

=====

**1993-1994**

**U.C. COOPERATIVE EXTENSION**

**PRODUCTION PRACTICES AND SAMPLE  
COSTS  
FOR FRESH MARKET ORGANIC APPLES**

***NORTH COAST  
(Mendocino and Sonoma Counties)***

Prepared by:

Karen Klonsky	Extension Economist, U.C. Davis
Laura Tourte	Postgraduate Researcher, U.C. Davis
Chuck Ingels	Perennial Cropping Systems Analyst, Sustainable Agriculture Research and Education Program, U.C. Davis

Contributing Authors:

Pete Livingston	Staff Research Associate, U.C. Davis
Glenn McGourty	Farm Advisor, Mendocino County
Paul Vossen	Farm Advisor, Sonoma County

Cooperating Growers:

Tim Bates	The Apple Farm, Mendocino County
Ted Richardson	Gabriel Farm, Sonoma County

=====

The University of California, in compliance with Titles VI and VII of the Civil Rights Act of 1964, Title IX of the education amendments of 1972, Sections 503 and 504 of the Rehabilitation Act of 1973, and the Age Discrimination Act of 1975, does not discriminate on the basis of race, religion, color, national origin, sex, mental or physical handicap, or age in any of its programs or activities, or with respect to any of its employment policies, practices, or procedures. Nor does the University of California discriminate on the basis of ancestry, sexual orientation, marital status, citizenship, medical condition (as defined in section 12926 of the California Government Code) or because individuals are special disabled veterans or Vietnam era veterans (as defined by the Vietnam Era Veterans Readjustment Act of 1974 and Section 12940 of the California Government Code). Inquiries regarding this policy may be addressed to the Affirmative Action Director, University of California, Agriculture and Natural Resources, 300 Lakeside Drive, 6th Floor, Oakland, CA 94612-3560. (510) 987-0097.

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

## 1993-1994 - U.C. COOPERATIVE EXTENSION

### OVERVIEW OF ORGANIC APPLE PRODUCTION FOR THE FRESH MARKET

#### *North Coast*

#### **Introduction:**

In past years the North Coast (Mendocino and Sonoma Counties) was considered a major apple producing area in California. More recently, the region's apple production has decreased because of escalating land values, encroaching urbanization, out-of-state and in-state competition and a shift away from apple production into wine grapes. Despite this, the North Coast is currently one of the leaders in the state for apples produced organically. In Mendocino and Sonoma Counties, between 40 and 45 percent of the total apple acreage, or 2,360 acres, are farmed organically. Varieties produced organically in the region include Fuji, Golden Delicious, Gravenstein, Jonathan, McIntosh, Red Delicious, Red Rome and Sierra Beauty.

This overview is meant to guide the reader through topics and issues that are integral to organic apple production specifically for the fresh market. Like conventional farming, there are numerous approaches to growing apples organically, from orchard spacing and floor management to irrigation system design and agricultural inputs. The following is a discussion of common practices and issues related to organic apple production for the North Coast.

The first section of this overview describes the seasonal flow of operations for a production year for organic apples. Next, the cover crop and pest management sections give greater details of these practices. Finally, marketing and the current status of regulations for organically grown apples are discussed.

#### **Production Practices:**

Cultural operations often begin in the fall after harvest with an annual sowing of a winter cover crop. Alternatively, some growers plant perennial or self-reseeding cover crop species, or simply allow resident vegetation to regeminate each year in their orchards. In this case, a yearly reseeding is not performed. The cover crop is generally not irrigated up nor is a postharvest irrigation performed. Growers typically rely on fall and winter rains to replenish moisture in the soil profile and for cover crop germination and growth. Refer to the **Cover Crops/Floor Management** section for additional information.

Fertilizing materials are usually applied to soils in the fall when tissue and/or soil analyses have shown it to be appropriate. Growers generally apply a limited amount of oystershell lime each year rather than one larger application every fourth or fifth year. This fertilizing material is used to add calcium to soils, help neutralize soil acidity (where applicable), improve drainage, soil tilth and the availability of certain nutrients for crop production. Soil pH should be monitored when lime is applied to orchard soils. Sulfate of potash is often applied every third or fourth year depending on the potassium requirements for the orchard. Fertilizing materials are either applied to the tree rows only or spread throughout the entire orchard depending on the orchard's size and fertility needs, the application rate and the grower's equipment complement. These materials are either disced into the soil immediately after spreading, or are left on the soil surface. If left on the soil surface, winter rains may assist in moving nutrients into the soil profile. Also, the materials are sometimes worked in with later operations such as discing or weeding. To be most effective, fertilizing materials should be incorporated. These operations are performed in September, October or November depending upon when harvest occurs. Alternatively, some growers apply fertilizing materials in the spring months.

Compost or composted manure is spread in some orchards in the fall to add organic matter to soils and provide nutrients for crop production during the following spring and summer. There is some debate as to whether fall-applied compost and composted manure is as beneficial for tree growth and crop production as is a spring application. Research indicates that nitrogen and other nutrients are assimilated by trees during the growth flushes of spring and summer and not during the dormant fall and winter months. Therefore, fertilizing materials that are applied in late winter or early spring (February or March) may be more efficiently utilized by trees and thus reduce the risk of nitrogen leaching and runoff during the dormant period. However, rains in the

North Coast frequently occur in late winter which often prevent growers from applying fertilizing materials during this time, thereby necessitating a fall application.

Orchard pruning can begin as early as December but can also be performed as late as April depending on the time of harvest and subsequent bloom, management practices and apple variety. Pruning helps growers balance the orchard's vegetative growth with fruit production and helps with apple thinning since chemical thinning methods are not legally acceptable for organic production. Larger prunings are cut, stacked and burned; smaller prunings are often shredded and chopped with a mower/chopper and spread in the orchard to return organic matter to the soil. Depending on floor management practices, pruning disposal takes place either immediately after pruning or later in the season in conjunction with spring mowing of the orchard floor. Sucker removal is performed jointly with tree pruning. Some varieties are summer pruned in May or June in addition to dormant pruning.

Older and marginally producing trees are replaced each year in the months of January, February or March. Typically, tree replacement is to semi-dwarf rootstock regardless of the previous tree size. Because of this, some orchards have a mixture of standard and semi-dwarf trees. Tree removal is either done by the grower or is custom performed. It is important that the deficient tree's old root system be thoroughly removed before replanting because soil fumigation to control soil borne root and crown rot diseases is prohibited under organic farming regulations. Trees are replanted by the grower. Some growers mix compost and/or nutrients with the surrounding soil to support growth of the newly replanted trees. If it is necessary, young trees are pruned and irrigated at the time of planting. Alternatively, growers prune and irrigate young trees later in the season when growth begins.

In addition to the mixed-age orchard described above, some apple acreage consists of newer, high density plantings, many of which use low-volume irrigation. The number of trees per acre for high-density plantings ranges from 250 to 500 in this area.

Pest management operations for disease, insect, mite, vertebrate and weed control often begin as early as February and extend through August depending on the farm location, the previous year's pest incidence and the seasonal climatic conditions. Refer to the **Pest Management** section for further information.

Frost protection is not a critical component of apple production in North Coast orchards. Therefore, growers seldom have on-farm investments in the form of wind machines or irrigation systems specifically for frost protection.

Although apples require bees for pollination, North Coast organic growers do not generally contract to bring hives into their orchards on a yearly basis. This is because the region has a large population of wild bees and also because growers sometimes maintain their own colonies. However, some growers do contract for hives for their orchards; this may improve pollination rates, increase fruit set and subsequently increase yields. Also, cross pollinating varieties are interplanted at the time of orchard establishment to insure adequate pollination.

Foliar nutrient sprays are applied each year during the months of April through August in most North Coast organic apple orchards. The number of spray applications are determined by appropriate tissue analyses and/or cropping history and grower experience. Fish emulsion and kelp extract are commonly used. These products provide trees with supplemental nitrogen, phosphorous, potassium and micronutrients. Calcium sprays are also used in some orchards to boost calcium levels and possibly decrease the incidence of bitter bit, a physiological disorder associated with calcium deficiencies in apples. Alternatively, some growers inject supplemental nutrients through their irrigation systems.

Apples are hand thinned during the months of May and June for a number of reasons including sizing for larger fruit, removal of poor quality fruit, reduction of pest damage and protection against limb breakage when the fruit load is exceptionally heavy. The number of thinnings depends on the variety, seasonal conditions and targeted market. For example, apples may not be thinned in years with light fruit loads or when fruit is grown specifically for processing. Growers often, however, thin higher value apples more than one time each year for the economic advantage of producing consumer-preferred large size fruit. Alternate-bearing varieties often produce more consistent and uniform yields when thinned within one month of bloom each year.

The associated increase in cultural costs for thinning alternate-bearing varieties each year is not necessarily beneficial from an economic perspective.

Not all North Coast orchards have sufficient water to irrigate. For those that do, orchard irrigations are generally performed from June through August. The delivery method and the amount of applied water may vary among locations. Total applied water will be dependent on the system design, seasonal rains, soil type, orchard age, the tree rooting depth, the number and size of trees in the orchard and how orchard floor vegetation is managed. For example, orchards with year-round cover crops or resident vegetation often require a greater amount of applied water because of competition between floor vegetation and trees for moisture. Drip and subsurface irrigation systems typically deliver water more efficiently than sprinkler systems and therefore require less total water to irrigate the orchard. Also, cover crops and soil organic matter content may play a role in the total number of irrigations used each year. Research indicates that cover cropped soils, and/or those high in organic matter, have improved water penetration and infiltration rates. Therefore, irrigation efficiency may be increased by reducing surface water ponding.

In many North Coast apple orchards, trees on standard rootstock are propped or tied in June or July to support fruit growth and development and decrease limb breakage prior to harvest. Properly trained orchards with semi-dwarf rootstock do not require tree propping or tying.

In this area, harvests are most often performed by the grower and not by a custom operator. Growers hand harvest for the fresh market on a "select-pick" basis. That is, apples are harvested for quality (large size, appropriate varietal color and lack of visible defects). Individual trees or portions of the orchard that do not have fresh market potential are generally designated for processing. Processing fruit may be harvested at the same time as the select-pick fruit, but is separated into different bins in the field. Alternatively, growers may harvest processing fruit after the select-pick by stripping trees. Processing fruit is shipped to a processor (for the organic or conventional market) after harvest. Fruit with fresh market potential is taken to a packing shed where it is sorted, sized and packed. The actual harvest period is determined by the county agricultural commissioner and is based on a variety's maturation date, minimum size and soluble solid content. Harvests take place over the period of late July through late October.

Yields for organic apples will vary depending on a number of factors including orchard age, planting density, variety, production location, irrigation practices and yearly growing conditions. Apples specifically earmarked for fresh market are required to meet certain grades and standards. The portion of the crop that does not meet fresh market standards is culled for processing. Apple yields are expressed as: 1) gross tonnage on a per acre basis, 2) the percent of the total tonnage that is then taken to the packing house with fresh market potential and 3) pack-out, or the portion of the crop that is saleable fresh market fruit. Pack-out is expressed in terms of percent of total tonnage and also in terms of boxes. Boxes are packed in one of three different ways: cello-bagged, loose-packed or tray-packed. Apple size determines the method of packing. In this area, yields for organically produced apples can range from 7 (low-density plantings) to 25 (high-density plantings) gross tons per acre. An estimated 70 to 85 percent of this tonnage will go to the packing shed; some of this fruit will be culled for processing. Depending on the operation's size, packing is done either by the grower or through a custom packing house.

The following table shows the approximate pack-out yield range for 40-pound tray-packed boxes and the percentage range of the total gross tonnage this represents for five apple varieties grown organically in the North Coast.

**Approximate Pack-out Yield Ranges for Five Apple Varieties  
Grown Organically in the North Coast<sup>1</sup>**

<u>Apple Variety</u>	<u>Boxes Per Acre</u>	<u>% of Gross Tonnage</u>
Golden Delicious	190-550	50-55
Gravenstein	315-385	42-51
Jonathan	315-425	42-50
McIntosh	170-300	45-60
Red Rome	225-625	52-63

<sup>1</sup> Tree spacing is 12 X 18 for a total of 202 trees per acre

## Cover Crops/Floor Management:

Cover crops can be beneficial for the production of organic apples in a number of ways. If leguminous cover crops are used, soil nitrogen may be increased through nitrogen fixation. Cover crop root growth and root exudates often stimulate microbial activity which has been shown to promote soil aggregate stability. When cover crops are incorporated into soil in the spring, microbes assist in the decomposition process by breaking down organic matter and releasing nutrients. Cover crops increase the plant diversity of the orchard and can attract and harbor alternate prey for beneficial arthropods (insects, spiders and predatory mites). In the flowering stage, they can provide nectar to attract and sustain beneficials. Cover crops can also reduce dust problems in orchard systems which in turn may help reduce spider mite pests. Weed suppression may be another direct benefit of cover cropping depending on the species or mix selected. Also, cover crops help control soil erosion particularly on sloped or hilly land. Lastly, farm machinery is able to enter orchards sooner after rains or irrigations when a cover crop's mat of root and vegetative growth provides support on wet soil. This may also serve to reduce soil compaction.

There may also be some disadvantages with using cover crops in orchards. Annually sown cover crops increase cash costs for seed and labor, and may require the rental or purchase of additional farm machinery. Additional inputs such as water and nutrients may be necessary because of competition between the cover crop and trees. The water requirement in particular should be taken into consideration because water may be in short supply in some North Coast orchards. If a cover crop blooms during the period of apple bloom, bees may prefer to visit flowers of the cover crop over the apple blossoms, thus reducing pollination. Also, cover crops may attract arthropod and vertebrate pests to the orchard. For example, research indicates that mustard cover crops are associated with increased populations of the insect pest orange tortrix.

Selection of a particular cover crop species should take into account the yearly production cycle of the tree crop as well as the climate, which dictates the planting time and winter cold tolerance of the cover crop. Also, growers should select cover crops for the specific needs of an orchard. For example, if soil nitrogen is in short supply, then a leguminous cover crop is generally preferred. However, if growers wish to increase the amount of biomass that is returned to the soil, then a cover crop that includes a grass may be best. In addition, the soil type and irrigation system should be taken into consideration. For example, cover crops such as vetch may not be the best choice for orchards with permanent sprinkler irrigation because vetch tends to climb and wrap around sprinkler heads. To alleviate this difficulty, cover crop mixes may include a grass or bell beans to provide an alternative means of support for vetch growth. Tall-growing cover crops may interfere with sprinkler irrigations if orchards require irrigation before the cover crop is mowed and/or incorporated. Growers in some areas may find that certain cover crop species and mixes are not appropriate for their soils and conditions. Often, the most suitable cover crop in each situation is determined by observation and experimentation over a period of years.

Cover crop management practices depend on the type of cover crop that exists in the orchard. For example, annually sown legume cover crops such as bell beans, vetch and winter peas, and grasses such as annual ryegrass, barley and oats are customarily planted in the fall after harvest in this region. Cover crops grow during the winter months and in the spring are typically mowed once and then incorporated into the soil by discing. Incorporating the cover crop speeds decomposition of the vegetation and recycling of nutrients for crop production. Moreover, competition for water and nutrients between the trees and the cover crop is also lessened during the spring and summer months. After incorporation of the cover crop, the ground is smoothed by rotovating or harrowing. Orchard floors are then mechanically cultivated (disced, rotovated or harrowed) periodically throughout the summer months to keep the floor free of vegetative growth. Growers report that total tillage operations may be decreased with rotovating or harrowing as opposed to discing because fewer overall passes are required during the summer months to keep the orchard floor free of vegetation.

Perennial species, self-reseeding annual species or resident vegetation are also managed as a cover crop. When these types of cover crops are used, vegetative growth is not incorporated by tillage operations. Orchard floor vegetation is mowed periodically (six to eight times) in the spring and summer months to reduce the above ground biomass. If leguminous species are not present in the orchard, nitrogen will probably be lacking in the system and require supplemental nutrients. Additional water may also be needed because of competition between the cover crop and tree growth.

## **Pest Management:**

Most pesticides that are currently used by producers of conventionally grown apples are not approved for use by organic apple growers. **Figure 1. ( on page 17) Pest Management Materials for North Coast Apples** includes information on specific materials, application rates and the appropriate months in which materials are usually applied by North Coast organic growers.

The pest management techniques utilized by growers do not necessarily conform to the University of California's Integrated Pest Management (U.C. IPM) Guidelines, nor are all materials listed in **Figure 1. (on page 17)** used by all farmers each year. Grower experience indicates that deviations from the U.C. IPM recommendations are sometimes necessary due to yearly variability in growing conditions, a material's availability and the total input costs.

In general, pest control products used by organic growers are not as effective as synthetic pesticides for immediate or acute problems. The cost for some organically acceptable pest control methods may also be prohibitive for many growers. Therefore, pest identification, monitoring and prevention are essential elements of successful organic apple production. Also, the timing of material applications is critical for effective insect, mite and disease control in apples. Growers should be certain that any materials used are in compliance with the rules and regulations of state and federal agencies and of certification organizations. (Refer to the **Regulations of Organically Grown Commodities section.**)

**Diseases.** The two most serious diseases in organic apple orchards in the North Coast are apple scab (*Venturia inaequalis*) and powdery mildew (*Podosphaera leucotricha*). Apple scab causes more fruit damage and yield loss than powdery mildew. Both pathogens affect young (and sometimes older) wood, foliage, flowers and fruit. These diseases overwinter on leaf litter or leaf and flower buds in the orchard. For apple scab infection to occur, moisture must be present over a certain period of time and within specific temperature ranges. Wet springs and/or overhead sprinkler irrigations frequently increase the incidence of this disease. Disease inocula in the orchard may be reduced if leaf litter decomposes sufficiently during the dormant season. Pruning and burning infected wood also helps lessen disease outbreaks, especially for powdery mildew. Powdery mildew is influenced by temperature (warm days and foggy nights) but does not require moist conditions to infect an orchard. It is primarily spread by wind. Both infectious diseases cause fruit to be russeted, scarred, distorted and/or smaller in size, decreasing overall fruit quality, yield and marketability.

Lime sulfur and/or wettable sulfur are the organically acceptable fungicides that are used preventatively to lessen the incidence of both apple scab and powdery mildew. Spray applications of either material generally begin in late March or early April at the green tip stage (when buds are just beginning to open). From one to nine additional sprays are then applied once every seven to fourteen days depending on rainfall and humidity. These materials should not be used in hot weather as phytotoxicity can occur. Higher temperatures may also inhibit some pathogen development and therefore decrease the number of fungicide sprays that are necessary.

**Insects and Mites.** Three insect pests cause the majority of fruit damage and yield loss in North Coast organic apple orchards. They are: codling moth (*Cydia pomonella*), rosy apple aphid (*Dysaphis plantaginea*) and green apple aphid (*Aphis pomi*). Less notable pests that occur in this area include apple pandemis (*Pandemis prysuana*), orange tortrix (*Argyrotaenia citrana*), and a number of different green fruitworm, leafroller, mite and thrips species. These pests overwinter in various locations within orchards including soil, twigs, branches, debris and mummy fruit. During the growing season they feed on fruiting wood, foliage, flower buds and the fruit itself; tree growth can be stunted or distorted and fruit can be misshapen and blemished and rendered unsaleable as a result. Reducing damage and/or controlling these pests often results from the integration of a number of different management techniques.

Many growers agree that the codling moth presents the principal challenge to growing apples organically. In the North Coast, fresh market organic apple production has been previously constrained for two reasons: 1) the climate and the length of the growing season allows up to four generations (flights) of codling moth to develop each year, and 2) effective overall pest control measures have been previously unavailable. A number of techniques have been and are still being used to combat codling moth. Some growers plant early harvest varieties such as Gravensteins to escape later and heavier flights of the pest. Horticultural oils are

sometimes applied to trees in the spring and summer months to increase mortality for codling moth during the egg stage. Codling moth populations may be reduced when apples are thinned carefully as some pests will be removed at the same time. Growers dispose of thinned apples that contain pests by submerging in water or discing into orchard soils. Microbial insecticide sprays such as the codling moth granulosis virus (CMGV) and the bacterium *Bacillus thuringiensis* (Bt) are also being utilized. One difficulty with the use of these insecticides, however, is that they must be ingested to be effective. A spray's timing is therefore critical in that it must be applied during or directly after egg hatch but before the time larvae enter the fruit and are protected. Another problem is that these materials break down rapidly and therefore have a short residual effect. Repeated applications may be necessary for adequate pest reduction, thereby making control somewhat costly and, at least for some growers, unrealistic economically. CMGV has been granted conditional registration in California and is now available for purchase through the Association for Sensible Pest Control. Additionally, numerous trials have shown that Bt may not be effective as a means of codling moth control.

More recently, pheromone-based mating disruption programs have emerged as a promising method for reducing codling moth populations for organic growers, particularly when used in conjunction with other control tactics. Dispensers containing codling moth pheromone (a species-specific female sex odor) are placed in large numbers (from 160 to 400 per acre depending on the brand) in trees throughout each orchard. The orchard air is essentially flooded with the female scent which in turn disorients males and disrupts mating. Dispensers are placed in trees two to three times yearly in the spring and summer months. Each application is weather dependent. Growers report that a significant decrease in codling moth damage can occur with the inclusion of this technique into the pest management regime.

Horticultural oils are also utilized for the control of aphid, apple pandemis, fruittree leafroller, mite, scale and thrips pests. Dormant (winter), delayed dormant (spring), and summer sprays are used to smother eggs and increase adult mortality. In general, dormant sprays are not harmful to beneficial insects. However, if oil sprays are used in the warmer spring and summer months when insect activity increases, beneficials within the orchard will be killed if sprayed directly. Pyrellin E.C. and insecticidal soap are also used to reduce aphid numbers in portions of the orchard with signs of significant pest damage and/or in years when pest pressure is severe. However, there is some debate as to whether or not these materials are effective. Pyrellin E.C. is a botanical insecticide derived from two plant extracts, pyrethrum and rotenone. Pyrethrum formulations are currently organically acceptable for insect control in California *provided they do not contain the synergist piperonyl butoxide*. Some growers have experienced a decrease in beneficial insect and predatory mite populations with pyrethrum use. Pyrellin E.C. and Bt may also be helpful for reducing populations of some caterpillar species. Insecticidal soap is allowed for use in California organic farming when it consists of fatty acids derived from vegetable or animal fats. Refer to **Figure 1. (on page 17)** for additional information.

Many beneficial arthropods, such as parasites and predators, occur naturally within organic orchards. Growers in the North Coast often augment these populations by releasing parasitic wasps of the genus *Trichogramma* and predators such as green lacewings (*Chrysoperla* spp) to regulate pest densities on a year-to-year basis. Parasitic wasps and predaceous arthropods including spiders, lacewings, and lady beetles can lessen overall insect pest damage within orchards and should be encouraged to proliferate by providing an appropriate habitat (cover crops) and avoiding insect and oil sprays whenever possible.

**Weeds.** Orchard weeds are most often controlled by discing, rotovating or mowing centers and by cultivation with a weed badger (or comparable implement) in the tree rows. In addition to these operations, weeds in tree rows are also controlled with a string weed trimmer or by hand hoeing. The number of mechanical cultivations, mowings and/or hand weedings varies among growers.

**Vertebrates and Miscellaneous Pests.** Rodents are largely controlled by trapping, but are also controlled with strychnine bait. Strychnine is an allowed material for organic farming by the State of California, but may be restricted or prohibited by some certification organizations.

Snail populations periodically increase to levels that require some pest management. When necessary, hand labor is used to remove snails from orchards.

## **Marketing of Organically Grown Apples:**

Commodities that are produced organically can often be sold for a higher price than conventionally grown products. Returns to growers for organically grown fresh market apples will vary depending on a number of factors including fruit variety and quality, industry supply and consumer demand. For example, if growers are early to market, returns may be higher due to limited market competition and heightened consumer demand. Also, growers with uniform production and consistent yields are generally better able to market their product effectively on a year-to-year basis. Alternatively, out-of-state imports and years with high yield levels may cause market gluts and reduce grower returns.

Organically grown apples must meet the same minimum quality grades and standards as conventionally grown apples. Quality indicators include appearance, flavor, nutritional value and food safety. While growers, marketers and consumers may have different perceptions of quality, the appearance of fresh market commodities probably impacts grower returns more significantly than all other quality factors. For example, fruit that is russeted, blemished or distorted is not often tolerated by today's consumers or by current grades and standards. Fruit size and color will also impact grower returns; larger-sized and well-colored fruit often commands a higher market price. These are visual characteristics that are generally preferred by marketers and consumers, but are not necessarily associated with better overall nutritional value, flavor and food safety.

In this area, apples that are grown organically for the fresh market are often custom-packed after harvest and then sold through a local produce broker. Produce brokers act as intermediaries between producers and buyers; that is, they facilitate cooling, handling, sales and distribution of the product for a fee or commission. For apples, produce brokers' fees range from ten to twelve percent of the gross sales. A produce broker's commission customarily excludes cooling fees. Sale of the product is generally guaranteed by the produce broker based on buyer acceptance. Alternatively, growers may pack their own fruit and sell the product directly through retail outlets and/or farmers markets.

Although fresh market apples are a perishable product, they may be cold-stored over a period of time to maintain quality if the product cannot be sold immediately or is held voluntarily in storage because of poor market prices. However, storage fees increase grower costs. Therefore, apples should be sold whenever possible in an expedient manner for growers to see the most satisfactory returns unless prices are anticipated to increase later in the year. It should be recognized that both market and production risks affect the profitability and economic viability of each apple operation.

## **Regulations of Organically Grown Commodities:**

As of January 1, 1992 all growers who choose to produce and market organic commodities must register on a yearly basis with the State of California under the California Organic Foods Act of 1990. Enforced under this act are the provisions of Article 4.5 (commencing with Section 26569.20) of Chapter 5 of Division 21 of the California Health and Safety Code and of the California Food and Agricultural Code commencing with Section 46000. These provisions contain rules and regulations that must be adhered to by all producers, processors and handlers of organic commodities. The act states that prior to January 1, 1995, producers of organic commodities may not apply prohibited materials or substances to annual or two-year crops for a minimum of twelve months prior to seed planting or twelve months prior to the appearance of flower buds for perennial crops to qualify as organic. From January 1, 1995 through December 31, 1995, this rule increases to a twenty-four month period of prohibition. On or after January 1, 1996 the restriction increases to thirty-six months. State registration fees apply and are estimated by the registrant's total gross sales from the previous year. If no sales occurred in the previous year, fee remittance is based on the projected gross receipts. First year registrants must pay a one-time only assessment equal to one and one-half times the yearly state registration fee. The state program is administered through the California Department of Food and Agriculture (CDFA).

On October 1, 1993, the federal Organic Foods Production Act of 1990 (OFPA) became effective. This act sets forth production standards and regulates all organic commodities on the national level. However, due to budget and time constraints, final recommendations for the law's implementation have not been completed. Therefore, even though the law is now in place, implementation and enforcement will be delayed for at least one year. Nonetheless, growers would be wise to conform to federal production standards (in addition to state regulations) at this time. The federal program is administered through the United States Department of Agriculture (USDA).

In most cases the OFPA preempts state law except in those cases where the state applies to the USDA for approval of stricter standards. Two differences between state and federal laws are noteworthy. First, the federal law stipulates that organic foods must not be produced on land to which a prohibited substance has been applied for a minimum of three years immediately preceding harvest of the crop to qualify as organic. Second, federal law states that growers must be certified by a federally accredited certifying agent on an annual basis if yearly gross sales total more than \$5,000. This federal requirement should not be confused with, and is separate from, state registration.

In 1992 only one-third of the registered organic farmers in California were certified by a certification agency. Approximately ninety percent of those certified were certified by California Certified Organic Farmers (CCOF). In addition to CCOF, five other organizations actively certify growers in the state. They are: Farm Verified Organic (FVO), the Organic Crop Improvement Association (OCIA), the Organic Growers and Buyers Association (OGBA), Quality Assurance International (QAI) and Scientific Certification Systems (SCS). Each agency should adhere to all state and federal laws regulating organic commodities, and in addition may enforce standards and procedures specific to their own agencies. Organizations differ with respect to the certification process and the associated costs. The above organizations are registered with the State of California. However, none are currently accredited by the USDA since the USDA's certification program has not yet been implemented. Refer to the references section of this publication for additional sources of information.

**1993-1994 - U.C. COOPERATIVE EXTENSION**  
**ORGANIC APPLES FOR THE FRESH MARKET**  
**COST AND RETURNS STUDY**  
*North Coast*  
**General Information**

The practices described for the hypothetical orchard used in this report are considered common for organic apple production in the North Coast. Sample costs given for labor, materials, equipment and contract services are based on 1993-1994 prices. **The use of trade names is not an endorsement or a recommendation nor is criticism implied by omission of similar products.** A blank **Your Cost** column is provided to enter your actual costs on **Table 1. Costs Per Acre - Operations** and **Table 2. Detail of Costs Per Acre - Inputs**. Some costs and practices detailed in this study may not be applicable to your situation. This study is only intended as a guide and can be used in making production decisions, determining potential returns, preparing budgets and evaluating production loans.

This report consists of the set of **Assumptions For Producing Organic Apples** and six tables.

- Table 1. Costs Per Acre - Operations**
- Table 2. Detail of Costs Per Acre - Inputs**
- Table 3. Monthly Cash Costs Per Acre**
- Table 4. Annual Equipment, Investment And Business Overhead Costs**
- Table 5. Hourly Equipment Costs**
- Table 6. Ranging Analysis**

For an explanation of calculations used for the study refer to the attached assumptions, call the Department of Agricultural Economics, Cooperative Extension, University of California, Davis, California, (530) 752-3583 or call the farm advisor in the county of interest.

A second cost study entitled "*Production Practices and Sample Costs For Fresh Market Organic Apples - Central Coast - 1993-1994*" is also available for those interested in apple production on the Central Coast.

A companion study entitled "*Sample Costs to Establish an Apple Orchard and Produce Apples, Sprinkler Irrigated, in Sonoma County - 1994*" is available for those interested in orchard establishment costs and for production costs of conventionally grown apples.

The above studies can be requested through the Department of Agricultural Economics, U.C. Davis, or from selected county Cooperative Extension offices.

The University of California, in compliance with Titles VI and VII of the Civil Rights Act of 1964, Title IX of the education amendments of 1972, Sections 503 and 504 of the Rehabilitation Act of 1973, and the Age Discrimination Act of 1975, does not discriminate on the basis of race, religion, color, national origin, sex, mental or physical handicap, or age in any of its programs or activities, or with respect to any of its employment policies, practices, or procedures. Nor does the University of California discriminate on the basis of ancestry, sexual orientation, marital status, citizenship, medical condition (as defined in section 12926 of the California Government Code) or because individuals are special disabled veterans or Vietnam era veterans (as defined by the Vietnam Era Veterans Readjustment Act of 1974 and Section 12940 of the California Government Code). Inquiries regarding this policy may be addressed to the Affirmative Action Director, University of California, Agriculture and Natural Resources, 300 Lakeside Drive, 6th Floor, Oakland, CA 94612-3560. (510) 987-0097.

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

## 1993-1994 - U.C. COOPERATIVE EXTENSION

### Cost of Production Assumptions For Fresh Market Organic Apples In The North Coast

This study reflects the practices and costs associated with a production system for organically grown apples in the North Coast region of California. While every effort is made to model a production system based on real world practices, this report cannot fully represent the costs and practices that are specific to each orchard, or the variations that exist between the two counties (Mendocino and Sonoma) included in this study. Production practices and management techniques are generally individualized to meet the specific needs of each grower. Therefore, this study should be interpreted as a representative operation and not as a statistical average. Costs are represented on an annual per acre basis.

The orchard in this report is assumed to have been established as a conventional orchard for apple production. It is considered to have completed the transition period and is registered and certified as organic. Changing a farming system from conventional to organic practices requires a transition period. Rules and regulations for organic production must be adhered to during this time period. Crops grown in transition years may not be sold or labeled as organic. Commodities that are produced organically can often be sold for a higher price than conventionally grown products. However, industry supply, consumer demand and market competition all affect grower returns.

The following is a description of general assumptions pertaining to sample costs for the organic apple orchard analyzed in this study.

#### 1. LAND:

The total orchard size is 18 acres. Land is owned by the grower and is valued at \$11,000 per acre. This figure is within a range of values for orchard land in the North Coast. Land costs per acre will vary within the region and within each county. Land is not depreciated. Land is assumed to be fairly level, with well drained soils of moderate depth and fertility.

#### 2. ORCHARD ESTABLISHMENT:

The establishment cost is the sum of the costs for the land preparation, planting, trees, cash overhead and production expenses for growing the trees through the first year that apples are harvested (year five). The orchard establishment cost is used to determine the non-cash overhead expenses, depreciation and interest on investment during the production years. Site selection is determined by a number of factors including location, slope, soil type, fertility and depth. (For more detailed information on this cost refer to the companion study *Sample Costs To Establish An Apple Orchard And Produce Apples, Sprinkler Irrigated, In Sonoma County - 1994*).

#### 3. TREES:

Apple varieties (for production and cross pollination) are not specified in this study. Factors affecting varietal selection include adaptability to climatic region, time to maturity and marketability. Trees are planted on a 12' x 18' spacing with 202 trees per acre. The orchard life is assumed to be 25 years beyond five establishment years.

#### 4. SPRINKLER IRRIGATION:

A permanent under-tree sprinkler irrigation system is assumed for the orchard. Water for the sprinkler irrigation system is pumped from a depth of 200 feet in a 300 foot well using a 20 horsepower (hp) pump. The cost for the sprinkler irrigation system includes the mainline and lateral pipe, risers, filtration system and labor charges for installation. In addition, 100% of the cost to refurbish the well and charges for the 20 hp pump and are included in the sprinkler irrigation system. The irrigation system has a 25 year lifespan, is an improvement to the property, and is therefore included in **Table 4. Annual Equipment, Investment and Business Overhead Costs** as an investment.

Incorporation of the cover crop in the spring minimizes the competition for soil moisture between the cover crop and trees. (See the **Cover Crop/Floor Management** section below). The pumping cost for irrigation water is estimated at \$62.88 per acre-foot. A total of 19 acre-inches of water is used to irrigate the orchard and to irrigate replanted trees. The orchard is irrigated four times between June and September.

## 5. PRODUCTION PRACTICES:

Production practices in this study are listed in **Table 1. Costs Per Acre - Operations**. This table shows the order in which the operations are performed, as well as the hours per acre required for each operation. Labor and custom rates, material and fuel and repair costs are also included in this table. **Table 2. Detail of Costs Per Acre - Inputs** shows the material inputs and rates of application. In addition, **Table 3. Monthly Cash Costs Per Acre** shows the monthly cash costs and sequence of operations.

The following table shows the fertilizing materials and crop nutrients that are applied to apples each year.

### Fertilizing Materials and Supplemental Crop Nutrients

Material	Number of Applications/Yr	Application Rate/Acre	Month Applied
Oystershell lime	1	500 lbs	October
Fish Emulsion	2	4 gals	April, July
Kelp Extract	2	2.5 lbs	April, July

A significant variation in costs exists for some operations in this region. The following table shows the range of costs and the assumed cost (rounded to the nearest dollar) for three practices. Costs will vary depending on variety, planting density and fruit load.

### Cost Ranges for Production Practices with Significant Variation

Operation	Cost Range \$/Acre	Study Cost \$/Acre
Hand Thin	0-1,000	352
Tie/Prop Trees	0-80	28
Hand Harvest	400-900	500

## 6. COVER CROPS/FLOOR MANAGEMENT:

In this study, a winter annual cover crop is sown each year in the fall. The planted cover crop is a mixture of annual ryegrass, bell beans, purple vetch and winter peas. No ground preparation is performed before seeding the cover crop. The seed mixture is broadcast throughout the entire orchard (rather than just in orchard centers) at a rate of 100 pounds per acre. This seeding rate represents a mixture of the four species of cover crops (3 pounds of ryegrass, 40 pound of bell beans, 25 pounds of purple vetch and 32 pounds winter peas). The orchard is then disced once in the centers only to cover the seed. The cover crop is not irrigated up, but is dependent on moisture in the soil profile and fall and winter rains for germination and growth.

In May the cover crop is mowed once and then incorporated into the soil by discing twice. Throughout the remainder of the spring and summer orchard centers are disced or rotovated to control weeds and vegetative growth. Therefore, no irrigation water is necessary in the late spring or summer months specifically for cover crops. A weed badger (or comparable implement) and hand weeding are used to control vegetative growth in the tree rows. No other means of weed control are used in this study.

## 7. PEST MANAGEMENT:

A number of treatments are commonly used to minimize pest damage in organic apple orchards. Pest management materials are used preventatively and for reducing and/or controlling certain diseases, insects and mites. Applications may vary on a year to year basis depending on seasonal conditions, pest populations and individual management techniques. Refer to **Table 1. Costs Per Acre - Operations** and **Table 2. Detail of Costs Per Acre - Inputs** following this section for the pest control techniques and materials used for the organic orchard analyzed in this study.

## **8. HARVEST:**

Harvest operations are performed by the grower. Fruit is hand harvested. Harvest costs will vary from orchard to orchard. This study assumes that harvest takes place in the month of September. Refer to **Table 1. Costs Per Acre - Operations** for the exact harvest costs used in this report.

For information on custom harvesting contact the farm advisor or companies contracting for apples in the area of interest. If growers choose to do custom harvesting, custom charges should be added to the harvest costs in **Tables 1. Costs Per Acre - Operations** and **3. Monthly Cash Costs Per Acre**. Equipment for the required operations, labor, fuel, repairs, depreciation and interest on investment, then, would not be included.

## **9. YIELD & RETURN RANGES FOR ORGANIC APPLES:**

In this study, the assumed fresh market yield for organic apples is 350 boxes per acre representing a 52% pack-out. Boxes weigh 40 pounds and are tray-packed. In addition, 7 tons per acre are assumed to be sold to a processor. These yields fall within a range of yields received by growers in this area. Yields vary widely depending on such factors as planting density, variety, orchard age, production location and seasonal growing conditions.

This report assumes that apples are custom-packed, that growers market their product through a local produce broker and that a pricing premium is received. Assumed returns are an average of \$20 per box. Returns to growers can, however, range from \$12 to \$28 per box depending on the variety, quality and yearly market conditions. Not all boxes are sold at one set price each year. These figures represent returns to growers after packing and cooling charges and a 9% to 12% produce broker fee have been subtracted. Assumed returns for processing apples are \$200 per ton which falls within the \$150 to \$260 range usually received by organic growers in this area.

For the orchard analyzed in this study, net returns above total costs are positive at a price for apples of \$20.00 per box when yields reach 300 boxes per acre. For prices at or below \$14.75 per box and for yields at or below 500 boxes per acre, it is not profitable to produce organic apples for the fresh market. The breakeven yield is 235 boxes per acre at a high price of \$28 per box. A ranging analysis for varying yields and prices is shown in **Table 6. Ranging Analysis**.

## **10. LABOR:**

Basic hourly wages for workers are \$6.15 and \$5.25 per hour for machine operators and field workers, respectively. Adding 34% for workers compensation, social security, insurance and other benefits increases the labor rates shown to \$8.24 per hour for machine labor and \$7.04 per hour for non-machine labor. The labor hours for operations involving machinery are 20% higher than operation time to account for extra labor involved in equipment set-up, moving, maintenance and repair. Wages for managers are not included as a cash cost. Any returns above total costs are considered returns to management and risk.

## **11. CASH OVERHEAD:**

Cash overhead consists of various cash expenses paid out during the year that are assigned to the whole farm and not to a particular operation. These costs include, but are not limited to, property taxes, interest on operating capital, offices expenses, property and liability insurance and equipment repairs.

Counties charge a base property tax rate of 1% on the assessed value of the property. In some counties special assessment districts exist and additional taxes are charged on property including equipment, buildings and improvements. For this study, county taxes are calculated as 1% of the average value of the property. Average value equals new cost plus salvage value divided by two on a per acre basis.

Interest on operating capital is based on cash operating costs and is calculated monthly until harvest at a nominal rate of 7.89% per year. A nominal interest rate is the going market cost for borrowed funds.

Office and business expenses are estimated at \$250 per acre. These expenses include office supplies, telephones, bookkeeping, accounting, legal fees, road maintenance, etc. Sanitation services provide portable toilets for field workers and cost the farm \$654 annually.

Insurance for farm investments varies depending on the assets included and the amount of coverage. Property insurance provides coverage for property loss and is charged at 0.713% of the average value of the assets over their useful life. Liability insurance covers accidents on the farm and costs \$336 per year. Cash overhead costs are found in **Tables 1, 2, 3, 4** and **5**.

## **12. NON-CASH OVERHEAD:**

Non-cash overhead is comprised of depreciation and interest charged on equipment and other investments. Although farm equipment is often purchased used, this study shows the current purchase price for new equipment adjusted to 60% of the new value to indicate a mix of new and used equipment. Annual equipment and investment costs are shown in **Tables 1, 2** and **4**. They represent depreciation and opportunity cost for each investment on an annual per acre basis.

Depreciation is a reduction in market value of investments due to wear, obsolescence and age and is on a straight line basis. Annual depreciation is calculated as the purchase price minus the salvage value divided by the years the investment is held. The purchase price and years of life are shown in **Table 4**.

Interest is charged on investments to account for income foregone (opportunity cost) that could be received from an alternative investment. The investments are assumed to be owned outright. Therefore, interest on investments is a non-cash cost. Investments include, but are not limited to, land, orchard establishment, buildings and equipment. Interest is calculated as the average value of the investment during its useful life, multiplied by 3.72% per year. Average value for the equipment and buildings equals the new cost plus the salvage value divided by two on a per acre basis.

Land is not depreciated. Therefore, the average value for land is equal to the purchase price. The interest rate used to calculate opportunity cost is the ten year average of the agricultural sector longrun rate of return to production assets from current income. It is used to reflect the long-term realized rate of return to these specialized resources.

## **13. EQUIPMENT CASH COSTS:**

Equipment costs are composed of three parts; cash overhead, non-cash overhead and operating costs. Both of the overhead factors are detailed in previous sections. The operating costs consist of fuel, lubrication and repairs.

In allocating the equipment costs on a per acre basis, the following hourly charges are calculated first and shown in **Table 5**. Repair costs are based on the purchase price, annual hours of use, total hours of life and repair coefficients formulated by the American Society of Agricultural Engineers (ASAE). Fuel and lubrication costs are also determined by ASAE equations based on maximum PTO horsepower (hp) and the type of fuel used. The fuel and repair costs per acre for each operation in **Table 1** is determined by multiplying the total hourly operating cost in **Table 5** for each piece of equipment used for the cultural practice by the number of hours per acre for that operation. Tractor time is 10% higher than implement time for a given operation to account for setup time. Prices for on-farm delivery of diesel and gasoline are \$0.85 and \$1.17 per gallon, respectively.

#### **14. ASSESSMENTS:**

In this study, a stepped scale organic grower's registration fee of \$300 is assessed by the State of California on the gross sales amount of \$126,000. The fee is calculated by multiplying the assumed yield (350 boxes per acre) by the price received (\$20 per box) and the number of acres (18). This is only an estimate of potential fees and will vary depending on yields and returns. Contact the County Agricultural Commissioner in your area for further details.

The grower is assumed to be certified by California Certified Organic Farmers (CCOF). Annual membership fees are \$125. Inspection fees are \$100. An assessment fee of 0.5% of gross sales, or \$630, is included as a cost of production. These fees are specific to this study. Fees are based on the number of acres and parcels contained in an operation as well as whether or not the farm is totally organic. Therefore, individual situations will vary.

#### **15. ACKNOWLEDGEMENT:**

Several organic apple producers furnished data and information for this study. Appreciation is expressed to those growers and other individuals who provided their invaluable assistance.

This study was funded by the National Agricultural Pesticide Impact Assessment Program (NAPIAP) of the United States Department of Agriculture (USDA), and by the University of California Sustainable Agriculture Research and Education Program (SAREP).

## REFERENCES

- Agrios, George N. 1988. *Plant Pathology*. Academic Press, Inc. San Diego, California.
- Bugg, Robert L. and Carol Waddington. 1992. *Managing Cover Crops to Manage Arthropod Pests of Or-chards*. Paper presented to The Int'l Congress of Entomology. Beijing, People's Republic of China.
- California Certified Organic Farmers, Inc. (CCOF). 1993. *California Certified Organic Farmers 1993 Handbook*. California Certified Organic Farmers, Inc. Santa Cruz, California.
- California Food and Agricultural Code. (section 14904 and commencing with section 46000.)
- California Health and Safety Code. (commencing with section 26569.20.)
- Chaney, David E., Laurie E. Drinkwater and G. Stuart Pettygrove. 1992. *Organic Soil Amendments and Fertilizers*. UC Sustainable Agriculture Research & Education Program. University of California, Division of Agriculture and Natural Resources. Publication 21505.
- Debach, P. and D. Rosen. 1991. *Biological control by natural enemies*. Cambridge University Press. Cambridge, U.K.
- Flint, Mary Louise. 1990. *Pests of the Garden and Small Farm. A Grower's Guide to Using Less Pesticide*. University of California, Statewide Integrated Pest Management Project, Division of Agriculture and Natural Resources. Publication 3332.
- Integrated Pest Management Education and Publications. 1991. *Managing Insects and Mites with Spray Oils*. University of California, Statewide Integrated Pest Management Project, Division of Agriculture and Natural Resources. Publication 3347.
- Integrated Pest Management Education and Publications. 1991. *U.C. IPM Pest Management Guidelines*. University of California, Statewide Integrated Pest Management Project, Division of Agriculture and Natural Resources. Publication 3339.
- Integrated Pest Management Education and Publications. 1991. *Integrated Pest Management for Apples & Pears*. University of California, Statewide Integrated Pest Management Project, Division of Agriculture and Natural Resources. Publication 3340.
- Kader, Adel A., Technical Editor. 1992. *Postharvest Technology of Horticultural Crops*. University of California, Division of Agriculture and Natural Resources. Publication 3311.
- Klonsky, Karen, and Laura Tourte. 1994. *State Registration and Organic Certification: A Guide for California Growers*. Department of Agricultural Economics, University of California. Davis, California.
- Miller, P.R., et al. 1989. *Covercrops for California Agriculture*. University of California, Division of Agriculture and Natural Resources. Leaflet 21471.
- Ogawa, Joseph M. and Harley English. 1991. *Diseases of Temperate Zone Tree Fruit and Nut Crops*. University of California, Division of Agriculture and Natural Resources. Publication 3345.
- Organic Foods Production Act of 1990, Title 21, 1990 Farm Bill, Public Law 101-624.
- Parnes, Robert. 1990. *Fertile Soil: A Grower's Guide to Organic & Inorganic Fertilizers*. agAccess. Davis, CA.
- University of California Cooperative Extension. 1983. *Commercial Apple Growing In California*. Division of Agricultural Sciences. Leaflet 2456.
- Vaupel, Suzanne. 1992. *What a Farmer Needs to Know. A Summary of California & Federal Organic Production Laws*. Suzanne Vaupel, Vaupel Associates. Sacramento, California

**Figure 1. Pest Management Materials for North Coast Organic Apples**

Material <sup>1, 2</sup>	Number of Applications/Year	Application Rate/Acre	Month(s) Performed <sup>3</sup>	Target Pest
Horticultural Oil (dormant & delayed dormant sprays)	1-3	2-8 gals	Feb-March	Aphids, apple pandemis, fruit tree leafroller, mites, scales, thrips (eggs, immature stages)
Lime Sulfur	3-10	3-10 gals	March-May	Apple scab, powdery mildew
Pheromones	2-3	160-400 dispensers <sup>4</sup>	March-June	Codling moth (adult stage)
Wettable Sulfur	1-7	6-10 gals	April-June	Apple scab, powdery mildew
Insecticidal Soap	1-3	1-2 gals	April-June	Aphids, mites, thrips (immature, adult stages)
Horticultural Oil (summer sprays)	1-3	2-4 gals	April-August	Aphids, codling moth, mites (egg, immature, adult stages)
Codling Moth granulosis Virus <sup>5</sup> (CMVG)	3-15	6 X 10 <sup>13</sup> GIB <sup>6</sup> (700 grams)	April-August	Codling moth (larval stage)
Bacillus thuringiensis	3-8	1 lb	April-August	Apple pandemis, codling moth, green fruitworm, leafroller spp., orange tortrix (larval stage)
Pyrellin E.C.	1-2	1 pint	May-June	Aphids, caterpillars (immature, adult stages)
Trichogramma spp. (release)	Variable	Suggested: 40,000-200,000	May-June	Caterpillars
Chrysoperla spp. (release in egg/larval stage)	Variable	Suggested: 10,000-50,000	May-June	Aphids/Soft bodies insects (immature, adult stages)
Strychnine bait <sup>7</sup>	See below	----	----	Rodents

<sup>1</sup> Not all growers use all materials each year.

<sup>2</sup> Some applications may cause phytotoxicity; care should be used when applying any pest management materials.

<sup>3</sup> The timing of material applications is critical for effective pest control and will vary from orchard to orchard.

<sup>4</sup> Application rate per acre depends on brand used.

<sup>5</sup> CMGV has been granted conditional registration in California and is now available for purchase through the Association for Sensible Pest Control.

<sup>6</sup> Granulosis inclusion bodies.

<sup>7</sup> This material is allowed for use in organic agriculture by the State of California, but may be restricted or prohibited by some certification organizations.

**\* The use of trade names is not an endorsement or a recommendation, nor a criticism implied by omission of similar products.**

TABLE 1  
U.C. COOPERATIVE EXTENSION  
COSTS PER ACRE TO PRODUCE FRESH MARKET ORGANIC APPLES - 1993-1994 - NORTH COAST - OPERATIONS

Labor Rate: \$8.24/hr. machine labor  
\$7.04/hr. non-machine labor

Interest Rate: 7.89%  
Yield per Acre: 350.00 40-pound tray-packed boxes

Operation	Operation Time (Hrs/A)	Cash and Labor Costs per Acre					Total Cost	Your Cost
		Labor Cost	Fuel,Lube & Repairs	Material Cost	Custom/ Rent			
<b>Cultural:</b>								
Plant Cover Crop - Broadcast Seed	0.33	6.53	2.54	54.23	0.00	63.29		
Disc - Cover Seed	0.43	4.25	2.84	0.00	0.00	7.10		
Oystershell Lime Application	0.82	8.12	4.82	27.90	0.00	40.84		
Disc - Incorporate Lime	0.43	4.25	2.84	0.00	0.00	7.10		
Prune Orchard	50.00	352.00	0.00	0.00	0.00	352.00		
Tree Replacement - 3 per acre	1.00	9.89	5.15	19.08	0.00	34.12		
Irrigate and Prune Replants	2.00	14.08	0.00	5.24	0.00	19.32		
Pruning Disposal	1.30	33.97	7.83	0.00	0.00	41.81		
Oil/Lime Sulfur Application	0.33	3.26	2.50	59.55	0.00	65.31		
Tie Pheromones - Spring	2.00	14.08	0.00	117.98	0.00	132.06		
Lime Sulfur Application 2X	0.66	6.53	4.99	38.64	0.00	50.16		
Foliar Nutrient Spray 2X	0.66	6.53	4.99	70.89	0.00	82.41		
Mow Cover Crop	0.67	6.59	4.13	0.00	0.00	10.72		
Disc 2X - Incorporate Cover Crop	0.86	8.50	5.69	0.00	0.00	14.19		
Rotovate 4X	3.20	31.64	19.95	0.00	0.00	51.59		
Wettable Sulfur Application 3X	0.99	9.79	7.49	6.24	0.00	23.52		
Granulosis Virus Application 3X	2.25	22.25	17.02	84.00	0.00	123.27		
Release Beneficial Insects - 1/4 of acreage	0.50	3.52	0.00	11.81	0.00	15.33		
Hand Thin	50.00	352.00	0.00	0.00	0.00	352.00		
Weed Control - In Row 2X	4.00	39.55	29.21	0.00	0.00	68.76		
Pyrellin EC Application	0.33	3.26	2.50	10.45	0.00	16.21		
Tie Pheromones - Summer	2.00	14.08	0.00	58.99	0.00	73.07		
Irrigation 4X	3.00	21.12	0.00	94.32	0.00	115.44		
Weed Control - Disc Centers 2X	0.86	8.50	5.69	0.00	0.00	14.19		
Tie or Prop Trees	4.00	28.16	0.00	0.00	0.00	28.16		
Broken Limbs - Misc Care	0.10	0.70	0.00	0.00	0.00	0.70		
Hand Weed	4.50	31.68	0.00	0.00	0.00	31.68		
Rodent Control - Trap	0.85	5.98	0.00	0.00	0.00	5.98		
Pickup Use	15.88	157.02	100.90	0.00	0.00	257.92		
<b>TOTAL CULTURAL COSTS</b>	<b>153.95</b>	<b>1,207.85</b>	<b>231.08</b>	<b>659.32</b>	<b>0.00</b>	<b>2,098.24</b>		
<b>Harvest:</b>								
Hand Harvest	71.00	499.84	0.00	0.00	0.00	499.84		
Equipment Use	0.40	3.96	2.08	0.00	0.00	6.03		
Transport of Product	4.00	39.55	29.42	0.00	0.00	68.98		
Packing Services	0.00	0.00	0.00	374.50	1,750.00	2,124.50		
Cooling Services	0.00	0.00	0.00	0.00	87.50	87.50		
<b>TOTAL HARVEST COSTS</b>	<b>75.40</b>	<b>543.35</b>	<b>31.50</b>	<b>374.50</b>	<b>1,837.50</b>	<b>2,786.85</b>		

U.C. COOPERATIVE EXTENSION  
 FRESH MARKET ORGANIC APPLES - 1993-1994 - NORTH COAST  
 Table 1. continued

Operation	Operation	----- Cash and Labor Costs per Acre -----					Total Cost	Your Cost
	Time (Hrs/A)	Labor Cost	Fuel,Lube & Repairs	Material Cost	Custom/Rent			
Assessments:								
California State Organic Registration Fees	0.00	0.00	0.00	16.67	0.00	16.67		
CCOF Membership Fees	0.00	0.00	0.00	6.94	0.00	6.94		
CCOF Inspection Fees	0.00	0.00	0.00	5.56	0.00	5.56		
CCOF - 0.5% of Gross Sales	0.00	0.00	0.00	35.00	0.00	35.00		
<b>TOTAL ASSESSMENT COSTS</b>	0.00	0.00	0.00	64.17	0.00	64.17		
Interest on operating capital @ 7.89%						91.34		
<b>TOTAL OPERATING COSTS/ACRE</b>		1,751.20	262.58	1,097.99	1,837.50	5,040.60		
<b>TOTAL OPERATING COSTS/BOX</b>							14.40	
<b>CASH OVERHEAD:</b>								
Office Expense						250.00		
Tissue/Soil Analysis						4.00		
Liability Insurance						18.67		
Sanitation Services						36.33		
Property Taxes						101.60		
Property Insurance						203.21		
Investment Repairs						39.44		
<b>TOTAL CASH OVERHEAD COSTS</b>						653.25		
<b>TOTAL CASH COSTS/ACRE</b>						5,693.85		
<b>TOTAL CASH COSTS/BOX</b>						16.27		
<b>NON-CASH OVERHEAD:</b>								
Investment	Per producing Acre	Depreciation	Interest @ 3.72%					
Buildings	833.33	25.00	17.05		42.05			
Fuel tanks & pumps	450.00	20.25	9.21		29.46			
Shop tools	611.11	36.67	12.50		49.17			
Land	11,000.00		409.20		409.20			
Orchard Establishment	9,428.00	377.12	175.36		552.48			
Irrigation System	1,527.78	55.00	31.26		86.26			
ATV - 4WD	423.06	76.14	8.66		84.80			
Product Bins	361.11	32.50	7.39		39.89			
Pruning Equipment	66.67	6.00	1.36		7.36			
Harvest Equipment	75.33	6.78	1.54		8.32			
Tree Props	505.00	18.18	10.33		28.51			
Equipment	3,522.04	323.64	72.06		395.70			
<b>TOTAL NON-CASH OVERHEAD COSTS</b>						1,733.20		
<b>TOTAL COSTS/ACRE</b>						7,427.05		
<b>TOTAL COSTS/BOX</b>						21.22		



U.C. COOPERATIVE EXTENSION  
 FRESH MARKET ORGANIC APPLES - 1993-1994 - NORTH COAST  
 Table 2. continued

Quantity/Acre	Unit	Price or Cost/Unit	Value or Cost/Acre	Your Cost
<b>CASH OVERHEAD COSTS:</b>				
			250.00	
			4.00	
			18.67	
			36.33	
			101.60	
			203.21	
			39.44	
<b>TOTAL CASH OVERHEAD COSTS/ACRE</b>			653.25	
<b>TOTAL CASH COSTS/ACRE</b>			5,693.85	
<b>TOTAL CASH COSTS/BOX</b>			16.27	
<b>NON-CASH OVERHEAD COSTS (DEPRECIATION &amp; INTEREST):</b>				
			42.05	
			29.46	
			49.17	
			409.20	
			552.48	
			86.26	
			84.80	
			39.89	
			7.36	
			8.32	
			28.51	
			395.70	
<b>TOTAL NON-CASH OVERHEAD COSTS/ACRE</b>			1,733.20	
<b>TOTAL COSTS/ACRE</b>			7,427.05	
<b>TOTAL COSTS/BOX</b>			21.22	

1. Per acre treatment cost is for 400 dispensers.
2. This material has been granted conditional registration in the State of California and is now available for purchase through the Association for Sensible Pest Control in Clayton, California.
3. Cost includes dry flow molasses as an attractant, diatomaceous earth as a desiccant and NuFilm P as a spreader-sticker.
4. Second per acre treatment cost is reduced by half when growers purchase dispensers from the same manufacturer.

TABLE 3  
U.C. COOPERATIVE EXTENSION  
MONTHLY CASH COSTS PER ACRE TO PRODUCE FRESH MARKET ORGANIC APPLES  
NORTH COAST - 1993-1994

Beginning OCT 93	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	TOTAL
Ending SEP 94	93	93	93	94	94	94	94	94	94	94	94	94	
Cultural:													
Plant Cover Crop - Broadcast	63.29												63.29
Disc - Cover Seed	7.10												7.10
Oystershell Lime Application	40.84												40.84
Disc - Incorporate Lime	7.10												7.10
Prune Orchard				176.00	176.00								352.00
Tree Replacement - 3 per acre					34.12								34.12
Irrigate and Prune Replants						19.32							19.32
Pruning Disposal						41.81							41.81
Oil/Lime Sulfur Application						65.31							65.31
Tie Pheromones - Spring							132.06						132.06
Lime Sulfur Application 2X							50.16						50.16
Foliar Nutrient Spray 2X							41.20			41.20			82.41
Mow Cover Crop								10.72					10.72
Disc 2X - Incorp Cover Crop								14.19					14.19
Rotovate 4X								12.90	12.90	25.80			51.59
Wettable Sulfur Application								15.68	7.84				23.52
Granulosis Virus Applications 3X								41.09	41.09	41.09			123.27
Release Beneficial Insects								15.33					15.33
Hand Thin								176.00	176.00				352.00
Weed Control - In-Row 2X								34.38	34.38				68.76
Pyrellin EC Application									16.21				16.21
Tie Pheromones - Summer									73.07				73.07
Irrigation 4X									28.86	28.86	28.86	28.86	115.44
Weed Control - Disc Centers									14.19				14.19
Tie or Prop Trees										28.16			28.16
Broken Limbs - Miscellaneous Care										0.70			0.70
Hand Weed											31.68		31.68
Rodent Control - Trap												5.98	5.98
Pickup Use												257.92	257.92
<b>TOTAL CULTURAL COSTS</b>	<b>118.32</b>			<b>176.00</b>	<b>210.12</b>	<b>126.44</b>	<b>223.42</b>	<b>320.29</b>	<b>404.54</b>	<b>165.81</b>	<b>60.54</b>	<b>292.77</b>	<b>2,098.24</b>
Harvest:													
Hand Harvest												499.84	499.84
Equipment Use												6.03	6.03
Transport of Product												68.98	68.98
Packing Services												2,124.50	2,124.50
Cooling Services												87.50	87.50
<b>TOTAL HARVEST COSTS</b>												<b>2,786.85</b>	<b>2,786.85</b>
Assessments:													
CA State Organic Registration Fees												16.67	16.67
CCOF Membership Fees												6.94	6.94
CCOF Inspection Fees												5.56	5.56
CCOF - 0.5% of Gross Sales												35.00	35.00
<b>TOTAL ASSESSMENT COSTS</b>												<b>64.17</b>	<b>64.17</b>
Interest on oper. capital	0.78	0.78	0.78	1.94	3.32	4.15	5.62	7.72	10.38	11.47	11.87	32.54	91.34
<b>TOTAL OPERATING COSTS/ACRE</b>	<b>119.09</b>	<b>0.78</b>	<b>0.78</b>	<b>177.94</b>	<b>213.43</b>	<b>130.58</b>	<b>229.04</b>	<b>328.01</b>	<b>414.92</b>	<b>177.29</b>	<b>72.41</b>	<b>3,176.33</b>	<b>5,040.60</b>
<b>TOTAL OPERATING COSTS/BOX</b>	<b>0.34</b>	<b>0.00</b>	<b>0.00</b>	<b>0.51</b>	<b>0.61</b>	<b>0.37</b>	<b>0.65</b>	<b>0.94</b>	<b>1.19</b>	<b>0.51</b>	<b>0.21</b>	<b>9.08</b>	<b>14.40</b>

U.C. COOPERATIVE EXTENSION  
 FRESH MARKET ORGANIC APPLES - 1993-1994 - NORTH COAST  
 Table 3. continued

Beginning OCT 93	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	TOTAL
Ending SEP 94	93	93	93	94	94	94	94	94	94	94	94	94	
<b>OVERHEAD:</b>													
Office Expense	20.83	20.83	20.83	20.83	20.83	20.83	20.83	20.83	20.83	20.83	20.83	20.83	250.00
Tissue/Soil Analysis													4.00
Liability Insurance													18.67
Sanitation Services													36.33
Property Taxes			50.80				50.80						101.60
Property Insurance				203.21									203.21
Investment Repairs	3.29	3.29	3.29	3.29	3.29	3.29	3.29	3.29	3.29	3.29	3.29	3.29	39.44
<b>TOTAL CASH OVERHEAD COSTS</b>	<b>24.12</b>	<b>24.12</b>	<b>74.92</b>	<b>227.33</b>	<b>24.12</b>	<b>24.12</b>	<b>74.92</b>	<b>24.12</b>	<b>24.12</b>	<b>24.12</b>	<b>24.12</b>	<b>83.12</b>	<b>653.25</b>
<b>TOTAL CASH COSTS/ACRE</b>	<b>143.22</b>	<b>24.90</b>	<b>75.70</b>	<b>405.26</b>	<b>237.55</b>	<b>154.70</b>	<b>303.96</b>	<b>352.13</b>	<b>439.04</b>	<b>201.41</b>	<b>96.53</b>	<b>3,259.45</b>	<b>5,693.85</b>
<b>TOTAL CASH COSTS/BOX</b>	<b>0.41</b>	<b>0.07</b>	<b>0.22</b>	<b>1.16</b>	<b>0.68</b>	<b>0.44</b>	<b>0.87</b>	<b>1.01</b>	<b>1.25</b>	<b>0.58</b>	<b>0.28</b>	<b>9.31</b>	<b>16.27</b>

TABLE 4  
U.C. COOPERATIVE EXTENSION  
ANNUAL EQUIPMENT, INVESTMENT, AND BUSINESS OVERHEAD COSTS  
FOR FRESH MARKET ORGANIC APPLE PRODUCTION - 1993-1994 - NORTH COAST

ANNUAL EQUIPMENT COSTS

Yr	Description	Price	Yrs Life	- Non-Cash Over. -		- Cash Overhead -		Total
				Depre- ciation	Interest	Insur- ance	Taxes	
94	60HP 4WD Tractor	30,030	12	2,252.25	614.41	165.16	82.58	3,114.40
94	Air Blast Sprayer	5,180	10	466.20	105.98	28.49	14.24	614.91
94	Brush Rake & Loader	6,025	15	361.53	123.26	33.14	16.57	534.50
94	Forklift - 3pt.	350	15	21.00	7.16	1.93	0.96	31.05
94	Manure Spreader	4,966	15	297.93	101.61	27.32	13.66	440.52
94	Offset Disc - 8'	5,090	15	305.40	104.14	28.00	14.00	451.54
94	Pickup 1/2 ton	16,500	7	2,121.43	337.59	90.75	45.37	2,595.14
94	Rotary Mower - 6'	2,923	10	263.10	59.80	16.08	8.04	347.02
94	Rotary Tiller - 6'	3,775	15	226.47	77.25	20.76	10.38	334.86
94	Spin/Spreader - 3pt.	800	15	48.00	16.37	4.40	2.20	70.97
94	Truck 2 ton	22,523	7	2,895.86	460.82	123.88	61.94	3,542.50
94	Weed Badger	7,500	15	450.00	153.45	41.25	20.63	665.33
TOTAL		105,662		9,709.17	2,161.84	581.16	290.57	12,742.74
60% of New Cost *		63,397		5,825.50	1,297.10	348.70	174.34	7,645.64

\* Used to reflect a mix of new and used equipment.

ANNUAL INVESTMENT COSTS

Description	Price	Yrs Life	- Non-Cash Over. -		----- Cash Overhead -----			Total
			Depre- ciation	Interest	Insur- ance	Taxes	Repairs	
INVESTMENT								
Irrigation System	27,500	25	990.00	562.65	151.25	75.63	150.00	1,929.53
Land	198,000			7,365.60	1,980.00	990.00	0.00	10,335.60
Orchard Establishment	169,704	25	6,788.16	3,156.49	848.52	424.26	0.00	11,217.43
ATV - 4WD	7,615	5	1,370.60	155.81	41.88	20.94	100.00	1,689.23
Buildings	15,000	30	450.00	306.90	82.50	41.25	100.00	980.65
Fuel tanks & pumps	8,100	20	364.50	165.73	44.55	22.28	125.00	722.06
Harvest Equipment	1,356	10	122.00	27.75	7.46	3.73	10.00	170.94
Product Bins	6,500	10	585.00	132.99	35.75	17.88	50.00	821.62
Tree Props	9,090	25	327.24	185.98	49.99	25.00	50.00	638.21
Pruning Equipment	1,200	10	108.00	24.55	6.60	3.30	25.00	167.45
Shop tools	11,000	15	660.00	225.06	60.50	30.25	100.00	1,075.81
TOTAL INVESTMENT	455,065		11,765.50	12,309.51	3,309.00	1,654.52	710.00	29,748.53

ANNUAL BUSINESS OVERHEAD COSTS

Description	Units/		Price/ Unit	Total Cost
	Farm	Unit		
Office Expense	18.00	acre	250.00	4,500.00
Tissue/Soil Analysis	18.00	acre	4.00	72.00
Liability Insurance	1.00	farm	336.00	336.00
Sanitation Services	1.00	year	654.00	654.00

TABLE 5  
U.C. COOPERATIVE EXTENSION  
HOURLY EQUIPMENT COSTS FOR FRESH MARKET ORGANIC APPLE PRODUCTION  
NORTH COAST - 1993-1994

		----- COSTS PER HOUR -----								
Yr	Description	Actual Hours Used	-Non-Cash Over- Depre- ciation	Interest	- Cash Overhead - Insur- ance Taxes	Repairs	Operating Fuel & Lube	Total Oper.	Total Costs/Hr.	
94	60HP 4WD Tractor	386.5	3.50	0.95	0.26	0.13	1.80	2.88	4.68	9.52
94	Air Blast Sprayer	94.0	2.98	0.68	0.18	0.09	2.42	0.00	2.42	6.34
94	Brush Rake & Loader	23.4	9.27	3.16	0.85	0.42	0.88	0.00	0.88	14.58
94	Forklift - 3pt.	7.2	1.75	0.60	0.16	0.08	0.05	0.00	0.05	2.64
94	Manure Spreader	14.8	12.09	4.12	1.11	0.55	0.72	0.00	0.72	18.60
94	Offset Disc - 8'	46.4	3.95	1.35	0.36	0.18	1.46	0.00	1.46	7.30
94	Pickup - 1/2 ton	285.8	4.45	0.71	0.19	0.10	2.99	3.36	6.35	11.80
94	Rotary Mower - 6'	12.0	13.16	2.99	0.80	0.40	1.05	0.00	1.05	18.40
94	Rotary Tiller - 6'	57.6	2.36	0.80	0.22	0.11	1.09	0.00	1.09	4.57
94	Spinner Spreader - 3pt.	6.5	4.41	1.50	0.40	0.20	0.86	1.44	2.30	8.82
94	Truck - 2 ton	72.0	24.13	3.84	1.03	0.52	5.41	1.95	7.36	36.88
94	Weed Badger	72.0	3.75	1.28	0.34	0.17	2.15	0.00	2.15	7.70

TABLE 6  
U.C. COOPERATIVE EXTENSION  
RANGING ANALYSIS  
FRESH MARKET ORGANIC APPLES - 1993-1994 - NORTH COAST

	COSTS PER ACRE AT VARYING YIELDS TO PRODUCE ORGANIC APPLES <sup>1</sup>						
	YIELD <sup>2</sup>						
	150	225	300	350	425	500	600
Fresh Market (Boxes/Acre)	150	225	300	350	425	500	600
Processing (Tons/Acre)	4.0	5.0	6.0	7.0	8.0	9.0	10.0
<b>OPERATING COSTS/ACRE:</b>							
Cultural Cost	2,098	2,098	2,098	2,098	2,098	2,098	2,098
Harvest Cost	1,192	1,790	2,388	2,787	3,385	3,983	4,780
Assessment Cost	64	64	64	64	64	64	64
Interest on operating capital	81	85	89	91	95	99	104
<b>TOTAL OPERATING COSTS/ACRE</b>	<b>3,435</b>	<b>4,037</b>	<b>4,639</b>	<b>5,041</b>	<b>5,643</b>	<b>6,245</b>	<b>7,047</b>
<b>TOTAL OPERATING COSTS/BOX</b>	<b>22.90</b>	<b>17.94</b>	<b>15.46</b>	<b>14.40</b>	<b>13.28</b>	<b>12.49</b>	<b>11.75</b>
<b>CASH OVERHEAD COSTS/ACRE</b>	<b>653</b>	<b>653</b>	<b>653</b>	<b>653</b>	<b>653</b>	<b>653</b>	<b>653</b>
<b>TOTAL CASH COSTS/ACRE</b>	<b>4,089</b>	<b>4,691</b>	<b>5,293</b>	<b>5,694</b>	<b>6,296</b>	<b>6,898</b>	<b>7,700</b>
<b>TOTAL CASH COSTS/BOX</b>	<b>27.26</b>	<b>20.85</b>	<b>17.64</b>	<b>16.27</b>	<b>14.81</b>	<b>13.80</b>	<b>12.83</b>
<b>NON-CASH OVERHEAD COSTS/ACRE</b>	<b>1,733</b>	<b>1,733</b>	<b>1,733</b>	<b>1,733</b>	<b>1,733</b>	<b>1,733</b>	<b>1,733</b>
<b>TOTAL COSTS/ACRE</b>	<b>5,822</b>	<b>6,424</b>	<b>7,026</b>	<b>7,427</b>	<b>8,029</b>	<b>8,631</b>	<b>9,434</b>
<b>TOTAL COSTS/BOX</b>	<b>38.81</b>	<b>28.55</b>	<b>23.42</b>	<b>21.22</b>	<b>18.89</b>	<b>17.26</b>	<b>15.72</b>

1. Refer to Table 1. Costs Per Acre - Operations for costs included in Operating, Cash and Total Costs.
2. Yields are for a combination of fresh market and processing production per acre.

NET RETURNS PER ACRE ABOVE OPERATING COSTS FOR ORGANIC APPLES

PRICE		YIELD <sup>2</sup>						
Fresh (Boxes)	Processing (Tons)	150	225	300	350	425	500	600
\$/Box	\$/Ton	4.0	5.0	6.0	7.0	8.0	9.0	10.0
12.00	150	-1,587	-587	-139	209	657	1,105	1,653
14.75	160	-1,164	82	746	1,242	1,906	2,570	3,403
17.50	180	-740	801	1,691	2,344	3,235	4,125	5,253
20.00	200	-355	1,463	2,561	3,359	4,457	5,555	6,953
22.50	220	30	2,126	3,431	4,374	5,680	6,985	8,653
25.25	240	454	2,844	4,376	5,477	7,008	8,540	10,503
28.00	260	877	3,563	5,321	6,579	8,337	10,095	12,353

NET RETURNS PER ACRE ABOVE CASH COSTS FOR ORGANIC APPLES

PRICE		YIELD <sup>2</sup>						
Fresh (Boxes)	Processing (Tons)	150	225	300	350	425	500	600
\$/Box	\$/Ton	4.0	5.0	6.0	7.0	8.0	9.0	10.0
12.00	150	-1,689	-1,241	-793	-444	4	452	1,000
14.75	160	-1,237	-572	92	589	1,253	1,917	2,750
17.50	180	-744	147	1,037	1,691	2,582	3,472	4,600
20.00	200	-289	809	1,907	2,706	3,804	4,902	6,300
22.50	220	166	1,472	2,777	3,721	5,027	6,332	8,000
25.25	240	659	2,190	3,722	4,824	6,355	7,887	9,850
28.00	260	1,151	2,909	4,667	5,926	7,684	9,442	11,700

NET RETURNS PER ACRE ABOVE TOTAL COSTS FOR ORGANIC APPLES

PRICE		YIELD <sup>2</sup>						
Fresh (Boxes)	Processing (Tons)	150	225	300	350	425	500	600
\$/Box	\$/Ton	4.0	5.0	6.0	7.0	8.0	9.0	10.0
12.00	150	-3,422	-2,974	-2,526	-2,177	-1,729	-1,281	-734
14.75	160	-2,970	-2,305	-1,641	-1,145	-480	184	1,016
17.50	180	-2,477	-1,587	-696	-42	849	1,739	2,866
20.00	200	-2,022	-924	174	973	2,071	3,169	4,566
22.50	220	-1,567	-262	1,044	1,988	3,294	4,599	6,266
25.25	240	-1,075	457	1,989	3,091	4,622	6,154	8,116
28.00	260	-582	1,176	2,934	4,193	5,951	7,709	9,966

1. Refer to Table 1. Costs Per Acre - Operations for costs included in Operating, Cash and Total Costs.
2. Yields are for a combination of fresh market and processing production per acre.