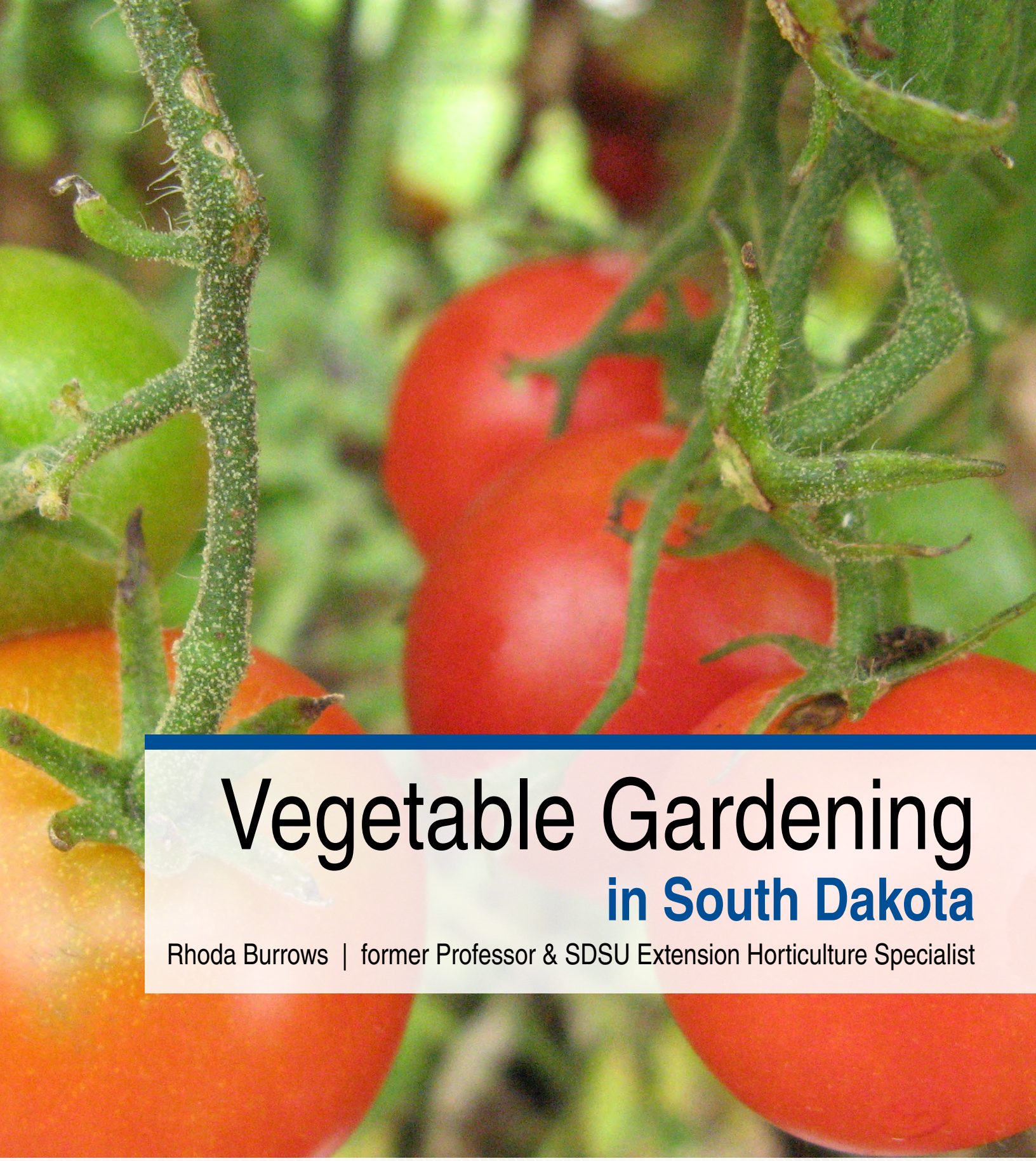

# Vegetable Gardening
## in South Dakota

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*Whatever your reasons to start a vegetable garden: fresh produce with great flavor, exercise, saving money, enticing children (and adults) to eat healthier food, or knowing where your food came from and how it was grown, this booklet will help you with basic information and tips to get started.*

## First things first: Where to place the Garden

Consider these points when deciding where to site a garden:

### Convenience

If a garden is close to the house, the gardener can easily check the plants' progress and provide the needed care. It's also easier to pick a tomato, cucumber or some radishes for a quick salad when the garden is located conveniently close to the house. Water is also usually more accessible near houses or other buildings. However, sometimes it may be good to locate the garden in another area because of poor soil, poor drainage, shade, or lack of space.

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. More attractive vegetables, such as peppers, can be mixed into flower beds. Vining plants such as cucumbers can be trellised against a wall, and most bush types of vegetables can be grown in containers.

### Light

Most vegetables need at least 6 to 8 hours of full sunlight a day. With fewer hours of sunlight, plants may grow tall and produce leaves but few or no tomatoes, peppers, squash, etc. Leafy vegetables (such as lettuce) may be grown in shadier areas during the hottest part of the summer.

### Exposure to Wind

If the garden is in an exposed area, consider providing some sort of windbreak. Trees and shrubs are effective, but if they are too close (within 50 ft. of full-grown trees) to the garden they can compete for soil moisture and nutrients, and shade the garden. The roots of a tree often extend out at least as far as the tree is tall, and regrow quickly if attempts are made to remove them by tillage. Applying additional water and fertilizer can compensate somewhat for the uptake of water and nutrients by nearby trees or shrubs, but be sure they are not shading the garden. Avoid planting anywhere near black walnut trees, as their roots produce a substance that will harm tomatoes and other garden plants.

Other possible 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, also can make an effective windbreak.

### Water

Vegetables require regular watering, an inch or more per week. The water source should be convenient or it will be challenging to water as often as is needed. If you are far from a water source, you can use a drip system fed by a water tank, but you'll need to fill the tank periodically.

Try to avoid spots that have a recent history (in the past year or two) of flooding, as flood waters can carry human pathogens or chemicals that can contaminate the vegetables and make them unsafe to eat.

**Water quality:** Not all water in South Dakota is suitable

for irrigation. Artesian water is often higher in salts or sodium and may not be usable. If the water quality is in question, check with SDSU Extension for information on how to have it tested.

### Soil

The soil should be fertile, easy to work, at least 6 to 8 inches deep, well drained, and not too alkaline or acid (see "Soil pH"). To test drainage, dig a hole 8-10 inches deep and fill with water. If any water remains after 12 hours, choose a different site, or use raised beds.

Loam soils are ideal, but sandy or clay soils can work if the garden is managed properly (read more in the section on soil preparation). See Fertilizing Gardens in South Dakota for information on how to take a soil test and amend soils. Contact SDSU Extension for a list of soil test laboratories.

## Soil pH

Most vegetables prefer a soil that is slightly acidic (pH 6.5-7.0). If the soil is too acid or too alkaline, the plant will not be able to take up certain nutrients from the soil and poor growth, or even death of the plant results.

The pH of the soil is determined by a soil test. 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, in some parts of the state, especially West River, the pH may reach 8 to 8.5 or even higher, making some vegetables difficult to grow.

Lowering pH: Acidifying the soil can be a slow and sometimes difficult process. Elemental sulfur is the most effective material: Apply 2 to 4 lbs. 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 the desired pH over time. However, if the soil has a high level of free lime (exhibited by "fizzing" when acid is dropped on it, quite common in our soils), sulfur will not be effective. For more information, see Fertilizing Gardens in South Dakota.

Raising pH: 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 never 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 over time.

### Animals

Rabbits, raccoons, woodchucks, gophers, deer, and even dogs or horses 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.

## What to plant where

Start small! A 4 ft. by 6 ft. garden that can be easily managed may produce more than a large one that has become overgrown with weeds or simply is harder to keep watered. A garden plan, whether a simple sketch or a detailed scaled drawing, can help determine how large a space is needed for the desired set of crops and to make optimal use of garden space.

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, vitamins, minerals, and fiber that each color group has to offer. Include your own favorite vegetables, and a few new ones to try.

### Arrangement

- Use Table 4 to determine how much space each kind of vegetable needs. If your garden is more than 3 ft. wide, you'll need to also include space for pathways for you to stand or crouch on while you weed or harvest your produce. Note when each type of vegetable should be planted (early cool season vs. later warm season crops, or crops such as beans that may be planted every few weeks).
- 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. Short-season crops include peas, beans, spinach, lettuce, beets, kohlrabi, radishes, onions for bunching, cabbage, cauliflower, and broccoli. Plant at one end of the garden to make it easier to replant after these crops are harvested, or interplant them with long-season crops (see below).
- Long-season crops. Examples are tomatoes, peppers, potatoes, vine crops (cucumbers, melons, winter squash, pumpkins, etc.), and sweet corn. These require most of the growing season to mature and be productive.

Place tall-growing plants such as sweet corn far enough away from short plants so as not to shade them, or put them on the north or east side of the garden. (However, lettuce and similar greens may benefit from this partial shade in mid-summer, protecting them from the hot afternoon sun.)

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

Good records of what varieties were grown and where they were planted will make it easier to plan next year's garden. Note which varieties performed well or had particular problems.

Records also aid in planning proper rotation of the vegetable locations in the garden. Change the location of 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 applies to members of the cole crop group (broccoli, cauliflower, cabbage, etc.) and the cucurbit group (melons, pumpkins, squash, gourds, cucumbers.)

**Rows**: Long rows are easier to cultivate with wheeled equipment than are short rows, and are more easily watered with a drip system or soaker hose. North-south rows will reduce the shading of adjacent rows by taller plants.

Fig. 1. Wide-row or block planting of lettuce

**Blocks/Wide rows:** Planting in blocks or bands can save space and make it easier to meet crop needs while reducing weeds (Fig. 1). Block planting is also recommended for better pollination of corn. Just don't make the block or band wider than you can reach across! Generally you can use slightly more than the in-row spacing in Table 4 (be sure to use the larger end of the range, for example, 36" for tomatoes). Vegetables particularly suited to wide row planting include root crops such as carrots, radishes, beets, turnip, and rutabaga, and leafy crops such as lettuce and spinach.

**Paths:** Some gardeners maintain walking paths in the same areas year after year. This reduces the problem of compacting soil over time. Old carpet scraps, cardboard, or other mulch can be used to decrease weed growth in the pathways.

### Re-using space...Succession Planting

Succession planting means planting one crop several times, often at a one to two week interval. For example, three or four plantings of beans could be seeded seven to ten days apart. Another option is to plant another crop into an area where one has already been harvested. For example, when peas have quit bearing, remove them and plant another crop such as snap beans or fall broccoli in their space.

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 will mature and be of good eating quality for less than two weeks. If two or three plantings were made one to two weeks apart, the vegetables will be available for a longer time. This also avoids non-productive open

## Raised Beds

Raised beds require extra work to build, but can save time and effort throughout the gardening year. A raised bed can simply be soil piled up (often mixed with compost) a few inches, or can be elaborately built structures with sides of wood or rock or other material. They're helpful to keep traffic out of the plants, as well as enabling those who have difficulty bending or stooping to still be able to garden. They also help avoid compaction of heavier soils by eliminating the need for foot traffic.

Beds should be a size that is convenient to reach across (3-4 ft. maximum) and walk around (usually not more than 6 to 8 ft. long). In areas with poor drainage or unsuitable soils (due to salts or contaminants) raised beds can be created with compost and topsoil brought in from another location. Plants should be at least 4 to 6" from the side of the bed to avoid roots drying out.

spaces, and weed control will be easier.

### Fall Garden – a type of succession planting

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

Succession Planting
Suggested latest planting date with avg. mid-Sept frost

| Vegetable | | Days to Harvest (Your variety may differ!) |
|---|---|---|
| Green Beans | July 10 | 55 days |
| Carrots | July 7-15* | 55-70 days |
| Cucumbers | July 15 | 50-60 days |
| Green Onion | July 15 | 50-60 DAYS |
| Peas | July 15 | 50-60 days |
| Beets | July 15 | 50 days |
| Summer Squash | July 20 | 50-60 days |
| Salad greens | Aug 1 to 15* | 30-50 days |
| Kohlrabi | Aug 1 | 40-50 days |
| Turnip | Aug. 1 | 40-50 days |
| Kale* | Aug. 15 | 60 days |
| Radish | Aug. 20 | 26 days |
| Spinach* | Sept 5 | 40 days |

* Earlier dates should be used for longer-day varieties
**Can tolerate light to moderate frosts

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. (See spring and fall frost maps on back cover, or ask a local gardener.) Except for potatoes, the Cool Season crops listed in Table 1 (p. 5) can withstand light frost.

## Soil Preparation...

### Tillage

Good soil preparation is essential for growing vegetable crops. The garden area can be plowed, rototilled or spaded, depending on available equipment and garden size. Plowing or spading can be done in the fall or in the spring; however fall may be preferable to avoid delays in the spring due to wet soils from snowmelt or spring rains. Work the soil about eight inches deep. Don't work the soil when it is too wet since this will cause compaction and development of clods. If the soil is too dry, however, it may also be difficult to work, and may need to be irrigated and let dry for a few days before working.

Just before planting, if needed, work the planting area again to loosen the soil with a rake, cultivator, or rototiller. However, do not pulverize the soil with frequent rototilling – this destroys the soil structure! For small areas, the soil can simply be spaded right in the planting row, and then broken up with a rake or hoe as necessary.

Converting lawn to garden? If you have a good supply of compost available, another way to begin a new garden is to wet down the area where you plan to place the beds, cover it with several layers of newspaper, and then several inches of compost over that. No spading or rototilling involved!

### Organic Matter

Almost all South Dakota soils can produce better crops if quality organic matter (OM) is added. It 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 6% is generally considered ideal. Sources include animal manure, green manure, compost, peat moss, and others.

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

Note: If you choose to apply manure to your garden, 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, and will also decrease the number of viable weed seeds remaining in it.

**Green manure** refers to cover crops such as rye, ryegrass, Sudan grass, oats, and legumes such as vetch, alfalfa, etc. (see Table 3, pg. 15) that are turned under before crop maturity, to decompose and add organic matter to the soil. With non-leguminous crops such as rye or oats, nitrogen must be added when they are turned under to help soil microbes to decompose the material

and prevent nitrogen starvation in the succeeding crop.

Cover crops generally are planted near the time of 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 standing crop may trap additional snow during the winter months. Cover crops can also be planted as part of a rotation within the garden during the growing season, or to fill in an area after a crop harvested earlier in the season, such as peas.

**Compost** consists of plant waste placed in a pile to decompose. Small amounts of soil or finished compost, and a nitrogen source are added to speed decomposition. Coffee grounds can also be used as a source of nitrogen, and will optimize the compost process when added at a volume of 5% to 20% of the composted materials. Compost makes a good substitute for animal manure for improving nutrient content, soil structure and water holding capacity, but may not supply all the nitrogen needed. Diseased plants should not be composted, as most home compost piles do not heat sufficiently to destroy pathogens. For that reason also, and to avoid attracting animals, no kitchen wastes such as fats, bones, or other similar wastes should be placed in compost.

## Planting the Garden...

### When to plant

Cool season crops can be planted earlier in the season than warm season crops; if planted too early, warm season crops will be injured. However, cool season crops generally do not tolerate heat very well. Table 1 lists cool and warm season crops and their soil temperature requirements.

Use the maps on back cover to determine the average date of the last spring frost and first fall frost for your location. Personal experience and the advice of experienced gardeners will also help, particularly in areas where there are wide variations in elevation. Smaller areas of soil can be warmed quickly with a clear plastic dropcloth and a few sunny days. Comparing the maps with the table below can help you determine planting dates, as well as the average length of the growing season in your area. For example, on average, most of the southeast part of the state is frost-free between May 1 and September 24th, for a total of 147 frost-free growing days.

Table 1. Soil temperature requirement for cool and warm season vegetable crops.

| COOL SEASON CROPS | | |
|---|---|---|
| Minimum soil temp. 40° to 45°F<br>Optimum soil temp. 60° to 65°F. | | |
| Group A. Plant in April or early May: will not grow well in hot weather. | | |
| spinach | peas | radishes |
| cauliflower* | head lettuce* | |
| Group B. Plant as early as Group A or shortly afterwards; these will tolerate some hot weather. | | |
| broccoli* | onions | cabbage* |
| chard | leaf lettuce | irish potato |
| carrots | turnips | beets |
| celery (difficult) | kohlrabi | |
| **WARM SEASON CROPS** | | |
| Do not grow well in cool (under 50°F) 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 | | |

*usually grown from transplants

## Equipment

Garden work can be much more enjoyable if high-quality tools are used and maintained properly. Adaptive tools are available to facilitate arthritic or handicapped gardeners.

Indispensable tools include a trowel, hoe, spade, spading fork, bucket or watering can, and garden hose. For fertilizer and pest control, measuring cups and spoons, and a hand duster or sprayer will be needed. For larger gardens, equipment such as a stout garden line and two pointed metal stakes (for making straight rows), soaker hoses or drip lines, wheel hoe cultivator, rototiller or a small garden tractor with attachments is highly desirable.

## 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 quality seed is clean, disease-free, germinates readily, and is true to name. To be certain of pure vigorous seed, purchase only from a reliable seed firm.

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. However, lettuce, onion, parsley and parsnip seed may be good for only one year. Seed can be tested by placing a sample (often 10 seed) onto a damp paper towel which is then rolled up loosely and placed in a plastic bag to retain moisture and kept at room temperature. Every few days, unroll the towel and check for germination.

Seed may be saved from healthy non-hybrid plants, but to do so takes special care and knowledge. Consult "Saving Seed for Next Year" for guidelines on how to select seed to save, 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.

The spacing and proper planting depth for various vegetables is given in Table 4 (page 16). If the seeds are planted too thickly, resulting seedlings will be crowded and spindly and not very productive. In addition, the job of thinning will be more tedious. Seeds can be sown somewhat deeper than recommended in Table 4 if the soil is sandy or if sown in summer when the surface soil is hot and dry.

The soil should be slightly moist but not wet when the seed is planted. After covering the seed, firm the soil gently (do not pack). This insures better contact of seed and soil and gives faster, more even germination. If the soil is heavy (i.e., high in clay), scatter lawn clippings, compost, straw, or pine needles lightly over the newly seeded row to prevent crusting after watering. Water gently to avoid dislodging the seed, but make sure the planted area is well-wetted. Mark each variety with a stake or label for future reference.

The distances to allow between rows and between plants in a row or block (after thinning) is given in Table 4. Planting in a wide row or block often can increase space utilization while still allowing good growth (see p. 4).

## Transplants

To get earlier yields or to lengthen the harvest season, transplants can be used for many crops. Long season crops (see Table 4) 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 and may not transplant well. Cucumbers, squash, muskmelons, and watermelons can be transplanted successfully if grown in individual containers such as peat pots and their roots are not disturbed when the plants are set in the garden. They must therefore be transplanted before their root tips are stopped by the wall of the container, usually just 2-3 weeks after seeding. *Note: crops started from seed will usually have deeper taproot systems, which can be helpful in dry years.*

Transplants can be started indoors, or in coldframes. If purchasing transplants, be sure to select stocky, well-grown plants, not tall, spindly ones. Don't purchase plants with spots on the leaves or stems, or ones that are rootbound. Two advantages of homegrown transplants are increased choice of varieties and better accessibility at planting time.

**Starting transplants:** Growing seedlings requires some skill and care. Factors such as light, temperature, moisture, and space must be considered. Most gardeners use artificial lights to grow their seedlings. Cool white or warm white fluorescent tubes in a shop light fixture make 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. (Special plant growth LED bulbs are starting to become available for homeowners; general LED replacement tube lights may not have the needed light spectrum.) Place the seedlings approximately three to five inches beneath the lights for 12 to 18 hours per day.

Almost any container can be used for starting seed—clay or plastic pots or flats are good. A prepackaged seed starter is usually the most convenient type of growing media to use for starting seeds. Pre-packaged mixes are free of insects and disease pathogens, and allow good moisture retention and aeration. Soil should only be used if pasteurized and combined with peat, vermiculite and/or perlite. Small quantities of such a growing media should be treated in the oven for a half hour at 160° F.

*Warning – the odor may be unpleasant and persistent!* Pots and other containers can be cleaned using a fresh 10% bleach solution, allowing the pot to dry afterward to dissipate any remaining chlorine.

After the seedlings have developed one pair of true leaves, they can be transplanted to containers filled with a good (pasteurized) 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 over a few days' time. Protect them at night if frost threatens.

**Planting transplants:** Avoid transplanting young seedlings on hot windy days. Cloudy conditions and cooler temperatures make it easier for the young plants to adapt. Seedlings may be "sunburned" if they are not hardened sufficiently and are transplanted when it is too hot and sunny, or windy.

When transplants are set outdoors, the mass of roots and soil should be disturbed as little as possible. Set plants at the spacing recommended in Table 4. Dig a hole wider than the root ball, setting each 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. 2). Fill in around the plant with soil, gently firming, and water thoroughly to insure that no air pockets remain between the roots and the soil. 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 reducing the watering as the roots develop and the plants become established.

Fig. 2 Tomato transplants set to the right depth (up to the lowest leaf) in soil

### Starter Solution

A starter solution is a dilute mixture of fertilizer, usually high in phosphorous, 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.

### Protecting plants from frost

Many crops can be transplanted outdoors earlier and will give earlier yields if they are protected from cold temperatures during the first two or three weeks of growth. Examples of plant protectors are hotcaps, plastic or spun bond row covers, milk jugs, and "wall-of-water" devices. These give some protection against wind as well as some protection 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.

## Fertilizing...

Vegetables need a well-balanced diet. It is often necessary to add 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 investment.

Fertilizer should be applied carefully. Too much nitrogen can cause excessive vegetative growth and reduce yields of fruiting vegetables. Too much potassium or other nutrients can prevent the plant from taking up other needed nutrients, or raise the soil pH. Micronutrients are rarely needed, and can also be toxic if overapplied (especially boron). If organic matter such as compost is added in large amounts or over a period of years, the nitrogen from it will gradually become available to plants and will decrease, though not usually completely eliminate, the need for additional nitrogen sources.

Organic fertilizers such as fish emulsion, manures,

and blood or bone meal are alternatives to chemical-based fertilizers. Their nutrients are usually much less concentrated than chemical fertilizers, so greater amounts will need to be applied. Generally their use promotes good soil structure and health, as they also often provide small amounts of micronutrients as well as organic matter. Many of the organic materials require the action of soil microbes to release the nutrients for plant use, so apply them early, even the fall before planting. Soil microbes can actually use up the available nitrogen as they decompose high carbon materials such as dry leaves or straw, so these should either be composted in a separate area, or higher nitrogen materials added with them to compensate. Fish meal or emulsion and blood meal are good choices, as they contain relatively high amounts of nitrogen that are readily available to plants.

See the publication "Fertilizing Gardens in South Dakota" for more information on organic sources of nutrients.

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 fertilizer must list the contents expressed as a percent of each nutrient in the material.

For example, a 20 lb. bag of 8-32-16 NPK fertilizer has:

Nitrogen (N) = 8%

Phosphate ($P_2O_5$) = 32%

Potash ($K_2O$) = 16%

and thus contains 1.6 lbs. nitrogen, 6.4 lbs phosphate, and 3.2 lbs. potash (potassium). The rest of the 20 lbs is an inert carrier (often clay particles).

### Nutrients for Plants

The three most important nutrients for plant growth are nitrogen (N), phosphorus (P), and potassium (K). These are considered the major nutrients 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, and are required in relatively small amounts, usually present in the soil.

South Dakota garden soils generally have adequate potassium, but most gardens require additional nitrogen, and sometimes phosphorus.

Plants grown in containers may require additional nutrients.

For maximum production, home gardeners should have a soil test to determine nutrient needs. Contact SDSU Extension for soil testing information.

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. Wait to side-dress fruiting vegetables, like tomatoes, peppers, eggplant, squash, pumpkin and cucumbers until after the plants have begun to set fruit. Fertilizing too early can reduce or even prevent fruit set.

A good lawn fertilizer that contains 20 to 30% nitrogen can work well. Be sure not to use any products that contain a broadleaf weed killer or seed germination inhibitor (such as those designed to control crabgrass)! When side-dressing, be sure to stay 6 to 8 inches away from the main stem of tomatoes and 3 to 4 inches away from onions. Leafy crops like lettuce, spinach, cabbage and sweet corn, may be side-dressed after they have developed three to five true leaves. Use about one cup for each 25 feet of row, worked into the top two inches of soil, along each side of the row.

## Watering...

Moisture is often a limiting factor in growing vegetables in South Dakota. Irrigation can increase yields and improve quality. In addition, earlier harvest may result, succession plantings of quick growing crops are possible, and drought sensitive crops such as head lettuce, and cauliflower may be grown successfully.

Consistent watering is one of the most essential factors for plant growth. Vegetables typically need 1 to 1½ inches of water per week (either rain or irrigation) for good growth. Productivity and quality may both be reduced before wilting is apparent, so check the soil to know when to water.

### 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 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 the user to place emitters themselves, but most now come with the emitters built into the tube, available in spacings ranging from 4" to 36" apart. Drip tubes can usually be reused for a number of years. Again, these systems work best with crops arranged in rows.

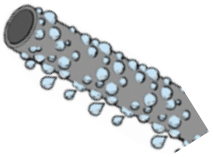

Fig. 3. Drip irrigation on double row of cabbage.

**Furrow**

Water is applied by allowing it to run down furrows between the plant rows. An area with a gentle slope is necessary. Short rows work better, as they are more uniformly wetted than long rows. Water of good quality must be used or high salt accumulations may result over time.

**Sprinklers**

Some lawn sprinklers apply water too rapidly for some garden soils, especially those high in clay. Starting and stopping the sprinkler at intervals will 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. These sprinklers can be attached to a garden hose or to portable aluminum pipe. 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, as wet foliage invites leaf diseases.

## When and How Much to Irrigate

In South Dakota, as much as ¼ 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, as crop growth and yield is often decreased before wilting is obvious. However, on a very hot day, even well-watered plants may exhibit leaf-rolling or other signs of wilt. These plants will recover overnight if there is sufficient moisture in the soil.

Under dry conditions, the soil surface of unmulched areas will dry out quickly. Gardeners should check the moisture level of lower depths (2 to 6 inches deep) by using a shovel or trowel. Except for very sandy soils, moist soils should be able to form a ball or ribbon in one's hand. Clay soils will become very hard when they are overly dry, often seen by deep cracks across the ground surface.

One strategy is to irrigate at least once a week unless the rainfall during the week totals at least 1 to 1½ inches and fell in amounts greater than 1/3 inch each time. Obviously, less water will be required during cool periods than hot and windy periods.

Generally, apply the 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. For best

results, soak the soil to a depth of eight to 12 inches. Check how deep the moisture has penetrated a few hours after irrigating, using a hand trowel or shovel. Or, place three or four coffee cans at random to find out how much water has been applied with a sprinkler irrigation system. When the average depth of water in the cans is 1½ inches, stop irrigating.

Following are some basic guidelines for irrigating:

- Do not water until the garden needs it. Once plants are established, water deeply, and then allow the top 1" of soil to dry before watering again. This will encourage deeper rooting.
- When water is needed, apply enough at a time to saturate the top eight to 12 inches of soil, which will ensure that the root zone is well watered,
- 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, and can harbor insect pests and diseases. The most effective methods of weed control in the home garden are hand weeding and cultivation.

### Cultivation

This can be accomplished by using a hoe, a wheel hoe, or garden tiller. Do not cultivate deeper than one inch 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 the following year.

### Herbicides

For most home gardeners, hand weeding, cultivating, and mulching are better choices for weed control than chemicals. However, on larger plots with fewer kinds of vegetables, chemical weed control may be practical.

Many chemicals are available for weed control, including a few organic options. Herbicides are very specific in their use. Be sure to read the label carefully to see if the product is labeled for the vegetable and will control the problem weeds. 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 must be applied at the correct rate or else 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.

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 young weeds (as well as vegetables, so be careful!). Be sure to rinse the sprayer out well, as vinegar will corrode any metal sprayer parts. Always keep separate sprayers for herbicide application and for insecticide or fungicide applications. Too often, residue of herbicide in a sprayer damages plants sprayed for pest problems.

## 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 injury to crops by cultivation, 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 include leaves, grass clippings, sawdust, crushed corncobs, straw (Fig. 4), hay, shredded bark or branches, and newspaper or shredded paper.

Warning: If you use straw or you save lawn clippings for mulch, make certain that herbicides containing clopyralid or aminopyralid have not 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 a number of products for controlling perennial weeds in lawns, field crops, pastures, and even some horticultural crops.

Fig. 4. Straw mulch applied between pea rows

Likewise, don't use grass clippings collected in the 3-4 mowings after application of 2,4-D herbicides. If in doubt, check the herbicide label!!

Organic mulches should be weed free. Place them on the soil after the plants are well established, usually just after the first cultivation 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 over the soil between rows and around plants.

The thickness of the mulch depends on the material. Leaves, straw, or hay can be applied about three inches deep. Grass clippings should be applied about ½ inch thick – otherwise moisture may not penetrate. Newspapers should also be only 3-4 layers thick; use only newsprint paper (i.e., not 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. The organisms that break down organic matter can compete with vegetables for nitrogen. To prevent problems, 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, but you may need to add extra nitrogen at that time to help the microorganisms process it.

### Plastic mulches

Plastic mulches can be effective for warming or cooling soils, preserving moisture, controlling weeds, and even repelling 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 good 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. White plastic will cool the soil (good for cool season crops), and may help repel some insects.

Plastic mulch comes in rolls of various widths (usually 36-48 inches) and is unrolled over the prepared bed before planting. Drip irrigation or soaker hoses may need to be laid before the mulch, since the mulches do not allow water to pass through. (For that reason, homeowners may want to consider using black landscape fabric, which allows the water to penetrate.) When applying mulch to a bed, anchor the edges of the material in small furrows about two inches deep, with 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; however, some biodegradable plastic mulches are available.

## Insect and Disease Control...

Proper preventive steps can control many problems that occur in vegetable gardens. Insects and diseases can quickly ruin a promising crop. Even if the plants survive, yield is reduced, quality is lowered, money and time are wasted, and keeping quality and storage life of many vegetables is decreased. 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 or insects. Such seed may be more expensive but is well worth it.

### Certified seed potatoes

Certified potato seed is produced under strict controls. Plant certified seed potatoes when possible, as they will have fewer diseases and often much higher yields. You will also avoid the possibility of bringing in a disease to your garden that may 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 insect pests 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 160°F) 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 crop.

### Encourage beneficial insects

Don't apply insecticides unless you notice unacceptable levels of damage, as these also can kill insect pest predators. Alyssum and dill are two plants whose flowers attract beneficial insects.

### Insecticides and Fungicides

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. Microbial insecticides, such as Bt or Nosema products, target specific insects with fewer effects on non-target species.

Fungicides protect only uninfected tissue – they do not "cure" infected plants. Towards the end of the season, many pests can be tolerated as long as they are not directly affecting harvested parts.

## Perennial Crops...

Asparagus and rhubarb are the two perennial vegetables commonly grown in South Dakota. An area about 6 ft. by 6 ft. with plants set 1½ feet apart, or a row about 25 feet long with plants 1½ feet apart, will supply more than enough fresh asparagus for an average family. Three hills (plants) of rhubarb spaced three 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.

> 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.

Mix a spadeful of well-rotted manure or two to three tablespoons of garden fertilizer 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 best way to start an asparagus planting is to purchase one-year-old crowns. Set the plants eight to ten inches deep in a hole or furrow and cover with two inches

of soil. Fill in the remaining soil as the young shoots grow during the first summer.

Do not cut any spears the first two years - the plant needs 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 Growing Asparagus: https://extension.sdstate.edu/growing-asparagus-0.

### Rhubarb

The usual method of starting rhubarb is to obtain pieces of the crown having at least one good bud. Plant these pieces three to four inches deep and cover with about one 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 four to eight weeks, depending on the age of the plants. Never harvest more than one-third of the plant at one time.

## Harvest, Preservation and Storage...

Table 4 provides information to determine when to harvest various vegetables.

Proper storage makes it possible to hold vegetables in good condition for several weeks to several months. Different kinds of vegetables require different storage conditions. Temperature, humidity, and ventilation are important factors in vegetable storage. Table 2 gives temperature and humidity requirements for some commonly stored vegetables.

Cellars, garages, outdoor banks, pits, or mounds can be used to store produce. 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 50°F) during the winter for storing many vegetables.

### Processing

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 regional extension office, or the SDSU Extension Food Safety Website: https://extension.sdstate.edu/food/safety.

### 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, and are 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 | Onion (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 onion | | | 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.

Table 3. Cover Crops for Gardens

| CROP | EASE OF ESTABLISHMENT | TIME OF PLANTING | OVERWINTER ABILITY | GROWTH AMOUNT | EASE OF INCORPORATION | WEED SUPPRESSION | SOIL STRUCTURE IMPROVEMENT | SEED RATE (OZ/ 100 FT2) | COMMENTS |
|---|---|---|---|---|---|---|---|---|---|
| (Cereal) Rye | Easy; can overseed into vegetables | Fall | *** | *** | ** | ** (not grasses) | ** | 3-4 | Drought tolerant; Can be used for windbreak; Helps decrease soil-borne diseases but may increase cutworms, wireworms |
| Oats | Easy | Aug - Sept | No | ** | *** | *** | ** | 4-6 | Prefers cool moist conditions; can be used as nurse crop for hairy vetch & other legumes |
| Barley | Easy | Spring/Fall | No | * | ** | ** | ** | 3-5 | Tolerates some drought, high pH soil |
| Buckwheat | Easy | Spring | No | ** | *** | *** | ** | 3-4 | Quick cover; don't allow to flower (can become weed); supports beneficial insects; Note: NOT heat or drought-tolerant; not for high pH or heavy soils |
| Annual Ryegrass | Easy | Aug - Sept | No | ** | ** | *** | *** | 1-2 | Relatively easy; uses a lot of N and water |
| Hairy Vetch | Moderate | Spring or early Fall | *** | ** | * | * | ** | 2-3 | adds 2-4.5 lb N/1000 $ft^2$ to the soil; good for tomatoes and pumpkins; somewhat drought tolerant; heavy crop will clog rototiller |
| Sweet Clover | Easy | Summer | *** | *** | ** | ** | *** | 1 | Tolerant of high pH, drought |
| Mustards, Canola | Moderate | 1 month before fall freeze | No | ** | ** | ** | ** | 1 | Can be grazed; or mix with other cover crops; may suppress soil fungi - plant after potatoes are harvested |
| Oilseed, Daikon radish | Easy | Spring; late summer to early fall | No | ** | *** | *** | *** | 1 | Can hold 1-4 lbs/1000 $ft^2$ N for other crops; need moisture for best root growth |
| Sorghum x Sudangrass | Moderate | late May/ July | No | *** | * | *** | *** | 1-3 | Drought and high pH tolerant; Requires heavy-duty mower; heavy N user; allelopathic - allow 4 wks after incorporation |
| Field Peas | Moderate | Spring or early fall | No | ** | ** | ** | ** | 3-10 | Mix with oats or barley and or hairy vetch; prefer cool moist conditions. |

*** = Relatively High

** = Moderate

* = Relatively Low

Note: Legumes such as vetch, peas, and clover should be inoculated unless they were grown in the last 5 years. Small grains can be mowed after flowering.

Table 4. Planting details for home gardens in South Dakota

| Vegetable | | Distance between rows (inches) | Distance between plants in row (inches) | Depth of planting (inch) | Weeks to transplant size | Time of planting or transplanting outdoors | Days to germinate | Days to harvest | Suggested amt per person per year (fresh use) | Frost hardy | When to harvest |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Asparagus | | 36 | 18 | 8–10 | | April | - | 2–3 yr | 10 ft. | Yes | Spears are 6-8” long |
| Beans, Lima | Pole | 30 | 36 | 1 | | Late May/ June | 7–10 | 80–90 | 4 hill | No | Just before pods reach full size and plumpness |
| | Bush | 24 | 3 | | | | | 75–80 | 10–15 ft | | |
| Beans, Snap | Pole | 30 | 36 | 1 | | May–July | 6–10 | 60–65 | 5 hills | No | Pods are full length but before seeds begin to swell |
| | Bush | 24 | 3 | | | | | 50–60 | 10–15ft | | |
| Beets | | 12–18 | 2–3 | 1/2 | | April–July | 7–12 | 50–65 | 3 ft | Semi | 1-2” in diameter |
| Broccoli | | 24–36 | 18–24 | – | 5-7 | April–May | - | 65–75 | 5 | Yes | Before dark green blossom clusters begin to open |
| Cabbage | | 24 | 18 | – | 5–7 | April–May | – | 60–90 | 3–5 | Yes | Heads are of desirable size, before they split |
| Carrots | | 12–18 | 2 | 1/4 | | April–June | 7–14 | 55–80 | 6 ft | Semi | Root is 1 – 1 1/2” diameter |
| Cauliflower | | 24 | 18 | – | 5–7 | 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 | | 30–36 | 8–10 | 1/2–1 | | May–early July | 5–12 | 60–95 | 15 plants | No | Kernels are fully filled out and in milk stage |
| Cucumbers | | 48–72 | 12 | 1/2–1 | 2–3 | May–June | 5–10 | 50–70 | 3 plants | No | Fruit 1 1/2” diameter |
| Eggplant | | 36 | 24 | – | 5–7 | May–June | – | 80–90 | 2 plants | No | Fruit three quarters grown; before color becomes dull. Cut fruit from plant. |
| Kohlrabi | | 24 | 4 | 1/4–1/2 | | April–May | 6–9 | 50–70 | 2 ft | Yes | Cut when crowns 2-3” in diameter |
| Lettuce | Leaf | 14 | 3 | 1/4 | 4 | April–May | 5–10 | 35–50 | 6 ft | Semi | Leaves desirable size<br>Heads are firm |
| | Head | 18 | 12 | | | | | 50–75 | 5 heads | | |
| Muskmelon | | 60–84 | 12 | 1/2–1 | 4 | May–June | 7–12 | 70–100 | 3 plants | No | Stem easily ‘slips’ from the fruit with gentle tug |
| Onions | Seed | 12–18 | 2–3 | 1/4 | 10–12 | April–May | 7–12 | 85–100 | 25 ft | Yes | For storage—when tops fall over; For fresh—when 1/4–3/4” diameter |
| | Sets<br>Plants | | | 1/2 | | – | – | | | | |
| Parsley | | 24 | 4 | 1/2 | | April–May | 14–21 | 75–90 | 3 ft | Yes | Anytime |
| Parsnip | | 24 | 3 | 1/4–1/2 | | April–May | 14–21 | 120–150 | 5 ft | Yes | Best after first hard frost |
| Peas | Green | 24 | 2 | 1 | | April–May | 6–10 | 50–80 | 10–15 ft | Yes | Green peas: Seeds just fill pod; Sugar/Snow Peas: Before seeds expand. |
| | Sugar/ Snow | | | | | | | | | | |

| Vegetable | | Distance between rows (inches) | Distance between plants in row (inches) | Depth of planting (inch) | Weeks to transplant size | Time of planting or transplanting outdoors | Days to germinate | Days to harvest | Suggested amt per person per year (fresh use) | Frost hardy | When to harvest |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Pepper | | 24–30 | 15–20 | – | 5–7 | May–June | – | 60–100 | 3 plants | No | Desirable size (will color and sweeten some with time) |
| Potatoes | | 36 | 12–18 | 4 | | April–May | 14–21 | 100–120 | 10–20 ft | Semi | Tubers are large enough (~10 wks. after planting); tubers grow until vines die; keep in dark place |
| Pumpkin | | 72–96 | 36–60 | 1/2–1 | 3–4 | May–June | 7–14 | 100–120 | 3 hills | No | Skins hard, color may change; cut fruit from plant |
| Radish | | 12 | 1 | 1/4 | | April–May | 3–7 | 22–30 | 2-3 ft | Yes | As soon as desired size |
| Rhubarb stems | | 48 | 30 | 8 | | April | – | 1 yr | 1 plant | Yes | 8–10 weeks in the spring |
| Squash | Summer | 36–48 | 4/48 | 1 | 3–4 | May–June | 7–10 | 50–70 | 2 plants | No | Summer: skin is soft; 6–8” long (zucchini) or 4” (patty pan) |
| | Winter | 48–60 | 36–48 | | 3–4 | | | 80–100 | 4 plants | | Winter: skin is hard |
| Tomatoes | | 48 | 18–36 | – | 5–7 | May–June | - | 55–90 | 2-4 plants | No | Fruits are of relatively uniform color |
| Turnips | | 18 | 6 | 1/4–1/2 | | April–June | 5–10 | 40–50 | 2-3 ft. | Yes | 2–3” in diameter |
| Watermelon | | 72–96 | 24–36 | 1 | 3–4 | May–June | 7–12 | 80–130 | 3 plants | No | Underside of the fruit turns yellow; tendril next to fruit dries; skin turns dull and hardens |

## Additional Information...

- Growing Asparagus https://extension.sdstate.edu/growing-asparagus-0
- Growing Tomatoes in South Dakota https://extension.sdstate.edu/growing-tomatoes-south-dakota
- Blossom End Rot of Tomatoes and other vegetables https://extension.sdstate.edu/blossom-end-rot-tomatoes-and-other-vegetables
- Fertilizing Gardens in South Dakota https://extension.sdstate.edu/fertilizing-gardens-south-dakota



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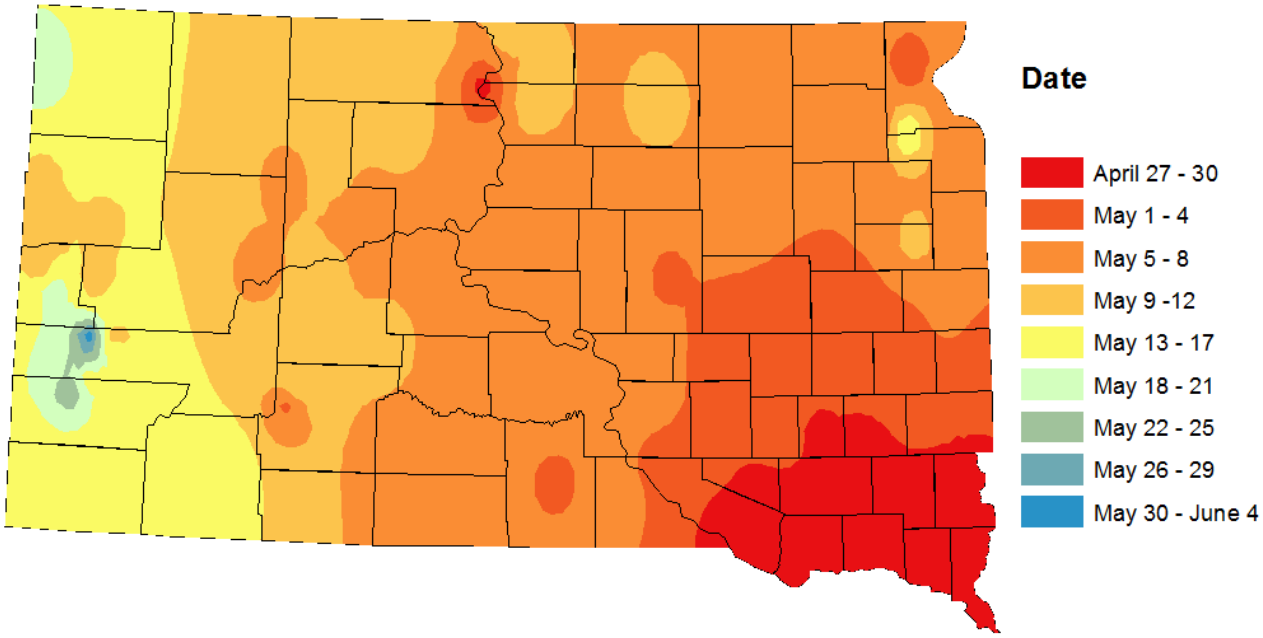
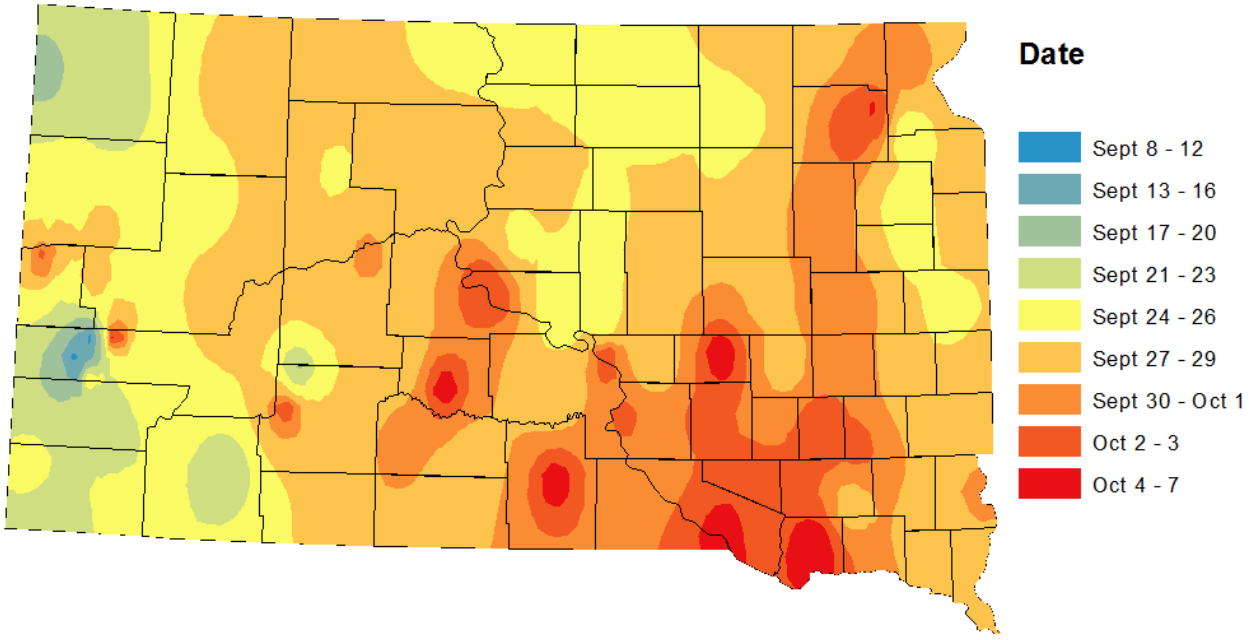



Average Last Spring Frost (32°F) – 50% probability (1983-2012) that the last spring 32°F temperature will occur on or before this date.




Average First Fall Frost (32°F) – 50% probability (1983-2012) that the first fall 32°F temperature will occur on or after this date.