CROPS**

**Group C.** Do not grow well in cool weather; damaged by frost. Optimum soil temperature 60 to 75°F. Minimum soil temperature:

| 50°F | 60°F | 65°F |
|---|---|---|
| lima beans | cucumbers | tomatoes* |
| sweet corn | muskmelons | eggplant* |
| squash | | pepper* |
| pumpkins | | watermelons |
| snap beans | | |

*generally planted as transplants

## Seeds

Good seed or healthy transplants are essential for a successful garden. The cost of the seed or transplant is very small when compared with the value of the vegetables harvested. Good seed is clean, disease-free, germinates readily, and is true to name. To be certain of pure seed, purchase only from a reliable seed firm.

In general, it is not the best practice to save seed from the home garden. However, if you wish to do so, consult *FS 911, Saving seed for next year,* for guidelines on selecting which seed to save, how to process and store it, and pitfalls to avoid. Never save seed from hybrid plants for replanting; they do not come true (produce the same variety) in the second year.

Purchased leftover seed often can be used with satisfactory results the second year if it is stored in an airtight container in a cool location.

Spacing and planting depth for various vegetables are given in Table 3. If the seeds are planted too thickly, resulting seedlings will be crowded and spindly and not very productive. The job of thinning also will be more tedious.

Seeds can be sown somewhat deeper than recommended in Table 3 if the soil is sandy or if sown in summer when the surface soil may be hot and dry.

After covering the seed, firm the soil (do not pack) with the back of the hoe. This insures better contact of seed with soil and gives faster, more even germination. If the soil is heavy, scatter lawn clippings or vermiculite lightly over the newly seeded row to prevent crusting after a rain.

The distances to allow between rows and between plants in the row (after thinning) are also given in Table 3. Use the narrower spacing if a hand hoe or wheel hoe is used for cultivation or if water is available for irrigation. Planting in a wide row often can increase space utilization while still allowing good growth. Vegetables suited to wide-row planting include root crops like carrots, radishes, beets, turnips, and rutabagas and leafy crops like lettuce and spinach.

## Transplants

To get earlier and larger yields and to lengthen the harvest season, use transplants (6- to 8-week old seedlings) for many crops. Crops such as early cabbage and tomatoes

often require too much time to reach the productive stage if seed is sown directly outdoors.

Vegetables commonly transplanted are marked with an asterisk in Table 1. Vegetables other than these are not commonly transplanted or do not transplant well. However, cucumbers, squash, muskmelons, and watermelons can be transplanted successfully if grown in individual containers and if the roots are not disturbed when the plants are set in the garden. Growers often use peat pots to ease transplanting of these crops. They must be transplanted before they become rootbound, usually at just 2-3 weeks after seeding.

Transplants can be started indoors, in coldframes or hotbeds, or they can be purchased. Typically it is easier and cheaper to buy transplants. Look for stocky, well-grown plants; do not buy tall, spindly ones. Two advantages of homegrown transplants are increased choice of varieties and better accessibility at planting time.

Growing seedlings requires some skill and care. Again, factors such as light, temperature, moisture, and space must be considered. Seedlings should have at least 6 hours of direct sunlight for best growth; many gardeners use artificial lights.

Cool white or warm white fluorescent tubes in a shop light fixture are an inexpensive grow light suitable for most seedlings. Although many other types of plant lights are available, they tend to be more costly and there is not much difference in plant growth. Place the seedlings approximately 3 to 5 inches beneath the lamps and operate the lights 12 to 18 hours per day.

Almost any container can be used—clay or plastic pots or flats are good. A prepackaged seed starter is usually the most convenient type of growing medium to use for starting seeds. Pre-packaged mixes are free of insects and disease pathogens. Vermiculite or mixtures of soil with vermiculite, sand, or peat can be used. It is a good idea to use a pasteurized medium and clean containers. Small quantities of a growing medium can be treated in the oven for a half hour at 160 °F. Pots and other containers can be cleaned using a 10% bleach solution.

After the seedlings have developed one pair of true leaves, transplant them to containers filled with a good potting soil. Perlite, vermiculite, or coarse sand can be added to improve drainage.

About 10 days before planting outdoors, "harden off" the young transplants by gradually reducing the water supply and by gradually exposing them to cooler temperatures and higher light. This enables the plant to withstand the shock of transplanting into the new growing conditions outdoors. The easiest way to do this is to place the transplants outdoors in a shaded location, gradually moving them into full sun. Protect them at night if frost threatens.

**Figure 4. Tomato transplants set properly deep (up to the lowest leaf) in soil.**

Avoid transplanting young seedlings if temperatures are high. Cloudy conditions and cooler temperatures make it easier for transplants to adapt. Seedlings may be sunburned if they were not hardened sufficiently and were transplanted when it was too hot and sunny. Some form of shade may help get plants used to the new, considerably higher light conditions with less damage.

Water frequently after first setting the seedlings out. Gradually reduce the watering as the roots develop and the plants become established.

When transplants are set outdoors, the mass of roots and soil should be disturbed as little as possible. Dig a hole wider than the root ball, setting the plant at about the same depth as in the original container. An exception is tomatoes, which may be set as deep as the lowest leaves (Fig 4). Fill in around the plant with soil, gently firm the soil, and water thoroughly to insure good contact between the roots and the soil so that no air pockets remain.

## Starter solution

A starter solution is a dilute mixture of a water-soluble high phosphorus fertilizer, in water, applied to transplants immediately after planting. It provides the plant with readily available nutrients that stimulate growth and may result in earlier, larger yields, especially in cool soils.

A starter solution can be made by dissolving one tablespoon of 10–20–10 or 15–30–15 soluble fertilizer in one gallon of water. Apply one cup of this solution per plant to give a vigorous start to such plants as tomato, pepper, and cabbage.

Several types of soluble fertilizers are available; follow label directions for recommended rate. Soluble fertilizer starter solutions are much more effective and less likely to burn tender roots than dry fertilizer. Over-fertilization, especially with nitrogen, early in the season, can reduce fruit production.

### Plant protection devices

Many crops can be transplanted outdoors earlier and will give earlier yields if they are protected from cold temperatures during the first 2 or 3 weeks of growth. Examples of plant protectors are hotcaps, hottents, polyethylene "in-the-row" greenhouses, milk jugs, spun bond row covers, and "wall-of-water". These can be purchased from garden catalogs, seed stores, garden centers, or some hardware stores, and give some protection against winds as well as from light frost.

On sunny days ventilation must be provided, or temperatures will become too high under some protectors. Whatever type is used, anchor it securely in the soil to prevent its being blown off and injuring the plant.

## Irrigating

### Vegetable needs

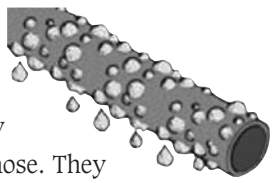
Moisture is often a limiting factor in growing vegetables in South Dakota. For best growth, most vegetables require 1 to 1 1/2 inches of water per week during the warm part of the growing season.

There are several benefits from irrigation: yields are increased, quality is improved, earlier harvest may result, successive plantings of quick-growing crops are possible, and drought sensitive crops such as celery, head lettuce, and cauliflower may be grown successfully.

Not all water in South Dakota is suitable for irrigation. Artesian water is often high in salts or sodium and may not be usable. If water quality is in question, check with the county Extension office for information on how to have the water tested.

### Methods

Methods of irrigation feasible for the garden include: soaker hoses, drip or trickle, furrow, sprinklers, and perforated plastic hose. Soaker hoses or drip irrigation help conserve water. Along with furrow irrigation, they generally help decrease foliar diseases: most plant diseases invade leaves when they are kept wet for several hours.



**Soaker hose.** These special hoses, manufactured from recycled tires, are designed to allow small amounts of water to seep out of tiny cracks and pores in the side of the hose. They are an excellent means of applying water directly to the plants by laying the hose along the row. They are only practical, however, for gardens planted in rows. Use clean water to avoid plugging the hoses.

**Drip or trickle.** There are a number of drip systems available to home gardeners. Some are as simple as bottles with holes poked in the bottom, while others may include timers and pressure reducers hooked up to a faucet. Drip irrigation tubing has special openings (emitters) to allow water to seep out in regulated amounts. Some systems allow you to place emitters themselves, but most now come with the emitters built into the tube, available in spacings ranging from 4 to 36 inches apart.

Drip tubes can usually be reused for a number of years. Again, these systems work best with crops arranged in rows.

**Perforated plastic hose.** Water is distributed by a plastic hose containing many small holes on the topside. The area wetted is usually 10 to 20 feet on either side of the hose. Alternatively, the hose can be turned over, so that the water is applied directly to the soil. If you do so, keep the water pressure low so that it does not wash away the soil next to plant roots. Plastic hose is relatively cheap and lasts several years. It also can be used on lawns, flowers, and woody plants.

Furrow. Water is allowing it to run down furrows between the plant rows. An area with a gentle slope is necessary. Short rows are more uniformly wetted than long rows. Advantages of furrow irrigation are that

water under pressure is not needed and less equipment is used. Also, foliage is kept dry, reducing disease problems. However, water of good quality must be used, or high salt accumulations may result.

Sprinklers. Many lawn sprinklers apply water too rapidly for some garden soils. If so, start and stop the sprinkler at intervals to allow the applied water to soak in until enough water has been applied. Rotary sprinklers allow water to be applied more slowly, more uniformly, and over a larger area than a lawn sprinkler.

When irrigating with sprinklers, be sure the areas irrigated overlap for complete coverage. Avoid watering during the hot, windy portions of the day to avoid excessive losses due to evaporation, but also avoid watering when the foliage won't have a chance to dry for several hours.

### When and how much to irrigate

Timing depends largely on the moisture content of the soil. In South Dakota, as much as 1/4 inch of soil moisture may be lost on a hot summer day through evaporation and transpiration.

Waiting until a crop looks dry and is wilted is not a good way to decide when to water. To avoid yield losses, water the crop before the plants are overly stressed. However, on a very hot day, even well-watered plants may exhibit leaf-rolling or other signs of wilt. These plants will recover overnight and do not require watering unless indicated by the following tests:

- Obtain a handful of soil from a depth of 3 to 6 inches. If a ball can barely be formed by squeezing it firmly in the hand, it is probably time to water. If it easily forms a ball, water is probably not needed yet.
- Another measure is to irrigate at least once a week unless the rainfall during the week totals at least 1 to 1 1/2 inches and fell in amounts greater than 1/3 inch each time.

Generally, apply water at a rate so that puddles do not form—in other words, not any faster than the soil can absorb it. This will vary with different soils. It is important to soak the soil to a depth of 8 to 12 inches. Check how deep the moisture has penetrated a few hours after irrigating. Use a hand trowel or shovel to dig down and see how far down the soil is moist. Or place three or four coffee cans at random within the sprinkler pattern. When the average depth of water in the cans is 1 1/2 inches, stop irrigating.

Whichever method of irrigation you choose, here are some basic guidelines to follow:

- Do not water until the garden needs it. Once plants are established, water deeply, then allow the top 1inch of soil to dry before watering again.
- When water is needed, apply enough at a time to saturate the top 8 to 12 inches of soil, which will ensure that the root zone is well watered. Then do not water again until the plants need it.
- If overhead watering, water the garden before noon so that free water from the leaves may have a chance to evaporate in the afternoon. This will reduce the possibility of foliar disease infection in the garden.

## Weed Control

Weeds rob garden plants of water, nutrients, and light. The most effective methods of weed control in the home garden are hand weeding and cultivation.

### Cultivation

Use a hoe, wheel hoe, or garden tiller. Do not cultivate deeper than 1 inch when close to the plants to avoid injuring plant roots near the soil surface. The best time to cultivate is as soon as the soil is dry enough to be worked. Avoid cultivating when the soil is wet, since this can cause compaction or form clods that may persist throughout the season.

The object is to uproot and expose weed seedlings and germinating weed seeds so they will be killed.

It is important to start weeding early in the season, as that is when crops are most sensitive to competition. However, it should be continued until killing frost, in order to prevent weeds from producing seed. As few as one or two weed plants can produce thousands of seeds ready to infest the garden for year.

### Herbicides

At present, there is no one chemical weed killer that can be used safely in the home garden to control all weeds in all vegetables.

Herbicides are very specific in their use. Read the label carefully to see if the product is labeled for the vegetable and will control the problem weeds.

Herbicides must be applied at the correct rate or else the vegetable plants may be damaged. Every year some homeowners find they have damaged their vegetables by using the wrong chemical or not reading and following the label directions carefully.

For most home gardeners, hand weeding, cultivating, and mulching often are better choices for weed control than

chemicals. However, on larger plots with fewer kinds of vegetables, chemical weed control may be practical. Non-selective, non-residual herbicides such as those containing glyphosate can be very effective if applied to growing weeds prior to planting vegetables or after the last harvest. Undiluted household vinegar will kill small weeds (as well as vegetables, so be careful!). Be sure to rinse the sprayer out well, as vinegar will corrode any metal sprayer parts.

Keep separate sprayers for herbicide application and for insectide or fungicide applications. Too often, herbicide residue in a sprayer will damage plants sprayed for pest problems. For more information on herbicides, check with your county Extension office.

## Mulching

Mulching is the practice of covering the soil around the vegetables with a protective material to reduce water loss, shade the soil, and reduce weed growth. It is particularly important in South Dakota because low rainfall and dry winds make it necessary to conserve moisture whenever possible.

Most vegetables benefit from mulching. Besides controlling weeds and conserving moisture, the mulch will regulate the soil temperature, keep the fruit clean, eliminate cultivation injury to crops and prevent erosion. Mulching makes gardening easier and may increase yield. After the mulch is applied, cultivation may be unnecessary for the rest of the season.

## Organic mulches

Organic mulches may be more environmentally sound than plastic since there is no disposal problem and organic matter is added to the soil as they decay. Organic mulches include leaves, grass clippings, sawdust, crushed corncobs, straw, hay, shredded bark or branches, and newspaper or shredded paper.

Organic mulches should be weed free. Place them on the soil after the plants are well established and after the soil has warmed. If placed too early in the season, they may keep the soil cooler than optimal for warm-season crops. Make sure the soil is thoroughly moistened before spreading the material evenly over the soil between rows and around plants.

The thickness of the mulch depends on the material and its cost. Leaves, straw, or hay can be applied about 3 inches deep. Grass clippings should be applied about 1/2 inch thick—otherwise, moisture may not penetrate. Newspapers should be only three or four layers thick; use only newsprint paper, not the slick-surfaced colored ad pages. Thoroughly wetting the mulch down after application can help reduce the chance of it blowing around—a common problem in our windy state!

As they begin to decompose, mulches such as sawdust, shredded bark, straw, or newspapers may cause a nitrogen deficiency to develop in the garden because the organisms that break down organic matter are competing with the vegetables for nitrogen. To prevent nitrogen deficiency, add extra nitrogen with the mulching material, about one pound of actual nitrogen per 1000 square feet.

One advantage of organic mulch is that, when turned under at the end of the growing season, it will add organic matter to the soil. Add nitrogen to the mulch before turning it under, if you did not add it earlier.

*Warning: Do not use straw or lawn clippings for mulch if herbicides containing clopyralid have been applied,* as this chemical breaks down only slightly during composting, and may damage sensitive plants such as beans, potatoes, and tomatoes at very low concentrations. This chemical is found in systemic herbicides used by commercial lawn care companies (it is not labeled for lawn use by homeowners). It is also in a number of products for controlling perennial weeds in a number of field crops, pastures, and even some horticultural crops.

**Figure 5. Straw mulch applied between pea rows.**

## Plastic mulches

Plastic mulches can warm or cool soils, preserve moisture, control weeds, and even repel insects, depending on their color.

Clear plastic warms the soil most effectively and can be used early in the spring to thaw the soil and warm it enough for seeding. Black plastic and "IRT" (dark-

green) plastics are most effective at weed control. IRT will allow more of the sun's heat to pass through to the soil than does black plastic, which can effectively shade the soil, especially if the soil underneath is not in perfect contact with the mulch. Red plastic is intermediate in warming the soil and allows some weed growth (especially grasses). However, red plastic can increase fruit set of tomatoes, due to infrared reflectance of the sun's energy. Green or ITR plastic seems to be most effective for melon fruit growth. White plastic will cool the soil (good for cool-season crops) and may help repel some insects.

Plastic mulch usually comes in rolls of various widths (usually 36-48 inches) and is unrolled over the prepared, well-fertilized seedbed before planting. Drip irrigation or soaker hoses may need to be laid before the mulch. Since plastic mulches do not allow water to pass through, you may want to consider using black landscape fabric, which does allow water to penetrate.

When applying the mulch to the bed, anchor the edges in small furrows about 2 inches deep and add soil on top of the edges. Make the furrows before the plastic is rolled out. After the material is rolled out over the soil, plant vegetable transplants (or seed) through holes cut in the mulch at the desired spacing.

A major disadvantage of plastic mulches is disposal of the plastic later. Some biodegradable plastic mulches are now on the market and may become more widely available over time.

## Insect and disease control

Proper preventive steps can keep insects and diseases from quickly ruining a promising crop. Even if the plants survive, there may be reduced yield, lowered quality, wasted money and time, and shorter keeping quality and storage life. Some insects and diseases may carry over to the following year and make control more difficult in the future.

There are several ways in which insect and disease problems can be reduced and possibly eliminated. Use as many of these practices as possible for effective pest control.

### Disease resistant varieties

Although there are few, if any, vegetable varieties resistant to insects, there are many varieties that are resistant to or can tolerate certain diseases, especially mildews and wilt diseases. Plant these whenever possible.

### Seed treatment

Seed treatment is an inexpensive means of controlling diseases of young seedlings. Many seed companies treat vegetable seeds with hot water to eliminate diseases, and some use chemical treatment to protect against certain diseases and insects. Such seed may be more expensive but is well worth it.

### Certified seed

Certified potato seed is produced under strict controls. Plant certified seed potatoes when possible, as they will have few diseases and often much higher yields. You also avoid the possibility of bringing in a disease to your garden that will persist for years to come.

### Rotation

Moving the garden from one area to another each year, or rotating crops in a single area helps reduce the insect and disease problems. Because they are closely related and can carry the same diseases, don't plant potatoes, eggplant, peppers, or tomatoes where any of the four were the previous year. The same principle follows for members of the cole crop group: broccoli, cauliflower, cabbage, etc.

### Sanitation

Remove, bury, or burn plant remains, including roots and especially leaf material, following harvest and before planting. Many diseases and some insects overwinter in dead plants. They can then become the source of an outbreak the following year.

Do not put diseased plants in the compost heap unless the compost pile is active enough (indicated by a temperature of 130 to 160ºF) to kill disease pathogens and insects.

In many cases, removing diseased foliage as soon as it is noticed will help slow the spread of the disease by reducing new inoculum. For example, removing lower tomato leaves infected with leaf spots or blights may delay disease development long enough to still harvest a bountiful tomato crop.

### Controlling weeds

Many weeds around the garden harbor insects and diseases. Keeping such weeds under control will aid in the pest control program. Check weeds growing in areas around the garden for signs of diseases and insects that may move into the garden. See previous section for information on controlling weeds.

### Spraying and dusting

These are probably the most widely used insect and disease control measures. A range of both organic and chemical insecticides and fungicides (chemicals used to control insects

and diseases, respectively) are available. Dusts are easier to apply but sprays adhere better and give better coverage.

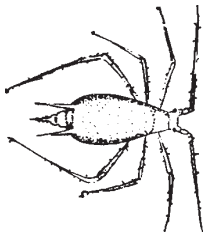
Whether a spray or dust is used, in early- to mid-season start at the first sign of disease or insect damage. This will prevent a buildup and make control easier. Toward the end of the season, many pests can be tolerated as long as they are not directly affecting harvested parts.

Always read and follow pesticide label directions carefully. Before selecting a pesticide, be certain that it lists on the label (1) the plant you want to treat and (2) the disease or insect you wish to control. When you apply the chemical, use appropriate equipment and personal safety protection (check the label). Also be sure to check for the "days to harvest" or "pre-harvest interval;" this will tell you how soon after pesticide application it will be safe to harvest and eat the vegetable you have treated.

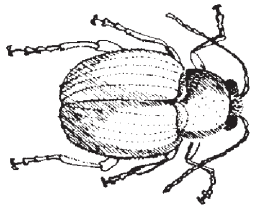
## Identification of insects and diseases

If a disease or insect is not properly identified, proper treatment is not possible. Take a specimen (roots and all) of the affected plant or the insect to the staff at your county Extension office. If they cannot identify the problem, they will forward it to experts at South Dakota State University. Consult the county office for proper sample preparation.

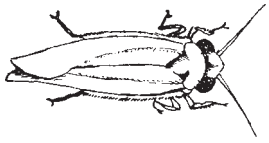
### Common garden insects



**Aphids or plant lice**
Small, soft-bodied, green to black. Generally clustered on stems and undersides of leaves.

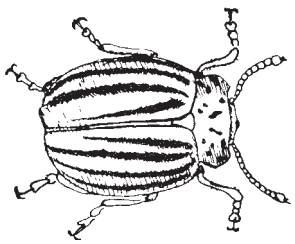


**Flea beetles**
Tiny (1/16-inch) rounded beetles, gray to black. Flea-like jumping habit. Cause characteristic "shot-hole" damage in leaves.

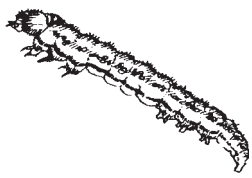


**Leafhoppers**
Small wedge-shaped bodies, greenish color, have characteristic jumping habit.

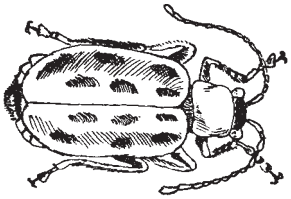
**Cabbage worms (caterpillars)**
Velvety green, chewing caterpillars. Chew large holes in leaves and heads. Adults are white butterflies.



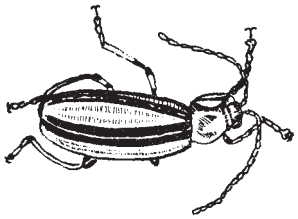
**Colorado potato beetles**
Yellow-and-black striped beetle 3/8 inch long. Eggs are yellow to orange, laid in clusters on leaf bottoms; larvae are soft-bodied, hump-backed, red to orangish, spotted with black. Will defoliate plants if allowed to become numerous.

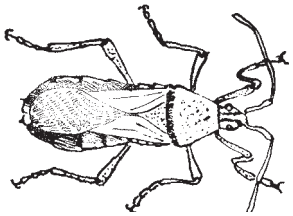


**Corn earworms**
Caterpillar with brown or green stripes. Enters the ear through the silk channel in the husks and feeds on the tip of the ear.

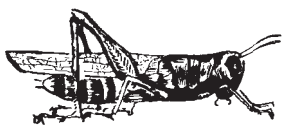


**Cucumber beetles**
Spotted beetle about 1/3 inch long, yellow to dark green wing covers. Striped beetle about 1/5 inch long, yellow with three black stripes on the wing covers. Both species eat holes in the leaves of young plants, and carry bacterial wilt.

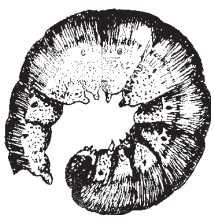




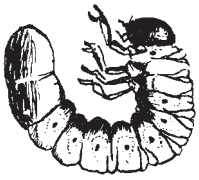
**Squash bugs**
Brown to black, flattened bugs. Will emit an unpleasant odor when disturbed.



**Grasshoppers**
Brown, gray, black, or yellow, and vary from 1/4 inch in length as nymphs to 2 inches as adults. Strong hind legs adapted for jumping. Many hoppers also are strong flyers.

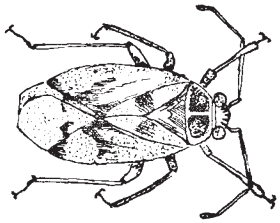


**Cutworms**
Dull gray-brown, striped or spotted, stout, soft-bodied caterpillars. Will curl up tightly when disturbed. Adult is a gray-brown "miller" or moth. Feed on young plants by chewing off the stems close to the soil.



**White grub**
White or cream-yellow larvae with brown heads. Curved bodies from 1/2 to 1 1/2 inch long. Adult is a large brown to black beetle. Larvae cause damage to plants roots.

**Slugs**
Grayish, legless, slimy, worm-like creatures. Found in dark, damp places; feed on leaves at night. Not insects; close relatives of snails.



**Plant bugs**
True bugs that feed on the foliage of certain vegetables. Feeding gives plants a burned appearance. Come in a variety of shapes, sizes, and colors.

## Perennial crops

Asparagus and rhubarb are the two perennial vegetables commonly grown in South Dakota. An area of about 16 square feet with plants set 1 1/2 feet apart or a row about 25 feet long with plants 1 1/2 feet apart will supply more than enough fresh asparagus for an average family. Three hills (plants) of rhubarb spaced 3 feet apart should provide all the family could use.

Both of these crops are heavy feeders. To keep the plants growing and yielding well, apply fertilizer or manure. Mix a spadeful of well-rotted manure or two to three tablespoons of garden fertilizer per plant in the soil before planting. Prepackaged, composted manures also can be used.

After the plants have become established, apply manure in the spring and add fertilizer after the final harvest in early summer.

### Asparagus

The easiest way to start an asparagus planting is to purchase 1-year-old crowns. Set the plants 8 to 10 inches deep in a hole or furrow and cover with 2 inches of soil. Fill in the remaining soil as the young shoots grow during the first summer.

Do not cut any spears the first 2 years—the plants need time to build up the crown for long-term production. After that, annually harvest spears up to July 1. If spears become pencil-sized or smaller before that time, immediately stop harvest. Allow the tops to grow until killed by frost to allow the plant to replenish its resources for the following year. Remove old tops before spring growth begins.

For more information on growing asparagus in South Dakota, see ExEx 6009, Growing asparagus.

### Rhubarb

The usual method of starting rhubarb is to obtain pieces of the crown having at least one good bud. Plant these pieces 3 to 4 inches deep and cover with about 1 inch of soil or just enough to cover the bud.

Do not harvest any stalks until the second year. Remove flower stalks when noticed. The harvest season will extend from 4 to 8 weeks, depending on the age of the plants. Never harvest more than one-third of the plant at one time.

## Preservation and storage

By planting more vegetables than can be used fresh, a family can have a surplus for freezing, canning, or storing. Most vegetables can be frozen or canned. Often the frozen product closely approaches the fresh product in quality. However, with some vegetables, canning is the only satisfactory method.

Not all vegetable varieties can be canned or frozen with good results. For help in selecting preservation methods, contact your county Extension office or go to the South Dakota State University Cooperative Extension Service Food Safety Website: http://extfcs.sdstate.edu/foodsafetysite/index.cfm

### Storage

Storage makes it possible to hold vegetables in good condition for several weeks to several months. Storage places can be cellars, garages, outdoor banks, pits, or mounds. If cellars can be kept cold enough, they are usually better for prolonged storage or during periods of very low temperatures. Areas in some basements will also remain cool enough (40 to 50ºF) during the winter for storing many vegetables.

Temperature, humidity, and ventilation are important factors in vegetable storage. Different kinds of vegetables require different storage conditions. Table 2 gives temperature and humidity requirements for some commonly stored vegetables.

### Drying

Fresh vegetables can be dried in a variety of ways. Home food dehydrators and microwave ovens are commonly used. Dried vegetables are nutritious and easy to store, an excellent means of storing extra crops.

**Table 2. Storage requirements for fresh vegetables.**

| Cool and humid (32 – 40°F) 95% humidity | Cool and dry (32 – 40°F) <65% humidity | Relatively Cool (45°F) Humid | Warm and humid (50 – 60°F) 90% humidity | Warm and dry (55 – 60°F) <65% humidity |
|---|---|---|---|---|
| Asparagus | Onions (bulb) | Green Beans | Basil | Winter squash |
| Carrots | Dry beans | Lima Beans | Cucumbers | Pumpkins |
| Beets | | Honeydew melon | Tomatoes | |
| Broccoli | | Peppers | Eggplant | |
| Cauliflower | | Summer Squash | Sweet potatoes | |
| Lettuce and other greens | | | Watermelon | |
| Green onions | | | Potatoes | |
| Muskmelon | | | | |
| Parsnips | | | | |
| Peas | | | | |
| Rutabagas | | | | |
| Sweet corn | | | | |
| Turnips | | | | |
| Cabbage | | | | |

Most vegetables, except potatoes, cabbage, and cauliflower, will store longer and remain in better condition if placed in perforated polyethylene bags. Carrots, cauliflower, cucumbers, and lettuce are sensitive to ethylene, which may be given off from apples and other fruit, so store them separately from fruit to avoid off-tastes.

- Cabbage will store better if the entire plant is harvested and the roots placed in moist sand.
- Harvest large green tomatoes before frost.
- Store potatoes in complete darkness to avoid tuber greening.
- Be sure all vegetables to be stored are free of disease. Handle carefully to avoid bruising.

## Additional information

For further information consult the county Extension educator or SDSU specialists. The following publications are available from the county Extension office:

ExEx 6004, Composting yard waste
ExEx 6005, Recycling lawn and yard waste
ExEx 6009, Growing asparagus
ExEx 6012, Pest control alternatives
ExEx 6015, Growing cabbage in the home garden
ExEx 6024, Growing beans in the home garden
FS 915, Growing tomatoes in the home garden
FS 909, Blossom end rot of tomatoes and other vegetables
FS 910, White mold of vegetables and ornamentals in the home garden
FS 911, Saving seed for next year
FS 926, Choosing vegetable varieties for South Dakota

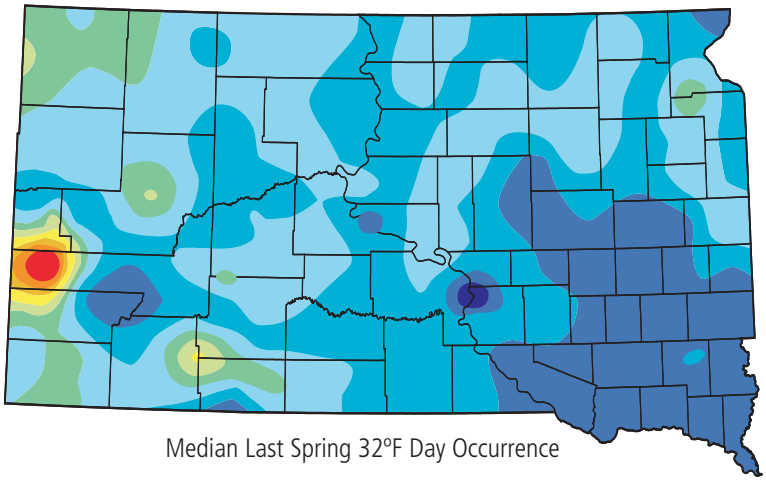
**Table 3. Planting details for home gardens in South Dakota.**

| Vegetable | | Approx # plants per oz of seed | Distance between rows (inch) | Distance between plants in row (inch) | Depth of planting (inch) | Time of planting | Days to germinate | Days to harvest | Suggested amount per person/year (fresh use) | Frost hardy | When to harvest |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Asparagus | | – | 36 | 18 | 8–10 | April | – | 2–3 yr | 10–15 | Yes | When spears are 6-8″ long |
| Beans, Lima | Pole | 20–70 | 30 | 36 | 1–2 | 2 wks after frost | 5–10 | 80–90 | 5 hills | No | Just before pods reach full size and plumpness |
| | Bush | | 24 | 3 | | | | 65–80 | 10–15 ft | | |
| Beans, Snap | Pole | 80 | 30 | 36 | 1–2 | May–July | 5–10 | 60–65 | 5 hills | No | When pods are full length but before seeds begin to swell |
| | Bush | | 24 | 3 | | | 4–8 | 50–60 | 10–15 ft | | |
| Beets | | 1,500 | 12–18 | 2–3 | 1/2 | April–July | 7–12 | 50–65 | 5–10 ft | Semi | When 1–2″ in diameter |
| Broccoli | | 7,000 | 24–36 | 18–24 | – | April–May | – | 65–75 | 5 | Yes | before dark green blossom clusters begin to open |
| Cabbage | | 7,000 | 24 | 18 | 1/2 | April–May | – | 60–90 | 3–5 | Yes | When heads are of desirable size, before they split |
| Carrots | | 16,000 | 12–18 | 2 | 1/4 | April–June | 7–14 | 55–80 | 10 ft | Semi | When root is 1–1_″ diameter |
| Cauliflower | | 8,000 | 24 | 18 | – | April–June | – | 65–75 | 3 heads | Semi | Before heads start to loosen. Tie leaves over the head when it is about 2–3″ diameter |
| Corn, Sweet | | 100–150 | 30–36 | 8–10 | 1 | May–early July | 5–12 | 65–95 | 15 ft (plant in blocks) | No | When kernels are fully filled out and in milk stage |
| Cucumbers | | 800 | 48–72 | 12 | 1 | May–June | 7–10 | 50–70 | 5 ft | No | When fruit is dark green and slender |
| Eggplant | | 5,000 | 36 | 24 | – | May–June | – | 80–90 | 2 ft | No | When fruits are three quarters grown; before color becomes dull. Cut fruit from plant. |
| Kohlrabi | | 7,000 | 24 | 4 | 1/2 | April–May | 6–9 | 50–70 | 3–5 ft | Yes | Cut when crowns 2–3″ in diameter |
| Lettuce | Leaf | 22,000 | 14 | 3 | 1/4 | April–May | 5–10 | 35–50 | 10 ft | Semi | Leaves desirable size, tenderness |
| | Head | | 18 | 12 | | | | 50–75 | – | | When heads are firm |
| Muskmelon | | 1,000 | 60–84 | 12 | 1 | May–June | 7–12 | 70–100 | 5 plants | No | When stem easily 'slips' from the fruit without cutting |
| Onions | Seed | 9,000 | 12–18 | 2–3 | 1/2 | April–May | 7–12 | 85–100 | 25–50 ft | Yes | For storage: when tops fall over; For fresh: when _– _″ diameter |
| | Sets | | | | 1–2 | | – | – | | | |
| Parsley | | 15,000 | 24 | 4 | 1/4 | April–May | 14–21 | 75–90 | 4 ft | Yes | Anytime after leaves are ready for use |
| Parsnip | | 10,000 | 24 | 3 | 1/2 | April–May | 14–21 | 120–150 | 5–10 ft | Yes | Best after first hard frost |
| Peas | Green | 50–150 | 24 | 2 | 1 | April–May | 7–10 | 50–80 | 10–15 ft | Yes | When seeds just fill pod |
| | Sugar or Snow | | | | | | | | | | Before seeds expand |
| Pepper | | 3,500 | 24–30 | 15–20 | – | May–June | – | 60–100 | 2–3 plants | No | When fruit reaches desirable size |
| Potatoes | | – | 36 | 12–18 | 4 | April–May | 14–21 | 100–120 | 10–20 ft | Semi | When tubers are large enough (~10 wks. after planting); tubers grow until vines die; keep in dark place |
| Pumpkins | | 100 | 72–96 | 36–60 | 1–2 | May–June | 7–14 | 100–120 | 3 hills | No | Skins should be hard and mature on the vine; cut fruit from plant |
| Radish | | 1,500 | 12 | 1 | 1/2 | April–May | 3–7 | 22–30 | 3–5 ft | Yes | When desirable size |

**Table 3. Planting details for home gardens in South Dakota (Continued).**

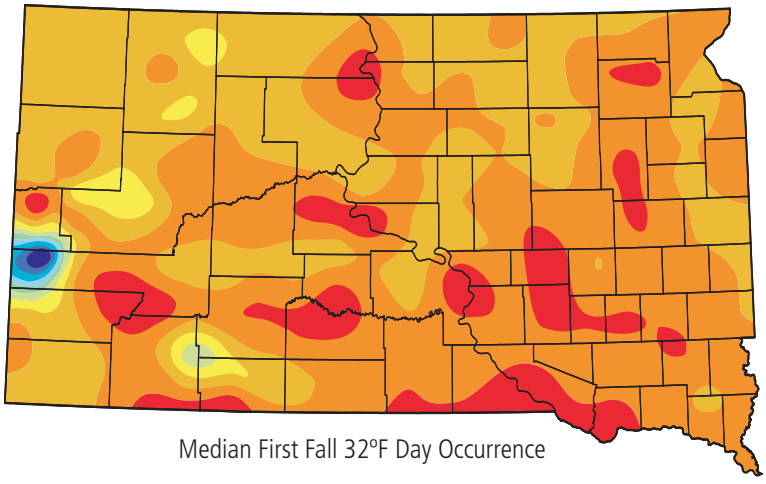
| Vegetable | | Approx # plants per oz of seed | Distance between rows (inch) | Distance between plants in row (inch) | Depth of planting (inch) | Time of planting | Days to germinate | Days to harvest | Suggested amount per person/year (fresh use) | Frost hardy | When to harvest |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Rhubarb stems | | – | 48 | 30 | 8 | April | – | 1 yr | 1 plant | Yes | 8-10 weeks in the spring |
| Squash | Summer | 250 | 36–48 | 4/48 | 1 | May–June | 7–10 | 50–70 | 2 hills | No | immature stage: skin is soft; 6–8″ long (zucchini) or 4″ (patty pan) |
| | Winter | | 48–60 | 36–48 | | | | 80–100 | | | Mature stage: skin is hard |
| Tomatoes | | 10,000 | 48 | 18–36 | – | May–June | – | 55–90 | 2–4 plants | No | when fruits are of uniform color, before they are soft |
| Turnips | | 11,000 | 18 | 6 | 1/2 | April–June | 5–10 | 40–50 | 10 ft | Yes | When 2-3″ in diameter |
| Watermelon | | 200–250 | 76–96 | 24–36 | 1 | May–June | 7–12 | 80–130 | 3 hills | No | When underside of the fruit turns yellow; tendril next to fruit dries; skin turns dull and hardens |

**50% probability that the last spring 32°F temperature will occur on or before this day (1974–2003)**




Median Last Spring 32°F Day Occurrence

**50% probability that the first fall 32°F temperature will occur on or before this day (1974–2003)**




Median First Fall 32°F Day Occurrence