VEGETABLE RESEARCH AND INFORMATION CENTER

Vegetable Production Series

DEHYDRATOR BULB ONION PRODUCTION IN CALIFORNIA

RONALD E. VOSS, Cooperative Extension Vegetable Specialist, University of California, Davis; KEITH S. MAYBERRY, University of California Cooperative Extension Farm Advisor, Imperial County

PRODUCTION AREAS AND SEASONS

Bulb onions for dehydrator processing are produced from the southern- to the northern-most borders of California, with main production areas in Imperial, Kern, and Fresno Counties, and the Tulelake Basin of Siskiyou and Modoc Counties. Dehydrator onions are planted from September through January in southern and central California and during the month of April in the Tulelake Basin. Harvest begins in May and is usually completed in October. More than 75 percent of US dehydrator onion production is in California, and comprises approximately 55 percent of total California bulb onion acreage.

DEHYDRATOR BULB ACREAGE AND VALUE

Year	Acreage	Average yield (*tons/acre*)	Gross value / acre
1997	26,000	18.5	$1,535
1996	26,600	19.0	$1,520
1995	25,100	19.1	$1,510

SOURCE: *County Agricultural Commissioner's Annual Report Data* (Sacramento: California Department of Food and Agriculture, 1995–1997); individual county agricultural commissioner reports.

CLIMATIC REQUIREMENTS

Onions are cool-season, biennial plants (requiring two seasons to complete the cycle from seed to seed) that are commercially grown as an annual crop. Bulbing is highly dependent on day length. Varieties adapted to California initiate bulbing at day lengths of approximately 12 to 15 hours. Dozens of varieties are grown in California because of the great difference in latitude between the Mexican border (32˚N) and the Oregon border (42˚N), and because several market classes are needed.

Onion growth is very dependent on temperature. The minimum temperature for emergence is higher than for most other cool-season vegetables at 55°F (12.8°C) for 70 percent emergence in up to two weeks. In addition, early growth rate is slow compared to other cool-season crops. Optimal leaf growth rate occurs at 68° to 77°F (20° to 25°C). However, total plant growth rate is dependent on the amount of light intercepted. Maximum light interception occurs with a leaf area index of approximately 8 or higher.

Bolting is primarily driven by temperature when plants with leaf bases greater than approximately ⅜ inch (9.5 mm) in diameter are subjected to temperatures of 45° to 50°F (7.2˚ to 10°C). A combination of factors, including planting date, variety, plant size, temperature, as well as timing and duration of temperature, determine if and when bolting occurs.

VARIETIES

Short-day dehydrator varieties are high dry matter selections derived from Creole, Creoso, or Primero varieties. They are small, globe-shaped, and white. The soluble solids content of varieties currently used in the industry ranges from 15 to 20 percent.

Long-day dehydrator varieties are usually selections or derivations from Southport White Globe. Both hybrids and open-pollinated varieties are used with a continuum of day-length requirements and maturity ranges to allow for harvest during the entire summer in the central and southern San Joaquin Valley, and a fall harvest in northern mountain valleys. Solids content for these varieties ranges from approximately 20 to 25 percent with high pungency.

PLANTING

All acreage for dehydrator onion bulb production in California is direct seeded. Onions are most commonly grown in multiple rows on raised beds 40 to 42 inches (102–107 cm) wide, but some production systems use 36-inch (91-cm) beds or wide beds of 60 to 80 inches (152–203 cm). Distribution of rows across the top of the bed varies (for example, 20–22 in; 50–55 cm with 40-inch beds) depending on the irrigation method and planter type. With drip or sprinkler irrigation, rows are spaced equidistant across the bed at approximately 4-inch (10-cm) intervals. When furrow irrigation is used, the center of the bed is left empty for salt accumulation with 2 or 3 rows planted on either side (bed shoulder). Most seeding is done with mechanical plate planters. Mostly raw seed, but some coated-pelleted seed, is used. The shallow planting of seed for dehydra-

University of California • Division of Agriculture and Natural Resources
Publication 7239

tor onions—at approximately ½ inch (12.5 mm)—requires a soil surface that is well prepared and must be kept moist until germination. More shallow plantings may increase the tendency for flatter bulbs, and deeper planting may result in lower rates of germination and emergence, and deeper-shaped bulbs.

Onion seed is susceptible to loss of vigor from high temperature and humidity; germination tests are critical. The storage life of opened seed containers can be shortened very rapidly if not immediately placed in an environment low in temperature and humidity. Seeding rates should be adjusted for lower germination. Dehydrator bulb onions are usually smaller in size than fresh market bulbs, and seeding rates and plant populations are correspondingly higher. Onion seed size may range from 100,000 to 130,000 seed per pound (220,000–286,000 seeds/kg). Dehydrator bulb onion seed is planted 4 to 5 pounds per acre (4.5–6 kg/ha).

SOILS

Onions will grow in a wide range of soil types: sand, loam, clay, and organic/peat. Onions are shallow-rooted and need a friable soil that retains moisture well. Excessively dense clay soils interfere with root growth and frequently result in a serious clod problem at harvest. Sandy soils require very frequent irrigation. Seed germination and seedling establishment require a seedbed that is uniform, clod-free, firm, and several inches deep. Compared to planting on the flat or small ridges, raised beds provide better drainage and an area for salt accumulation away from the root zone.

Onions are sensitive or moderately sensitive to salinity, primarily at the stages of germination and emergence. Once plants are established, higher levels of salinity are tolerated. Yield reductions of 50 percent may occur at electrical conductivity levels of 4 to 5 mmho/cm (dS/m). Onions are more sensitive to salinity, sodium, and boron than are lettuce, cauliflower, broccoli, and cabbage.

IRRIGATION

Onion seed must not dry out, and the soil surface must not be allowed to crust over during the postplanting, pre-emergent state (which can last 10 to 20 days following initial irrigation). Sprinkler irrigation is the best management practice for stand establishment.

Onions require frequent irrigation throughout the season for several reasons. The root system is shallow, so very little water is extracted from soil depth of more than 24 inches (61 cm), and most is from the top 12 inches (30 cm). Onion roots are mostly non-branching, and all roots originate at the stem, or basal plate of the plant. This means that upper soil areas must be kept moist to stimulate root growth. Rates of transpiration, photosynthesis, and growth are lowered by even mild water stress. Onion plants show little capacity for reducing leaf water potential by osmotic adjustment to compensate for reduced water availability at the root, whether caused by salinity or dry soil. Stressed plants become stunted, may result in doubles and splitting, and are generally higher in pungency.

The amount and frequency of irrigation depend on the method, soil type and conditions, and temperature. For optimal plant growth, irrigate when 25 percent of the available moisture in the top 24 inches (61 cm) of soil is depleted. In general, an onion crop will use 24 to 30 inches (61–76 cm) of water. With 70 to 80 percent water use efficiency, applications of 30 to 36 inches (76–91 cm) of water should be sufficient. If more water is being used, the frequency and length of irrigation should be examined or a different method of irrigation should be considered (drip, surge, sprinkler).

FERTILIZATION

Because onions are shallow rooted and usually planted in cool soils, they are responsive to fertilization. Soil analyses are the best indicators for phosphorus (P), potassium (K), and micronutrient needs. Tissue analyses, combined with soil and cropping history, are the best indicators for nitrogen (N) needs. Typically, no more than ⅓ of the nitrogen should be available at planting, ⅓ at early season (3–4 leaf stage), and ⅓ at mid-season. Too much late season nitrogen availability can delay maturity, decrease storability, and contribute to bulb splitting. Because onions are sensitive to ammonia, forms of fertilizer that contain high amounts of it should be avoided. Total supplemental nitrogen needs may vary from 100 to 400 pounds of nitrogen per acre (112–448 kg/ha), depending on soil and cropping history and irrigation efficiency. High rates of phosphorus (200 lb/acre; 224 kg/ha) may be needed if soils are low or deficient. Onions are not responsive to potassium in most California soils. Zinc and other micronutrients may be needed in many soils. To meet planting and early season nitrogen and other nutrient needs, 5 to 10 tons per acre (11–22 metric tons/ha) of composted manure is sometimes used. Soil tests, tissue analyses, and preliminary quick tests on tissues (for nitrogen) are available.

INTEGRATED PEST MANAGEMENT

UC IPM Pest Management Guidelines for onions have been updated (including photographs) and are available for weed, insect, disease, and nematode pests. Sanitation, crop rotation, resistant varieties, and frequent monitoring are essential in the prevention and control of the numerous onion pests. Visit the UC IPM Website at http://www.ipm.ucdavis.edu or see *UC IPM Pest Management Guidelines,* ANR Communication Services Publication 3339.

Weed management. Onions compete poorly with

weeds because it takes a long time for them to achieve ground cover, and the long growing season allows for successive flushes of winter and summer weeds. Hand weeding can be very destructive to the root system of onions and is not economically viable in the production of onions bound for processing. Therefore, field selection and a good early cultivation program are essential. Currently, a selection of effective pre-emergence and postemergence herbicides is available.

Insect identification and management. Thrips and onion maggot are frequently the most serious insect problems for onions, but mites, seed corn maggot, leafminers, and armyworms can also be serious pests.

Disease identification and management. Downy mildew *(Peronospora destructor)* and purple blotch *(Stemphylium vesicarium,* most common in California; and *Alternaria porri)* are the most serious foliar diseases. Bacterial rots (*Pseudomonas* and *Erwinia* spp.) start as foliar diseases before spreading to the bulb. They are a particular threat to plants grown under sprinkler irrigation throughout the season. Bacterial contamination is intolerable in processing plants and should be kept to a minimum. Pink root *(Phoma terrestris),* white rot (*Sclerotium cepivorum* Berk.), and Fusarium basal rot *(F. oxysporum* f.sp. *cepae)* are serious root and bulb diseases common during production. Black mold *(Aspergillus niger),* neck rot *(Botrytis allii),* and blue mold *(Penicillium hirsutum)* are the most common harvest and postharvest diseases.

Nematode identification and management. Stem and bulb nematode *(Ditylenchus dipsaci)* and root-knot nematodes (*Meloidogyne* spp.) can be a problem in California onion production, but this does not occur frequently.

HARVESTING AND HANDLING

The dehydrator bulb industry is entirely mechanized. Special harvesters that include color sorter technology to eliminate green bulbs have been fabricated by processing companies.

Irrigation management before harvest is critical. Water use demand remains high until maturity begins, then decreases rapidly. Careful evaluation must be made for the last irrigation. Stopping irrigation too soon will reduce yield; irrigating too late, or applying too much water late in the season, can cause splitting, delay maturity, and increase the incidence of decay. The last irrigation is best applied when 10 to 50 percent of the tops are over.

Dehydrator bulb harvest is preceded by rolling the tops after the final irrigation; cutting off the tops with a rotary beater once the tops are fully dry; undercutting, windrowing, and covering with a thin layer of soil; and allowing the bulbs to fully cure for 1 to 3 weeks. At harvest, the onions are graded in the field for diseased and green bulbs, and elevated into bulk trucks. The bulbs are transported to processing plants and usually dehydrated within 24 hours.

MARKETING

All onion bulbs grown for dehydration in California and other western states are grown under contract with one of the processing companies. Contracts are written on value per ton of bulbs, with provisions for deductions for culls, dirt, etc. The processors determine the varieties to be grown, provide the seed, and advise the growers on cultural practices and pest management. In all areas, except the Tulelake Basin, the processors conduct the harvest and transportation of the bulbs. All processing plants in California are located in the central regions. In the Tulelake Basin, the growers harvest with their own diggers and bulk harvesting equipment; the processors provide transportation.

76-pr-3/99-GM

ISBN 978-1-60107-030-2