OASIS: A Campus-Based, Organic, Community Supported Agriculture Farm[1]

Research Report 760

Constance L. Falk, Pauline Pao, Christopher S. Cramer, and Erin Silva[2]

Agricultural Experiment Station • College of Agriculture and Home Economics

SUMMARY

An organic production class was operated for five years at New Mexico State University using the Community Supported Agriculture (CSA) model of farming. This was the first organic garden on the NMSU main campus, the first organic vegetable production class at NMSU, and the first CSA venture in southern New Mexico. In five years, the project earned $115,201 in gross income and grew 554 varieties, including 372 varieties of 39 vegetables, 32 varieties of 15 herbs, and 150 varieties of 72 flowers, on approximately an acre of land. This document outlines the project, including an overview of the farm, the CSA, and cool- and warm-season crop performance.

Table of Contents

INTRODUCTION

Development of agricultural marketing and production alternatives in New Mexico is an important activity necessary to sustain the rural sector. Statewide, variability in elevation and latitude provides a wide range of production zones and microclimates for a diverse crop potential. This diversity may also limit the ability to maintain large-scale commodity production economies. Although irrigable river-bottom lands and nearly year-round growing capacity provide many horticultural opportunities, the vegetable industry is concentrated in a few crops (Table 1).

Table 1. Harvested vegetables, 2003, in southern N.M. counties

	Hidalgo	Luna	Sierra	Chaves	Doña Ana	Lea	Eddy
	----------Harvested Acres----------						
Onions		2,600	400		4,400		
Chile	2,800	5,000	600	500	3,400	1,500	500
Lettuce (iceberg)					622		
Cabbage					251		
Spinach	254 acres in unidentified counties						

Source: New Mexico Statistical Office, 2003.

A limited crop portfolio exposes producers to undue risks. In addition, recent contraction in vegetable production in southern New Mexico threatens the viability of a regional sector, because as farms convert to urban uses or pecans the infrastructure needed to support a vegetable industry (packing houses, brokers, shippers, etc.) also begins to disappear. The long-term sustainability of communities, given concerns about global warm-

[1]This research was supported by the New Mexico Agricultural Experiment Station, New Mexico State University, Las Cruces and the USDA Hispanic-Serving Institutions Grant program. The database support provided by Sylvia Beuhler and Jennifer Kreie is greatly appreciated.

[2] Respectively, Professor, Department of Agricultural Economics and Agricultural Business; former Specialist, Department of Agricultural Economics and Agricultural Business; Associate Professor, Department of Plant and Environmental Sciences, all of New Mexico State University, Las Cruces; and Associate Scientist, Department of Agronomy, CIAS, University of Wisconsin, Madison.

Table 2. Farm size trends in counties located along the Rio Grande

	1974[1]	1978	1992	1997	2002	1997	2002
	----------Percentage of irrigated farms----------						
County	--------Farms with ≤ 50 acres---------					≤ 10 acres	
Statewide	34.2	39.7	50.2	51.2	44.7	24.8	23.6
Doña Ana	37.9	55.7	73.8	77.5	81.1	55.0	61.1
Bernalillo	66.4	79.2	89.4	89.1	83.2	62.0	59.2
Santa Fe	72.7	61.8	72.9	64.5	65.2	38.1	38.9
Valencia	59.1	71.4	78.8	80.0	85.7	39.4	53.2

[1]Irrigated farms by size class were not available for this year. These farms include irrigated and non-irrigated farms. Sources: U.S. Department of Commerce, 1981; U.S. Department of Agriculture, 1999, 2002.

ing and food miles embedded in long-distant transport, may mean that investment in a diversified and regional food system will become a higher priority.

Most commercial-scale horticultural production takes place in two southern N.M. counties, Doña Ana and Luna. The number of vegetable farms fell from 185 to 107 in Doña Ana County and from 70 to 37 in Luna County from 1997 to 2002. Vegetable production in acres decreased 42% in Doña Ana County and 50% in Luna County in the same period (USDA-NASS, undated).

Agronomic characteristics that make land suitable for vegetable production (warm winter temperatures, adequate water and level, well-drained soils) also make land appealing for urbanization (Heimlich & Anderson, 2001). Urban development sets up countervailing pressures on vegetable production—urbanization bids up the price of land, making it attractive to farmers to sell to real estate developers; at the same time, population growth increases demand for locally grown produce. Since vegetable production typically generates higher returns than do other crops, urbanization can have the effect of increasing vegetable production in urbanizing areas (Heimlich & Anderson, 2001).

In New Mexico, urbanization has concentrated along the Rio Grande corridor, home to three of the state's largest cities: Albuquerque, Las Cruces, and Santa Fe. The number of small-acreage irrigated farms, as a percentage of irrigated farms in the state, is significant. In Doña Ana County, 81% of the farms were less than 50 acres in 2002; 61% were less than 10 acres (Table 2).

Organic production may be particularly suitable for New Mexico farmers, given small farm sizes and varied microclimates in the state. Producers of certified organic chile and pecans receive higher prices for their products than conventional counterparts. Two chile processors in southern New Mexico are certified organic by the New Mexico Organic Commodity Commission (Quinn, 2005). Optimistic market conditions for organic growers also indicate untapped potential for southern New Mexico vegetable growers.

Organic produce markets

Certified organic acreage has increased in the U.S. due to market demand and federal rule changes that, beginning in 2002, standardized the certification process. Organic produce represented 42% of total organic food sales in the US in 2003, and is expected to grow from $4.3 to $8.5 billion in retail sales from 2003 to 2010, according to *The Nutrition Business Journal* data quoted by Oberholtzer et al. (2005). The U.S. imported an estimated $1–$1.5 billion in organic foods in 2002, according to USDA Foreign Agricultural Service (FAS) data (Oberholtzer et al., 2005). Imported organic produce that competes directly with local organic produce may face a challenge, however, as 41% of consumers look for "in-season" produce, according to UN FAO reports (Oberholtzer et al., 2005).

In 2001, 6% of U.S. farmland was certified organic, with organic vegetables accounting for a good portion of that—1.6% of U.S. farmland, or 71,600 acres. A third of this organic vegetable acreage was planted in lettuce, tomatoes, or carrots (Greene & Kremen, 2003). In 2003, 4% of carrots, 1% of tomatoes, and 5% of lettuce acres were certified organic, according to the authors. In a national survey conducted by the Organic Farming Research Foundation (OFRF), 43% of the 1,200 respondents indicated they produced organic vegetables, with 74% being sold in fresh markets. The top four vegetables by acreage were spinach, sweet corn, lettuce, and broccoli (Walz, 2004).

In New Mexico, 26,464 acres were certified organic in 1997, increasing 60% to about 42,015 acres in 2001 (Greene & Kremen, 2003). Although the growth in certified organic acreage in New Mexico might indicate a thriving organic production sector in the state, the majority is in pastureland, and the bulk of the organic vegetable production is in northern New Mexico, according to the New Mexico Organic Commodity Commission (NMOCC), the state agency that certifies the majority of certified organic land in the state (Quinn, 2003). However, the diversity of certified organic products grown in the state reflects the diversity of production environments; the list include apples, garlic, raspberries, lamb, beef, yaks, cotton, peanuts (N.M. is the leading organic peanut producer in the nation), Pima cotton, turkey, chicken, pecans, blue corn, pinto beans, alfalfa, eggs, chile, tomatoes, and wheat.

The OASIS project

In 2002, in response to these issues, faculty members in the New Mexico State University College of Agriculture and Home Economics established, with federal funds, an organic garden to serve as a site for teaching students. The project became the focal point for an integrated organic and sustainable small farming and food security program. The organic garden was operated as a Com-

munity Supported Agriculture (CSA) venture at New Mexico State University (NMSU) for five years, from January 2002 until November 2006. For ten semesters, students enrolled in a junior-level organic vegetable production class or a senior-level honors class during spring and fall semesters. Students were hired in the summer. A full-time farm manager coordinated production, harvest, distribution, and student activities on the farm.

The CSA model of farming involves the sale of shares to members who receive weekly assortments of the farm's output (Henderson & Van En, 1999). The project, named Organic Agriculture Students Inspiring Sustainability (OASIS), had the following objectives:

- to provide students with a multi-disciplinary, experiential educational opportunity;
- to investigate the feasibility of small scale, organic, drip-irrigated farming in the Chihuahuan Desert;
- to demonstrate the CSA model to the local community;
- to trial vegetable varieties;
- to provide a site where faculty could conduct research or student laboratory exercises.

This was the first organic garden on the NMSU main campus, the first organic vegetable production class at NMSU, and the first CSA venture in southern New Mexico. The project was enthusiastically received by the community; students from across campus took the class and sought OASIS summer jobs; and long waiting lists of people requested memberships every year. However, land and financial constraints on campus brought the project to an end after five years of production. This report profiles the CSA operations, farming activities, and crop production. An article describing the class was published previously (Falk et al., 2005).

Operation of the CSA

The OASIS CSA sold half- and full-share memberships each year. In 2002, only 18.5 full-share equivalents (5 full and 27 half) were sold (Table 3). A perusal of then-available literature on CSAs led the project managers to estimate that 20 full shares was a reasonable number of shares to sell from an acre of land. A recent review of CSAs in the Midwest confirms this; from 43 respondents, the average number of members per acre was 13.4 (Tegtmeier & Duffy, 2005). Nevertheless, after the first year the project managers more than doubled the number of full-time equivalent memberships to 41.5, even though the land base remained the same.

Unfortunately, the second year of production was the lowest of the five years because of delayed rains, cutbacks on irrigation, reduction in application of injected liquid fish fertilizer, and loss of some crops. The third year, the memberships were scaled back to 35. In the final two years, 40 full-share equivalent memberships were sold. After the first year, the number of member families was between 60 and 70 (Table 3).

Table 3. CSA memberships and members.

	2002	2003	2004	2005	2006
	----------Number----------				
Vegetable memberships, Full / Half	5 / 27	10 / 59	10 / 50	12 / 56	14 / 52
Flower memberships, Full / Half	0	0	20 / 16	24 / 11	23 / 12
Total Memberships	32	69	60	68	66
Full Share Equivalents	18.5	41.5	35	40	40

Table 4. Membership costs.

	2002	2003	2004	2005	2006
Vegetable, Full ($)	450	500	500	500	500
Vegetable, Half ($)	250	300	300	300	300
Vegetable Unit Cost, Full ($/lb)[1]	0.44	1.23	0.92	0.94	1.03
Vegetable Unit Cost, Half ($/lb)[1]	0.46	1.42	1.05	1.11	1.17
Flower, Full[2] ($)	N/A	N/A	65	65	75
Flower, Half[3] ($)	N/A	N/A	25	25	32
Flower bunch ($/bunch to members / public)	N/A	N/A	3.50	3.50 / 5.00	3.50 / 5.00

[1]Includes weight of herbs

[2]Full flower shares entitled members to one bunch per week for 25 weeks

[3]Half flower shares entitled members to one bunch per week for 10 weeks.

Full shares were sold for $450 and included flowers in the first year (Table 4). The combined vegetable and flower full-share price was increased to $500 in the second year. In 2004, the third year, prices were not raised, but flower shares were sold separately. Members who bought full flower shares received one bouquet per week for 25 weeks; half flower shares lasted 10 weeks. Vegetable share prices were not raised again, but flower share prices were raised in 2006. Flower bunches were sold to members and the public for $3.50 in 2004, but were priced $3.50 to members and $5.00 to the public in 2005–2006.

In the first year, since production was high for the number of members, full-share members each took home more than 1,000 lb (Table 5) over the course of the season, resulting in a $0.44/lb cost of vegetables and herbs, but in subsequent years the price per lb was close to $1.00, which was the target established (Table 4). In years 2003–2006, the target was to produce about 20,000 lb and distribute about 500 lb each to 40 full-

Table 5. Distribution summary, 2002–2006.

	2002	2003	2004	2005	2006
Dates of distribution	4/10–11/27	4/02–11/19	3/31–11/17	4/16–11/16	4/5–11/15
Number of weeks of distribution	34	34	34	33	33
Vegetables & herbs, full share (lb/share)	1,021	408	542	534	486
Vegetables & herbs, half share (lb/share)	543	212	285	271	257
Mean weekly, vegetables & herbs, full share (lb/share)	33	12	16	16	15
Lowest and highest weekly distribution of vegetables & herbs, full share (lb/share)	1.09 / 101.00	1.70 / 27.66	1.78 / 55.10	3.89 / 27.76	2.58 / 40.80

share equivalents; with a $500/year share price for full shares, the $1.00/lb estimate was the target. The 500-lb per full share equivalent target was met or nearly met after the first year (Table 5). Part of what made these targets reasonable was the length of the growing season. Distribution took place starting in early April (except in 2004 when it started the last day of March) and continued for 33 or 34 weeks until before the Thanksgiving holiday (Table 5).

Gross income from the project in the first two years was based on vegetable memberships but became increasingly diversified as flower shares, flower bunches, and outside sales for other growers were added (including apple cider, fruit shares, and pecans). In 2005, additional income was produced by a silent auction organized by OASIS students and contributed to by members. Items for auction included electric scooters, artwork, crafts, and jewelry. After the first year, gross sales ranged between $22,000 and $23,000 for vegetable memberships. The other sales contributed roughly $3,000–$4,000 each year in the three years 2004–2006 (Table 6).

In a study of 19 CSA growers, mostly in Wisconsin and ranging in size from one to more than 70 acres, gross sales from vegetables, averaged across three years, ranged from $15,623/acre for CSA farms up to 3 acres in size to $10,810/acre for farms greater than 12 acres in size (Hendrickson, 2005). Similarly, net cash income per acre from vegetables was highest on small farms, averaging $5,664 on the farms with fewer than 3 acres and $3,757/acre on the larger farms. In this study, net cash income was defined as returns to depreciation, land, opportunity costs, and management. At all scales, these farms invested 12–15% of their income on equipment, and the net cash returns are net of cash outlays on farming equipment.

Net profits were difficult to estimate since this project was not operated as a for-profit business, and had educational and research goals. Seed costs were probably excessive due to the small quantities of many varieties purchased. In the Hendrickson study (2005), the small farms with less than three acres spent $700/acre on seed, averaged across three years, while the farms with greater than 12 acres spent an average of $327/acre on seed, reflecting their ability to buy in bulk. In contrast, the cost for seeds and transplant materials (potting soil, etc.) at OASIS, averaged across the first four years, was $1,653 per year. OASIS never managed a full acre of land except in 2004, when OASIS managed 1.16 acres.

At OASIS, field operations performed by tractors were paid by the hour, $25/hour from 2002 until July 1, 2005, when field work by tractors increased to $30/hour. Irrigation costs were $2/hour for application time and $25 per acre foot of water. An acre foot of water is 325,848 gallons of water. Cooler room and greenhouse electricity was paid for by the university. The distribution room for OASIS was the classroom where the OASIS class was taught. Tables and chairs were rearranged to accommodate weekly distributions. OASIS purchased its own tools and supplies (bins, baskets, golf cart, wagons, shears, knives, stakes, storage shed, shelves, etc.) and installed refrigeration equipment in an existing walk-in cooler. Many of these upfront expenses were paid for by the USDA Hispanic-Serving Institutions grant that initially funded the project.

Student labor was not tracked, and in contrast to a more commercial operation the project sought to offer summer jobs to as many students as possible to provide learning opportunities. Student summer wages started at $6.50 per hour in 2002, and students who worked multiple summers earned raises each year so that some students earned $7 to $7.50/hour by 2006. During the fall and spring semesters, students enrolled in the class provided additional labor. Faculty members contributed labor, and a full-time farm manager also put in many hours each week on the project. Significant secretarial help was involved in managing the membership accounting and records. Several database classes helped with the website design and database design. Student employees helped with database entry.

Many factors thus complicate an assessment of the profitability of OASIS. However, it is clear that the small size of the farm limited its potential ever to be self-supporting, as the full-time farm manager earned in excess of $35,000/year (including salary and benefits). The farm manager, however, contributed significantly to the teaching and research part of the project. In the Hendrickson study, the calculated hourly wage for the farmers (net cash returns divided by number of hours

Table 6. Annual gross income, 2002–2006.

	2002	2003	2004	2005	2006
	---------- U.S. $ ----------				
Vegetable shares	9,000.00	23,000.00	23,000.00	22,800.00	22,600.00
Flower shares			1,732.00	1,857.00	2,109.00
Flower bunches sold individually			2,012.00	2,286.00	2,539.00
Herb bunches			37.00	20.00	92.00
Fruit share commissions				158.00	27.74
Pecan sales profits				17.50	
Silent auction				1,026.50	
Unaccounted sales				420.00	
OASIS greeting cards					19.50
Santa Fe sparkling cider profits					50.00
Extra vegetables					397.68
Total gross income	**9,000.00**	**23,000.00**	**26,781.00**	**28,585.00**	**27,834.9**

Table 7. New members, 2003–2006.

	Number of new members (#)	New members as a percentage of all members (%)
in 2003	51	75
in 2004	20	33
in 2005	19	28
in 2006	12	18

Table 8. Longevity of memberships at the end of the 2006 season.

	Members (#)	Percentage of Total (%)
5-year members	8	6
4-year members	22	17
3-year members	18	14
2-year members	29	22

worked), averaged across three years, ranged from a low of $4.96/hour for farms smaller than three acres to a high of $11.36/hour for farms larger than 12 acres. For reference, a person grossing $12/hour for 50 weeks of the year, working 50 hours per week, will earn $30,000.

Membership retention

After the first year, 75% of OASIS members departed (Table 7). One possible explanation is the large amount of produce that 2002 members received (described in more detail below). The highest weekly distribution to full share members in 2002 was in excess of 100 lb (Table 5). The burden of what to do with that much produce overwhelmed some members. However, after the dramatic adjustments of 2002–2003, the number of new members decreased every year, and only 18% of 2006 members were new (Table 7). At the end of 2006, of the 130 total OASIS members during the five years, 59% were multi-year members and 41% were members for only one year, which could have been any one of the five years (Table 8). Four of the 130 members dropped at some point and rejoined, which was not particularly easy, since every year OASIS had 50–70 people on the waiting list.

MATERIALS AND METHODS

Fields and farming practices

The field production site was located less than one mile from the New Mexico State University main campus at the Fabian Garcia Science Center in Las Cruces, N.M., which is at an elevation of 3,891 feet, has an average of 220 frost-free days per year (Herrera, 1989), and is in USDA climactic zone 7. The crops were grown on soil that is a Glendale loam [fine-silty, mixed (calcareous), thermic Typic Torrifluvent].

In 2002 and 2003, OASIS used as its "main" field a plot 29,700 square feet in area and containing 53 beds, each 22 in. wide and 150 ft long with 20-in. furrows. The field had previously been used to grow vegetables and onions (*Allium cepa*) using conventional production techniques. The Main Field was planted each of the five years in three seasons of primarily vegetables, without rotation to green manures or cover crops.

In 2004, a new 1/10-acre field was planted in perennial and annual herbs and flowers and most of the flowers previously planted in the Main Field were transferred to the smaller plot. A third field came under temporary OASIS management in summer 2004 for one year only—a 4/10-acre plot, the Lower Field, so that the Main Field could be planted in a cover crop during the winter and spring months.

The Lower Field was planted in summer cover crops, ornamental and edible corn (*Zea mays*), flowers, and soybeans (*Glycine max*), followed by vegetables and

Table 9. Total planted space in all fields by season and crop category, 2002–2006

	2002	2003	2004	2005	2006
	----------linear feet----------				
Spring	2,409	5,307	3,936	5,784	4,902
Summer	4,411	4,989	6,885	8,482	6,850
Fall	3,313	4,503	4,555	4,437	4,919
Vegetables	9,436	13,288	12,801	16,491	14,339
Herbs	280	429	445	509	538
Flowers	417	1,028	2,130	1,703	1,794
Total	**10,133**	**14,799**	**15,379**	**18,702**	**16,671**

flowers in fall 2004, spring 2005, and summer 2005. Squirrels (species unidentified) disrupted plantings in this field due to their appetite for lettuce (*Lactuca sativa*) and seeds from plants such as summer squash (*Cucurbita pepo*). Drainage was also a problem in this field.

The cover crop planted on the Main Field in 2004 contained a rye (*Secale cereale*) and an Austrian winter pea (*Pisum sativum ssp. arvense*) obtained from local certified organic growers. The cover crop also included a Soil Builder Mix from Peaceful Valley Farm Supply in Grass Valley, California. The Soil Builder Mix contained common vetch (*Vicia sativa*), purple vetch (*Vicia benghalensis*), Lana Woolypod vetch (*Vicia dasycarpa*), Cayuse oats (*Avena sativa*), bell bean (*Vicia faba*), and Magnus/Biomaster pea (*Pisum sativum cv. Magnus*).

The total planted area varied each year, since fields besides the Main Field became available in different years. In addition, planting intensity varied each year. For example, radishes (*Raphanus sativus*) were planted three or four rows per bed. One way to express total planted area is total linear feet, which is a function of the number of beds, length of beds, and rows per bed (Table 9). Summer always used a significant portion of the field because many summer crops sprawled across multiple beds or could only be planted a single row down the bed. However, linear feet devoted to spring and fall crops increased after 2002 as plantings became more dense with closer crop spacing and additional rows per bed (Table 9). By crop category, vegetables were the dominant use of the fields, ranging from a low of 9,436 linear feet in 2002 to more than 16,491 linear feet in 2005. Linear feet in herbs and flowers also increased dramatically after 2002, almost doubling for herbs and for flowers increasing by a factor of four in 2005 and 2006 (Table 9).

Major planting dates for the three seasons were late January, early April, and early August for spring, summer, and fall crops, respectively. Although the official last freeze date for Las Cruces is mid-April, the early April planting of summer crops never encountered an untimely freeze. Harvest took place beginning in early April for the spring crops and continued until mid-November, making cover cropping logistically impossible on the Main Field without alternative fields for rotation.

Tractor operations usually took place twice a year, once at the beginning of the year when the whole field was prepared, and again after the spring season was completed, in preparation for the fall planting. In the two seasons it was used, the temporary Lower Field was plowed, disked, listed, and bed shaped. The Main Field was plowed with a moldboard plow, disked, listed, and bed shaped with on-farm tractor equipment every year except 2005, when the field was ripped (or chisel plowed) and not plowed using the mold board plow.

Eight mil (0.200 mm) drip tape with 8-in. emitter spacing (either T-Tape from T-Systems International, Inc. in San Diego, CA, or Aqua-Traxx from Toro Micro-Irrigation in El Cajon, CA) was injected 4 in. below the surface down the middle of the beds on the Main Field for each planting, except in those adjacent unplanted beds where no irrigation tape was injected since they were used to make room for sprawling summer crops, such as melons (*Cucumis melo*) or winter squash (*Cucurbita pepo*).

The perennial portions of the Perennial Field were not reworked after the year it was first planted. At the end of 2005, some of the drip lines in the Perennial Field were not watering the rows evenly due to plugged emitters, despite regular flushing of the lines. As a result, new drip tape was placed on top of the rows used for non-perennial flowers and herbs. Also in 2006, after a shallow disking, compost was added to the portion of the Perennial Field that contained annuals. This area was listed to incorporate the compost, then bed shaped.

Organic practices were followed during the five years of production, and only materials appearing on the Organic Materials Review Institute (OMRI) list, organically certified, or otherwise allowed under National Organic Program (NOP) rules, were used in the fields (Tables 10 &11). The main source of supplemental fertility, aside from the annual application of aged manure, was injected fish fertilizer.

The quantity of liquid fertilizer applied each year on the Main Field (Table 14) dropped from 110 gallons in 2002 to 26 in 2006. The drop from 2002 to 2003 was a deliberate attempt to reduce usage; instead of applying the liquid fertilizer each irrigation, applications were cut back to once per week. Beginning in 2004, problems with the injector developed and were never solved, accounting for the decrease in quantity after 2004. Replicated field research is needed to determine appropriate and economic liquid fish fertilizer application rates in mixed organic vegetable production.

Twelve gallons of liquid alfalfa fertilizer were applied to the OASIS field in 2005. Locally grown organic alfalfa hay (Medicago) was anaerobically digested using a process developed in the College of Engineering. In that

Table 10. Materials and water applied on all plots, 2002–2006.

	2002	2003	2004	2005	2006
Square feet	29,700	29,700	52,011	52,011	34,596
Pesticides (gal)[1]	0.91[2]	0.59[3]	0.059[3]	0.274[4]	0.178[5]
Surround WP[6] (kaolin clay) (dry oz)	0	0	0	576	40
Manure or compost (total tons)	20	31	22	13	35
Manure or compost (lb/sq ft)	1.35	2.09	0.85	0.49	2.02
Liquid fish, 2-4-0.5 (gal)	110	81.5	159	78	42
Liquid alfalfa (gal)				18	
Water (gal)	740,322	738,085	983,585	1,129,788	891,177
Water (acre feet)	2.2719	2.2651	3.0185	3.4672	2.7349
Other	200 lb rock phosphate (0-3-0)			winter cover crop & 70 Bioflora chicken crumbles (4-6-3)	

[1]Dipel DF concentration: 2 tsp/gal. Pyganic 1.4 EC concentration: 2.5 Tbsp/gal. Safer's Soap concentration: 2.5 oz/gal.
[2]Safer's soap, Dipel (Bt), Pyganic (pyrethrins), vegetable oil
[3]Dipel and Safer's soap
[4]Dipel and Pyganic
[5]Safer's Soap, Dipel, Pyganic
[6]Surround WP concentration: 1 c/gal.

Table 11. Materials and water applied on the Main Field[1] only, 2002–2006.

	2002	2003	2004	2005	2006
Pesticides (gal)[2]	0.91[3]	0.57[4]	0.015[4]	0.26[5]	0.0097[6]
Surround WP[7] (kaolin clay) (dry oz)	0	0	0	576	40
Manure or compost (total tons	20	31	14	5	20[8]
Manure or compost (lb/sq ft)	1.35	2.09	0.94	0.34	1.35
Liquid fish, 2-4-0.5 (gal)	110	81.5	71	42	26
Liquid alfalfa				12	
Water (gal)	740,322	738,085	474,873	589,681	753,495
Water (acre feet)	2.2719	2.2651	1.4573	1.8096	2.3123
Other	200 lbs. rock phosphate (0-3-0)			winter cover crop	

[1]The Main Field was 29,700 square feet
[2]Dipel DF concentration: 2 tsp/gal. Pyganic 1.4EC concentration: 2.5 Tbsp/gal. Safer's Soap concentration: 2.5 oz/gal.
[3]Safer's soap, Dipel (Bt), Pyganic (pyrethrins), vegetable oil
[4]Dipel and Safer's soap
[5]Dipel and Pyganic
[6]Safer's Soap, Dipel, and Pyganic

research, pot studies of chiles (*Capiscum annuum*) were produced in the greenhouse using anaerobically digested grass clippings. This process is undergoing a patent application (Samani, 2007). Whether liquid alfalfa fertilizer is an effective alternative to fish fertilizer is an open research question.

An application for organic certification through the New Mexico Organic Commodity Commission (NMOCC) was made in early 2005 for the Main Field, after three years of transition to organic status. The NMOCC granted certification, with conditions imposed that were difficult to meet given the main OASIS field's proximity to conventional agriculture fields, the farm crew's practice of not washing tractor implements between operations on nearby conventional onion plots and on OASIS plots, uncontrolled greenhouse access, and shared lathe house space.

Soil tests were conducted periodically throughout the project, at least once per year.

Raising transplants

At OASIS, transplants were prepared three times a year for the three main plantings: spring, summer, and fall. Fall and spring cool-season transplanted vegetable crops were broccoli (*Brassica oleracea*, italica group), cabbage (*Brassica oleracea*, capitata group), cauliflower (*Brassica oleracea*, botrytis group), and kohlrabi (*Brassica oleracea*, gongylodes group). Radicchio (*Cichorium intybus*) was transplanted in spring 2004–2005. Chinese cabbage (*Brassica rapa*, pekinensis group) was transplanted in 2002 only; after this experience, Chinese cabbage was direct seeded, as it matured quickly and germinated well. Warm-season transplanted vegetable crops were eggplant (*Solanum melongena*), bell and chile peppers (*Capsicum annum*), tomatillo (*Physalis ixocarpa*), and tomato (*Lycopersicon esculentum*). Sweet potato (*Ipomoea batatas*), a summer crop, was grown using slips (cuttings) produced from potatoes harvested the previous year. All other vegetable crops were direct seeded in the field.

Transplanting procedures relevant for all seasons

Seeds were typically started 6–8 weeks before transplanting to the field. Transplanted crops were sown 2 seeds per cell in 6-packs (6 cells per pack; cell size: 2 1/4 in. x 2 in. x 3 1/4 in.). Flats held six 6-packs (36 plants per tray). The cell packs used were made by T.O. Plastics (model #606 Deep) and were obtained from Greenhouse and Garden Supply (3820 Midway Pl. NE.; Albuquerque, NM 87109; 1-800-627-4769; www.greenhouseandgarden.com). Deep 6-packs were used because they allowed for growth of large, sturdy transplants with good root systems.

Once the number of plants of each variety to be grown was determined, that number was divided by 36 (the number of plants per tray) and rounded up to the nearest whole number to get the number of flats to sow. Some "extras" were included in this number, so that losses from poor germination or death in the greenhouse could be covered. Sometimes this number was adjusted up or down depending upon how many extra plants were needed. For example, if the field plan called for 38 plants, 2 entire flats would result in too many extra plants and a waste of seed, soil, water, fertilizer, and time. So one flat and two packs would instead be sown.

The soil used for all transplants was 2-cu. ft bags of Black Gold All Organic Soil (made by Sun Gro Horticulture Distribution Inc.), also obtained from Greenhouse and Garden Supply. One bag of soil would typically fill seven flats.

Transplants were fertilized at the rate of 2 Tbsp/gal with Alaska Fish Fertilizer 5-1-1 (made by Lilly Miller Brands), obtained from Greenhouse and Garden Supply. This was mixed and applied using a watering can weekly, with the first application taking place approximately 2 weeks after seeds were sown. Plants were thinned to one per cell at the cotyledon stage, before true leaves appeared.

Spring crop transplanting procedures

Since the spring planting date was usually the last week of January, transplanted crops were seeded about the second week in December. Vigilance for cabbage loopers (*Trichoplusia ni*) and cabbage aphids (*Brevicoryne brassicae*) was important in order to spray organic pest controls before populations got out of control. Spring transplanted crops usually had excellent germination. A great percentage of cells had both seeds germinate. The greenhouse temperature was set at 65–70º F and adjusted to speed or slow the crop's growth.

The process of hardening off transplants usually began 1–2 weeks before field planting, approximately mid-January. Hardening consisted of lowering the thermostat by 5ºF every day until heat was completely shut off. Once transplants needed no supplemental heat during the night, vents were opened immediately at 7 a.m. and kept open during the day. Eventually, vents were kept open during the night. The progression of stepping down the heat to allowing the vents to stay open during the night spanned about 1 week. After this process, plants were taken one step further and placed in the lathe house to complete the hardening process until field planting began.

Summer crop transplanting procedures

Summer transplants were started in the greenhouse during the second or third week of February to be ready for an early April field planting. Peppers needed to be sown a minimum of 8 weeks before the field planting date. Tomatoes and tomatillos were relatively quick to germi-

nate, so they were sown 6 weeks before field planting.

The greenhouse temperature was set at 70–75ºF and was adjusted to speed or slow crop growth. The process of hardening off began 1–2 weeks before field planting, usually mid- to late March. Pest control was not typically needed for summer transplants.

Tomatoes were sown 2 seeds per cell. Even if both seeds germinated they were typically not thinned, to make the plant appear more bulky and less attractive to the leafhopper. Cells where only one seed germinated were left that way. Peppers were also not thinned if both seeds germinated because the potential for fruit sunscald was reduced from extra foliage with two plants transplanted together. Eggplant was always thinned to one plant per cell as soon as one true leaf emerged.

Germination percentage of summer transplanted crops (mainly vegetables and flowers) was often less than that of spring and fall transplanted crops. Sometimes one or both seeds germinated, or maybe no seeds germinated. If no seeds germinated, a plant from a cell where two seeds germinated was transplanted into the empty cell. As long as each cell had at least one plant or as long as there were enough cells for field planting, seed was not resown.

Sweet potatoes grown 2002–2005 were bought from Mountain View Market, a local food cooperative. They were planted for slip production around the second week of February (coinciding with the summer transplant sowing). The number of potatoes to purchase was based on an estimate that ten slips could be obtained from each potato. If planting began and there were not enough slips, more would grow after the initial harvest of rooted cuttings.

Sweet potatoes were placed in heavy flats approximately 4 in. deep. Flats were filled with sand or Black Gold soil. The medium was not important because sweet potatoes have storage reserves to produce shoots. Potatoes were placed on their sides and buried so the top side was exposed to the air. To slow transfer of pathogens, potatoes were not allowed to touch one another in the flats. Slips were ready to be planted when they were about 4 in. long. They were harvested for planting by tugging them out of the flat. Usually, roots accompanied each stem when pulled from the flat.

Because of certification issues, OASIS produced slips in 2006 from potatoes grown by OASIS during the 2005 season. Since proper storage to hold potatoes until February was not available, sweet potatoes were prone to immediate sprouting. The alternative method was to plant the potatoes in flats as described. Vines grew that had to be trimmed at least once and allowed to grow back so the proper size of slips could be achieved for summer season planting at the beginning of April. Careful monitoring was needed to ward off whitefly and aphid infestations. If OASIS were to resume, this extended slip production technique would be used in the future.

Fall crop transplanting procedures

With a fall planting date scheduled the first week of August, fall transplanted crops were seeded approximately the third week of June. Sowing seeds 6 weeks before transplanting to the field was adequate because summer warmth accelerated maturity. Unlike in other seasons, fall transplant crops were not grown in the greenhouse. Outside temperatures were ideal for raising fall transplants in the lathe house without supplemental heat. Aphid and cabbage looper monitoring and treatment were important since there was no protection in the lathe house.

Field planting

Planting depth and seeding rates by crop

Planting depth and seeding rates for cool- and warm-season crops shown in Appendix A are the guidelines OASIS settled on after five years of trial and error. In particular, seeding rates changed as experience guided choice of rows per bed and in-row plant spacing, detailed below. Initial in-row spacing and rows per bed were determined based on recommendations in planting charts available in 2002 seed catalogues from Fedco Seeds (Waterville, Maine) and Territorial Seed Company (Cottage Grove, Oreg.). As the project farm manager learned more about what made sense with 42-inch beds (42 in. center to center), adjustments were made based on experience. The changes adopted were determined by the need to conserve space but still provide good yields and facilitate effective harvesting (Appendix B1-B2).

Days to harvest, seed sources, seed types, weeks of harvest, and seed costs by variety

The primary criteria used to select seed sources were organic status and cost. Seeds were purchased from companies such as Johnny's (J), Territorial (T), Fedco (F), Seeds of Change (SC), High Mowing (HM), Turtle Tree (TT) and others. Company details and code explanations can be found in Appendix C.

Seed costs per acre were estimated based on seeding rates of each crop and the cost per pound, based on 2007 prices. The price per pound was based on the catalogue OASIS ordered seed from in 2006, if bulk organic prices were available from that company. If bulk organic prices were not available for a particular variety, but a similar variety seed with an organic bulk price was quoted by that company, that price was used. If no similar variety was sold in bulk organically by that company, another company's catalog for 2007 was consulted. The tables summarizing this information contain the seed source for the seed purchased by OASIS each

year and the seed source used for calculating seed costs. Non-organic seed prices were used only for crops that were never available organically, such as hybrid broccoli and the Joi Choi variety of bok choi (*Brassica chinensis*). Although OASIS did purchase seeds in packets and OASIS also used donated seed on occasion, this analysis used bulk prices since most farmers of any size would purchase seeds in bulk.

Days to harvest for transplanted crops were based on the date transplanted into field, not seeded. For direct-seeded crops, days to harvest were based on date of seeding in the field. Days to harvest, weeks of harvest, seed source, and seed type are included in the same tables as seed cost estimates and are referenced in the results section.

Bed space, rows per bed, and in-row plant spacing by variety

Mean yields were estimated using annual averages. One could estimate mean yields by dividing total pounds produced, compiled from all the years a variety was grown, by total bed feet; however, the procedure used was to calculate each year's pounds per bed foot and then take an average of those averages.

To extrapolate small plot yields to per-acre yields, mean pounds per bed foot were multiplied by 12,445.71. This number was estimated as follows: there are 43,560 square feet in an acre, which contains 12,445.71 plots, each 3.5 sq ft in area. The number 3.5 is 42/12 and represents one square foot of field space because each bed was 42 in. wide center to center.

In years when a crop failed, for whatever reason, data for that year were ignored, and only the years for which data were available were used for means and totals. Where multiple answers are given for data such as in-row plant spacing, values provided are for each year the crop was grown. When only one value is provided, it did not change from year to year. Bed space, rows per bed, and in-row plant spacing data are included in the same tables as variety yields and are referenced in the results section.

Data gathering procedures

A harvest assessment was conducted each week on Tuesday, the day before main harvest and distribution to CSA members. Certain crops were pre-counted; in other words, crops that could not obviously be distributed to all members had to be pre-counted for distribution as one of the optional crops offered on the miscellaneous table. For example, say there were 80 half-share equivalent memberships. Only 40 eggplant of harvestable size were available. Since 80 eggplants were needed to supply all half-share equivalents, and only 40 were available, eggplant had to go on the miscellaneous table. The pre-harvest assessment sheet would note that 40 should be harvested. The harvest assessment sheet was used by the harvest crew, who would harvest no more than 40 (at least not without permission), and a notation was made in the harvest records of the additional eggplant.

The procedure, then, was for crops whose harvest could not supply all members in a particular week to be harvested collectively in multiples of 80 (assuming 80 half-share equivalents) and placed on the miscellaneous table. For example, the miscellaneous table might contain 40 eggplants, 40 sacks of tomatoes, 20 sacks of Big Jim peppers and 60 sacks of green beans, 50 bags of basil (*Ocimum basilicum*) and 30 bags of okra (*Abelmoschus esculentus*)—240 total items—and members would be asked to select 6 items if they had a full share or 3 items if they had a half share.

Once the assessment was done on Tuesday, a computer-generated data collection sheet was printed containing a blank line for weight and count for each crop and variety planned for harvest. Those crops that were not counted, such as beans and peas, had an "X" in the count field. Pre-determined counts, such as the 40 eggplant, were printed out in the data collection sheet. Also, previous weights and counts were added to this sheet from varieties that were harvested earlier in the week—since certain crops, such as tomato, peas (*Pisum sativum*), beans, melon, watermelon (*Citrullus lanatus var. lanatus*), cucumber (*Cucumis sativus*), summer squash, and okra, ripened too fast to be harvested only once a week. The weight and count of harvest on a given Wednesday included the weights from the previous Friday and Monday. Thus, all yields would be accounted for when dividing that week's crops among shareholders.

On Wednesday, the main harvest day, the data collection sheet resided in the cooler where weights and counts were recorded before shelving. Staff and students chose a variety to harvest from the list in the field. Once harvested, they placed in the harvest sack or bin a label with the variety name and count. Upon being brought to the cooler for storage, crops were weighed, counted (if not pre-counted or field-counted), and these data recorded.

All vegetables and herbs were weighed by variety, herb bunches were counted and most vegetables were counted by variety as well, with the exception of peas and beans, which were only weighed (and not counted) by variety. Obviously, damaged crops were omitted from harvest or culled after harvest, although some crops with minor damage, such as peppers with minor sunburn, were weighed and distributed to members.

In summer 2004, the great loss of tomato plants due to curly top virus meant that commercial transplants had to be purchased to replace OASIS greenhouse-grown transplants. Because of the large number of varieties purchased, individual variety tomato yields were not kept that season. Root vegetables such as turnips (*Brassica rapa*), beets (*Beta vulgaris*), radishes, and

carrots (*Daucus carota* var. *satifus*) were not counted or weighed until after they were washed, to exclude soil weight. Beets, turnips, carrots, and radishes were weighed with their tops except in 2002 and 2003 when tops were removed and weighed separately. To make the data consistent, tops and root weights were combined in 2002 and 2003, so that all yields represent combined weight of roots and tops. Tops were left on root crops because bunching was easier and presentation was improved. Vegetables that needed to be trimmed of leaves (kohlrabi, cauliflower) were trimmed before weighing.

Flowers were not weighed, but flower bunch counts were made of the multiple-variety bunches created each week. Flower plantings increased once flower memberships were offered separately from vegetable memberships in 2004.

Once the harvest sheet was completed in the cooler or after root crops were washed and weighed, harvest numbers were used to determine the quantities full- and half-share holders would receive. On another sheet, crops were listed in order from heaviest to lightest, and the week's allocations for full and half shares were noted. This information was transferred to the white board to guide shareholders around the room, with tables placed in an open U shape. Vegetables were then placed on the tables in order of how they were written on the board. Shareholders picked up their appropriate amounts and their attendance was checked. To increase the sense of choice, a swap table was created at the end of the U, on the way out, so that members could make final swaps among vegetables.

The next day, all weights were tallied to give total pounds harvested for that distribution. All items on the handwritten distribution sheet were attributed a weight so as to determine the total pounds that full- and half-share holders received that week. In addition, a list of shareholders who did not pick up in any given week was recorded, as were all cash sales (flower bunches, fruit, cards, etc.). All information was transferred to Microsoft Excel files.

Data entered into spreadsheets were next entered into a Microsoft Access database. This database was designed by a succession of students in several database classes taught by two instructors who were also OASIS shareholders. Because the database was not available at the beginning of the project, the practice was established early of entering the data first into Excel spreadsheets; this practice was followed throughout the project. Printouts from the Excel spreadsheets were then used to create the database. Data entry at each step was checked for errors. The information in this publication was generated from Access database queries.

PRODUCTION RESULTS

Production diversity

Because one project goal was to test varieties, the OASIS project grew more varieties than would normally be grown by a commercial CSA farm. For the five years from 2002 to 2006, a total of 554 different varieties of vegetables, flowers, and herbs were grown, including 372 varieties of 39 vegetables, 32 varieties of 15 herbs, and 150 varieties of 72 flowers (Table 12). The number of varieties grown each year was influenced by experience as time passed, by preference of students in the class who expressed interest in trying certain crops, and by participation in Cornell University's Organic Seed Partnership (OSP) project, in which OASIS grew organic seed from public and private seed breeders. Most of the production was in vegetables and the bulk of production took place during the summer season (Table 13).

Table 12. Number of varieties and crops* planted, 2002–2006.

	2002	2003	2004	2005	2006
	----------# of Varieties / Crops----------				
Vegetables	124 / 35	116 / 33	99 / 36	144 / 33	94 / 30
Herbs	10 / 8	15 / 12	14 / 11	18 / 13	18 / 13
Flowers	12 / 5	29 / 20	44 / 30	90 / 56	84 / 34
Total	**146 / 48**	**160 / 65**	**157 / 77**	**252 / 102**	**196 / 77**

*Crops include vegetables such as broccoli and carrots.

Table 13. Production[1] by season and crop category, 2002–2006.

	2002	2003	2004	2005	2006
	----------total lb----------				
Spring	1,279	3,821	2,764	4,305	3,503
Summer	16,569	10,135	12,653	11,131	13,070
Fall	2,263	2,504	2,921	5,184	3,041
	----------lb/bunches----------				
Vegetables (lb)	19,633	16,207	17,659	20,214	19,215
Herbs (lb/bunches)	478 / 2,405	253 / 3,511	670 / 4,940	406 / 3,524	399 / 3,777
Flowers (bunches)	682	1,183	1,868	1,728	1,817
Total pounds	**20,111**	**16,460**	**18,329**	**20,620**	**19,614**

[1] Since flowers were not weighed, seasonal production in pounds is for vegetables and herbs only.

As might be concluded from increases in field space devoted to flowers, flower production rose significantly from 2002 to 2006, almost tripling in terms of bouquets produced (Table 13). Flower and herb production increased as a result of the dedicated Perennial Field. Increases in flower production were a consequence of flower share sales being separated from the vegetable/herb shares in 2004. Flower shares were introduced to take advantage of the increase in flower production and to earn income to offset labor costs associated with flower harvest and bouquet making. Many flower memberships were sold to passersby who stopped at OASIS after noticing a sign, placed next to the street, advertising fresh-cut flower bouquets.

The weather and its impact on production

Normal annual rainfall averaged 6.55 in. from 1945 to 1958 and 8.35 in. from 1892 to 1959 at the NMSU weather station (Western Regional Climate Center, 2007). Concentrations fall in the monsoonal season, from July to September. During the five years OASIS was in production, annual rainfall averaged 10.26 in., with a low of 0.51 in. in 2004 and a high of 14.18 in. in 2006. Southern New Mexico temperatures typically range from the high 20s to 30s (ºF) in December and January and peak in the high 90s in June though August (Appendix D).

Production was good in 2002, OASIS's first year, and the average weather experienced that year could be part of the reason. In June 2002, temperatures hit 98ºF, although the maximum annual temperature averaged 78ºF. The minimum average temperature in 2002 was 29ºF in January. Total rainfall was 7.62 in. with the rainy season arriving in a normal pattern, with the heaviest rains falling in July, August, October, and December.

Heavy rainfall in December 2002 (1.56 in.) and in February 2003 (1.68 in.) led to conditions propitious for beet curly top virus (BCTV) infestation in the tomatoes. Wet falls and winters are linked to increased curly top virus because the beet leaf hopper (*Circulifer tenellus*), which is the vector for the virus, has opportunities for overwintering in the region (Creamer et al., 2003). Late fall and winter rains typically produce more London rocket mustard plants (*Sisymbrium irio*), which provide the beet leafhopper with winter habitat (Ray et al., 2006). More than 90% of tomato plants succumbed to curly top virus in 2003. The rest of 2003 was fairly dry, and total rainfall for 2003 was 5.51 in. below average. Winter was warmer in 2003 than in 2002.

Average maximum annual temperature, 79ºF, was higher in 2003 than in 2002. The elevated summer temperatures continued into the fall with the average maximum temperature for October at 83ºF, the highest of any October OASIS year. The fall season was planted on July 28, a week earlier than the previous year, to determine whether fall production could be started earlier. This may have been a good strategy, except that many of the cool-season fall crops failed to germinate and required replanting due to the higher-than-normal fall temperatures. Growth and flavor of some varieties were also affected. The lowest average minimum temperature in 2003 was in December (27ºF). The lack of rainfall in 2003, the extreme temperatures, plus the decision to try to conserve water and fish fertilizer probably all contributed to lower yields that year. In addition, the first year had residual fertilizer in the field, unrestrained irrigation water, good amounts of rainfall, and more injected fish fertilizer. As a result, 2003 proved to be the lowest yielding year for OASIS.

The winter of 2003–2004 was very dry, and lower losses from curly top were expected in summer 2004. This proved true, with fewer tomato plants dying. However, 2004 turned out to be a mild and wet year, with total rainfall of 13.15 in.. The highest monthly average maximum temperature for 2004 was in July (95ºF) and the annual average maximum temperature was 76ºF. Crops produced well in 2004 (18,329 lb) but did not exceed the total pounds from Year 1 (20,111 lb) (Table 13).

The rains in the winter of 2004–2005 were significant enough to suggest another bad curly top virus year in 2005. To prevent major losses, several methods were tested to combat the spread of the disease. Surround WP (kaolin clay) was sprayed weekly on certain tomato rows, and reflective mulch on other tomato rows, in an attempt to minimize curly top virus (total quantities in Table 10 & 11). The winter squash planting was infected with curly top and all varieties failed. However, some of the loss may have been related to lack of experience with many of the varieties; they were part of variety trial with Cornell University's Organic Seed Partnership. Rainfall in 2005 was above average at 10.86 in. A warm spring with similar temperatures to the 2003 season was followed by a relatively typical summer where the highest monthly average maximum temperature was in July (98ºF) and the average maximum annual temperature was 78ºF. Crops produced well in 2005 with pounds totaling 20,620, more than any other OASIS year. However, because OASIS used the Lower Field until the end of the 2005 summer, more area was under production; thus, 2005 actually was the second-to-least productive year, slightly edging out 2003, the lowest producing year.

Early warm temperatures in 2006 caused an outbreak of cabbage aphids (*Brevicoryne brassicae*) on cauliflower and broccoli varieties, a crop failure in the Chinese broccoli due to early bolting, and a substandard stand of both varieties of corn cockle (*Agrostemma githago*). Fall temperatures in 2006 were typical.

The lack of rainfall in November and December 2005 and the low rainfall in January through April 2006 reduced worries about curly top. Nevertheless, Surround

Table 14. Soil test results, Main Field north, 2002–2006.

Date	Soil pH[1]	NO_3-N[2]	P[3]	K[3]	Elect. cond.[4]	Organic matter
		ppm	ppm	ppm	mmhos/cm	percent
03/05/02	7.84	30.6	25.5	896	2.02	0.62
11/08/02	7.76	7.0	22.0	54	1.28	0.90
01/08/03	7.52	41.5	35.5	115	3.30	1.32
08/07/03	7.69	8.2	56.9	125	2.49	1.88
10/31/03	7.42	5.8	33.3	60	2.01	1.03
01/29/04	7.64	24.9	42.9	141	4.35	1.91
10/15/04		33.8	47.9	176	3.47	1.24
09/02/05	7.90	5.4	36.7	91	2.14	1.31
04/04/06	7.64	7.6	49.6	18	3.50	1.61

[1]Measured by soil saturation paste.

[2]1:5 Soil water extract

[3]$NaHC0_3$ extracted

[4]Soil paste extract

Table 15. Soil test results, Main Field south, 2002–2006.

Date	Soil pH[1]	NO_3-N[2]	P[3]	K[3]	Elect. cond.[4]	Organic matter
		ppm	ppm	ppm	mmhos/cm	percent
03/05/02	7.57	117.0	23.3	125	5.31	0.62
11/08/02	7.60	40.4	25.9	90	2.90	1.14
01/08/03	7.66	96.0	55.4	193	5.84	1.36
08/07/03	7.68	60.2	30.4	160	4.89	1.20
10/31/03	7.48	10.0	50.0	108	1.94	1.45
03/30/04		44.3	56.2	197	4.73	1.76
10/15/04		17.1	35.8	117	2.92	0.93
09/02/05	7.88	8.0	37.6	109	2.87	1.35
02/06/06		20.7	45.6	144	2.74	1.79

[1]Measured by soil saturation paste.

[2]1:5 Soil water extract

[3]$NaHC0_3$ extracted

[4]Soil paste extract

Table 16. Production outcomes, 2002–2006.

	2002	2003	2004	2005	2006
Vegetable and herb production (/linear ft)	2.07	1.20	1.29	1.21	1.32
Flower production (bunches/linear ft)	1.64	1.15	0.88	1.01	1.01
Gross income per pound ($/lb)	0.45	1.40	1.46	1.39	1.42
Veg. & herb income per pound ($/lb)	0.45	1.40	1.26	1.11	1.16
Water efficiency, vegetable and herb production (gal/ lb)	36.81	44.84	53.66	54.79	45.44
Water efficiency, gross income (gal/$)	82.26	32.09	36.73	39.52	32.02

was sprayed on all tomato plants once. Spraying was abandoned when it became clear that low populations of beet leafhoppers existed. Monsoonal rains began in July (1.28 in.) with 5.01 in. in August, 4.39 in. in September, and 2.40 in. in October. Thus, 2006 was the wettest OASIS year with 14.18 in. of rainfall. The fall planting was hampered by the heavy rains and muddy field conditions. Germination of some crops (lettuce, carrots) was compromised by the rain, which allowed a crust to form on the surface of beds, making it hard for the delicate seedlings to emerge. As a result, some lettuce varieties required replanting. Still, 2006 turned out to be the second most productive year. Given that 2002's productivity was somewhat of an aberration, 2006 was the most productive OASIS year, despite the heavy rains.

Soil test results

Soil test results show slight increases in soil organic matter over the course of the project and adequate management of soil salt content as indicated by electrical conductivity (EC) results (Tables 14 &15). The pH was between 7.4 and 7.9, which is considered slightly alkaline (Herrera, 2000). Soil organic matter on Doña Ana County farms averages 1.3%, with a standard deviation of 0.9 (Flynn, 2007). Soils with EC ratings lower than two are considered to have very low salinity; EC ratings of between 2 and 4 indicate low-saline soil and between 4 and 8 moderately saline soil. In the range of 4 to 8, salinity problems start to become evident, particularly in vegetable crops such as radishes (Raphanus sativus), spinach (*Spinacia oleracea*), celery (*Apium graveolens*), and green beans (*Phaseolus vulgaris*), which all have poor salt tolerance (Herrera, 2000).

Other productivity measures

Income generated per pound of product sold was estimated (Table 16). In the first year, income per pound ($0.45) was low because of the tremendous production and the conservative number of memberships sold that year. In the last four years, when memberships were doubled, and considering all income, about $1.40/lb was earned. In 2004, flower membership sales began, and from 2004 to 2006 the vegetable and herb income per pound of output was between $1.11 and $1.26/lb.

Water efficiency measures were also calculated (Table 16). Between 37 and 55 gallons of water were needed per pound of output, although water usage per pound is overestimated since flowers were not weighed. In terms of gross income generated, between 32 and 82 gallons were needed to produce $1 in gross income, although after the first year the range was between 32 and 40 gallons to generate $1 in gross income.

Weeds and their impact on production

Weed problems in the Main Field became progressively worse throughout the five years OASIS was in produc-

Table 17. Weed frequency, 2002–2006.

Latin Name	Common Name	Location[1]	Frequency[2]
Amaranthus sp.	Pigweed	Main Field	High
Anoda cristata	Spurred anoda	Main Field	Low
Chenopodium album	Lambsquarter	Main Field	Low
Convolvulus arvensis	Field bindweed	Main Field (south edge)	Low
Cynodon dactylon	Bermuda grass	Field Edge	Low
Cyperus esculentus	Yellow nutsedge	Main Field	High
Cyperus rotundus	Purple nutsedge	Main Field	High
Datura innoxia	Datura	Main Field	Very Low
Digitaria sp.	Crabgrass	Main Field	Low
Echinochloa colona	Junglerice	Main Field	High
Ipomoea sp.	Morning glory	Main Field	Low
Kochia scoparia	Kochia	Main Field	High
Lactuca serriola	Prickly lettuce	Main Field	Low
Physalis wrightii	Wright groundcherry	Main Field	Low
Poa annua	Annual bluegrass	Ditch	High
Rumex crispus	Curly dock	Ditch	Moderate
Salsola tragus	Russian thistle	Field Edges	Low
Solanum elaeagnifolium	Silverleaf nightshade	Field Edge (south side)	High
Solanum rostratum	Buffalobur	Main Field	Low
Sonchus oleraceus	Annual sowthistle	Main Field	Low
Sorghum halepense	Johnson grass	Main Field	Low
Sphaeralcea sp.	Globemallow	Ditch	Low
Stelaria verticillata	Bristly foxtail	Main Field	High
Tribulus terrestris	Puncture vine	Field Edges	High

[1] Weeds in Field Edges or Ditch were rarely present in the Main Field itself. However, without management weeds in the ditch or along the field edges, especially those on the edges, would eventually spread across the Main Field.

[2] Very Low and Low describe weeds scattered across the field or those concentrated in isolated areas of the field. High indicates weeds that invaded most areas of the Main Field.

tion. By the fifth year, the lack of alternative methods to manage the weeds made it impossible to continue planting in the Main Field. The problems intensified over the years because crop rotation and cover cropping were not possible with the limited space. Warm-season weeds were the most problematic. Weeds in the cool spring growing season were not a challenge, since only one-third of the field was in production at the time and these weeds were easily handled. As temperatures warmed up and the summer crop was planted, the warm-season weeds immediately began competing for resources and continued doing so through the middle of the fall season, which remained relatively warm. When summer crops finished producing, attention was focused on the warm-season weeds in the fall planting. With this focus and the cooling temperatures, the weeds in this section were usually kept under control; however, the weeds that got out of control in the summer plantings usually were able to set seed.

Many weeds presented problems (Table 17), but perennial yellow and purple nutsedge (*Cyperus esclentus* and *Cyperus rotundus*, respectively) caused tremendous challenges. The nutsedges spread progressively across the field as the nutlets were cut and distributed by cultivation practices. Grasses such as bristly foxtail (*Stelaria verticillata*) and junglerice (*Echinochloa colona*), and broadleaf weeds pigweed (*Amaranthus sp.*) and kochia (*Kochia scoparia*) were also difficult to keep from spreading. Each summer, additional student workers were hired to weed.

In the beginning of the season, besides planting, weeding was the primary labor task. Once vegetable harvest began, weeding time decreased and many of the gains achieved early in the summer proved inconsequential by the fall when populations exploded across the field. The incidence of the various weed species in the field were based on the farm manager's subjective assessment (Table 17). The ratings of Very Low and Low were used to describe weeds scattered across the field or those concentrated in isolated areas of the field. High indicates weeds that invaded most areas of the Main Field. Weeds in Field Edges or Ditch were rarely present in the Main Field itself. However, without management, weeds in the ditch or along the field edges, especially those on the edges, would eventually spread across the Main Field.

Other factors compromising yields

Besides unpredictable weather, invasive weeds, and curly top virus, other factors may have compromised yields. Vertebrate and invertebrate pests, pollination issues, and disease were the main culprits (Table 18).

Vertebrate pests affected germination and harvestable product. In 2004, ground squirrels excavated and ate newly planted squash seed. In fall 2006, white-winged doves (*Zenaida aiatica*) plucked pea seeds out of the ground. An unidentified gopher inflicted moderate damage to sweet potatoes in 2002 and minimal damage in subsequent years. Unidentified field mice routinely nibbled tomatoes at their perfect ripeness and crops such as summer squash and eggplant to a lesser degree. This sort of damage was especially noticeable in 2005.

Although the exact impact of insects on yields is unknown, many insects did inflict damage. Flea beetles

Table 18. Other causes of production losses and treatments attempted.

Problem	Latin Name	Crops damaged	Treatment	Effectiveness	Notes
Ground Squirrel	Species unknown	squash	trapping	poor	Animals ate newly planted squash seed; trapped only one of many.
Gopher	Species unknown	sweet potato	trapping	poor	Critter never caught—still at large.
Dove	*Zenaida Asiatica*	pea	none	N/A	Doves ate seed or just flipped it out of the soil to desiccate.
Flea beetle	*Epitrix sp.*	broccoli, turnip, mustard, Brussels sprouts, arugula, cress, cabbage, kohlrabi, cauliflower, collards, cabbage, Chinese cabbage, radish	Pyganic 1.4 EC	good	Treatment effective
Eggplant lacebug	*Gargaphia solani*	eggplant, sunflowers	Safer's Soap	good	Treatment effective
Aphids	Various species	eggplant, collard, radish, turnip, pea, kohlrabi, cabbage, cauliflower, broccoli, snap bean, flowers, dill	Safer's Soap	good	Treatment very effective when implemented. Due to time constraints, field spraying was not always done, leading to yield losses.
Beet leaf hopper	*Circulifer tenellus*	tomato	Surround WP	moderate	Plants were sprayed on a weekly basis.
Whitefly	*Bemisia argentifolii*	eggplant, broccoli, cauliflower, Brussels sprouts, kohlrabi, cabbage	Safer's Soap	good	Treatment effective
Cabbage looper	*Trichoplusia ni*	cabbage, broccoli, cauliflower, kohlrabi	Dipel DF	good	Treatment very effective when implemented. Due to time constraints, field spraying was limited, leading to yield losses.
Squash bug	*Anasa tristis*	summer squash, winter squash	Pyganic 1.4 EC	poor	When sprayed, pesticide was effective, but constant spraying during nymphal stages is necessary to make a difference.
Thrip	*Thrips tabaci* or *Frankliniella occidentalis*	onion, leeks	Pyganic 1.4 EC, Safer's Soap	poor	Constant spraying necessary to combat high levels of insects due to conventional onions in close proximity.
Corn earworm	*Helicoverpa zea*	corn	Dipel DF, corn oil	poor	Application timing is extremely important for both treatments to be effective.
Root knot nematode	*Meloidogyne incognita*	tomato, eggplant, okra, snap bean	none	N/A	Relationship between nutsedge and nematode populations.
Powdery mildew	fungi species	pepper, cucumber	none	N/A	Wider plant spacing to encourage more air circulation may have helped but space constraints prohibited this.
Rotting fruit	fungi species	tomatoes, melon, cucumber, squash, peppers, eggplant	none	N/A	Mulching rows so fruit wouldn't have direct contact with moist soil would have been a solution, but time and money prevented this solution.
Pollination	corn	switch variety and bigger planting blocks	good		This occurred in the first year of production.
Split melons	muskmelon, watermelon	none		N/A	Isolated watering of rows or sections would have helped but was impossible.

(*Epitrix sp.*) usually attacked young radish, turnip, Chinese cabbage or gai lan (*Brassica oleracea*), and bok choi seedlings a few weeks after emergence. Once these crops were treated, growth resumed with no ill effect to the harvestable product. Eggplant lacebug (*Gargaphia solani*) also attacked young eggplant and sunflowers (*Helianthus annuus*) but once plants were treated did not further stunt their development. In 2002, whitefly (*Bemisia argentifolii*) was a problem on the foliage of mature broccoli and cauliflower plants. Green peach aphid (*Myzus persicae*) was a problem on mature pea plants, which were treated for the infestations and harvested.

Cabbage loopers (*Trichoplusia ni*) were a problem on all cole crops. Since they mainly damaged the leaves, they did not pose a major problem when reproductive structures were harvested, such as on broccoli or cauliflower. The frass left on harvestable heads was a nuisance and unsightly, but rarely resulted in discarding the crop, especially in the context of a CSA. However, heavy looper damage to cabbage leaves or loopers boring to the center of the head did cause some product to be rejected from harvest.

Cabbage aphids (*Brevicoryne brassicae*) on cole crops when treated early did little to hamper yields. However, when allowed to multiply, they did cause crops to become infested and unharvestable. Their great numbers on cabbage caused heads to be pulled and discarded. On heavily infested broccoli plants, insects eventually migrated to the head, intermingling with the beads, causing them to become unmarketable. On cauliflower, this occurred only in very extreme cases; more often, the insects' production of honeydew caused sooty mold to grow on the surface.

Squash bugs (*Anasa tristis*) were a constant problem. First-round plantings of summer squash suffered minimal yield decreases. However, these plantings were prematurely terminated upon the emergence of the squash bugs from their numerous overwintering sites around the Main Field. Yields from subsequent plantings were greatly abbreviated once populations from earlier infestations were allowed to take hold. Heavily infested plants would wilt and die or large populations of squash bugs would feed on young fruit. Eventual migration to less desirable crops such as winter squash or melons was inevitable, although the damage was much less serious.

In 2002 poor variety selection adversely affected onion production; in 2003 varieties suited to the growing season of southern New Mexico were used. However, thrips (either onion thrips, *Thrips tabaci*, or Western flower thrips, *Frankliniella occidentalis*) became a problem. Significant thrips damage to the leaves caused substandard yields. Because OASIS was surrounded by conventionally grown onions that were routinely sprayed for thrips, it became a haven for insects that more benign, organically approved pesticides failed to control. OASIS did not consider growing onions after 2003 because of these issues and because of the access to onions from the Onion Breeding Program (shareholders did not seem to mind their conventionally grown origins).

Root knot nematode (*Meloidogyne incognita*) was known to exist in the Main Field at the start of the OASIS project. Infected roots were noticed on tomato, eggplant, okra, and beans when unusually stunted plants were pulled during or at the end of the season. Northern areas of the Main Field seemed more heavily infested. Not by accident, the most heavily infested nematode areas were also the areas that initially had the worst nutsedge problems. Southern root-knot nematodes and both purple and yellow nutsedge have a mutually beneficial relationship. The nematodes increase the nutsdege problems by increasing tubers and reducing the ability of crops to compete with the nutsedges (Schroeder et al., 1993; Schroeder et al., 2004; Schroeder et al., 2005; Thomas et al., 2005). In southern New Mexico, the least-cost, most successful control method available to combat the nutsedge/nematode complex is rotation with alfalfa. At OASIS, no such rotation possibility existed.

Low corn yields due to poor pollination in 2002 were not repeated in subsequent years because of improved variety selection. However, corn earworm (*Helicoverpa zea*) hampered yields every year corn was grown. Most corn crops were husked and damaged tips cut before offered to shareholders. In years when they were not husked, shareholders would peel back every ear searching (in vain) for the ear that did not contain a worm.

Due to close spacing and summer rains, powdery mildew was a problem in cucumbers and peppers, causing premature loss of plants. On peppers, defoliation caused fruit to be stunted, unable to ripen, or sun scalded, all of which made them unmarketable. In some cases, the plants would recover and push out new growth, but yields during the time of defoliation were compromised.

Other losses contributing to decreases in recorded yields worth noting were cracked melons (due to variety or irrigation management) and rotting fruit such as tomatoes, cucumbers, melon, and squash (due to direct contact with moist soil and lack of mulch).

Vegetables

Winners and losers

Crops chosen to be grown multiple years generally proved themselves through trial and error. Some varieties were grown once or twice and then dropped because of poor performance or because other varieties were better in some way. Sometimes varieties were planted once or twice at the request of students or faculty, or because

seed was available. Over time, varieties that were planted repeatedly for many years were considered "winners" (Tables 19-20).

Some crops were good producers but not popular, or vice versa. For example, bok choi and Chinese cabbage both performed well in the field but were not in high demand by shareholders. They filled a gap in the production schedule, so they were planted faithfully; however, over time less was offered each season, dropping from 4 weeks to 2 weeks per season. Smaller blocks were planted to shorten the season. Often there wasn't enough for all shareholders in a given week, but shareholders did not mind. Small amounts of bok choi and Chinese cabbage were frequently offered at the same time on the miscellaneous table as they are similar in terms of consumer demand.

In other cases, all varieties of a particular crop that we evaluated were good performers, as in the case of carrots, so that no variety "winners" could be clearly determined. Carrots generally grew well, although most varieties did not grow longer than 4–5 in. despite descriptions listing otherwise. The varieties that performed well at OASIS and were all available organically were Kurota Chantenay, Red Core Chantenay, Scarlet, Scarlet Nantes, Rodelika, and Danvers 126.

Cauliflower was challenging because not many organic varieties were available. In addition, it can be time consuming to tie the leaves to blanch heads, but OASIS considered the effort worth it because the result was a sweet crop. Chard always was a good crop at OASIS, with the multi-colored and single-color (not green) varieties being a little slower to recover from harvest. Collards (*Brassica oleracea*) were not popular with members and were only grown once at the request of a student. The variety grown, in small amounts, was Champion, which had nice large leaves, but aphids were an issue.

Sweet corn was grown for a few seasons but due to space considerations and corn earworm problems was eliminated from the crop mix, even though it was highly popular with the members. Damage that did result had to be managed by cutting off parts of the ears so that members received ears without visible damage. However, it was labor-intensive to cut out the worms and their damage to the ears.

Eggplant produced throughout a long growing season in southern New Mexico. Members tired of it towards the end of the season. Garlic (*Allium sativum*) was grown once, but discontinued due to space constraints. The Purple Italian Easy Peel variety was grown, a hardneck variety with excellent flavor. An unpopular and infrequently grown crop was kale (*Brassica oleracea*). Kohlrabi was another less popular crop that grew well and filled an early window for distribution. Shareholders liked leeks (*Allium porrum*), but they were time consuming to wash and prepare for distribution. Although OASIS had limited experience with leeks, two varieties that performed well were Kilima and Winter Giant.

Lettuce generally grew well, and no clear winner can be determined, although varieties such as Trout's Back, Black Seeded Simpson, Jericho, Buttercrunch, and Outredgeous were all grown in multiple years because they were dependable and added various colors. Other varieties were added for additional flavors and textures. Lettuce was usually an important crop for CSA members, and growing a mix with various colors and textures created a pleasing offering. Salad greens were not extremely popular, but made nice additions to lettuce for salads. Since salad greens are a continual cut crop, people tired of it over the season. Arugula (*Eruca vesicaria ssp. sativa*) was the most popular of salad greens and was a good producer.

With melons, sweetness and texture were observed to be important to CSA members. Higher yielding melons will not make much of an impression if they don't taste good. The best tasting melons were two F1 hybrids, Sivan and Galia, and an open pollinated variety, Charantais. Casaba-style melons Casaba Sungold and Santo Domingo were also popular. Hale's Best Jumbo was also a nice standard cantaloupe melon.

Because okra was not uniformly loved by all members it was always grown as a miscellaneous crop, which means quantities planted would never allow all members to take home a bag each week. Green onions (*Allium fistulosum*) were grown and had outstanding flavor, but they were time-consuming to wash and prepare for distribution. Snow peas were prolific but not as sweet as snap peas. There was no clear winner among snap pea varieties; more trialing is necessary. Nice tasting but not very prolific varieties of snap peas were Sugar Lode or Mega.

In the case of bell peppers, Cal Wonder, Sunrise Orange and Corno de Toro or Red Marconi were all high yielding and colorful additions to the crop mix. Potatoes (*Solanum tuberosum*) were attempted twice and only in 2002 did they perform well, probably because southern N.M. is too hot for potatoes. In addition, their space requirements were more than was really available on the small Main Field. Although shareholders were not particularly enthusiastic about radishes, they grew well and made nice additions to salads. Easter Egg, Parat Sperling, Pink Beauty, Purple Plum, Sparkler, and French Breakfast were all OASIS radish winners, although Sparkler was a favorite. Bloomsdale and Whale spinach varieties were the two favorites; Whale in particular yielded well. Its big leaves made harvest easier and were useful in recipes requiring use of spinach leaves as a "wrap."

Table 19. Variety comments for cool season vegetables considered "winners."

Crop	Variety	Comments[1]
Beet	Bull's Blood	OP; OG; Grown mostly for its burgundy foliage; Roots with subtle zoning; Small roots; Roots not real round; Good staggered maturity.
	Chioggia	OP; OG; Nice large root; Distinctive zoning; Roots don't pop out of the soil as much as other beet so somewhat difficult to tell if mature; Top are somewhat whimpy & weak; Leaves & ribs all green; Customers preferred a red beet; Not as sweet as red beets; Good staggered maturity.
	Detroit Dark Red	OP; OG; Really round roots; Small tops; Greens with red ribs; Somewhat small roots; Good staggered maturity.
	Early Wonder Tall Top	OP; OG; Widely adaptable; Excellent reliability; Large greens with red ribs; Roots not real round; Large roots; Excellent staggered maturity; Vigorous growth in cool soils.
Bok Choi	Joi Choi	F1; NOT OG; Excellent; Very reliable; Slow to bolt; Watch for flea beetle damage right after germination; Nice vase shape; Easy to band.
Broccoli	Arcadia	F1; NOT OG; Excellent; Long days to harvest; Usually last to head up; Large, full heads with small beading; Extended sideshoot production; Good staggered maturity; Good in spring & fall seasons; Quite cold resistant.
	Early Dividend	F1; NOT OG; Good; Usually the 1st to head up; Large heads; Good sideshoot production; Staggered maturity; Good spring & fall.
	Early Green	OP; OG; First to head up but very small heads; Not very satisfying; An open-pollinated, organic variety—otherwise would not grow.
	Packman	F1; NOT OG; Moderately sized heads; Spring planted crops may tend to "button-up" prematurely due to early planting; Early season broccoli. Good sideshoots.
	Umpqua	OP; NOT OG; Moderately sized heads; Good sideshoots; Staggered maturity.
Cabbage	Early Jersey Wakefield	OP; OG; Cone shaped; Heirloom variety; Prone to loopers and aphids; Nice, light, sweet flavor.
	Red Express	OP?; NOT OG; Nice but small heads—mini cabbage; Red cabbage never performed well generally, but of varieties tried, this one was best.
Carrot	Nantaise	OP; OG; Nice; Longer roots than Red Core Chantenay; Most carrots do fine
	Red Core Chantenay	OP; OG; Reliable—Always good; Strong tops; Most carrots do well.
	Rodelika	OP; OG; Fine; Most carrots do well for us.
	Scarlet Nantes	OP; OG; Nice; Small tops w/ large roots—make sure soil is moist when harvesting. Most carrots do well for us.
Cauliflower	Snow Crown	F1; NOT OG; Always reliable & dependable; Needs tying.
Chard	Bright Lights	OP; NOT OG; Pretty colors; Slower to grow back after cut; Chard always does well.
	Rhubarb	OP; OG; Vigorous grower; Grows back rapidly after harvest; Nice dark red ribs.
Chinese Cabbage	Minuet	F1; NOT OG; Reliable; Nice sized heads; Good vase shape easy for banding; Tight heads; Excellent germination.
Collards	Champion	OP; NOT OG; Large leaves; Watch for aphid infestations; Not popular with customers.
Kohlrabi	Early White Vienna	NOT OG; Nice, moderately sized, green variety; Less tasty than others.
Leek	Winter Giant	OP; OG; Nice and stocky; Long days to harvest—7 months
Lettuce	Black Seeded Simpson	OP; OG; Widely available seed; Good lime-green color; Light, wavy leaves; Large heads; Low bolting percentage; Always nice; Early
	Buttercrunch	OP; OG; Low bolting percentage; Reliable—always nice; Small, open, tight head; Like all butterhead lettuce—grows back weird
	Jericho	OP; OG; Romaine type; Always nice—reliable; Slow to bolt; Nice vase-shaped heads;
	Oaky Red Splash	OP; OG; Nice oak leaf lettuce; bronzy-green color
	Prizehead	NOT OG; Free seed from Dr. Cramer
	Red Ridinghood	OP; OG; Nice butterhead lettuce; Mostly red; Very soft leaves
	Trout's Back (Forellenschluss)	OP; OG; Loose-headed romaine; Pretty red speckled leaves
	Victoria	OP; OG; Green butterhead; Tight heads; Weird regrowth like all butter.
	Winter Density	OP; OG; Compact romaine; Dark green
Pea, Snow	Oregon Sugar Pod II	OP; OG; Sweeter and larger pods than Sugar Pod 2; Reliable variety; Pods never as sweet as snap peas
	Sugar Pod 2	OP; OG; Reliable—always good; Less sweet than Oregon Sugar Pod II
Radish	Easter Egg	NOT OG; Excellent; Always solid/never pithy; Pretty colors; Always reliable; A real winner
	Parat Sperling	OP; OG; Nice harvested large or small; Sometimes too big; No splitting; Sometimes color pink not red.
	Pink Beauty	OP; OG; Reliable; Nice pink roots; Never pithy; twice color was purple, not pink.
Salad Greens	Arugula	OP; OG; Reliable; Always nice; Some members love & some hate; grow limited amounts.
	Radicchio 'Indigo'	F1; NOT OG; Nice; Good heads '04; Bolted early '05; Tight heads; Very pretty; Customers thought it was red cabbage; Customers didn't appreciate.
Spinach	Bloomsdale	OP; OG; Germination problems when too warm; Good flavor; Not extremely vigorous; Does not like heat (bolts and dies rapidly).
Turnip	Purple Top	OP; OG; Cheap, widely available seed; Very reliable; Top prone to mildew and aphids late in season; Be sure to thin on time or roots mature misshapen—thin and long, ugly.

*OP: Open pollinated. OG: Organic. F1: Hybrid

Table 20. Variety comments for warm season vegetables considered "winners."

Crop	Variety	Comments[1]
Snap Bean (Bush)	Blue Lake	OP; OG; Very reliable; Excellent flavor; Moderate yields in all seasons; Best yields in cooler seasons; Steady producer.
	Dragon's Tongue	OP; OG; Wide yellow beans w/ purple striping; Very prolific; Fruits earlier than Blue Lake; Attractive.
	Royal Burgundy	OP; OG; Attractive color turning dark green upon cooking; Slower to fruit than Blue Lake; Lower yields than Blue Lake; Better producer when cooler.
Soybean (Edamame)	Butterbean	OP; OG; Mostly 1–3 bean pods; Delicious; Harvesting is time-consuming.
Corn	Supersweet Jubilee	F1; NOT OG; Excellent; Tender & Sweet; Holds sweetness; Hold quality on and off plant; 8-ft plants; good for compost.
Cucumber	Diva	F1; OG; Thin skin without prickles; Tender; Fairly prolific.
	Lemon	OP; OG; Excellent; Very tender; No need to peel; Pick when light yellow.
	Poinsett 97	OP; OG; Fine, standard cucumber.
Eggplant	Imperial Black Beauty	OP; OG; Standard purple eggplant; Excellent; Large, shiny fruits; Popular with customers.
	Japanese Pickling	OP; OG; Slender, Asian eggplant; Very tender; Nice for kabobs or grill.
	Rosa Bianca	OP; OG; Mild flavor; No bitterness; Attractive; Less popular w/ customers based on appearance only.
Okra	Mammoth Spineless	OP; OG; Good; Large plants; Large, tender pods.
	Red Velvet	OP; OG; Nice; Large plants; Prolific; Pretty red pods.
Pepper, Asst. Hot	Jalapeño	OP; OG; Excellent; Somewhat small and stubby; Customers enjoy.
	Habanero	OP; OG; Attractive; Novelty; Customers took very few over the season.
Pepper, NM-Type	Anaheim	OP; OG; Standard green chile; Mildly hot pepper; Good yields.
	Joe E. Parker	OP; OG; Another standard green chile; Tall plants; Mildly hot; Slightly higher yields than Anaheim or Big Jim.
Pepper, Sweet	Cal Wonder 300	OP; OG; Standard green to red bell.
	Sunrise Orange	OP; OG; Matures from yellow to deep orange-yellow; Very attractive.
Summer Squash	Black Beauty	OP; OG; Large plants; Always dependable; Prolific; Always tender.
	Cocozelle Bush	OP; OG; Striped fruit; Nice.
Winter Squash	Butternut	OP; OG; Large, vigorous plants; Heavy bearing vines; Less attractive to squash bugs than other winter squashes.
Sweet Potato	Garnet	OG; Excellent; Red skinned w/orange flesh; Good tuber set; Customers preferred to Jewel (tan skin) or Japanese (white flesh).
	Jewel	OG; A fine variety w/ tan skin; But customers preferred a red-skinned sweet potato.
Tomatillo	Verde	OP; OG; Plants may be erect and branching or squat and compact; large fruits. Medium popularity.
Tomato	Celebrity	F1; NOT OG; Determinate; Heavy bearer; Highest yielder. Slight to moderate cracking near stem.
	Fantastic	F1; NOT OG; Indeterminate; #1 in taste test of 2005; Heavy yielder. Excellent.
	Striped German	OP; OG; Indeterminate; Very large tomatoes; Yellow-red marbled fruit; Very sweet and delicious.
	Thessaloniki	OP; OG; Indeterminate; Tennis-ball sized red fruit; Prolific; Good flavor.
	Wisconsin 55	OP; OG; Indeterminate; Excellent flavor—#2 in taste test '05.
	Zapotec Pleated	OP; OG; Indeterminate; Interesting shape—deeply pleated; Rated last in 2005 taste test. Good yields.
Watermelon	Sugar Baby	OP; OG; 10–20 lb; Totally dark green rind; Nice; Sweet.

[1]OP: Open pollinated. OG: Organic. F1: Hybrid

Several summer squash varieties (*Cucurbita pepo*) were winners, such as Black Beauty, Dark Green, Yellow Crookneck, and Cocozelle. Winter squash filled a window in the CSA because it could be harvested and stored for later distribution in the fall when other crops had slowed. Waltham Butternut or Butternut (*Cucurbita moschata*) were favorite butternut types, both somewhat resistant to squash bugs and popular. Sweet Reba was an excellent acorn-style squash (*Cucurbita pepo*), and Bush Delicata was an excellent delicata type (*Cucurbita pepo*). Spaghetti squash (*Cucurbita pepo*) were prolific and popular.

Sweet potatoes were a good crop in southern New Mexico, and Garnet was the top performing variety, with excellent yields. Tomatillos were grown for the miscellaneous table, and Verde and Purple Milpa were prolific green and purple varieties, respectively.

There were many tomato varieties that were favorites or winners, depending on the importance placed on various criteria such as size, shape, color, yield, and flavor. For example, one of the most flavorful tomatoes, Striped or Old German, was large and low-yielding. Among tomatoes, Fantastic had excellent yields and great taste. Thessaloniki had great yields, but only good flavor, while Persimmon had an excellent flavor but lower yields.

Turnips were not a particularly popular crop, but turnip green harvests helped to fill an early window. Purple top was a fine variety, and the seed was inexpensive and widely available organically. Watermelon varieties that were popular were Sugar Baby, Crimson Sweet, Sweet Dakota Rose, and Moon & Stars, all reliable and red-fleshed. Desert King was a yellow sweet variety and Orangeglo was an orange-fleshed variety that was not as sweet but was refreshing.

Some crop varieties and even some crops were considered complete or near failures (Tables 21–22). For example, Brussels sprouts (*Brassica oleracea*, capitata group) were tried once only because of the long cool growing season they need. Failure at OASIS however, does not imply failure in southern New Mexico. Brussels sprouts may well be a good crop given sufficient time in the field or a different planting date, but the CSA distribution schedule and land constraints did not permit additional experimentation. Some crops, such as perennial asparagus and artichokes, could never be tried because of land constraints.

Generally, cool-season crop failures tended to be weather-related. In 2002, spring cole crop failures were due to an inability to use transplants because the project start date was in January and spring transplants needed to be started in the greenhouse in early December. Early fall season failures were related to inexperience with the length of the season and varieties that either bolted or needed more time to grow. Summer crop failures were often more related to pest pressures or use of experimental and unfamiliar varieties in the OSP trials (Table 22).

Seed sources and costs by variety

Seed costs for cool-season crops ranged from less than $10/acre for fall and spring non-organic, untreated, Snow Crown cauliflower from Johnny's Seeds, to more than $2,900/acre for fall and spring non-organic, untreated Arcadia broccoli, also from Johnny's Seeds (Tables 23–24). Organic seed prices were similarly wide ranging, with a low price of about $48/acre for organic Black Seeded Simpson lettuce from High Mowing Seeds and Early Jersey Wakefield cabbage from Seeds of Change Seed Co. High-end organic seed prices included Nantaise and Rodelika carrots from Territorial at $1,736/acre, Winter Giant leeks from Abundant Life at $1,837/acre, and Sparkler radishes from Baker Creek Heirloom Seeds at $2,800/acre.

In the summer, seed prices did not vary so dramatically but typically were in the range of $60/acre to $500/acre (Table 25). Organic Butterbean soybeans, grown for edamame, from High Mowing Seeds, and organic Poinsett 97 cucumbers from Territorial cost a little more, at $921/acre and $1,219/acre, respectively. Sweet potatoes were another exception; before slips were created from harvested potatoes held back, the cost was about $1,000/acre based on potatoes purchased at the local food cooperative (Table 25). Tomato seed prices were priced in the $100–$200 per acre range, with the exception of Legend, which cost $1,947/acre in 2007 (Table 26). The majority of the summer crop seeds purchased were organic.

Yields by variety

Vegetable varieties grown for two years or more were included in the yield analyses (Tables 27–30). Some varieties were grown multiple years because of their higher yields or contribution to the overall mix of crops. Not all crops grown once and not repeated were abandoned for production reasons, although some were. Not too much can be read into the number of years a variety was grown. Varieties grown for three or more years were those that were considered reliable, high-yielding, good tasting, or some other highly desirable characteristic.

Mean spring crop yields ranged from a low of 5,783 lb/acre for Red Riding Hood lettuce to a high of 49,269 lb/acre for Kolibri kohlrabi and 48,430 lb/acre for Joi Choi bok choi (Table 27). Mean fall crop yields ranged from a low of 3,434 lb/acre for Oregon Sugar Pod II snow peas to a high of 67,228 lb/acre for Joi Choi bok choi (Table 28). Varieties that were grown both in fall and spring sometimes performed equally well in both seasons. For example, Chioggia beets were grown in three spring seasons and two autumn seasons and averaged 32,830 lb/acre in the fall but only 23,309/lb/acre in the spring.

Table 21. Reasons for cool-season vegetable crop failures.

Crop	Variety	Year	Failure level	Reason
Spring Crops				
Broccoli	De Cicco	2002	Complete	OASIS began Jan '02–no transplants started Dec. '01
Broccoli	Calabrese	2002	Complete	OASIS began Jan '02–no transplants started Dec. '01
Brussels Sprout	Igor	2002	Complete	OASIS began Jan '02–no transplants started Dec. '01
Cabbage	Vertus Savoy	2002	Complete	OASIS began Jan '02–no transplants started Dec. '01
Cabbage	Red Express	2002	Complete	OASIS began Jan '02–no transplants started Dec. '01
Cabbage	Red Drumhead	2003	Nearly	Most did not mature on time…only 26
Cabbage	Ruby Ball	2004	Nearly	Very few harvested (12); Slow to mature
Carrot	Atomic Red	2005	Nearly	Most bolted and roots were too woody to be edible
Carrot	Cosmic Purple	2005	Complete	All bolted and roots were too woody to be edible
Cauliflower	Snow Crown	2002	Complete	OASIS began Jan '02–no transplants started Dec. '01
Chinese Cabbage	Market Pride	2002	Nearly	Late planting meant early bolting
Chinese Broccoli	Autumn Poem	2006	Complete	Premature bolting
Onion	Walla Walla	2002	Complete	Wrong onion variety for southern N.M.
Potato	Caribe	2003	Nearly	Plants came up fine but turned and stayed yellow.
Potato	Cranberry Red	2003	Nearly	Stunted with extremely low production.
Potato	Yukon Gold	2003	Nearly	Stunted with extremely low production.
Fall Crops				
Broccoli		Early Green	2002 Nearly	Didn't produce heads; Extremely vegetative.
Brussels Sprouts	Bedford Fillbasket	2002	Complete	Did not produce Brussels sprouts; Only vegetative.
Brussels Sprouts	Rubine	2002	Complete	Did not produce Brussels sprouts; Only vegetative.
Cabbage	Red Express	2003	Nearly	Very few harvested (12); Most didn't mature.
Cauliflower	Snow Ball Self Blanching	2003	Nearly	Only produced 3 heads before season ended.
Salad Greens	Orach	2003	Nearly	Very poor germination; Very few plants to harvest.
Cabbage	White Ballhead	2004	Complete	Did not head up before end of season.
Cauliflower	Amazing	2004	Complete	Headed up AFTER last distribution.
Salad Greens	Corn Salad: Medallion	2004	Complete	Matured only AFTER last distribution.
Peas, Snap	Sugar Sprint	2004	Complete	Failed to germinate even after planting twice.
Summer Squash	Black Beauty	2004	Nearly	Nice, but freeze stopped production prematurely.
Summer Squash	Early Prolific Straightneck	2004	Nearly	Nice, but freeze stopped production prematurely.
Summer Squash	Black Beauty #3	2006	Nearly	Warm-season crops don't appreciate prematurely cold temperatures.
Summer Squash	Romulus #3	2006	Nearly	Warm-season crops don't appreciate prematurely cold temperatures.
Soybean	Butterbean	2006	Nearly	Something ate off all growing points.
Chinese Cabbage	Minuet #2	2006	Complete	Failed to head up before end of season.

Table 22. Reasons for warm season vegetable crop failures.

Crop	Variety	Year	Failure level	Reason
Cucumber	Mideast Prolific #2	2006	Nearly	Overwhelmed by weeds.
Cucumber	Suyo Long #2	2006	Nearly	Overwhelmed by weeds.
Bean	Oregon Trail	2005	Nearly	Poor germination.
Melon	NY04-218-1R	2005	Complete	Plants died—overwhelmed by weeds.
Melon	Hanna's Choice	2005	Nearly	Plants were lousy—OSP? squash bugs? weeds?
Melon	NY04-213-5L	2005	Nearly	Plants were lousy—OSP? squash bugs? weeds?
Melon	NY04-217-1	2005	Nearly	Plants were lousy—OSP? squash bugs? weeds?
Melon	NY04-219-6R	2005	Nearly	Plants were lousy—OSP? squash bugs? weeds?
Melon	NY04-222-1L	2005	Nearly	Plants were lousy—OSP? squash bugs? weeds?
Melon	Eel River	2005	Nearly	Weeds overwhelmed the plants.
Pumpkin	Fairytale	2004	Complete	Heavy infestation of squash bugs.
Pumpkin	Small Sugar	2004	Complete	Heavy infestation of squash bugs.
Soybean	Butterbean	2006	Complete	Poor germination due to bad seed from company.
Winter Squash	Buttercup	2004	Complete	Heavy infestation of squash bugs.
Winter Squash	OSU 19	2005	Complete	OSP variety; Curly Top Virus; Squash Bugs.
Winter Squash	Red Kuri	2005	Complete	OSP variety; Curly Top Virus; Squash Bugs.
Winter Squash	Sugar Loaf	2005	Complete	OSP variety; Curly Top Virus; Squash Bugs.

Early Wonder Tall Top beets, grown in three falls and three springs (but not in the same three years), averaged 29,927 and 31,219 lb/acre in fall and spring, respectively. Thus, neither fall nor spring was routinely better for beets, based on the OASIS experience.

Based on five years of production experience in the fall and four in the spring, the bok choi variety Joi Choi produced on average 67,228 lb/acre in the fall and 48,430 lb/acre in the spring. If one were going to specialize in bok choi and prices did not differ too dramatically between fall and spring, the higher production in fall may indicate that fall is a better time to plant bok choi in southern New Mexico, based on the OASIS experience.

Summer crop yields ranged from 3,809 lb/acre for Butterbean soybeans (edamame) to more than 100,000 lb/acre for Diva cucumbers, casaba melons, and Dakota Rose watermelons. The highest yielding summer crop was Sugar Baby watermelons, which produced almost 230,000 lb/acre. Other notable high-yielding varieties were Imperial Black Beauty and Rosa Bianca eggplant; Mideast Prolific, Suyo Long, and Lemon cucumbers; Galia melons; Black Beauty and Cocozelle summer squashes; Verona watermelons; and Garnet sweet potatoes, each producing between 60,000 and 90,000 lb/acre (Table 29).

Tomato yield information was not very useful, since information by variety had to be abandoned in the years curly top losses were severe. Replanting with commercial varieties complicated variety collection information. For this reason, tomato yield information was provided separately (Table 30).

Herbs and flowers

As was the case for vegetables, only those herbs and flowers grown twice or more in the same season were analyzed for production. Few herbs were grown as cool-season crops, although cilantro (*Coriandum sativum*) and dill (*Anethum graveolens*) were an exception (Tables 31–34). Santo Cilantro was grown for three years, 2004–2006, while Bouquet dill was grown for two years, 2005–2006, in both fall and spring. The majority of herbs grown for distribution as culinary plants (rather than flowers) were grown in the summer (Tables 35–37). Higher-yielding summer herbs included spearmint (*Mentha spicata*), Italian flat leaf parsley (*Petroselinum crispum*), and French tarragon (*Artemisia dracunculus*). Since only 6 total pounds of tarragon were harvested, the estimate for yields is not as robust as, say, the estimate of Italian flat leaf parsley yields, which is based on five years of data and an average harvest per year of nearly 30 lb (Table 36). Sweet Genovese was the only basil grown all years and it averaged about 72,000 lb/acre over the five years it was grown (Table 38).

Yields by flower variety were not recorded, although bunches made from many different flowers (and herbs) were counted each week (Table 13) and flower bunch production per linear foot planted was estimated (Table 16). About 1 bunch (although ranging from 0.88 to 1.64 bunches) was produced per linear foot planted during the five years. Planting information (rows per bed, in-row spacing) and number of weeks harvested, by variety, were kept (Tables 39–40). Most of the information in the tables is from annual flowers, although several perennial flowers were planted, but records were not kept

Table 23. Seed costs and sources for fall vegetable varieties, 2002–2006.

Crop	Variety	Years grown	Seed source for seed purchases[1]	Type of seed[2]	OASIS days to harvest	OASIS weeks of harvest	Seed price per lb, 2007 ($)	Seed cost per acre, 2007 ($)	Seed source for estimates
Beet	Detroit Dark Red	'04–'06	HM, SC, F	OG	69, 76, 76	6, 5, 5	44.80	696.96	F
Beet	Bull's Blood	'03, '04	F, J	OG	72, 76	7, 5	34.10	530.50	J
Beet	Chioggia	'02, '05	T, SC	OG	57, 83	9, 4	29.90	465.16	HM
Beet	Golden	'02, '03	J, T	Untreated ('02); OG ('03)	71, 114	7, 1	97.00	1,509.04	J
Beet	Early Wonder Tall Top	'02, '03, '05	J, F, HM	OG	57, 72, 76	9, 5, 5	11.60	180.46	HM
Bok Choi	Joi Choi	'02–'06	T	Untreated	51, 51, 62, 55, 62	10, 5, 7, 8, 5	381.60	284.96	T
Broccoli	Arcadia	'03–'06	J	Untreated	100, 90, 76, 76	3, 3, 5, 5	4,379.20	2,925.61	J
Broccoli	Early Dividend	'03–'06	T	Untreated	72, 69, 55, 69	7, 6, 8, 5	495.20	330.83	T
Broccoli	Early Green	'02, '04	SC	OG	84, 69	1, 6	98.25	65.64	SC
Cabbage	Early Jersey Wakefield	'02,'03	SC	OG	79, 79	6, 6	110.40	47.71	N
Cabbage	Gonzalez	'05, '06	T	Untreated	62, 83	6, 4	549.60	237.51	T
Cabbage	Red Express	'02, '03	J	Untreated	78, 107	6, 2	102.60	44.34	J
Carrot	Red Core Chantenay	'02, '03,'05, '06	SC	OG	85, 93, 97, 90	4, 4, 2, 3	23.00	178.91	HM
Carrot	Scarlet Nantes	'04–'06	SC, SC, TT	OG	97, 104, 90	2, 1, 3	122.80	955.21	SC
Carrot	Nantaise	'02, '03	T	OG	85, 100	5, 3	223.20	1,736.18	T
Carrot	Rodelika	'03, '04	T	OG	100, 97	3, 2	223.20	1,736.18	T
Cauliflower	Snow Crown	'03–'06	J	Untreated	107, 83, 76, 90	3, 4, 5, 3	50.00	9.82	F
Cauliflower	Early Dawn SG	'05, '06	T	Untreated	76,90	5,3	670.40	130.37	T
Chard	Rainbow Mix	'03, '06	TT, HM	OG	51, 55	10, 8	68.15	530.11	HM
Chard	Rhubarb Chard	'02, '04, '05	T, HM, SC	Untreated ('02); OG ('04–'05)	57, 55, 55	9, 8, 8	44.20	343.81	SC
Chinese Cabbage	Minuet	'03–'06	J	Untreated	58, 69, 62, 62	5, 6, 7, 6	276.64	135.91	J
Kohlrabi	Kolibri	'04–'06	T	OG ('04); Untreated ('05–'06)	48, 41, 48	9, 7, 4	540.00	593.00	T
Lettuce	Black Seeded Simpson	'02–'04	SC, F, HM	OG	44, 51, 48	5, 7, 5	22.00	47.92	HM
Lettuce	Buttercrunch	'02–'04	SC, Dr. C, N	OG ('02, '04); Untreated ('03)	51, 58, 48	7, 7, 9	108.00	235.22	N
Lettuce	Jericho	'04–'06	SC	OG	48, 48, 55	5, 9, 5	105.00	228.69	J
Lettuce	Trout's Back	'03, '04, '06	F, T, SC	OG	44, 48, 62	5, 7, 7	100.00	217.80	F
Lettuce	Mikola	'02, '06	J, TT	Untreated ('02); OG ('06)	49, 55	4, 5	384.00	936.35	TT
Lettuce	Rouge de Grenoblouge	'05, '06	SC	OG	41, 48	10,6	188.95	411.53	SC
Pea, Snow	Oregon Sugar Pod II	'03, '05, '06	N, OSU, OSU	OG ('03); Untreated ('05–'06)	65, 62, 90	8, 7, 3	5.19	807.42	N
Radish	Easter Egg	'02, '04, '05	J	Untreated	35, 34, 33	8, 2, 3	11.80	275.36	J
Radish	French Breakfast	'02, '06	T, HM	Untreated	36,34	10,4	27.00	630.16	HM
Radish	Pink Beauty	'04–'06	J	OG	41, 44, 41	1, 3, 5	26.10	609.06	J
Salad Greens	Arugula	'04, '06	SC, F	OG	41,41	6,10	21.00	171.52	SC
Spinach	Bloomsdale	'03–'05	N	OG	58, 48, 69	9, 8, 5	25.00	278.44	F
Spinach	Whale	'05, '06	J, HM	OG	69,76	6,5	20.38	291.70	J
Turnip	Purple Top	'02–'06	T, F, N, F, F	Untreated ('02); OG ('03–'06)	43, 65, 62, 55, 69	10, 8, 7, 6, 6	6.40	29.87	F

[1]Seed company codes are provided in Appendix C.
[2]OG: Organic

Table 24. Seed costs and sources for spring vegetable varieties, 2002–2006.

Crop	Variety	Years grown	Seed source for seed purchases[1]	Type of seed[2]	OASIS days to harvest	OASIS weeks of harvest	Seed price per lb, 2007 ($)	Seed cost per acre, 2007 ($)	Seed source for estimates
Bean, Fava	Broad Windsor	'05–'06	T	Untreated	105,105	3,4	3.70	920.98	T
Beet	Chioggia	'02–'04	T	OG	126,111,108	4,5,4	29.90	465.16	HM
Beet	Early Wonder Tall Top	'02, '04, '06	FM, T, F	OG ('02,'06); Untreated ('04)	126,105,98	5,4,5	11.60	180.46	HM
Bok Choi	Joi Choi	'03–'06	T	Untreated	104, 79, 84, 76	3, 4, 5, 6	381.60	284.96	T
Broccoli	Arcadia	'04–'06	J	Untreated	63,70,70	8,5,9	4,379.20	2,925.61	J
Broccoli	Packman	'03–'06	J, T, J, T	OG ('04); Untreated ('03, '05, '06)	70, 63, 70, 58	4, 4, 5, 6	566.72	378.61	J
Broccoli	Umpqua	'03,'05	T	Untreated	70	4,5	80.00	53.45	F
Cabbage	Derby Day	'04–'06	T	Untreated	91,84	3,5	148.00	63.96	T
Cabbage	Red Express	'05–'06	J	Untreated	91,91	5,4	102.60	44.34	J
Carrot	Danvers	'02–'03	FM,T	OG ('02),	140,118	4,3	23.00	178.91	HM
Carrot	Red Core Chantenay	'04–'06	SC, SC, HM	OG	112,111, 112	3,2,2	23.00	178.91	HM
Carrot	Scarlet Nantes	'03–'06	SC, SC, SC, HM	OG	118, 112, 119, 119	4, 3, 2, 2	23.00	178.91	HM
Cauliflower	Snow Crown	'03–'06	J	Untreated	84, 98, 70, 84	4, 3, 5, 3	50.00	9.72	F
Chard	Bright Lights	'03–'05	J, T, J	Untreated	97, 91, 91	6	60.00	466.71	F
Chard	Broadstem Green	'02,'06	SC	OG	126, 84	2,10	44.20	343.81	SC
Chinese Cabbage	Minuet	'03–'06	J	Untreated	90, 91, 84, 91	3, 4, 3, 4	276.64	135.91	J
Kohlrabi	Early White Vienna	'03–'04	Dr. C.	Untreated	84, 83	4	11.00	12.08	F
Kohlrabi	Kolibri	'05–'06	T	Untreated	83, 84	4	540.00	566.05	T
Leek	Winter Giant	'02–'03	SC, Al	OG	168, 174	1,1	157.45	1,837.10	SC
Lettuce	Black Seeded Simpson	'02–'05	FM, SC, SC, SC	OG	68, 76, 70, 77	6, 7, 6, 6	22.00	47.92	HM
Lettuce	Buttercrunch	'02, '03, '05, '06	FM, Dr.C, Dr.C, N	OG ('02, '06) Untreated ('03, '05)	68, 83, 77, 69	6	24.00	52.27	F
Lettuce	Jericho	'05–'06	SC	OG	77, 70	6, 8	105.00	228.69	J
Lettuce	Oaky Red Splash	'04–'05	T	OG	58, 62	6	276.00	601.13	HM
Lettuce	Outredgeous	'02–'05	T	OG	68, 76, 70, 77	6, 7, 6, 5	117.00	254.83	J
Lettuce	Prizehead	'03, '05	Dr. C	Untreated	83, 85	6	11.00	23.96	F
Lettuce	Red Riding Hood	'03, '05	SC	OG	76, 98	6, 1	126.00	274.43	SC
Lettuce	Trout's Back	'02–'06	T, SC, SC, SC, SC	OG	68, 83, 58, 62, 70	6, 6, 6, 5, 7	100.00	217.80	F
Lettuce	Victoria	'04–'05	T	OG	65, 55	5, 6	168.00	365.90	SC
Lettuce	Winter Density	'04–'05	SC	OG	70, 62	6, 3	168.00	365.90	SC
Pea, Snap	Mega	'05–'06	T	Untreated	98, 98	5, 5	3.45	536.72	T
Pea, Snow	Oregon Sugar Pod II	'03, '06	T, N	Untreated ('03); OG ('06)	97, 91	4, 7	5.19	807.42	N
Pea, Snow	Sugar Pod 2	'04–'05	SC	OG	84, 91	8, 4	6.63	1,030.66	SC
Radicchio	Indigo	'04–'05	J	Untreated	110, 112	2, 1	560.00	196.02	F
Radish	Easter Egg	'03–'05	J	Untreated	56,48,47	5,2,4	11.80	275.36	J
Radish	Parat Sperling	'04–'05	SC	OG	44, 44	2, 2	42.00	990.10	SC
Radish	Sparkler	'03, '05	BC	OG	56, 40	3, 2	120.00	2,800.28	BC
Salad Greens	Arugula	'02, '04, '05, '06	C, SC, SC, SC	OG	63, 55, 41, 48	4, 4, 1, 4	21.00	171.52	SC
Salad Greens	Mustard	'02, '04, '05, '06	FM, T, HM, SC	OG	75, 48, 40, 48	2, 1, 3, 4	65.55	535.38	SC
Spinach	Bloomsdale	'02–'06	FM, Dr. C, SC, F, N	Untreated ('03); OG ('02, '04–'06)	68, 90, 70, 70, 77	6, 4, 5, 6, 4	25.00	291.70	F
Spinach	Whale	'05–'06	J	OG	70, 77	6	20.38	237.84	J
Turnip	Purple Top	'02, '03, '05, '06	FM, F, F, F	OG	89, 90, 84, 77	4, 6, 6, 6	6.40	29.87	F

[1]Seed company codes are provided in Appendix C.

[2]OG: Organic

Table 25. Seed costs and sources for summer vegetable varieties, except tomatoes, 2002–2006.

Crop	Variety	Years grown	Seed source for seed purchases[1]	Type of seed[2]	OASIS days to harvest	OASIS weeks of harvest	Seed price per lb, 2007 ($)	Seed cost per acre, 2007 ($)	Seed source for estimates
Bean, Bush	Blue Lagoon	'05–'06	OSU (OSP)	Untreated	70	15, 11	4.03	500.94	SC
Bean, Bush	Blue Lake	'02–'06	FM, SC, SC, SC, SC	OG	63, 70, 63, 70, 70	22, 22, 18, 13, 16	4.03	500.94	SC
Bean, Bush	Dragon's Tongue	'04–'06	F	OG	63, 55, 63	17, 11, 13	4.20	522.72	F
Bean, Bush	Royal Burgundy	'02, '05	SC	OG	70, 55	21, 9	4.40	547.61	SC
Corn	Supersweet Jubilee	'04, '05	T	Untreated	69, 83	2, 2	14.05	327.87	T
Cucumber	Diva	'02–'03	J	OG	70, 84	20, 15	149.50	475.73	J
Cucumber	Lemon	'02–'05	SC	OG	77, 77, 84, 77	15, 8, 9, 5	49.00	155.92	HM
Cucumber	Mideast Prolific	'05–'06	SC	OG	55, 70	10, 15	71.25	226.73	SC
Cucumber	Poinsett 97	'04–'05	T, Cornell (OSP)	OG ('04); Untreated ('05)	91, 91	8, 3	383.20	1,219.40	T
Cucumber	Suyo Long	'05–'06	SC	OG	55, 91	10, 13	103.15	328.24	SC
Eggplant	Imperial Black Beauty	'04–'06	SC	OG	84, 77, 84	16, 21, 17	427.75	126.03	SC
Eggplant	Japanese Pickling	'02–'04	SC	OG	70, 70, 77	21, 23, 16	427.75	126.03	SC
Eggplant	Rosa Bianca	'02, '03, '05	SC	OG	70, 91, 84	21, 20, 18	427.75	126.03	SC
Melon	Charentais	'03 '06	J, SC	OG	105, 105	6, 4	118.10	159.49	SC
Melon	Galia F1	'05–'06	SC, HM	OG	105, 91	11, 10	460.80	622.29	HM
Melon	Casaba	'02–'03	SP, SC	OG	133, 133	6, 7	118.10	159.49	SC
Melon	Sivan F1	'05–'06	SC, HM	OG	112, 98	8, 7	556.80	751.93	HM
Okra	Clemson Spineless	'02, '06	FM, SESE	OG	77, 77	19, 19	76.00	325.17	SESE
Okra	Mammoth Spineless	'03–'06	SC	OG	77, 70, 84, 77	21, 17, 18, 19	81.35	413.82	SC
Okra	Red Velvet	'02, '05	SC	OG	77, 70	20, 20	81.35	338.80	SC
Pepper, Bell	Cal Wonder	'03–'06	SC, T, T, HM	OG ('03-'04, '06); Untreated ('05)	70, 98, 77, 91	21, 11, 20, 12	392.00	316.21	HM
Pepper, Bell	Sunrise Orange	'02–'03	SC	OG	77, 70	19, 21	503.75	406.36	SC
Pepper, Chile	Anaheim	'03–'06	SC	OG	70, 84, 84, 84	22, 15, 20, 14	513.00	413.82	SC
Pepper, Chile	Habanero	'02, '03, '05	SC	OG	105, 140, 126	15, 13, 14	461.75	372.48	SC
Pepper, Chile	Jalapeño	'02–'06	FM, SC, Dr. B, SC, SC	Untreated ('04); OG ('02-'03, '05-'06)	49, 91, 63, 77, 84	19, 20, 17, 21, 13	256.00	206.51	HM
Pepper, Chile	NM Joe E. Parker	'02, '04, '06	FM, Inst., Inst,	OG ('02); Untreated ('04, '06)	63, 84, 70	18, 15, 15	384.00	309.76	HM
Pepper, Chile	NuMex Big Jim	'05–'06	Plts of the SW, Inst.	Untreated	84, 77	20, 14	513.00	413.82	SC
Pepper, Chile	Rio Grande Hot	'05–'06	SC	OG	77, 91	21, 12	420.00	338.80	SC
Soybean	Butterbean	'04–'05	HM	OG	112, 83	2, 4	7.40	920.98	HM
Squash, Summer	Black Beauty	'02, '03, '06	SC, SC, HM	OG	49, 63, 56	21, 23, 17	26.00	62.92	HM
Squash, Summer	Cocozelle	'02, '05	SC	OG	49, 56	24, 13	52.48	126.99	SC
Squash, Summer	Yellow Crookneck	'02–'03	FM, J	OG	56, 63	22, 12	40.40	99.77	J
Squash, Winter	Butternut	'02, '03, '04, '06	SC, SC, F, F	OG	126, 147, 128, 168	10, 3, 3, 1	30.00	81.03	F
Sweet Potato	Garnet	'02–'06	Co-Op ('02-'05); OASIS ('06)	OG	283, 217, 210, 268, 217	3, 2, 3, 1, 2	1.07	1,065.35	CO-OP
Sweet Potato	Jewel	'02–'03	Co-Op	OG	290, 224	2, 1	1.07	1,065.35	CO-OP
Tomatillo	Verde	'03–'05	SC	OG	84, 63, 70	11, 15, 8	784.00	69.70	HM
Watermelon	Desert King	'05–'06	SC	OG	112, 105	10, 9	110.20	255.12	SC
Watermelon	Dakota Rose	'05–'06	SC	OG	119, 98	12, 11	115.50	267.39	SC
Watermelon	Sugar Baby	'02, '04	SC, HM	OG	84, 112	13, 7	110.20	255.12	SC
Watermelon	Verona	'05–'06	SC	OG	112, 105	10, 10	110.20	255.12	SC

[1]Seed company codes are provided in Appendix C.
[2]OG: Organic

Table 26. Seed costs and sources of tomato varieties, 2002–2006.

Variety	Years grown	Years variety data gathered	Seed source for seed purchases[1]	Type of seed[2]	OASIS days to harvest	OASIS weeks of harvest	Seed Price per lb, 2 007 ($)	Cost per acre, 2007 ($)	Seed source for estimates
Celebrity	’04–’06	’05–’06	J, J, T	Untreated	77, 70	21, 18	2,413.44	241.37	J
Fantastic	’04–’06	’05–’06	T	Untreated	77, 63	18, 19	1,660.80	166.35	T
Legend	’05–’06	’05–’06	OSU (OSP)	Untreated	77, 63	18, 19	19,440.00	1,947.22	T
				OG (’02, ’04, ’05)					
Old/Striped German	’02–’05	’02, ’05	FM, J, J, J	Untreated (’03)	84, 98	13, 12	552.00	55.29	J
Persimmon	’02, ’05	’02, ’05	SC	OG	77, 84	13, 20	630.00	63.10	SC
Wisconsin 55	’04–’06	’05–’06	SC	OG	84, 70	15, 19	840.00	84.14	SC
Zapotec Pleated	’02, ’05	’02, ’05	SC	OG	84, 84	13, 13	630.00	63.10	SC

[1]Seed company codes are provided in Appendix C.

[2]OG: Organic

for many of the perennials. The flowers marked A/P are flowers that are annuals but due to the mild climate overwintered and were not resown unless a plant died. Flowers grown multiple years can be considered flower bunching favorites. In particular, various sunflowers (*Helianthus annuus*), pincushion flowers (*Scabiosa atropurpurea*), zinnias (*Zinnia elegans*), and corn cockle (*Agrostemma githago*), coreopsis (*tinctorea*), black eyed Susans (*Rudbeckia spp*), celosia (*Celosia argentea spicata*) and other flowers were frequent contributors to the bouquet enterprise. Several sunflowers, considered summer crops, were started in the spring in 2006, including Holiday, Valentine, Strawberry Blond and Starburst Lemon Aura, but their results were not included since 2006 was the only year sunflowers were planted as a spring crop.

SUMMARY AND CONCLUSIONS

From 2002–2006, the OASIS project earned $115,201 in gross income and grew 554 varieties, including 372 varieties of 39 vegetables, 32 varieties of 15 herbs, and 150 varieties of 72 flowers on approximately an acre of land. After adjustments made following the first year of production, gross annual income from vegetable memberships was about $22,000 to $23,000. One hundred and thirty families were OASIS members during the five years of operation, and the class was taught ten semesters.

Because the Main Field was planted in vegetables for five years in all three seasons, without rotation to green manures or cover crops, weed management became a serious issue. Various issues contributed to the intensive cropping. Fixed expenses, such as the farm manager’s salary, increased the pressure to sell the maximum number of shares. In addition, the objective to trial vegetable varieties in each of the three seasons each year played a role in the intensive cropping patterns. Since only one field was available, it was in continuous production from January through November, leaving no window to cover crop. The fall crop always had to be planted in the same space as the spring crop, and time between the two seasons was inadequate to get a cover crop planted and turned in. The winter months between November and January were also too cold to get much growth in a cover crop. Lastly, the class was offered spring and fall semesters, and field activities were needed both semesters for pedagogical reasons. A rethinking of all of these issues must accompany any effort to resume the project or class.

For the project to be sustainable, the Main Field needed more frequent rotation. Also needed was testing of weed management strategies. Possible strategies would include a tractor-pulled flaming implement, organically approved herbicides such as drip-injected acetic acid, rotations with cover crops, mulching, and specialized cultivation implements. Ways to reduce off-farm inputs such as the fish fertilizer transported from the East Coast needed to be explored. One option could be to integrate a small tilapia project to create a local source of fish fertilizer as well as fish, or to rely upon fertility produced by composting and cover crops—which most likely implies a cover crop must follow each vegetable planting—and/or alfalfa mulch applied to the plots.

Future organic research should examine all of these system components in addition to refining the variety trialing techniques and data gathering and recording. One of the lessons of OASIS is that yield is only one of many criteria determining whether a variety is useful in a CSA operation. Typically, commercial and specialized agriculture focuses on disease and pest resistance crop characteristics, because yield is a primary concern. Shelf life may also be an important attribute of crops destined for distant markets. But in a CSA business, crops are needed to fit into a continuous production schedule.

Table 27. Yields and spacing of spring vegetable varieties, 2002–2006.

Crop	Variety	Years of harvest	Mean annual bed length (feet)	Rows per bed (#)	Mean annual linear feet (length of bed x rows per bed)	In-Row plant spacing (in.)	Total harvest (lb)	Mean annual harvest (lb)	Mean annual yield (lb/bed ft)	Mean annual yield (lb/acre)
Bean, Fava	Broad	'05–'06	210.00	2	420.00	6	422.28	211.14	1.01	12,628
Beet	Chioggia	'02–'04	70.17	2	140.33	4, 4,3	407.29	135.76	1.87	23,309
Beet	Early Wonder Tall Top	'02, '04, '06	43.67	2	87.33	4, 3, 3	338.46	112.82	2.51	31,219
Bok Choi	Joi Choi	'03–'06	29.33	2	58.67	12, 8, 6, 6	835.17	208.79	3.89	48,430
Broccoli	Arcadia	'04–'06	100.00	2	200.00	8	335.66	111.89	1.11	13,808
Broccoli	Packman	'03–'06	74.75	2	149.50	8	203.62	50.91	0.71	8,834
Broccoli	Umpqua	'03, '05	72.00	2	144.00	8	101.74	50.87	0.74	9,176
Cabbage	Derby Day	'04, '06	37.50	2	75.00	12	189.93	94.97	2.45	30,509
Cabbage	Red Express	'05–'06	39.00	2	78.00	12	153.24	76.62	1.96	24,450
Carrot	Danvers	'02–'03	39.50	2, 4	125.00	3, 2	209.18	104.59	2.61	32,540
Carrot	Red Core Chantenay	'04–'06	60.33	2	120.67	2	420.32	140.11	2.32	29,908
Carrot	Scarlet Nantes	'03–'06	73.25	4, 2,2,2	169.00	2	561.54	140.39	2.12	26,413
Cauliflower	Snow Crown	'03–'06	111.75	1	111.75	12	406.78	101.70	0.91	11,321
Chard	Bright Lights	'03–'05	44.33	2	88.67	6, 6, 4	304.88	101.63	2.27	28,258
Chard	Broadstem Green	'02, '06	28.00	1, 2	50.50	6, 4	168.78	84.39	3.10	38,565
Chinese Cabbage	Minuet	'03–'06	40.67	2	81.33	12	673.34	168.34	2.76	34,358
Kohlrabi	Early White Vienna	'03–'04	40.00	2	80.00	4	270.24	135.12	3.50	43,593
Kohlrabi	Kolibri	'05–'06	48.00	2	96.00	4	398.06	199.03	3.96	49,269
Leek	Winter Giant	'02–'03	23.50	2, 3	65.00	3	64.00	32.00	1.80	22,456
Lettuce	Black Seeded Simpson	'02–'05	61.50	2	123.00	10, 6,6,6	324.61	81.15	1.19	14,799
Lettuce	Buttercrunch	'02, '03, '05, '06	41.13	2	82.25	10, 6,6,6	226.57	56.64	1.22	15,233
Lettuce	Jericho	'05–'06	62.50	2	125.00	6	295.34	147.67	2.46	30,664
Lettuce	Oaky Red Splash	'04–'05	39.50	2	79.00	6	81.04	40.52	1.13	14,068
Lettuce	Outredgeous	'02–'05	45.38	2	90.75	10, 6,6,6	170.07	42.52	0.88	10,969
Lettuce	Prizehead	'03, '05	54.00	2	108.00	6	151.28	75.64	1.38	17,197
Lettuce	Red Riding Hood	'03, '05	67.00	2	134.00	6	67.36	33.68	0.46	5,783
Lettuce	Trout's Back	'02–'06	50.50	2	101.00	10, 6, 6, 6,6	358.00	71.60	1.37	17,011
Lettuce	Victoria	'04–'05	39.50	2	79.00	6	115.46	57.73	1.54	19,141
Lettuce	Winter Density	'04–'05	55.00	2	110.00	6	106.18	53.09	0.96	11,944
Pea, Snap	Mega	'05–'06	79.50	1	79.50	1	99.50	49.75	0.64	7,979
Pea, Snow	Oregon Sugar Pod II	'03, '06	135.00	1	135.00	1	190.14	95.07	0.69	8,644
Pea, Snow	Sugar Pod 2	'04–'05	108.00	1	108.00	1	176.42	88.21	0.81	10,050
Radicchio	Indigo	'04–'05	30.00	2	60.00	12, 8	36.80	18.40	0.61	7,633
Radish	Easter Egg	'03–'05	34.50	4, 3, 3	109.50	2	144.54	48.18	1.05	13,104
Radish	Parat Sperling	'04–'05	55.00	3	165.00	2, 1	235.24	117.62	2.15	26,759
Radish	Sparkler	'03, '05	8.00	4, 3	30.00	2, 1	23.25	11.63	1.63	20,229
Salad Greens	Arugula	'02, '04, '05, '06	21.75	2, 3,3,3	76.67	8, 1,1,1	104.01	26.00	0.80	9,995
Salad Greens	Mustard	'02, '04, '05, '06	17.30	2, 3,3,3	48.60	8, 1,1,1	99.71	24.93	1.15	14,358
Spinach	Bloomsdale	'02–'06	85.20	2	170.4	6,3,3,3,3	435	86.98	1.03	12,878
Spinach	Whale	'05–'06	80.00	2	160	3	258.64	129.32	1.51	18,818
Turnip	Purple Top	'02, '03, '05, '06	48.75	2	97.50	4, 3,3,3	601.40	150.35	2.91	36,270

Table 28. Yields and spacing of fall vegetable varieties, 2002–2006.

Crop	Variety	Years of harvest	Mean annual bed length (feet)	Rows per bed (#)	Mean annual linear feet (length of bed x rows per bed)	In-Row plant spacing (in.)	Total harvest (lb)	Mean annual harvest (lb)	Mean annual yield (lb/bed ft)	Mean annual yield (lb/acre)
Beet	Bulls Blood	'03, '04	53.50	2	107.00	4,3	137	69	1.285	16,000
Beet	Chioggia	'02, '05	35.00	2	70.00	4,3	171	85	2.637	32,830
Beet	Early Wonder Tall Top	'02, '03, '05	48.00	2	96.00	4,4,3	342	114	2.400	29,927
Beet	Golden	'02, '03	49.50	2	99.00	4	141	71	02.01	25,107
Bok Choi	Joi Choi	'02–'06	46.20	2	92.40	12,12,6,6,6	1,095	219	5.400	67,228
Broccoli	Arcadia	'03–'06	74.75	2	149.50	8	402	100	1.109	13,797
Broccoli	Early Dividend	'03–'06	93.50	2	187.00	8	351	88	0.887	11,045
Broccoli	Early Green	'02, '04	53.00	2	106.00	8	33	17	0.298	3,712
Cabbage	Early Jersey Wakefield	'02, '03	49.00	1,2	73.00	12	177	89	1.793	22,316
Cabbage	Gonzales	'05, '06	48.00	2	96.00	12	304	152	3.166	39,412
Cabbage	Red Express	'02, '03	49.00	1,2	73.00	12	43	22	0.433	5,397
Carrots	Nantaise	'02, '03	37.00	4,2	94.00	2	174	87	2.590	32,274
Carrots	Red Core Chantenay	'02,'03, '05,'06	37.75	4,4,2,2	99.00	2	305	76	2.608	32,457
Carrots	Rodelika	'03, '04	48.00	4,2	96.00	2	158	79	1.620	20,169
Carrots[1]	Scarlet Nantes	'04–'06	48.67	2	97.33	3,2,2	260	87	1.770	22,087
Cauliflower	Early Dawn SG	'05, '06	85.50	1	85.50	12	306	153	1.734	21,586
Cauliflower	Snow Crown	'03–'06	81.75	1	81.75	12	698	175	2.118	26,359
Chard	Rainbow Mix	'03, '06	31.50	2	63.00	6,4	244	122	4.029	50,152
Chard	Rhubarb Chard	'02, '04, '05	47.00	2	77.33	6,4,4	501	167	3.160	39,355
Chinese Cabbage	Minuet	'03–'06	73.00	1,2,2,2	122.00	12	886	221	3.128	38,926
Kohlrabi	Kolibri	'04–'06	50.67	2	101.33	4	534	178	3.510	44,441
Lettuce	Black Seeded Simpson	'02–'04	45.33	2	90.67	6	123	41	0.960	11,912
Lettuce	Buttercrunch	'02–'04	46.00	2	92.00	6	103	34	0.840	10,426
Lettuce	Jericho	'04–'06	42.33	2	84.67	6	157	52	1.270	15,808
Lettuce	Mikola	'02, '06	30.00	2	60.00	6	32	16	0.550	6,861
Lettuce	Rouge de Grenoblouse	'05, '06	37.00	2	74.00	6	101	50	1.434	17,855
Lettuce[2]	Trouts Back	'03, '04, '06	47.00	2	94.00	6	105	35	0.740	9,171
Peas, Snow	Oregon Sugar Pod II	'03, '05, '06	270.67	1	270.67	1	144	48	0.280	3,434
Radish	Easter Egg	'02, '04, '05	34.00	4,3,3	106.00	1	212	71	1.820	22,602
Radish	French Breakfast	'02, '06	16.00	4,3	54.00	2	52	26	1.631	20,305
Radish	Pink Beauty	'04–'06	36.67	3	110.00	2	191	64	1.890	23,491
Salad Greens	Arrugula	'04, '06	22.00	3	66.00	1	157	78	4.551	28,324
Spinach[2]	Bloomsdale	'03–'05	141.33	2	282.67	3	215	72	0.490	6,113
Spinach	Whale	'05, '06	160.00	2	320.00	3	150	75	0.485	6,046
Turnip	Purple Top	'02–'06	40.60	2	81.20	2,3,3,3,3	801	160	3.930	48,933

[1]Weights of beets, carrots, and radishes include tops

[2]Weights of lettuce and spinach are from cut-and-come-again harvests

Table 29. Yields and spacing of summer vegetable varieties (except tomatoes), 2002–2006.

Crop	Variety	Years of harvest	Mean annual bed length (feet)	Rows per bed (#)	Mean annual linear feet (length of bed x rows per bed)	In-Row plant spacing (in.)	Total harvest (lb)	Mean annual harvest (lb)	Mean annual yield (lb/bed ft)	Mean annual yield (lb/acre)
Bean, Bush	Blue Lagoon	'05–'06	82.00	2	164.00	2	465.52	232.76	0.79	9,888
Bean, Bush	Blue Lake	'02–'06	83.93	2	167.87	4,4,2,2,2	1,280.25	256.05	1.06	13,198
Bean, Bush	Dragon's Tongue	'04–'06	56.71	2	110.00	2	578.07	192.69	1.69	21,090
Bean, Bush	Royal Burgundy	'02, '05	25.40	2	50.80	4, 2	153.63	76.82	1.22	15,166
Corn	Supersweet Jubilee	'04–'05	730.00	1	730.00	8	813.92	406.96	0.57	7,082
Cucumber	Diva	'02–'03	15.50	1	15.50	8	623.27	311.64	9.63	119,808
Cucumber	Lemon	'02–'05	19.50	1	19.50	8	409.32	102.33	4.52	56,298
Cucumber	Mideast Prolific	'05–'06	24.67	1	24.67	8	493.56	246.78	6.55	81,480
Cucumber	Poinsett 97	'04–'05	20.00	1	20.00	8	124.61	62.31	1.58	19,651
Cucumber	Suyo Long	'05–'06	26.33	1	26.33	8	334.87	167.44	4.68	58,224
Eggplant	Imperial Black Beauty	'04–'06	94.67	1	94.67	12	1,770.38	590.13	6.09	75,809
Eggplant	Japanese Pickling	'02–'04	82.67	1	82.67	18, 18, 12	862.11	287.37	3.85	47,944
Eggplant	Rosa Bianca	'02, '03, '05	87.67	1	87.67	18, 18, 12	1,567.06	522.35	6.90	85,871
Melon	Charantais[1]	'03, '06	94.00	1	94.00	12	394.64	197.32	2.12	26,422
Melon	Galia F1	'05–'06	104.00	1	104.00	12	1,438.56	719.28	7.07	87,984
Melon	Casaba[2]	'02–'03	65.00	1	65.00	12	1,437.02	718.51	13.55	168,649
Melon	Sivan F1	'05–'06	104.00	1	104.00	12	432.39	216.20	2.01	25,038
Okra	Clemson Spineless	'02, '06	32.50	1	32.50	12	133.86	66.93	2.80	34,803
Okra	Mammoth Spineless	'03–'06	69.25	1	69.25	12	590.62	147.66	1.78	22,214
Okra	Red Velvet	'02, '05	23.00	1	23.00	12	88.11	44.06	2.19	27,194
Pepper, Bell	Sunrise Orange	'02–'03	53.00	1	53.00	12, 6	374.41	187.21	3.63	45,206
Pepper, Bell	Cal Wonder[3]	'03–'06	26.67	1	26.67	6	418.98	91.24	3.14	39,024
Pepper, Chile	Anaheim	'03–'06	36.00	1	36.00	6	515.88	128.97	3.48	43,356
Pepper, Chile	Habanero	'02, '03, '05	18.33	1	18.33	12, 6, 6	138.11	46.04	1.90	23,585
Pepper, Chile	Jalapeño[4]	'02–'06	14.60	1	14.60	12,6,6,6,6	199.12	39.82	2.71	33,764
Pepper, Chile	NM Joe E. Parker	'02, '04, '06	34.00	1	44.67	12, 6, 6	316.50	105.50	3.10	38,545
Pepper, Chile	NuMex Big Jim	'05–'06	37.00	1	37.00	6	230.44	115.22	3.02	37,598
Pepper, Chile	Rio Grande Hot	'05–'06	8.50	1	8.50	6	46.78	23.39	2.53	31,516
Soybean	Butterbean	'04–'05	341.67	2	683.33	1	294.02	147.01	0.31	3,809
Squash, Summer	Black Beauty	'02, '03, '06	47.71	1	47.71	24	2,720.28	395.64	5.85	72,812
Squash, Summer	Cocozelle	'02, '05	84.75	1	84.75	24	1,335.68	667.84	7.51	93,506
Squash, Summer	Yellow Crookneck[5]	'02–'03	33.50	1	33.50	24	594.23	297.12	4.45	55,387
Squash, Winter	Butternut[6]	'02, '03, '04, '06	84.00	1	84.00	36,36,36,36,24	1,664.98	416.25	4.00	49,780
Sweet Potato	Garnet	'02–'06	73.40	1	73.40	12	1,953.28	390.66	4.91	61,165
Sweet Potato	Jewel	'02–'03	48.50	1	48.50	12	367.12	183.56	3.19	39,732
Tomatillo	Verde	'03–'05	57.00	1	57.00	18, 18, 12	528.79	176.26	3.18	39,602
Watermelon	Dakota Rose	'05–'06	79.00	1	79.00	12	1,550.44	775.22	9.50	118,197
Watermelon	Desert King	'05–'06	55.50	1	55.50	12	529.12	264.56	4.70	58,513
Watermelon	Sugar Baby	'02, '04	125.00	1	125.00	24	3,945.28	1,972.64	18.47	229,835
Watermelon	Verona	'05–'06	79.50	1	79.50	12	934.54	467.27	6.04	75,142

[1]Variety name '03: 'Savor'; Variety name '06: 'Charantais'
[2]Variety name '02: 'Santo Domingo'; Variety name '03: 'Sungold'
[3]Variety name '03: 'Cal Wonder'; Variety name '04-'05: 'Cal Wonder 300'; Variety name '06: 'California Wonder'
[4]Variety name '03: '05, '06: 'Jalapeño'; Variety name '02: 'Jalapeño Early'; Variety name '04: 'Jalapeño Tula'
[5]Variety name '02: 'Early Yellow Crookneck'; Variety name '03: 'Yellow Crookneck'
[6]Variety name '02-'03: 'Butternut'; Variety name '04, '06: 'Waltham Butternut

Table 30. Spacing and yields for tomato varieties, 2002–2006.

Crop	Variety	Years of harvest	Mean annual bed length (feet)	Rows per bed (#)	Mean annual linear feet (length of bed x rows per bed)	In-Row plant spacing (in.)	Total harvest (lb)	Mean annual harvest (lb)	Mean annual yield (lb/bed ft)	Mean annual yield (lb/acre)
Celebrity	'04–'06	'05–'06	54	1	54	24	1,293.54	324.66	6.04	75,196
Fantastic	'04–'06	'05–'06	54	1	54	24	1,270.37	315.47	5.88	73,183
Legend	'05–'06	'05–'06	54	1	54	24	735.78	154.14	2.95	36,746
Old/Striped German[1]	'02–'05	'02–'05	49	1	49	24	262.65	131.33	3.07	38,258
Persimmon	'02, '05	'02, '05	48	1	48	24	206.36	103.18	2.41	30,013
Wisconsin 55	'04–'06	'05–'06	54	1	54	24	752.35	184.45	3.44	42,870
Zapotec Pleated	'02, '05	'02, '05	48	1	48	24	155.92	77.96	1.78	22,267
All slicers 2002[2]	2002	--	31	1	31	24	1,621.82	180.20	4.74	59,020
All tomatoes 2003[3]	2003	--	45	1	45	24	1,480.21	--	3.12	37,099
All tomatoes 2004[4]	2004	--	56	1	56	24	2,209.95	--	3.59	42,620
All slicers 2005[5]	2005	--	58	1	58	24	1,825.82	152.15	2.61	32,498
All slicers 2006[6]	2006	--	50	1	50	24	3,141.89	261.82	5.24	65,172

[1] Variety name '02: 'Old German'; Variety name '03–'05: 'Striped German'

[2] 2002 Slicer Varieties: Manitoba, Old German, Paragon, Persimmon, Red Super Marmande, St. Pierre, Thessaloniki, Tigerella, Zapotec Pleated

[3] *All Tomatoes 2003* includes one Cherry variety ('Large Red Cherry'); 2003 Slicer Varieties: Amana Orange, Peron Sprayless, Persimmon, Pruden's Purple, Siletz, Striped German, Thessaloniki, Heartland, Super Fantastic, Beef Master, Celebrity, Double Red, Red Calabash, Large Red Cherry

[4] *All Tomatoes 2004* includes one Paste variety ('Debarao'); 2004 Slicer Varieties: Big Beef, Celebrity, Debarao (paste), Delicious, Fantastic, Green Zebra, New Girl, Orange Blossom, Striped German, Sun Leaper, Thessaloniki, Wisconsin 55

[5] 2005 Slicer Varieties: Arkansas Traveller, Celebrity, Crimson Sprinter, Fantastic, Legend, Marvel Striped, Oregon Spring, Persimmon, Pink Beauty, Striped German, Wisconsin 55, Zapotec Pleated,

[6] 2006 Slicer Varieties: Celebrity, Fantastic, Legend, Wisconsin 55

Table 31. Spring herb field space, 2002–2006.

Crop	Variety	Years of harvest	Mean annual bed length (feet)	Rows per bed #	Mean annual linear feet (feet)	In-row plant spacing (in.)
Cilantro	Santo	’04–’06	26.67	2	53.34	Sow evenly
Cilantro	Slow Bolt	’03	30	2	60	Sow evenly
Dill	Bouquet	’05–’06	17.5	2	35	Sow evenly

Table 32. Spring herb harvests, 2002–2006.

Crop	Variety	Years grown	Total harvest (lb)	Mean annual harvest (lb)	Mean annual yield (lb/bed foot)	Mean annual yield (lb/acre)
Cilantro	Santo	’04–’06	90.26	30.09	1.11	13,765
Dill	Bouquet	’05–’06	34.76	17.38	0.94	12,554

Table 33. Fall herb field space, 2002–2006.

Crop	Variety	Years of harvest	Mean annual bed length (feet)	Rows per bed #	Mean annual linear feet (feet)	In-row plant spacing (in.)
Cilantro	Santo	’04–’06	29.33	2	58.66	Sow evenly
Cilantro	Slow Bolt	’02–’03	25.00	2	50.00	Sow evenly
Dill	Bouquet	’05–’06	20.50	2	41.00	Sow evenly

Table 34. Fall herb harvests, 2002–2006.

Crop	Variety	Years grown	Total harvest (lb)	Mean annual harvest (lb)	Mean annual yield (lb/bed foot)	Mean annual yield (lb/acre)
Cilantro	Santo	’04–’06	77.56	25.85	0.84	10,409
Cilantro	Slow Bolt	’02–’03	27.18	13.59	0.54	6,749
Dill	Bouquet	’05–’06	33.62	16.84	0.81	10,069

Table 35. Summer herb field space, 2002–2006 (except basil).

Crop	Variety	Years grown	Mean annual bed length (feet)	Rows per bed (#)	Mean annual linear feet (feet)	In-row plant spacing (in.)
Chives	Purly	’05–’06	9.33	1	9.33	6
Chives	Garlic	’05–’06	16.67	1	16.67	6
Lemon Balm		’03–’05	14.67	2	29.34	12
Mint	Spearmint	’03–’06	16.67	2	33.34	6
Oregano	Greek	’02–’06	17.00	2	34.00	10 in ’02, 12 ’03–’06
Parsley	Italian flat leaf	’02–’06	12.80	2	25.60	8 in ’02, sown evenly ’03–’06
Parsley	Moss curled	’05–’06	12.00	2	24.00	Sown evenly
Rosemary		’03–’06	16.00	1	16.00	12
Sage	Common	’03–’06	15.50	2	31.00	12
Stevia		’04–’06	8.67	2,2,1	14.00	6
Tarragon	French	’05–’06	1.00	2	2.00	12
Thyme	English	’02–’06	14.60	2	29.20	8 in ’02, 6 ’03–’06
Thyme	Orange	’04–’05	10.00	2	20.00	6

Table 36. Summer herb harvests, 2002–2006 (except basil).

Crop	Variety	Years grown	Total harvest (lb)	Mean annual harvest (lb)	Mean annual yield (lb/bed foot)	Mean annual yield (lb/acre)
Chives	Purly	’05–’06	5.36	1.79	0.20	8,764
Chives	Garlic	’05–’06	12.26	4.09	0.70	2,533
Lemon Balm		’03–’05	35.00	11.67	0.68	8,445
Mint	Spearmint	’03–’06	120.16	30.04	1.76	21,946
Oregano	Greek	’02–’06	80.35	16.07	0.94	11,639
Parsley	Italian flat leaf	’02–’06	148.16	29.63	2.13	26,472
Parsley	Moss curled	’05–’06	28.76	14.38	1.18	14,736
Rosemary		’03–’06	42.70	10.68	0.67	8,304
Sage	Common	’03–’06	92.52	23.13	1.48	18,454
Stevia		’04–’06	35.76	11.92	1.50	18,646
Tarragon	French	’05–’06	6.00	3.00	3.00	37,337
Thyme	English	’02–’06	74.64	14.93	1.02	12,722
Thyme	Orange	’04–’05	22.57	11.29	1.13	14,045

Table 37. Basil field space, 2002–2006.

Variety	Years of harvest	Mean annual bed length (feet)	Mean annual linear feet[1] (feet)	In-row plant spacing (in.)
Sweet Genovese	’02–’06	21.40	21.40	12 in ’02, 6 ’03–’06
Super Sweet Chen	’06	12.00	12.00	6
Italian Large Leaf	’06	12.00	12.00	6
Aroma 2	’06	12.00	12.00	6
Lemon	’03	14.00	14.00	6
Lime	’04	14.00	14.00	6
Thai	’02	32.00	32.00	12

[1]There was 1 row per bed for all varieties all years.

Table 38. Basil harvests, 2002–2006.

Variety	Years grown	Total harvest (lb)	Mean annual harvest (lb)	Mean annual yield (lb/bed foot)	Mean annual yield (lb/acre)
Aroma 2	’06	42.64	N/A	3.55	44,224
Cinnamon[1]	’02	37.80	N/A	1.18	14,701
Italian Large Leaf	’06	69.24	N/A	5.77	71,812
Lemon	’03	35.65	N/A	2.01	31,692
Lime	’04	27.66	N/A	1.98	24,589
Super Sweet Chen	’06	42.42	N/A	3.54	43,996
Sweet Genovese	’02–’06	689.49	137.9	6.05	75,354
Thai	’02	121.64	N/A	3.80	47,309

[1]Cinnamon basil was grown for distribution as an herb in 2002 but as a flower in subsequent years and therefore in ’03–’06 was not weighed.

Table 39. Flowers grown and seed source, 2002–2006.

Common name	Latin name	Cultivar name	Years grown	Season	Seed Source[1]	Transplant or Direct seed	Annual, Perennial, Biennial
Bachelor Button or Corn Flower	*Centaurea cyanus*		'03–'06	Summer	SC	TP, DS	A
Basil	*Ocimum basilicum*	Cinnamon	'03–'06	Summer	J, SC	TP	A
Basil	*Ocimum basilicum*	Red Rubin	'04–'06	Summer	J	TP	A
Black Eyed Susan	*Rudbeckia x hirta hybrida*	Cherokee Sunset	'03–'06	Summer	T, P	TP	A/P
Black Eyed Susan	*Rudbeckia hirta*	Prairie Sun	'03–'06	Summer	J	TP	A/P
Campanula	*Campanula medium*	Cup & Saucer	'04, '06	Summer	Pl	TP	B
Celosia	*Celosia argentea spicata*	Flamingo Feather	'02–'06	Summer	J	TP, DS	A
Celosia	*Celosia argentea plumosa*	Pampas Plume	'04–'06	Summer	J	TP	A
Chinese Forget Me Not	*Cynoglossum amabile*	Firmament	'04–'06	Spring	J	TP	A
Coreopsis	*Coreopsis tinctoria*	Bouquet Magic	'04–'06	Summer	SC	TP	A
Corn Cockle	*Agrostemma githago*	Ocean Pearls	'03–'06	Spring	J	TP	A
Corn Cockle	*Agrostemma githago*	Purple Queen	'03–'06	Spring	J	TP	A
Cosmos	*Cosmos bipinnatus*	Picotee	'02–'03	Summer	SC	DS	A
Dahlia	*Dahlia hortensis*	Mixed Giant	'04–'05	Summer	SC	TP	P
Dill	*Anethum graveolens*	Vierling	'05–'06	Summer	J	TP, DS	A
Feverfew	*Tanacetum parthenium*	Tetra White	'03, '06	Summer	J	TP	P
Floss Flower	*Ageratum houstonianum*	Red Top	'03–'04	Summer	J	TP	A
Flowering Tobacco	*Nicotiana langsdorfii*		'04–'06	Summer	B, SSE	TP	A
Globe Amaranth	*Gomphrena globosa*	Globe Amaranth Mix	'03–'04	Summer	J	TP	A
Globe Amaranth	*Gomphrena haagenana*	Strawberry Fields	'05–'06	Summer	J	TP	A
Marigold	*Tagetes erecta*	African	'03–'06	Summer	SC	TP, DS	A
Millet	*Setaria italica*	Limelight	'04–'06	Summer	J	DS	A
Ornamental Pepper	*Capsicum annuum*	Nippon Taka 101	'04–'06	Summer	J	TP	A
Pincushion Flower	*Scabiosa atropurpurea*	Black Knight	'04–'06	Summer	J	TP	A
Pincushion Flower	*Scabiosa atropurpurea*	Olympia Mix	'03–'06	Summer	J	TP	A
Salvia	*Salvia farinacea*	Gruppenblau	'04, '06	Summer	J	TP	A/P
Snapdragon	*Antirrhinum majus*	Rocket Mix	'03–'06	Spring	J	TP	A
Statice	*Limonium sinuatum*	Pacific Mix	'04, '06	Summer	J	TP	A
Sunflower	*Helianthus annuus*	Bashful	'05–'06	Summer	J	DS	A
Sunflower	*Helianthus annuus*	Holiday	'03–'06	Summer	J	DS	A
Sunflower	*Helianthus annuus*	Moulin Rouge	'02, '05	Summer	J	DS	A
Sunflower	*Helianthus annuus*	Peach Passion	'04, '05	Summer	T	DS	A
Sunflower	*Helianthus annuus*	Ring of Fire	'02,'05–'06	Summer	J, T	DS	A
Sunflower	*Helianthus annuus*	Sorya	'02, '06	Summer	J	DS	A
Sunflower	*Helianthus annuus*	Starburst Lemon Aura	'04–'06	Summer	H, J	DS	A
Sunflower	*Helianthus annuus*	Strawberry Blonde	'05–'06	Summer	J	DS	A
Sunflower	*Helianthus annuus*	Valentine	'02–'06	Summer	J	DS	A
Zinnia	*Zinnia elegans*	Benary's Deep Red	'05–'06	Summer	J	DS	A
Zinnia	*Zinnia elegans*	Benary's Giant Lime	'05–'06	Summer	J	DS	A
Zinnia	*Zinnia elegans*	Benary's Giant Mix	'02–'06	Summer	J	DS	A
Zinnia	*Zinnia elegans*	Benary's Salmon Rose	'05–'06	Summer	J	DS	A
Zinnia	*Zinnia elegans*	Benary's White	'04–'06	Summer	J	DS	A
Zinnia	*Zinnia elegans*	Giant Cactus Double M	'03–'04	Summer	T, J	DS	A
Zinnia	*Zinnia elegans*	Righteous Red	'02–'03	Summer	SC	DS	A

[1]Seed company codes are provided in Appendix C.

Table 40. Flower field space and weeks of harvest, 2002–2006.

Common name	Latin name	Cultivar name	Rows per bed	In-row plant spacing	Total plants grown	Total bed feet	Mean bed feet	Total linear feet	Mean weeks of harvest
Bachelor Button or Corn Flower	*Centaurea cyanus*		2	6	450	112	22.40	224	12.20
Basil	*Ocimum basilicum*	Cinnamon	1	8	75	50	12.50	50	21.25
Basil	*Ocimum basilicum*	Red Rubin	1	8	60	40	13.33	40	21.33
Black Eyed Susan	*Rudbeckia x hirta hybrida*	Cherokee Sunset	2	8	195	65	16.25	130	18.00
Black Eyed Susan	*Rudbeckia hirta*	Prairie Sun	2	8	195	65	16.25	130	14.00
Campanula	*Campanula medium*	Cup & Saucer	1	6	40	25	15.00	25	0.00
Celosia	*Celosia argentea spicata*	Flamingo Feather	2	4	564	84	16.80	188	19.00
Celosia	*Celosia argentea plumosa*	Pampas Plume	2	4	260	43	14.33	86	17.33
Chinese Forget Me Not	*Cynoglossum amabile*	Firmament	2	6	360	108	36.00	216	5.50
Coreopsis	*Coreopsis tinctoria*	Bouquet Magic	2	4	204	34	11.33	68	7.66
Corn Cockle	*Agrostemma githago*	Ocean Pearls	2	6	484	121	30.25	242	4.33
Corn Cockle	*Agrostemma githago*	Purple Queen	2	6	504	126	31.50	252	4.00
Cosmos	*Cosmos bipinnatus*	Picotee	1	8	54	36	18.00	36	22.50
Dahlia	*Dahlia hortensis*	Mixed Giant	1	8	53.5	35	17.50	35	23.50
Dill	*Anethum graveolens*	Vierling	2	Sow evenly	600	25	12.50	50	6.00
Feverfew	*Tanacetum parthenium*	Tetra White	2, 1	8, 12	75	35	17.50	55	14.50
Floss Flower	*Ageratum houstonianum*	Red Top	2	6	160	40	20.00	80	25.00
Flowering Tobacco	*Nicotiana langsdorfii*		2	8	128	42	14.00	84	19.33
Globe Amaranth	*Gomphrena globosa*	Globe Amaranth Mix	2	6	162	40	20.00	80	16.00
Globe Amaranth	*Gomphrena haageana*	Strawberry Fields	2	6	88	22	11.00	44	22.00
Marigold	*Tagetes erecta*	African	2	6, 12	172	73	18.25	146	9.75
Millet	*Setaria italica*	Limelight	1, 2	Sow evenly	816	44	14.66	68	2.66
Ornamental Pepper	*Capsicum annuum*	Nippon Taka 101	1	6	89	44	14.66	44	6.00
Pincushion Flower	*Scabiosa atropurpurea*	Black Knight	2	8	180	60	20.00	120	24.33
Pincushion Flower	*Scabiosa atropurpurea*	Olympia Mix	2	8	252	84	21.00	168	22.25
Salvia	*Salvia farinacea*	Gruppenblau	2	6, 12	68	22	11.00	44	24.50
Snapdragon	*Antirrhinum majus*	Rocket Mix	2	6	460	115	28.75	230	5.00
Statice	*Limonium sinuatum*	Pacific Mix	2	8	78	26	13.00	52	7.50
Sunflower	*Helianthus annuus*	Bashful	3	3	144	12	6.00	36	2.00
Sunflower	*Helianthus annuus*	Holiday	3	3	432	36	9.00	108	3.50
Sunflower	*Helianthus annuus*	Moulin Rouge	3	3, 4	306	32	16.00	96	7.50
Sunflower	*Helianthus annuus*	Peach Passion	3	3	192	16	8.00	48	2.00
Sunflower	*Helianthus annuus*	Ring of Fire	3	3, 4	378	38	12.66	114	3.66
Sunflower	*Helianthus annuus*	Sorya	3	3, 4	306	32	16.00	96	5.50
Sunflower	*Helianthus annuus*	Starburst Lemon Aura	3	3	192	16	8.00	48	3.50
Sunflower	*Helianthus annuus*	Strawberry Blonde	3	3	144	12	6.00	36	3.00
Sunflower	*Helianthus annuus*	Valentine	3	3, 4	546	52	13.00	156	6.75
Zinnia	*Zinnia elegans*	Benary's Deep Red	2	4	112	12	6.00	24	21.50
Zinnia	*Zinnia elegans*	Benary's Giant Lime	2	4	112	12	6.00	24	21.50
Zinnia	*Zinnia elegans*	Benary's Giant Mix	1, 2	4	532	92	18.40	144	19.80
Zinnia	*Zinnia elegans*	Benary's Salmon Rose	2	4	112	12	6.00	24	21.50
Zinnia	*Zinnia elegans*	Benary's White	2	4	172	22	7.33	44	20.66
Zinnia	*Zinnia elegans*	Giant Cactus Double M	1, 2	4, 6	182	50	25.00	80	19.00
Zinnia	*Zinnia elegans*	Righteous Red	1	4	120	40	20.00	40	17.00

Thus, days to harvest, taste, color, size, and texture all play a role in determining whether a particular variety fits well into a CSA crop mix.

This project began a process of alternative vegetable crop experimentation, replicated across years and in a few cases for the OSP project, within the field. This kind of experimentation is needed to reduce farmers' learning curves in new crop adoption. In addition, demonstration and teaching of alternative organizational farming structures, such as CSAs, is needed to provide examples of how local growers can provide fresh foods that meet the nutritional and cultural needs of the community.

The decision to collect particular data by variety in this project was a compromise between perceived importance to regional farmers and the feasibility of collecting and maintaining a large data set. For example, flower yields by variety were never collected, which means that cut flower growers will need additional information before being able to use the OASIS results. In addition, other crop features may become salient; collecting and organizing that information should be planned from the outset of the project. For example, a Philippine family visited OASIS early in the project and harvested sweet potato leaves for a soup, a use for sweet potatoes that previously was completely unknown to us. The plethora of criteria potentially used to evaluate crop characteristics should not be underestimated, especially the diversity of plants and uses for plants in various ethnic communities. In a project in the Philippines, seed banking was accompanied by information gathering on sweet potato cultural practices; growth habits; and morphological, gastronomic, and post-harvest characteristics (Nazarea, 1998).

Despite various challenges and shortcomings, the OASIS project managed to produce on a consistent basis about 1.20 lb of vegetables and herbs per linear foot or 27,000 lb/acre, using organic production techniques on sub-surface drip irrigation in the Chihuahuan Desert. Organic matter in the soil increased about one percentage point over the course of the five years without significant increases in soil salinity, as measured by electrical conductivity.

REFERENCES

Creamer, R., J. Carpenter, and J. Rascon. 2003. Incidence of the beet leafhopper, Circulifer tenellus (Homoptera: Cicadellidae) in New Mexico chile. Southwestern Entomologist 28:177-182.

Falk, C., P. Pao, and C.S. Cramer. Teaching diversified organic crop production using the community supported agriculture farming system model, Jour. of Natural Resources and Life Sci. Educ. 34(2005):8-12.

Flynn, R. P. Personal communication. Artesia, N.M., 2007.

Greene, C., and A. Kremen. 2003. *U.S. organic farming in 2000-2001: Adoption of certified systems.* Agriculture Information Bulletin No. 780, U.S. Department of Agriculture, Economic Research Service, April.

Heimlich, R.E. and W.D. Anderson. 2001. Development at the urban fringe and beyond: impacts on agriculture and rural land. USDA-ERS Agricultural Economic Report No. 803. Available at www.ers.usda.gov/publications/aer803/ (accessed 11 Nov. 2003).

Henderson, E. with R. Van En. 1999. *Sharing the harvest: A guide to community-supported agriculture.* White River Junction, VT: Chelsea Green Publishing Co.

Hendrickson, J. 2005. *Grower to grower: Creating livelihood on a fresh market vegetable farm.* Univ. of Wisconsin-Madison, College of Agricultural and Life Sciences, Madison, WI.

Herrera, E. 1989. Average freeze-free periods by weather stations during 1982-1987 seasons. N. M. State Univ. Coop. Ext. Guide H-111.

Herrera, E. Soil test interpretations. 2000. N. M. State Univ. Coop. Ext. Guide A-122.

Nazarea, V. D. 1998. Cultural memory and biodiversity. Tucson: University of Arizona Press.

New Mexico Statistical Office, 2003. *New Mexico Agricultural Statistics, 2003*. New Mexico Department of Agriculture.

Oberholtzer, L., C. Dimitri, and C. Greene. 2005. *Price premiums hold as U.S. organic produce market expands.* Electronic Outlook Report VGS-308-01. U.S. Department of Agriculture, Economic Research Service, May. Available at www.ers.usda.gov.

Quinn, J. Personal communication, Albuquerque, N.M., July 2003.

Quinn. J. What's new in organicsville? *Fertile Ground*, newsletter of the New Mexico Organic Commodity Commission, 5,3, 2005.

Ray, J., J. Schroeder, R. Creamer, and L. Murray. 2006. Planting date affects phenology of London rocket (*Sisymbrium irio*) and interaction with beet leafhopper (*Circulifer tenellus*) in southern New Mexico. *Weed Science* 53: 54:127-132.

Samani, Z. Personal communication, Las Cruces, N.M. July 2007.

Schroeder, J., S. H. Thomas, and L. W. Murray. 2005. Impacts of crop pests, and their management, on weeds. *Weed Science* 53:918-922.

Schroeder, J. S. H. Thomas, and L. W. Murray. 2004. Root-knot nematodes affect annual and perennial weed interactions with chile pepper. *Weed Science* 52:28-46.

Schroeder, J., S. H. Thomas, and L. Murray. 1993. Yellow and purple nutsedge and chile peppers host southern root-knot nematode. *Weed Science* 41:150-156.

Tegtmeier, E. and M. Duffy. 2005. Community supported agriculture (CSA) in the Midwest United States: A regional characterization. Leopold Center for Sustainable Agriculture, Iowa State University, Ames, Iowa.

Thomas, S. H., J. Schroeder and L. W. Murray. 2005. The role of weeds in nematode management. *Weed Science* 53:923-928.

U.S. Department of Agriculture. 1999. 1997 Census of Agriculture—New Mexico State and County Data. National Agricultural Statistics Service. AC97-A-31, Volume 1. Geographic Area Series, part 31. Available at http://www.usda.gov/nass/ (Accessed 30 Sept. 2003).

U.S. Department of Agriculture, National Agriculture Statistics Service. "Land Used for Vegetables and Vegetables Harvested for Sale, 2002 and 1997." 2002 Census of Agriculture, Vol 1, Chapter 2, New Mexico County Level Data. Available at http://www.nass.usda.gov/census/census02/volume1/nm/index2.htm (Accessed 26 July 2007).

U.S. Department of Commerce, Bureau of the Census. 1981. 1978 Census of Agriculture—New Mexico State and County Data. A78-A-31, Volume 1.

Walz, E. 2004. *Final Results of the Fourth National Organic Farmers' Survey: Sustaining Organic Farms in a Changing Organic Marketplace*, Available at www.ofrf.org/publications/survey/index.html/.

Western Regional Climate Center. Accessed online February 2, 2007. Available at www.wrcc.dri.edu.

LIST OF TABLES AND APENDICES

APPENDIX

Appendix A. Planting depth and seeding rates

Crop	Seed Planting Depth (in.)	Seeding rates (oz/linear foot)	Seeding rates (lb/acre)
Cool season vegetables			
Bean, Fava	1.000	0.16000	248.91
Beet	0.500	0.01000	15.56
Bok Choi	0.500	0.00048	0.75
Broccoli	0.250	0.00043	0.67
Cabbage	0.250	0.00028	0.43
Carrots	0.250	0.00500	7.78
Cauliflower	0.250	0.00025	0.19
Chard	0.500	0.00500	7.78
Chinese Broccoli	0.250	0.00310	4.82
Chinese Cabbage	0.500	0.00032	0.49
Collards	0.500	0.00119	1.84
Daikon	0.500	0.00500	7.78
Garlic	2.000		3,555.92
Green Onion	0.500	0.00500	11.67
Kale	0.500	0.00180	2.80
Kohlrabi	0.250	0.00071	1.10
Leek	0.250	0.00500	11.67
Lettuce	0.250	0.00140	2.18
Onion	0.500	0.01000	31.11
Peas	0.500	0.20000	155.57
Potato	2.000		1,414.29
Radicchio	0.125	0.00023	.35
Radish	0.500	0.01000	23.34
Salad Greens	0.250	0.00350	8.17
Spinach	0.500	0.00750	11.67
Turnip	0.250	0.00300	4.67
Warm Season Vegetables			
Bean, Bush	1.000	0.08000	124.46
Corn	1.000	0.03000	23.34
Cucumber	0.500	0.00409	3.18
Eggplant	0.250	0.00038	0.29
Melon	0.500	0.00174	1.35
Okra	0.500	0.00514	4.00
Pepper	0.500	0.00104	0.81
Soybean	1.000	0.08000	124.46
Squash, Summer	1.000	0.00311	2.42
Squash, Winter	0.500	0.00347	2.70
Sweet Potato	cuttings		995.66
Tomatillo	0.250	0.00011	0.07
Tomato	0.250	0.00013	0.10
Watermelon	0.500	0.00298	2.32

Appendix B1. Changes made to recommended cool season vegetable in-row plant spacing and rows per bed

Crop	Changes adopted
Bok Choi	12”–18” was the recommended in-row spacing for Chinese cabbage, the closest relative to bok choi with designated spacing. Over time, spacing was reduced to 6” apart without any ill effects. For “baby” varieties like ‘Fuyo Shomi’, 4” spacing was viable.
Brussels Sprouts	This crop was attempted twice before it was abandoned due to the lack of a prolonged cool season. The recommended spacing for Brussels sprouts was 18”–24”. The second time it was planted, the 18” recommendation was selected to conserve space.
Cabbage	The recommended distance between rows was 24”–36”. With 22”-wide beds, 1 row seemed feasible. However, 2 rows per bed were adopted, which is commercial practice in the valley. Recommended in-row spacing was 18”–24”. The high end, 24”, seemed excessive and 18” should have been adopted, but 12”-spacing worked well. Commercial practice in the Mesilla Valley is greater than 12” to allow for larger heads.
Chinese Cabbage	The recommended distance between rows was 18”–24”. With 22”-beds, only 1 row seemed feasible. However, 2 rows did work well, although for very large varieties like ‘Rubicon’ one row per bed is better.
Carrots	The recommended distance between rows was 12”–16”—meaning that 2 rows would fit. However, in order to maximize space, 4 rows straddling the drip tape were attempted. Three rows might have compromised the integrity of the drip tape, which was placed 4” below the soil surface running down the middle of the bed. Although 4 rows were feasible, the crowding made harvesting difficult. Thin to spacing was recommended at 1”–3”; however, 2”-spacing was the best for repeated harvests from the same plot. If the entire crop would be harvested all at once, 1”-spacing would probably work well.
Collards	The recommended distance between rows was 24”–36”, which means 1 row. The thin to spacing was 12”–16”. These recommendations were used in Spring 2002. The second and only other time collards were planted was Spring 2004. By that time spacing had been reduced in so many crops, the rows were doubled and the spacing reduced by half with confidence.
Swiss Chard	The number of rows per bed was doubled after the first spring 2002 growing season because it was obvious that space was wasted. The recommended in-row spacing was 10”–12”, but to conserve field space, 6” was used. When 4” spacing was attempted, yields did not suffer, so we kept 4” spacing.
Kale	The recommended spacing was 24” between rows and 18–24” between plants. This seemed excessive so plants were first spaced 8” in 2 rows per bed, but then 4” spacing was used. 4–6” is probably ideal.
Kohlrabi	The recommended spacing was 3–8” apart in rows 24” apart. 2 rows worked best, but 3 rows were attempted, which was too crowded. 4” in-row spacing proved effective.
Leek	The recommended spacing was 3–4” apart in rows 12–18” apart. We spaced plants 3” apart as recommended, in 2 rows per bed. Later, to save space, 3 rows were planted successfully.
Lettuce	Since lettuce was grown as a cut-and-come-again crop instead of as heads, spacing was not critical. However, lettuce was always sowed and thinned as it would have been for head production. Spacing was decreased from 8” to 6” after the Spring 2002 since the 8” seemed to waste space.
Salad greens	Using recommended spacing, the initial 8” plant spacing proved to be a waste of space since salad greens were harvested in their “baby” stages. Sowing a continuous line of seeds without thinning and in 3 rows proved effective. 4 rows was a little too dense.
Onion	The recommended spacing for onions was 4” in 2 rows. We planted 4 rows in Spring 2003 on recommendation of local experts.
Green onion	1” spacing in 3 rows per bed was the preferred spacing.
Peas	In Spring 2002, spacing was 3” apart, but reduced to 1” between plants in subsequent seasons.
Radish	In-row spacing was reduced to 1” apart, but this was too close and 2” spacing was considered ideal. Four rows per bed works, but three was less crowded and easier to harvest over an extended window.
Spinach	The recommended in-row spacing was 3”, which is what we adopted, rather than 6”, after Spring 2002.
Turnip	A 6”-spacing was too much; 4”-spacing was fine, and 3”-spacing also worked.

Appendix B2. Changes made by Pauline Pao, to recommended warm season vegetable in-row plant spacing and rows per bed

Crop	Reason for changing in-row spacing and/or rows per bed
Bean, Bush	4” was the recommended thin to distance. When planting, students followed directions and spaced the seed 4” apart whereas when I planted, I would space them closer together knowing that not every seed would germinate. Student-planted rows would have large gaps where seed did not germinate and had to be replanted. In 2004 I decided to use the 2” spacing to account for the fact that not every seed would germinate and to make sure the stand of beans was solid. Realizing that this was in essence buying 2x more seed than we needed, in fall 2004, I tinkered with the field space chart by putting 3” as the spacing to reduce seed cost, thereby buying 50% more seed than absolutely necessary.
Bean, Soybean	Seed spacing was reduced from 2” to 1” to account for gaps in germination.
Eggplant	18”–24” is the recommended in-row spacing. Over time I reduced it to 12” partly because calculations were easier with this spacing and production didn’t seem to be compromised.
Onion	4” in row with 2 rows is proper, recommended spacing for onions. Four rows were planted in Spring 2003 on recommendation of local experts
Green Onion	In-row spacing and number of rows per bed were tinkered with somewhat. I prefer 1” spacing with 3 rows across the tops of beds.
Pepper	12–18” is the recommended spacing for all peppers. In an attempt to prevent sunscale on fruit, plants were spaced at 6” apart to encourage shading.
Winter Squash	36” was already a compromise in the recommended spacing of 6–10’! It was further reduced to 24” to save a little space in the planted row as well in the amount of space it requires for trailing.
Tomatillo	Copying the spacing for tomato, tomatillo was spaced at 24” apart. Over time, it was reduced to 18” then to 12” without ill effects.

Appendix C. Seed Companies

Code	Company	State	Address	Phone, Fax	Website
AL	Abundant Life Seeds	OR	P.O. Box 157, Saginaw, OR 97472	(541) 767-9606, (866) 514-7333	www.abundantlifeseeds.com
B	W. Atlee Burpee & Co	PA	300 Park Avenue, Warminster, PA 18974	1-800-888-1447, 1-800-487-5530	www.burpee.com
BC	Baker Creek Heirloom Seeds	MO	2278 Baker Creek Rd, Mansfield, MO 65704	(417) 924-8917, (417) 924-8887	www.RareSeeds.com
C	Cook's Garden	PA	P.O Box C5030, Warminster, PA 18974	1-800-457-9703, 1-800-457-9705	www.cooksgarden.com
Co-Op	Mountain View Market	NM	1300-El Paseo Rd #M, Las Cruces, NM 88001	(505) 523-0436, (214) 748-3647	
Cornell (OSP)	Cornell University	NY	Dept. of Plant Breeding, 106 Love Lab/Caldwell Rd Ithaca, NY 14853	(607) 255-1241 or (607) 254-6442	www.plbr.cornell.edu
Dr. B	Dr. Paul Bosland, NMSU	NM	Dept. of Plant and Environmental Sciences, MSC 3Q Las Cruces, NM 88003	(505) 646-3405, (505) 646-6041	
Dr. C	Dr. Chris Cramer, NMSU	NM	Dept. of Plant and Environmental Sciences, MSC 3Q Las Cruces, NM 88003	(505) 646-3405, (505) 646-6041	
F	Fedco Seeds	ME	P.O. Box 520, Waterville, ME 04903	(207) 873-7333, (207) 872-8317	www.fedcoseeds.com
FM	Ferry-Morse Seed Company			1-800-283-3400	www.ferry-morse.com
HM	High Mowing Organic Seeds	VT	P.O. Box 180, Wolcott, VT 05860	(802) 472-3201, (802) 472-3201	www.highmowingseeds.com
Inst.	Chile Pepper Institute, NMSU	NM	Dept. of Plant and Environmental Sciences, MSC 3Q Las Cruces, NM 88003	(505) 646-3028, (505) 646-6041	www.chilepepperinstitute.org
J	Johnny's Selected Seeds	ME	955 Benton Avenue, Winslow, ME 04901	1-877-564-6697	www.johnnyseeds.com
N	Nichols Garden Nursery	OR	1190 Old Salem Road NE, Albany, OR 97321	1-800-422-3985, 1-800-231-5306	www.nicholsgardennursery.com
OASIS	OASIS CSA-NMSU	NM	Dept. of Ag. Econ & Ag. Bus., MSC 3169, P.O. Box 30003 Las Cruces, NM 88003	(505) 646-4731 or (505) 646-4321	agecon.nmsu.edu/oasis/
OSU (OSP)	Oregon State University	OR	See information above for Cornell		
P	Park Seed Company	SC	1 Parkton Avenue,Greenwood, SC 29647	1-800-213-0076	www.parkseed.com
PL	Plantation Products	MA	202 S. Washington Street, Norton, MA 02766	1-508-285-5800, 1-508-285-7333	www.plantationproducts.com
Plts of the SW	Plants of the Southwest	NM	3095 Aqua Fria Rd., Santa Fe, NM 87507	1-800-788-7333, (505) 438-8800	www.plantsofthesouthwest.com
PV	Peaceful Valley Farm Supply	CA	P.O. Box 2209, Grass Valley, CA 95945	1-888-784-1722	www.groworganic.com
SC	Seeds of Change	NM	P.O. Box 15700, Santa Fe, NM 87592	1-888-762-7333, 1-800-392-2587	www.seedsofchange.com
SESE	Southern Exposure Seed Exchange	VA	P.O. Box 460, Mineral, VA 23117	(540) 894-9480, (540) 894-9481	www.southernexposrue.com
SO	Sow Organic Seed	OR	P.O. Box 527, Williams, OR 97544	1-888-709-7333	www.organicseed.com
SP	Sourcepoint Organic Seeds	CO	1452 2900 Road, Hotchkiss, CO 81419	(970) 250-0951	
SSE	Seed Saver's Exchange	IA	3094 North Winn Road, Decorah, IA 52101	(563) 382-5990, (563) 382-5872	www.seedsavers.org
T	Territorial Seed Company	OR	P.O. Box 158, Cottage Grove, OR 97424	1-800-626-0866, 1-888-657-3131	www.territorialseed.com
TT	Turtle Tree Seed	NY	Camphill Village, Copake, NY 12516	1-888-516-7797, 1-678-202-1351	www.turtletreeseed.com

Appendix D. Las Cruces precipitation and mean temperature records, 2002–2006.

	2002	2003	2004	2005	2006
	----------in.----------				
January	0.37	0.00	0.28	0.90	0.02
February	0.92	1.68	0.01	2.55	0.16
March	0.00	0.08	1.22	0.15	0.00
April	0.00	0.00	1.85	0.23	0.04
May	0.10	0.00	0.08	0.52	0.36
June	0.01	1.15	1.53	0.00	0.23
July	1.90	0.65	0.47	0.45	1.28
August	1.45	0.79	2.93	1.38	5.01
September	0.22	0.23	1.76	3.11	4.39
October	1.07	0.23	1.25	1.57	2.40
November	0.02	0.70	1.38	0.00	0.17
December	1.56	0.00	0.39	0.00	0.12
Total in.	**7.62**	**5.51**	**13.15**	**10.86**	**14.18**

	2002	2003	2004	2005	2006
	----------degrees Fahrenheit----------				
Avg. Max.	78.39	79.40	76.18	77.17	77.94
Avg. Min	48.29	48.97	48.04	48.55	48.78
Average	63.34	64.19	62.11	63.13	63.36

	Jan	Feb	Mar	Apr	May	Jun
Average Max	61.23	61.15	69.72	79.23	87.55	94.11
Average Min	31.32	33.69	39.76	46.92	54.74	64.41

	Jul	Aug	Sep	Oct	Nov	Dec
Average Max	96.16	92.36	87.83	77.75	67.16	57.84
Average Max	69.41	67.24	60.63	49.46	36.77	28.26