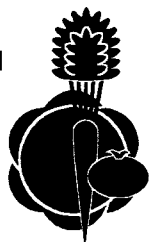


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# CAULIFLOWER PRODUCTION IN CALIFORNIA

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## PRODUCTION AREAS AND SEASONS

Cauliflower (*Brassica oleracea* var. *botrytis*) is produced in many areas of California, including the central coast (Monterey, San Benito, and Santa Cruz Counties); the south coast (Ventura, Santa Barbara, and San Luis Obispo Counties); the Central Valley (Tulare, Fresno, Stanislaus, and San Joaquin Counties); and the southern deserts (Riverside and Imperial Counties).

In the central and south coast, cauliflower is transplanted and harvested year-round. In the Central Valley, planting begins in mid-July for harvest from October to November. In the southern deserts, cauliflower planting starts in August and continues until early December for harvest from early December through mid-March.

## CAULIFLOWER ACREAGE AND VALUE

Year	Acreage	Average yield (tons/acre)	Gross value/acre
1995	40,700	6.3	\$4,215
1994	41,500	6.0	\$3,493
1993	43,000	6.3	\$3,703
1992	42,000	6.5	\$3,691

*Source: California Agricultural Resource Directory 1995 (Sacramento: California Department of Food and Agriculture, 1996).*

## CLIMATIC REQUIREMENTS

Cauliflower is a cool-season crop with distinct temperature requirements for producing a marketable curd (the edible immature flower buds). The optimal temperature range for growth and development is 65° to 68°F (18° to 20°C) during the day. Most California growing regions have daytime temperatures from 63° to 83°F (17° to 29°C) and night temperatures from 37° to 53°F (3° to 12°C). At temperatures of 80°F (27°C) and above cauliflower tends to have small jacket leaves, small curds, solar yellowing, and “riceyness” of the curd. At freezing temperatures, the curds may be damaged and secondary decay will occur.

## VARIETIES AND PLANTING TECHNIQUES

Proper varietal selection is crucial for cauliflower production. Varieties have biological clocks based on plant

age and ambient temperature that trigger the curd to develop at a specific time. Depending on the variety, the period of adaptation may be from two weeks to more than a month. Varieties grown out of slot will not develop satisfactorily. If a mistake is made in varietal selection, the resulting planting may exhibit “ricey,” yellow, or lightweight curds. Breaking of the florets may also occur.

In the southern desert several cauliflower varieties should be planted to produce a continuous supply throughout the season. Commonly used varieties are Snow Crown, Candid Charm, Rushmore, Ravella, Incline, McKinley, Cumberland, Yukon, White Magic, White Passion, Batsman, Minuteman, Snow Grace, Mystique, Starbrite Y, Igloo, and Serrano.

In the central and south coast, Incline and White Magic are used in the winter; Guardian and White Rock in the summer; and Apex, Mariposa, and Silver Star in the spring and fall. Some Yukon, Shasta, and Snow Mystique are also being used. In the Central Valley, mainly one variety, Snowman, is grown.

While direct seeding is still practiced, the majority of growers use greenhouse-grown transplants. With transplants a more uniform plant stand and earlier harvests are possible. Transplanted cauliflower is placed in single rows on 40-inch (100-cm) beds and spaced 12 inches (30 cm) apart. Plants are typically planted with the crown below the soil surface to reduce plant damage caused by winds. Some cultivars must be hand-tied with rubber bands to prevent the developing curd from being exposed to sunlight, which can cause curd yellowing. Other cultivars form a leaf jacket that shades the flower, eliminating the need for tying. Still other varieties do not develop an appreciable amount of solar yellowing even with direct exposure to the sun.

## SOILS

Cauliflower is grown on many soil types, from clay to loamy sand. Soils with a high moisture-holding capacity are preferred in the summer as water stress adversely affects curd development. In the winter, soils that dry rapidly after a rain are preferred so farm equipment can enter to perform cultural and harvesting operations.

## **IRRIGATION**

Cauliflower is sprinkler-irrigated for the first 2 weeks after transplanting. While some fields are sprinkled throughout the entire production period, the majority of acreage is furrow-irrigated after transplants are established. Cauliflower needs uniform moisture. Irrigations are made every 1 to 2 weeks depending on the soil type and time of year. Since cauliflower is grown throughout the year, the water required to grow a crop is quite variable, ranging from 1.5 to 3.0 acre-feet (1,850–3,700 cu. m).

## **FERTILIZATION**

In the southern deserts and the Central Valley, most growers apply preplant  $P_2O_5$  at 150 to 300 pounds per acre (168–336 kg/ha). Ammoniated phosphate, such as 11-52-0, is often broadcast before listing or applied in bands during listing, generally followed by one or two sidedress nitrogen (N) applications of 50 to 80 pounds per acre (56–90 kg/ha). In a typical fertilizer program in the Salinas Valley, the field is listed and fertilized with 400 pounds per acre (448 kg/ha) of a complete fertilizer (5-17-17). At transplanting, 300 pounds per acre (336 kg/ha) of ammonium sulfate (21-0-0) is broadcast over the bed top and dissolved by irrigation. Two to three additional applications of N are made during the production period. About 250 pounds per acre (280 kg/ha) of N is used for the crop.

## **INTEGRATED PEST MANAGEMENT**

Contact the UC Davis IPM World Wide Web site at <http://www.ipm.ucdavis.edu> or your local county Farm Advisor for current pest management information (*UC IPM Pest Management Guidelines*, DANR Communication Services Publication 3339). Herbicides, insecticides, and fungicides should always be used in compliance with label instructions.

**Weed management.** Integrated weed management should be practiced prior to cauliflower seeding or transplanting. Such management steps include crop rotation, weed removal before weeds produce seed, preplant irrigation and disking to germinate and kill weed seedlings, timing the planting date to reduce weed impact, and careful preparation and spacing of beds and precise positioning of seed or plants so that cultivating tools can be accurately aligned.

Weed control is most critical for the first 30 days after planting or transplanting or until the crop begins to form a plant canopy to shade out weeds. Some pre-plant or postplant herbicides are available for use on cauliflower; consult your local Farm Advisor, as approved chemicals change often. Surface spray-banding of liquid fertilizer may have the added benefit of

burning small weed seedlings as well as fertilizing the crop. Subsequent cultivation by tractor and hand-weeding may also be necessary. Weeds of concern include common groundsel, prickly lettuce, annual sowthistle, London rocket, shepherd's purse, nutsedge, cheeseweed, burning nettle, and chickweed, depending on the region and the time of year.

**Insect identification and management.** The most damaging insect pests are worms, aphids, and whiteflies, depending on the region and time of year. In coastal areas, the cabbage aphid (*Brevicoryne brassicae*) is the most important pest. In the southern deserts, the silverleaf whitefly (*Bemisia argentifolii*) causes slow growth and delayed maturity of the crop. In all production areas, worms are potential problems depending on the time of year and weather conditions. Worms should be managed by using selective materials to avoid making other insect problems more severe. Rotation of products to slow insecticide resistance should be practiced. Concerns of resistance to new-generation pesticides are present whenever one chemical is heavily relied upon as a control measure.

**Disease identification and management.** Greenhouse transplants may be stunted and weakened by downy mildew and bacterial leaf spot, but once plants are transplanted and established in the field, these diseases are not usually important in California. Newly transplanted cauliflower is subject to wirestem infections until plant hypocotyls thicken and become immune to the pathogen. Wirestem can be minimized if soil is not overly wet when plants are transplanted and if plants are not placed too deeply into the soil.

Blackrot (*Xanthomonas campestris*) may cause significant problems when introduced from greenhouse-grown transplants in the southern desert growing regions. To prevent the disease, blackrot-free seed should be used for producing transplants.

*Phytophthora* root rot (*Phytophthora* spp.), clubroot (*Plasmiodiphora brassicae*), and *Verticillium* wilt (*Verticillium dahliae*) are three soilborne diseases that affect the crop during its main growth phase. *Phytophthora* root rot is best managed by careful irrigation scheduling. Clubroot is a persistent disease that is effectively managed by raising soil pH with calcium and magnesium liming materials. *Verticillium* is present in the coastal valleys and is controlled only if effective soil fumigants are used or if infested fields are planted to cauliflower in the winter.

Sooty mold or curd smudge (*Cladosporium* sp.) is a surface curd contaminant that frequently occurs near harvest. It is held in check by the use of chlorinated water sprays before packing. Washing also helps to remove dust and debris from the curds.

While mature cauliflower is subject to several foliar diseases, including *Alternaria* leaf spot (*Alternaria brassicae* and *A. brassicicola*), *Sclerotinia* white mold (*Sclerotinia sclerotiorum* and *S. minor*), and downy mildew (*Peronospora parasitica*), the crop is usually not significantly impacted by these diseases and control measures are rarely needed.

**Other pests and problems.** Cauliflower is a host to the cyst nematode (*Heterodera schachtii*). However, it appears that extremely high populations of this nematode need to be present for significant yield reductions to occur. Threshold levels have not been established for cyst nematode on cauliflower.

Wind whip causes girdling and death of small seedlings. Later, surviving plants may wilt and fail to form a curd. The stems of affected plants become very brittle. Seedlings are more susceptible to wind whip after thinning or weeding. Check the weather forecasts to minimize wind whip injury.

During certain times of the growing season, cauliflower may develop a physiological condition in which sections of the curds turn light tan to brown while retaining normal texture and firmness. With time, these areas may decay due to secondary rot organisms. The exact cause of this condition is not known, but it is most likely involved with changes in environmental conditions and the physiological status of the plant.

Field mice (*Microtus* spp.) may be a problem near harvest. Once mice become established in a field they are nearly impossible to control. Prebaiting and destroying grassy areas on the perimeter of the field may be effective prevention and control.

Blind bud, a condition where no curd forms, may be due to mechanical injury, insect chewing, or bird feeding. On occasion blind bud is a genetic trait in the seed lot.

### **HARVESTING AND HANDLING**

All cauliflower is hand-harvested in the field. Fields are normally harvested 2 to 4 times or more depending on the market. Mature curds (6 inches [15 cm] or larger) are hand-selected and trimmed of excess wrapper leaves, making a crown-cut shape. Smaller curds will usually grow enough to be harvested as the next larger size within a couple of days. The curds are placed on a harvesting platform and sorted and packed by size. Cauliflower should never be allowed to roll or have the white curd touch a table or work surface. Scuffed curds are subject to decay and browning.

Curds are placed in plastic bags, sealed with tape, and packed in cartons according to size. Curds are packed 9, 12, 16, and 20 per carton; the market is strongest for 12s. Cauliflower is always packed in a single-layer carton to prevent bruising (as opposed to double-layer cartons used with lettuce and cabbage). Some cauliflower in the southern coast is hand-harvested, placed in bulk bins, and transported to a freezer plant. These curds are harvested with more jacket leaves than carton-packed cauliflower to prevent curd damage during transport and unloading. The curds are trimmed again at the freezer plant.

Some cauliflower is cut into florets for the food-service trade. Cartons containing two 3-pound (1.4-kg) bags of 1½- to 3-inch (3.7–7.5-cm) florets are common. In addition to conventional cartons, cauliflower is marketed as small and large cut pieces and mixed with broccoli and carrots. Yields of 500 to 600 23-pound (10.4-kg) cartons per acre are possible.

### **POSTHARVEST HANDLING**

Cauliflower is extremely perishable and should be stored only for very short periods of time. The storage temperature should be 32°F (0°C) at greater than 95 percent relative humidity. Storage at high temperature rapidly causes deterioration of cauliflower quality and shelf life: at 32°F (0°C) the shelf life is 21 to 28 days; at 38°F (3°C) it is 14 days; at 41°F (5°C) it is 7 to 10 days; at 50°F (10°C) it is 5 days; and at 59°F (15°C) only 3 days. When there is an oversupply, cauliflower is often stored at too high a temperature and too low a humidity. Long-term or improper storage results in bad quality at arrival, price adjustments, and a poor-quality product at retail markets. Cauliflower should not be stored or transported with commodities that produce ethylene gas such as apples, bananas, or melons.

### **MARKETING**

California is the major cauliflower-producing state in the nation with about 90 percent of the supply. Arizona is second, followed by New York, Washington, and Texas. There is no major peak period for the crop. Supplies are steady throughout the year, limited only by adverse weather at harvest sites. Rain or snow at major terminal markets makes unloading and distribution of the product very difficult.

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