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**1993-1994**

**U.C. COOPERATIVE EXTENSION**

**PRODUCTION PRACTICES AND SAMPLE COSTS  
TO PRODUCE ORGANIC APPLES  
FOR THE FRESH MARKET**

***CENTRAL COAST***  
***(Monterey, San Benito and Santa Cruz Counties)***

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**1993-1994 - U.C. COOPERATIVE EXTENSION**  
**OVERVIEW OF ORGANIC APPLE PRODUCTION**  
**FOR THE FRESH MARKET**  
*In The Central Coast*

**Introduction:**

The Central Coast (Monterey, San Benito and Santa Cruz Counties) has long been an established apple production region in the State of California. In recent years, some apple production acreage has been diverted for urban expansion or is now planted to higher value commodities, particularly those with the potential for multiple crops each year. Growers in the area also face increased competition from apple producing regions out-of-state and in the Central Valley of California. Nonetheless, the Central Coast supports a number of growers who now produce apples organically. The total acreage dedicated to both conventional and organic apple production in 1993 was 4,785. Approximately 310 acres, or six percent of the total acreage, was farmed organically. Varieties that are grown organically in this area include Fuji, Granny Smith, Jonagold, McIntosh, Red Delicious and Yellow Newtown Pippins.

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 Central 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 usually begin each year after harvest by planting a cover crop. The cover crop is generally not irrigated up nor is a postharvest irrigation performed. Growers most often rely on fall and winter rains to replenish moisture in the soil profile and for cover crop germination and growth. Refer to the **Cover Crop/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. In the Central Coast, growers report that yearly applications of many materials are neither necessary nor economically viable. Therefore, oystershell lime, sulfate of potash and other soil additives for pH regulation and/or nutrient additions are typically applied every third or fourth year only.

Compost or composted manure is spread in some orchards in the fall after a cover crop is sown to add organic matter to soils and to supply trees with nitrogen and other nutrients for crop production during the following spring and summer. Alternatively, compost or composted manure is applied in the spring after mowing or discing the vegetative growth in the orchard. There is some debate as to whether a fall application 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 may be more efficiently utilized by trees and thus reduce the risk of nitrogen leaching and runoff during the dormant period.

Orchard pruning can begin as early as November and can be completed as late as March 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 or discing of the orchard floor. Sucker removal is performed jointly with tree pruning. Some varieties are summer pruned in May, June, July or August in addition to dormant pruning.

In older orchards with standard rootstocks (75 to 100 trees per acre), marginally producing trees are replaced each year in the months of January, February or March. Typically, tree replacement is to size-controlling 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 old tree's 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 other 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. Still other growers may practice a type of "crop rotation" by not immediately replanting trees in the same area, helping to break pest cycles. When large enough blocks of land are taken out of tree production, alternate crops may then be planted to produce farm income during the rotation period.

In addition to the mixed-age orchards described above, about one-third of the apple acreage in the Central Coast 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 800. In order to maintain competitiveness with Central Valley fresh market apple production, many new orchards are being planted to Braeburn, Fuji and Jonagold. These cultivars produce optimum flavor and color in the cooler climate of the Central Coast. For earliest production, M7 (dwarfing) rootstock is used most frequently in high-density plantings. Seedling rootstock or sometimes MM111 are used for replants or in poor soil.

Pest management operations for disease, insect, mite, vertebrate and weed control often begin as early as the month of January 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 Central Coast orchards. Therefore, growers do not have on-farm investments specifically for frost protection.

Because apples require bees for pollination, Central Coast organic growers generally contract to bring hives into their orchards on a yearly basis. One to two hives per acre is common. This practice 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.

Apples are hand thinned in May or 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 such as Yellow Newtown Pippins often produce more consistent and uniform yields when thinned within one month of bloom each year. However, the associated increase in cultural costs for thinning alternate-bearing varieties each year is not necessarily beneficial from an economic perspective.

Foliar nutrient sprays are not commonly applied in Central Coast organic apple orchards. Growers report that material costs often outweigh the short-term economic benefits. However, calcium sprays are used periodically in some orchards to boost calcium levels and possibly decrease the incidence of bitter bit, a physiological disorder associated with calcium deficiencies in apples.

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 the orchard floor vegetation is managed. For example, if orchards have year-round cover crops or resident vegetation, a greater amount of applied water may be necessary due to competition between floor vegetation and trees for moisture. 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 this region, sprinkler (movable pipe) irrigation is most often used in mixed-age orchards. Some orchards are flood irrigated. Low-volume systems are more prevalent in orchards with high-density plantings. Low-volume irrigation systems typically deliver water more efficiently than sprinkler or flood systems and therefore less total water may be required to irrigate the orchard.

Some orchards in the Central Coast are dry-farmed (not irrigated). These orchards are typically older blocks planted to standard rootstock with fewer trees per acre. Dry-farmed orchards are not necessarily managed as intensively as are the newer high-density plantings. Also, apples harvested from dry-farmed orchards are sometimes processed rather than sold on the fresh market.

In many Central Coast apple orchards, trees on standard rootstock are propped 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.

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 and/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 mid-August 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. For example, small sized apples are generally cello-bagged and large sized apples tray-packed. However, in some cases special orders may dictate a different packing protocol. In this area, yields for organically produced apples can range from 7 (low-density plantings) to 30 (high-density plantings) gross tons per acre. An estimated 70 to 95 percent of this tonnage will go to the packing shed; some of this fruit will be culled for processing. Packing is done primarily by a custom packing house. Some small-scale growers pack their own product.

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 four apple varieties grown organically in the Central Coast.

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

| <b>Apple Variety</b>          | <b>Boxes Per Acre</b> | <b>% of Gross Tonnage</b> |
|-------------------------------|-----------------------|---------------------------|
| <b>Granny Smith</b>           | <b>355-600</b>        | <b>50-60</b>              |
| <b>Jonagold<sup>2</sup></b>   | <b>700</b>            | <b>70</b>                 |
| <b>McIntosh</b>               | <b>225-300</b>        | <b>45-80</b>              |
| <b>Yellow Newtown Pippins</b> | <b>120-240</b>        | <b>25-30</b>              |

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

<sup>2</sup> Jonagold yield is based on a high-density planting. No ranges are shown.

## 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 beneficial insects. 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 reduce 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 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 and/or pumping costs high in this area. 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 systems 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, disced 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.

In Central Coast organic apple orchards, annually sown cover crops are customarily planted in the fall after harvest. Legumes such as bell beans and vetch, and grasses such as barley, oats and rye are the preferred cover crop species. Less often, resident vegetation and/or perennial species are managed as the cover crop.

In the spring months cover crop management depends on the type of cover crop that exists in the orchard. For example, annually sown cover crops are generally 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. Orchard floors are then disced periodically throughout the summer to keep the floor free of vegetative growth.

If resident vegetation or perennial species are managed as the cover crop, vegetative growth is not incorporated by tillage operations. Orchard floor vegetation is mowed periodically 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. *Pest Management Materials for Central Coast Apples*** includes information on specific materials, application rates and the appropriate months in which materials are usually applied by Central 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 on **Figure 1. (on page 16)** used by all farmers each year. Growers 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, orchard sanitation, 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 Central Coast are apple scab (*Venturia inaequalis*) and powdery mildew (*Podosphaera leucotricha*). 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. During drought years apple scab incidence is typically lowered. 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 or micronized sulfur are the organically acceptable fungicides that are used 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 four 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.

Unlike apple scab and powdery mildew, the bacterial disease fire blight (*Erwinia amylovora*) seldom occurs in orchards in this area. However, some apple rootstocks (for example M26) and varieties (such as Fuji) are more susceptible to this disease than others. In addition, the disease is more common in warmer areas such as San Benito County. This disease can be spread by water, insects or wind. The pathogen overwinters in twigs, branches or tree trunks and requires moist, warm springs to spread. Preventative treatments include mineral-based copper sprays or the naturally occurring antibiotic streptomycin. Some growers prune and burn diseased wood to control the bacteria if it is already present in an orchard.

Sunburn or sunscald, a physical disorder that occurs in some apple varieties grown in the Central Coast can markedly reduce fresh market yields. Fruit with minor sunburn damage may be diverted for processing; fruit with severe damage may not be salvageable at all. Pruning and training methods may influence the amount of fruit injury and damage.

**Insects and Mites.** Four insect pests cause the majority of fruit damage and yield loss in Central Coast organic apple orchards. They are: codling moth (*Cydia pomonella*), rosy apple aphid (*Dysaphis plantaginea*), apple pandemis (*Pandemis prysuana*) and orange tortrix (*Argyrotaenia citrana*). Less notable pests that occur in the area include a number of different aphid, mite and scale 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. Unlike many apple producing regions within the state, the Central Coast enjoys somewhat of a control advantage for codling moth; mild temperatures during the growing season inhibit development and thus the number of generations (flights) that occur each year. Nonetheless, effective overall reduction or control methods for codling moth were previously unavailable. A number of techniques have been and are still being used to combat this pest. Horticultural oils are sometimes applied to trees in the spring months to increase mortality of 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, burying or discing into orchard soils. The botanical insecticide ryania and 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 in Clayton, California. 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. Pheromone traps are used to monitor insect populations to determine pest pressure and appropriate treatments. In addition, dispensers containing codling moth pheromone (a species-specific female sex odor) are placed in large numbers (160 to 400 per acre depending on the brand purchased) 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.

Mating disruption programs may also have some limitations. Grower experience indicates that this codling moth control technique is not necessarily effective on sloped land or in orchards with missing trees, possibly due to non-uniform application rates. Also, mated females from adjacent untreated orchards may fly into pheromone-treated orchards and subsequently cause fruit damage. In either case, codling moth control in total can be reduced.

Horticultural oils are also utilized for the control of aphid, apple pandemis, mite and scale pests. Dormant (winter) and delayed dormant (green tip) 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, beneficial insects within the orchard will be killed if sprayed directly. Apple pandemis and orange tortrix populations may be reduced with spray applications of Bt. Some growers prune aphid-infested trees in late spring or early summer to remove damaged branches and reduce pest populations. Prunings are disposed of by chopping and/or burning. Insecticidal soap sprays may also be 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. Insecticidal soap is thought to be most effective when applied early in the season, however, there is some debate as to whether or not this material is effective in reducing aphid populations overall. 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 16)** for additional information.

Aphid populations can be reduced by controlling honeydew-seeking ant species. It is commonly known, for example, that some ants protect aphids from their natural enemies in order to feed on the aphid exudate honeydew. When ants successfully reduce natural enemies in orchard settings, this can indirectly increase in pest populations of species other than aphids because natural controls are reduced in total. Some organic apple growers apply sticky materials such as Tanglefoot or Stickem to tree trunks to form barriers and block the access of ants to foliage and tree tops. A tree wrap should be used on young trees before applying these materials as damage may result to the tree bark.

Many beneficial arthropods such as parasites and predators occur naturally within organic orchards. Growers in the Central Coast rarely augment these populations with purchased (supplemental) beneficial insects. 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.** Weeds are most often controlled in the spring and summer months by discing orchard centers and, when tree spacing allows, cross discing to reduce weed growth in tree rows. Weeds in tree rows are also controlled by hand hoeing in addition to mechanical cultivations. The number of mechanical cultivations 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 by the State of California, but may be restricted and/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 negatively impact 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 or 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 sales agent or local produce broker. Sales agents charge a fee or commission for coupling growers and buyers for their mutual benefit. When growers use a sales agent, they often enlist the services of a consolidator to cool, inventory and ship their product. Sales agents' fees are generally nine to ten percent of the product sold; consolidators charge a flat rate on a per box basis. Alternatively, produce brokers act as intermediaries between producers and buyers. They receive the product after packing and in turn facilitate cooling, handling, sales and distribution 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. Additionally, growers may sell their 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 voluntarily held 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 transition period. On or after January 1, 1996 the transition 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).

The OPFA 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 law are noteworthy. First, 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 information sources.

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

### ORGANIC APPLES FOR THE FRESH MARKET COST AND RETURNS STUDY

#### *Central Coast*

#### General Information

The practices described for the hypothetical orchard used in this report are considered common for organic apple production in the Central 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 **Cost of Productions Assumptions For Producing Fresh Market 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) 752-3589 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 - North Coast - 1993-1994*" is also available for those interested in organic apple production in the North Coast.

A companion study entitled "*Sample Costs to Establish an Apple Orchard and Produce Apples, Sprinkler Irrigation, 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.

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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 Central Coast

This study reflects the practices and costs associated with a production system for organically grown apples in the Central 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 three counties (Monterey, San Benito and Santa Cruz) 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 40 acres. Land is owned by the grower and is valued at \$15,000 per acre. This figure is within a range of values for orchard land in the Central 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 Irrigation, 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:

Movable sprinkler irrigation pipe is assumed to be used for orchard irrigation. Irrigation water is pumped from a depth of 150 feet in a 200 foot well using a 30 horsepower (hp) pump. Because the land is owned, 100% of the cost to refurbish the well in addition to the cost for the underground mainline pipe is included in this study. The irrigation system has a 25 year lifespan, is considered 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 \$56.28 per acre-foot. A total of 13 acre-inches of water is used to irrigate the orchard and to irrigate replanted trees. The orchard is irrigated three times between June and August.

## 5. PRODUCTION PRACTICES:

The production practices for 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. 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.

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

**Cost Ranges for Production Practices with Significant Variation**

| Operation      | Cost Range<br>\$/Acre | Study Cost<br>\$/Acre |
|----------------|-----------------------|-----------------------|
| Hand Thin      | 0-1,000               | 292                   |
| Tie/Prop Trees | 0-80                  | 51                    |
| Hand Harvest   | 200-1,100             | 599                   |

## 6. COVER CROPS/FLOOR MANAGEMENT:

In this study, a winter annual cover crop is sown each year in the fall. A mixture of bell beans, oats and purple vetch is planted as the cover crop. The orchard is disced twice in the fall after harvest to prepare the ground for seeding of the cover crop. Seed is then broadcast in the orchard centers only at a rate of 100 pounds per acre using 30 pounds of bell beans, 50 pounds of oats and 20 pounds of purple vetch. The orchard centers are then disced once 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 late April the cover crop is mowed once to reduce the above ground biomass and to improve accessibility for farm equipment. The cover crop is then incorporated into the soil by discing once. After these practices, composted manure is applied to the soil and a second discing incorporates both the manure and remaining cover crop. Throughout the remainder of the spring and summer orchard centers are disced periodically to control weeds and vegetative growth. Hand weeding is used to control any vegetative growth in the tree rows. No other means of weed control are used in this report. Therefore, no irrigation water is necessary in the late spring or summer months specifically for cover crops.

## 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 October. 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 375 boxes per acre representing a 58% pack-out. Boxes weigh 40 pounds and are tray-packed. In addition, 5.5 tons are assumed to be sold to a processor for the organic market. These yields fall within a range of yields received by growers in this area. Yields may vary widely depending on such factors as planting density, variety, orchard age, production location and seasonal growing conditions.

This report assumes that fresh market apples are custom-packed, consolidated by the packer and sold through a sales agent for a premium price. Assumed returns for fresh market apples are \$20 per box. Returns to growers can, however, range from \$12 to \$27 per box depending on the variety, quality and yearly market conditions. Not all boxes are sold at one set price each year. In some cases, returns for large sized specialty apples such as Jonagold and Fuji can be as high as \$35 per box. These figures represent returns to growers after packing and consolidation charges plus a 9% to 10% sales agent fee have been subtracted. Assumed returns for processing apples are \$200 per ton which falls within the \$150 to \$260 range usually received by growers in this area.

For the orchard analyzed in this study, net returns above total costs are positive at a price of \$20.00 per box when yields reach 300 boxes per acre for fresh market apples. For prices at or below \$15.50 per box and for yields below 475 boxes per acre, it is not profitable to produce organic apples for the fresh market. At a high price of \$27 per box, the breakeven yield is 221 boxes per acre. A ranging analysis for varying yields and prices is shown in **Table 6. Ranging Analysis**.

## 10. LABOR:

Basic hourly wages for workers are \$6.60 and \$5.45 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 \$8.85 per hour for machine labor and \$7.30 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 \$450 is assessed by the State of California on the gross sales amount of \$300,000. The fee is calculated by multiplying the assumed yield (375 boxes per acre) by the price received (\$20 per box) and the number of acres (40). 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 \$1,500, 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 may vary.

## 15. ACKNOWLEDGEMENT:

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## 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 Orchards*. Paper presented to The International 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 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 Univ. 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, California.
- 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 Central Coast 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) | 1-2                              | 4-6 gals  | Jan-March                       | Aphids, apple pandemis, mites, scales (eggs, immature stages) |
| Lime Sulfur  | 2-3                              | 4-10 gals   | March-May                       | Apple scab, powdery mildew                                    |
| Wettable or micronized sulfur                        | 1-5                              | 6-10 lbs  | March-June                      | Apple scab, powdery mildew                                    |
| Insecticidal Soap <sup>4</sup>                       | 1-2 applications every 3-4 years | 1 gal   | April-June                      | Aphids (immature, adult stages)                               |
| Codling Moth granulosis Virus <sup>5</sup> (CMVG)    | 3-12                             | 6 X 10 <sup>13</sup> GIB <sup>6</sup> (700 grams) | April-August                    | Codling moth (larval stage)                                   |
| Ryania <sup>7,8</sup>                                | 2-12                             | 8-16 lbs  | April-August                    | Codling moth (larval stage)                                   |
| Bacillus thuringiensis                               | 2-3                              | 1 lb  | April-August                    | Apple pandemis, codling moth, orange tortrix (larval stage)   |
| Pheromones   | 2-3                              | 160-400 dispensers <sup>9</sup>                   | April-August                    | Codling moth (adult stages)                                   |
| Horticultural Oil (Summer spray)                     | 1-2                              | 4-6 gals  | May-August                      | Aphids, mites, scales, codling moth (egg, immature stages)    |
| Tanglefoot/Stickem <sup>10</sup>                     | Use only if needed               | ----  | ----                            | Ants (for aphids)   |
| Strychnine bait <sup>7</sup>                         | See below                        | ----  | ----                            | Rodents   |

1 Not all growers use all materials each year.

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

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

4 This material is most effective when applied early in the season.

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

6 Granulosis inclusion bodies

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

8 This material is used instead of CMGV by some growers.

9 Application rate per acre depends on brand used

10 Do not apply to bark of young trees.

Table 1. COSTS PER ACRE TO PRODUCE FRESH MARKET ORGANIC APPLES - 1993-1994 - CENTRAL COAST – OPERATIONS

TABLE 1  
U.C. COOPERATIVE EXTENSION

Yield per Acre: 375.00 40-pound tray-packed boxes

Labor Rate: \$8.85/hr. machine labor  
\$7.30/hr. non-machine labor

Interest Rate: 7.89%

| Operation                                  | Operation<br>Time<br>(Hrs/A) | Cash and Labor Costs per Acre |                        |                  |                 |                 | Total<br>Cost | Your<br>Cost |
|--|------------------------------|-------------------------------|------------------------|------------------|-----------------|-----------------|---------------|--------------|
|  |                              | Labor<br>Cost                 | Fuel,Lube<br>& Repairs | Material<br>Cost | Custom/<br>Rent |                 |               |              |
| <b>Cultural:</b>                           |                              |                               |                        |                  |                 |                 |               |              |
| Disc 2X - Ground Preparation               | 0.86                         | 9.13                          | 6.06                   | 0.00             | 0.00            | 15.19           |               |              |
| Plant Cover Crop - Broadcast Seed          | 0.33                         | 7.01                          | 2.35                   | 41.90            | 0.00            | 51.26           |               |              |
| Disc - Cover Seed                          | 0.43                         | 4.57                          | 3.03                   | 0.00             | 0.00            | 7.60            |               |              |
| Prune Orchard                              | 45.00                        | 328.50                        | 0.00                   | 0.00             | 0.00            | 328.50          |               |              |
| Oil Spray - Pest Management 2X             | 0.50                         | 5.31                          | 3.97                   | 38.61            | 0.00            | 47.89           |               |              |
| Pruning Disposal                           | 1.30                         | 23.30                         | 7.10                   | 0.00             | 0.00            | 30.40           |               |              |
| Tree Replacement - 3 per acre              | 1.00                         | 10.62                         | 5.58                   | 19.08            | 0.00            | 35.28           |               |              |
| Irrigate and Prune Replants                | 2.00                         | 14.60                         | 0.00                   | 4.69             | 0.00            | 19.29           |               |              |
| Lime Sulfur Application 2X                 | 0.50                         | 5.31                          | 3.97                   | 48.30            | 0.00            | 57.58           |               |              |
| Pollination                                | 0.00                         | 0.00                          | 0.00                   | 0.00             | 32.00           | 32.00           |               |              |
| Mow Cover Crop                             | 0.33                         | 3.54                          | 2.21                   | 0.00             | 0.00            | 5.75            |               |              |
| Tie/Hang Pheromones - April                | 3.00                         | 21.90                         | 0.00                   | 117.98           | 0.00            | 139.88          |               |              |
| Wettable Sulfur Application 3X             | 0.75                         | 7.97                          | 5.96                   | 3.12             | 0.00            | 17.05           |               |              |
| Disc - Incorporate Cover Crop              | 0.43                         | 4.57                          | 3.03                   | 0.00             | 0.00            | 7.60            |               |              |
| Spread Composted Manure                    | 3.00                         | 31.86                         | 18.91                  | 75.00            | 0.00            | 125.77          |               |              |
| Disc - Incorp. Cover Crop/Compost          | 0.43                         | 4.57                          | 3.03                   | 0.00             | 0.00            | 7.60            |               |              |
| Hand Weed 2X                               | 20.00                        | 146.00                        | 0.00                   | 0.00             | 0.00            | 146.00          |               |              |
| Snail Removal - 1/2 of acreage             | 5.00                         | 36.50                         | 0.00                   | 0.00             | 0.00            | 36.50           |               |              |
| Hand Thin                                  | 40.00                        | 292.00                        | 0.00                   | 0.00             | 0.00            | 292.00          |               |              |
| Tie/Hang Pheromones - June                 | 3.00                         | 21.90                         | 0.00                   | 58.99            | 0.00            | 80.89           |               |              |
| Disc - Weed Control/Surface Prep 2X        | 0.86                         | 9.13                          | 6.06                   | 0.00             | 0.00            | 15.19           |               |              |
| Irrigation 3X                              | 2.55                         | 18.62                         | 0.00                   | 56.28            | 0.00            | 74.90           |               |              |
| Insect. Soap Application 1/3 of acreage    | 0.08                         | 0.85                          | 0.64                   | 6.23             | 0.00            | 7.72            |               |              |
| Prop Trees                                 | 7.00                         | 51.10                         | 0.00                   | 0.00             | 0.00            | 51.10           |               |              |
| Broken Limbs - Misc. Care                  | 0.10                         | 0.73                          | 0.00                   | 0.00             | 0.00            | 0.73            |               |              |
| Rodent Control -Trap                       | 2.00                         | 14.60                         | 0.00                   | 0.00             | 0.00            | 14.60           |               |              |
| Pickup Use                                 | 7.17                         | 76.15                         | 45.56                  | 0.00             | 0.00            | 121.70          |               |              |
| <b>TOTAL CULTURAL COSTS</b>                | <b>147.62</b>                | <b>1,150.32</b>               | <b>117.47</b>          | <b>470.18</b>    | <b>32.00</b>    | <b>1,769.97</b> |               |              |
| <b>Harvest:</b>                            |                              |                               |                        |                  |                 |                 |               |              |
| Hand Harvest                               | 82.00                        | 598.60                        | 0.00                   | 0.00             | 0.00            | 598.60          |               |              |
| Equipment Use                              | 0.40                         | 4.25                          | 1.85                   | 0.00             | 0.00            | 6.10            |               |              |
| Transport to Packing Shed                  | 4.00                         | 42.48                         | 29.42                  | 0.00             | 0.00            | 71.90           |               |              |
| Packing Services                           | 0.00                         | 0.00                          | 0.00                   | 401.25           | 1,875.00        | 2,276.25        |               |              |
| Consolidation Services                     | 0.00                         | 0.00                          | 0.00                   | 0.00             | 262.50          | 262.50          |               |              |
| <b>TOTAL HARVEST COSTS</b>                 | <b>86.40</b>                 | <b>645.33</b>                 | <b>31.28</b>           | <b>401.25</b>    | <b>2,137.50</b> | <b>3,215.36</b> |               |              |
| <b>Assessments:</b>                        |                              |                               |                        |                  |                 |                 |               |              |
| California State Organic Registration Fees | 0.00                         | 0.00                          | 0.00                   | 11.25            | 0.00            | 11.25           |               |              |
| CCOF Membership Fees                       | 0.00                         | 0.00                          | 0.00                   | 3.13             | 0.00            | 3.13            |               |              |
| CCOF Inspection Fees                       | 0.00                         | 0.00                          | 0.00                   | 2.50             | 0.00            | 2.50            |               |              |
| CCOF - .5% of Gross Sales                  | 0.00                         | 0.00                          | 0.00                   | 37.50            | 0.00            | 37.50           |               |              |
| <b>TOTAL ASSESSMENT COSTS</b>              | <b>0.00</b>                  | <b>0.00</b>                   | <b>0.00</b>            | <b>54.38</b>     | <b>0.00</b>     | <b>54.38</b>    |               |              |
| Interest on operating capital @ 7.89%      |                              |                               |                        |                  |                 | 101.60          |               |              |
| <b>TOTAL OPERATING COSTS/ACRE</b>          |                              | <b>1,795.64</b>               | <b>148.75</b>          | <b>925.81</b>    | <b>2,169.50</b> | <b>5,141.30</b> |               |              |
| <b>TOTAL OPERATING COSTS/BOX</b>           |                              |                               |                        |                  |                 | <b>13.71</b>    |               |              |

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

| Cash and Labor Costs Per Acre        |                               |                     |                         |                 |              |
|--------------------------------------|-------------------------------|---------------------|-------------------------|-----------------|--------------|
|                                      |                               |                     |                         | Total<br>Cost   | Your<br>Cost |
| <b>CASH OVERHEAD:</b>                |                               |                     |                         |                 |              |
| Office Expense                       |                               |                     |                         | 250.00          |              |
| Tissue/Soil Analysis                 |                               |                     |                         | 4.00            |              |
| Liability Insurance                  |                               |                     |                         | 8.40            |              |
| Sanitation Services                  |                               |                     |                         | 16.35           |              |
| Property Taxes                       |                               |                     |                         | 110.87          |              |
| Property Insurance                   |                               |                     |                         | 158.09          |              |
| Investment Repairs                   |                               |                     |                         | 22.75           |              |
| <b>TOTAL CASH OVERHEAD COSTS</b>     |                               |                     |                         | <b>570.46</b>   |              |
| <b>TOTAL CASH COSTS/ACRE</b>         |                               |                     |                         | <b>5,711.76</b> |              |
| <b>TOTAL CASH COSTS/BOX</b>          |                               |                     |                         | <b>15.23</b>    |              |
| <b>NON-CASH OVERHEAD:</b>            |                               |                     |                         |                 |              |
|                                      | <u>Per producing<br/>Acre</u> | <u>Annual Cost</u>  |                         |                 |              |
| <u>Investment</u>                    |                               | <u>Depreciation</u> | <u>Interest @ 3.72%</u> |                 |              |
| Buildings                            | 500.00                        | 15.00               | 10.23                   | 25.23           |              |
| Fuel tanks & pumps                   | 202.50                        | 9.11                | 4.14                    | 13.26           |              |
| Shop tools                           | 275.00                        | 16.50               | 5.63                    | 22.13           |              |
| Land                                 | 15,000.00                     |                     | 558.00                  | 558.00          |              |
| Orchard Establishment                | 9,428.00                      | 377.12              | 175.36                  | 552.48          |              |
| Product Bins                         | 227.50                        | 20.48               | 4.65                    | 25.13           |              |
| Irrigation Pipe                      | 162.50                        | 14.62               | 3.32                    | 17.95           |              |
| Tree Props                           | 505.00                        | 20.00               | 9.49                    | 29.48           |              |
| Pruning Equipment                    | 30.00                         | 2.70                | 0.61                    | 3.31            |              |
| Harvest Equipment                    | 33.90                         | 3.05                | 0.69                    | 3.74            |              |
| Irrigation System                    | 440.00                        | 15.84               | 9.00                    | 24.84           |              |
| ATV - 4WD                            | 190.37                        | 34.27               | 3.90                    | 38.16           |              |
| Equipment                            | 1,945.71                      | 175.57              | 39.81                   | 215.38          |              |
| <b>TOTAL NON-CASH OVERHEAD COSTS</b> | <b>28,940.49</b>              | <b>704.26</b>       | <b>824.84</b>           | <b>1,529.10</b> |              |
| <b>TOTAL COSTS/ACRE</b>              |                               |                     |                         | <b>7,240.86</b> |              |
| <b>TOTAL COSTS/BOX</b>               |                               |                     |                         | <b>19.31</b>    |              |



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

|   | Cost/<br>Acre   | Your<br>Cost |
|---|-----------------|--------------|
| <b>CASH OVERHEAD COSTS:</b>                                   |                 |              |
| Office Expense  | 250.00          |              |
| Tissue/Soil Analysis  | 4.00            |              |
| Liability Insurance   | 8.40            |              |
| Sanitation Services   | 16.35           |              |
| Property Taxes  | 110.87          |              |
| Property Insurance  | 158.09          |              |
| Investment Repairs  | 22.75           |              |
| <b>TOTAL CASH OVERHEAD COSTS/ACRE</b>                         | <b>570.46</b>   |              |
| <b>TOTAL CASH COSTS/ACRE</b>                                  | <b>5,711.76</b> |              |
| <b>TOTAL CASH COSTS/BOX</b>                                   | <b>15.23</b>    |              |
| <b>NON-CASH OVERHEAD COSTS (DEPRECIATION &amp; INTEREST):</b> |                 |              |
| Buildings   | 25.23           |              |
| Fuel tanks & pumps  | 13.26           |              |
| Shop tools  | 22.13           |              |
| Land  | 558.00          |              |
| Orchard Establishment   | 552.48          |              |
| Product Bins  | 25.13           |              |
| Irrigation Pipe   | 17.95           |              |
| Tree Props  | 29.49           |              |
| Pruning Equipment   | 3.31            |              |
| Harvest Equipment   | 3.74            |              |
| Irrigation System   | 24.84           |              |
| ATV - 4WD   | 38.16           |              |
| Equipment   | 215.38          |              |
| <b>TOTAL NON-CASH OVERHEAD COSTS/ACRE</b>                     | <b>1,529.10</b> |              |
| <b>TOTAL COSTS/ACRE</b>                                       | <b>7,240.86</b> |              |
| <b>TOTAL COSTS/BOX</b>  | <b>19.31</b>    |              |

1. Per acre treatment cost is for 400 dispensers.
2. Second per acre treatment cost if 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 - 1993-1994  
CENTRAL COAST

| Beginning NOV 93                  | NOV          | DEC           | JAN           | FEB           | MAR          | APR           | MAY           | JUN           | JUL          | AUG          | SEP           | OCT             | TOTAL           |
|-----------------------------------|--------------|---------------|---------------|---------------|--------------|---------------|---------------|---------------|--------------|--------------|---------------|-----------------|-----------------|
| Ending OCT 94                     | 93           | 93            | 94            | 94            | 94           | 94            | 94            | 94            | 94           | 94           | 94            | 94              |                 |
| Cultural:                         |              |               |               |               |              |               |               |               |              |              |               |                 |                 |
| Disc 2X-Ground Preparation        | 15.19        |               |               |               |              |               |               |               |              |              |               |                 | 15.19           |
| Plant Cover Crop-Broadcast        | 51.26        |               |               |               |              |               |               |               |              |              |               |                 | 51.26           |
| Disc-Cover Seed                   | 7.60         |               |               |               |              |               |               |               |              |              |               |                 | 7.60            |
| Prune Orchard                     |              | 109.50        | 109.50        | 109.50        |              |               |               |               |              |              |               |                 | 328.50          |
| Oil Spray-Pest Management         |              |               | 26.09         |               | 21.80        |               |               |               |              |              |               |                 | 47.89           |
| Pruning Disposal                  |              |               |               | 30.40         |              |               |               |               |              |              |               |                 | 30.40           |
| Tree Replacement-3 per acre       |              |               |               | 35.28         |              |               |               |               |              |              |               |                 | 35.28           |
| Irrigate and Prune Replants       |              |               |               | 19.29         |              |               |               |               |              |              |               |                 | 19.29           |
| Lime Sulfur Application 2X        |              |               |               |               | 28.79        | 28.79         |               |               |              |              |               |                 | 57.58           |
| Pollination                       |              |               |               |               | 32.00        |               |               |               |              |              |               |                 | 32.00           |
| Mow Cover Crop                    |              |               |               |               |              |               | 5.75          |               |              |              |               |                 | 5.75            |
| Tie/Hang Pheromones-April         |              |               |               |               |              | 139.88        |               |               |              |              |               |                 | 139.88          |
| Wettable Sulfur Application       |              |               |               |               |              | 5.68          | 11.36         |               |              |              |               |                 | 17.05           |
| Disc-Incorp. Cover Crop           |              |               |               |               |              | 7.60          |               |               |              |              |               |                 | 7.60            |
| Spread Composted Manure           |              |               |               |               |              | 125.77        |               |               |              |              |               |                 | 125.77          |
| Disc-Incorp. Cover Crop/Compost   |              |               |               |               |              | 7.60          |               |               |              |              |               |                 | 7.60            |
| Hand Weed 2X                      |              |               |               |               |              | 73.00         |               | 73.00         |              |              |               |                 | 146.00          |
| Snail Removal-1/2 of acreage      |              |               |               |               |              |               | 36.50         |               |              |              |               |                 | 36.50           |
| Hand Thin                         |              |               |               |               |              |               | 146.00        | 146.00        |              |              |               |                 | 292.00          |
| Tie/Hang Pheromones-June          |              |               |               |               |              |               |               | 80.89         |              |              |               |                 | 80.89           |
| Disc-Weed Control/Surf.Prepare    |              |               |               |               |              |               |               | 7.60          | 7.60         |              |               |                 | 15.19           |
| Irrigation 3X                     |              |               |               |               |              |               |               | 24.97         | 24.97        | 24.97        |               |                 | 74.90           |
| Insect. Soap App. 1/3 of ac.      |              |               |               |               |              |               |               | 7.72          |              |              |               |                 | 7.72            |
| Prop Trees                        |              |               |               |               |              |               |               |               | 51.10        |              |               |                 | 51.10           |
| Broken Limbs-Misc. Care           |              |               |               |               |              |               |               |               | 0.73         |              |               |                 | 0.73            |
| Rodent Control-Trap               |              |               |               |               |              |               |               |               |              | 14.60        |               |                 | 14.60           |
| Pickup Use                        |              |               |               |               |              |               |               |               |              |              | 121.70        |                 | 121.70          |
| <b>TOTAL CULTURAL COSTS</b>       | <b>74.05</b> | <b>109.50</b> | <b>135.59</b> | <b>194.47</b> | <b>82.59</b> | <b>394.07</b> | <b>193.86</b> | <b>340.17</b> | <b>84.39</b> | <b>39.57</b> | <b>121.70</b> |                 | <b>1,769.97</b> |
| Harvest:                          |              |               |               |               |              |               |               |               |              |              |               |                 |                 |
| Hand Harvest                      |              |               |               |               |              |               |               |               |              |              |               | 598.60          | 598.60          |
| Equipment Use                     |              |               |               |               |              |               |               |               |              |              |               | 6.10            | 6.10            |
| Transport to Packing Shed         |              |               |               |               |              |               |               |               |              |              |               | 71.90           | 71.90           |
| Packing Services                  |              |               |               |               |              |               |               |               |              |              |               | 2,276.25        | 2,276.25        |
| Consolidation Services            |              |               |               |               |              |               |               |               |              |              |               | 262.50          | 262.50          |
| <b>TOTAL HARVEST COSTS</b>        |              |               |               |               |              |               |               |               |              |              |               | <b>3,215.36</b> | <b>3,215.36</b> |
| Assessments:                      |              |               |               |               |              |               |               |               |              |              |               |                 |                 |
| Ca. St. Org. Reg. Fees            |              |               |               |               |              |               |               |               |              |              |               | 11.25           | 11.25           |
| CCOF Membership Fees              |              |               |               |               |              |               |               |               |              |              |               | 3.13            | 3.13            |
| CCOF Inspection Fees              |              |               |               |               |              |               |               |               |              |              |               | 2.50            | 2.50            |
| CCOF - .5% of Gross Sales         |              |               |               |               |              |               |               |               |              |              |               | 37.50           | 37.50           |
| <b>TOTAL ASSESSMENT COSTS</b>     |              |               |               |               |              |               |               |               |              |              |               | <b>54.38</b>    | <b>54.38</b>    |
| Interest on oper. capital         | 0.49         | 1.21          | 2.10          | 3.38          | 3.92         | 6.51          | 7.79          | 10.02         | 10.58        | 10.84        | 11.64         | 33.14           | 101.60          |
| <b>TOTAL OPERATING COSTS/ACRE</b> | <b>74.54</b> | <b>110.71</b> | <b>137.69</b> | <b>197.85</b> | <b>86.51</b> | <b>400.58</b> | <b>201.65</b> | <b>350.19</b> | <b>94.97</b> | <b>50.40</b> | <b>133.34</b> | <b>3,302.87</b> | <b>5,141.30</b> |
| <b>TOTAL OPERATING COSTS/BOX</b>  | <b>0.20</b>  | <b>0.30</b>   | <b>0.37</b>   | <b>0.53</b>   | <b>0.23</b>  | <b>1.07</b>   | <b>0.54</b>   | <b>0.93</b>   | <b>0.25</b>  | <b>0.13</b>  | <b>0.36</b>   | <b>8.81</b>     | <b>13.71</b>    |

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

| Beginning NOV 93                 | NOV          | DEC           | JAN           | FEB           | MAR           | APR           | MAY           | JUN           | JUL           | AUG          | SEP           | OCT             | TOTAL           |
|----------------------------------|--------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|--------------|---------------|-----------------|-----------------|
| Ending OCT 94                    | 93           | 93            | 94            | 94            | 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              |              |               |               |               |               |               |               |               |               |              |               |                 | 8.40            |
| Sanitation Services              |              |               |               |               |               |               |               |               |               |              |               |                 | 16.35           |
| Property Taxes                   |              | 55.43         |               |               |               | 55.43         |               |               |               |              |               |                 | 110.87          |
| Property Insurance               |              |               | 158.09        |               |               |               |               |               |               |              |               |                 | 158.09          |
| Investment Repairs               | 1.90         | 1.90          | 1.90          | 1.90          | 1.90          | 1.90          | 1.90          | 1.90          | 1.90          | 1.90         | 1.90          | 1.90            | 22.75           |
| <b>TOTAL CASH OVERHEAD COSTS</b> | <b>22.73</b> | <b>78.16</b>  | <b>180.82</b> | <b>22.73</b>  | <b>22.73</b>  | <b>78.16</b>  | <b>22.73</b>  | <b>22.73</b>  | <b>22.73</b>  | <b>22.73</b> | <b>22.73</b>  | <b>51.48</b>    | <b>570.46</b>   |
| <b>TOTAL CASH COSTS/ACRE</b>     | <b>97.27</b> | <b>188.87</b> | <b>318.51</b> | <b>220.58</b> | <b>109.24</b> | <b>478.74</b> | <b>224.38</b> | <b>372.92</b> | <b>117.70</b> | <b>73.13</b> | <b>156.07</b> | <b>3,354.35</b> | <b>5,711.76</b> |
| <b>TOTAL CASH COSTS/BOX</b>      | <b>0.26</b>  | <b>0.50</b>   | <b>0.85</b>   | <b>0.59</b>   | <b>0.29</b>   | <b>1.28</b>   | <b>0.60</b>   | <b>0.99</b>   | <b>0.31</b>   | <b>0.20</b>  | <b>0.42</b>   | <b>8.94</b>     | <b>15.23</b>    |

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

ANNUAL EQUIPMENT COSTS

| Yr                | Description               | Price   | Yrs<br>Life | - Non-Cash Over. - |          | - Cash Overhead - |        | Total     |
|-------------------|---------------------------|---------|-------------|--------------------|----------|-------------------|--------|-----------|
|                   |                           |         |             | Depre-<br>ciation  | Interest | Insur-<br>ance    | Taxes  |           |
| 94                | 50HP 2WD Tractor          | 29,480  | 12          | 2,211.00           | 603.16   | 115.61            | 81.07  | 3,010.84  |
| 94                | Brush Rake & Loader       | 6,025   | 15          | 361.53             | 123.26   | 23.63             | 16.57  | 524.99    |
| 94                | Forklift - 3pt.           | 350     | 15          | 21.00              | 7.16     | 1.37              | 0.96   | 30.49     |
| 94                | Manure Spreader           | 4,966   | 15          | 297.93             | 101.61   | 19.48             | 13.66  | 432.68    |
| 94                | Offset Disc - 8'          | 5,090   | 15          | 305.40             | 104.14   | 19.96             | 14.00  | 443.50    |
| 94                | Orchard Sprayer - 300 Gal | 6,698   | 10          | 602.80             | 137.04   | 26.27             | 18.42  | 784.53    |
| 94                | Orchard Crawler           | 34,358  | 12          | 2,576.83           | 702.97   | 134.74            | 94.48  | 3,509.02  |
| 94                | Pickup - 1/2 ton          | 16,500  | 7           | 2,121.43           | 337.59   | 64.70             | 45.37  | 2,569.09  |
| 94                | Rotary Mower - 6'         | 2,923   | 10          | 263.10             | 59.80    | 11.46             | 8.04   | 342.40    |
| 94                | Spinner Spreader - 3pt.   | 800     | 15          | 48.00              | 16.37    | 3.14              | 2.20   | 69.71     |
| 94                | Truck - 2 ton             | 22,523  | 7           | 2,895.86           | 460.82   | 88.32             | 61.94  | 3,506.94  |
| TOTAL             |                           | 129,713 |             | 11,704.88          | 2,653.92 | 508.68            | 356.71 | 15,224.19 |
| 60% of New Cost * |                           | 77,828  |             | 7,022.93           | 1,592.35 | 305.21            | 214.03 | 9,134.51  |

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

ANNUAL INVESTMENT COSTS

| Description           | Price     | Yrs<br>Life | - Non-Cash Over. - |           | ----- Cash Overhead ----- |          |         | Total     |
|-----------------------|-----------|-------------|--------------------|-----------|---------------------------|----------|---------|-----------|
|                       |           |             | Depre-<br>ciation  | Interest  | Insur-<br>ance            | Taxes    | Repairs |           |
| INVESTMENT            |           |             |                    |           |                           |          |         |           |
| Irrigation System     | 17,600    | 25          | 633.60             | 360.10    | 69.02                     | 48.40    | 250.00  | 1,361.12  |
| Land                  | 600,000   |             |                    | 22,320.00 | 4,278.00                  | 3,000.00 | 0.00    | 29,598.00 |
| Orchard Establishment | 377,120   | 25          | 15,084.80          | 7,014.43  | 1,344.43                  | 942.80   | 0.00    | 24,386.46 |
| Tree Props            | 20,200    | 25          | 799.92             | 379.48    | 72.73                     | 51.01    | 50.00   | 1,353.14  |
| ATV - 4WD             | 7,615     | 5           | 1,370.60           | 155.81    | 29.86                     | 20.94    | 100.00  | 1,677.21  |
| Buildings             | 20,000    | 30          | 600.00             | 409.20    | 78.43                     | 55.00    | 100.00  | 1,242.63  |
| Fuel tanks & pumps    | 8,100     | 20          | 364.50             | 165.73    | 31.76                     | 22.28    | 125.00  | 709.27    |
| Harvest Equipment     | 1,356     | 10          | 122.00             | 27.75     | 5.32                      | 3.73     | 10.00   | 168.80    |
| Irrigation Pipe       | 6,500     | 10          | 585.00             | 132.99    | 25.49                     | 17.88    | 100.00  | 861.36    |
| Product Bins          | 9,100     | 10          | 819.00             | 186.19    | 35.69                     | 25.02    | 50.00   | 1,115.90  |
| Pruning Equipment     | 1,200     | 10          | 108.00             | 24.55     | 4.71                      | 3.30     | 25.00   | 165.56    |
| Shop tools            | 11,000    | 15          | 660.00             | 225.06    | 43.14                     | 30.25    | 100.00  | 1,058.45  |
| TOTAL INVESTMENT      | 1,079,791 |             | 21,147.42          | 31,401.29 | 6,018.58                  | 4,220.61 | 910.00  | 63,697.90 |

ANNUAL BUSINESS OVERHEAD COSTS

| Description          | Units/ |      | Price/<br>Unit | Total<br>Cost |
|----------------------|--------|------|----------------|---------------|
|                      | Farm   | Unit |                |               |
| Office Expense       | 40.0   | acre | 250.0          | 10,000        |
| Tissue/Soil Analysis | 40.0   | acre | 4.0            | 160           |
| Liability Insurance  | 1.0    | farm | 336.0          | 336           |
| Sanitation Services  | 1.0    | year | 654.0          | 654           |

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

| Yr | Description               | ----- COSTS PER HOUR ----- |                                      |          |   |         |                             |                |      | Total<br>Costs/Hr. |
|----|---------------------------|----------------------------|--------------------------------------|----------|---|---------|-----------------------------|----------------|------|--------------------|
|    |                           | Actual<br>Hours<br>Used    | -Non-Cash Over-<br>Depre-<br>ciation | Interest | - Cash Overhead -<br>Insur-<br>ance Taxes | Repairs | Operating<br>Fuel &<br>Lube | Total<br>Oper. |      |                    |
| 94 | 50HP 2WD Tractor          | 169.8                      | 7.81                                 | 2.13     | 0.41                                      | 0.29    | 1.77                        | 2.4            | 4.17 | 14.81              |
| 94 | Brush Rake & Loader       | 52                         | 4.17                                 | 1.42     | 0.27                                      | 0.19    | 0.88                        | 0              | 0.88 | 6.93               |
| 94 | Forklift - 3pt.           | 16                         | 0.79                                 | 0.27     | 0.05                                      | 0.04    | 0.05                        | 0              | 0.05 | 1.19               |
| 94 | Manure Spreader           | 120                        | 1.49                                 | 0.51     | 0.1                                       | 0.07    | 0.72                        | 0              | 0.72 | 2.88               |
| 94 | Offset Disc - 8'          | 120.4                      | 1.52                                 | 0.52     | 0.1                                       | 0.07    | 1.46                        | 0              | 1.46 | 3.67               |
| 94 | Orchard Sprayer - 300 Gal | 73.2                       | 4.94                                 | 1.12     | 0.22                                      | 0.15    | 3.36                        | 0              | 3.36 | 9.79               |
| 94 | Orchard Crawler           | 323.1                      | 4.79                                 | 1.31     | 0.25                                      | 0.18    | 1.72                        | 3.36           | 5.08 | 11.59              |
| 94 | Pickup - 1/2 ton          | 286.8                      | 4.44                                 | 0.71     | 0.14                                      | 0.09    | 2.99                        | 3.36           | 6.35 | 11.73              |
| 94 | Rotary Mower - 6'         | 13.3                       | 11.84                                | 2.69     | 0.52                                      | 0.36    | 1.05                        | 0              | 1.05 | 16.46              |
| 94 | Spinner Spreader - 3pt.   | 14.5                       | 1.98                                 | 0.68     | 0.13                                      | 0.09    | 0.86                        | 1.44           | 2.3  | 5.18               |
| 94 | Truck - 2 ton             | 160                        | 10.86                                | 1.73     | 0.33                                      | 0.23    | 5.41                        | 1.95           | 7.36 | 20.51              |

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

| COSTS PER ACRE AT VARYING YIELDS TO PRODUCE ORGANIC APPLES <sup>1</sup> |                    |              |              |              |              |              |               |
|---|--------------------|--------------|--------------|--------------|--------------|--------------|---------------|
|   | YIELD <sup>2</sup> |              |              |              |              |              |               |
|   | 175.0              | 225.0        | 300.0        | 375.0        | 475.0        | 575.0        | 700.0         |
| Fresh Market (Boxes/Acre)   | 175.0              | 225.0        | 300.0        | 375.0        | 475.0        | 575.0        | 700.0         |
| Processing (Tons/Acre)  | 4.0                | 4.5          | 5.0          | 5.5          | 6.0          | 6.5          | 7.0           |
| <b>OPERATING COSTS/ACRE:</b>  |                    |              |              |              |              |              |               |
| Cultural Cost   | 1,770              | 1,770        | 1,770        | 1,770        | 1,770        | 1,770        | 1,770         |
| Harvest Cost  | 1,504              | 1,932        | 2,574        | 3,215        | 4,071        | 4,927        | 5,997         |
| Assessment Cost   | 54                 | 54           | 54           | 54           | 54           | 54           | 54            |
| Interest on operating capital   | 90                 | 93           | 97           | 102          | 107          | 113          | 120           |
| <b>TOTAL OPERATING COSTS/ACRE</b>                                       | <b>3,418</b>       | <b>3,849</b> | <b>4,495</b> | <b>5,141</b> | <b>6,003</b> | <b>6,864</b> | <b>7,941</b>  |
| <b>TOTAL OPERATING COSTS/BOX</b>  | <b>19.53</b>       | <b>17.11</b> | <b>14.98</b> | <b>13.71</b> | <b>12.64</b> | <b>11.94</b> | <b>11.34</b>  |
| CASH OVERHEAD COSTS/ACRE  | 570                | 570          | 570          | 570          | 570          | 570          | 570           |
| <b>TOTAL CASH COSTS/ACRE</b>  | <b>3,989</b>       | <b>4,420</b> | <b>5,066</b> | <b>5,712</b> | <b>6,573</b> | <b>7,435</b> | <b>8,511</b>  |
| <b>TOTAL CASH COSTS/BOX</b>   | <b>22.79</b>       | <b>19.64</b> | <b>16.89</b> | <b>15.23</b> | <b>13.84</b> | <b>12.93</b> | <b>12.16</b>  |
| NON-CASH OVERHEAD COSTS/ACRE  | 1,529              | 1,529        | 1,529        | 1,529        | 1,529        | 1,529        | 1,529         |
| <b>TOTAL COSTS/ACRE</b>   | <b>5,518</b>       | <b>5,949</b> | <b>6,595</b> | <b>7,241</b> | <b>8,102</b> | <b>8,964</b> | <b>10,041</b> |
| <b>TOTAL COSTS/BOX</b>  | <b>31.53</b>       | <b>26.44</b> | <b>21.98</b> | <b>19.31</b> | <b>17.06</b> | <b>15.59</b> | <b>14.34</b>  |

| NET RETURNS PER ACRE ABOVE OPERATING COSTS FOR ORGANIC APPLES |                   |                    |       |       |       |       |        |        |
|---|-------------------|--------------------|-------|-------|-------|-------|--------|--------|
| PRICE   |                   | YIELD <sup>2</sup> |       |       |       |       |        |        |
| Fresh (Boxes)   |                   | 175.0              | 225.0 | 300.0 | 375.0 | 475.0 | 575.0  | 700.0  |
|   | Processing (Tons) | 4.0                | 4.5   | 5.0   | 5.5   | 6.0   | 6.5    | 7.0    |
| \$/Box  | \$/Ton            | \$/Acre            |       |       |       |       |        |        |
| 12.0  | 150               | -1,270             | -474  | -145  | 184   | 597   | 1,011  | 1,509  |
| 15.5  | 160               | -644               | 359   | 955   | 1,552 | 2,320 | 3,089  | 4,029  |
| 17.5  | 180               | -286               | 899   | 1,655 | 2,412 | 3,390 | 4,369  | 5,569  |
| 20.0  | 200               | 162                | 1,551 | 2,505 | 3,459 | 4,697 | 5,936  | 7,459  |
| 22.5  | 220               | 610                | 2,204 | 3,355 | 4,507 | 6,005 | 7,504  | 9,349  |
| 25.0  | 240               | 1,057              | 2,856 | 4,205 | 5,554 | 7,312 | 9,071  | 11,239 |
| 27.0  | 260               | 1,415              | 3,396 | 4,905 | 6,414 | 8,382 | 10,351 | 12,779 |

| NET RETURNS PER ACRE ABOVE CASH COSTS FOR ORGANIC APPLES |                   |                    |        |       |       |       |       |        |
|--|-------------------|--------------------|--------|-------|-------|-------|-------|--------|
| PRICE  |                   | YIELD <sup>2</sup> |        |       |       |       |       |        |
| Fresh (Boxes)  |                   | 175.0              | 225.0  | 300.0 | 375.0 | 475.0 | 575.0 | 700.0  |
|  | Processing (Tons) | 4.0                | 4.5    | 5.0   | 5.5   | 6.0   | 6.5   | 7.0    |
| \$/Box   | \$/Ton            | \$/Acre            |        |       |       |       |       |        |
| 12.0   | 150               | -1,289             | -1,045 | -716  | -387  | 27    | 440   | 939    |
| 15.5   | 160               | -637               | -213   | 384   | 981   | 1,750 | 2,518 | 3,459  |
| 17.5   | 180               | -207               | 328    | 1,084 | 1,841 | 2,820 | 3,798 | 4,999  |
| 20.0   | 200               | 311                | 980    | 1,934 | 2,888 | 4,127 | 5,365 | 6,889  |
| 22.5   | 220               | 829                | 1,633  | 2,784 | 3,936 | 5,435 | 6,933 | 8,779  |
| 25.0   | 240               | 1,346              | 2,285  | 3,634 | 4,983 | 6,742 | 8,500 | 10,669 |
| 27.0   | 260               | 1,776              | 2,825  | 4,334 | 5,843 | 7,812 | 9,780 | 12,209 |

| NET RETURNS PER ACRE ABOVE TOTAL COSTS FOR ORGANIC APPLES |                   |                    |        |        |        |        |        |        |
|---|-------------------|--------------------|--------|--------|--------|--------|--------|--------|
| PRICE   |                   | YIELD <sup>2</sup> |        |        |        |        |        |        |
| Fresh (Boxes)   |                   | 175.0              | 225.0  | 300.0  | 375.0  | 475.0  | 575.0  | 700.0  |
|   | Processing (Tons) | 4.0                | 4.5    | 5.0    | 5.5    | 6.0    | 6.5    | 7.0    |
| \$/Box  | \$/Ton            | \$/Acre            |        |        |        |        |        |        |
| 12.0  | 150               | -2,818             | -2,574 | -2,245 | -1,916 | -1,502 | -1,089 | -591   |
| 15.5  | 160               | -2,166             | -1,742 | -1,145 | -549   | 221    | 989    | 1,929  |
| 17.5  | 180               | -1,736             | -1,202 | -445   | 312    | 1,291  | 2,269  | 3,469  |
| 20.0  | 200               | -1,218             | -549   | 405    | 1,359  | 2,598  | 3,836  | 5,359  |
| 22.5  | 220               | -701               | 104    | 1,255  | 2,407  | 3,906  | 5,404  | 7,249  |
| 25.0  | 240               | -183               | 756    | 2,105  | 3,454  | 5,213  | 6,971  | 9,139  |
| 27.0  | 260               | 247                | 1,296  | 2,805  | 4,314  | 6,283  | 8,251  | 10,679 |

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.