Economic Return in Production of Lettuce and Cantaloupe Is Affected by Cropping System and Management Practice

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Additional index words. cost-benefit analysis, cover crops, organic production, sustainable agriculture, vegetables

Abstract. Economic analysis compared the returns of cropping systems and management practices for production of fall lettuce (*Lactuca sativa* L.) and spring cantaloupe (*Cucumis melo*) following summer cover crops. The cover crop treatments included: cowpea [*Vigna unguiculata* (L.) Walp.] incorporated into the soil in the fall, cowpea used as mulch in the fall, sorghum sudangrass [*Sorghum bicolor* (L.) Moench] incorporated into the soil in the fall, and a bare ground control. Lettuce and cantaloupe were managed using conventional, integrated, and organic practices. The effect of each cropping system and management practice on crop yield, cost of production and net return was determined. In 1999 and 2000, yield and net return were greatest for cantaloupe and lettuce when the cowpea cover crop was incorporated into the soil before planting. The effect of crop management practice varied with type of cover crop. When lettuce was planted into cowpea-incorporated treatment in 1999, conventional management had the highest cash return followed by integrated crop management. In 2000, organically-grown lettuce after cowpea incorporated had the highest net return followed by integrated crop management grown under cowpea incorporated treatments. In 1999 and 2000, integrated cantaloupe following cowpea-incorporated treatment had the highest yield and cash-return. A 20% price premium for organic produce increased the net returns for the organic-grown lettuce and cantaloupe. Organic lettuce following cowpea-incorporated treatments produced a high net of \$2,516/ha in 1999 and \$5,971/ha in 2000. The net returns due to 20% organic premium price varied between 1999 and 2000 in cantaloupe production. They were highest for organic cantaloupe after bareground with a net return of \$4,395 in 1999 and \$3,148 in 2000 for organic cantaloupe after sudangrass.

Lettuce and cantaloupe are important components of the vegetable production systems in California. Lettuce is a cool-season crop that is planted in fall in the low desert for harvest in December. Cantaloupe is a warm-season vegetable generally planted in March for a June harvest. Weed, disease, and pest management often include methyl bromide fumigation under plastic mulch. However, due to the phase-out of methyl bromide, concerns about the effects of conventional production systems on the environment and health, and growing interests in organic produce, vegetable growers have embraced sustainable agricultural techniques (Batte et al., 1993; Bond et al., 1998; Buys, 1993; Clark et al., 1999; Liebman and Davis, 2000). In addition

to sustainable agricultural practice, vegetable growers have integrated summer cover crops and the use of compost into their production system (Creamer and Baldwin, 2000; McGiffen et al., 2000; Ngouajio and McGiffen, 2001). Many growers have begun to plant a summer cover crop before fall planted lettuce. The summer cover crops commonly used in California are sudangrass (*Sorghum bicolor*) and cowpea (*Vigna unguiculata*). The cash crop is usually managed either conventionally with synthetic fertilizers or organically with compost amendments (Ngouajio and McGiffen, 2002). The integration of summer cover crop into vegetable production systems has resulted in increased yields in both lettuce and cantaloupe (Ngouajio, unpublished data). Our goal was to determine the economic viability of different cropping systems and management practices, using summer cover crops, fall-planted lettuce, and spring-planted cantaloupe as a model for sustainable farming systems.

Materials and Methods

Field experiments were established at the

University of California Desert Station in the Coachella Valley from 1998 to 2001 to study the effect of cover crops and management practices on vegetable production. The cropping sequence was summer cover crops followed by 'Shining Star' lettuce in the fall and 'Magellan' cantaloupe in the spring. Summer cover crops were sown in July of each year and included 'Iron Clay' cowpea or 'Piper' sudangrass. Lettuce and cantaloupe were transplanted at densities of 45,000 and 15,000 plants per hectare, respectively, with two rows per bed for lettuce and one row per bed for cantaloupe.

The experiment was a split-plot with a randomized complete block design and four replications. Main plot treatments were summer cowpea used as mulch in the fall, summer cowpea incorporated into the soil in the fall, summer sudangrass incorporated into the soil in the fall, and summer fallow (bare-ground). Each main plot treatment was subdivided into three crop management practices: i) conventional (standard management practice), where synthetic fertilizer 15N–15P–15K was applied at the rate of 170 kg-ha⁻¹, ii) organic where compost (50% chicken manure and 50% yard waste) was applied and incorporated into the soil at 5 Mt-ha⁻¹, and iii) an integrated crop system (low-input system) where pesticide was only applied when insect populations reached economic threshold levels, however fertilizer used (15N–15P–15K) was the same as in conventional treatments. Main plot sizes were 12 m long × 9 m wide and consisted of six beds. Each main plot was subdivided into 4 m long × 3 m wide to accommodate the three crop management practices. To allow year-to-year buildup of treatment effects, all treatments were maintained in the same location throughout the duration of the experiment.

To maintain consistency across all crops, sprinkler irrigation was used to establish the cash crop; then drip irrigation was used for the remainder of the season. Lettuce and cantaloupe were harvested at maturity. Lettuce was harvested on 13 Dec. 1999 and 15 Dec. 2000. Cantaloupe was harvested twice on 8 and 16 June 2000; and 4 and 15 June 2001. Yield was sorted into marketable and non-marketable yield. Yield data were also subjected to analysis of variance (ANOVA) for treatment and years, and LSD separated the treatment means at $P \leq 0.05$.

Marketable yield was used to perform the partial budget analysis (Ogbuchiekwe and McGiffen, 2001) that compares the effect of cover crop treatments and crop management programs on yield, gross value, net return, and total variable cost. Gross value is the market price per box of the crop multiplied by the number of boxes harvested. The gross values of lettuce and cantaloupe were based on the average price of \$8.00/box (15.9 kg) for lettuce and \$7.70/box (18 kg) for cantaloupe (USDA, 2001). To simplify our analysis and see the effect of yield variability within years and treatments, it was assumed that prices for fresh lettuce and cantaloupe were the same for 1999 and 2000. The net return for each treatment represented total gross values less

Received for publication 10 June 2003. Accepted for publication 26 Nov. 2003. We thank Laura Tourte, Trent Teegerstrom, and Gene Miyao comments on the early version of this work. This research was partially supported by USDA's Western Region Sustainable Agriculture Research and Education program (WRSARE).

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total variable cost. Total variable costs consist of production and harvest costs. Production costs include adjusted standard desert conventional production cost, land rent and cash overhead. The production operation cost is the same in 1999 and 2000 for lettuce or cantaloupe (Table 3 and 5). Standard desert conventional production costs for leaf lettuce and cantaloupe (Mayberry et al., 1995) were adapted to reflect actual costs for the specific cover crops and crop management practices used in our experiment (e.g., labor for hoeing, fertilizer, compost and pesticide application costs). The harvest cost was adjusted to reflect the variation in crop yield for each treatment in each year. The sum total of variable costs was used to calculate the economic value of each cropping system and net return from harvesting lettuce and cantaloupe. The net return is not net profit, since net return estimates include total variable costs common to all treatments that are specific for our study (Ogbuchiekwe and McGiffen, 2001).

A sensitivity analysis was performed using organic premium prices. Sensitivity analysis identified the parameters, which, if varied slightly, changed net returns and costs (Centro Internacional de Mejoramiento de Maiz y Trigo, 1988b). Commodities that are produced organically can often be sold for a premium price of 20% more than conventionally grown produce (Brumfield et al., 1999). Therefore, the values of organically grown lettuce and cantaloupe were re-calculated using the 20% premium price since there was no published price recorded for organic grown lettuce or cantaloupe. This corresponded to \$9.60 and \$9.24 per box for cantaloupe and lettuce, respectively.

Results and Discussions

Effect of cover crop on net return. Lettuce net return in 1999 was greatest following incorporated cowpea cover crop (1,226 boxes/ha), with a net return of \$2,732/ha. The next best treatment was lettuce grown on no cover crop (bareground) with 990 boxes/ha and a net return of \$2,291/ha. The system with cowpea mulch produced 948 boxes/ha and returned \$1,662/ha. Lettuce grown after a sudangrass cover crop lost \$162 from 552 boxes/ha.

Cowpea-incorporated treatments had the highest yield, with 1,466 boxes/ha harvested in 2000 for a net return of \$3,656/ha (Table 1). Lettuce following cowpea mulch returned \$2,389 with 1137 boxes/ha. Lettuce yields in 2000 were greater than in 1999 for most treatments, and lettuce grown after sudangrass had a positive return of \$2,414 on 1,137 boxes/ha. Lettuce grown in bareground returned only \$1,610/ha due to low yield (813 boxes/ha) in 2000.

Cantaloupe grown after cowpea-incorporated treatments had the highest net return in 1999 with \$2,400/ha from 1,186/ha (Table 2). Cantaloupe after sudangrass returned \$2,126 with 1,112 boxes/ha compared to \$1,988 for cantaloupe grown in the fallow treatments. Cantaloupe grown in cowpea mulch had the lowest net return, with 691 boxes/ha and \$594/ha.

In general, cantaloupe yield in 2000 was much higher than 1999, which accounted for the higher returns obtained in the 2000. Cantaloupe grown after cowpea-incorporated treatments maintained the highest net return of \$4,354/ha with 1,714 boxes/ha. The net return on cantaloupe after sudangrass was also higher returning \$3,296/ha with 1,428 boxes/ha. Cantaloupe after bareground or cowpea mulch returned \$3,105/ha and \$1,175/ha from 1,250 and 848 boxes per ha in 2000.

Combined effect of cover crop and management practice on net return. The next analysis focuses on economic returns from the three management systems (conventional, integrated, and organic) under each cover crop system. Lettuce and cantaloupe yield data were used to calculate gross return, total variable cost and net return. Net returns from the different management practices varied greatly with year and the cover crop system.

Lettuce. In 1999, the organic system produced the lowest net return, irrespective of the prior cover crop system (Table 4). Organic lettuce production following sudangrass resulted in a net loss of \$1,983/ha. Within individual cover crop system, net returns were greatest

when lettuce was managed conventionally or by integrated management system under cowpea incorporated and mulch cover crops. The exception was observed with bareground (no cover crop) with high net return of (\$2,384/ha) obtained with the conventional management system. In 2000, however, the organic management system produced the highest net return of any cover crop system other than sudangrass (Table 3). The greatest net return of \$3,434/ha was obtained with organic lettuce in a cowpea-incorporated system. Increased in net return in the organic lettuce was due in part to greater yield compared to yield in 1999. Increase in crop yield with time has been reported during the organic transition phase (Ngouajio and McGiffen, 2002; Ngouajio et al., 2003). Lettuce grown conventionally in the system with no cover crop gained only \$24/ha in 2000, suggesting that the summer fallow system used by some growers in the Coachella Valley may not be sustainable over time.

Cantaloupe. Within individual cover crop systems, net return in production of cantaloupe was the lowest in the organic system (Table 4). This was observed in both the 1999 and 2000 growing seasons. In both years net return

Table 1. Net return from cropping system in production of fall leaf lettuce in 1999 and 2000 based upon a partial budget analysis all calculated value in (\$/ha).

Treatment	Avg yield (boxes/ha)	Gross return ^z	Total production cost ^y	Harvest cost ^x	Total variable cost ^w	Net return ^v
1999						
Cowpea incorporated	1226	9808	1988	5088	7076	2732
Cowpea mulch	948	7584	1988	3934	5922	1662
Bare-ground	990	7920	1520	4109	5629	2291
Sudan-grass	552	4416	1963	2291	4254	-162
LSD (0.05)	112	---	---	---	---	---
2000						
Cowpea incorporated	1466	11728	1988	6084	8072	3656
Cowpea mulch	1137	9096	1988	4719	6707	2389
Bare-ground	813	6504	1520	3374	4894	1610
Sudan-grass	1137	9096	1963	4719	6682	2414
LSD (0.05)	153	---	---	---	---	---

^zGross return was calculated as average price of \$8.00/ box multiply by average boxes /ha.

^yTotal production cost includes all cost for growing cover crop excluding cost of harvesting lettuce.

^xHarvest was adjusted based on number of boxes harvested per treatment multiply by \$4.15 picking cost.

^wTotal variable cost include production and harvest cost.

^vNet return was calculated as gross return minus total variable cost.

Table 2. Net return from cropping system in production of spring cantaloupe in 1999 and 2000 based upon a partial budget analysis all calculated value in (\$/ha).

Treatment	Avg yield (boxes/ha)	Gross return ^z	Total production cost ^y	Harvest cost ^x	Total variable cost ^w	Net return ^v
1999						
Cowpea incorporated	1186	9132	1988	4744	6732	2400
Sudan-grass	1112	8562	1988	4448	6436	2126
Bare-ground	948	7300	1520	3792	5312	1988
Cowpea mulch	691	5321	1963	2764	4727	594
LSD (0.05)	377	---	---	---	---	---
2000						
Cowpea incorporated	1714	13198	1988	6856	8844	4354
Sudan-grass	1428	10996	1988	5712	7700	3296
Bare-ground	1250	9625	1520	5000	6820	3105
Cowpea mulch	848	6530	1963	3392	5355	1175
LSD (0.05)	452	---	---	---	---	---

^zGross return was calculated as average price of \$7.7/box multiply by average boxes/ha.

^yTotal production cost includes all cost for growing cover crop excluding cost of harvesting cantaloupe.

^xHarvest was adjusted based on number of boxes harvested per treatment multiply by \$4 picking cost.

^wTotal variable cost include production and harvest cost.

^vNet return was calculated as gross return minus total variable cost.

Table 3. Preharvest variable costs that was common to crop management system in production of fall lettuce in 1999 and 2000 all treatment calculated values in (\$/ha).

Operation	Cowpea mulch			Cowpea incorporated			Sudangrass			Bare ground		
	CON ^z	ICM ^y	ORG ^x	CON	ICM	ORG	CON	ICM	ORG	CON	ICM	ORG
Production cost												
Stubble disc	---	---	---	20	20	20	20	20	20	---	---	---
Subsoil	---	---	---	35	35	35	35	35	35	35	35	35
Disc 2x	---	---	---	22	22	22	22	22	22	22	22	22
Landplane 2x	---	---	---	23	23	23	23	23	23	23	23	23
Border, cross check and break	16	16	16	16	16	16	16	16	16	16	16	16
Wil-Rich Chisel plow	---	---	---	15	15	15	15	15	15	15	15	15
Disc 1x	---	---	---	11	11	11	11	11	11	11	11	11
Triplane 1x	---	---	---	11	11	11	11	11	11	11	11	11
Fertilizer and chicken manure plus cost of application	76	76	45	76	76	45	76	76	45	76	76	45
List	---	---	---	14	14	14	14	14	14	14	14	14
Power mulch beds	---	---	---	30	30	30	30	30	30	30	30	30
Transplant (materials \$616 plus 52 h labor @ \$6)	928	928	928	928	928	928	928	928	928	928	928	928
Install drip and repair (system \$500 plus 10 h labor @ \$60)	560	560	560	560	560	560	560	560	560	560	560	560
Spike 2x	5	5	5	5	5	5	5	5	5	5	5	5
Hand weed 1x	105	105	105	105	105	105	105	105	105	105	105	105
Irrigation 6x	100	100	100	100	100	100	100	100	100	100	100	100
Insect control 9x (varies within treatment)	135	67	101	135	67	101	135	67	101	135	67	101
Stubble disc	0	0	0	20	20	20	20	20	20	20	20	20
Subtotal	1924	1856	1860	2124	2056	2059	2124	2056	2059	2104	2036	2039
Land rent	225	225	225	225	225	225	225	225	225	225	225	225
Cash overhead (17% subtotal cost and land rent)	365	354	354	399	388	388	399	388	388	396	384	385
Total production cost	2515	2435	2439	2748	2668	2673	2748	2668	2673	2725	2645	2649

^zCON = conventional practice.

^yICM = integrated crop management practice.

^xORG = organic practice.

for organic cantaloupe varied from \$476/ha to \$2,561/ha compared to a net return from \$723/ha to \$5,627/ha for the integrated management system and \$752/ha to \$5,534/ha for the conventional system. The highest net return was obtained when cantaloupe was grown using the integrated management system after a cowpea-incorporated cover crop. Net returns were \$5,627/ha and \$3,134/ha in 1999 and 2000, respectively. Cantaloupe production resulted in positive net return for all possible combinations of the four cover crop systems and three crop management practices.

Sensitivity analysis with organic price premium. Sensitivity analysis examined the effect of a 20% price premium increase in net returns for organic grown lettuce and cantaloupe in 1999 and 2000. In 1999, the net return from organically grown lettuce under cowpea mulch increased to \$1,730/ha, compared to a net return of \$506 using conventional pricing (Table 4). The net return from organic lettuce under the cowpea-incorporated treatment was even higher at \$2,516/ha. The net return in 2000 lettuce was much higher with the 20% organic price premium; organic lettuce under to cowpea mulch returned \$4,243/ha. The highest return due to 20% price premium was in organic lettuce grown under cowpea-incorporated treatments with \$5,971/ha compared to \$3,434 previously realized using conventional pricing. Using 20% price premium, the organic lettuce

following either sudangrass or bare-ground returned \$2,510 and \$2,566 respectively.

Net return in organic cantaloupe was also high with 20% price premium over conventional pricing in 1999. The organic cantaloupe grown under cowpea mulch gained \$1,899/ha more than previous net return of \$790/ha that used conventional pricing (Table 6). All other organic cantaloupe grown under three other cropping systems returned over \$3,500/ha in 1999. In 2000, organically grown cantaloupe was also profitable due to 20% price premium with \$1,454/ha for organic cantaloupe under cowpea mulch, \$2,975/ha under cowpea incorporated, \$3,148/ha under sudangrass and \$2,383/ha for organic cantaloupe grown on bare ground. These results suggest that organic lettuce and cantaloupe production would be profitable with a premium price for these crops.

This study indicates that cover crop and crop management practices affect lettuce and cantaloupe yield, as well as the associated net return. The system where summer cowpea cover crop is incorporated into the soil prior to lettuce planting in the fall followed by cantaloupe planting in the spring produced the greatest yield and net return. Results from bare ground, sudangrass, and cowpea mulch systems varied with years. Yield in the organic lettuce system increased with time, with the greatest yield (1,586 boxes/ha) and net return (\$3,434/ha)

obtained in the cowpea-incorporated plots. For cantaloupe, the greatest returns (\$5,627/ha in 1999 and \$3,134/ha in 2000) were obtained in cowpea-incorporated plots, grown using integrated management practices. Organic lettuce production following a cowpea incorporated cover crop showed high potential, with a net return of \$3,434 without a price premium in 2000. Using the 20% price premium for organic produce, this system was even more beneficial with a net return of \$5,971.

Economic return in production of lettuce and cantaloupe in the desert area of Coachella Valley was affected by prior cover crops and in-season management system. In either case, including a summer cowpea into their production techniques could increase their economic return for both organic and conventional vegetable growers.

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Table 4. Net returns from crop management system in production of fall lettuce in 1999 and 2000 based upon a partial budget analysis of all treatment calculated values in (\$/ha).

Summer cover crop system	Crop management practice	Avg yield (boxes)	Gross return ^z	Total production cost ^y	Harvest cost ^x	Total variable cost ^w	Net return ^v	Net return ^u
1999								
Cowpea mulch	Conventional	1001	8008	2515	4154	6669	1339	1339
Cowpea mulch	ICM ^r	1076	8608	2435	4465	6900	1708	1708
Cowpea mulch	Organic	765	6120	2439	3175	5614	506	1730
Cowpea incorporated	Conventional	1406	11248	2748	5835	8583	2665	2665
Cowpea incorporated	ICM	1320	10560	2668	5478	8146	2414	2414
Cowpea incorporated	Organic	952	7616	2673	3951	6623	993	2516
Sudangrass	Conventional	795	6360	2748	3299	6047	313	313
Sudangrass	ICM	592	4736	2668	2457	5125	-389	-389
Sudangrass	Organic	179	1432	2673	743	3415	-1983	-1697
Bareground	Conventional	1327	10616	2725	5507	8232	2384	2384
Bareground	ICM	1127	9016	2645	4677	7322	1694	1694
Bareground	Organic	516	4128	2649	2141	4791	-663	163
LSD _(0.05)		296	---	---	---	---	---	---
2000								
Cowpea mulch	Conventional	1028	8224	2515	4466	6781	1443	1443
Cowpea mulch	ICM	1159	9272	2435	4810	7245	2027	2027
Cowpea mulch	Organic	1226	9808	2439	5088	7527	2281	4243
Cowpea incorporated	Conventional	1427	11416	2748	5922	8670	2746	2746
Cowpea incorporated	ICM	1387	11096	2668	5756	8425	2671	2671
Cowpea incorporated	Organic	1586	12688	2673	6582	9254	3434	5971
Sudangrass	Conventional	1196	9568	2748	4963	7711	1857	1857
Sudangrass	ICM	1265	10120	2668	5250	7918	2202	2202
Sudangrass	Organic	951	7608	2673	3947	6619	989	2510
Bareground	Conventional	714	5712	2725	2963	5688	24	24
Bareground	ICM	769	6152	2645	3191	5836	316	316
Bareground	Organic	957	7656	2649	3972	6621	1035	2566
LSD _(0.05)		275	---	---	---	---	---	---

^zGross return was calculated as average price of \$8/box multiply by average boxes /ha.

^yTotal production cost include all costs excluding harvest cost.

^xHarvest was adjusted based on number of boxes harvested per treatment multiply by \$4.15 picking cost.

^wTotal variable cost include total production and harvest cost.

^vNet return was calculated as gross return minus total variable cost.

^uNet returns calculated using 20% organic premium price.

^rICM = integrated crop management practice.

Table 5. Preharvest variable costs that was common to crop management system in production of spring cantaloupe in 1999 and 2000 all treatment calculated values in (\$/ha).

Operation	Cowpea mulch			Cowpea incorporated			Sudangrass			Bare ground		
	CON ^z	ICM ^y	ORG ^x	CON	ICM	ORG	CON	ICM	ORG	CON	ICM	ORG
Production cost												
Stubble disc 1x	0	0	0	22	22	22	22	22	22	22	22	22
Disc 2x	0	0	0	23	23	23	23	23	23	23	23	23
Spray fertilizer and chicken manure 1x @ \$22.50/27 cu ft	76	76	45	76	76	45	76	76	45	76	76	45
List and rerun beds	0	0	0	14	14	14	14	14	14	14	14	14
Transplant (materials \$308 plus 26 h labor @ \$6)	464	464	464	464	464	464	464	464	464	464	464	464
Install drip and repair (system \$500 plus 10 h labor @ \$60)	560	560	560	560	560	560	560	560	560	560	560	560
Hand weed 1x, but 2x for cowpea mulch	210	210	210	105	105	105	105	105	105	105	105	105
Pollination 1.5 hives @ \$25/hive	38	38	38	38	38	38	38	38	38	38	38	38
Irrigation 5x	117	117	117	117	117	117	117	117	117	117	117	117
Insect control 2x, except organic	30	0	0	30	0	0	30	0	0	30	0	0
Disc out beds	0	0	0	22	22	22	22	22	22	22	22	22
Subtotal	1494	1464	1433	1469	1439	1408	1469	1439	1408	1469	1439	1408
Land rent (net hectare)	225	225	225	225	225	225	225	225	225	225	225	225
Cash overhead (13% of subtotal cost and land rent)	223	220	216	220	216	212	220	216	212	220	216	212
Total production cost	1942	1908	1874	1914	1880	1845	1914	1880	1845	1914	1880	1845

^zCON = conventional practice.

^yICM = integrated crop management practice.

^xORG = organic practice.

Table 6. Net returns from crop management system in production of spring cantaloupe in 1999 and 2000 based on a partial budget analysis of all treatment calculated values in (\$/ha).

Summer cover crop system	Crop management practice	Avg yield (boxes)	Gross return ^z	Total production cost ^y	Harvest cost ^x	Total variable cost ^w	Net return ^v	Net return ^u
1999								
Cowpea mulch	Conventional	954	7346	1942	3816	5758	1588	1588
Cowpea mulch	ICM ⁱ	860	6622	1908	3440	5348	1274	1274
Cowpea mulch	Organic	720	5544	1874	2880	4754	790	1899
Cowpea incorporated	Conventional	2013	15500	1914	8052	9966	5534	5534
Cowpea incorporated	ICM	2029	15623	1880	8116	9996	5627	5627
Cowpea incorporated	Organic	1099	8462	1845	4396	6241	2221	3913
Sudangrass	Conventional	1562	12027	1914	6248	8162	3866	3866
Sudangrass	ICM	1615	12436	1880	6460	8340	4096	4096
Sudangrass	Organic	1105	8509	1845	4420	6265	2243	3945
Bareground	Conventional	1215	9356	1914	4860	6774	2582	2582
Bareground	ICM	1345	10357	1880	5380	7260	3097	3097
Bareground	Organic	1191	9171	1845	4764	6609	2561	4395
LSD _(0.05)		782	---	---	---	---	---	---
2000								
Cowpea mulch	Conventional	728	5606	1942	2912	4854	752	752
Cowpea mulch	ICM	711	5475	1908	2844	4752	723	723
Cowpea mulch	Organic	635	4890	1874	2540	4414	476	1454
Cowpea incorporated	Conventional	1284	9887	1914	5136	7050	2837	2837
Cowpea incorporated	ICM	1355	10434	1880	5420	7300	3134	3134
Cowpea incorporated	Organic	920	7084	1845	3680	5525	1559	2975
Sudangrass	Conventional	1348	10380	1914	5392	7306	3074	3074
Sudangrass	ICM	1035	7970	1880	4140	6020	1950	1950
Sudangrass	Organic	953	7338	1845	3812	5657	1681	3148
Bareground	Conventional	1099	8462	1914	4396	6310	2153	2153
Bareground	ICM	937	7215	1880	3748	5628	1587	1587
Bareground	Organic	807	6214	1845	3228	5073	1140	2383
LSD _(0.05)		652	---	---	---	---	---	---

^zGross return was calculated as average price of \$7.7/ box multiply by average boxes /ha.

^yTotal production cost include all costs excluding harvest cost.

^xHarvest was adjusted based on number of boxes harvested per treatment multiply by \$4.0 picking cost.

^wTotal variable cost include total production and harvest costs.

^vNet return was calculated as gross return minus total variable cost.

^uNet returns calculated using 20% organic premium price.

ⁱICM = integrated crop management practice.

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