ORGANIC MIXED PRODUCTION BLOCKS FOR DIRECT MARKETS ON CALIFORNIA'S CENTRAL COAST: A Guide for Beginning Specialty Crop Growers

Introduction

Crop diversity on small-scale farms is key to direct marketing strategies such as Community Supported Agriculture (CSA), farmers' markets, farm stands, and restaurant accounts. Crop diversity also benefits on-farm ecology, risk management, and economic viability. However, managing a diverse cropping system requires significant experience and planning for the farm operation to be productive, competitive, and financially viable.

This guide focuses on producing mixed blocks of 30- to 60-day, direct sown and transplanted crops suitable for CSA and direct market sales, with the goal of improving cropping system efficiencies and economic viability. Note that the guide does not address specific crop information, but focuses instead on managing the mixed crop production block as a whole.

Although not covered in detail in this guide, the same planning and management principles apply to crops with an extended harvest (and possibly successional plantings), such as tomatoes, beans, and zucchinis. Single planting/single harvest storage crops such as onions, potatoes, and winter squash can also be managed in production blocks. These three main types of blocks—short season, extended season, and single harvest storage crops—can complement each other in CSA and other direct marketing efforts.

Features of mixed crop blocks

- Simplify bed preparation, planting, and harvesting
- Diversify products available for direct marketing
- Supply a continuous harvest of crops throughout the season

Features of CSA marketing

- Provides a guaranteed market and up-front capital at start of season
- Offers growers and customers an opportunity to connect directly with each other
- Provides consumers the chance to directly support farmers and their farms
- Allows for creative community partnerships, e.g., with schools, businesses, faith-based groups

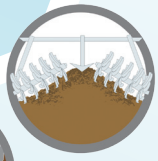
PRODUCTION SEQUENCE – SUMMARY

(crop day -25*) In spring, mow cover crop to facilitate breakdown.

(crop day -25) Incorporate cover crop residue.

(crop day -11) Form beds with rolling cultivator or listing shovels.

(crop day -10) Pre-irrigate beds with overhead irrigation (1.5"). Wait for dry down and weed emergence.



(crop day -1) Work bed surface lightly to terminate weeds and re-form beds.

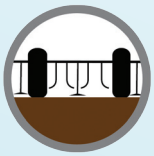
(crop day -1) Shape beds using bed shaper or rototiller/shaper combination. Mark planting rows.

(crop days -1, 0) Plant direct seeded crops and transplants (if planting takes place over two days, plant transplants last).

(crop days 0, 1, 4, 7) Irrigate (overhead) to water in and establish transplants.

***Numbers in parentheses refer to crop day, with crop day 0 = planting day, based on a typical season at the CASFS/ UC Santa Cruz Farm.**

See Appendix (page 8) for more on crop days and related activities.



(crop day 11) Cultivate for weed management.

Lay drip lines.

(crop day 11) Hoe out small weeds.

(crop day 12) Initiate drip irrigation.

(crop day 21) Thin carrots and beets.

(crop day 21) Hand weed direct sown and transplanted crops.

(crop day 35) Initiate harvests.

Following completion of harvests, remove drip lines from field, mow crop residue, and undercut beds.

Prepare ground for subsequent planting or cover crops.

Mixed Production Blocks

What this guide refers to as "CSA blocks" or "mixed production blocks" are crop areas within the farm specifically designated to grow a set of short season crops (30–60 days to maturity), e.g., lettuces, leafy greens such as spinach and chard; short season brassicas such as kale, turnips, kohlrabi, broccoli, and cauliflower; as well as carrots, bunching onions, beets, fennel, basil, and cilantro. Staggered plantings of these crops are essential for providing a consistent supply of diverse products throughout the season to a CSA project and/or other direct markets.

The practice of "blocking" production areas on diverse small-scale farms is a critical component of a well-thought-out production system. Crop blocking is the basis for improved management efficiencies related to fertility, tillage operations, weed control, irrigation management, and harvest operations.

At the UCSC Farm, ten 300'-long beds on 3' centers make up each production block of 30' x 300' (Figure 1). This size is based on two factors:

- **Irrigation management:** The field block can be irrigated using a 30'-long irrigation pipe running along the top of the beds and ten 30' pipes placed down either side of the block for pre-irrigation and post plant out irrigation sets.
- **Production quantity:** The average yield per block supplies the needs of the farm's marketing outlets (125-member CSA and other direct sales).

Adjust your block size and design according to your field size, preferred bed size, and equipment settings. Based on a 6' center to center tractor system, blocks could consist of either six 60" beds or twelve 30" beds.

Number of plant lines per bed depends on bed size and crop. Beets, lettuces, chard, and other small crops are usually planted in at least 2 lines in a narrow bed, and up to 8 lines in a 60" bed. Broccoli and cauliflower may be transplanted in a single or double line. Potatoes must be planted in a single line to allow for hilling. The planting arrangement needs to maximize productivity and efficiency, as well as yield and ease of weed management.

FIGURE 1. Spring-planted crop blocks at the UCSC Farm (above and below).
Photos: Martha Brown

Planning and managing mixed crop blocks

Blocks of short-season crops are managed with a single set of practices during the establishment phase. All the crops within the block should be either direct sown or transplanted on the same day (or over a period of two days). They can then be irrigated and cultivated on a schedule consistent with single crop management until the time of harvest. The one difference is that, often, direct sown crops require thinning.

Mixed production blocks typically include both transplanted and direct sown crops. For example, broccoli, cabbage, cauliflower, kohlrabi, collards, fennel root, bunching onions, and head lettuces are typically transplanted, either by hand or with a mechanical transplanter. Beets, spinach, salad mix, radishes, turnips, and carrots are direct seeded. Figure 2 shows a typical mixed production block schematic at the UCSC Farm.

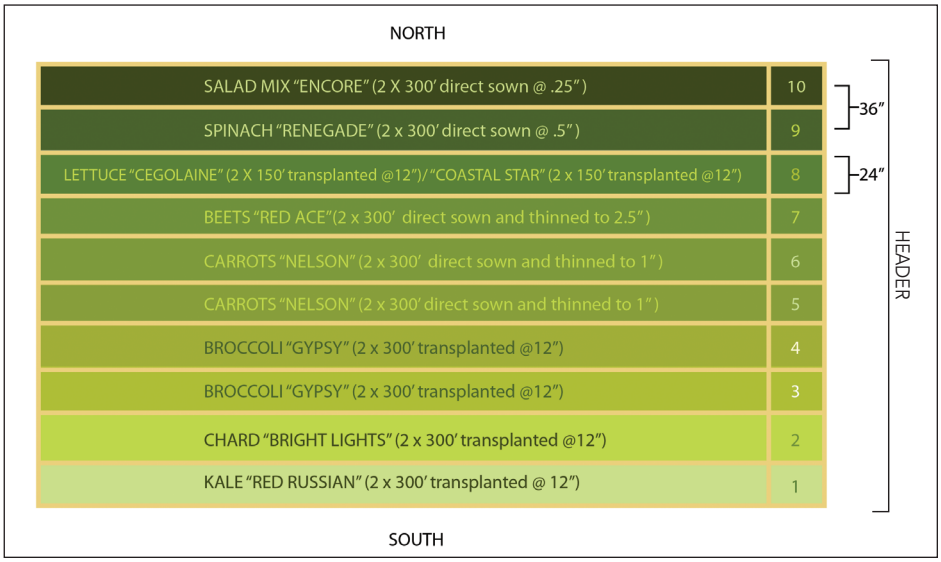


FIGURE 2. Crop block schematic, UCSC Farm.

TABLE 1: MIXED PRODUCTION BLOCK CROPS MATURATION CHART

CROP	DAYS TO MATURITY (APPROX)	PLANTING METHOD	MULTIPLE HARVEST
arugula	30	direct sown	
asian greens	60	direct sown	
beets	60	direct sown	
broccoli	60	transplant	
bunching onions	60	transplant	
cabbage	90	transplant	
carrots	60	direct sown	
cauliflower	90	transplant	
chard	60	transplant	
collards	70	transplant	yes
kale	60	transplant	yes
kohlrabi	60	transplant	
lettuce	60	transplant	
salad mix	30	direct sown	yes
spinach	40	direct sown	
radish	30	direct sown	
turnips	40	direct sown	

Mixed crop production blocks can also include a beneficial insectary row, depending on aphid pressure and surrounding habitat. A fast-blooming crop such as alyssum (transplanted) or annual buckwheat (direct sown) provides a nearby nectar source and habitat for beneficial insects as the crops mature.

Some tips for planning a mixed crop block:

- Designate an entire bed to each specific crop within the block. Although this can be challenging, especially when dealing with small lots of transplants, it will greatly facilitate irrigation uniformity and harvest efficiency.
- If you plant a mix of varieties of specific crops in a single bed (for example red, golden, and striped beets), use flags or other markers to delineate varieties.
- Put crops with similar days to maturity or harvest methods next to each other for ease of mowing and undercutting following harvest (Table 1).

To keep pace with product demand, plant a new mixed crop block every 10 to 14 days during the production season. Good recordkeeping facilitates future planting selections and schedules to meet specific harvest windows and to ensure consistent product flow. Track your production (harvest dates, yield) and how closely it meets your marketing plans and needs (for example, see Appendix, page 8). Keep notes on weather and other factors that influence crop growth, maturity dates, and product quality.

Other considerations in managing mixed crop blocks

Bed preparation and early season planting

When preparing beds for mixed production blocks, use the standard pre-irrigation and weed control sequence (e.g., Production Sequence — Summary, page 2). See the publication *Tillage, Bed Formation, and Planting to Moisture* in this Grower Guide series for additional details.

Note that early season production on California's Central Coast can be challenging during wet years, especially on heavier soils. Incorporating heavy residue legume/cereal cover crops and waiting for them to decompose can significantly delay initial plantings.

There are several ways to facilitate early plantings:

- Select locations on the farm that dry down early for initial block planting.

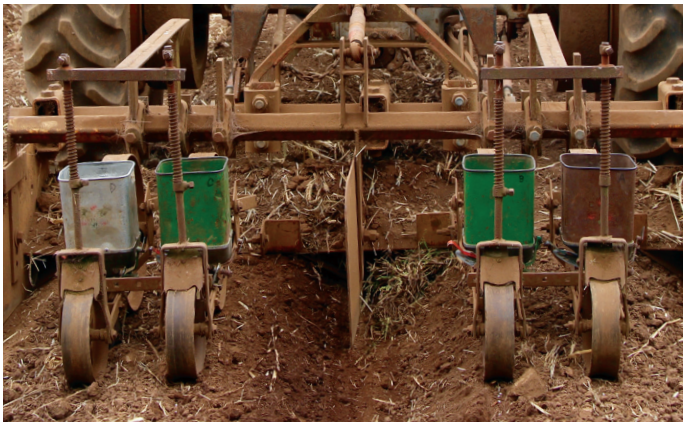


FIGURE 3. Planet Jr. tractor-drawn seeder (above) and push seeder (below) used for direct-sown crops. *Photos: Martha Brown*

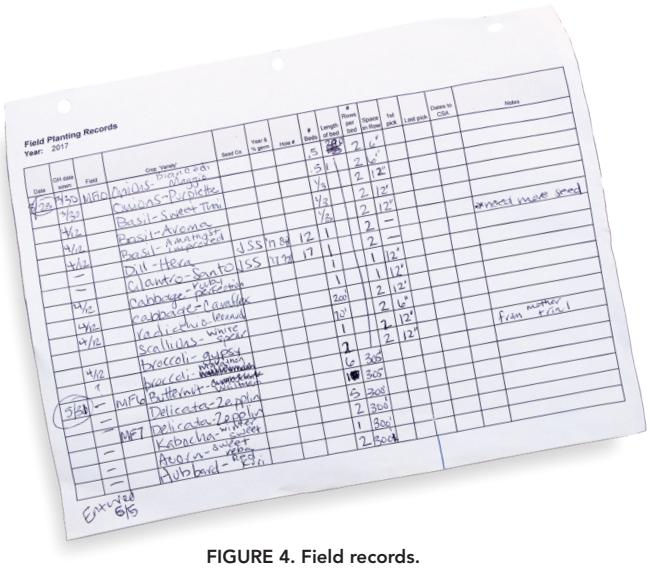


FIGURE 4. Field records.

- Use a winter cover crop that produces less biomass such as legumes or mustards that break down more quickly than mixes that include cereals.
- Use high tunnels for springtime season extension as a way to start the season earlier.

Direct sowing and transplanting

Depending on your scale of production, you can direct sow seeds using tractor-mounted or push-behind seeders designed to plant from one to six rows at a pass, e.g.:

- Planet Jr., one of the most commonly used and most versatile (Figure 3)
- Clean Seeder AP or Jang JP Series, best suited to precision planting of coated carrot seed
- Earthway seeder, very lightweight and inexpensive

Besides good seedbed preparation, two critical aspects of the direct sowing process are proper seed spacing to minimize thinning, and appropriate planting depth to ensure quick and uniform seedling emergence. Write down what you do so you can build on your own experience and inform future decisions: record the depth setting, the type of opening shoe used, and the plate hole size for all of the different seeds being direct sown (Figures 4, 5).

Transplanted crops need good root ball placement for even stand establishment. Small-scale farms can transplant seedlings by hand (Figure 6). As farms scale up, investment in equipment to increase transplanting efficiencies can be worth the cost. One of the simplest to set up is a transplant "sled" that consists of seats and plant tray holders on a three point mounted tool bar run behind a tractor (Figure 7). The unit provides a mark or an opening to drop the plants. Operators seated close to the beds drop the plants by hand into lines as the tractor moves slowly down the row.

The next step up in mechanization is a commercially available mechanical transplanter. These units are expensive, can be difficult to field adjust, and are therefore better suited to larger-scale production systems.

FIGURE 5. Selecting seed plates for direct sowing. *Photo: Martha Brown*

FIGURE 6. Transplanting seedlings at the UCSC Farm. *Photo: Martha Brown*

FIGURE 7. Transplant sled with seats.

Irrigation

Ideally, each mixed crop block has access to a dedicated irrigation riser with the capacity to supply adequate flow and pressure to run either overhead or drip irrigation. Overhead irrigation is most effective for pre-irrigating beds and "watering in" crops immediately following planting because it wets the soil quickly, but if water is limited, direct sown and transplanted crops can be watered in using only drip irrigation.

Apply water as soon as possible following transplanting to limit transplant shock and get the seedlings off to a good start; when planting out a block that has both direct sown crops and transplants, do the direct sowings first. Assuming there is adequate moisture deeper in the soil, once the crops are established, remove the overhead irrigation lines and initiate weed management strategies prior to installing drip tape—by 2 weeks after planting and initial irrigation.

A common mistake made by inexperienced growers is to apply excess irrigation water during the initial establishment phase of the mixed crop block. Over-watering has the potential to:

- increase production costs (especially where the cost of water is high)
- create surface crusting, which limits plant emergence and growth, and impedes good weed management
- increase weed emergence
- leach nutrients below the root zone—especially on lighter-textured soils

Irrigate initially just enough to get good emergence on the direct-sown crops and root establishment on the transplanted crops; 2–3 waterings per week until plants are well established. Irrigation frequency will depend on soil and weather conditions.

Once plants are established, irrigation within the block is set at two different schedules. Direct-sown crops need shorter but more frequent irrigations (2–5 day intervals, with water quantity and interval gradually increasing as the crop matures). Transplanted crops receive 25% of evapotranspiration (Et) for a week or two and then 50% of Et (see cimis.water.ca.gov for local Et rates). At full canopy, a typical mixed crop block crop in the Central Coast region uses no more than 1.5" of water per week.

Another common mistake is to under apply irrigation water to crops in full canopy. Superficial watering limits the crop's ability to access water and nutrients deeper in the soil profile. Use a soil probe to check moisture in the root zone of deeper rooting crops.

Initial weed management

As direct-sown crops emerge, annual weeds also come up in response to irrigation. Use stirrup hoes (hula hoes) to eliminate newly emerged weeds on the bed tops while they are still very small (Figure 8). If soil conditions are right (soil relatively dry and friable), a weeding crew can quickly move through the field and eliminate all of the weeds in and around the growing crops. Follow this hand weeding with mechanical cultivation of furrows and bed sides to eliminate weeds.

The best option for mechanized weed management is a tractor-mounted, three-point or belly bar cultivator (or both) to undercut weeds in the furrow bottoms, bed sides, and even the bed top using precisely adjusted knives and sweeps. Depending on soil type, you may need crust breakers to break soil crust ahead of knives. This mechanical cultivator set up, adjustment, and operation takes time, skill, and care, but will save many hours of tedious hand work. During this cultivation, run small furrow chisels behind the tractor tires to mitigate potential soil compaction issues in the furrows that receive tire traffic. Crops tend to respond favorably to the shallow soil disturbance that results from cultivation. See the *Introduction to weed management in a small scale organic production system* video in Additional Resources for an example of this type of weed management.

Once the hand weeding and tractor cultivation are complete, wait for at least a day of sunny weather to ensure desiccation and effective "kill" of the recently undercut annual weeds, then install and run the drip irrigation lines. On most soil types, a single line of drip tape between plant lines set 10–14" apart is adequate, assuming establishment was achieved with overhead irrigation (Figure 9). The crop canopy will close quickly and, assuming your weeding was effective, there should be only minimal weed pressure throughout the

FIGURE 8. Use hula hoes to control weeds on bed tops when they are still small (bottom). *Photo: Jim Clark*

FIGURE 9. Drip tape on beets and kale at the UCSC Farm. *Photo: Martha Brown*

remainder of the crop cycle. Note that if perennial weeds and/or grasses are present, additional hand and tractor work may be needed to keep them in check and to minimize crop-weed competition.

Post harvest weed management

Following harvest of some of the earlier-maturing crops in the mixed crop block (e.g., spinach, salad mix, radishes), stop irrigation on those beds, remove the drip line, mow the remaining crop residue, and undercut the bed with a "weeder" bar to terminate any weed growth and minimize the chance of weed seed set.

Once harvest is complete, the entire block can be tilled and prepared for the subsequent crop cycle or cover crop. When cultivating, run chisels in the furrows to break up tractor tire compaction. This will facilitate all follow-up undercutting and tillage operations, minimize clod formation, and improve water-holding capacity.

ADDITIONAL RESOURCES

Introduction to weed management in a small scale organic production system (video). Produced by the Center for Agroecology & Sustainable Food Systems. www.youtube.com/user/casfsvideo

Knock weeds out at critical times, by Mark Schonbeck. eOrganic, 2010. articles.extension.org/pages/18882/knock-weeds-out-at-critical-times

Quick and easy annual insectary rows, Jane Kuhn, May 8, 2016, Tend blog website www.tend.ag/blog/quick-easy-annual-insectary-rows.html

Teaching direct marketing and small farm viability: Resources for instructors, edited by Jan Perez, Martha Brown, and Albie Miles. 2015. See Unit 3: Community Supported Agriculture (CSA) for details on crop planning. casfs.ucsc.edu/about/publications

Organic Mixed Production Blocks for Direct Markets on California's Central Coast: A Guide for Beginning Specialty Crop Growers by Jim Leap, Kirstin Yogg-Comerchero, and Darryl Wong. Edited by Ann Baier and Martha Brown.

Additional Grower Guides are available online at casfs.ucsc.edu/about/publications. This publication was supported by the Specialty Crop Block Grant Program at the U.S. Departmentof Agriculture (USDA) through Grant 14-SCBGP-CA-0006. Its contents are solely the responsibility of the authors and do not necessarily represent the official views of the USDA.

Photos, p. 1: Elizabeth Birnbaum (left), Abigail Huetter (right)

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APPENDIX: PRODUCTION SCHEDULE, ECONOMIC DATA

Crop day	Sub Crop	# beds (1 bed = .02ac)	Action	work rate (hr/ac)	fixed rate (hrs)	Total labor cost @ $16.10/hr	Total machine cost @ $21.70/hr	Harvest Amt.	Harvest Value
-25		10	Flail Mow:heavy	2.5	0.2		$15.19		
-25		10	Spade	4.8	0.2		$25.17		
-11		10	Mark Lines	2.0	0.2		$13.02		
-11		10	List	1.3	0.2		$9.77		
-11		10	Overhead Irr:set up	3.8		$12.08			
-10		10	Overhead Irr:run		0.5	$8.05			
-1		10	Light cultivation	1.3	0.2		$9.77		
-1		10	Shape/Seed CSA	3.0	0.2		$17.36		
0	Transplants	5	Transplant:2 line	116.0	0.5	$194.81			
0		10	Overhead Irr:run		0.5	$8.05			
1		10	Overhead Irr:run		0.5	$8.05			
4		10	Overhead Irr:run		0.5	$8.05			
7		10	Overhead Irr:run		0.5	$8.05			
11		10	Overhead Irr:break down	3.8		$12.08			
11		10	Cultivate	2.0	0.2		$13.02		
11		10	Drip:set up	10.0	0.25	$36.23			
11		10	Hoe:2 line	72.6		$233.77			
12-50	Salad Mix/Spinach/Lettuce	3	Drip:run x 2/wk @ 5 wks		0.3	$24.15			
12-70	Broccoli	2	Drip:run x 2/wk @ 8 wks		0.3	$38.64			
12-90	Beets/Carrots/Chard/Kale	5	Drip:run x 2/wk @ 11 wks		0.3	$53.13			
21	Beets/Carrots	3	Thin	121.0		$116.89			
21	Salad Mix/Spinach	2	Hand Weed:small weeds	74.5		$47.98			
21	Transplants	5	Hand Weed:big weeds	8.0		$12.88			
			Week 6 Harvest						
42	Salad Mix	1	Harvest x 2	290.4	0.5	$54.80		73	$290.40
42	Spinach	1	Harvest x 2	290.4	0.5	$54.80		87	$348.48
42	Lettuce	1	Harvest x 2	193.6	0.5	$39.22		232	$348.48
42	Chard	1	Harvest x 2	121.0	0.5	$27.53		145	$363.00
			Week 7 Harvest						
49	Salad Mix	1	Harvest x 2	290.4	0.5	$54.80		73	$290.40
49	Spinach	1	Harvest x 2	290.4	0.5	$54.80		87	$348.48
49	Lettuce	1	Harvest x 2	193.6	0.5	$39.22		232	$348.48
49	Kale	1	Harvest x 2	121.0	0.5	$27.53		145	$363.00
			Week 8 Harvest						
56	Beets	1	Harvest x 2	106.5	0.5	$25.19		48	$119.79
56	Chard	1	Harvest x 2	121.0	0.5	$27.53		145	$363.00
60	Salad Mix/Spinach/Lettuce	3	Undercut	2.0	0.2		$6.94		
60	Salad Mix/Spinach/Lettuce	3	Flail Mow:light	1.3	0.2		$5.97		
			Week 9 Harvest						
63	Broccoli	2	Harvest x 2	68.5	0.5	$30.09		192	$383.33
63	Beets	1	Harvest x 2	106.5	0.5	$25.19		48	$119.79
63	Kale	1	Harvest x 2	121.0	0.5	$27.53		145	$363.00
			Week 10 Harvest						
70	Broccoli	2	Harvest x 2	68.5	0.5	$30.09		192	$383.33
70	Beets	1	Harvest x 2	106.5	0.5	$25.19		48	$119.79
70	Kale	1	Harvest x 2	121.0	0.5	$27.53		145	$363.00
70	Carrots	2	Harvest x 2	154.9	0.5	$57.92		155	$387.20
			Week 11 Harvest						
77	Beets	1	Harvest x 2	106.5	0.5	$25.19		48	$119.79
77	Kale	1	Harvest x 2	121.0	0.5	$27.53		145	$363.00
77	Carrots	2	Harvest x 2	154.9	0.5	$57.92		155	$387.20
			Week 12 Harvest						
84	Carrots	2	Harvest x 2	154.9	0.5	$57.92		155	$387.20
90	Broccoli/Chard/Kale/Beets/ Carrots	7	Flail Mow:light	1.3	0.2		$8.14		
90	Broccoli/Chard/Kale/Beets/ Carrots	7	Undercut	2.0	0.2		$10.42		
110		10	Disc:x1	0.5	0.2		$6.51		
-		10	Drill/Cover Crop	1.6	0.2		$11.28		
					Sub-total:	$1,620.43	$152.55	*Sub-total:*	$6,560.14
					Labor + Machine Cost:	***$1,772.98***			

Harvest Assumptions	*Salad Mix*	*Spinach*	*Lettuce*	*Beets*
Unit	#	#	hds	bu.
Harvest (unit/acre)	7,260	8,712	23,232	9,583
Harvest (unit/row foot)	0.25	0.3	0.8	0.33
Harvest Window (weeks)	2	2	2	4
Harvest Rate (unit/hr)	25	30	120	90
Harvest (hr/ac)	290.4	290.4	193.6	106.5
Price ($/unit)	4	4	1.5	2.5
Revenue ($/acre)	$29,040	$34,848	$34,848	$23,958

Item	***Cost per unit***	***Cost per acre***
Starts	$.025/plant	$726.00
Drip Tape	$120/7500'	$232.32
Rubber Bands	$91.25/bx	$91.25
Boxes: Broccoli	$2.067/box	$651.11
Boxes: Cilantro	$1.186/box	$474.40
Boxes: Romaine	$2.589/box	$569.58
Perforated Liners	$85.05/1000 liners	$85.05
Total Expenses (per acre):		***$2,829.71***

Per Acre Totals	
Income:	$32,800.68
Labor + Machine Cost ($)	-$8,864.92
Expenses	-$2,829.71
Production Profit:	**$21,106.05**