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# Onions in South Dakota

P. Prashar

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The cover features several black and white photographs of onion cross-sections. These sections show the concentric rings of the onion bulb, with some areas appearing darker and more textured than others, possibly indicating different varieties or stages of growth. The sections are arranged in a scattered pattern around the central text.

Bulletin 579

# onions in South Dakota

Agricultural Experiment Station  
South Dakota State University, Brookings

**This publication summarizes recommendations resulting from 5 years of onion research at the Agricultural Experiment Station, South Dakota State University. These recommendations apply equally for either commercial or home garden production of onions, except for special machinery or operations used with large-scale plantings.**

Published in accordance with an Act passed in 1881 by the 14th Legislative Assembly, Dakota Territory, establishing the Dakota Agricultural College and with the Act of re-organization passed in 1887 by the 17th Legislative Assembly, which established the Agricultural Experiment Station at South Dakota State University.

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# onions

## in South Dakota

By  
Paul Prashar, professor,  
Horticulture-Forestry Department

The onion, believed to be a native of Asia, has been cultivated in America since 1629. It is a major vegetable in the American diet, being used in many different ways. By value, this crop ranks in the top four vegetables of America. Raw onions are high in vitamin C, as well as other nutrients.

New onion varieties and hybrids produce excellent yields. Lack of water during the growing season is the major limiting factor in commercial onion production in South Dakota.

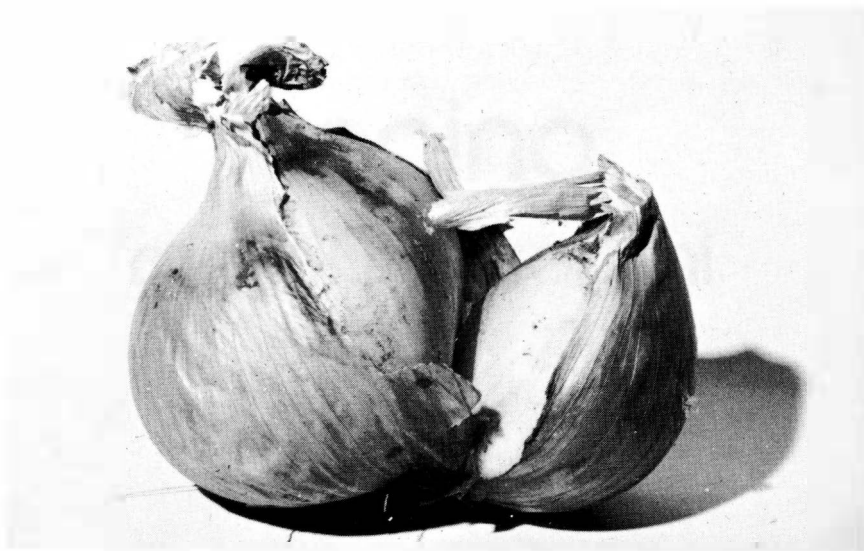
### **Soil and Soil Preparation**

Many South Dakota soils are not suitable for onion production. Onions prefer sandy loam soil. Good onion soil should be friable, fertile, well supplied with humus and well drained. The onion plant is sensitive to high acidity and produces maximum yields over a fairly narrow range of soil pH. Good yields are produced on muck soils over a wider range of soil pH than on mineral soils. High acid soils and muck soils

are not generally found in South Dakota. The maximum yields of onions are produced at a soil pH of 5.8 to 6.5. A heavy soil that breaks after rain or irrigation is not desirable. Soil should be plowed to a depth of 8 to 9 inches, and the surface should be well worked and smooth. Rough, lumpy ground is not suited to planting onion seed or small sets. The Sweet Spanish variety, a large onion, particularly responds to deep cultivation and well drained soil. Onions do best if the field is prepared in the fall.

### **Manure and Fertilizers**

Organic matter in the form of either barnyard or green manure should be added to the soil at every opportunity. It conserves soil moisture, improves physical condition of the soil, and tends to retard loss of available nutrients. Barnyard manure should be added at the rate of 15 to 20 tons per acre. When manure is used, it is advisable to apply it to the crop which precedes onions,



**Figure 1. DOUBLE ONION—This characteristic is particularly undesirable in onions used for onion rings.**

especially if it is not well rotted. Fresh manure usually contains weed seeds, and unless plowed under, interferes with planting and cultivation. Even when well rotted, barnyard manure should be applied only in the fall.

The proportion of nitrogen, phosphoric acid, and potash to apply to the soil for the highest percentage of mature onions is determined by soil type, soil pH, previous fertilization, drainage, variety, and date of planting. A deficiency of any of these three nutrients or other essential elements may result in small immature bulbs. Increasing the proportion of phosphoric acid to potash hastens maturity of the onion plants and therefore would be advisable on late plantings and late maturing varieties.

A desirable ratio of N-P-K under average conditions for onions is 1-2-2. An acre of an average onion crop removes approximately 65 pounds of nitrogen, 30 pounds of phosphorus, and 99 pounds of potassium from the soil. The average onion yield per acre is about 28,000 pounds. For best yields in South Dakota, 1,000 pounds of 8-16-8 fertilizer should be plowed under before planting. However, it is best that the amount of fertilizer added be determined by soil test. When the crop is 6 to 7 weeks old or when bulbs start forming, the onions should be side dressed with ammonium nitrate (33½-0-0) at the rate of 100 pounds per acre. This should be repeated two or three times, depending upon the bulb formation of the crop. Early plantings should be side dressed

one or two times more than late plantings.

### **Climatic Requirements**

The onion is a cool season plant that will grow well over a wide range of temperatures. It is fairly resistant to frost injury. Onion seed will germinate satisfactorily at a temperature of 45° to 85° F. The plant will grow best between 55° and 75° F. Best grade and quality result from cool temperatures during early development and warm temperatures during maturity. A dry atmosphere at harvest time is desirable to obtain satisfactory curing of the bulbs.

A chemical method of "measuring" pungency of onions by determining the amount of volatile sulfur has shown that environment markedly affects onion flavor. Pungency increases with average growth temperatures, with a decrease in soil moisture, and with several months in storage. Onions grown in warm regions as a winter crop are far milder than those grown as a summer crop in the cooler states. Northern grown onions contain a greater percentage of volatile substance that gives the onion a pungent flavor compared to onions grown under winter temperatures in the South.

Bulbing of the onion is affected by length of day and not by age of the plant. The day length required for bulbing varies with varieties and ranges from 12 hours for very early types to 15 hours for late types. The size of the mature bulb is closely related to the size of the plant at the time bulb formation starts. Therefore, size will be determined by factors that influenced plant growth

during the period prior to bulbing as well as during completion of bulbing and maturity. Cultural factors favoring large bulb size include:

- Early planting
- Increased space per plant
- Weed control beginning early in the season
- Prevention of damage from blowing soil particles
- Control of insects and pests
- Adequate soil moisture

Irrigation helps plants quickly resume growth following transplanting or seeding and allows for continuous growth until development has been almost completed.

There is an interaction between day length and temperature with respect to the flowering of onions grown from sets and sometimes to those grown from seed. When temperatures are favorable for bulbing, long days discourage flowering. If temperatures are low enough to prevent or delay flowering or delay bulbing, long days accelerate appearance of flower stocks. Day length does not affect flower initiation but only influences the rate of development of seed stocks.

Split and double bulbs are undesirable in onions. The percentage of split and double bulbs is influenced by varieties and strains. Environmental factors also play an important part in their formation. For example, in the variety Sweet Spanish, thin stands or wide spacing of plants within the row results in more splitting and doubling than in thick stands or narrow spacing. When plants are set out at uniform distances, the amount of fertilizer

treatment that results in large yields is likely to give a higher percentage by weight of doubles than smaller amounts of fertilizer. Transplanting large sets results in more doubling than the transplanting of medium or small sets. Sets planted 1½ inches deep produce more doubles than sets planted 3 inches deep. Seedlings remaining too long in the seed bed favor the production of doubles and splits. Large plants that suffer a serious check in growth due to cold weather, insufficient moisture or lack of nutrients are liable to produce more doubles if stimulated into active growth by side dressing with nitrogen, irrigation, or warmer weather. Continued growth at day length and temperatures unfavorable for bulb formation and maturity also result in doubling and splitting. Under South Dakota conditions, sets of Sweet Spanish onions planted 3 inches deep resulted in a larger percentage of deformed and round or oval shaped bulbs than sets planted 1½ inches deep.

### **Selecting Varieties and Seeds**

Rapid changes are occurring in onion varieties with the new F<sub>1</sub> hybrids replacing many older standard varieties throughout the country. Onion hybrids are being produced in all the major types. The superior hybrids are more uniform and higher yielding than standard varieties. Variety selection should depend on market demand for commercial onions and personal preference for home garden types. If the onion crop is grown for onion rings, yellow varieties producing onion bulbs from 3 to 4.5 inches in diameter should be selected. If onions are grown and sold for the hamburger

market, white varieties which produce bulbs 2 to 3 inches in diameter should be selected.

Two dry bulb groups of onions are generally recognized in the United States. The American or domestic group includes many varieties; the other group, the European or foreign group, contains chiefly the Bermuda and Spanish types. These two groups of onions are supplemented by a third group, which is grown for green bunching, and includes such varieties as Japanese Bunching, South Board, White Lisbon and White Spanish. Any standard variety can be used for green bunching onions if harvested at the proper stage. White varieties such as Japanese Bunching, White Spanish Bunching, and White Portugal are most generally used. Varieties developed for green onions should be planted for green bunching because these types will not form bulbs. Regardless of the variety being grown, it pays to buy good seed that has high germination and is true to type. Good seed is rarely inexpensive, but the product of good seed will usually repay the extra cost many times over.

Onion varieties and hybrids vary in color, shape, flavor and keeping quality as well as time of maturity. Yellow varieties of the American type make up about three fourths of the bulb crop grown in this country. Like the American types the Sweet Spanish type requires a long day length to bulb. There are a number of strains of both the white and yellow types.

Some recommended onion varieties which have done fairly well in South Dakota are Early Harvest,

Early Yellow Globe, White Portugal, Brigham Yellow Globe and Sweet Spanish (Utah Strain). For further information on varieties to be grown in a particular area, consult the current Fact Sheet on "Vegetable Varieties for South Dakota." This publication is available in your county Extension agent's office or from the Horticulture-Forestry Department at South Dakota State University, Brookings, South Dakota 57006.

Although temperature and length of day are important in bulb formation and maturity, the size and age of the plant at the time the minimum length of day for bulb formation is reached are also important factors. Late seeding or late plant-

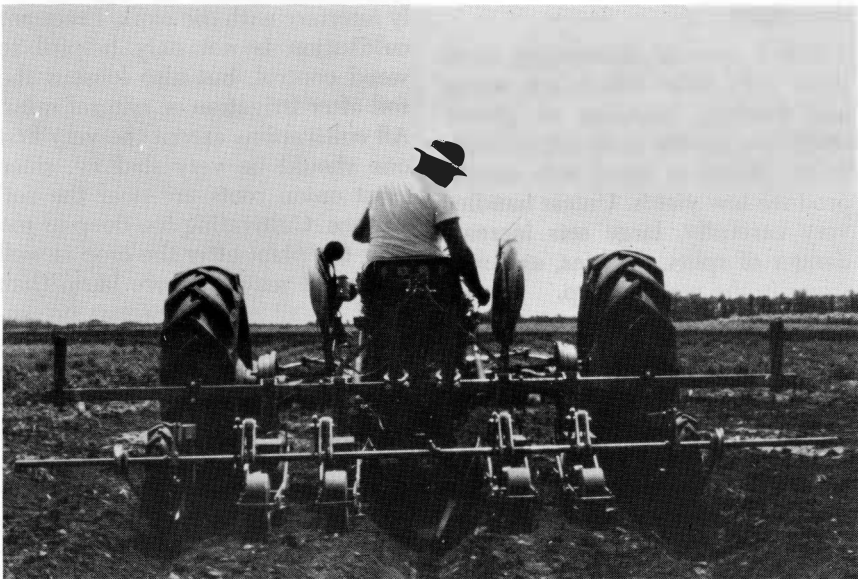
ing delay maturity. Onions grown from seed planted on a given date naturally mature later than onions grown from sets or bulbs set out on the same date.

#### **Time and Method of Planting**

Direct seeding in South Dakota should be as early as possible after danger of severe frost is past. Generally onions are planted between April 5 and April 20. Late seeding reduces yield and sometimes the onions are not quite mature at harvest time. If sets are used, they may be planted a couple weeks later and still produce a good crop. Planting sets early is advisable for an early maturing crop.

The two common methods of planting onions are sowing seed

**Figure 2. Four row precision planter used for direct seeding of vegetable crops. It is adjustable for row width and spacing within rows.**





directly in the field, and transplanting sets. On commercial acreage seed is generally sowed with a precision planter. The rate of seeding usually varies with the variety, purpose for planting, and distance between rows. When the bulb crop is to be grown to maturity, 3 to 4 pounds of seed per acre is common, if rows are spaced 18 inches apart. However, the rate may vary from 1 to 10 pounds depending on various factors and growth preference. When using a precision planter, seed should be placed 3 inches apart within rows for varieties producing large bulbs. The distance between plants may vary according to the variety or the purpose for which they are grown. Distance between rows often depends upon equipment used for cultivation. Generally, four rows are planted 18 inches apart simultaneously and then a 36-inch strip is left before another four rows are planted. This generally makes cultivation and other operation easier.

When sets or plants are used, plant only those which are strong and healthy. Medium or pencil-sized sets are the most dependable. Small plants or small sets usually produce low yields. Unless handled very carefully, large sets increase danger of splits, doubles, and seed stems in the mature crop.

### **Irrigation**

The field is usually irrigated immediately after planting and as necessary to maintain moisture conditions until seeds germinate. After the seed has germinated, onion varieties require seven to nine irrigations for maximum yield, or a total of about 24 inches of water during

the growing season. When onions are bulbing, irrigation may be as often as once a week or every 10 days. Frequent irrigation at this time not only promotes good growth but also helps to keep the soil firm around the bulb. Soil breaks around the bulb causes misshapen onions. When the plants start to mature, irrigation should be stopped to permit the soil to dry out as much as possible. When 10% of the tops of the onion crop has begun to break over, it is a sign that the crop has started to mature.

### **Cultivation and Weed Control**

Weed control is essential to produce a good crop of onions. This is especially important during early stages because small onions grow slowly, have shallow roots, and lack dense foliage. Onions, more so than most vegetables, cannot withstand weed competition. Cultivation usually begins as soon as plants appear and continues until the tops seriously interfere with the work. Frequent cultivation is not only helpful to weed control, but also loosens the soil after irrigation or natural rains. All cultivations except the very first one should be very shallow, since most onion roots are near the soil surface. Cultivating too deep or too near the plant after the crop is well advanced may do more harm than good. Small garden tractors or special models of regular farm tractors made for closely spaced crops are used for this purpose. Blade attachments which cultivate about an inch deep are superior to other types of cultivator attachments. Onions frequently require at least one or two hand weeding. Chemical weed control is discussed in Table 1.

**TABLE 1. CHEMICAL WEED CONTROL**

Expensive hand weeding in large plantings of onions has been virtually eliminated through use of chemical weed control. A number of herbicides listed in the following table can be used to control weeds in onions at different stages of development.

Product	Rate per treated acre	Time of application	Weeds controlled	Remarks
Bexton 65W	6-7.5 lbs. 65W	Preemergence.	Annual ryegrass, barnyardgrass, crabgrass, foxtails, goosegrass, purslane, lambsquarters, pigweed, wild buckwheat, stinkgrass.	Excellent crop safety, and annual grass control.
Dacthal W-75	4.5-10.5 lbs. *a.c. (6-14 lbs. W-75)	Preemergence or preplant incorporation to seeded onions; immediately after setting transplants; application as lay-by treatment can be made up to 14 weeks after planting.	Crabgrass, barnyardgrass, other annual grasses, purslane, carpetweed, common chickweed.	Use on seed and/or transplanted onions. Shallow pre-plant incorporation may enhance weed control especially in furrow irrigated fields.
Furioe Chloro-IPC 4E	4-8 lbs. 4E	Preemergence; also directed spray, post-emergence.	Annual weeds and most broad-leaved weeds.	Apply before weed seedlings are over ½ inch tall and before seeded onions are beyond the loop stage. Do not apply during flag stage. Do not use on sandy soils. Do not apply within 1 month before harvest.
Furioe Chloro-IPC 10G	60-80 lbs. 10G	Preemergence.		
Randox 4EC	1.5 gal. 4EC	Just before emergence; 1 delayed application.	Annual bluegrass, barnyardgrass, careless weed, carpet weed, cheatgrass, crabgrass, foxtails, pigweed, purslane, stinkgrass.	Not for green onions, do not use on sandy soil or within 30 days of harvest (45 days for EC).
Randox 20G	30 lbs. 20G	One preemergence and 3 postemergence after 3 true leaves have developed.		

*Continued on page 10*

Product	Rate per treated acre	Time of application	Weeds controlled	Remarks
TOK WP-50 (nitrogen)	3-4 lbs. *a.c. (6-8 lbs. WP-50)	Postemergence. Apply from emergence of crop up to 6 inches growth stage.	Annual bluegrass, crab grass, goosefoot, lambsquarters, malva, nightshade, nettle, pigweed, purslane, shepherds purse, spargularia, groundsel.	Only a single application post-emergence. Do not incorporate.
TOK E-25 (nitrogen)	3-4 lbs. *a.c. (1½-2 gal. E-25)	Postemergence. Spray when onions in 2 to 3 leaf stage of growth.		
Light aromatic oil emulsion	75 gals.	Preemergence.	Annual grasses and broadleaved weeds.	
	40 gals.	Postemergence to crook stage.		Use as directed spray on established plants.

\*Active chemical.

### Trends in Production Efficiency

The cost of producing onions varies greatly depending upon seed, fertilizers, cultural practices, irrigation, acreage, and the extent of mechanization. In recent years, growers have spent about 140 man hours per acre in growing and harvesting onions.

### Diseases

#### Insects and Fungi

Yellowing of the tips and rapid death of the onion leaf are symptoms of attack by mildew, Fusarium rot or white rot. Yellowing and stunting of leaves are symptoms of root knot nematodes, yellow dwarf, or pink rot. A whitening or silvering of onion foliage is caused by feeding damage of thrips, a tiny, pale yellow insect.

#### Fertilizer Deficiencies

Soils not too acid and not deficient in nitrogen, potassium or magnesium, will show phosphorus deficiency by a larger than normal green color foliage. Nitrogen starvation is indicated by yellowing of leaves and stunted growth. These symptoms may also indicate wet, cold soils and excessive irrigation.

#### Physiological Problems

Rain during the curing period tends to produce a dark, dingy surface on the onions. Excessive rains during curing will fade the outer skin of yellow and red onions. If rains occur when the soil is wet, the soil will discolor the onions. White onions must be protected from sunburning during curing. Yellow

onions also take on a greenish cast if exposed to frequent rains during curing, or may become bleached by hot dry air when immature or moist. The onion skin that dries down in storage is frequently better colored than that which dries down very quickly in the field. Slowdown of growth due to water shortage or low temperatures increases the amount of flowering.

### **Harvesting and Curing**

Onions for storage should be harvested after the tops have begun to break over but before the foliage has dried down completely. If left in the ground until the tops are dead, bulbs are likely to develop roots which reduce their market value. The best time to harvest onions is when about 75% of the tops have broken over. On a small scale, in certain areas, the onion crop is pulled by hand and allowed to dry on the ground before being topped. When onions are pulled by hand they may be left in the field to dry from 3 to 10 days depending on the weather. After the tops are fairly well dried down, they should be cut off by hand with shears or knife, or by a topping machine that also sorts the bulbs into sizes. It is desirable to leave about an inch of the top attached to the bulb. If cut too close, the neck does not close well

and decay organisms have ready access to the bulbs. Onions can also be harvested by a machine that removes the bulb from the soil and cuts off the tops. After topping, the onion should be cured properly. Curing should be done in sheds instead of the field to protect onions from rain or freezing weather conditions. The length of curing time depends largely on weather conditions. Thorough curing requires 3 or 4 weeks and even longer in some seasons. Curing should be done in a well-ventilated area with onions not more than two or three layers deep.

### **Storage**

Varieties vary considerably in storage characteristics. Bermuda onions are notoriously poor keepers and are rarely kept for any length of time. Late maturing American or domestic types are generally much better in storage. However, marked varietal differences exist within this group. Essential conditions for successful storage are good ventilation, uniform and comparatively low temperature, dry atmosphere, and protection against actual freezing. Onions should be stored at 32°F. with a relative humidity of about 64%. Good storage ventilation requires 1.5 cubic feet of air circulation per minute for each cubic foot of onions.

