SAN DIEGO COUNTY AGRICULTURAL DIRECTORY OF SERVICES & GUIDELINES TO PRODUCTION COSTS AND PRACTICES 1987-1988

AUTHOR

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University of California, the United States Department of Agriculture and County of San Diego cooperating.

Contents

Forward

San Diego Agriculture - Billion Dollar Industry

San Diego agriculture in its many forms is a billion dollar a year industry. Agricultural endeavors include: brush and grazing land management; the production of eggs, flowers, fruit, livestock, nursery plants, small grains and vegetables; and related support business. This agricultural business complex not only makes a significant economic impact on the county, but also contributes to the beauty and diversity of life in the region.

Ag Directory - Reference Guide

This publication was prepared as a directory and reference guide for growers, shippers and handlersof agricultural products, bankers, investors, and agricultural suppliers within San Diego County. It can also be useful in developing an understanding of production costs and techniques utilized in this area.

County Production Practices

Crop production practices outlined in this publication have evolved to meet the unique needs of vegetable production in San Diego County. They reflect resource constraints of water costs, topography, and soil type and should be viewed in the context of those constraints.

County Production Costs

Figures used in production cost sheets were developed by farm advisors based on information supplied by growers, pest control advisors, fertilizer and seed companies, and independent contractors. These figures should be regarded as estimates of average costs. Production costs for individual growers and seasons will depend on factors such as: soil type, pest management, labor cost, size of production unit, and management practices.

The overhead expense, estimated as 10% of preharvest cost and land rent, includes office, utilities, insurance, finance charges, supplies, transportation and administrative expenses. Land rents are based on gross acreage; and water costs on an average of district charges ($400/acre foot). These factors, therefore, must be considered when comparing the attached cost sheet figures to individual operations.

Wayne L. Schrader, Farm Advisor

B. Diane Wallace, County Director

Introduction to San Diego Agriculture

Economic Impact

In 1985 U. C. Berkeley Agricultural Economists evaluated the impact of San Diego's agriculture to the county economy. Their findings show that:

1) agricultural production and processing in San Diego County created over 23,500 full time equivalent jobs;

2) San Diego agriculture generated 475.4 million dollars of personal income; and that

3) San Diego's agricultural output generated 1.33 billion dollars in the economy.

Diversity

In addition to the economic benefits of flower, plant, fruit, vegetable, and livestock production, San Diegans enjoy the green belts that are preserved by agricultural enterprises. The unique climate found in San Diego County makes it a world center for agricultural diversity. Nowhere else do people enjoy the year-round variety and quality of San Diego's locally grown ag products.

Technological Innovation

University of California researchers working with progressive local growers in this unique setting have made San Diego County a center for agricultural technology as well as production diversity. The commercial use of drip irrigation systems was pioneered in San Diego and the largest producers of drip irrigation systems are headquartered here. County agriculture has gained the title as the most efficient agricultural water user in the United States. The use of plastics for crop protection also developed in response to San Diego agriculture's needs and is another example of a special local technology which has spread throughout the country.

Future Prospects

Agriculture is not dying in San Diego County but is changing from an industry based on the production of a few major commodities for interstate trade to a diversified and responsive industry serving local needs as well as interstate and international markets.

San Diego agriculture is struggling to respond to changing markets, local needs, urbanization, rising water costs, and difficult competition from Mexico and Florida. With support and understanding from San Diego's residents and government, agriculture can continue to be a vital part of San Diego County's economic base, diversity, and charm.

AGRICULTURAL RESOURCES OF SAN DIEGO COUNTY

University of California Cooperative Extension
5555 Overland Ave., Bldg. 4, San Diego Ca 92123 565-5376

University advisors consult on specific agricultural questions and problems via phone and farm visits, conduct local field experiments and demonstrations, introduce new methods of plant and animal production, and seek solutions for local agricultural problems. The Extension office distributes agricultural literature published by the University of California.

Cooperative Extension Staff	Office Day
County Director B. Diane Wallace, Extension Director Telephone 565-5110	by Appt.
Avocados, Citrus, and Deciduous Fruit Gary S. Bender, Farm Advisor Telephone 565-5387	Tuesday
Brushland & Environmental Management Walter L. Graves, Farm Advisor Telephone 565-5378	Monday
Cut Flowers & Indoor Decorative Plants Seward T. Besemer, Farm Advisor Telephone 565-5379	Monday
Dairy, Livestock, Forage Crops Herbert W. Weisheit, Farm Advisor Telephone 565-5383	Thursday
Home Gardening Master Gardener Volunteers Telephone 565-5571	Mon.- Fri.
Limited Scale Agricultural Enterprises Faustino N. Muñoz, Farm Advisor Telephone 565-3535	Wednesday
Nursery Crops, Turf, and Landscaping position vacant, Farm Advisor Telephone 565-5376	- - -
Urban Horticulture, Pest Management Vincent F. Lazaneo, Farm Advisor Telephone 565-3983	Wednesday 1 - 5 pm
Vegetables & Strawberries Wayne L. Schrader, Farm Advisor Telephone 565-5385	Monday

County Agricultural Commissioner/Weights and Measures

The county agricultural commissioner conducts agricultural commodity inspections and enforces California state agricultural laws and regulations. Provides agricultural pest inspection, identification, and quarantine, and information on pesticide use.

Area Office:	
5555 Overland Ave., Bldg 3., San Diego 92123	565-5764
Agricultural Commissioner - Kathleen Thuner	565-5789
Exclusion/Quality Control - Omar Beck	565-5747
Pest Detection/Eradication - George Opel	565-5763
Plant Pathology/Nematology - Ken Sims	565-5778
Asst. Sealer/Commissioner (acting) - Ken Sims	565-5781
Pesticide Use Information/Enforcement - Marilyn Corodemas or Carolyn Nielsen	565-5764
Field Offices:	
El Cajon - 250 E. Main St. 92020	579-3440
Escondido - 600 E. Valley Parkway 29025	741-4406
Fallbrook - 130 E. Alvarado St. 92028	728-7488
Ramona - 1420 Montecito Rd. 92065	789-1340
Vista - 855 Williamston St. 92083	758-6366

Soil Conservation Service - USDA

The USDA Soil Conservation Service provides information on soil, land and water use, conservation practices, and erosion control. Helps farmers and ranchers determine the type(s) of soil they are working with and supplies soil maps of their area.

County Field Offices:	
El Cajon - 1132 N. 2nd St. 92021	442-0559
Fallbrook - 1181 E. Mission 92028	728-1332
Escondido - 1523 East Valley Parkway, Ste. 205 92025	745-2061
Ramona - 1416 Montecito Rd. 92065	789-1800

National Weather Service

Climate data for San Diego County.

Area Office:	
2980 Pacific Highway, San Diego 92101	297-2107

Agricultural Weather Information:

162.40 VHS Weather Radio agricultural reports
Every Day from, 10 to 11:00 am and 4 to 5:00 pm

107.1 FM KAVO Fallbrook
During frost season; noon, 6:00, and 11:00 pm
Daily Report is at 6:30 am

1450 AM KOWN Escondido
During frost season; 6:00 and 7:00 pm
Daily Reports; 6:30 am, noon, and 5:00 pm

Latest Weather Forcast 289-1212

AGRICULTURAL MARKETING INFORMATION

Federal-State Market News Service
1220 N. Street, Sacramento 95806 916-445-5721

Provides information on market prices, supply, demand, movement, quanity, and quality of agricultural commodities.

Area Offices:

Fruits and Vegetables
1320 East Olympic Blvd., Suite 212 213-894-3077
Los Angeles, CA 90021

395 Broadway, Produce Exchange Building 352-3562
El Centro, CA 92244

Livestock, Grain, Feed, and Poultry
5600 Rickenbacker Rd., Section A, Bldg. 7,
Bell, CA 90201
Livestock & Meat 213-267-6736
Hay, Grain & Feed 213-620-3473
Eggs & Poultry 213-267-6880

Foreign Agricultural Services
USDA Information Division, 202-447-3448
Washington, D.C. 20250

Provides statistical information and reports on foreign agricultural trade. Works to maintain and expand export sales. Cooperates with State departments of agriculture, and non-profit trade associations.

California Department of Food and Agriculture — 213-749-5775
Direct Marketing Program

Gives information to farmers on how to market products directly to consumers, prints farmer to consumer directory, and instructs farmers how to start a certified farmer's market.

California Crop and Livestock Reporting Service
P.O. Box 1258, Sacramento 95806 — 916-445-6076

Estimates of production and value for agricultural products.

California Department of Food and Agriculture-
Bureau of Agricultural Statistics:
1200 N. Street, Room 243, Sacramento 95814

Vegetables	916-445-4313
Field Crops	916-445-6082
Fruit Crops	916-445-3214
Livestock	916-445-6788

U.S. Agricultural Economic Reports-
Economics Statistics and Cooperative Service:
USDA, Washington, D.C. 20250 — 202-447-4230

AGRICULTURAL LOANS AND ASSISTANCE RESOURCES

Agricultural Stabilization and Conservation Service
(ASCS), USDA, 83-203 Highway 86, Suite 6
Indio 92201 — 347-3675

Price support programs for honey and wool, Dairy Liquidation Program, and Production Adjustment Program for wheat.

California State Department of Veterans Affairs
Room 6060, 1350 Front Street, San Diego 92101 — 237-7682

Home and farm loans to California veterans.

Federal Land Bank Association of Riverside
210 S. Juniper, Suite 101, Escondido 92025 — 745-5901

Long term farm loans.

Southwest California Production Credit Association
Farm Credit Bldg., 144 West Woodward Ave., Escondido 92025 — 746-5055

Short and intermediate term loans.

USDA Farmers Home Administration
1681 West Main St. Suite 412, El Centro 92243 — 352-3314

USDA Farmers Home Administration
Farm and Rural Housing Loans
1523 E. Valley Parkway, Suite 205, Escondido 92025 — 743-2577

MISCELLANEOUS AGRICULTURAL RESOURCES

San Diego County Farm Bureau
1670 East Valley Pkwy., Escondido 92027 — 745-3023
from San Diego (no charge) Ask Opr. for — Zenith 70897

San Diego County Department of Health Services
Primary Health Center, 1700 Pacific Highway, San Diego 92101 — 236-2237

Industrial hygiene, sanitation, vector and rodent control, veterinary services, water sampling, and health education.

San Diego County Veterinarian
5555 Overland Ave., Bldg 4, San Diego 92123 — 565-5395

The county veterinarian provides a diagnostic laboratory service for rabies and other animal disease control programs.

San Diego Water Authority
2750 4th Ave., San Diego 92013 — 297-3218

San Diego County Operations Center-Mapping Section
5201 Ruffin Road, San Diego, 92123 — 565-5081

Topographical maps and aerial photos of San Diego County.

California Agricultural Labor Relations Board
1350 Front St., San Diego 92101 237-7119

California Certified Farmer's Market-Vista

Location: Vista, Ca. behind Vista City Hall
at Escondido and Eucalyptus Ave's.
Time: Saturday 8:00 am - noon, year round

California Farmer-to-Consumer Directory Service
CDFA Direct Marketing Program
1414 K Street, Suite 320, Sacramento 95814 (916)445-5294

California State Employment Development Department
1664 Industrial Bl., Chula Vista 92011 575-0191

California Department of Fish and Game
Room 6042, 1350 Front St., San Diego 92101 237-7311

California State Department of Forestry
2249 Jamacha Rd., El Cajon 92020 588-0364

Tree seedlings, listings and order forms.

California State Hide and Brand Inspectors
632 Bougher Rd., San Marcos 92069 744-1348

Dairy Council of California
9606 Tierra Grande, Suite 103, San Diego 92126 237-7221

Present nutrition education programs and materials to professionals in the fields of education and medicine.

Cal-OSHA
450 Golden Ave., San Francisco 94102 415-557-1946

Enforce regulations on occupational health and safety.

U.S. Bureau of Land Management
1695 Spruce St., Riverside 92507 714-351-6394

U.S. Forest Service
880 Front St., Rm. 6-S-5, San Diego 92188 293-5050

Management of the Cleveland National Forest.

U.S. Geological Survey
7638 Federal Bldg., 300 N. Los Angeles St., Los Angeles 90012 213-688-2850

Supplies geological, groundwater, topographic, satellite, aerial, and other maps.

AGRICULTURAL COMMODITY ORGANIZATIONS, BOARDS, COMMISSIONS

Advisory boards and commissions under federal or state regulation research, promote, and aid marketing of various agricultural products. Many boards and commissions make information available on their particular commodity (ie. promotional information and recipes).

Information on state regulated boards and commissions can be obtained from:

California Department of Food and Agriculture 916-445-5141
Bureau of Marketing, 1220 N. St., Room 210,
Sacramento 95814

California Research Advisory Boards for Celery, 209-591-4866
Fresh Market Tomatoes, Melons, and Potatoes
531-D N. Alta, Dinuba 93618

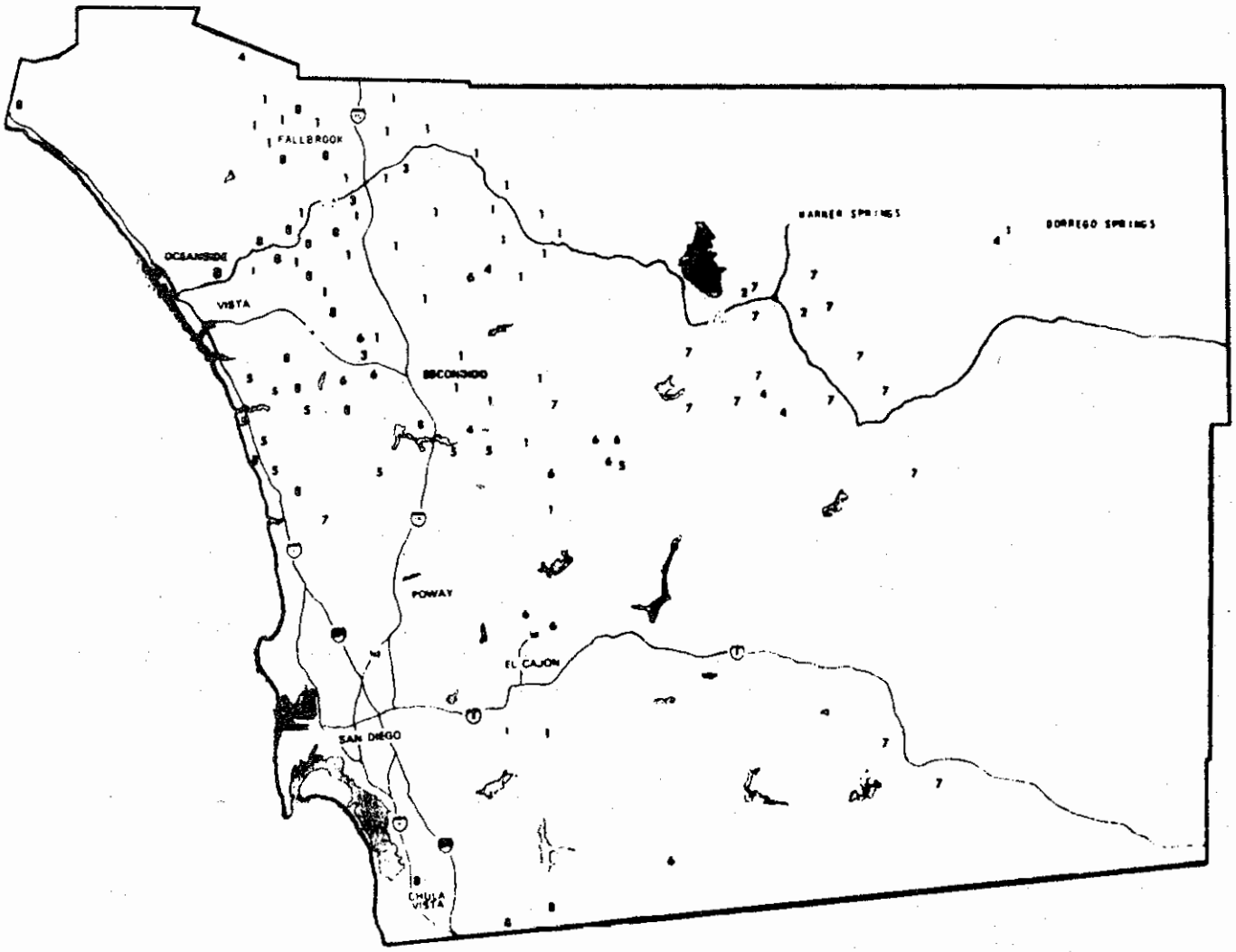
California Strawberry Advisory Board 408-724-1301
P. O. Box 269, Watsonville, CA 95077

Processing Strawberry Advisory Board of 408-724-5454
California
P. O. Box 929, Watsonville, CA 95077

Information on federally regulated boards can be obtained from:

United States Department of Agriculture

Marketing Field Offices:
Sacramento - Bill Blackburn 916-484-4855
Fresno - Richard Van Diest 209-487-5175
Los Angeles - Rowland Harris 213-688-3190



SAN DIEGO COUNTY AGRICULTURAL PRODUCTION AREAS

1 = AVOCADO & CITRUS CROPS

2 = BEEF PRODUCTION

3 = DAIRY OPERATIONS

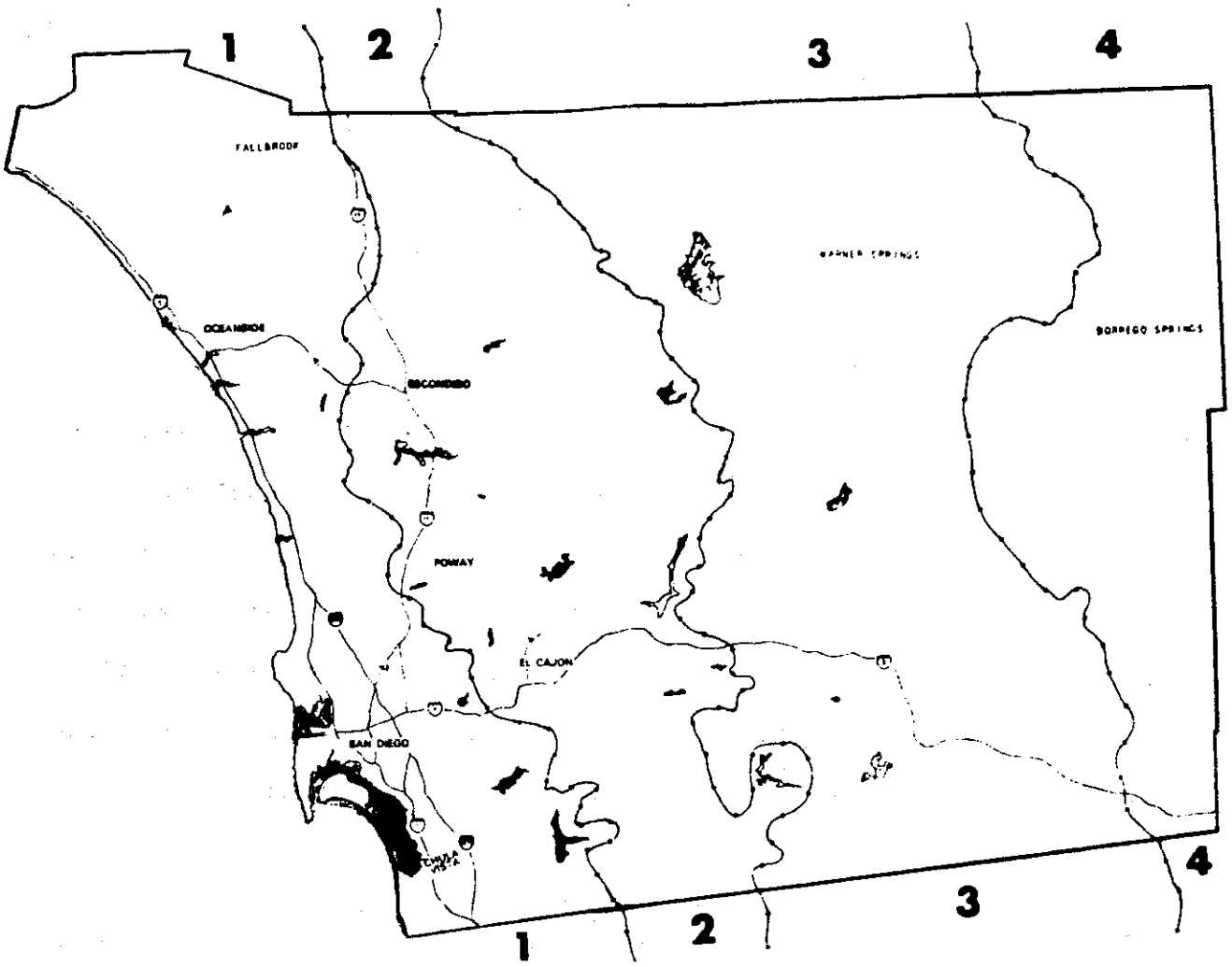
4 = DECIDUOUS TREE CROPS

5 = FLORAL & NURSERY STOCK

6 = POULTRY RANCHES

7 = RANGELAND

8 = VEGETABLE & STRAWBERRY



CLIMATE

San Diego County generally has a mild climate, however there are large differences between the climates of the coastal strip (1), the transitional zone (2), the central uplands (3), and the desert (4).

Temperatures

Average summer highs and winter lows of coastal, inland, and desert areas range from, 70° - 40°F, 90° - 30°F, and 110° - 30°F respectively. Freezing temperatures near the coast are very rare. In the mountain and desert regions temperatures from zero to the teens occur.

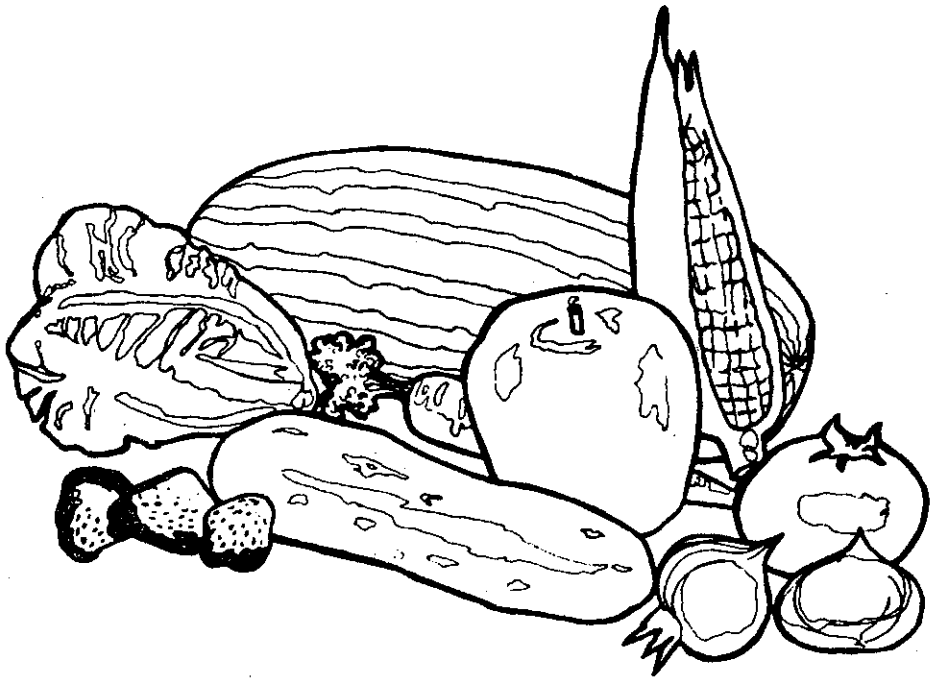
Precipitation

The yearly average rainfall along the coast is 10 inches. However, one year in twenty only 5 inches will fall, and with the same frequency, the same location will receive over 20 inches of precipitation. The amount of precipitation increases near the mountains as the air rises in elevation, cools, and moisture condenses and falls as rain or snow.

San Diego County Soils

San Diego County is approximately 70 miles from east to west and 60 miles from north to south. Stretching from the Pacific Ocean on the west to the desert on the east, San Diego County includes nearly three million acres of land. The San Diego area has been divided into four major physiographic areas - the coastal plains, the foothills, the mountains, and the desert. Soils within each of these areas range from sandy loams to the heaviest clays.

The heterogeneity of soils in this county make general soil maps difficult to produce and risky to use. The use of detailed soil maps is necessary for evaluating the soil at specific sites. To obtain more information contact the U. S. Soil Conservation Service which supplies soil maps of specific areas at no charge.



VEGETABLE CROPS

Commercial Production
Plant / Harvest Schedule

	Season	Plant	Harvest
Beans (green)	Spring	Feb - Mar	May
	Fall	Jul	Sep - Oct
Cabbage*	Midwinter	Sep - Mar	Nov - Jun
Cauliflower*	Midwinter	Sep - Feb	Nov - Apr
Celery*	Midwinter	Aug - Oct	Nov - Mar
Corn (sweet)	Summer	Feb - Jul	Jun - Oct
Cucumbers	Spring	Jan - Feb	Apr - Jun
	Summer/Fall	Mar - Aug	May - Nov
Eggplant*	Summer	Apr - Jun	Jun - Oct
Peppers	Spring	Feb - May	Jun - Aug
	Fall	Jul	Sep - Dec
Potatoes (white)	Spring	Mar - Apr	Jun - Jul
Pumpkin	Summer	Apr - Jul	Aug - Nov
Squash (summer)	Spring	Jan - Mar	Mar - May
	Fall	Aug	Oct - Dec
Sweet Potato	Summer	Apr - May	Aug - Sep
Strawberries	Winter/Spring	Oct - Nov	Jan - Jul
Tomatoes	Spring	Jan	May - Jul
	Fall	Jun - Jul	Sep - Dec

* from transplants

Production Practices & Costs

Note: Growers have developed many different practical production methods for specific crops. Production methods outlined here attempt to reflect methods frequently used and are not intended to be comprehensive.

Varieties differ in fruit characteristics, disease resistance and adaptability to climatic conditions. Soil, climate, cropping history and market acceptance should be considered in variety selection.

BEANS (Green)

Year	Acres	Yield/Acre(tons)	Value/Ton
1985	387	5.2	$ 422
1984	326	4.2	$1116
1983	316	3.6	$ 800
1982	459	2.4	$1358

Planting Dates: Spring - late Feb thru Mar for May production;
Fall - Jul for Sep/Oct production.

Production Practices: Both pole and bush production methods are utilized in San Diego County. Pole production predominates in the spring when direct seeding is done from late February through March for producton in May. Direct seeding of bush varieties generally takes place in July for harvesting in September and October. Currently about 80% of county production is with bush varieties for fall production.

Bush beans can be planted in single rows with 2-3 inch in-row x 30 inch between row spacing; or with double rows staggered on either side of the drip tape with 4-6 inch in-row spacing on 40 inch beds. Pole varieties are generally grown in single rows with 6 inch x 60 inch spacing. Multiple planting dates are used to spread out harvests.

Climatic Requirements: Snap beans are a warm season crop that grow best at temperatures between 60-70°F. As a general rule, temperatures above 80°F or below 50°F should be avoided.

Varieties: "KY-191" is commonly used for pole production and "Green Crop" is often used for bush plantings. A wide range of alternate commercial and specialty bean varieties are also currently being produced.

Soils: Well-drained soils are preferred. Beans have a low salt tolerance and a 25% yield reduction can be expected with a soil salinity of 2.0 ECe(mmho/cm @ 25°C). Lighter soils which warm up more quickly are generally used for spring plantings.

Irrigation: Drip irrigation is utilized in all commercial plantings. Furrow irrigation is sometimes used on smaller acreages produced for roadside sale. The use of tensiometers to monitor soil moisture and degree of leaching is recommended.

Fertilizers: Beans require less fertilizer than other vegetable crops to produce top yields. Research indicates that fertilizer rates of 100#N; 50#P_2O_5; and 50#K_2O per acre are adequate for maximum yields. Growers, however, frequently apply as much as 200#N, 100#P_2O_5 and 150#K_2O in commercial production.

Insects and Diseases: Cutworms, darkling ground beetles, seed-corn maggot, cucumber beetle, leaf hoopers, leaf miners, loopers, aphids, spidermites and white fly are among the most prevalent insect pests. Root-knot nematode is occasionally found. Stem and root rots, and powdery mildew appear to be the major disease problems. For latest information contact your farm advisor.

Harvesting: Beans are harvested by hand once or twice a week depending on climatic conditions. Yields of 3.5 tons/acre for bush or 8-12 tons/acre for pole varieties are common. Beans are sorted for size and quality and packed in fiberboard cartons averaging about 28 pounds each.

CABBAGE

Year	Acres	Yield/Acre(tons)	Value/Ton
1985	170	15.3	$157
1984	412	12.2	$273
1983	438	14.3	$163
1982	430	18.1	$198

Planting Dates: Transplanting takes place from October thru February for winter and spring production; cabbage may be planted year round near the coast. Commercial cabbage fields use transplants produced in seedbeds planted in September thru December.

Production Practices: Cabbage is generally transplanted on double row, drip irrigated 36-40" beds. Rows are spaced about 12" apart with in-row spacing ranging from 10-12". Spacing and fertilizer practices are varied to control head size. Compact harvestable heads should average 2-3 pounds with 24 heads weighing about 55 pounds per carton.

Climatic Requirements: Cabbage is a hardy cool-season crop that grows best at 60-65°F. As a general rule temperatures above 75° and below 40°F should be avoided.

Varieties: "Headstart" and "Coppenhagen" are commonly grown in San Diego County. Many new hybrid varieties are available but fusarium resistant varieties should be chosen.

Soils: Cabbage is planted on a wide variety of soils depending on location. Well drained soils are preferred to help prevent root diseases.

Irrigation: All commercial fields are drip irrigated. The use of tensiometers to monitor soil moisture and control leaching is recommended.

Fertilizers: Research indicates that 150-200 pounds of N and 100 pounds each of P_2O_5 and K_2O are sufficient under most conditions to give maximum quality and yields in cabbage production. Growers in San Diego County typically apply 300 pounds of N and 150 pounds of P_2O_5 and K_2O per acre on cabbage.

Insects and Diseases: Cutworms, cabbage looper, armyworm and aphids are the most destructive insect pests. Sclerotinia, botrytis, bacterial soft rot and downey mildew are among the major disease problems. It is advisable to plant varieties resistant to fusarium.

Harvesting: Field and shed packing are commonly used for cabbage production. Compact heads weighing 2-3 pounds each are cut and trimmed in the field. Cabbage is generally packed in fiberboard cartons of about 24 heads per carton. Finished cartons weigh approximately 55 pounds each. Most fields are harvested more than once due to differences in maturity. The ultimate goal in cabbage production is uniformity and once over harvesting. High yielding and uniform hybrid varieties have helped to advance toward this goal. Eight hundred to one thousand cartons to the acre are considered good yields on drip irrigated fields. Exceptional yields of 1200+ cartons per acre have been achieved in San Diego County.

Production Cost: Sample production (i.e. breakeven) costs including growing, overhead, harvest, packing and selling costs -

Total Cost/Acre	Yield (cartons/acre)	Cost per 55 lb. carton
$5400	900	$6.00

CAULIFLOWER

Year	Acres	Yield/acre(tons)	Value/ton
1985	660	9.2	$404
1984	735	8.0	$475
1983	577	8.0	$555
1982	650	8.5	$522

Planting Dates: Cool temperatures are required during curd development for optimum cauliflower quality. Seed is planted in nursery beds from July thru November for transplant production. Transplants are set into fields in September thru early January for winter and spring production.

Production Practices: Cauliflower is transplanted on single row 30-36" beds or on double row, drip irrigated 40" beds. In double row plantings, plants are staggered on either side of the drip tape to achieve between plant spacing of approximately 14 inches. Fourteen to fifteen inch in-row spacing is used in single row plantings. Rubber bands are used to keep wrapper leaves tightly closed during curd enlargement to exclude light which yellows the cauliflower. Because of the lack of uniformity of curd development tying is done at least weekly during curd filling using different color bands each time.

Climatic Requirements: Cauliflower is a half hardy cool season crop that grows best at 60°-65°F. As a general rule temperatures above 75°F and below 45°F should be avoided.

Varieties: "Snowball Y" and "Snowball 123" are commonly grown in San Diego County. Many other varieties are available and grown, but all varieties have planting date and climatic limitations.

Soils: Cauliflower is planted on a wide variety of soils depending on location and planting date. Lighter soils are usually selected for early spring production.

Irrigation: Most fields are drip irrigated. The use of tensiometers to monitor soil moisture and leaching is recommended.

Fertilizers: High fertility soils and rapid uninterrupted growth are necessary for top quality production. Research indicates that 200 pounds of N and 100 pounds of both P_2O_5 and K_2O per acre should be sufficient for maximum quality and yield in cauliflower production in most cases. Growers in San Diego County typically apply 300 or more pounds of N and 150 pounds of P_2O_5 and K_2O per acre per season.

Insects and Diseases: Cutworms, cabbage looper, and armyworm are the predominant insect pests. Sclerotinia, botrytis, bacterial soft rot and downey mildew are among the common disease problems.

Harvesting: Marketable cauliflower curds should be compact, white and free of leaves. Riciness associated with over maturity and warm growing conditions should be avoided. The most desirable size is approximately 6 inches in diameter. High quality heads are cut in the field with one or two sets of wrapper leaves for protection and taken to the shed for trimming, grading, film wrapping, and packaging. Film-wrapped heads are packaged 9, 12 or 16 heads per 23-pound carton. Twelve heads per carton is preferred. Yields of 450-600 cartons per acre are considered good to excellent.

Production Cost: Sample production (i.e. breakeven) costs including growing, overhead, harvest, packing and selling costs -

Total Cost/Acre	Yield (cartons/acre)	Cost per 23-lb. carton
$4500	600	$7.50

CORN (Sweet)

Year	Acres	Yield/Acre(tons)	Value/Ton
1985	860	5.2	$357
1984	929	5.2	$355
1983	911	4.5	$335
1982	865	4.3	$326

Planting Dates: Feb thru Jul for production from Jun thru Oct.

Production Practices: Sweet corn is direct seeded in single rows on drip irrigated 30-36 inch beds or staggered on either side of the drip lines with in-row spacings of 8-12 inches. Plant populations of 15,000 to 20,000 plants per acre are common. Suckering (removal of side shoots) has been shown to increase earliness by a few days in early spring plantings but does not increase yield or ear size. Sweet corn is wind-pollinated and should be planted in blocks to assure adequate pollination and full ear development. Hot weather or dry hot winds can cause incomplete kernel development known as blanking.

Sweet corn color and taste can be affected by cross pollination with other corn varieties. Check with the farm advisors' office to determine isolation requirements for different varieties.

Climatic Requirements: Sweet corn is a tender warm season crop that grows best at 60° - 75°F. As a general rule, temperatures above 95°F and below 50°F shold be avoided.

Varieties: "Silver Queen", "Kandy Korn", and "Jubilee" are commonly used varieties. Many super sweet or sugar enhanced varieties are available but require isolation from standard varieties. Establish market acceptance before planting large acreages of new varieties.

Soils: Corn is planted on a wide range of soils depending on location. Deep well drained soils are preferred. Corn is moderately sensitive to salt and soil salinity should be monitored to achieve top yields.

Irrigation: Most commercial fields are drip irrigated. The use of tensiometers to schedule irrigations and monitor leaching is recommended.

Fertilizers: Sweet corn has a high nitrogen requirement to achieve top production. Two hundred pounds of N per acre, and 100 pounds of both P_2O_5 and K_2O are recommended for early spring plantings on light soils. One hundred pounds of N and 75 pounds of both P_2O_5 and K_2O are generally adequate for later plantings on heavier soils.

Insects and Diseases: Corn earworm, seedcorn maggot, armyworm, cutworm, aphid and thrip are among the most common insect pests. Mosaic virus, smut and root rot are among the major diseases in San Diego county. Smog damage sometimes leads to leaf scorching.

Harvesting: In San Diego county corn is harvested by hand about 3-5 weeks after tasseling depending on climatic conditions. For top quality, sweet corn must be harvested at the proper stage of maturity. Over maturity leads to tough starchy kernels. At 85°F, the corn is at peak flavor for only one or two days.

The field must be examined regularly as the crop reaches maturity to determine harvest dates. Ears at the correct harvest maturity should have: full size ears for the variety; slightly dried silk; fully developed kernels; and a milky liquid in the kernels. Fields are usually harvested two or three times at 3-5 day intervals. Preferably harvesting should be done in the early morning when ears are cool. Sweet corn must be cooled to 35°F - 40°F as soon after harvest as possible to protect shelf life and optimal flavor. Corn should be hydro-cooled before it is graded, packed, and stored in cold rooms.

Corn is generally graded in sheds and packed in wirebound crates or waxed cartons with 4 to 6 dozen ears per container which weigh 40-50 pounds each. Yields of 500-600 crates per acre are good.

Production Cost: Sample production (i.e. breakeven) costs per carton include growing, overhead, harvest, pack, and sell costs -

Total Cost/Acre	Yield (cartons/acre)	Cost per 50-lb carton
$3200	500	$6.40

CUCUMBERS

Year	Acres	Yield/Acre(tons)	Value/Ton
1985	1198	18.6	$298
1984	1220	22.6	$367
1983	1122	19.0	$365
1982	933	18.6	$506

Planting Dates: Spring - Jan (under tunnels) for production Mar thru Jun.
Summmer/Fall - Mar thru Aug from May thru Nov.

Early cucumber plantings in San Diego county are made under protective plastic tunnels. Open planting is done for summer and fall production.

Production Practices: Cucumbers are generally direct seeded by hand three inches from driplines in single rows at 20" spacing on 60" beds. Approximately one-and-a-half pounds of seed is used per acre. Some transplanting is done in the early spring under plastic tunnels. Vines are often trained to avoid fruit developing on wet soil.

Climatic Requirements: Cucumber is a very tender warm season crop that grows best at 65°-75°F. As a general rule temperatures above 90°F and below 60°F should be avoided.

Varieties: Common slicing varieties planted in San Diego County include "Dasher II", "Slicemaster" and "Sprint 442".

Soils: Cucumbers are planted on a wide variety of soils depending on location. Lighter soils are usually selected for earlier maturing fields.

Irrigation: All commercial fields are drip irrigated. The use of tensiometers to monitor soil moisture and leaching is recommended.

Fertilizers: Growers in San Diego County typically apply 300 or more pounds of N and 150 pounds of both P_2O_5 and K_2O per acre through the drip systems during the season to cucumber plantings. Approximately 60 pounds of N is applied per month during growth and harvesting.

Insects and Diseases: Seed-corn maggots, wireworms, cucumber beetles, aphids, spider mites, and thrips are the most common insect pests. Sclerotinia, botrytis, powdery mildew and angular leaf spot are among the major disease problems. Virus diseases spread by white fly, aphids and leafhoppers are currently the number one problem in summer and fall cucumber production.

Harvesting: Cucumbers are hand harvested one to three times per week depending on weather and stage of growth. Fruit is generally graded and sized in sheds and packed by count of 40, 42 or 46 per fiberboard carton. Box weights average about 25-30 pounds. Yields of 20-30 tons per acre are considered good, and 40+ ton per acre yields have occasionally been achieved on spring fields.

Production Cost: Sample production (i.e. breakeven) costs per carton include growing, overhead, harvest, pack and sell costs -

Total Cost/Acre	Yield (cartons/acre)	Cost per 25-lb carton
$7500	1700 (25 tons/acre)	$4.41

PEPPERS (Bell)

Year	Acres	Yield/Acre(tons)	Value/Ton
1985	297	10.5	$332
1984	387	8.9	$303
1983	305	10.6	$424
1982	431	6.8	$573

Planting Dates: Spring - Feb thru May for production in late May thru Aug;
Fall - Jul for production in Sep thru Nov.

Early spring plantings of bell peppers are planted under plastic tunnels for temperature control.

Production Practices: Peppers are transplanted in single rows on 36" drip irrigated beds with 12 inch in-row spacing or on 72" beds with double rows staggered on either side of the drip tape with 12 to 18 inch in-row spacing. Crowding of plants can lead to poor color development of fruit in shaded areas.

Peppers need warm weather and adequate moisture for proper growth and fruit development. Peppers grown in cool weather have poor pollen development and incomplete fruit sizing. Shaking plants or vibrating flowers helps to set fruit during cool periods. Excessively warm weather (>95°F) or hot dry winds often cause flower drop and split sets.

Climatic Requirements: Pepper is a very tender warm season crop that grows best at 70° - 75°F. As a general rule temperatures above 80° and below 65° should be avoided.

Varieties: Keystone resistant giant "KRG - 3" or "KRG- 4" and "Yolo Wonder" strains are commonly used in San Diego County.

Soils: Peppers are grown on a wide range of soil types depending on location. Well drained soils are preferred.

Irrigation: Most commercial fields are drip irrigated. The use of tensiometers to monitor soil moisture and leaching is recommended.

Fertilizers: Pepper plants need to grow rapidly after transplanting or they can flower and set fruit while plants are

too small. Premature fruit set retards plant development and reduces total yield. Adequate fertility, moisture and temperature control are essential to maintain proper growth rate.

Two hundred pounds of N and 100 pounds of both P_2O_5 and K_2O per acre should be adequate for most situations. Higher rates of N and P (up to 300 pounds of N and 150 pounds of P) may be required in early spring fields on lighter soil. Growers frequently use 300-400 pounds of N, 150-200 pounds of P_2O_5 and 100 or more pounds of K_2O per season on peppers.

Insect and Diseases: Cutworms, wireworms, seedcorn maggots, darkling ground beetles, flea beetles, leaf miners, aphids, loopers, and armyworms are among the common insect pests that attack pepper plants. Phytophthora root rot, virus disorders, and alternaria, are the most common disease problems. Blossom end rot and sunscald are common physiological problems.

Harvesting: Peppers are harvested by hand one or two times a week. Harvesting can continue for six or more times depending on market and weather conditions. Peppers are usually washed, waxed and graded in sheds for size, color and shape. Fruit is generally packed in fiberboard cartons weighing about 30 pounds each.

Production Cost: Sample production (i.e. breakeven) costs including growing, overhead, harvest, packing and selling costs -

Total Cost/Acre	Yield (cartons/acre)	Cost per 30-lb carton
$5600	750	$7.47

SQUASH (Summer)

Year	Acres	Yield/Acre(tons)	Value/Ton
1985	532	9.1	$289
1984	544	5.2	$387
1983	540	8.4	$484
1982	1020	7.9	$426

Planting Dates: Spring - Jan thru Mar for Mar thru May prod.;
Fall - Aug for Oct thru Nov harvests.

Early spring fields of summer squash are planted under plastic tunnels for temperature control. (Pumpkins are planted from April thru July for harvesting in August thru November; Halloween pumpkins are planted from mid-June to early July depending on the variety. Multiple plantings with staggered planting dates are used to assure continued and timely production.)

Production Practices: Squash is direct seeded or transplanted in single rows on drip irrigated 60-inch beds. In-row spacings of 18-24 inches are commonly used for bush squashes with 36-60 inch or wider in-row spacing being used for pumpkins and other vining types. Squash should be kept growing rapidly for top quality and yield.

Summer squash requires insect pollination for production. Placing one or two bee hives near the field per acre ensures good pollination and fruit set.

Climatic Requirements: Squash is a very tender warm season crop which grows best at 65° - 75°F. As a general rule temperatures above 90°F and below 50°F should be avoided.

Varieties: Zucchini, also known as Italian-squash, is the type that is predominantly produced. Scallop and yellow crookneck are also grown commercially. 'Chefini", "Ambassador" and "Blackjack" are common dark green zucchini varieties. Many new hybrid varieties with excellent production qualities are available.

Soils: Squash is produced on a wide range of soils depending on location. Early spring fields are usually planted on south facing lighter soils.

Irrigation: Most commercial fields are drip irrigated. The use of tensiometers is recommended to monitor soil moisture and to avoid water stress. Inadequate soil moisture during fruit formation can lead to misshapen fruits.

Fertilizers: Squash is a short season rapid growing crop that in most cases requires 100-150 pounds of N, and 50-75 pounds of P_2O_5 and K_2O per acre for top quality and yields.

Insects and Diseases: Insect pests include aphids, white fly, leaf hoppers, mites, cutworms, armyworms, leaf miner and thrips. Powdery mildew and virus disorders are currently the major disease problems. Virus diseases including watermelon mosaic virus I and II, squash mosaic, squash leaf curl, and zucchini yellow mosaic virus spread by white fly, aphids, and leaf hoppers have caused total losses or severe yield reductions in some recent plantings. All varieties are equally affected and no genetic resistance is currently available.

Harvesting: Zucchini squash is harvested by hand when fruits are 6-8 inches in length. Harvesting must be done frequently to avoid oversized fruit. Squash is usually harvested every three days early in the season and twice a week as plants mature.

Squash is extremely sensitive to bruising and abrasion and must be handled carefully. Zucchini is usually carried to sheds in picking lug boxes where it is trimmed, graded, sized and packed in fiberboard cartons weighing about 28 pounds each. Yields of five to eight tons per acre are common. Seven to eight hundred 28-pound lugs per acre is considered a good yield.

Production Cost: Sample production (i.e. breakeven) costs per carton include growing, overhead, harvest, pack and sell costs -

Total Cost/Acre	Yield (cartons/acre)	Cost per 28-lb. carton
$4300	800	$5.38

STRAWBERRIES

Year	Acres	Yield/Acre (tons)	Value/Ton (% of crop) Fresh	Proc.
1985	1344	24.8	$850(55%)	$374(45%)
1984	1086	24.5	$791(78%)	$380(22%)
1983	1220	24.7	$947(70%)	$641(30%)
1982	1004	29.0	$725(41%)	$681(59%)

Planting Dates: Winter plantings for commercial production in San Diego County are made in late Oct or early Nov for production in Feb thru Jun. Planting too early reduces plant vigor and causes small soft fruit. Delayed planting or excessive cold storage can cause early runnering and yield loss.

Production Practices: Transplants produced in high altitude, northern California nurseries are planted in four rows on 60-64" fumigated beds with two drip lines between rows. In-row spacing of 9-10 inches is frequently used. Clear polyethylene mulch is used to increase bed temperature and maintain winter growth.

Strawberries have a chilling requirement similar to deciduous fruit trees. In winter production, plants grown at northern California nurseries that have received chilling and stored starch are transplanted in southern California where winter temperatures are warm enough to keep the plants growing. This winter transplanting results in an extended fruiting period. Strawberry plants must be protected from frost.

Climatic Requirements: Strawberries are the most widely adapted of the fruit crops. They are not truly hardy, however, and can be severely damaged by frost or freezing.

Varieties: "Douglas" is the preferred variety for winter plantings. Ninety percent of the acreage in San Diego County is planted to "Douglas". The remaining acreage is in "Tufts", "Parker", and "Chandler" varieties. Several new day neutral varieties are becoming available that can be planted in August and which can fruit during winter and summer months if protected from frost.

Soils: Strawberries are very salt sensitive and must be planted on well drained soils. Most winter plantings are near the coast and/or warmer south facing slopes to prevent frost damage and maintain growth during cold winter months.

Irrigation: All commercial production is drip irrigated. Tensiometers are used to prevent over watering under the plastic mulch. Excessive watering increases the likelihood of red stele disease.

Fertilizers: Controlled release fertilizer totaling 200-250 pounds of N, and 100 pounds of both P_2O_5 and K_2O is usually applied preplant in a slot beneath the planting rows. Small amounts of nitrogen (30 units or more) may be added thru the drip line during the first three months of growth.

Insects and Diseases: Although soil fumigation decreases soil pathogens, insects and weed pressures; verticillium, red stele, black root rot, and vascular collapse are, occasionally seen. Powdery mildew, leaf spot, angular leaf spot, and botrytis are among the common disease problems. Insect pests include spider mites, aphids, thrips, lygus bugs, cutworms, snails and earwigs.

Harvesting: Fruits are hand harvested directly into flats of 12 one-pint baskets. Each pint basket holds about one pound of fruit. Small wheelbarrow like flat carriers are used as picking aids. Harvesting normally begins in Feb and continues thru June. Early harvesting usually consists of one pick per week but increases to two or three times per week during peak production. Harvested fruit must be protected from sun, wind and high temperatures as soon as it is harvested. Fruit is forced air cooled to 32°F and stored in cold rooms as soon after harvest as possible.

Production Cost: Sample production (i.e. breakeven) costs include growing, overhead, harvest, packing, and selling costs -

	Cost/Acre	Yield	Cost/flat (ton)
Fresh(70%)	$17,500	3000 flats	$5.83 ($972)
Proc.(30%)	$ 7,500	7.5 tons	($1000/ton)
Total	$25,000	25.5 tons	($ 980/ton)

TOMATOES (Fresh Mkt.)

Year	Acres	Yield/Acre(tons)	Value/Ton
1985	2525	22.9	$326
1984	2928	30.7	$419
1983	5467	23.4	$315
1982	5619	27.5	$377

Planting Dates: Spring - mid Jan for harvest in May thru July; Fall - Jun to early Aug for production from Sep thru Jan.

Tomatoes are grown under "full tent" plastic row covers for temperature control when planting in Jan or Feb. Half tents are used to protect plantings made in mid-Mar. Open plantings are possible from Apr thru Aug but market price restricts production to spring and fall periods.

Production Practices: Fresh market tomatoes have generally been pole grown in San Diego County. This practice greatly increases total production costs but lowers unit costs because of extended harvest periods and increased yields.

Tomato transplants are planted on single row, drip irrigated 60-72 inch beds with 18-20 inch in-row spacing. Stakes are placed between every two or three plants. Wires are stapled to the stakes and anchored at row ends.

Plants are pruned to one shoot below the first flower cluster and tied up with horizontal "figure-eight" wraps of twine between stakes. Plants are tied four to six times during the season at approximately one foot intervals as plants grow up the supporting lattice. Tying is done in the dry time of the day for added vibration of flowers when pollen is less sticky to increase pollination and fruit set.

It takes from 80-110 days from transplanting to first harvest in pole tomato production depending on the growing season. Harvesting may last for 70-120+ days depending on the market, disease, insect and climatic pressures.

Climatic Requirements: Tomato is a tender warm season crop that grows best at 70° - 75°F. As a general rule temperatures above 80° and below 65°F should be avoided.

Varieties: "Casino Royale", "Sunny", "Bingo", and "Celebrity" are among the commonly grown varieties. Tomato varieties differ in fruit characteristics, disease resistance and adaptability to climatic conditions. These factors should be carefully considered when selecting varieties for production.

Soils: Tomatoes are produced on a wide range of soils depending on location. Early spring fields are usually planted on lighter soils and south facing slopes. Well drained soils are preferred.

Verticillium race II fungus has been found in San Diego county soils. There are no effective control measures or resistant varieties for vert. II, and the disease can cause severe losses in tomato production. Vert. II infested ground should be avoided.

Irrigation: Most commercial fields are drip irrigated. The use of tensiometers is recommended to monitor soil moisture and leaching.

Fertilizers: Pole tomatoes require heavy annual fertilizer applications to keep plants producing over the extended harvest period. Research suggests that up to 300 pounds or more of N, P_2O_5 and K_2O are needed to maximize pole tomato yield. Amounts required depend on soil type, irrigation practices and residual field fertility.

Growers frequently apply 80 units of N, P_2O_5 and K_2O preplant. The rest of the fertilizer is applied thru the drip system at the rate of 40 units of N, P_2O_5 and K_2O per month.

Insects and Diseases: In the spring common insect and disease problems include corn earworm, leaf miner, cabbage loopers, pinworm, phytophthora, botrytis, and bacterial speck. In the fall serious pest and disease problems include corn earworm, beet armyworm, pinworm, heliothus, tomato powdery mildew, botrytis and bacterial speck.

Harvesting: Tomatoes are harvested by hand into lug boxes when fruits are between the breaker and pink stages of color development (USDA #2 and #4). Fruit is transported to sheds where it is washed and graded for size and color and place packed in two or three layer cardboard flats. Two layer flats (4x4 to 6x6) contain 32 maximum large to 72 medium sized tomatoes and weigh about 18 pounds. Three layer flats (6x6 to 7x8) contain 108 medium to 168 maximum small fruit and weigh approximately 28 pounds.

Harvesting is done frequently to avoid overripe fruit. Picking is done from one to three times per week depending on weather and harvest period. Yields of 2500-3000 cartons (30-35 tons) per acre are average and yields of 4000 cartons (45-50 tons) per acre have been achieved.

Production Cost: Sample production (i.e. breakeven costs) include growing, overhead, harvest, packing and selling costs -

	Total Cost/Acre	Yield(cartons/acre)	Cost/Carton
Spring	$15,600	2500	$6.24
Fall	$13,600	2500	$5.44

Rotations

In San Diego County many rotations are possible with soil fumigation and drip irrigation, including successive plantings of the same crop. Rotation should be used, however, to prevent the build up of crop related soil pathogens and the depletion of specific soil nutrients. Common vegetable rotations used in San Diego agriculture include:

Spring	Summer	Fall	Winter
1. ------ corn--------	cucumbers----------	cauliflower---	
2. cucumber----------	pepper----------	squash------	
3. cucumber----------	tomato----------	squash or cauliflower	
4. tomato or cucumber----------	celery----------		
5. tomato----------	squash-------	cucumber----------	
6. ----------	squash----------	strawberries----------	

When planning rotations keep in mind your specific climatic conditions, crop pathogens, pesticide residues, fumigation requirements, market potential, soils, water quality and management expertise. It is safer to start small, see what you can grow well, and establish market channels before producing large quantities of produce.

Row Covers and Mulches

Row covers and mulches are used for frost protection and to control growing temperatures in fall, winter and spring vegetable production in San Diego County. Air temperature usually increases from six to twenty degrees Fahrenheit inside enclosed row covers at mid-day depending on the type of tunnel and materials used. Soil temperatures are raised four to eight degrees Fahrenheit in the day time to a depth of three inches. Heat is released at night from the soil and held in the tunnel by water which condenses on the inside of the row cover. Early and late season production of warm season crops allows growers to target more profitable production periods.

Rigid Row Covers

Materials

The following materials and equipment are needed to build rigid two sided row covers or tunnels: 1) plastic laying apparatus; 2) 1.5 to 3.0 mil clear plastic sheeting 36 inches wide with a haze factor of 12 to 20 percent (solid or perforated with 1/4 inch holes, 3 inches apart); 3) wire hoops, 9 gauge and 70 inches long; 4) strong clothespins; 5) rolls of 16 gauge wire; 6) heavy duty stapler gun; 7) 1 inch x 1 inch in-row stakes (stake height depends on crop); and 8) 2 inch x 3 inch anchor stakes for ends of rows. Note - 60 inch rows require 18,000 feet of plastic sheet per acre.

Construction

Installation of tunnels is usually done well in advance of planting to avoid rain delays and assure planting on the desired date. To avoid wind damage the plastic sheets are pinned down to the soil level until needed with the same clothespins that will secure the two sheets to the apical wire at planting.

Staked tomatoes - Two sheets of plastic are laid 26 to 28 inches apart down the center of 60 inch rows with 6 to 8 inches of one edge of each sheet anchored into or covered with soil. Six foot stakes are spaced three to four feet apart in the center of the bed. An apical sixteen-gauge wire is stapled to the stakes at a 20 to 22 inch height and tied to anchor stakes at the ends of each row. Nine gauge wire hoops, 70 inches long, are placed at alternate stakes over the apical wire and forced into the ground just inside the plastic sheets to cover an area 26 to 28 inches wide. The plastic sheets are pulled up to cover the hoops forming a tunnel. At the top of the row cover, the two sheets overlap three or four inches and are pinned to the apical wire with strong clothespins. Three or four pins are used between two stakes.

Cucumbers and squash - Cucurbit row covers are similar to those used for staked tomatoes. These crops, however, are grown as bush plantings and do not require tall stakes. Stakes one inch, by one inch, by 26 inches long are driven into the ground, giving a row cover height of 16 to 18 inches. These stakes are spaced 10 to 15 feet apart in the rows. An apical, sixteen gauge wire is stapled to the top of the stakes. Hoops are spaced four to eight feet apart down the rows to form the tunnel shape and to keep the plastic taut. The same type and width of plastic is used and secured to the apical wire with clothespins.

In windy areas row covers should be constructed with extra hoops placed above the plastic and over the supporting bottom hoop. This top hoop keeps the plastic from flapping and tearing in the wind. Where severe winds are a problem, "twistems" are used to secure the top hoop, bottom hoop and apical wire together. This reinforced construction has weathered even moderately heavy storms.

Venting and Management

The two sheet construction permits the clothespins to be released and one side of the cover to be dropped down for weeding, pesticide application, or other cultural operations. Venting is accomplished by pinning the top edge of the row cover back to the hoops. A one or two inch triangular opening can be made at each hoop in this way for early venting, and this top space widened as the plant grows or as seasonal spring temperatures increase. Later in the season both sides of the plastic are moved down the wire hoops until the entire row cover is open at the top. Where row ends face into the wind or tunnels are on a slope the tunnel ends can be opened for venting. Most row covers are constructed using one or two perforated plastic sheets. This gives a built in venting which allows firmer plant growth and avoids excessive mid-day temperatures.

Optimal temperatures, for warm season crop plant growth and quality fruit production, are 65-85 degrees Fahrenheit. Temperatures within the tunnels can be controlled by venting or closing the tunnels. When possible, tunnel temperatures should not be allowed to fall below 60-65 degrees or exceed 80-90 degrees Fahrenheit. Temperatures below 60 degrees lead to chilling injury of many warm season crops. Above 90 degrees Fahrenheit plants are damaged and flowers aborted.

Venting and management of tomatoes - Three or four weeks after planting, one plastic sheet is dropped and pruning (removal of the bottom side shoots) is completed. Spraying, weeding and tying to the stake are carried out at the same time and the tunnel reclosed. When plants develop functional flower clusters,

the cover is vented to allow wind pollination or flowers are vibrated to help establish the crown set. Depending on climatic conditions four to eight separate ventings are made in the process of opening the row covers. If temperatures are too low for natural fruit setting, plant growth regulators can be used to spray clusters and establish fruit set. When harvesting begins, the two plastic sheets are dropped to the ground where they are used as a soil mulch for several weeks.

Venting and management of cucurbits - Cucumbers are more tender than tomatoes or peppers, and venting is delayed 50 to 70 days after seeding. The plants usually fill most of the inside of the covers before venting begins. Small "V" vents are opened at each hoop a few days before first harvest. At the completion of the second harvest, both sheets are lowered three to six inches on the hoops. After three or four harvests are made, the plastic is moved to a double windbreak by placing the hoops lengthways along each side of the rows and securing the plastic to them. These windbreaks protect the plants from foot traffic as well as wind and are left up until harvesting ends.

Venting and management of peppers - Venting begins within four to five weeks after transplanting in pepper production and tunnels are opened more rapidly as flowers develop on the plants. The need for pollination of flowers by air movement and insects necessitates this earlier opening or vibration of flowers for early fruit set. As the venting area is increased and opened on both sides of the cover, the sheets are used as windbreaks as in cucumber production.

Irrigation and Frost Protection
All crops grown commercially in San Diego county under tunnels are currently drip irrigated. A small furrow is usually placed near the drip line inside the tunnel to channel away excess moisture during rains. This small furrow helps to prevent wash outs of tunnel sides.

Plastic row covers alone generally give little frost protection. When row covers are combined with drip irrigation, however, several degrees of protection are obtained. Running the drip irrigation system during cold weather releases heat in the tunnel and protects plantings.

Floating Row Covers

Floating row covers are one piece loose-weave bonded, fabric materials without supporting hoops or stakes. They "float" or rest on top of the crop as it grows. Floating covers reduce installation cost and venting labor by about 80%, but also reduce the degree of temperature protection.

Temperatures under clear poly covers generally range 2°-3°F warmer than under floating bonded fabrics. With moderate weather and sunny days there is little difference between bonded materials and clear poly covers. If the weather is cool, however, clear poly gives a temperature advantage.

Row cover materials vary in their abilities to transmit light and heat energy to the soil and maintain above ambient temperatures at night. All covers increase daytime temperatures. Bonded fabrics, however, generally allow about 10% less light energy to get to the soil than clear plastic covers. Polyethylene allows more heat radiation to escape at night than does polypropylene materials. Porous bonded materials also transfer heat out of row covers by air mixing. This is probably why these materials appear to be less effective under windy conditions.

Mulches

Soil mulches are commonly used to modify soil temperatures, control weeds, conserve water, protect fruit from soil moisture, protect plants from insects, and control erosion. The color and clarity of the mulch dictates how it will affect soil temperatures. The following chart relates how different mulches affect soil temperatures during the night and day:

	MULCH AFFECT ON	
MULCH COLOR	night temp.	day temp.
Clear	warmer	warmer
Black	warmer	same
White	warmer	cooler
Aluminum	warmer	cooler

Besides affecting soil temperatures, mulches that are opaque (stop light) control weed growth. Black mulches get hot and may burn fruit that touches it during the day. Aluminum mulches are also used to disrupt aphid flights and decrease the chances of aphid transmitted diseases. All mulches help conserve soil moisture and control soil erosion.

Strawberry and other crops are mulched with clear plastic during the winter to warm the soil. On strawberries the mulch is applied one to two weeks after transplanting. The plastic is applied over each row and a butane burner is used to cut a two to three inch diameter hole through which the plant can grow.

Irrigation Practices

Ninety percent of all commercial vegetable production in San Diego County is under drip irrigation to conserve $300-$500/acre foot water. Exceptions are vegetables produced near rivers with well water and sprinkler or furrow irrigation. Well water quality varies greatly and water should be chemically analyzed before being used for irrigating vegetables.

Drip irrigation systems apply water frequently, slowly, and directly to the root zone of plants through emitters along water delivery lines. Drip systems wet much less of the soil than other irrigation methods and water savings of 30-50% are frequently obtained. Examples include:

Crop	Annual Water Application (in/acre)	Irrigation Method
Strawberries	24-36	drip irrigation
	36-48	furrow irrigation
Tomatoes	24-36	drip irrigation
	30-48	furrow irrigation
Other Vegetables	24-48	
Greenhouse Crops	36-60	
Avocado	24-36	drip irrigation
	36-48	sprinklers
Citrus	18-24	drip irrigation
	18-36	sprinklers

Water used in drip irrigation systems must be conditioned and filtered properly to assure that particulate matter or organisms will not clog the emitters. Where solubility and regulations permit, fertilizers and pesticides can be delivered through the drip system reducing application costs. Information about drip irrigation can be obtained through University pamphlets and from manufacturers of drip systems.

Fertilizer Practices

Soil and Tissue Testing

Accurate, timely, and usable information on soil properties, residual fertility, and plant fertility status are essential in making effective fertilizer management decisions to assure highest yields and crop quality. A regular program of properly obtained and analyzed soil and plant tissue samples, and accurate record keeping on a field-by-field basis are necessary for effective fertility program planning and control.

Proper sampling methods, testing procedures and test interpretation tables are outlined in University of California Bulletin #1879, entitled "Soil and Plant Tissue Testing in California". This publication is available through County University of California Cooperative Extension offices. A laboratory which uses soil and plant tissue analytical methods consistent with this publication should be selected to assure that meaningful interpretation of laboratory results can be made. Consult with your local Cooperative Extension farm advisor for help in sampling methodology or interpretation of test results.

Fertilizer Applications with Drip Irrigation

Drip irrigation systems facilitate the frequent and economical application of fertilizers while allowing mid-season changes in fertilizer practices as indicated by tissue testing results. Fertilizer materials should be applied through drip systems only after their compatibility with local irrigation water has been tested.

Introduction of liquid or dry fertilizers into irrigation water should only be done upstream of the filters to avoid unexpected precipitates from clogging the drip tape.

Nitrogen Fertilizer Use

Nitrogen is difficult to manage in vegetable production. It is lost to the air through denitrification and below the root zone by leaching. It comes in various forms and mixtures, and different amounts and application times are needed depending on the season and crop being grown.

In order to make good nitrogen fertilizer decisions, a few basic concepts are important.

1. Nitrogen comes in two basic forms: nitrate-N(NO_3), as in calcium nitrate, is mobile in soil and moves with the water; and ammoniacal-N (NH_4), as in urea is generally immobile in soil and sticks to soil particles. Bacteria change NH_4-N to NO_3-N quickly (a few days) or slowly (weeks) depending on amount of NH_4-N applied, how it was applied, temperature, moisture, and bacteria populations.

2. NO_3-N moves in a deep heart shape away from the emitter in drip irrigation. Band applied N moves away from the band along a straight line drawn from the source of applied water through the band.

3. Plants require less N as seedlings and more as they grow rapidly and develop fruit.

4. Plants generally take up more of the NO_3-N form but can also use the NH_4 form of nitrogen. The NO_3-N form is generally preferred by plants in warm soils. Adding some NH_4-N has been shown, however, to increase N uptake in cool (near 55°F) winter and spring soils.

When planning nitrogen fertilizer applications, consider:

1. where irrigation water will move the nitrate-N (NO_3);

2. trying an increase rate application schedule which gives a little less N to smaller plants and more N to rapidly growing ones;

3. adding some NH_4-N (20-50% by weight) in winter/spring fertilizer applications;

4. how long it will take to change NH_4-N to the NO_3-N form (i.e., you would not add urea a few days before final harvest); and

5. that over-irrigation leads to nitrogen loss as N moves below the root zone (leaching) and to the air (denitrification) in waterlogged soils. Using tensiometers properly can help fine tune irrigations, saving water and fertilizer.

Phosphorous Fertilizer Use

Several factors need to be taken into consideration when determining how and when to apply P. We know that P is relatively immobile in soil and that plants need P the most early in the season. Different crops require different amounts of available P for top yields, and soil temperature influences crop responses to added P.

If applied by drip irrigation alone, most of the P is tied up in the top inch of soil and only slowly gets down into the root zone, if at all. A safer way to assure meeting early plant needs is to band most or all of the P to be applied in a preplant application where slopes permit.

Fertilizer Formulations

Fertilizer formulations for use in San Diego County commercial vegetable production vary dramatically depending on dealers and growers experiences and needs. Many growers use custom blends formulated to meet specific growing conditions. General statements can, however, be made about fertilizer practices within San Diego's specialized agricultural environment.

The majority of fertilizer applications are made through drip irrigation systems. Formulations, therefore, are predominantly complete liquid mixtures. Liquids are frequently made with:

1) N portion - AN20, UN32, or liquid urea (23-0-0);

2) P portion - white phosphoric acid (0-54-0), and

3) K portion - KNO_3, K_2SO_4, or KC1 + H_2SO_4

Most vegetable crops receive weekly applications of formulations like 7-7-7 or 12-12-12 injected in the later part of drip irrigations during growth and harvest periods. Preplant applications of dry materials like 16-20-0 or 18-46-0 are often shanked in before transplanting where slopes permit to assure early growth requirements for P are met.

Fertilizer Recommendations

Amounts of fertilizers recommended for application are based on yield responses in field research. Setting up a sensible fertilizer program based on research, soil tests and accurate farm records is the only way to be sure that you are getting the most for your fertilizer dollars. See the production practices section for typical and recommended rates of application for individual crops.

PRODUCTION COST MANAGEMENT

A vegetable farm may be one of the most difficult businesses to manage because of the difficulty in keeping track of the costs and profits associated with each field. This often leads growers to manage by "the seat of their pants," rather than through proper planning and good record keeping.

Field Costing

You do not need a computer or even a management consultant to make good basic decisions. You do, however, need to keep accurate farm records on production costs. You also should be able to calculate gross profits or loss on a field-by-field basis. This allows you to find out why you made money on one field, but lost on another. By careful analysis you can minimize mistakes and repeat profitable ventures. By keeping the right information, your records can become a basis for profit increasing decisions, rather than just for reporting your loss to the bank or the IRS.

Most large vegetable producers have accounting systems that keep track of production costs. If you do not already keep these records the "production input costs worksheet" which accompanies this section can be copied and used to establish production costs on a crop or field basis. Use the sheet to keep a running total of actual production input costs. Space is provided for updating cost data as they increase during the season. Sample costs are for reference only and should only be used as a general guide in data collection.

An easy to use, IBM PC compatible computer program for smaller growers which simplifies the collection and evaluation of production cost data on a field-by-field basis is available from the San Diego University of California Cooperative Extension office. For information on this program, call Wayne Schrader at (619) 565-5385.

Increasing Profitability

After taking a hard look at profit and loss on a field-by-field basis, you may be surprised to learn that a small percentage of your effort produces most of your profits. By dropping crops and activities giving poor returns you free up time, money, and labor for work in more profitable areas. Diversification into different crops can also often help your cash flow and decrease your risk of having losing years.

Production Input Costs Worksheet

Crop _____ Field _____ Planting Date_____

Cultural Operation	Sample Cost per acre	Your Cost
Field Preparation		
Sub soil 2x	$15.00	
Disc 4x	30.00	
Survey field	3.50	
Fumigate (field/bed)	1000/200	
Mark beds	7.00	
Mulch beds	300.00	
Install drip system	600.00	
Herbicide	30.00	
Fertilize (preplant 200# 11-48-0)	30.00	
Other		
Other		
Growing Period		
Seed	100.00	
Transplanting ($0.06/plant x 6000 plts./acre + 48 hrs x $5/hr)	600.00	
Irrigation (3 acre feet of water x $400/A ft.)	1200.00	
Prune 2x (35 hrs x $5/hr)	70.00	
Stake (20 hrs x $5/hr + equip. $20)	120.00	
String 6x (55 hrs x $5/hr + twine at $150)	425.00	
Weed Control (cultivate 2x @ $28; handweed 2x, 12 hrs. x $5/hr)	88.00	
Fertilize in drip irrigation(300# of 12-12-12 @ .52/unit)	156.00	
Pest and Disease Control (20x $20/A drag line applic.)	400.00	
PCA ($7/acre/mo. x 7 mo.	49.00	
Insecticides and fungicides	400.00	
Pull stakes (35 hrs x $5/hr)	175.00	
Disc and roll refuse 2x	15.00	
Other		
Total Growing Costs	$4650.00	

Overhead		
Land rent ($30/A/month x 7 months)	210.00	
Cash overhead 12% of preharvest cost and land rent)	540.00	
Total Overhead	**$750.00**	
Harvest/Pack/Sell		
Pick and haul to shed @$1.30/box x 2000	2600.00	
Pack @$2.50/flat x 2000	5000.00	
Sell 8% x 2000 x $6.00 avg. price	960.00	
Total for Harvest/Pack/Sell	**$8,560.00**	
Total All Costs	**$13,600.00**	

Marketing

Market Windows

To zero in on the most profitable production periods, the grower needs to understand not only which crops can be grown and when, but also when competition occurs in other regions that affects his local market prices. A simple chart made up for each crop being grown showing weekly local market prices averaged for the past five years can be very helpful in finding the more profitable times to harvest. These higher profit periods are called market windows. Growers target them for greater production whenever possible. This section contains several market diagrams showing weekly Los Angeles wholesale market prices averaged for the past five years.

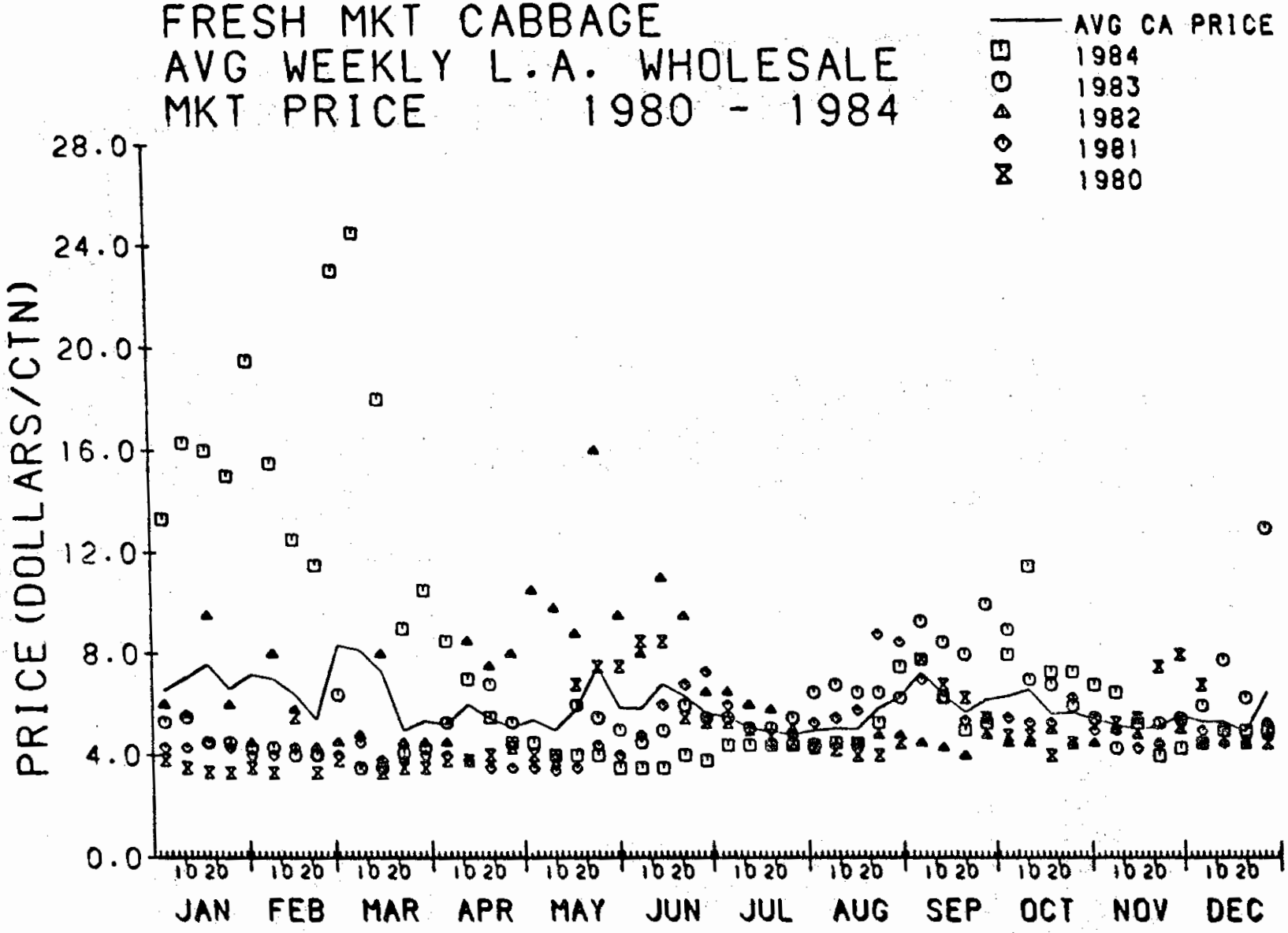
Direct Marketing

Growing the right crop at the right time isn't the only way to increase profits. Even larger growers are looking at alternate marketing strategies to take advantage of every bit of possible profit. Direct sales through roadside stands or farmers' markets and local marketing to restaurants and independent grocers should be explored as well as traditional market chains.

Direct Marketing can bring greater financial stability for many growers. Producers who sell directly eliminate most or all of the cost of packing, shipping, handling, brokering, wholesaling, distributing and retailing which accounts for about 70 cents of every retail dollar spent on vegetables and fruits. Average farmers market prices received by growers usually run about 20 percent higher than wholesale market prices. Growers, therefore, not only often get a higher price per unit in direct sales but also keep a much larger percentage of available profit.

The growth potential for direct marketing is exceptional, especially in southern California where large population centers are adjacent to production areas. Based on production and consumption levels in southern counties, 45% of all demand could eventually be filled by local sales.

The California Farmer-to-Consumer Directory compiled by CDFA lists growers willing to deal with the public, the crops they grow, when produce is available, location of the direct market stand and phone number. If you would like to be listed in this free publication, call 916/445-5294 and ask for more information.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AVG CA PRICE
1984
1983
1982
1981
1980
PRICE (DOLLARS/CTN)
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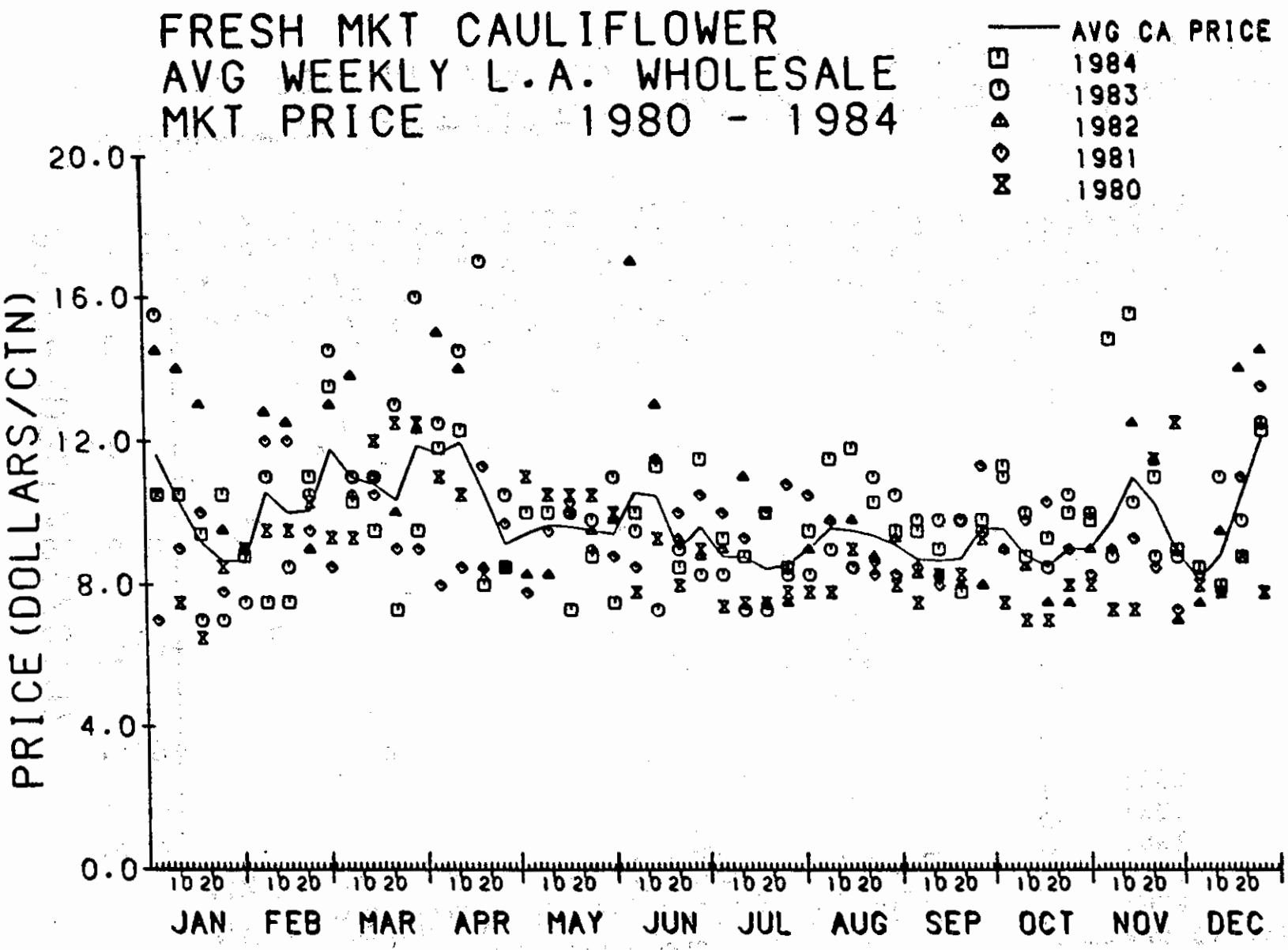
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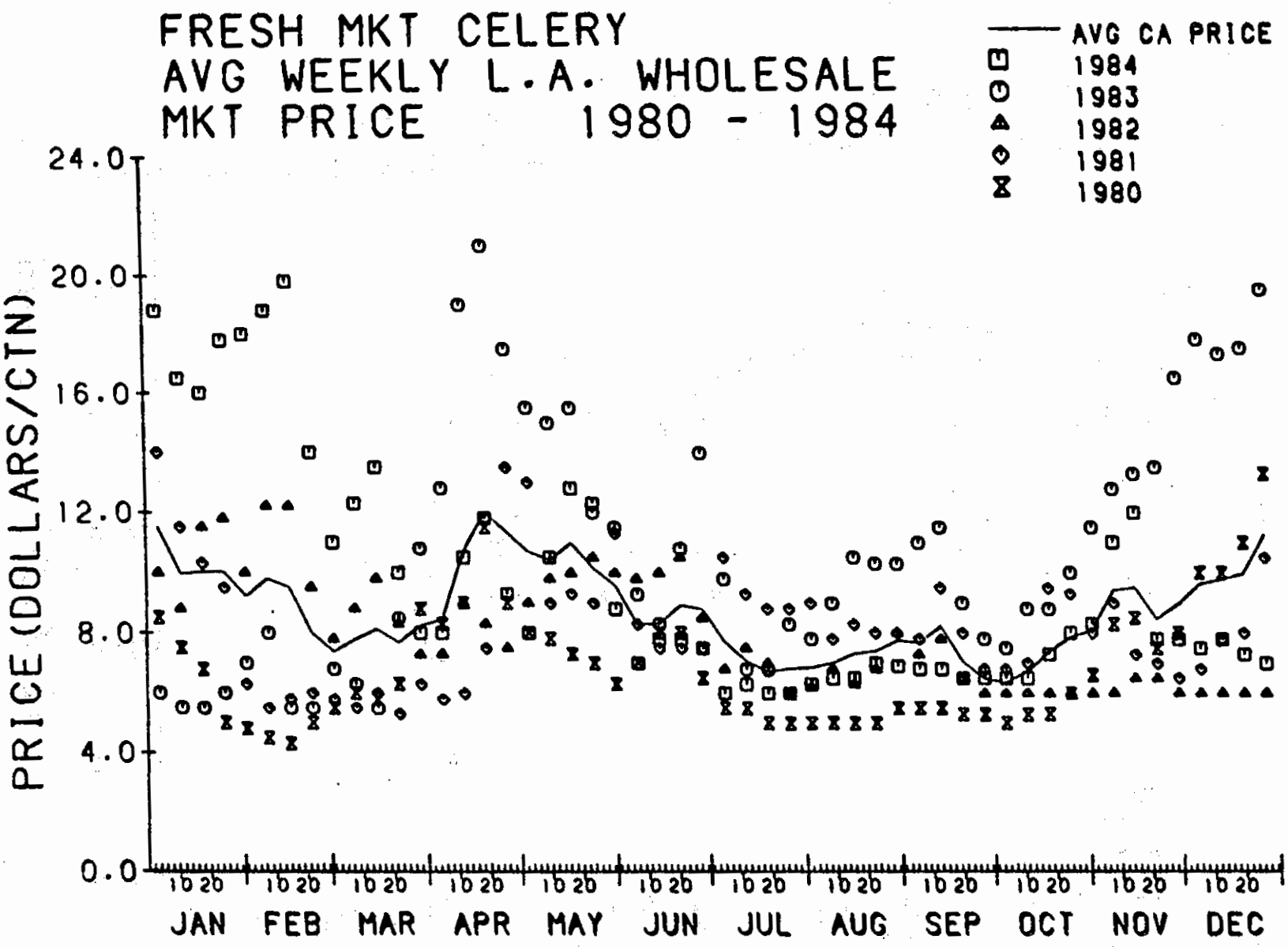
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AVG CA PRICE
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PRICE (DOLLARS/CTN)
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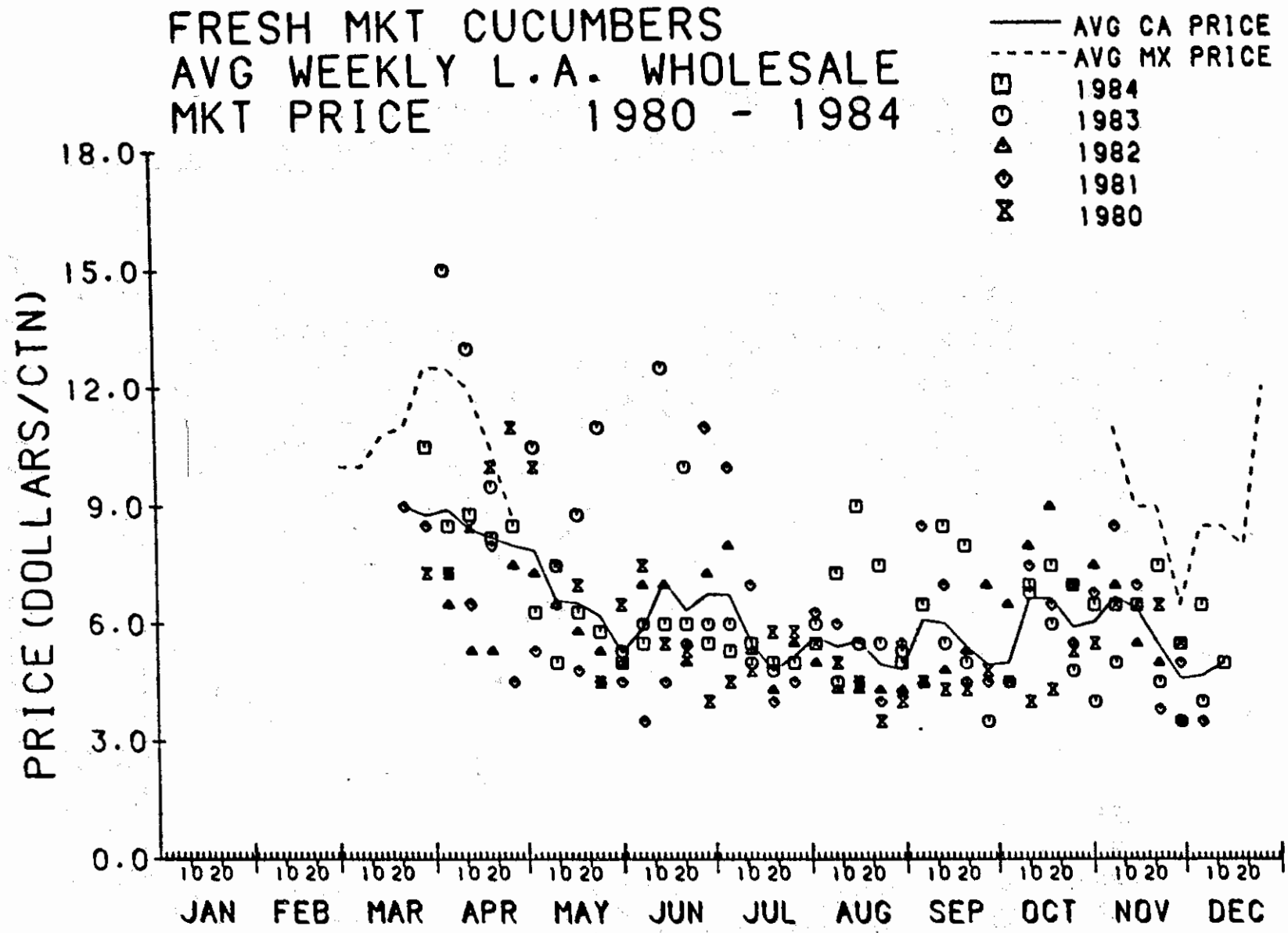
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AVG CA PRICE
AVG MX PRICE
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PRICE (DOLLARS/CTN)
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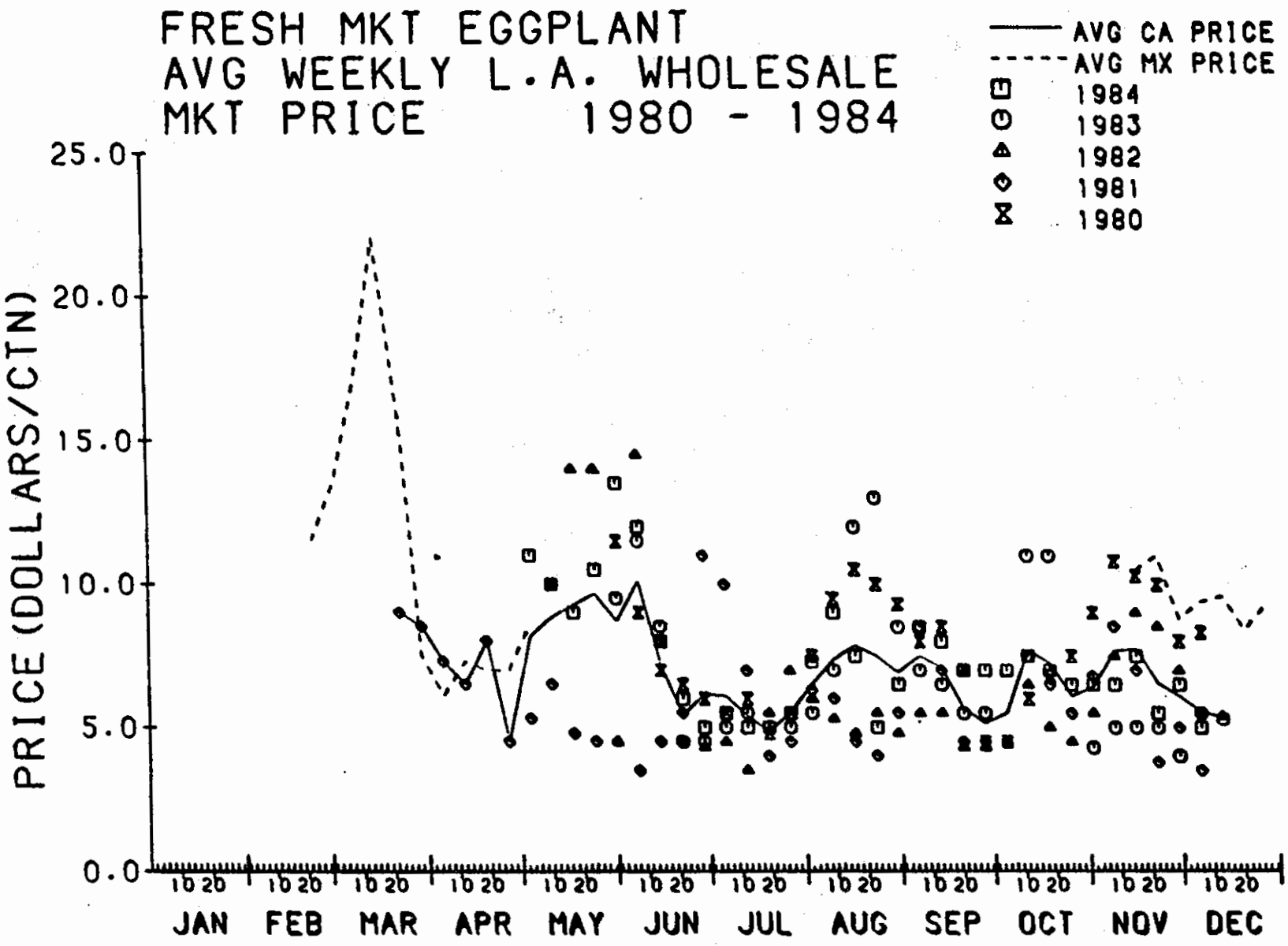
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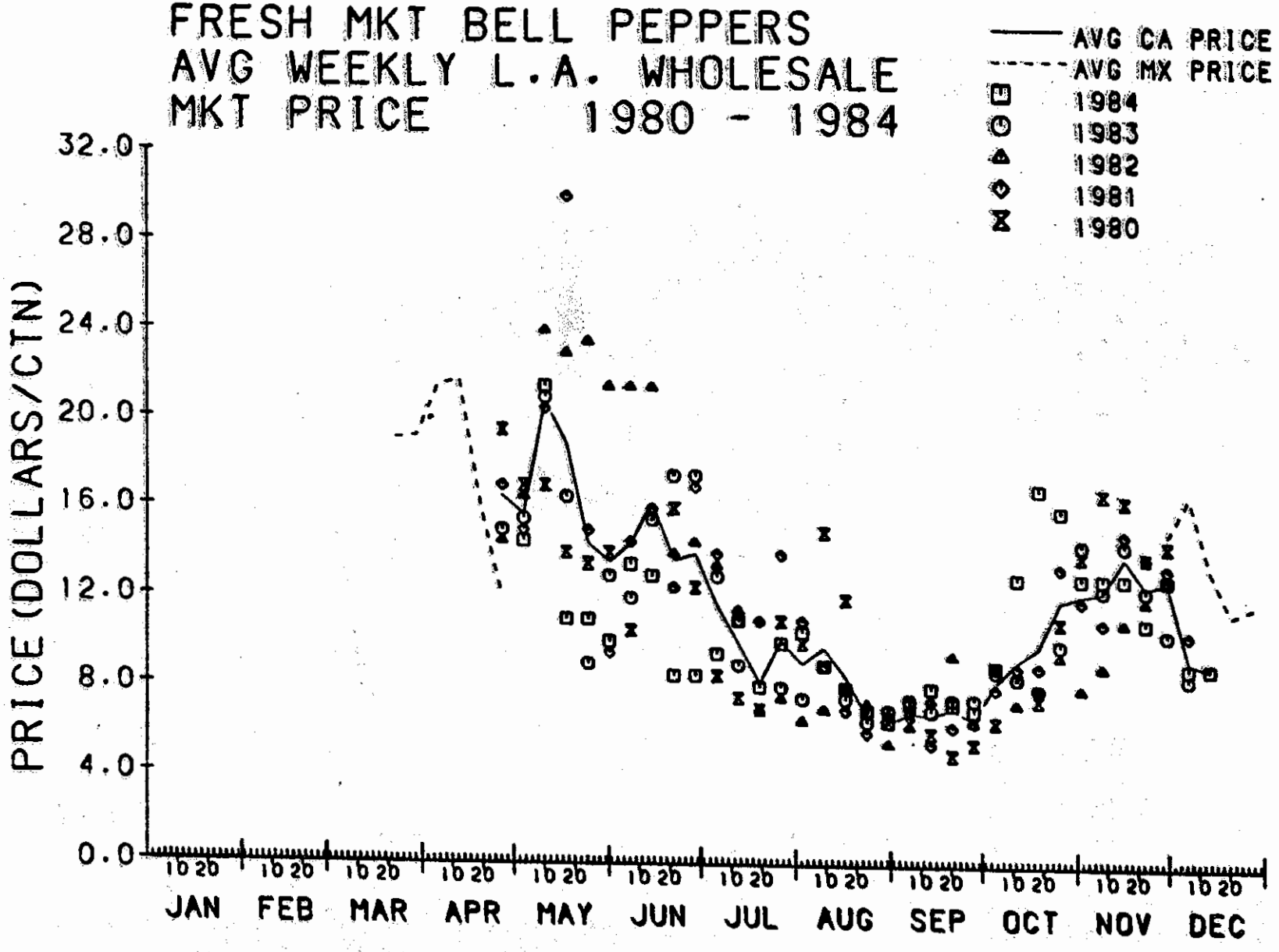
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PRICE (DOLLARS/CTN)
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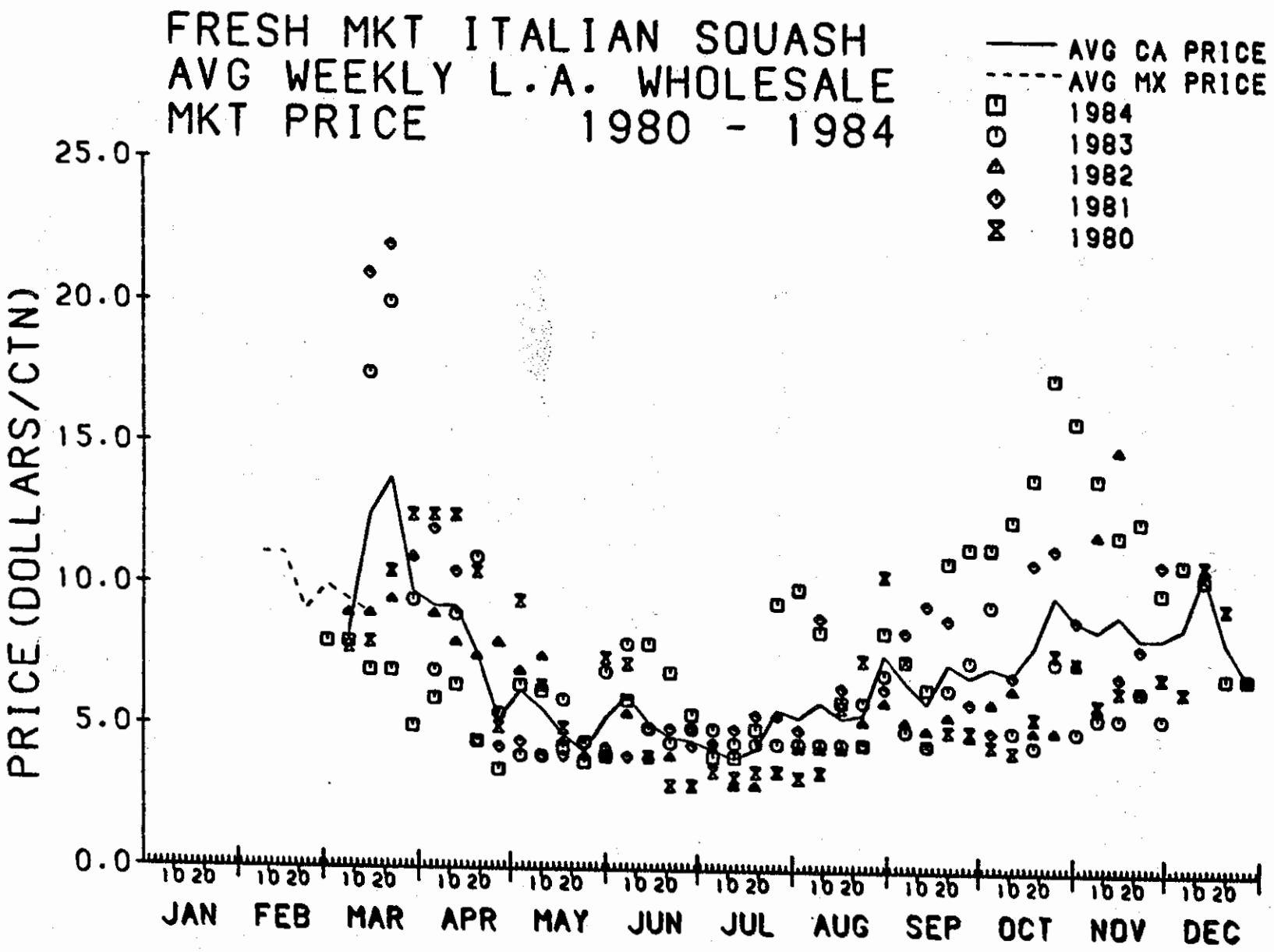
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PRICE (DOLLARS/CTN)
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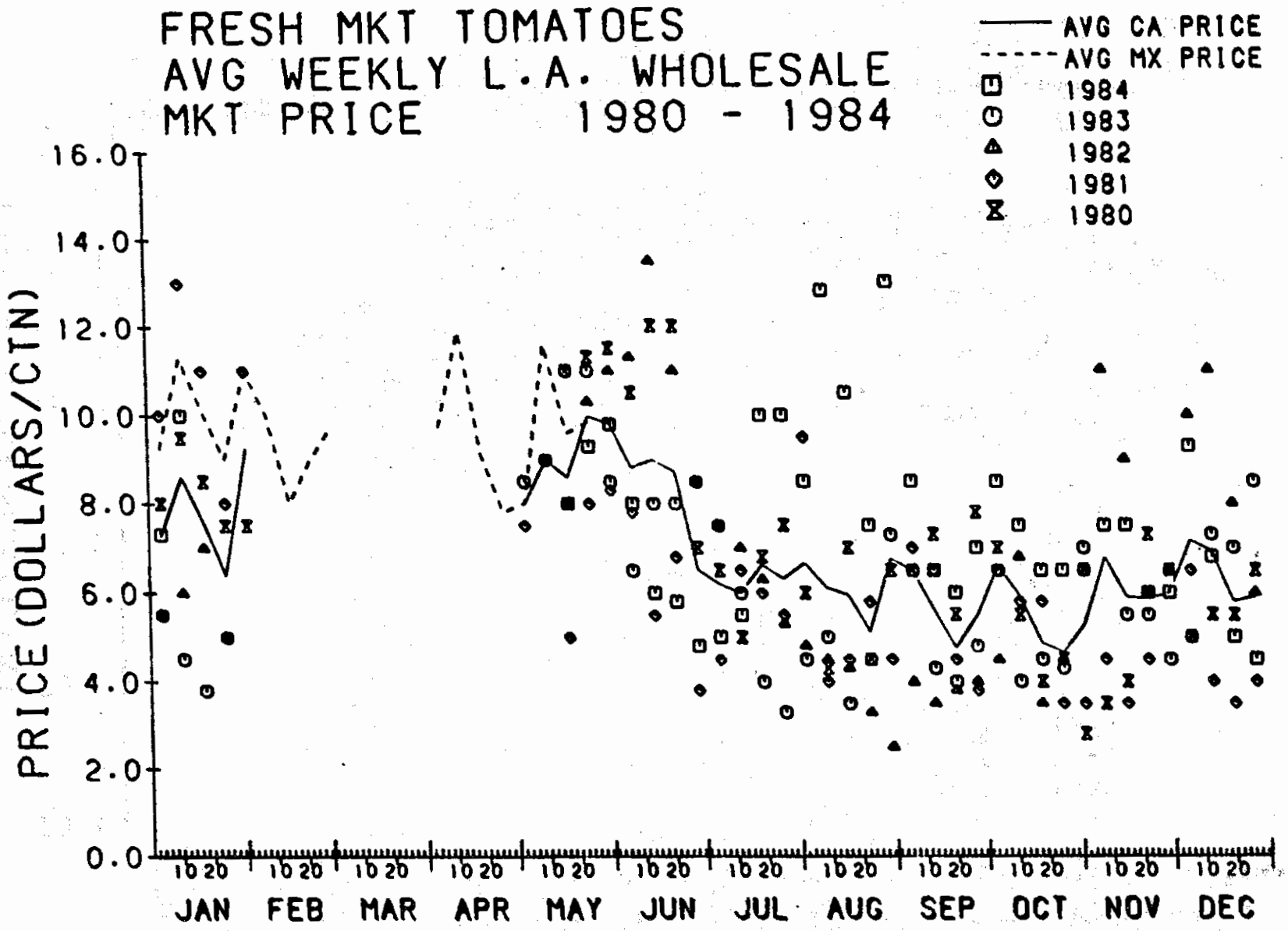
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PRICE (DOLLARS/CTN)
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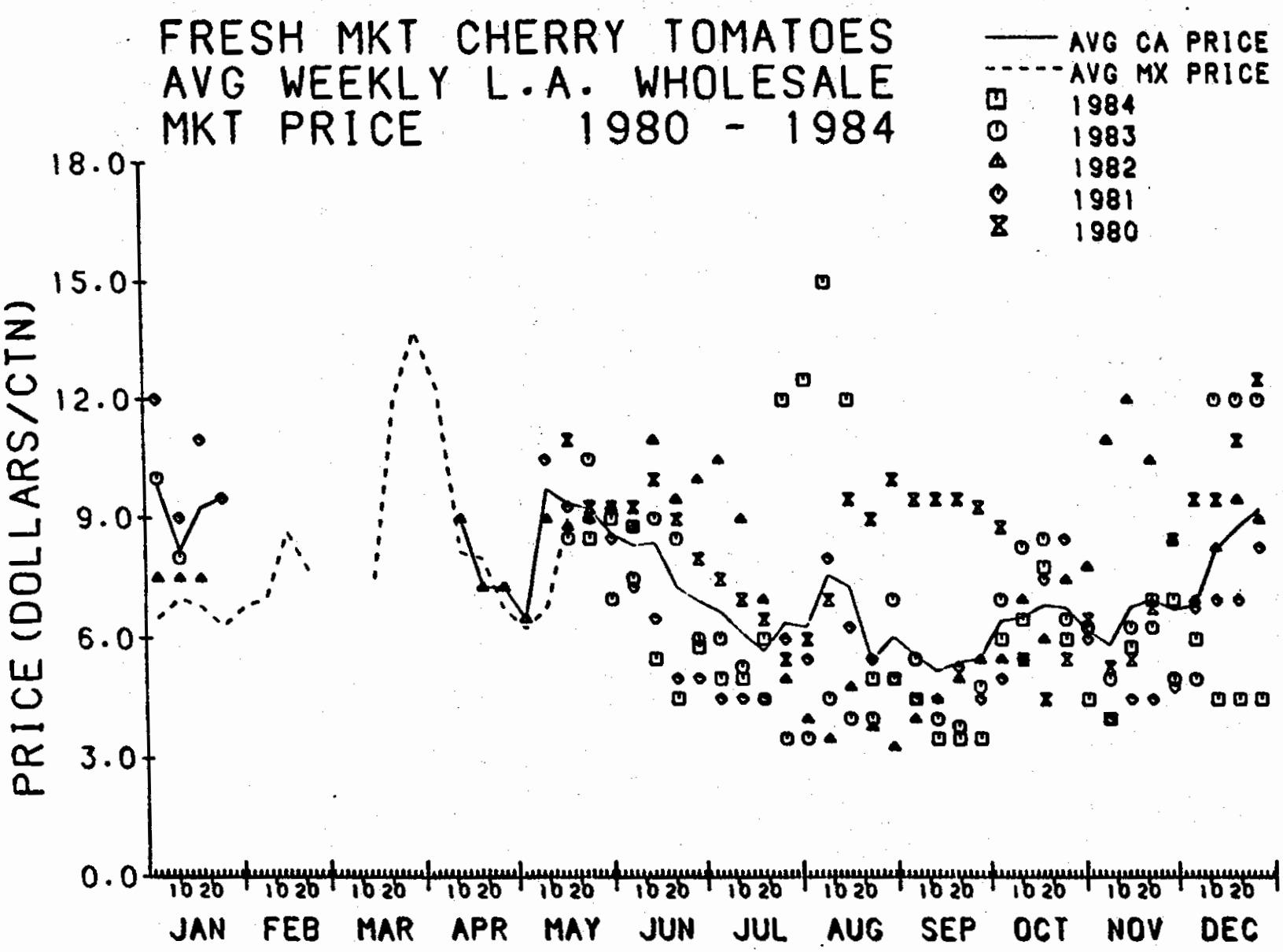
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AVG MX PRICE
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PRICE (DOLLARS/CTN)
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Organic Agriculture

Organic Produce

Public concern about the effects of pesticides on health and the environment has led to the development of a market for organic vegetables. Organic produce generally sells for a higher price and some farmers are interested in dedicating a part of their farming operation to the production of organic vegetables to take advantage of this marketing opportunity. Organic farming can reduce the cost of production by eliminating chemical inputs, but growers of organic produce face difficulties in managing pests and maintaining soil fertility.

Organic farmers maintain fertile soil by applying compost and manure, plowing in legumes, and rotating crops. They build up the organic matter in the soil to improve soil tilth and increase nutrients available to the crop. Organic growers say that building up the organic matter content of the soil is fundamental to their success.

Organic farmers pay close attention to insect pest populations and use a variety of techniques to keep them at manageable levels. Typically, organic farmers plant small acreages of several crop species to decrease the buildup of high pest populations. They use beneficial insects such as trichogramma wasps to keep pests at economically acceptable levels. If all else fails, organic farmers can use *Bacillus thuringiensis* and various naturally occurring pesticide spray.

Organic produce often brings a premium price but it pays to be sure that you have an outlet or broker to handle your organic vegetables before you start production. Like any other specialty item, large acreages of a single organically grown vegetable can severely depress the market price.

Consumer demand for organic produce is increasing and the trend shows no sign of slowing down. Production of organic produce to diversify farming operations and to take advantage of new markets may become an attractive option for many growers.

Organic Production Regulations

The Organic Food Act of the California Health and Safety code, (Sections 26569.11-17) of 1982 states that "no synthetically compounded fertilizers, pesticides, or growth regulators shall be applied by the grower to the field or area in which the (organic)

commodity is grown for 12 months prior to seed planting or transplanting and throughout the entire growing and harvest season". The law also says what material can and cannot be used and outlines required record keeping procedures.

The California Certified Organic Farmers (C.C.O.F.) have a certification process for organic produce that satisfies the Organic Food Act. They have a reputation for quality produce and a logo that is gaining consumer recognition. There is a chapter in San Diego County.

Postharvest Handling and Storage

Temperature Management

Temperature management is the most important consideration in postharvest handling of produce. The optimal storage temperature for individual vegetables and fruits varies. Storing at the wrong temperatures reduces quality and shelf life. Below optimal temperatures cause chilling or freezing injuries. A few hours at field temperature can cause the loss of days of storage life. Never leave harvested produce in the sun.

Produce starts to deteriorate as soon as it is harvested. The faster produce can be cooled to an ideal storage temperature, the longer it will remain at an acceptable quality level. Produce can be cooled with ice, hydrocooling, or with forced air cooling.

Roadside operations usually try to combine forced air cooling with cool room storage, which involves some compromises. Remember that just putting produce into a cool room will not remove the field heat from the fruit or vegetables. In order to cool the produce, the air must be forced to flow through the packaged commodity. An adequate airflow for cooling is about one to three cubic feet per minute per pound of produce.

Forced air cooling of produce can be accomplished in cool room storage if air can be forced past the commodity (i.e. through all of the packages of produce in the stack), and if the cool room has adequate refrigeration capacity. Produce must be boxed in packages that have 3 to 5 percent of the wall area open to permit adequate airflow. Cooling produce requires a lot more refrigeration power that just holding precooled commodities at a given temperature.

Temperature Uniformity and Humidity

Temperature uniformity in the storage facility is very important. Uniformity is maintained by installing fans to circulate air. Fan capacity should be 7.5 room volumes per hour. Actual storage temperature should be checked periodically with a calibrated thermometer. Relative humidity should be held near 95 percent to keep produce from wilting. High humidity can be maintained in a small facility by keeping the floor wet. Assure safety, however, by installing nonskid material or wooden floor slats.

Ethylene Gas

Some commodities produce large amounts of ethylene gas, a naturally occurring ripening agent, which may cause unwanted ripening or deterioration in other commodities. Don't store ethylene producing commodities next to ethylene sensitive perishables. Roadside operations need to be particularly aware of this problem because many items are stored in a single cool room.

RECOMMENDED STORAGE CONDITIONS FOR SELECTED VEGETABLES

Commodity	Storage Temp. (F)	Relative Humidity (percent)	Approximate Storage Life	Ethylene Production Rate (1)	Sensitivity to Ethylene Action (2)	Air Exchange Requirements (3)
Artichoke, globe	32	95-100	2-3 weeks	VL	L	L
Asparagus	32-35	95-100	2-3 weeks	VL	M	M
Beans, green or snap	40-45	95	7-10 days	L	M	M
Beets, bunched	32	98-100	10-14 days	VL	L	VL
Beets, topped	32	98-100	4-6 months	VL	L	VL
Broccoli	32	95-100	10-14 days	VL	H	H
Cabbage, Chinese	32	95-100	2-3 months	VL	H	M
Cabbage, green	32	98-100	5-6 months	VL	H	H
Carrots, topped	32	98-100	7-9 months	VL	L	VL
Cauliflower	32	95-98	3-4 weeks	VL	H	H
Celery	32	98-100	2-3 months	VL	M	M
Chard	32	95-100	10-14 days	VL	H	H
Corn, sweet	32	95-98	5-8 days	VL	L	VL
Cucumbers	50-55	95	10-14 days	L	H	M
Eggplant	46-54	90-95	1 week	L	L	VL
Greens, leafy	32	95-100	10-14 days	VL	H	H
Leeks	32	95-100	2-3 months	VL	M	L
Lettuce	32	98-100	2-3 weeks	VL	H	H
Mushrooms	32	95	3-4 days	VL	M	L
Peas, green	32	95-98	1-2 weeks	VL	M	M
Peppers, bell (sweet)	45-55	90-95	2-3 weeks	L	L	L
Potatoes, table	varies	90-95	5-10 months	VL	M	L
Pumpkins	50-55	50-70	2-3 months	L	L	VL
Radishes, spring	32	95-100	3-4 weeks	VL	L	VL
Spinach	32	95-100	10-14 days	VL	H	M
Squashes, summer	41-50	95	1-2 weeks	L	M	L
Squashes, winter	50	50-70	varies	L	L	VL
Tomatoes, mature-green	55-70	90-95	1-3 weeks	VL	H	M
Tomatoes, breaker to light pink	46-50	90-95	4-7 days	M	H	M

1) VL = very low (<0.1 ul [microliter] C_2H_4/Kg-hr)
L = low (0.1-1.0 ul [microliter]/Kg-hr)
M = moderate (1.0-10.0 ul [microliter]/Kg-hr)
H = high (10-100 ul [microliter]/Kg-hr)
VH = very high (>100 ul [microliter]/Kg-hr)

2) Sensitivity to detrimental effects of ethylene; relative sensitivity is less when low O_2 MA is used; H = highly sensitive, M = moderately sensitive, L = low sensitivity.

(3) Introduction of fresh air into the container during transit to prevent accumulation of ethylene, CO_2, or other gases; N = none, L = low (30 cfm), VL = very low (15 cfm), M = medium (45 cfm), H = high (75 cfm), VH = very high (150 cfm).

USEFUL REFERENCES

University of California Cooperative Extension Publications

Publications Catalog -major headings:

- Animals
- Chemicals
- Economics and Farm Management
- Engineering and Safety
- Field Crops
- Fire Protection
- Food, Nutrition
- Family, and Consumer
- Forestry
- Fruits and Nuts
- Insects and Other Arthropods
- Landscaping
- Marine Resources
- Plant Diseases
- Range and Pasture
- Soils, Water
- Plant Nutrition
- Weather
- Vegetables
- Weeds
- Wildlife
- Spanish Language Publications
- 4-H Publications

Books

Knott's Handbook for Vegetable Growers, Second Edition, 1980
by Oscar A. Lorenz and Donald N. Maynard
John Wiley and Sons, New York.

Western Fertilizer Handbook Seventh Edition 1985
by California Fertilizer Association
The Interstate Printers and Publishers, Inc.
Danville, Illinois 61832

The Commercial Storage of Fruits, Vegetables, and Florist and Nursery Stocks, 1986
United States Department of Agriculture, Handbook Number 66
Superintendent of Documents, Goverment Printing Office
Washington, D.C. 20402

The Buying Guide For Fresh Fruits, Vegetables, Herbs, and Nuts
Seventh Edition, 1980
P.O. Box 1118
Hagerstown, Marland 21740

Fruit and Vegetable Quality Control - Standardization Extracts, 1982
California Department of Food and Agriculture
1220 "N" Street
Sacramento, CA 95814

Periodicals

American Vegetable Grower
Meister Publishing Co.
37841 Euclid Av.,
Willoughby, Ohio 44094

California Agriculture
Agricultural Experiment Station
2120 University Av., Floor 7,
Berkeley, CA 94720

California-Arizona Farm Press
P.O. Box 1420
Clarksdale, Miss. 38614

California Farmer
83 Stevenson St.
San Francisco, CA 94105

The New Farmer (organic farming information)
222 Main Street
Emmaus, PA 18049

The Packer
P.O. Box 2939
Shawnee Mission, KS 66201

Western Grower and Shipper
P.O. Box 2130
Newport Beach, CA 92633

Statistical Information

Federal-State Market News
1320 E. Olympic Blvd., Suite 212
Los Angeles, CA 90021
(213) 894-3077

California Crop and Livestock Reporting Service
P.O. Box 1258
Sacramento, CA 95806
(916) 445-6076