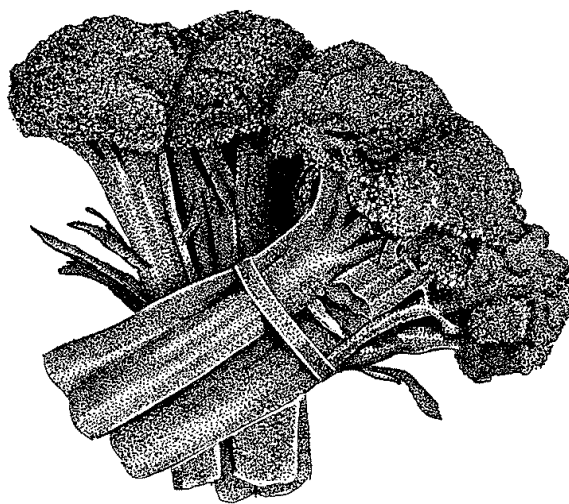


U.C. COOPERATIVE EXTENSION

SAMPLE COST TO ESTABLISH AND PRODUCE

BROCCOLI



IMPERIAL COUNTY – 2004

Prepared by:
Herman S Meister Farm Advisor, U.C. Cooperative Extension, Imperial County

For an explanation of calculations used for the study refer to the attached General Assumptions or call the author, Herman Meister, at the Imperial County Cooperative Extension office, (760)352-9474 or e-mail at hmeister@ucdavis.edu.

The University of California Cooperative Extension in compliance with the Civil Rights Act of 1964, Title IX of the Education Amendments of 1972, and the Rehabilitation Act of 1973 does not discriminate on the basis of race, creed, religion, color, national origins, or mental or physical handicaps in any of its programs or activities, or with respect to any of its employment practices or procedures. The University of California does not discriminate on the basis of age, ancestry, sexual orientation, marital status, citizenship, medical condition (as defined in section 12926 of the California Government Code) or because the individuals are disabled or Vietnam era veterans. Inquiries regarding this policy may be directed to the Personnel Studies and Affirmative Action Manager, Agriculture and Natural Resources, 2120 University Avenue, University of California, Berkeley, California 94720, (510) 644-4270.

University of California and the United States Department of Agriculture cooperating.

FOREWORD

We wish to thank growers, pest control advisors, chemical applicators and chemical dealers, custom farm operators, fertilizer dealers, seed companies, contract harvesters, equipment companies, and the Imperial County Agricultural Commissioner's office for providing us with the data necessary to compile this circular. Without their cooperation we could not have achieved the accuracy needed for evaluating the cost of production for the field crop industry in Imperial County.

The information presented herein allows one to get a "ballpark" idea of field crop production costs and practices in the Imperial County. Most of the information was collected through verbal communications via office visits and personal phone calls. The information does not reflect the exact values or practices of any one grower, but are rather an average of countywide prevailing costs and practices. Exact costs incurred by individual growers depend upon many variables such as weather, land rent, seed, choice of agrichemicals, location, time of planting, etc. No exact comparison with individual grower practice is possible or intended. The budgets do reflect, however, the prevailing industry trends within the region.

Overhead usually includes secretarial and office expenses, general farm supplies, communications, utilities, farm shop, transportation, moving farm equipment, accountants, insurance, safety training, permits, etc. Eleven to 13% of the total of land preparation, growing costs and land rent was used to estimate overhead. Hourly rates vary with each crop depending on the workman's compensation percentages.

Since all of the inputs used to figure production costs are impossible to document in a single page, we have included extra expense in man-hours or overhead to account for such items as pipe setting, motor grader, water truck, shovel work, bird and rodent control, etc. Whenever possible we have given the costs of these operations per hour listed on the cultural operations page. Some custom operators have indicated that they are instituting a "fuel surcharge" to reflect "spikes" in fuel cost.

Not included in these production costs are expenses resulting from management fees, loans, providing supervision, or return on investments. The crop budgets also do not contain expenses encumbered for road and ditch maintenance, and perimeter weed control. If all the above items were taken into account, the budget may need to be increased by 7-15%.

Where applicable we have used terminology that is commonly used in the agricultural industry. These terms are compiled in a glossary at the end of the circular. We feel that an understanding of these terms will be useful to entry-level growers, bankers, students and visitors.

Herman S Meister, Agronomy Advisor &
Senior Editor

Contributors:

Eric T. Natwick
Tom A. Turini
Khaled M. Bali
Juan N. Guerrero
Keith Mayberry, Emeritus

**2004-2005 Tillage & Harvest Rates
IMPERIAL COUNTY**

**HEAVY TRACTOR WORK & LAND
PREPARATION**

<u>OPERATION</u>	<u>\$/ACRE</u>
Plow.....	32.00
Subsoil 2 nd gear.....	45.00
Subsoil 3 rd gear.....	38.00
Landplane.....	14.00
Triplane.....	12.00
Chisel 15".....	26.00
Wil-Rich chisel.....	17.00
Big Ox.....	25.00
Slip plow.....	43.00
Mark/disc borders.....	10.50
Make cross checks (taps).....	6.75
Break border.....	6.50
Stubble disc/with cultipack.....	22.50/24.50
Regular disc/with cultipack.....	13.00/15.00
List 30"-12 row/40" 8 row.....	16.50
Float.....	11.50
Dump (scraper) borders.....	18.25
Corrugate.....	14.00

LIGHT TRACTOR WORK

Power mulch dry.....	27.50
Power mulch with herbicide.....	31.00
Shape 30" 6-row / 40" 4-row.....	12.75/12.75
Plant sugar beets & cotton 30"/40".....	17.00/15.00
Plant vegetables.....	20.00
Mulch plant wheat.....	20.25
Plant alfalfa (corrugated).....	18.50
Plant alfalfa (beds).....	19.00
Plant bermudagrass.....	13.75
Plant with drill (sudangrass, wheat).....	14.75
Plant corn slope.....	17.00
Cultivate 30"/40" beds 4-row.....	16.00/14.00
Spike 30"/40" beds 4-row.....	13.00/11.00
Spike and furrow out 30"/40" 4-row.....	14.00/12.00
Furrow out 30"/40" beds 4-row.....	13.00/11.00
Lilliston 30" 6-row / 40" 4-row.....	14.00/14.00
Lilliston 30" 6 row / 40" 4-row/ herb.....	15.50/15.50
Inj fert & fur out 30"/ 40" beds 4-row.....	16.50/14.50
Fertilize dry & fur out 30"/ 40" 4-row.....	17.00/15.00
Inject fertilizer flat.....	15.00
Broadcast dry fertilizer.....	8.00
Ground spray 30"/40" 8-row.....	12.00
Chop cotton stalks 30"/40"beds.....	16.00/14.00
List 80" melon beds.....	20.00
Plant 80" melon slope beds.....	22.00

Back fill furrow (melons).....9.5

Cultivate 80" melon slope beds.....	18.00
Center 80" melon beds.....	17.00
Re-run 80" melon beds.....	11.00
Inject fertilizer & furrow out 80" melon beds.....	18.00
Bust out 80" melon beds.....	12.00

HARVEST COSTS-FIELD CROPS

BY UNIT

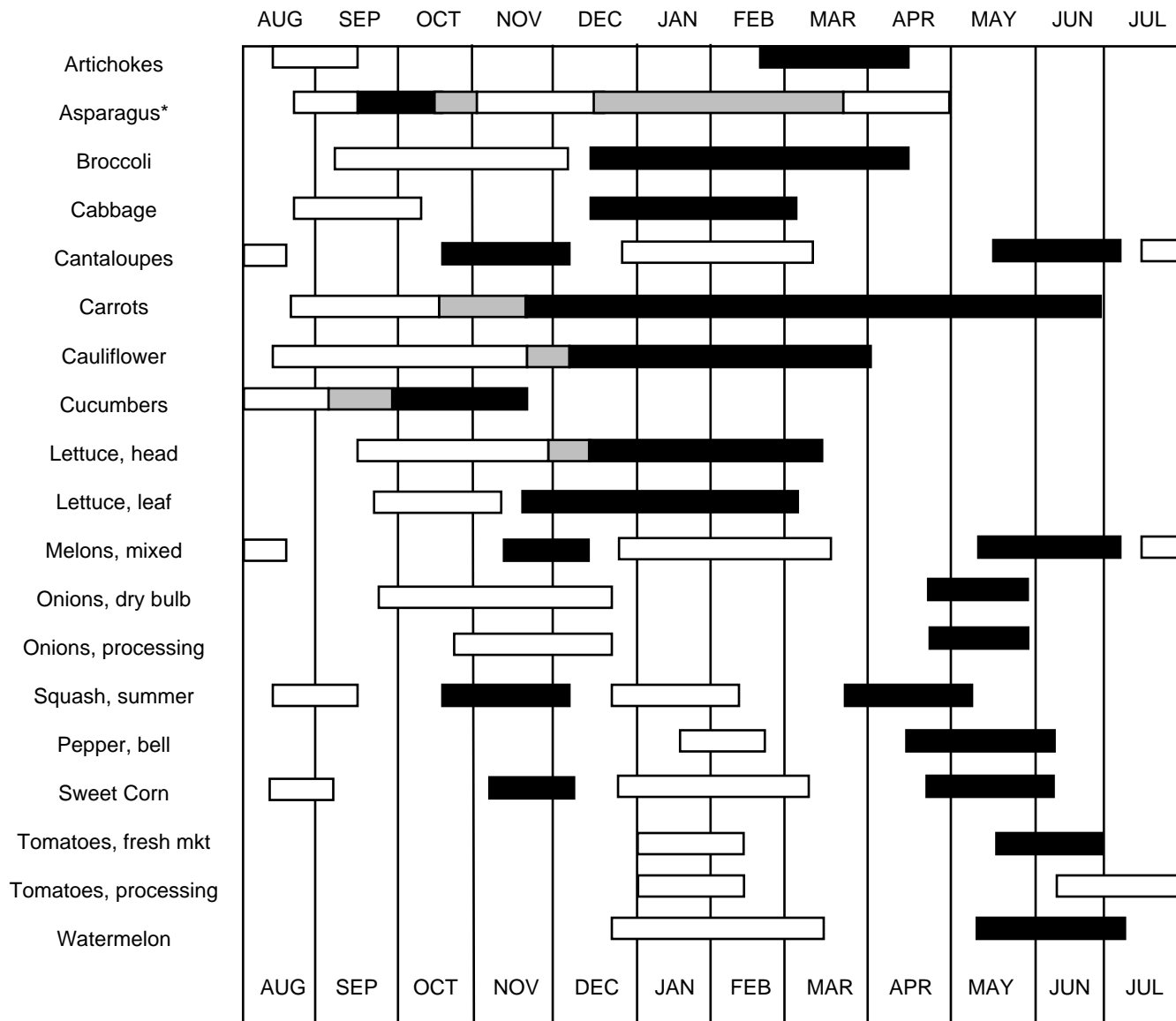
Windrow alfalfa seed.....	17.50/acre
Combine alfalfa seed.....	41.00/acre
Swath bermudagrass.....	13.75/acre
Rake bermudagrass.....	5.50/acre
Swath sudangrass.....	11.25/acre
Rake sudangrass.....	6.00/acre
Swath alfalfa.....	8.75/acre
Rake alfalfa.....	5.00/acre
Bale (all types of hay- small bale).....	0.70/bale
Haul & stack hay – small bale.....	0.27/bale
Bale (large bale 4X4).....	7.50/bale
Haul & stack big bale.....	3.50/bale
Load with hay squeeze.....	62.50 / load
Dig sugar beets.....	2.65/clean ton
Haul sugar beets.....	2.50/clean ton
Combine wheat16.00 per acre + 0.60 /cwt. over 1 ton	
Haul wheat.....	5.00/ton
Combine bermudagrass seed 1st time.....	42.50/acre
Combine bermudagrass seed 2nd time.....	26.50/acre
Haul bermudagrass seed (local).....	175/load
Pick Cotton 1 st /2 nd03cts/lb/35.00/acre

MISCELLANEOUS RATES BY THE HOUR

\$/HR

Motor grader.....	55.00
Backhoe.....	50.00
Water truck.....	40.00
Wheel tractor.....	35.00
Scraper.....	36.00
Versatile.....	60.00
D-6.....	56.00
D-8.....	73.00
Buck ends of field.....	35.00
Pipe setting (2 men).....	38.00
Laser level.....	90.00
Work ends (disc out rotobucks).....	40.00

VEGETABLE CROPS PLANTING & HARVESTING CALENDAR IMPERIAL VALLEY, CALIFORNIA

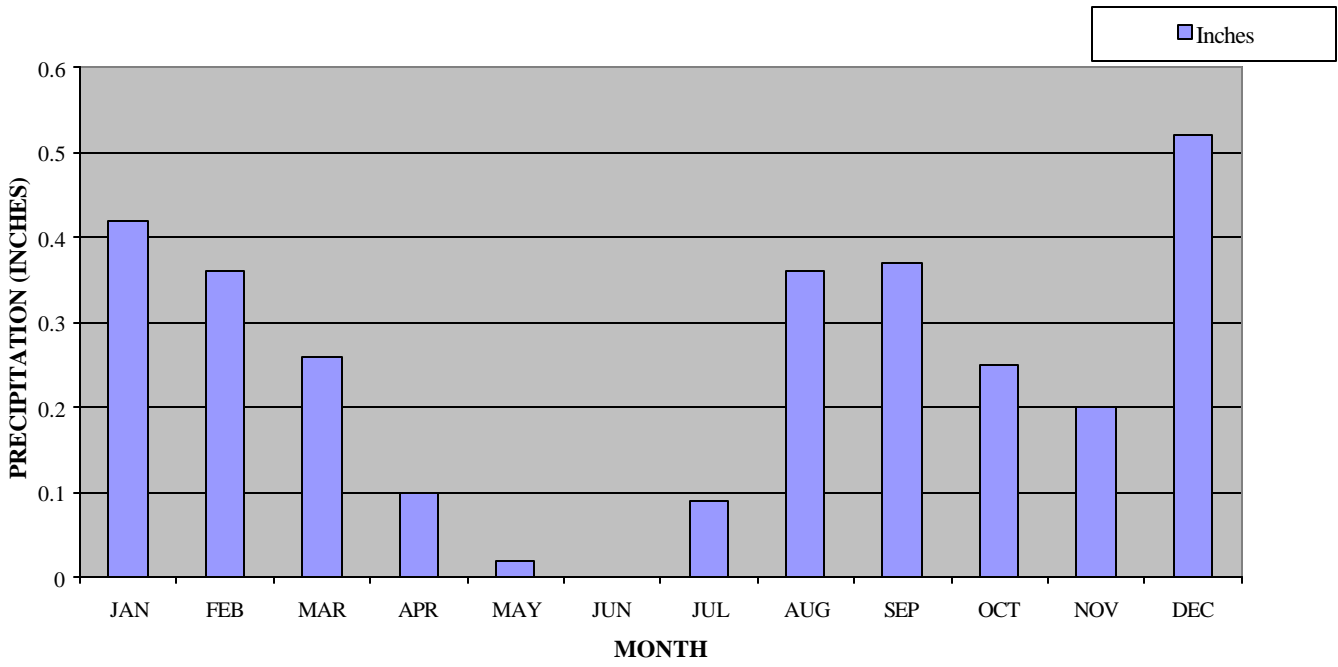
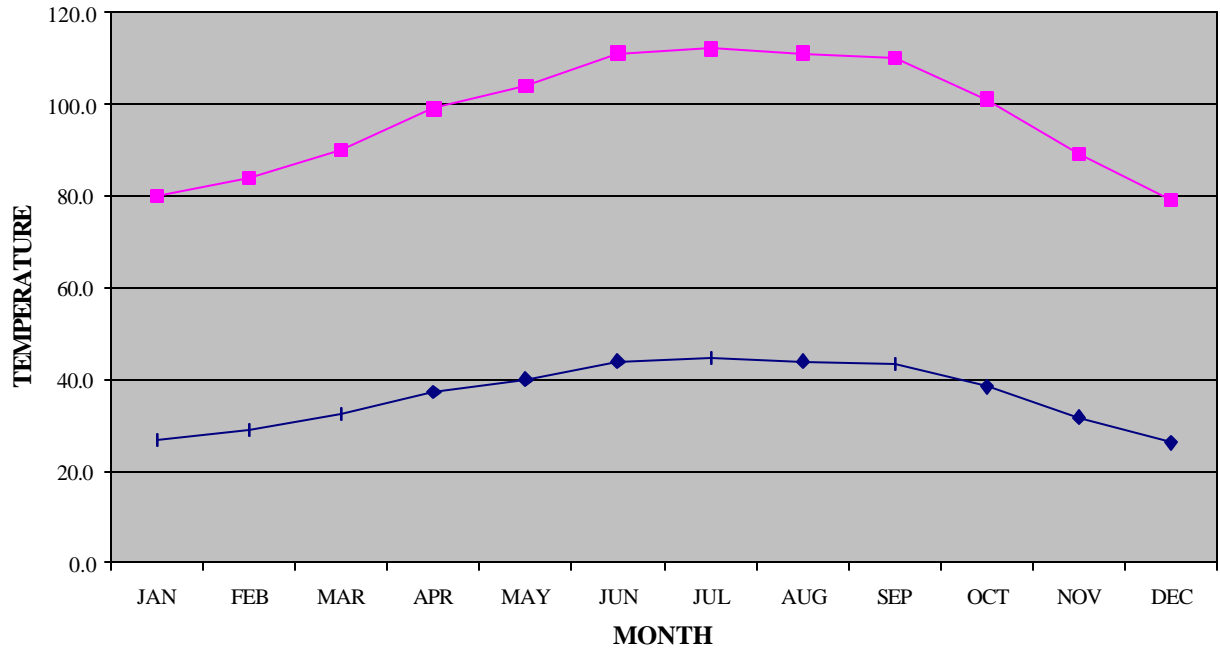
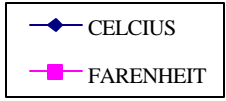


MONTH

- planting
- planting/harvesting
- harvesting
- * perennial

IMPERIAL COUNTY WEATHER

Imperial Irrigation District
81 year average (1914-1994)



DAYS REQUIRED FOR SEEDLING EMERGENCE* AT VARIOUS SOIL TEMPERATURES

Vegetable	Soil Temperature (°F)								
	32	41	50	59	68	77	86	95	104
Asparagus	NG	NG	53	24	15	10	12	20	28
Beet	/	42	17	10	6	5	5	5	/
Cabbage	/	/	15	9	6	5	4	/	/
Cantaloupe	/	/	/	/	8	4	3	/	/
Carrot	NG	51	17	10	7	6	6	9	NG
Cauliflower	/	/	20	10	6	5	5	/	/
Celery	NG	41	16	12	7	NG	NG	NG	/
Cucumbers	NG	NG	NG	13	6	4	3	3	/
Eggplant	/	/	/	/	13	8	5	/	/
Lettuce	49	15	7	4	3	2	3	NG	NG
Okra	NG	NG	NG	27	17	13	7	6	7
Onion	136	31	13	7	5	4	4	13	NG
Parsley	/	/	29	17	14	13	12	/	/
Parsnip	172	57	27	19	14	15	32	NG	NG
Peppers	NG	NG	NG	25	13	8	8	9	NG
Radish	NG	29	11	6	4	4	3	/	/
Spinach	63	23	12	7	6	5	6	NG	NG
Sweet Corn	NG	NG	22	12	7	4	4	3	NG
Tomato	NG	NG	43	14	8	6	6	9	NG
Watermelon	/	NG	/	/	12	5	4	3	/

*planting depth = 0.5 inches; NG = no germination; / = not tested; Source: Harrington, J. F. and P. A. Minges, Vegetable Seed Germination. California Agricultural Extension Mimeo Leaflet (1954).

SEED CALCULATIONS (M)

Number of seed (x1000) required¹ per acre for common plant spacing combinations within rows and between beds. Commonly coded as “M” or 1000 seed

Plant spacing within rows ² (inches)	Spacing between beds ³ (inches)					
	30	40	42	60	66	80
1	209.1	156.8	149.4	104.5	95.0	78.4
1.5	139.4	104.5	99.6	69.7	63.4	52.3
2	104.5	78.4	74.7	52.3	47.5	39.2
2.5	83.6	62.7	59.7	41.8	38.0	31.4
3	69.7	52.3	49.8	34.8	31.7	26.1
4	52.3	39.2	37.3	26.1	23.8	19.6
6	34.8	26.1	24.9	17.4	15.8	13.1
8	26.1	19.6	18.7	13.1	11.9	9.8
10	20.9	15.7	14.9	10.5	9.5	7.8
12	17.4	13.1	12.4	8.7	7.9	6.5
14	14.9	11.2	10.7	7.5	6.8	5.6
24	8.7	6.5	6.2	4.4	4.0	3.3
36	5.8	4.4	4.1	2.9	2.6	2.2

¹ Seeds per acre was calculated assuming one seed per spacing combination. Factors influencing the actual amount of seed needed are seed delivery method and seed viability; ² Values are based on beds with a single row. For multiple rows, multiply by the number of rows per bed; ³ Beds are measured from center to center.

Linear feet per acre for common bed widths

Bed width (inches)	Linear feet per acre
30	17,424
40	13,068
42	12,446
60	8,712
66	7,920
80	6,534

IMPERIAL COUNTY BROCCOLI PROJECTED PRODUCTION COSTS 2004-2005

40 Acre Field

Hand labor at \$9.95 per hour (\$6.75 plus SS, unemployment insurance, workman's compensation and fringe benefits)

Yield-500 26-lb. cartons

Field packed

OPERATION	Cost	Materials		Hand Labor		Cost
		Type	Cost	Hours	Dollars	
LAND PREPARATION						
Stubble disc / ring roller	24.50					24.50
Subsoil 2nd gear	45.00					45.00
Disc 2x	13.00					26.00
Triplane	12.00					12.00
Border,cross check & break borders	23.75					23.75
Flood irrigate		Water 1 ac/ft	16.00	1	9.95	25.95
Disc 1x / ring roller	15.00					15.00
Triplane	12.00					12.00
Fertilize, spread	8.00	500 lb. 11-52-0	75.00			83.00
List	16.50					16.50
TOTAL LAND PREPARATION						283.70
GROWING PERIOD						
Power mulch	27.50					27.50
Precision plant, shape & inject insecticide	22.00	Seed 52M Admire @ 16 oz.	170.00 60.00			252.00 60.00
Weed Control, pre-emergence	12.50	Herbicide	100.00			112.50
Sprinkler irrigate	165.00					165.00
Chemigation		Insecticides	5.50			5.50
Thinning*				10.00	9.95	99.50
Spike 1x	11.00					11.00
Cultivate 1x	14.00					14.00
Fertilize & furrow out 1x	14.50	80 lb. N as UAN 32	30.40			44.90
Water-run fertilizer		40 lb. N as UAN 32	15.20			15.20
Hand weed 1x				5	49.75	49.75
Irrigate 6x		3 ac/ft	48.00	3.5	34.83	82.83
Gated pipe	20.00					20.00
Insect control 4x	9.50	Insecticides	75.00			113.00
Chop stalks	14.00					14.00
TOTAL GROWING PERIOD COSTS						1,086.68
GROWING PERIOD & LAND PREPARATION COSTS						1,370.38
Land Rent (net acres)						225.00
Cash Overhead----		13% of preharvest costs & land rent				207.40
TOTAL PREHARVEST COSTS						1,802.77
HARVEST COST** - FIELD PACK						
Cut, pack, haul, cool and sell		500 26 lb cartons @		4.50 /carton		2,250.00
TOTAL OF ALL COSTS						4,052.77

PROJECTED PROFIT OR LOSS PER ACRE

Price/ 26-lb. carton (dollars)

		Price/ 26-lb. carton (dollars)					Break-even \$/carton
		5.00	6.00	7.00	8.00	9.00	
300		-1653	-1353	-1053	-753	-453	10.51
400	Cartons	-1603	-1203	-803	-403	-3	9.01
500	per	-1553	-1053	-553	-53	447	8.11
600	acre	-1503	-903	-303	297	897	7.50
700		-1453	-753	-53	647	1347	7.08

*Applies to the very early planted broccoli only

**Harvest cost varies with the field conditions, the shipper and the market. Export quality costs more.



IMPERIAL COUNTY FRESH MARKET BROCCOLI CULTURE 2004-2005

Annual acreage, yield, and value of fresh market broccoli in
Imperial County, CA (1999-2003)

Year	Acres	Yield/Acre	Gross
2003	9,929	502	\$3,158
2002	6,798	445	\$5,607
2001	7,764	500	\$3,270
2000	11,349	404	\$2,706
1999	13,603	428	\$2,625

* 26-pound cartons

Source: Imperial County Agricultural Commissioners Reports 1999-2003

PLANTING-HARVESTING DATES: Broccoli is planted beginning early September and continues through early December. Normal harvesting begins early December and is completed by mid-March. A few late-planted fields (maturing in April) tend to produce short plants with a purplish cast and irregular-sized beads on the broccoli heads if the weather is hot during head formation. Sometimes early-planted fields develop "brown bead", a physiological disorder thought to be the result from lack of calcium uptake and excessive heat during head formation.

VARIETIES: Captain *Seminis*; Legacy *Seminis*; Green Belt *Syngenta*; Everest *Syngenta*; Marathon *Sakata*; Signal *Syngenta*; Coronado *Seminis*; Liberty *Seminis*; Triathlon *Sakata*; General *Seminis*; Gypsy *Sakata*; Heritage *Seminis*; and Belstar *Bejo*

Almost any commercial broccoli variety will produce a crop when planted late August to mid-November, however, many varieties are best adapted to early, mid, or late-season planting slots. The highest yield and most desirable head quality will be achieved by selecting the proper variety for a given planting date.

The ideal broccoli head is compact, dome-shape and has small-to-medium, uniform beads. A dome shape of the head is preferred because dew or rainwater will run off the heads instead of promoting fungal and bacterial growth. The ideal stem is smooth with relatively few leaves. Removing leaves results in stem scars when stripping off leaves during packing. Heads should mature uniformly, allowing for once-over harvesting. However, most fields are harvested twice. Heads may be dark green or have a purplish cast. Either color is acceptable. However, mixtures of green and purple detract from the appearance of a packed carton. Broccoli grown for the "crown cut" market is becoming more common. Crown-cut packaging requires that the stem be approximately 5 inches in length.



PLANTING INFORMATION: Nearly 100% of the broccoli crop is direct seeded. A mechanical precision planter or an air planter is often used to sow the crop. Seed are placed up to a ¼ inch deep on 40-inch beds (two seed lines per bed). Spacing between seed lines is usually about 13 inches. Broccoli is planted to stand (no thinning). Normal plant spacing is 4-¼ to 5 inches apart. Plant spacing within rows varies according to grower preference. Factors to consider in determining plant spacing are percent-inbred seed-count, seedbed texture, planting period, insect pressure, and variety.

Inbred seed of some varieties produces marketable broccoli heads while others produce plants with very small, non-salable heads. University research has shown that plants develop larger heads with wider spacing and more compact heads with narrow spacing. Improper plant spacing often results in reduced yields due to the production of heads that are either too large or too small.

Some varieties grown under unfavorable climatic conditions produce large stems (1½ or more), which are objectionable to consumers. Wide plant spacing may also contribute to "hollow stem" in broccoli, a condition that reduces product value.

In order to precision plant, broccoli seed must be sized and closely matched to the hole size in a Stanhay planter belt. Skips or doubles will occur when seed size and belt hole size do not match. Seed and equipment dealers usually have testing equipment to evaluate your needs.

Natural or non-pelleted seed is typically used for broccoli planting. Seed is sold in units of one thousand (M). Broccoli seed will germinate at temperatures of 40-95°F.

"Cat eye" (also called "starring") is a condition where some beads prematurely break into yellow flower. Some varieties have a tendency to develop this defect more quickly than others. A yellow-green color on the sides of the beads is not considered a defect. This condition is the result of lack of exposure of the beads to light during growth.

SOILS: Broccoli grows best on well-drained soils; however, it will tolerate a wide range of soil textures. Excellent broccoli crops have been produced on soils ranging from dune sand to silty clay. When grown on silty clay soils, it is necessary to prepare a fine seedbed in order to precision plant effectively. Broccoli has greater salt tolerance than lettuce, carrots or onions.

IRRIGATION: Sprinkler irrigation is normally used for stand establishment in the Imperial Valley; furrow irrigation is frequently used in Yuma, Arizona. After sprinkling and seedling emergence the field is converted to furrow irrigation. Broccoli is irrigated 6-8 times during the season.

FERTILIZERS: Five hundred pounds of ammoniate phosphate (11-52-0) are normally broadcast prior to listing the beds. This provides ample nutrients for the crop until the first cultivation and



sidedressing. Some growers prefer to add small amounts of nitrogen through the sprinklers or in the first irrigation (water-back) after sprinkling. About 80 pounds (units) of nitrogen (N) per acre are applied in a single sidedress application. UAN 32 or AN 20 are popular nitrogen fertilizers. If needed, additional N may be applied later in the irrigation water. Broccoli is not a heavy user of fertilizer compared to crops such as cauliflower or tomatoes.

PEST CONTROL: Late-season broccoli is not prone to suffer significant damage from insects. However, early season plantings are more likely to be attacked by flea beetles and worms. Cabbage loopers, armyworms, salt-marsh caterpillars, cutworms, flea beetles and aphids can cause extensive damage unless controlled.

The silverleaf whitefly can cause substantial damage to broccoli seedlings due to massive feeding pressure. Whitefly feeding can cause a 2- to 3-week delay in the normal maturity of the crop, completely throwing plantings out of their targeted market windows. In addition, "white stalk" of broccoli has developed on some plantings. This disorder is believed to be a reaction from a toxin that results from whitefly feeding. There are systemic neonicotinoid insecticides that can alleviate the problem.

Blind bud is a condition where the growing point of a seedling has been damaged. The leaves thicken and enlarge, but there is no head formation.

Downy mildew (*Peronospora parasitica*) is the major fungal disease in broccoli. University research has shown that foliage can suffer a substantial amount of mildew lesions without affecting yield or quality. Mildew-tolerant varieties are available.

Broccoli is a host for the cyst nematode (*Heterodera schachtii*), and should not be planted in a rotation with sugar beets.

Black rot (*Xanthomonas campestris* pv. *campestris*) occurs occasionally in Imperial County. It is usually introduced to a farm through infected seed or transplants. Field conditions are not usually conducive for development of this disease in the desert. Use disease-free planting material.

Cladosporium spp. are often surface contaminants on broccoli heads especially during rainy periods or when there is heavy morning dew.

WEED CONTROL: Herbicides are fairly effective at controlling weeds in broccoli with the exception of London rocket and shepherd's purse. Hand weeding is often necessary to remove weeds that develop during the winter.

HARVESTING: Broccoli is normally field-packed. A crop will be harvested twice with roughly a 10-day period between the first and second cut. Over-maturity is a major problem, especially in warmer weather. There is a tendency to plant too many acres in broccoli because it's an easy crop to grow. Most growers either ship the product themselves or have a contract with a shipper.



Broccoli heads are removed from the stalk by hand cutting. Leaves are stripped from the stem and the heads and placed on the table of a field-harvesting machine.

Heads are chosen on the basis of size and shape. Heads should be 3 to 8 inches in diameter. Heads should also be free from defects such as "cat eye", broken florets, dirt, debris, and irregular bead size

Normally, bunches are comprised of 2-4 heads with 8 inches in stem length and are secured together with a rubber band. If the market price is high, more heads may be used to make a bunch. Broccoli is packed in 26-pound waxed-fiberboard carton containing 14 or 18 bunches.

Broccoli sold for export costs more to harvest and pack as many markets have specific size requirements for heads and stalk length. The criteria may vary with the buyer.

A small amount of the crop is sold as field-cut "florets." The loose florets are placed in mesh bags and packed in 9-12 pound cartons containing 3-4 bags each. There is also some "crown cut" broccoli sold. Crown-cut broccoli consists of the top dome with no more than 5 inches of length including stem. While crown-cut broccoli commands a high market price, the harvesting process is slow and meticulous. Crown-cut buyers have very demanding standards.

POSTHARVEST HANDLING: Broccoli requires rapid cooling to insure preservation of quality. Harvested cartons should be taken to the cooler immediately. Liquid-icing is the standard cooling method. The process consists of injecting ice/water slush into waxed cartons. This provides immediate cooling of the product because the slush contacts a very high proportion of the product surface area. Broccoli cartons should never be allowed to set for more than an hour on the dock before cooling. Immediately after icing broccoli should be taken into refrigerated storage. Failure to cool broccoli quickly will cause a loss of quality and/or shelf life.

Bunched broccoli stored at 32°F with a relative humidity of 90-95 percent should have a 10-14 day shelf life. At higher temperatures the shelf life will decrease drastically. Storage at 50°F, for example, will reduce the shelf life to 5 days. Excessive storage time will cause yellowing and softening of the tissue and beads. Off-flavor and bad odor may also develop.

Broccoli should never be stored with ethylene sources such as ripening melons, avocados, bananas, apples, or pears. Exposure to ethylene will accelerate the yellowing of beads.

For more information see "Broccoli Production in California", DANR Publication 7211 available from the Imperial County Cooperative Extension Office or on the Internet at <http://anrcatalog.ucdavis.edu/specials.ihtml> .



GLOSSARY

Air spray The application of chemicals by aircraft.

Back fill furrows To shave soil off the top of melon beds and place it into a furrow in order to bring the irrigation water closer to the melon seedline.

Bed Mounded soil that is shaped and used for planting; beds are separated by furrows.

Bell Bell pepper.

Big Ox A chisel with 7 shanks used to rip soil 18-24 inches deep.

Blacken the beds To wet/darken a bed with irrigation water.

Black Ice Ice formation on asparagus that is clear and therefore difficult to detect.

Blanks Lack of individual kernel formation in corn.

Brassicas Plants belonging to the genus *Brassica*, of the mustard family (Cruciferae), including cabbage, kale, broccoli, cauliflower, turnip, and mustard; all brassicas are crucifers, but not all crucifers are brassicas.

Break a field To harvest a crop the first time in a season.

Break borders To tear down flat flood borders or flat crop borders.

Breaker A tomato fruit that is beginning to show color change from green to pink on the blossom end; preceded by the *mature green* stage.

Brix A measure of sugar content, especially in tomatoes; a graduated scale, used on a hydrometer, that indicates the weight of sugar per volume of solution.

Brown bead A physiological disorder of broccoli thought to be related to lack of calcium uptake and excessive heat during head formation.

Buck ends of field The remaking of beds at the end of a field in order to channel irrigation water properly; a necessary practice when beds at the end of a field are destroyed due to insufficient turn around space for farm equipment.

Cateye A condition in broccoli where some beads begin breaking into yellow flower; also called *starring*.

Cello Poly bags which hold one or two pounds of carrots; from "cellophane".

Chisel A tractor-mounted, knife-like implement used to rip soil about 20 inches deep.

'choke Artichoke

Cole crops Any of various plants of the genus *Brassica*, of the mustard family.

Cos Romaine Lettuce

Cross checks Small dikes at perpendicular angles to borders used for water diversion into a field.

Crucifers Plants belonging to the Cruciferae or mustard family (e.g., broccoli, brussel sprouts, cabbage, cauliflower, etc.).

Cucurbits Plants belonging to the melon or gourd family (e.g., cantaloupe, watermelon, pumpkin, cucumbers, squash, etc.).

Cull To separate unwanted product from desirable product.

Cultipacker A farm implement used to break up clods of soil; consists of groups of knobbed metal rings stacked together.

Cultivate To work beds after planting in order to control weeds, loosen soil, and allow for application of fertilizer.

Curd The edible portion of marketed cauliflower.

Custom rate The value assigned to a cultural operation by farmers for cost accounting; normally includes the cost of the operator.

Damping-off A fungal disease of seedlings that causes rotting of the stem at the soil level and collapse of the plant.

Doubles The placement of two seeds rather than one when one is intended.

Drift Agrichemicals, dust or pests, which inadvertently fall on nearby (usually adjacent) non-target crops; usually the result of spraying products (especially products of small particle size) on windy days or of poor equipment operation.

Drip Irrigation The slow application of low pressure water in tubes or pipes (buried or on the surface): sometimes called trickle irrigation.

Edema (oedema) A physiological disorder of plant resulting from over-watering; numerous small bumps on the lower side of leaves or on stems divide, expand, and break out of the normal leaf surface and at first form greenish-white swellings or galls; the exposed surface

later becomes rusty colored and has a corky texture; especially common in cabbage.

Excelsior Fine wood shavings; used for stuffing, packing, etc.

Feathering Premature flowering of asparagus due to high temperatures.

Flats Flattened asparagus spears caused by certain varietal characteristics.

Float A large, wooden frame pulled with a tractor for rough leveling of the soil surface.

Flood irrigation A method of irrigation where water is applied to a field by gravity; the water is applied to a field by gravity; the water is channeled by earth borders that are usually 70 feet apart.

'flower Cauliflower

Forking The division of a tap root (especially carrots and lettuce) into branches; can be caused by nematode feeding, soil-borne pathogens, and soil texture.

Frost kissed Produce that has been frozen in the field and has a frosty appearance.

Furrow irrigation A method of irrigation where water is applied to fields by gravity flow down furrows; the water enters the bed by capillary action.

Furrow out The removal of soil from furrows by tractor-mounted shovels.

Gated pipe Large diameter pipes used to deliver low pressure water to each furrow; used to keep head end of field dry for cultivation or harvesting.

Green line A term used to describe the appearance of an emerging row crop as plants germinate and emerge above the soil line, a *green line* appears; often growers switch from sprinkler to furrow irrigation when a field can be *green-lined*.

Ground spray The application of an agrichemical by a tractor-mounted sprayer.

Hollow stem A physiological disorder in broccoli resulting from excessive plant spacing.

Honeydew Sweet excrement from aphids and whiteflies as a result of feeding on plant sap. Honeydew attracts ants and will support the growth of fungi (sooty mold).

Hydrocool To cool produce using ice cold water.

Inject fertilizer The application of liquid fertilizer in the top or sides of a bed.

Jelly Gelatinous material present in *mature-green* tomatoes (see also *locule*).

Landplane A large, tractor-pulled, land leveling machine.

Laser level A land surface leveler that uses a laser guiding device to maintain an accurate grade.

Layby To apply an herbicide or other agrichemical at the last opportunity to enter a field with a tractor prior to harvest.

Lilliston A rolling cultivator with curved tines which uses ground speed to assist in working up the soil surface in order to destroy weeds.

Listing Throwing soil in to a mound to make beds.

Locules Tomato fruit seed cavity.

Mature-green A stage of tomato fruit development when the fruit is fully grown and shows brownish ring at the stem scar after removal of the calyx; color at the blossom end has changed from light green to yellow-green and the seeds are surrounded by *jelly*.

Motor grader A large grader normally used to cut tail ditches for draining off excess surface water.

Naked pack Head lettuce packed without a wrapper.

Pegging the emergence of a *radicle* from seed and its placement in the soil.

Pipe setting Installing 2-inch plastic tubes through a soil berm with a hydraulic ram; the pipes are used to control the flow or irrigation water.

Power mulch A tractor-mounted, power rototiller.

Precision planter Planters which drop seeds at exact intervals; may function mechanically or by vacuum.

Primed seed Lettuce seed that has been *primed* for germination by soaking in *osmotic* solutions (e.g., polyethylene glycol [PEG]) as a preventative to *thermodormancy*.

Pull borders To make flood berms used to channel the water.

Punching pipe see *pipe setting*.

Putting the crop to sleep A phrase used to describe the over-watering of tomatoes by furrow irrigation following sprinkler irrigation; encourages shallow rooting and decreased plant growth.

Radicle The embryonic root.

Random flow planter A non-precision planter; seed drop is regulated by agitating the seed in a hopper over a hole; planting rate depends upon hole size and tractor speed.

Ricing Undesirable granulation of floret tips in cauliflower.

Roll beds A large, metal roller used to firm beds prior to thinning.

Rototill To mechanically mix soil.

Row A line of plants or a bed with a single line of plants.

Seedline A line down a bed in which seeds are planted.

Sidedress To place agrichemicals in a band next to a row of plants.

Silking Period of corn ear formation when silky threads emerge from the ear tip.

Slant bed A culturing technique where beds are slanted towards the winter sun (35-37 degrees from horizontal) such that the bed is perpendicular to the sun's rays.

Slip plow An implement pulled by a caterpillar and used to make deep cuts into the soil whereby soil from below is carried upward into the cut; used to improve drainage.

Slush-ice-cooling A cooling method used on broccoli; a mixture of water and ice is forced rapidly into cartons to cool the product.

Spike The running of tractor-mounted shanks into the soil or beds to improve aeration and drainage.

Sprinkler irrigate The application of irrigation water by pressurized injection into the air.

Starring see *cateye*

Stinger A root emerging from seed; a *radicle*

Stubble disc An implement used to chop crop residue and incorporate it into the soil; the blades are scalloped and operate like a pizza cutter.

Subbing Irrigation method where water is applied to a field in furrows and allowed to travel across beds by capillary action.

Subsoil The pulling of large, hard-faced shanks through the soil up to 42 inches deep; used to shatter soil layers and improve drainage.

Swamper Watermelon harvesting crew member.

Swath To cut a tall crop such as asparagus fern.

Taps See *cross checks*

Tasseling The emergence of corn inflorescence.

Thermodormancy A condition of lettuce seed where high temperatures (>86°F) make seed go dormant, thus inhibiting germination.

Thin The removal of excess crop plants and weeds in the seedline in order to achieve desired plant spacing.

Tillering Emergence of multiple stalks from the same root in corn.

Tip burn A condition, especially in lettuce, where leaf tips are burned; thought to be due to lack of calcium uptake; foliar applications of calcium do not correct the problem.

Trió A head lettuce having crew unit consisting of two cutters and a packer; only used in *naked pack* lettuce.

Triplane A smaller, three-wheeled version of a *landplane*.

Triwall cardboard Triple-layered, corrugated cardboard used to make very sturdy fiberboard containers for watermelon.

Vacuum cooling A cooling method whereby commodities are placed in a strong-walled room, air pressure is reduced and heat consumed in the process cools the product.

Versatile A large caterpillar-sized tractor with rubber tread; used to pull discs and other implements; safe for crossing asphalt roads.

Water run An application of an agrichemical in irrigation water (i.e., furrow irrigation).

White star White markings at the blossom end of tomatoes that turn from green to white as the fruit matures; an indicator of maturity in tomatoes.

Wil-rich chisel plow An implement used to work wet or moist soils prior to making beds.

Wind whip Girdling of seedling stems due to high winds. Seedlings are especially susceptible following thinning or weeding; cole crops are most susceptible.