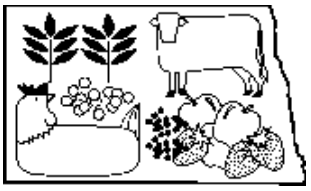

Onions

Author: **Randy Sell**, Research Associate
Department of Agricultural Economics, NDSU

Series Editor: **Dwight Aakre**, Farm Mangement Specialist
NDSU Extension Service

By value, onions rank in the top 10 vegetables produced in the United States. They are believed to be indigenous to Asia and have been cultivated in this country since 1629. Flexibility of the onion in the American diet is the main reason it is used so extensively in the United States. In recent years, the United States has exported about 3 percent of its total annual `dry bulb' onion production. This publication provides agronomic characteristics, production information, potential market contacts and an example economic and cash flow budget for dryland onion production in North Dakota.

Agronomic Characteristics

Onions are a cool season plant which grows well in a wide range of temperatures. Young onion plants are highly resistant to frost. Onions may be established by planting seed or transplanting sets (young onion plants). Onion seed will germinate well at soil temperatures from 45 to 81 F. For most onion varieties, about 8,000 seeds weigh an ounce. Onion plants will express their best growth at temperatures from 55 to 75 F. High quality onions require cool temperatures during early development and warmer temperatures during maturity. Onion plants have shallow roots and relatively few, slender leaves, which make onions poor weed competitors. Thus, chemical and mechanical weed control are critical to high yields. Usually a combination of both methods is successful. The average yield for dry bulb onions in the United States is about 340 hundredweight per acre.

The relative pungency of onions is affected by growing and storage environments. Pungency increases with higher average growth temperatures, lower soil moisture and more months in storage. Northern-grown onions generally have a more pungent flavor and aroma than onions grown during the winter in the southern states. However, onions produced in the northern climates are milder than onions produced during the summer in the southern states.

Onions go through a process called `bulbing' to produce the onion bulb. Bulbing is affected by amount of daylight, not by plant age. Daylight necessary to initiate bulbing depends on the variety of onion and can range from 12 hours for early maturing types to 15 hours for late maturing types. Mature onion bulb size is highly correlated to the size of the onion plant at the time bulb formation begins. Thus, bulb size is influenced by the same factors which influenced plant growth prior to the beginning of bulbing, plus environmental conditions during the completion of bulbing and maturity. Factors affecting large bulb formation include early planting, space per plant, soil moisture, weed competition early in the growing season, and damage from blowing soil particles, insects and pests.

Double or split onion bulbs are undesirable and are discounted in the market. The ratio of double or split bulbs is influenced by variety and environment. The Sweet Spanish variety will produce a higher percentage of splits or doubles, if grown at wider spacings or in thin stands. Also, when plants are grown in uniform stands, fertilizing at a rate which produces large yields will result in more doubles than a lower rate. Larger onion sets will result in more doubles than smaller sets. Also, sets planted 3 inches deep versus 1.5 inches deep will produce more doubles and splits.

Varieties

Hybrid onions are recommended because they are more uniform and higher yielding than standard varieties. Variety selection will depend on two main factors: (1) type of market for which the onions are being produced and (2) environmental growing conditions. If onions are being produced for onion rings, yellow varieties that produce an onion bulb from 3 to 4.5 inches in diameter should be selected. If onions are being produced for the hamburger market, then white varieties that produce an onion bulb from 2 to 3 inches is recommended.

United States producers grow two main groups of onions. The American group contains several varieties; the European or foreign group is mainly composed of the Bermuda and Spanish varieties. Onion varieties vary in color, shape, flavor, storage life and time to reach maturity. Yellow varieties compose about 75 percent of all onions grown for bulb production in the United States. Most American varieties and the Sweet Spanish variety require a long day length to bulb. Early harvest or 80 to 100-day onions are recommended for production in North Dakota. Several varieties of white and yellow hybrid onions are currently on the market.

Another group of onions are the green bunching varieties. This group is composed of such varieties as Japanese Bunching, South Board, White Lisbon and White Spanish, although any standard variety can be marketed as green bunched onions if harvested at the correct stage. Green bunching varieties represent a small proportion of the onion market in the United States.

Seeding

Planting seeds and transplanting sets are two methods of establishing onions for commercial production. Transplanting sets should result in earlier maturity and earlier harvest. However, transplanting sets is more costly and labor intensive. Most producers establish commercial plots using seed. Seeds may be planted with precision vegetable planters.

Onions should be seeded in North Dakota as soon as the danger of a severe frost has passed. The range of soil temperatures that may result in adequate seed germination for onions is 50 to 95 F, with the optimum at 75 F. Onions planted half an inch deep in 50 F soil will take 13 days to germinate, whereas seeds planted into 75 F soil should germinate within 4 days. Generally, onions should be established from seed by mid-April to mid-May and planted 1 inch deep. Onions which are planted later will yield less and may not reach maturity. Onion sets may be planted a couple of weeks later than onion seeds.

Depth of planting onion seeds or transplanting onion sets has a dramatic impact on the shape of the mature bulb. The onion bulb forms immediately above the onion stem plate, which is formed at the point where the seed germinates. Onion bulbs may form above or below the soil surface depending on the placement of the seed and the subsequent movement of the soil (due to cultivation) after seed germination. Deeper planting results in longer, narrow bulbs while shallow planting tends to produce flatter bulbs.

Fertile soils with adequate drainage are ideal for onion production. Soil tests are recommended to determine amounts and types of soil nutrients necessary to obtain a realistic yield goal. Ideal soil pH for onion production is 6.6. Different levels of nutrients may affect taste of onion bulbs even within varieties.

Onions should be rotated with other vegetable crops to prevent a buildup of disease and insect pests. Onions work well in a rotation with carrots or potatoes.

Onions seeds are planted between 2 to 4 pounds per acre. Onions rows should be spaced 16 to 24 inches apart. Onions are particularly responsive to variations of spacing within rows. Optimum plant spacing within the rows ranges from 1 to 4 inches, depending on row width and onion variety.

Irrigation

Onions must have an adequate supply of moisture in the top 12 inches of the soil profile because onions are shallow rooted crops. Onion fields are generally irrigated immediately after planting and as necessary thereafter to maintain moisture levels until seeds germinate. After germination, most onion varieties will require about 17 to 24 inches of water to attain maximum yields, depending on soil type and weather conditions. As onions begin bulbing, irrigation may be necessary every seven to 10 days. More frequent irrigation at this point promotes good growth and helps keep the soil firm around the onion bulb. Cracks in soil and inconsistent soil pressure around the onion bulb result in misshaped onions. As onions begin to mature, irrigation should be stopped to allow the soil to dry before to harvest. Irrigation should be discontinued when 10 percent of the tops have begun to break over, as this is an indication of bulb maturity. If moisture is not reduced as onions near maturity, softer onion bulbs may result. Softer onion bulbs may break down faster and result in greater storage problems.

Weed control

Of all vegetable crops, onions are the least able to compete with weeds. Weed pressure can be especially damaging to young onion plants because they are slow growing, have shallow roots and do not have enough foliage to adequately shade the ground. Depending on weed pressure and success of chemical control, several cultivation trips may be necessary. All cultivation must be very shallow or it may damage onion roots and cause plant damage. Blades or shanks which result in vigorous mixing of the top 1 inch of soil are ideal.

A combination of preemergence and postemergence herbicides may be used for onions. Chlorpropham may be used pre- or postemergence for the control of many annual weeds; however, it is not recommended for application on coarse-textured soils with less than 4 percent organic matter. Oxyfluorfen may be applied postemergence for effective control of annual broadleaf weeds. Oxyfluorfen should not be applied if the onion plants are under stress or have less than two true leaves.

Diseases and controls

Smut is a common infection of onion seedlings that is most effectively controlled through crop rotation and using a fungicide seed treatment. Thiram fungicide mixed with onion seed may be used to prevent smut infections. Downy Mildew and Purple Blotch are diseases that may be a problem during periods of high humidity. They may be controlled by applying Mancozeb at label rates. Mancozeb may be used to control Leaf Blight caused by *Botrytis squamosa*. Fusarium basal root rot may cause serious crop losses but can be controlled by planting Fusarium-resistant varieties. Neck rot is usually caused by the Botrytis fungus; however, it may be followed by a soft-rot bacteria. To control neck rot, plant varieties which mature properly so that neck tissues are dry before harvest. Pink root is caused by common soil fungi and can be prevented through crop rotation.

Insects

Onion maggots are the most serious insect problem, especially after a series of cool, wet springs. The brownish-gray adults emerge in early spring and lay eggs on the onion seedling base. Upon hatching, the larvae burrow into the onion roots. More than 40 percent of an onion crop can be destroyed by maggots. Onion maggots are most effectively controlled by applying an insecticide in the furrow when planting. Thrips are very small (one-sixteenth inch) cream- to brown-colored insects which migrate into fields in the summer. Thrips rapidly multiply during hot, dry weather. They cause a rasping type of feeding injury to onion plants by feeding on the leaves, but can be controlled with a long-lasting, systemic insecticide applied with a wetting agent and a large volume of water (100 gallons per acre).

Harvest and Storage

Onions are mature and ready to harvest when their tops fall over. If bulbs are going to be stored following harvest, they

should be allowed to dry and cure before harvesting. However, onion bulbs should not be left in the ground until tops dry completely or bulbs are likely to develop roots, which will decrease their market value. If bulbs are to be shipped immediately or only stored for a short period of time, producers can break the necks (called "roll the onions") of the onions to induce maturity. Some producers undercut the roots from one to three weeks before harvest to keep bulbs from absorbing more moisture to accelerate maturity and to help keep onion bulbs a uniform size. Chemicals that will prevent sprouting in storage are available. If applied too early, these chemicals can cause decomposition of onions in storage. Onion tops should be left in place to protect the top of the onion bulb from direct sunlight. Direct sunlight can cause `sun scald,' which reduces bulb quality.

During harvest, producers need to ensure that bulbs are handled carefully to prevent bruising and cutting. Shorter day varieties and some Sweet Spanish varieties have a softer bulb, which is more prone to harvest injury. These softer varieties are usually harvested by hand. Longer day varieties are more firm and are harvested mechanically. High quality onion harvesting implements are equipped with rubberized chains and short drops into padded receptacles to prevent damage.

Proper storage is critical in maintaining high quality onions. Onions should be stored in a cool, dry, well ventilated building. Air temperature should be 40 to 45 F with a relative humidity of 64 percent. The ventilation system should provide about 1.5 cubic feet of air per minute for every cubic foot of onions. Onions stored in this manner may be kept in good condition for many months.

Marketing

The principal market outlet for U.S. dry onion production is the fresh market, but the processed market, including frozen, canned, onion rings and dehydrated products, is also important. California is the leading producer of onions for the processed market. Approximately 75 percent of the total annual onion production is marketed through the fresh market.

Per capita consumption of onions has trended upward. In the 1975-77 period, onion consumption was 14 pounds per capita. In 1982-85, consumption was 17 pounds per capita. An estimate of consumption for the mid-1990s shows a 0.29 pound per capita annual increase, along with an increase in population of 19 million from 1985 to 1995. If this occurs, total consumption of onions will increase by 25 percent from 1985 to 1995. This increase in onion consumption is attributed to several factors: (1) more health-conscious consumers increasing their consumption of fresh vegetables, (2) more away-from-home consumption that typically includes a greater proportion of processed onions, and (3) increased popularity of Mexican and other onion-rich ethnic foods.

The United States historically exports 3 to 6 percent of its annual onion production. About 75 percent of exports go to Canada (50 percent) and Japan (25 percent). Canadian imports from 1979 to 1989 have averaged about 59,000 metric tons or about 25 percent of their total consumption. The United States has about 95 percent of the Canadian onion import market share. From 1986 to 1989, Japan has imported an average of 82,000 metric tons of onions, with the United States having between 35 to 50 percent of their market.

In 1992, onions were produced on about 300 acres in North Dakota. About 85 percent of the total acreage of onions were produced in Sargent County. Most onions produced in North Dakota are marketed through local retailers or contracted through food brokers. Marketing consultation and credit service organizations are available to help producers obtain financing and market their crop. Names and addresses of some of these organizations are: Produce Reporter Company, 315 West Wesley Street, Wheaton, Illinois 60187, phone (708) 668-3500, and "PRONET" 7950 College Boulevard, Overland Park, Kansas 66210, phone (800) 255-5113. Also, the National Onion Growers Association (see endnotes for address) may be able to aid interested producers in obtaining marketing and production information.

Economics

North Dakota farmers may be able to diversify their farm income and crop rotations by raising onions. Farmers who may be interested in producing onions on their farm need to investigate profitability and cash flow of this alternative crop. Onion budgets were developed for dryland onion production. Commercial onion production without irrigation results in lower total costs and lower yields; however, variability of yields may increase drastically. Production coefficients used to develop the budgets are shown in Table 1, while the economic and cash flow budgets are shown in Table 2.

Onion yields are typically measured in 50-pound bag units. The dryland yield used to calculate the example budgets was 290 bags per acre, with an estimated selling price of $5.05 per bag. The market price for onions is highly variable and has ranged from $2 to $20 per bag. Onions were assumed to be transported 150 miles one way to be marketed. The seeding rate was 3 pounds per acre. Seed cost was assumed to be $34.50 per pound. A mechanized onion drill and harvester were added to the machinery complement to accommodate onion production. Grading, bagging and sizing the onions was assumed to be custom hired for $2 per bag. This cost is reflected in the miscellaneous cost under the variable cost heading of the budgets.

Table 1. Production coefficients for raising dryland dried onion bulbs in North Dakota, 1993

Interest rate on debt (%)	9.5
Interest rate on equity (%)	5.5
Debt-to-asset ratio	.34
Market price per bag	$5.05
Market yield (bags/acre)	290
Bag weight (lb)	50
Field size (acres)	25
Land value per acre	$757.00
Estimated labor requirement (hours/acre)	11.5
Onion seed per acre (lb)	3
Onion seed cost per lb	$34.50
Nitrogen applied per acre (lb)	100
Nitrogen cost per lb	$0.11
Phosphorus applied per acre (lb)	50
Phosphorus cost per lb	$0.18
Trace elements per acre (lb)	1
Trace elements per lb cost	$13.00
Grading, bagging and loading onions ($/bag)	$2.00

Table 2. Economic and cash flow budgets for producing dryland dried onion bulbs in North Dakota, 1993

	Profitability -per acre-	Cash flow -per acre-
Gross Revenue	$1,464.50	$1,464.50
Variable Costs		
-Seed	$103.50	$103.50
-Herbicides	95.08	95.08
-Fungicides	16.40	16.40
-Insecticides	19.80	19.80
-Fertilizer	36.65	36.65
-Crop insurance	19.00	19.00
-Fuel and lubrication	64.10	64.10
-Repairs	42.40	42.40
-Miscellaneous	591.00	591.00
-Operating interest	46.45	46.45
Total Variable Costs	$1,034.38	$1,034.38
Fixed Costs		
-Miscellaneous overhead	$37.61	$15.97
-Machinery depreciation	154.09	xxx.xx
-Machinery investment	91.57	188.44
-Land taxes	6.31	6.31
-Land investment	49.02	25.05
Total Fixed Costs	$338.60	$235.77
Total Listed Costs	$1,372.98	$1,270.15
Return to labor and management	$91.52	xxx.xx
Net cash flow	xxx.xx	$194.35

The economic budget is generated by charging market rates for all resources needed for production. It helps answer the question "Is this enterprise profitable?" The bottom line represents a return to labor and

management.

The cash flow budget is an estimate of the out-of-pocket cash needed to run the enterprise, including not only direct costs but indirect cash costs such as principle and interest payments, insurance and taxes. It helps answer the question "Can I meet my cash obligations if I go into this enterprise?" Total cash expenses are subtracted from total cash receipts to calculate the net cash which is available for family living and other needs.

For further information contact:

Baker, Larry, Hendricks, J. Scott; and Jones, Rick. "ASGROW Onion Crop Management Report, Factors Affecting Onion Bulb Quality." Asgrow Seed Company. North Central States Station, 1984 Berlin Road, Sun Prairie, Wisconsin 53590.

Lorenz, Oscar A. and Maynard, Donald N. *Knott's Handbook for Vegetable Growers*. Third Edition. New York: John Wiley & Sons.

National Onion Association, 1 Greeley National Plaza, Suite 510, Greeley, Colorado 80631, Phone (303) 353-5895; Fax (303) 351-0357.

Prashar, Paul. "Onions in South Dakota." Agricultural Experiment Station, South Dakota State University. Brookings, South Dakota. Bulletin 579, 1971.

Radke, Rudy. Area Agricultural Diversification Specialist. North Dakota State University Extension Service. Phone (701) 845-8528.

Schoenemann, J.A., Bundy, L.G.; Wyman, J.A.; Stevenson, W.R.; Binning, L.K.; and Schmidt, K.P. "Commercial Production of Muck Crops-Carrot, Celery, Lettuce, and Onion (Dry Bulb)." University of Wisconsin, Cooperative Extension Service. Madison, Wisconsin. A3344, 1987.

Shapley, Allen E. and Dudek, Thomas A. "Costs of Producing Onions on Muck Soils in Michigan." Cooperative Extension Service, Michigan State University. Extension Bulletin E-2026, 1987.

Funds to support the research for and production of the Alternative Agriculture Series were made availalbe to the Value-Added Agriculture project by "Growing North Dakota" legislation through Technology Transfer, Inc.

Alternative Agriculture Series, **Number 17,** August 1993

Go to Alternative Agriculture Publication Index

Information for Prospective Students

NDSU is an equal opportunity institution

North Dakota State University Agriculture and University Extension
Dept. 7070, Morrill 7, P.O. Box 6050, Fargo, ND 58108-6050