Sustainable Agriculture Research and Education
Farmer / Grower Grant # AFNE96-146

Alternative Rotations for Vegetable Crops
1996 Final Report

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Farmer's Alternative Resources and Marketing Co-op

Sustainable Agriculture Research and Education Program

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Northeast Region Sustainable Agriculture Research and Education Program

#AFNE-96-146

Project Title: Alternative Rotation System for Vegetables
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GOALS OF PROJECT

We are demonstrating an alternative rotation system for growing vegetables on hilly land by comparing a conventional farming plan and practices , with a more sustainable approach. This is the fourth year's growing season of a long term seven year demonstration project.

The original USDA Soil Conservation Plan approved for our vegetable farm required a seven year crop rotation, with vegetables grown only one year per "strip" in the cycle. This project used a more sustainable approach. An alternative, acceptable plan has been practiced using a four year crop rotation cycle, with vegetables grown in 3 out of 4 years. Over the full cycle, this yielded an average of $848 more per acre profit in the sustainable fields versus the conventional fields.

Our sustainable approach uses conservation tillage, reduced use of herbicides and pesticides, living green mulches, integrated pest management, and narrower field strips to reduce costs as well as reducing the loss of top soil. After four years we have been successful in demonstrating both increased economical benefits, and reduced soil loss.

With assistance from the Cooperative Extension Service, the Soil Conservation Service, and the Conservation District we have developed an acceptable alternative that was continued through the fourth year's rotation in order to demonstrate long term results. We were originally funded as the only "farmer" generated and written proposal funded through the Northeast's S.A.R.E. Program for 1993, '94, and '95.

Goals:

#1. To monitor and compare yields between conventional and sustainable practices for peppers, sweet corn, pumpkins, hay and small grain.

#2. To reduce soil loss using alternative sustainable practices of tilling, and various mulches.

UPDATE ON FARMING OPERATION

Our family owns and operates a full-time vegetable farm and greenhouse operation on 148 acres in Southwestern Pennsylvania. Both my father and brother farm full time, while I limit my time to full-time during the growing season. My mother, as well as my wife, sister-in-law, children, sisters, and nieces all work in various aspects of the farm from the greenhouse, to cultivating, harvesting, packing, sales, and farmers markets.

The sustainable practices we use are gradually being integrated within our entire farming operation. In 1997, part of the farm will be certified for organic production.

The 4 year rotation cycle, instead of a seven year cycle, is essential to our remaining viable as vegetable farmers. To move to a seven year rotation would have required us to grow corn, hay, and small grains as major crops, instead of vegetables.

On what are comparatively steep slopes, we raise sweet corn, tomatoes, peppers, pumpkins, squash, watermelons, cantaloupe, eggplant, beans, Indian corn, and various other vegetables for wholesale and retail farmer's markets. For this project we continued to monitor soil loss, accurately record all production costs, and record income from yields. We have made a seven year economic projection of the benefits from the sustainably farmed vs. conventionally farmed strips. We also became more involved in the " Integrated Pest Management" program for sweet corn and peppers supported by Penn State Cooperative Extension Service.

COOPERATORS

Cooperators included a farmer in Southern Indiana, who also farms sustainably, and provided direct contact with Purdue Extention staff. Also assisting were Steve Spangler from Penn State, who compiles IPM material; and Gary Stokum, from our local Conservation District Office.

This project can benefit vegetable farmers throughout the Northeast by (1) emphasizing economic outcomes from using sustainable practices and providing comparisons for long term input, yield, and profit results; (2) providing I.P.M. records and benefits for tracking European corn, corn earworm, and Fall armyworm and their impact in sweet corn and peppers; (3) sharing these practices with farmers and; (4) provide a means for encouraging the use of sustainable practices in developing soil conservation plans that meet goals for reduced soil erosion.

PROJECT METHODS

The established diversion ditches and a drainage system were repaired and used to measure soil loss on a hillside with 15% to 18% slope. Conventional fields are set up with the 80 ft. strips and a crop rotation cycle originally recommended in our S.C.S. soil conservation plan. This rotation uses conventional mold board plowing, overhead sprinklers for irrigation, traditional use of herbicides, fungicides and pesticides. The crop rotation includes vegetables followed by a winter cover, two years of corn, small grain, then three years of hay. (7 Years) Because of the rotation, in this fourth year, Pumpkins, grain, and hay were the crops produced.

The sustainable fields cover a similar area, but with 36 ft. wide strips separated by 8 ft. grass-ways. Tilling practices used include mulch till, strip till, and no till depending on the crop to be planted. The rotation of row crops included peppers with trickle irrigation and a living mulch planted between rows, sweet corn, pumpkins, and then a mixed clover cover on the field left to a cover crop.

Conventional use of fertilizers, pesticides, fungicides, and herbicides continued on the conventional strips. On the sustainable strips, an integrated pest management system was followed. Maryland traps for corn earworms, a "blacklight trap" for European corn borer, and plastic pheromone traps for Fall army worm were used to monitor pests throughout the season. Pesticides were used sparingly, and only when detrimental moths are at their peak cycle. Information was sent into a statewide "IPM Hotline" which shared information across the state. (enclosed is a sample newsletter)

These ideas were also shared with Purdue University and a Midwestern SARE Project, conducting similar "IPM" trials in Indiana. Comparisons of catches with Maryland traps for corn earworm will be documented and shared this coming year.

Rainfall was exceptionally great this year, totalling nearly 6-7 inches above normal. It was monitored regularly. Sediment loss was collected and measured from the project fields.

Micro-organisms are used to build soil nutrients in the sustainable fields with use of few chemical fertilizers. Chemical fertilizer recommendations from soil tests and the Extention Service were followed in the conventional fields. Black plastic mulch, with trickle irrigation was used on conventional crops. Trickle irrigation under a biodegradable (hay) mulch was used on sustainable row crops. A Living mulch was be planted between pepper rows in the sustainable fields.

SITE INFORMATION, ECONOMIC FINDINGS, AND RESULTS

Goal #1: Comparison of Sustainable Practices versus Conventional

On a relative basis, 1996 was a good growing year. Rainfall and length of season were above average. Perhaps the most valuable lesson learned was the need for accuracy, and coordination in keeping records of tilling practices, production, harvesting, "off farm" inputs, and labor costs. Rotation of fields, and crops produced greatly effects the outcome.(CHART 5)

Over the four years studied to date, we see a total per acre profit of $5,122 for a conventional fields ($1,280/acre/year) versus a per acre profit of $6,521 ($1,630/acre/year) for a sustainable field. This profit definitely depends on the specific crops to be planted.

When estimated over a full seven year rotation, an even bigger difference becomes apparent. The conventional rotation averaged an income of $906/ acre, compared to an average yield of $1,754/ acre for the sustainable fields. This is explained in detail in CHART 6.

Records of all inputs for tilling, planting, cultivating, and harvesting were kept for project fields. Costs for all sustainable and conventional inputs are documented for comparisons. Harvest yields and income were recorded. (Please refer to CHART 2 - Pumpkins, CHART - 3 Sweet Corn, and CHART 4 - Peppers)

Another useful comparison was to compare harvested value of the various crops. For example, most local farmers see sweet corn as a prime cash crop. However, depending on the year, gross income per acre varied from an average of only $1,085 to $1,934. However, once production and harvests costs are subtracted, average net per acre profit was far less. (CHART 3)

Overall, in the conventional fields, after production costs are included, sweet corn averaged $1,063/ acre profit. Peppers on the other hand yielded an average $1,722 profit. Even more interesting was that pumpkins grossed an average $4,080 /acre with a $2,567 per acre net profit.

In the sustainable fields, net profit after production costs were subtracted was also highest for pumpkins at $2,848 per acre. The net profit of Peppers yielded 76% of this at $2,166. Sweet corn averaged $1,363 per acre profit, or only 48% the per acre income from pumpkins. (CHART 6)

Average Net Profit	Sweet Corn	Peppers	Pumpkins
Conventional	$1,063	$1,722	$2,668
Sustainable	$1,363	$2,166	$2,848

Goal #2: To reduce soil loss by using alternative sustainable practices of tilling, and mulches.

Over the four year period, both types of fields averaged a soil loss of approximately 0.18 tons per acre (6% of allowable loss). According to our conservation district, the Universal Soil loss equation allows for up to 3 tons of soil to be lost per acre. Our paractices yielded less that 6% of that allowed. Despite fluctuations each year, the differing approaches were very successful. Both of our fields far exceeded these expectations, and we successfully demonstrated an alternative that is far more economically feasible.

Diversion ditches established in 1993 were cleaned and repaired. Soil loss was monitored using practices set by representatives from the local Conservation District. These measurements were used to substantiate the conservation plan that reduced rotation for vegetables from a seven year cropping pattern, to the four year rotation using sustainable practices. Rainfall was accurately monitored and information used for resulting plan. (See CHART 7)

Of special interest, is that even in a year with heavy rainfall like we had in 1996, soil loss was much less than permitted in the Universal Soil Loss Equations set by the USDA for our overall farm conservation plan. In fact the sustainable strips almost an equal amount as the conventional strips.

It is important to remember that the sustainable fields had 8 foot rows of cover separating 36 foot wide strips, while the conventional plan called for their strips to be 80 feet wide. Just as significant is that the less fields are tilled, the more soil that is saved, and the less compaction occurs.

Construction of the diversion collection system itself disturbed a significant amount of ground, and created difficulty in establishing cover crops the first year. In fact, once cover strips were established, the sustainable field area lost an average of 0.143 tons/ acre versus the 0.290 tons of soil lost the first year. The average for conventional fields drop to 0.15 tons per acre if the first year is disregarded.

ADDITIONAL RESULTS

Integrated pest management included monitoring of traps for European corn borer, corn earworm, and fall armyworm. This information was shared through Penn State's IPM program, as well as transferred to a "sister" IPM project. In 1997, we expect to make a comparison of IPM field trial results from the Purdue University collections in Indiana, with our results from Penn State University. Information was sent to Penn State's IPM program for conclusions, recommendations, and distribution.

NEXT STEPS

Practical implications of these field tests include generalization to full farm production in many ways.

We have already begun to implement the rotation identified through this demonstration. In fact, we are experimenting with living mulches between rows for other crops such as tomatoes. A self-propelled "in-row" mower is now used across the farm to control weeds, and retain moisture. The chisel plow has also now become one of our primary ways to till the soil. IPM practices have lead to a reduced use of pesticides, and we are using BT, and natural predators more extensively. For 1996, approximately 5 acres used for the project will be included in organic production as certified by the recently established "PA. Certified Organic" Association.

OUTREACH AND CONTACT WITH OTHER PRODUCERS

Key aspects of our S.A.R.E. Farmer / Grower Grant were shared with the Agricultural Awareness Foundation, Penna. Assoc. for Sustainable Agriculture, and the Pa. Dept. of Agriculture's Sustainable Ag. Board for publication through their newsletters.

Information compiled from the I.P.M. portion of this project was shared weekly during the growing season through the Penn State I.P.M. hotline and newsletter. In addition, in 1997, we plan to present results and slides at a field day with a vegetable producer in Southern Indiana who will be doing similar trappings for corn earworms. Our information will be shared through them with Penn State University and Purdue University's Program staff.

We were selected by the Penna. Sustainable Agri. Assoc. as a demonstration farm for 1995. We will have a summary of project results presented in their statewide newsletter "Passages". We have already received coverage in the " American Vegetable Grower" magazine, and plan a follow-up article next year.

We plan to have a project summary printed in the newsletters of the Conservation District, the Cooperative Extention Service, and the statewide magazine "Resources" of the Pennsylvania Association of Conservation Districts.

A summary presentation of the S.A.R.E Project #ANE 92.11 was made in 1993, 1994, and 1995 at the Penna. Sustainable Agri. Assoc. Annual Conference attende by 600 people. Another presentation was made at the 1995 Northeast S.A.R.E. Conference in New Jersey. Similar presentations will be made as appropriate in 1996/97. (See enclosed slides)

Farmer/Grower Grants - 1996

Actual Rebudgeted Worksheet

Project title: Alternative Rotation System for Vegetables

Project Leader: Allen G. Matthews Telephone: 412+632-3352

1. Personnel	Grant Funds	Non-federal Matching Funds	Other Federal Cont.
A. Participants			
Coordinator's Time Growing, recording, writing, presenting.	$1000	$1,271	
Conservation Staff		$480	
S.C.S. Staff			$250
B. Other Hired labor			
Volunteer with Conservation District		$560	
Data Collection & Reports	$800		
Field labor		$1,920	
2. Other Items			
A. Supplies			
Pepper plants, covers, pumpkin seed, sweet corn fertilizers, sprays, mulches Pheromones, etc.	$200	$693	
Computer, copies, mail rent, etc.	$180	$800	
B. Travel			
Conferences & travel	$480	$444	
C.Lease of Land & Equip.			
Farm Machinery for project		$1,745	
Irrigation Equipment		$480	
Acreage		$250	
D. Equipment Purchases			
Solar Battery for I.P.M. Blacklight trap, additional Maryland trap, Pheromone supplies, Slides	$200	$400	
E. Outreach			
Reports and Handouts	$100	$240	
F. Miscellaneous			
Total Grant Funds	$2,960		
Total Matching Contributions		$9,291	$250

Attachments

S.A.R.E. PROJECT — 1996: YEAR # 4

F.A.R.M. CORP., INC. — SOIL TYPE: CULLEOKA COMPLEX

15% TO 18% GRADE — DORMONT SILT LOAM

SIDE A CONVENTIONAL — SIDE B SUSTAINABLE

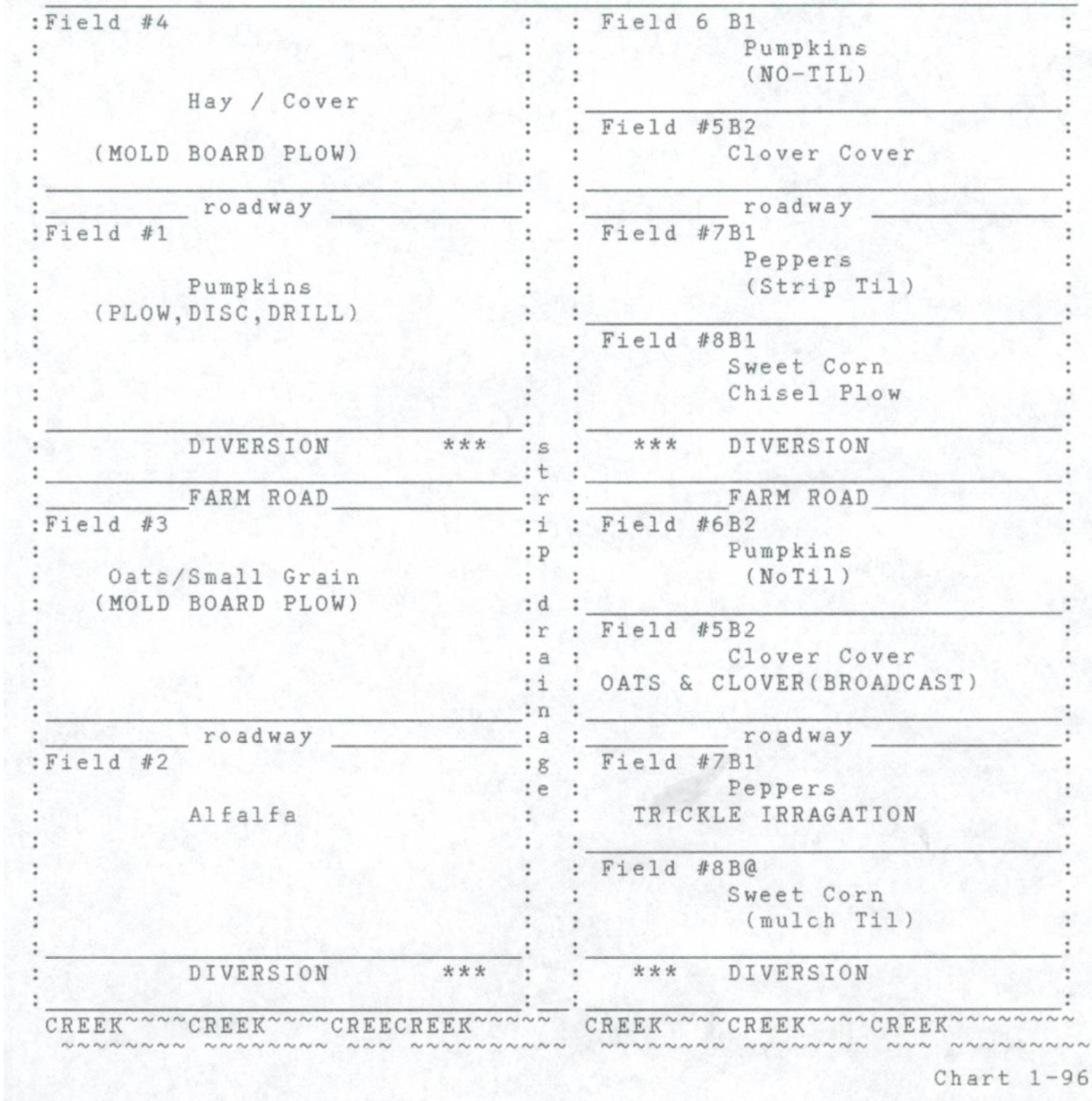

Chart 1-96

Pumpkin Production 1996

PROJECT COSTS	PROJECT COST CONVENTIONAL	PROJECT COST SUSTAINABLE	PER ACRE CONVENT	PER ACRE SUSTAIN.
TONAGE	10,880	8,900	34000	32930
VALUE	$1,305.60	$1,068.00	$4,080.00	$3,951.60
SEED	$30.58	$24.80	$95.56	$91.76
PLANTING/CULTIVATION	$148.00	$60.25	$462.50	$222.93
FERTILIZER	$27.80	$14.04	$86.88	$51.95
SPRAYS/CHEM.	$42.73	$18.04	$133.53	$66.75
HARVEST	$144.00	$102.00	$450.00	$377.40
TRANSPORT	$91.00	$77.42	$284.38	$286.45
PRODUCT COST	$484.11	$296.55	$1,512.84	$1,097.24
PROFIT(LOSS)	$821.49	$771.45	$2,567.16	$2,854.37

COSTS = 1097.24

PER ACRE VALUE	Conventional $2,567.16	Sustainable $2,854.37 for 1996

Averages from pumpkin harvests from 93 to 96 were used for purpose of projecting yields over course of the project, and for 7 year projections.

Chart 2/96

SWEETCORN

PROJECT COSTS	SUSTAIN.	PER ACRE SUSTAIN.
YIELD VALUE	$465.00	$1,934.40
SEEDING	$10.29	$42.81
CULT/PLANT	$60.00	$249.60
FERTILIZER	$20.30	$84.45
SPRAY/CHEM.	$13.80	$57.41
HARVEST	$17.92	$74.53
TRANSPORT	$15.00	$62.40
TOTAL COST	$137.31	$571.20
PROFIT(LOSS)	$327.69	$1,363.20

PER ACRE VALUE $1,363.20

Chart 3-96

PRODUCTION RECORD Sweet Corn

SARE 96

DATE	SUST FLDS AMT.	SUST FLDS EQUIV /Acre	SUST TIME MIN	SUST TIME EQUIV /Acre
8/25/96	1080	4493	95	395.2
8/30/96	1152	4792	120	499.2
		0		0
Subtotal	2232	9285	215	894
Total Value	$465.00	$1,934.40	$17.92	$74.53

Chart C96

S.A.R.E. PROJECT CROP ROTATION 1996

CONVENTIONAL FIELDS

SEVEN YEARS OF ROTATION

fields	1	2	3	4	5	6	7
3	PUMPKINS	CORN	CORN	GRAIN	HAY	HAY	HAY
2	PEPPERS	PUMPKINS	CORN	HAY	HAY	HAY	CORN
1	HAY	HAY	HAY	PUMPKINS	CORN	CORN	GRAIN
4	CORN	PEPPERS	GRAIN	HAY	HAY	HAY	CORN

(FOR PROJECT, PUMPKINS WERE ACCEPTABLE IN FIELD 2 VS. CORN)

SUSTAINABLE FIELDS

FOUR YEARS OF ROTATION

fields	1	2	3	4	5	6	7
5	PUMPKINS	CORN	PEPPERS	COVER	PUMPKINS	CORN	PEPPERS
6	CORN	PEPPERS	COVER	PUMPKINS	CORN	PEPPERS	COVER
7	COVER	PUMPKINS	CORN	PEPPERS	COVER	PUMPKINS	CORN
8	PEPPERS	COVER	PUMPKINS	CORN	PEPPERS	COVER	PUMPKINS

Chart 5-96

Pepper Production Average 93 - 96

	CONVENTIONAL PROJECT VALUES (3 years)	SUSTAINABLE PROJECT VALUES (4 years)	PER ACRE SUSTAIN.	ADJUSTED CONVENT. PER ACRE
YIELD	$874.25	$1,396.00	$5,081.44	$5,378.04
SEED/PLANTS	$150.65	$254.75	$927.29	$927.35
IRRAG/CULT	$286.00	$190.00	$691.60	$1,031.00
FERTILIZER	$26.75	$16.50	$60.06	$164.56
SPRAY/CHEM.	$52.40	$7.68	$27.96	$322.34
HARVEST	$183.75	$290.00	$1,055.60	$1,130.36
MULCH	$22.00	$42.00	$152.88	$80.00
TOTAL COST	$721.55	$800.93	$2,915.39	$3,655.61
PROFIT/LOSS	$152.70	$595.07	$2,166.05	$1,722.43

ADJUSTMENT PER ACRE	CONVENTIONAL	SUSTAINABLE
VALUE	$1,722.43	$2,166.05

Note:
In 1996, we had an exceptional amount of rain which helped Production. Aveages are taken over 4 years, 1993 to 1996. Conventional peppers were planted in single rows using a Black plastic mulch, while sustainable peppers were planted in double rows using natural mulch. Newspaper was dropped as a mulch because it drained nitrogen from the soil. Adjustments were made in the table above representing an equal number of plants in each project field. Black plastic mulched fields averaged a 10% loss of plants, compared to only a 4% loss in the sustainable fields muched with hay.

Adjusting for a similar number of plants per acre per field, the conventional fields would produce from 2,374 plants out of 2,640 peppers planted

Chart 4/96

Income Projections Examples

Conventional Rotation

	PUMPKINS	CORN	CORN	GRAIN	HAY	HAY	HAY
Income	$2,668	$1,063	$1,063	$328	$406	$406	$406
/Acre	Field #1		Total =	$6,340 or $906 /Year			

Sustainable Rotation

	PUMPKINS	CORN	PEPPERS	COVER	PUMPKINS	CORN	PEPPERS
Income	$2,848	$1,363	$2,166	$144	$2,848	$1,363	$2,166
/Acre	Field #5		Total =	$12,898 or $1,842 / Year			

	PEPPERS	COVER	PUMPKINS	CORN	PEPPERS	COVER	PUMPKINS
Income	$2,166	$144	$2,848	$1,363	$2,166	$144	$2,848
/Acre	Field #8		Total =	$11,679 or $1,668 / Year			

Over the Full seven years rotation, using income from pumpkins the 4 Year sustainable rotation has the potential to yield an average of $1,754 per acre versus a $906 per acre average in the 7 Year conventional rotation with little difference in erosion of top soil. Peppers or Corn yield agreater difference.

CHART 6-96

(1842+1668)/2 = 1754

1754 - 906 = 849 = additional benefit per acre per year for growing sustainable

Soil Collection
Sediment loss

Total Conventional Acres = 2.35 Acres
Total Sustainable Acres = 2.1 Acres

Collection Date 7/1/96

Conventional Upper	192 lbs
Convrntional Lower	181 lbs
Conventional Total	373 lbs
Sustainable Upper	192 lbs
Sustainable Lower	144 lbs
Sustainable Total	336 lbs

Collection Date 11/4/96

Conventional Upper	198 lbs
Conventional Lower	154 lbs
Conventional Total	352 lbs
Sustainable Upper	168 lbs
Sustainable Lower	104 lbs
Sustainable Total	272 lbs

Total 1996 Collection

Conventional Total	725 lb. total
Sustainable Total	608 lbs. total

	1993	1994	1995	1996	Average
Conventional	0.26 Tons	0.10 Tons	0.195 Tons	0.154 Tons	0.177 Tons
Sustainable	0.29 Tons	0.13 Tons	0.154 Tons	0.145 Tons	0.180 Tons

4 Year Average Per Acre
Conventional = 0.177 Tons per acre
Sustainable = 0.180 Tons per acre

Chart 7 -96