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The Cauliflower Industry of California

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THE CAULIFLOWER INDUSTRY OF CALIFORNIA[1]

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CAULIFLOWER is a crop of considerable economic importance in California; of the total carlot movements in the United States during the years 1921 to 1933, inclusive, 71.73 per cent originated here. The carlot shipments of this commodity for the entire country reached a peak in 1930 (fig. 1); but since then there has been a gradual decline caused principally, no doubt, by a decrease in the purchasing power of the public.

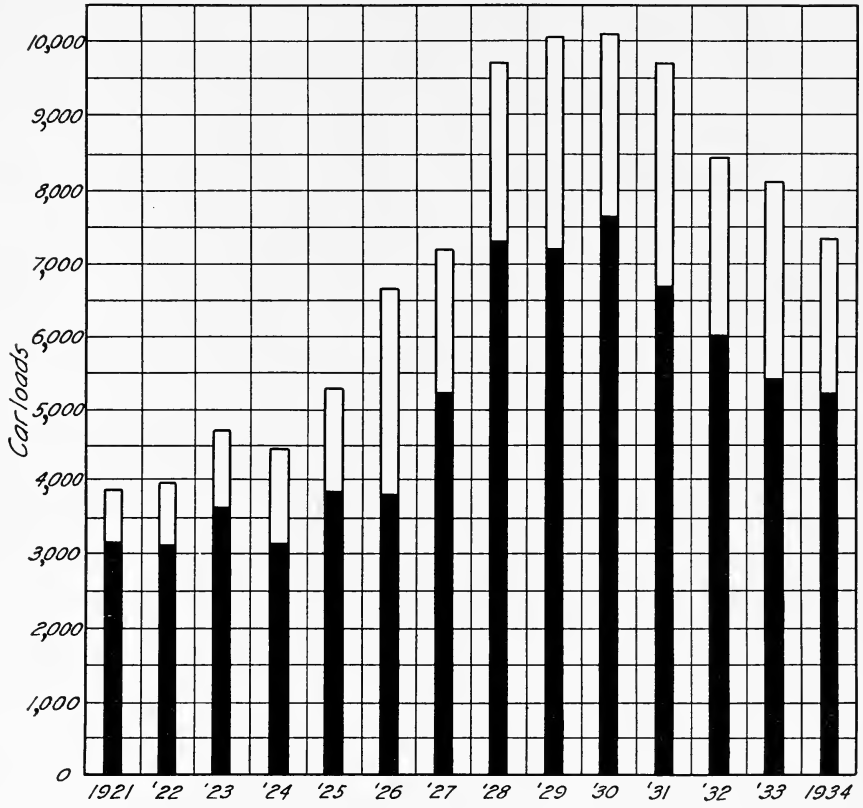

Fig. 1.—Carlot shipments of cauliflower for the United States by years for 1921 to 1934 inclusive. Shaded portions represent California shipments.

[1] This circular supersedes Agricultural Extension Circular 11, *Cauliflower Production in California,* by H. A. Jones and F. H. Ernst.

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PRODUCTION AREAS AND SHIPPING SEASONS FOR THE UNITED STATES

Though some cauliflower is grown in almost all parts of the country, the large production centers are confined to coastal areas or to the high altitudes where climatic conditions are favorable. California is the most important shipping state; other leaders are Arizona, Colorado, New York, Oregon, Texas, Utah, and Washington. Some fairly important production areas of the East are not reflected in these carlot shipments (table 1) because much of the crop is hauled to market by truck. Monthly shipments of the important states for 1933 and 1934 are given in table 2. Seasons of shipment from the various states will vary somewhat from year to year, according to climatic conditions.

The shipping season for cauliflower has been lengthened considerably. Before about 1923 very little cauliflower was produced for shipment from May to August (table 3); but in recent years the shipments during this period have increased gradually as new varieties have been developed and areas have been found with a climate suitable for summer production. California has been mainly responsible for the increase in shipments during April and May (table 4). In time, no doubt, there will be a plentiful supply of this commodity on the markets of the country throughout the year.

PRODUCTION AREAS IN CALIFORNIA

At present the main production area in California is the Santa Maria Valley of Santa Barbara County. From this district cauliflower is now shipped from December to June, inclusive, with the peaks in February and March; from no other section of the state is cauliflower shipped in quantity in May. Monterey County moves most of its crop in December and from February to April, and Alameda County has a similar season except that more is shipped during January. Most of the Los Angeles crop is shipped from November to February inclusive. Though the dates will vary from year to year because of climatic conditions, they will usually be about as shown in table 5.

TEMPERATURE, MOISTURE, AND SOIL REQUIREMENTS

Cauliflower develops best where the temperature during the latter part of the growing period is cool and uniform, and the moisture fairly abundant. Its production, therefore, is localized mainly in areas where the climate is tempered by large bodies of water, as in the coastal counties of California and Oregon, and on Long Island. A young plant exposed to extremely low temperatures may "button" or head prematurely. Freezing of the curd or head impairs the carrying quality.

TABLE 1

CARLOT SHIPMENTS OF CAULIFLOWER BY STATES FOR THE YEARS 1921 TO 1934*

State	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934†
Arizona	0	0	0	0	2	3	12	29	53	108	91	187	346	152
California:														
Northern district	1,087‡	1,012‡	1,131‡	630	223	86	3	27	2	1	8	.....	.....	.....
Southern district	2,116	2,125	2,444	1,879	2,322	2,231	3,078	3,515	3,092	3,562	2,308	1,651	785	804
Central district	.....	.....	.....	641	1,305	1,523	2,174	3,759	4,147	4,102	4,365	4,345	4,621	4,434
Colorado	2	4	101	29	191	220	411	843	1,500	1,309	1,495	1,173	958	660
Florida	6	0	2	9	0	0	1	16	26	2	0	2	0	0
Michigan	4	1	34	66	0	0	0	10	0	3	1	0	0	0
Minnesota	5	3	18	6	21	13	13	7	0	0	0	0	0	0
New Mexico	0	0	8	35	18	0	0	1	3	0	0	0	0	0
New York	571	683	653	696	834	1,019	696	574	375	234	184	171	178	185
Oregon	83	133	277	415	333	1,454	581	690	445	620	961	693	1,056	1,042
Texas	0	0	0	3	2	15	34	57	162	1	13	80	10	0
Utah	0	1	0	3	6	17	172	150	176	89	59	29	32	0
Virginia	14	15	13	37	12	30	7	13	0	0	0	0	0	0
Washington	1	0	1	2	9	50	49	31	69	92	205	182	137	73
Total for United States	3,895	3,991	4,695	4,466	5,288	6,661	7,241	9,724	10,050	10,123	9,693	8,477	8,125	7,353

* Data from mimeographed sheets issued by the Bureau of Agricultural Economics, United States Department of Agriculture. States that shipped only an occasional car have not been listed, hence the totals for the columns do not necessarily correspond to the totals given for the United States.

† Subject to revision.

‡ Northern and Central districts combined.

TABLE 2

CARLOT SHIPMENTS OF CAULIFLOWER BY MONTHS FOR THE VARIOUS STATES*

State	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
						1933						
Arizona	233	15	0	0	0	0	0	0	0	0	0	98
California:												
Southern district	200	5	3	19	21	0	0	0	0	9	207	321
Central district	741	974	1,522	523	291	61	6	2	0	3	59	439
Colorado	0	0	0	0	0	0	1	166	691	98	2	0
New York	0	0	0	0	0	0	0	18	27	120	2	0
Oregon	0	0	0	0	0	0	0	0	0	350	664	42
Texas	8	0	0	0	0	0	0	0	0	0	0	2
Utah	0	0	0	0	0	0	0	0	4	26	2	0
Washington	0	0	0	0	0	63	57	14	0	3	0	0
Total for United States	1,182	994	1,525	542	312	124	64	202	722	609	947	902
						1934†						
Arizona	109	1	0	0	0	0	0	0	0	0	0	42
California:												
Southern district	44	0	1	39	0	0	0	0	0	0	120	600
Northern district	1,117	1,268	807	443	149	1	4	0	0	0	90	555
Colorado	0	0	0	0	0	0	20	261	292	72	15	0
New York	0	0	0	0	0	0	0	5	34	136	3	7
Oregon	9	86	58	0	0	0	0	0	4	183	645	57
Washington	0	0	0	0	20	11	28	5	1	8	0	0
Total for United States	1,279	1,355	866	482	169	13	53	271	332	399	873	1,261

* Data from mimeographed sheets issued by the Bureau of Agricultural Economics, United States Department of Agriculture. States that shipped only an occasional car have not been listed, hence the totals for the columns do not necessarily correspond to the totals given for the United States.

† Subject to revision.

TABLE 3

CARLOT SHIPMENTS OF CAULIFLOWER BY MONTHS FOR THE UNITED STATES, 1921 TO 1934*

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1921	654	516	782	7	22	2	0	13	171	493	631	604	3,895
1922	580	544	1,046	219	27	17	0	22	150	320	283	783	3,991
1923	1,142	698	965	191	34	20	7	41	123	464	621	389	4,695
1924	623	975	777	161	108	16	1	65	157	477	621	485	4,466
1925	838	822	484	215	96	6	20	270	521	531	479	1,006	5,288
1926	881	1,094	1,604	245	58	23	6	109	223	1,032	871	515	6,661
1927	1,187	901	956	618	455	26	14	106	666	752	762	798	7,241
1928	1,698	1,617	1,417	792	384	28	9	116	703	760	978	1,222	9,724
1929	1,879	1,232	1,223	987	742	68	29	330	875	931	574	1,180	10,050
1930	1,488	1,527	1,583	927	68	39	29	384	759	747	1,526	1,046	10,123
1931	1,430	1,312	1,495	665	168	50	126	327	771	1,011	1,242	1,096	9,693
1932	1,388	1,252	1,573	451	450	100	119	327	555	647	886	729	8,477
1933	1,182	994	1,525	542	312	124	64	202	722	609	947	902	8,125
1934†	1,279	1,355	866	482	169	13	53	271	332	399	873	1,261	7,353

* Data from mimeographed sheets issued by the Bureau of Agricultural Economics, United States Department of Agriculture.

† Subject to revision.

TABLE 4

CARLOT SHIPMENTS OF CAULIFLOWER BY MONTHS FOR CALIFORNIA, 1921 TO 1934*

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1921	649	508	718	4	7	2	0	13	44	185	476	597	3,203
1922	580	544	1,037	116	12	16	0	4	11	14	65	738	3,137
1923	1,141	698	802	92	22	17	7	5	8	33	443	307	3,575
1924	618	872	591	83	81	6	0	17	1	50	375	456	3,150
1925	838	818	429	213	84	5	4	5	4	127	348	975	3,850
1926	877	897	840	235	45	0	0	6	1	50	406	483	3,840
1927	1,150	889	798	485	452	10	0	0	4	77	598	792	5,255
1928	1,661	1,558	1,175	769	379	26	1	0	1	45	496	1,190	7,301
1929	1,712	1,189	1,188	923	741	47	0	0	0	20	316	1,105	7,241
1930	1,448	1,524	1,533	914	68	2	0	5	18	173	1,132	848	7,665
1931	1,370	1,308	1,385	661	168	13	12	1	4	48	664	1,047	6,681
1932	1,179	1,225	1,444	427	450	36	1	3	2	5	567	657	5,996
1933	941	979	1,525	542	312	61	6	2	0	12	266	760	5,406
1934†	1,161	818	713	481	149	1	4	0	0	0	200	1,147	4,674

* Data from mimeographed sheets issued by the Bureau of Agricultural Economics, United States Department of Agriculture.

† Subject to revision.

Hot weather during transplanting time may interfere with the rapid establishment of the plants in the field. If it occurs while curds are maturing it often causes yellowing, riciness, or fuzziness. In addition, growth is sometimes so rapid that harvesting at the best stage of development is almost impossible, especially on large acreages. Areas subject to cool climatic conditions usually suffer smaller losses from overmaturity. High temperatures, apparently, stimulate growth of the head leaves, often causing them to appear through the top of the curd.

TABLE 5

CARLOT SHIPMENTS OF CAULIFLOWER BY MONTHS FOR CALIFORNIA BY COUNTIES*

County	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1932													
Alameda	237	86	116	3	0	0	0	0	0	1	7	125	575
Contra Costa	0	0	13	0	0	0	0	0	0	0	0	0	13
Kern	8	0	0	0	0	0	0	0	0	0	0	0	8
Los Angeles	457	106	51	9	1	0	0	0	0	4	52	388	1,536
Monterey	40	114	494	7	0	0	0	0	0	0	11	63	729
Orange	13	0	0	0	0	0	0	0	0	0	26	6	45
San Bernardino	0	2	0	0	0	0	0	0	0	0	0	0	2
San Diego	0	0	0	37	31	0	0	0	0	0	0	0	68
San Luis Obispo	0	1	2	0	0	0	0	0	0	0	0	3	6
San Mateo	5	0	5	0	0	0	0	0	0	0	0	8	18
Santa Barbara	300	855	671	370	418	36	1	3	2	0	3	57	2,716
Santa Clara	115	59	84	0	0	0	0	0	0	0	0	7	265
Santa Cruz	4	2	8	1	0	0	0	0	0	0	0	0	15
1933													
Alameda	347	263	220	44	1	1	0	0	0	0	12	145	1,033
Contra Costa	0	0	0	3	0	0	0	0	0	0	1	0	4
Kern	3	1	0	0	0	0	0	0	0	0	0	0	4
Los Angeles	200	5	3	5	0	0	0	0	0	9	207	321	750
Monterey	56	152	367	110	0	1	0	0	0	0	26	144	856
San Diego	0	0	0	14	21	0	0	0	0	0	0	0	35
San Luis Obispo	13	22	32	2	0	0	0	0	0	0	0	0	69
San Mateo	17	0	0	0	1	0	0	0	0	0	0	31	49
Santa Barbara	214	455	872	362	289	59	0	1	0	1	12	49	2,314
Santa Clara	91	81	31	1	0	0	6	1	0	2	8	61	282
Santa Cruz	0	0	0	0	0	0	0	0	0	0	0	9	9
1934†													
Alameda	347	86	20	1	0	0	0	0	0	0	39	232	725
Los Angeles	44	0	1	2	0	0	0	0	0	0	125	592	764
Monterey	237	77	185	2	12	0	0	0	0	0	19	137	669
Orange	0	0	0	0	0	0	0	0	0	0	0	7	7
San Bernardino	0	0	0	0	0	0	0	0	0	0	0	3	3
San Diego	0	0	0	38	0	0	0	0	0	0	0	0	38
San Luis Obispo	7	28	1	0	0	0	0	0	0	0	0	0	36
San Mateo	10	0	0	0	0	0	0	0	0	0	0	0	10
Santa Barbara	443	549	497	436	129	1	1	0	0	0	17	141	2,214
Santa Clara	51	68	3	2	8	0	3	0	0	0	0	35	170
Santa Cruz	22	10	6	0	0	0	0	0	0	0	0	0	38

* Data from Federal-State Market News Service.

† Subject to revision.

Cauliflower should always have a sufficient supply of moisture in the soil to insure continuous and steady growth; either well-distributed rainfall or carefully regulated irrigations are necessary. It does not thrive in dry sections, especially where extremes of temperature or strong winds prevail, but develops best in a moist atmosphere.

Cauliflower can be grown very successfully on a variety of soil types provided they are fertile, of good physical condition, retentive of moisture, and well drained. Light sandy and heavy clay soils, however, are not suitable.

SEED BED

Preparation.—In most of the commercial cauliflower-growing districts of California, the plants are started in the open field. For the seed bed a fertile sandy loam soil, well leveled and finely pulverized, is preferred. The two types generally used are the sunken, or panel, and the raised bed. On a light, porous soil, not subject to packing, sunken seed beds are often preferred. These are prepared in long, narrow lanes, 12 to 16 feet wide, with small levees on each side to facilitate flooding. One acre of land in panels will probably accommodate more plants than the same area in raised beds. Moreover, sunken beds have a minimum of surface exposed and hence dry out more slowly than raised beds. Sunken beds are sown by broadcasting or drilling.

On the heavier types of soil, raised beds like those prepared for lettuce are usually satisfactory. They are about 6 inches high and 3 feet from center to center, with irrigation furrows between. Each bed has two or four rows; if only two rows are grown, the seed is usually distributed in a wide band. In the Santa Maria district practically all the plants are grown on raised beds, two rows to the bed.

Sowing the Seeds.—Four to six pounds of seed will sow one acre of nursery, though heavier seeding is often practiced. This amount will suffice for 20 or more acres of field planting. A surplus should be grown so that only the best plants need be used. Those that have been stunted by remaining in the seed bed too long often head prematurely. The different varieties should be well labelled to avoid confusion and mistakes at time of transplanting.

Seed should be sown with a drill, sufficiently deep to be in contact with moist soil but not so deep as to prevent the seedlings from reaching the surface. In hot, dry weather the depth should be greater than in cool, moist weather; but ½ to ¾ inch is usually sufficient. In flat beds the rows are spaced about 12 inches apart; but on ridges they may be closer, especially if there are more than two rows to the bed.

Planting Schedule.—Most varieties have been developed for particu-

lar seasons of the year and must therefore be planted at the proper time. For these there exists a rather definite range of planting dates, outside of which favorable results are unlikely.

In the Los Angeles district Snowball, an early variety, is usually seeded in the nursery from March to June 15, but some seed of Extra Early Snowball is sown directly in the field as early as February 10 to 15. Four or five seeds are dropped every 18 to 20 inches in the row; later the plants are thinned to one in a place. The various strains of the Pearl variety are seeded from May 15 to August 15. Some growers make plantings every ten days, beginning with the Early Pearl and following this with the Half Early Pearl, the Late Pearl, and broccoli. The Early Pearl is usually sown from May 15 to June 15, and the Half Early Pearl from June 5 to July 1, sowings in each case being made every ten days. First sowings of the Late Pearl are made about June 25; late ones at ten-day intervals up to August 10. The various strains of broccoli are usually seeded every ten days from about July 1 to August 15. Thus a succession of crops is secured throughout the season, so that harvesting, once begun, is a continuous operation.

In Alameda County, the varieties Morse's December and Morse's February are those most extensively planted; but Snowball and Morse's January, March, and April are also planted to some extent. These varieties mature in approximately the months for which they are named. Snowball is set in July and cut in October and November. For the December variety field planting should be completed by August 15; for the January and February varieties by September 1. The March and April varieties should be in by October 10.

Managing the Seed Bed.—Care should be exercised to produce healthy, stocky plants. If the seedlings are too thick they should be thinned to prevent overcrowding. An effort should be made to secure a uniform, continuous growth. Soil that does not hold water well should be irrigated frequently. In the flat beds especially, one can sometimes produce good plants without irrigating after the seed has been sown. An irrigation shortly before pulling of the plants produces succulent roots, many of which die during transplanting. If the plants have been deprived of water somewhat and have been allowed to harden, the shock of transplanting is less severe than if they are in a tender, rapidly growing condition. In hard soil where the plants cannot be pulled readily, the beds should be irrigated the day before pulling. It is best not to wet more of the plant bed than will be used the following day. In loose soil, however, this irrigation is unnecessary. Plants are usually large enough for transplanting 6 to 9 weeks after seeding, the rate of growth depending upon

the time of the year. Only the largest are removed at the first pulling; then an irrigation may be given to settle the soil and stimulate the growth of the remaining plants. If plants remain in the seed bed too long, growth is severely checked, and premature heading may result.

In the Colma region the beds are usually located on southern slopes, protected from the wind. After being well manured, they are plowed,

Fig. 2.—The figure shows the size of plant that is used for transplanting to the field. (From Agr. Ext. Cir. 11.)

finely pulverized, and seeded. During the drier part of the year they are often covered with litter to prevent baking. They are usually irrigated by revolving overhead sprinklers and are kept weeded, and cultivated. The plants are allowed to grow larger before transplanting than in most other sections.

PULLING PLANTS

A common practice is to pull plants during the fore part of the afternoon and then to transplant with the same crew during the remainder of the day. The plants are sorted and packed in lug boxes (fig. 2), which are kept covered with moist burlap sacks. As a rule only as many plants are pulled as can be transplanted the same day. The largest and stockiest are selected and, if well hardened, need little if any cutting back of the leaves. When grown on raised beds, sufficient plants are often left for a stand to mature in place.

LAYING OUT THE LAND FOR IRRIGATION

The land should be well graded to a moderate slope so that the water can be applied uniformly. Otherwise, certain areas of the field are flooded during irrigation, while others remain high and dry. Leveling should be done well before planting. If much soil has been moved, a test irrigation will settle the soil and reveal the depressions and elevations. The necessary retouching can be done after the land has dried sufficiently. Though cauliflower is commonly grown on sidehills in the northern and central districts, this practice is not to be recommended, especially in the warmer parts of the state.

Rows should be run so that there will be enough fall to facilitate irrigation and surface drainage. Light soils that take water very rapidly should be laid out for short runs of 200 to 400 feet, which generally give more rapid irrigation. The ditches and furrows should be made in the direction to give the desired fall. If, however, the soil does not absorb water readily, a minimum fall should be planned for and runs may be as long as 600 feet. There should be no waste water except on very steep slopes, and the excess from the higher levels should be used to irrigate the lower.

PREPARING THE LAND AND TRANSPLANTING

In preparing land for planting, the soil should be finely pulverized so that furrowing will not expose large clods. The furrows, which are usually made with a lister, should be spaced a uniform distance apart throughout their entire length to facilitate cultivation. In applying water for furrow irrigation, head ditches are commonly used. These should have sufficient capacity to irrigate adequately and quickly.

After having been pulled, the plants are set into the field as soon as possible. They are dropped just ahead of the planters, who set them in the bottom of the furrows with short-handled hoes. Some growers plant in furrows by machine. They do not depend upon water from the machine tank but follow with irrigation water as in hand planting. A considerable acreage, too, is set by machine planters on level pre-irrigated land. Water is added from the tank at the time of planting and again soon after the new furrows are made for irrigation.

On soils that are light to medium in texture, planting in the furrow bottom is especially desirable (fig. 3); on heavy types the side of the furrow is often used (fig. 4). Plants should be set so that they will not be submerged by the irrigation water. Rows should be 34 to 36 inches apart, and plants about 24 to 30 inches apart in the row, the spacing

depending upon the variety. Crowding should be avoided, for it reduces the size of the curd. Replanting, when necessary, should be done as soon as possible.

Fig. 3.—Plants set in the center of the furrow; photographed three days after setting. (From Agr. Ext. Cir. 11.)

Fig. 4.—Plants set on the side of the ridge. (From Agr. Ext. Cir. 11.)

IRRIGATING

When plants are set in dry soil, the water should be applied almost immediately. If the soil is porous, it may take a long time to get water through, and the plants may suffer in consequence. Under these conditions an irrigation may precede transplanting. Where the rows are long, the water is often started as soon as a few plants have been set and is allowed to flow slowly down the row after the planter.

During the summer and early fall, when the weather is warm and the plants are growing rapidly the crop should be carefully observed so that there will be no stunting from lack of moisture. Some growers in the southern cauliflower districts count on about five irrigations during the season. The number needed, however, varies with the different types of soil and with weather conditions. The chief object should be to keep the soil sufficiently moist to a depth of 3 or 4 feet throughout the life of the plant to secure a uniform and steady growth. Surface rooting should not be encouraged by frequent light irrigations, especially during the early life of the plant.

In furrow irrigation the water is at first run down beside the plants; later the soil is moved toward the plants by cultivation; and finally the water is run midway between the rows.

The number of furrows irrigated at one time depends upon the method of irrigation, the head of water, and the soil type. If the furrows have a pronounced fall, the water may be run in small streams. The operator may gauge the penetration of the moisture very easily and accurately with a soil auger. The size of head used should be gauged so that the water will reach the end of the furrow without too much waste.

Overhead irrigation has been successful. The portable overhead sprinkling equipment now used in some districts should prove especially advantageous on hillsides. On well-leveled land, however, furrow irrigation continues to be the most popular method.

CULTIVATING

Cultivation for weed control and preparation for irrigation are usually accomplished in one operation by attaching a large shovel at the rear of the cultivator. During the later stages of growth, cultivation should be shallow, so as not to destroy too many of the surface roots. As a rule the last cultivation smooths the soil between the rows, thus facilitating harvest. Cultivation usually follows each irrigation except perhaps the last two or three. About five cultivations are required during the season. If these can be performed at the proper time, hoeing is reduced to a minimum or rendered unnecessary.

SOIL IMPROVEMENT

The soil must be sufficiently fertile to produce a plant of good size. A large curd cannot be obtained from a small plant. The plant food elements should be present in available form and in sufficient amount for continuous growth. Nitrogen seems to be the element most generally needed in the soil—phosphorus, potash, and the other necessary plant food elements being usually present in adequate amounts.

Crop Rotation.—Some type of crop rotation is always advisable. Diseases as well as insects, accumulating in the soil, infect and injure in increasing amount the succeeding crops. Planting cauliflower continuously on the same land, therefore, is undesirable. In California it is often grown as a fall and winter crop, following spring and summer crops of early potatoes, sweet corn, early tomatoes, peas, spinach, horse beans, and spring lettuce. Alfalfa is frequently used in a long rotation.

Intercropping.—In Los Angeles County some cauliflower is grown as an intercrop among deciduous fruit and English walnut trees. If the trees are large, the crop should be planted so that maximum growth will occur while they are bare; thus extreme shading will be avoided.

Manuring.—Many growers, especially in Alameda and Los Angeles counties, have supplies of barnyard manure available either from their own or from neighborhood dairies. Where livestock is kept on the same farm, the task of maintaining the soil in a highly productive condition is usually not difficult. Fresh manure, if used should be applied and disked or plowed under in time to decompose partially before the crop is planted. Ten to 20 tons of barnyard manure or 4 to 5 tons of chicken manure may be considered a good application.

Green-Manure Crops.—If manure cannot be obtained in sufficient amount to supply the needed organic matter and plant food, green-manure crops may be used alone or with commercial fertilizer. The cover-crops or green-manure crops, preferably legumes, should be adapted to the local climatic conditions and should produce a good tonnage. It is better to grow green-manure crops to plow under than to leave the fields idle during part of the year. Such crops keep down weeds and help conserve the soluble mineral elements of the soil, especially in regions of heavy winter rainfall. They prevent erosion, multiply the favorable bacterial flora of the soil, help aerate the subsoil, improve the texture of heavy soils, and increase, to some extent, the moisture-holding capacity of sandy soils. One may seed the green-manure crop when the cauliflower is disked up and then plow it under again when preparing for cauliflower. If this is done, the only expense for covercropping is the seed and water. In the Centerville district some growers have obtained

excellent results with *Melilotus indica* by sowing the seed at the last cultivation of the cauliflower. Where nematodes are prevalent, resistant crops or varieties should be grown.

Commercial Fertilizers.—In certain cauliflower sections the productivity of the soil must be maintained largely by the use of commercial fertilizers. No single kind of fertilizer and no uniform rate of application can be specified for the entire state or for any large district within the state. Each grower should make sufficient tests on his own farm to determine the kind to use and the most profitable amount to apply. In general, growers have found that it is the lack of nitrogen which limits the growth of the cauliflower plant. Nitrogenous fertilizers, therefore, usually give the greatest growth response.

Fertilizer tests conducted on vegetable crops, particularly in southern California, indicate that a combination of inorganic and organic nitrogenous fertilizers such as 250 pounds of sulfate of amonia mixed with 500 pounds of fish meal per acre gives good results, especially if applied before the crop is planted. In the Santa Maria district a mixture of 200 pounds of sulfate of ammonia and 500 pounds of fish meal is applied at the rate of 500 pounds per acre shortly after transplanting. This material is sometimes added at the first cultivation with the single-horse cultivator drills or sometimes with the larger two or three-row fertilizer drills; in either case, an irrigation follows. Another common practice in this district is to apply 200 to 250 pounds of sulfate of ammonia shortly before harvest. Other inorganic materials such as nitrate of soda, nitrate of lime, especially when combined with covercrops or barnyard manure, likewise give good results. These may be applied before planting, with a broadcaster or with a seeder drill; or after planting, as a side dressing in one or more applications in amounts sufficient to add from 60 to 100 pounds of nitrogen per acre. In the case of sulfate of ammonia, 500 pounds per acre would be required to add 100 pounds of nitrogen. When applied, these inorganic materials should be either drilled into the soil or leached into it with irrigation water in order that they may be placed in the root zone and become available to the plant. Judging from preliminary trials in the Centerville district, a response is obtained by the addition of superphosphate.

BLANCHING

The market demand is for pure-white curds. Varieties such as Snowball have a scanty foliage, which neither covers the curd nor protects it from the sun and weather. The curd when small is well protected by the small inner incurving leaves; but these gradually lift as its size increases. To prevent discoloration, therefore, the outer leaves must be gathered to-

gether and tied over the head while the small inner leaves still protect it. During warm weather the curd may be ready for harvest within two or three days; but during the cooler part of the year, as long as two weeks may be required. Varieties of the so-called cauliflower broccoli depend upon the nature of foliage development for protection and are usually not tied (fig. 5).

Fig. 5.—Curd in ideal condition for cutting. The inner incurving leaves of some varieties protect the developing curd from the sun and frost, keeping it pure white in color. (From Agr. Ext. Cir. 11.)

HARVESTING

Every few days after the crop begins to mature, all heads in the proper stage of development are cut, trimmed, and hauled in a high-wheeled cart to the ends of the rows. In some districts they are dumped and field-packed; in others they are transferred to wagons or trucks (fig. 6) and hauled to the packing shed. The axles of the cauliflower cart are bent, thus elevating the bed to clear the tops of the standing plants. The bed works on a hinge to facilitate unloading. Wheels equipped with pneumatic tires are more satisfactory than those with steel rims. Four or five such carts are usually required for a field of 60 acres.

The cauliflower head, with the jacket leaves attached, is severed from the plant with a large knife. Enough jacket leaves are left on to give good protection. Many growers cut the stem in the field so that it needs no further trimming before packing. The tips of the leaves may be cut back at harvest time or left uncut until the crate is packed.

The heads must be cut while still compact. If the plants have not made good growth, the heads will not grow large, regardless of the length of time they remain in the field. The best policy, apparently, is to disregard the size feature at time of harvest and consider only the stage of maturity.

Fig. 6.—The cauliflower heads are thrown into small two-wheeled carts which are pulled through the field. The heads may be dumped and packed at the end of the rows, or they may be transferred to wagons or trucks and hauled to the packing shed. (From Agr. Ext. Cir. 11.)

Since cauliflower matures very rapidly in warm, rainy weather, much of the crop may be lost unless additional labor is provided during these periods. If part of the field has become overmature, one should accept the loss and continue to cut only the desirable heads rather than attempt to harvest those that have passed their best marketable condition. Occasionally during a rush period the cauliflower heads are cut and left inverted in the field for a short time. This procedure checks the growth and prevents many losses.

GRADING

Certain inherent characteristics apparently make cauliflower more subject to deterioration than most other vegetable crops shipped from California. There is usually a good demand for cauliflower of high quality, but almost no market for poor stock. Rigid grading, therefore, is imperative.

Overmaturity.—The stage of development of the head markedly affects its carrying qualities. The longer the heads are left in the fields after they are ready to cut, the more wilted they appear when they reach the market. A curd that has begun to separate (figs. 7 and 8) deteriorates much faster than a curd that is compact at the time of cutting. If the heads are spread, they reach the eastern markets in an almost unsalable

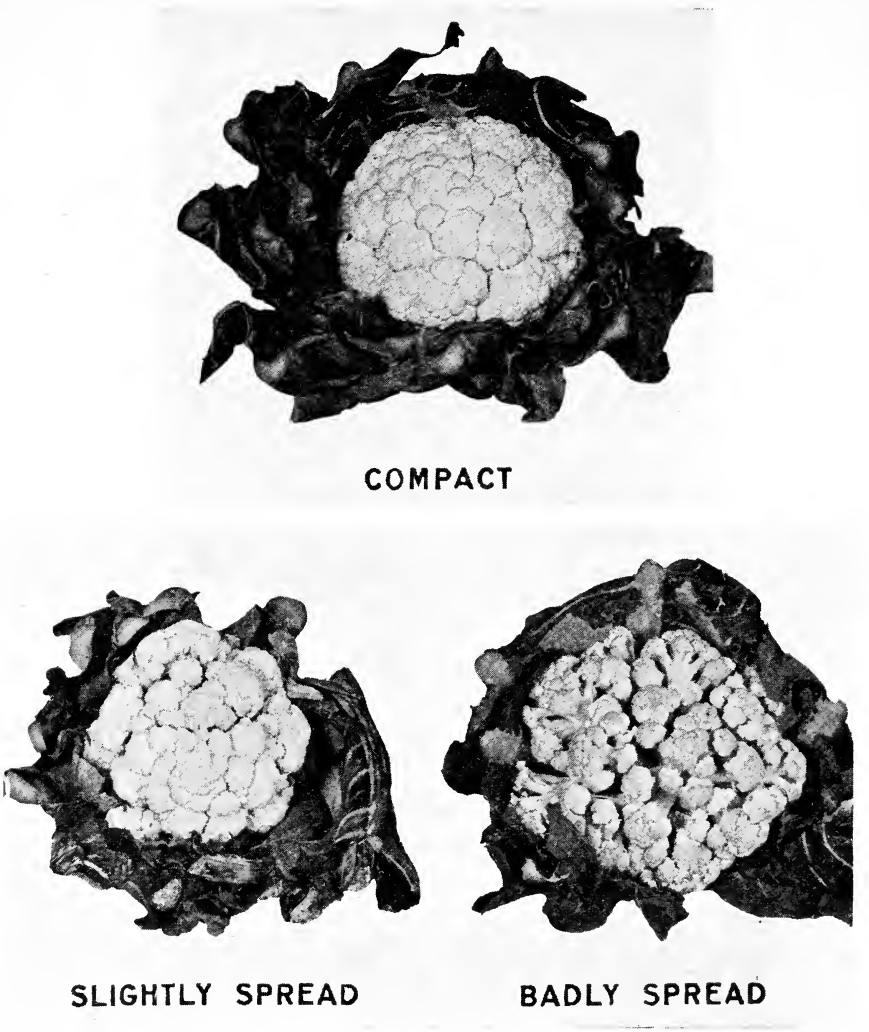

Fig. 7.—The heads should arrive at their destination in a solid condition, as illustrated by the compact head above. If cut and packed when slightly overmature, they spread considerably more before they reach the eastern markets and appear like the heads labeled "slightly spread" and "badly spread." Although the heads pictured are neither ricy nor fuzzy, the badly spread and loose condition is objectionable. (From Agr. Ext. Cir. 11.)

condition. Every effort, therefore, should be made during cutting and packing to discard all heads that are slightly spread, for the spreading is usually much more pronounced by the time they reach their destination. One overmature head spoils the appearance of the entire crate, being very conspicuous because the leaves are spread and the curd is exposed. At the proper stage of maturity the curds are well concealed in the jacket leaves.

Fig. 8.—Cauliflower head decidedly overmature. Curds of this age should not be harvested. (From Agr. Ext. Cir. 11.)

"Riciness."—A condition known as "riciness" is caused by the elongation of the ultimate branches. This defect gives the head a granular appearance (fig. 9) and less compactness than it should have. A ricey head is not so objectionable, however, as one that is badly spread. Riciness may be largely overcome by planting seed of good quality under the most favorable climatic conditions. It is usually more likely to occur when the crop matures in exceptionally warm, dry weather, or if the heads become slightly overmature. Heads may become badly spread, however, without being ricey.

"Fuzziness."—When the individual flower stems or pedicels elongate, the head appears velvety or fuzzy (fig. 10). The entire head or only a small portion may be so affected. Some varieties are more predisposed than others to fuzziness. This abnormality is usually produced by adverse growing conditions, sometimes by slight overmaturity of the heads.

It can be largely overcome by observing the same precautions as for riciness.

Leafy Curds.—Leafy curds are those having small green leaves between the segments (fig. 11). They are undesirable and, if possessing many leaflets, should be discarded.

Small Sizes.—Small sizes usually mean a lower price to the crate and fewer crates to the acre. They are usually the result of growing the crop on unproductive soil or of getting the plants started too late in the fall.

Fig. 9.—Ricey head of cauliflower. (From Agr. Ext. Cir. 11.)

For winter and early spring crops, the plants should be set in the field in time to secure a good growth before cold weather.

Color of the Leaves.—When the heads reach the eastern markets, the jacket leaves should be green, not yellow. If subjected to high temperatures after cutting they will turn yellow and drop during transit or after reaching their destination.

Discoloration of Curd.—Curds exposed to the sun develop a very objectionable brown pigment. Varieties such as Snowball should have the leaves well tied over the head to prevent discoloration. If the plants are not to be tied, only those varieties and strains should be grown that have their heads naturally well protected. As the surface of the curd becomes discolored if bruised, it should not be handled during the harvesting and packing operations.

Insect Injury.—Heads having a large portion of the leaf blades eaten by worms or having deposits of green excrement in the white curd present a poor appearance. Aphids on the leaves at the time of packing are also objectionable, for during transit they may migrate to the surface and the spaces between the branches of the curd.

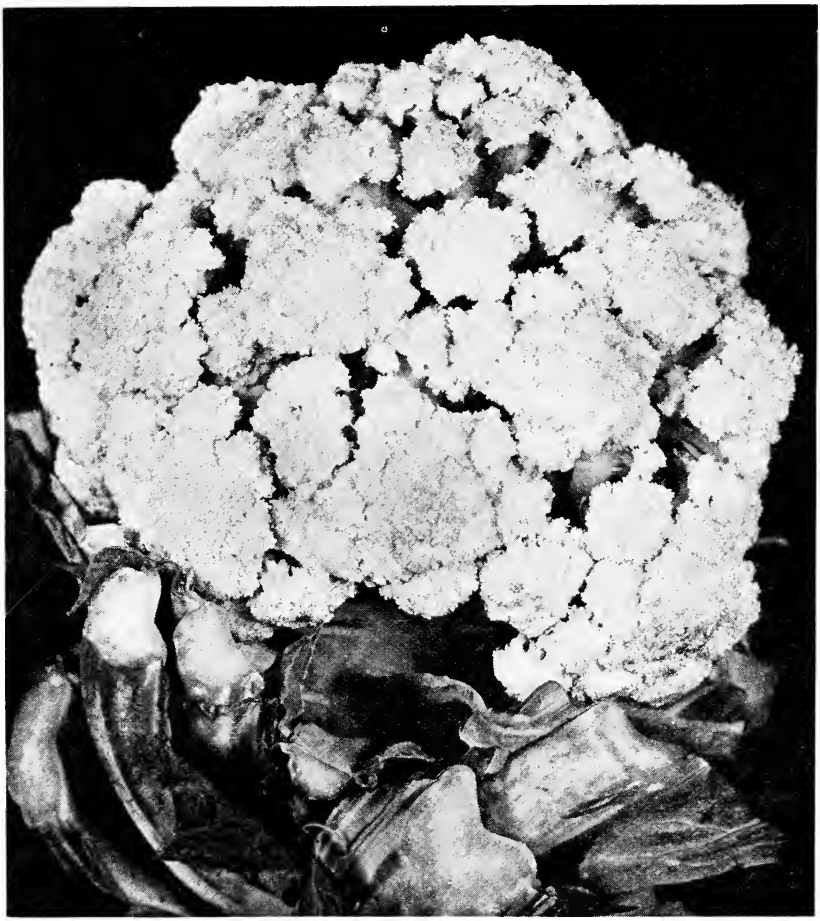

Fig. 10.—A fuzzy head of cauliflower in which the stalks of the individual flower buds have started to elongate. This condition may accompany overmaturity but also occurs when the crop has been grown under unfavorable climatic conditions. (From Agr. Ext. Cir. 11.)

CALIFORNIA STANDARDS FOR CAULIFLOWER AND BROCCOLI

All cauliflower and broccoli offered for sale in California must comply with the provisions set forth in the Agricultural Code[5] of California.

Cauliflower and broccoli. 813. Cauliflower and broccoli shall be free from rots and worm or other insect injury which has penetrated or damaged the curd; and free

[5] California State Department of Agriculture. Agricultural code. p. 138. 1933.

from serious damage due to freezing, sunburn, or other causes. Damage to the head of any one cauliflower or broccoli is not serious unless it causes a waste of twenty per cent of the edible portion of the individual cauliflower or broccoli. Not more than five per cent, by count, of the heads in any one lot of containers or bulk lot may be below these requirements but no container or bulk lot of less than ten heads shall have more than twenty per cent, by count, of the heads which are below these requirements.

Cauliflower and broccoli when packed in any container, shall be properly trimmed. Properly trimmed means that the number of jacket leaves shall be limited to those necessary to protect the head.

Fig. 11.—Leafy head. Heads in which a considerable number of small leaves appear between the segments of the curd should be discarded. (From Agr. Ext. Cir. 11.)

UNITED STATES STANDARDS FOR CAULIFLOWER[6]

The tolerances for the standards are placed on a container basis. However, individual packages in any lot may vary from the specified tolerances as stated below, provided the averages for the entire lot, based on sample inspection, are within the tolerances specified.

For a tolerance of 10 per cent or more, individual packages in any lot may contain not more than one and one-half times the tolerance specified, except that when the package contains 15 specimens or less, individual packages may contain not more than double the tolerance specified. For a tolerance of less than 10 per cent, individual packages in any lot may contain not more than double the tolerance specified, provided at least one specimen which does not meet the requirements shall be allowed in any one package.

U. S. No. 1 shall consist of compact heads of cauliflower which are not discolored, ricey, or overmature; which are free from soft or wet decay and from dirt or other

[6] United States Department of Agriculture. Handbook of United States standards for grading and marketing fresh fruits and vegetables. U. S. Dept. Agr. Misc. Publ. No. 190:38–40. 1934.

foreign matter, bruises, diseases, insects, damage caused by wilting, fuzziness, enlarged bracts, or mechanical or other means. Jacket leaves shall be fresh, green, well trimmed, and free from serious damage by any cause. (See Minimum Size.)

In order to allow for variations incident to proper grading and handling, not more than a total of 10 per cent, by count, of the heads in any container may be below the requirements of this grade but not more than one-tenth of this amount, or 1 per cent, may be affected by soft or wet decay affecting the curd.

Unclassified shall consist of cauliflower which is not graded in conformity with the foregoing grade.

Unless otherwise specified the minimum size shall be 4 inches in diameter. In order to allow for variations incident to proper packing, not more than 15 per cent, by count, of the heads in any container may be below the specified minimum size.

As used in these grades:

"Compact" means that the flower clusters are closely united and the heads feel solid.

"Discolored" means that the head is of some abnormal color.

"Ricey" means that the stems of the flower clusters have started to elongate, causing the clusters to separate and give the head a loose or open and sometimes granular appearance.

"Overmature" means a stage of growth which is beyond that of a compact, properly developed head. An overmature head usually is loose or ricey.

"Damage" means any injury or defect which materially affects the appearance, or the edible or shipping quality of the head. "Damage by fuzziness" means that more than half the head has a distinctly fuzzy appearance. Mold which causes the flesh of the curd to disintegrate or which exceeds three-eighths inch in diameter in the aggregate, or any single spot which exceeds one-fourth inch in diameter shall be considered as damage.

"Enlarged bracts" means leaves growing up through and extending above the curd. Bracts, including small white bracts and enlarged bracts which do not materially injure the appearance of the head shall not be considered as "damage."

"Well trimmed" means that the jacket leaves shall be limited to the number and length necessary to protect the head. No wrapper leaves are required on heads which are individually wrapped.

"Serious damage" means any injury to the jacket leaves which severely affects the appearance of the head.

"Diameter" refers to the average diameter of the head exclusive of the jacket leaves.

PACKING

Cauliflower is packed mainly in pony crates or flats, with only one layer of heads in a container. In come districts packing is done in the field; in others in the packing shed. The heads are set erect in the crate (fig. 12); the foliage is trimmed to a bulge of 1½ to 2 inches; and then three narrow slats are nailed across the top.

LOADING

During the winter months uniced refrigerator cars lined with a heavy gray building paper are generally used. A carload consists of 16 tiers of 32 crates per tier. Each tier consists of 7 layers: the bottom layer has 5 crates; then layers of 4 and 5 crates alternate. A carload is 512 crates.

Four-crate layers provide tunnels for ventilation and additional ice. Crushed ice is placed on each layer of crates; the tunnels are fairly well filled. A large amount of the crushed ice is spread on top of the load also, usually with a mechanical blower. The crates are inverted in the car so that the melting ice water will trickle down over the leaves rather than

Fig. 12.—After packing, the leaves are trimmed to a bulge of about 1½ inches, and the top slats nailed on. (From Agr. Ext. Cir. 11.)

collect in the heads. The ice forms a solid layer during transit. In cool weather additional ice during transit may not be required. Two cleats are nailed across each tier of crates to help hold the load stationary.

SEED GROWING

As a rule, the production of seed by the average grower is not recommended. Since success in growing cauliflower largely depends upon

good seed, growers will probably find it more profitable to purchase seed from sources having the trained personnel and equipment for handling this rather complex procedure.

INSECT PESTS

Cabbage Aphid.—A pest attacking the cauliflower plant very seriously at times is the cabbage aphid (*Brevicoryne brassicae* Linn.). Aphids lower the vitality of the plant by sucking out the juice. They are present in all parts of the United States and live upon the wild and cultivated members of the mustard family. They are green, have a whitish, mealy covering and color, and on cauliflower are usually found on the young succulent inner leaves and on the undersides of the older leaves. Often they can be detected by yellowish spots on the leaves where the tissue has been injured. When the colonies appear on the edge of the leaf, they cause it to curl inward. Aphids are controlled somewhat by numerous parasitic enemies, which become most active as the weather becomes warm, and also by predaceous insects such as the ladybird beetles and syrphus fly larvae. Hard-driving rains also destroy many of them.

A good liquid spray for the cabbage aphid is made as follows:

Nicotine sulfate (40 per cent)	1 pint
Fish oil soap	5 pounds
Water	100 gallons

In general, a perfect kill is seldom obtained with a liquid spray, because it is almost impossible to reach the small central leaves and to get a complete coverage on both surfaces of the older ones. For best control, liberal and repeated applications are necessary.

Dusts containing nicotine sulfate are being used more and more because the small particles can be blown into and about the plant, contacting every portion of it. A good mixture is 95 pounds of hydrated lime with 5 pounds of 40 per cent nicotine sulfate. Mixing should be thorough, and in amounts sufficient only for immediate use. Complete directions for the home mixing of the dust are given in Farmers' Bulletin 1499.[7] For cauliflower plants less than half grown, about 30 pounds of dust will be required per acre; for more mature plants, about 50 pounds. When power dusters are used, long trailers should be attached (fig. 13) to hold the dust close to the ground and about the plants. Factory-made dusts can be purchased from insecticide dealers.

Since many wild mustards and other native crucifers are hosts to the cabbage aphid, they should be kept out of the fields and away from the roadsides, fences, and other waste places.

[7] Chittenden, S. H., and W. H. White. The melon aphid and its control. U. S. Dept. Agr. Farmers' Bul. 1499:1–16. 1926.

Common Cabbage Worm.—The cabbage worm (*Pieris rapae* Linn.) is one of the most serious pests that attack the cauliflower. The larvae may entirely consume the young succulent leaves or skeletonize the older ones. The eggs, which are deposited singly on either side of the leaf, are light greenish yellow. The mature larvae are 1¼ inches long and a velvety green. The adult is the common white butterfly often seen flying over cabbage and cauliflower fields. The color and markings of the adult female are shown in figure 14.

Fig. 13.—The best aphid control is obtained when a cloth trailer is pulled behind the duster to hold the dust near the plants. (From Agr. Ext. Cir. 11.)

Cabbage Looper.—The larva of the cabbage looper (*Autographa brassicae* Riley) is pale to dark green. When this insect is walking, the central part of the body forms a loop or arch.

Diamond-Back Moth.—Larvae of the diamond-back moth (*Plutella maculipennis* Curtis) may also cause injury at times. When mature they are about 3/10 inch in length and pale green in color. They are active and very irritable.

Control for Cabbage Worm, Cabbage Looper, and Diamond-Back Moth.—For all the leaf-eating insects, including the common cabbage worm, the cabbage looper, and the diamond-back moth, the insecticides used have been stomach poisons, principally materials containing arsenic. Recent years have shown, however, that arsenical dusts and sprays are less effective than desired and cannot be used at sufficient concentrations and late enough in the growth of the plant because of the poisonous-residue problem. Many departments of health and the Food

and Drug Administration of the United States Department of Agriculture are on the alert for poisonous residues in excess of the federal tolerance (0.01 grain of arsenic trioxide per pound of produce, 0.018 grain of lead, and 0.01 grain of fluorine). Analyses are made not only of the cauliflower curd, but also of the outer leaves of the material offered for sale, because these are occasionally served by restaurants as food.

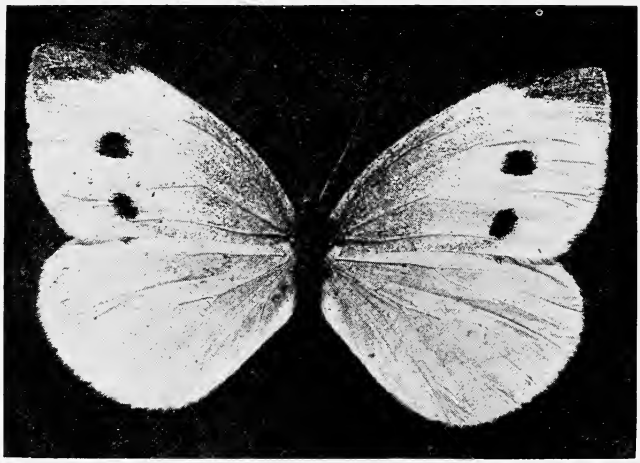

Fig. 14.—Female butterfly of the imported cabbage worm, *Pieris rapae* (Linn.) enlarged one and one-half times. (From Agr. Ext. Cir. 11.)

Since experimental data have demonstrated the effectiveness of derris compounds in controlling leaf-eating insects, these materials should supplant the arsenical dusts and sprays. The only justifiable use of arsenates would be during the first 30 days after the cauliflower plants are set out, before any problem of poisonous residue might develop.

Where good materials have been properly used, the derris compounds have given satisfactory control of the cabbage worm, the looper, and the diamond-back moth. As rotenone is the principal killing agent, derris dust should be purchased on the basis of its rotenone content, which is from 4 to 5 per cent. For dilution purposes this material may be mixed with talc or with diatomaceous earth, but never with lime or gypsum. Derris dust as used in the field should have a rotenone concentration of 0.5 per cent in order to obtain a satisfactory kill. One pound of derris dust of 5 per cent rotenone content, when mixed with 9 pounds of talc will provide 10 pounds of 0.5 per cent dust. Although rotenone extracts are being developed for spraying purposes this material is sold principally as a dust, and only in the dust form does it compare favorably in price with arsenical and fluorine insecticides. Derris dusts are applied

in the same manner as other dusts. Though generally classed as nonpoisonous to human beings because it does not leave a poisonous residue, the material is poisonous in the liquid form or when just applied. Applications may be made every 10 to 20 days, and two or three applications will generally give good control, though a single one often suffices. It is best to apply derris dust when the weather is quiet and rain unlikely.

In mixing this dust at home, the operator should avoid breathing it, for it irritates the mucous membranes of the nose and mouth.

Pyrethrum sprays and dusts are also used for controlling leaf-eating insects. As pyrethrum does not leave a poisonous residue, it is beginning to be substituted for arsenical insecticides. In addition it is used as a mixture with rotenone.

Crop rotation and field sanitation are also recommended. Since the chrysalids of the cabbage worm pass the winter on the old cauliflower stumps and other refuse in the fields, the plants should be destroyed and the field plowed as soon as possible after the crop has been harvested.

Harlequin Cabbage Bug.—The harlequin cabbage bug (*Murgantia histronica* Hahn.) is shining black or deep blue, marked with brilliant orange or red. It is about ½ inch long and flattened. The eggs are laid in regular or irregular groups, usually about a dozen eggs being present in one cluster. Both the adults and the young suck the juice from the leaves; the injured parts become yellow and often wither and die.

As these insects cannot well be controlled with the ordinary contact insecticides, preventive measures must be used. The adults, being very sluggish, can be caught by hand and dropped into kerosene or some other killing solution; this must be done when they first appear and are still few in number. The egg masses should also be picked and destroyed. Trap crops, such as kale and other brassicas, should be planted to precede the commercial crops in districts where this insect is abundant. Both crops and insects are then destroyed by spraying with kerosene. All weeds, especially those belonging to the mustard family, should be destroyed throughout the year. During the winter they serve as a source of food and also as a protection for this pest. The nymphs can be killed by the following formula:

Commercial oil emulsion (60 to 70 second velocity and 90 per cent unsulfonatable) or tank-mix oil of like specifications with 4 ounces of blood albumin spreader	1½ gallons
Nicotine sulfate 40 per cent (for example Black Leaf 40)	¾ pint
Ammonia (20 to 24 per cent solution)	½ pint
Water to make	100 gallons

This spray is not very effective against the adults.

Cabbage-Root Maggot.—The root maggot (*Phorbia brassicae* Bouché) is not at present a serious pest in most cauliflower districts of California. The adult flies lay their eggs on the stem of the cauliflower plant near the surface of the ground or on the soil close to the plant. The larvae are hatched within a few days, the length of time required depending largely upon the temperature. They migrate to the below-ground portions of the plant and begin to feed. If severely tunneled, the plant wilts down and often does not recover. When the attack is light, about the only evidence is a slowing up of plant growth. The white larvae or maggots reach a length of about ¼ inch.

As the root maggot infests many of the crucifers such as radishes, turnips, and cabbage, it is desirable to practice a rotation with crops not related to this group. The soil should be plowed and well cultivated during the late fall, winter, and early spring to expose and destroy the pupae. In some districts tarred paper disks have been used extensively to prevent the adult flies from depositing their eggs about the plant. When used, these disks should be applied at transplanting time or at least before the flies start to deposit their eggs. At present, however, corrosive sublimate is generally used for the control of this pest. This compound is first dissolved in a small amount of hot water, then diluted so that every 10 gallons of the solution will contain 1 ounce of the poison. Being corrosive, this material should be mixed not in metal containers but in wooden barrels or earthenware. At each application about ½ teacup of the solution is applied at the stem of each plant, or approximately 200 gallons an acre. The first application must be made 3 or 4 days after transplanting, the second about a week later, and the third a week or ten days after the second. Each treatment costs $8.00 to $10.00 an acre.

DISEASES[8]

Damping-off.—This disease, occurring frequently in the seed bed, is recognized by a shriveling of the stem of the young seedling at the surface of the ground. The young plant then falls over and dies. This damping-off, which may be caused by a number of different fungi, is most prevalent in seed beds that are crowded, damp, and poorly ventilated. To control it, preventive rather than curative measures should be used. The bed should have plenty of sunlight and good circulation of air. The young seedlings should not be watered on cloudy days. On bright days, water should be applied early in the morning. Frequent light waterings are less desirable than thorough wettings at longer intervals.

[8] This section was prepared by Dr. C. Emlen Scott, Specialist in Agricultural Extension.

Seed should be sown in rows far enough apart to allow a good circulation of air about the plants and to permit the sun's rays to strike the soil. As a rule, the plants are subject to damping-off during their younger stages only.

Brown Rot.[9]—The brown rot of cauliflower is mainly a transit disease, which develops most rapidly when the temperature and humidity are high. It causes a browning and spotting of the head which destroy the market value when the infections are numerous or severe. During most seasons the disease is not sufficiently serious to justify control measures on the plants in the field other than seed bed and field rotation. At the time of packing, all heads that show any brown or decayed spots should be discarded. Temperatures during transit should be 42° F or below.

Downy Mildew.—Downy mildew (*Peronospora parasitica*), a common disease of crucifers, may cause a loss of seedlings and leaves of older plants. Cauliflower is subject to attack from the time it emerges in the seed bed until harvest. Large, angular, yellowish or tan blotches are produced on older leaves. In the early stages of the disease the white, moldy growth or "down" of the fungus is produced on the under surface of the spots. The fungus is favored by cool, moist weather and dews. Seed beds should receive the care suggested in the paragraph on damping-off. Downy mildew can be controlled in cabbage seed beds with bordeaux mixture, but cauliflower is reported to be injured by this spray.

Root Rot.—Cauliflower and other crucifers are subject to a root rot caused by *Phytophthora megasperma.* This disease occurs in poorly drained areas where rain or irrigation water has accumulated. Affected plants show a reddening or purpling of the leaves, sudden wilting, and decay of the lower end of the root. Plants of all ages are susceptible. Although this is a soil-borne fungus, affected areas may be safely replanted if adequate drainage can be provided.

Mosaic.—This disease is particularly prevalent in the San Francisco Bay region, causing stunting of plants. The leaves of affected plants are twisted and mottled. This disease is transmitted by aphids, which should be controlled in the seed beds.

Ringspot.—Under conditions of high humidity the fungus called ringspot (*Mycosphaerella brassicicola*) may cause a serious loss of leaves, but not destruction of the plants. Nearly all parts may be attacked, but most of the damage is caused by the circular spots on the leaves. The spores of the fungus produced on the leaves are spread by rain and by overhead irrigation.

[9] For more detailed discussion of brown rot of cauliflower see: Weimer, J. L. Jour. Agr. Research 29:421–441. 1924.

Ringspot is most abundant in humid regions where cauliflower has been grown intensively for many years. Under such conditions Weimer[10] found that seed treatment, seed-bed sanitation, and spraying were ineffective. Cauliflower is subject to injury from bordeaux spray.

ACKNOWLEDGMENTS

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[10] Weimer, J. L. Ringspot of crucifers caused by *Mycosphaerella brassicicola* (F. R.) Lindau. Jour. Agr. Research 32:97. 1926.

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