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Organic farming research project report submitted to the Organic Farming Research Foundation:

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Participatory Evaluation of Organic Production System in Southwestern Louisiana

FINAL PROJECT REPORT

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Summary

Through a participatory approach, an organic production system demonstration project was established on a University of Louisiana at Lafayette (UL Lafayette) research farm in southwestern Louisiana in 2002. In the first year, four weed suppression techniques were evaluated in an organic tomato production: mechanical treatment, hay mulch, red plastic mulch, and flaming, Hay mulch applied at 25 t ha^{-1} was the most effective weed control technique compared to red plastic mulch, mechanical treatment and flaming. Weed biomass at harvest in hay mulch plots was lowered by 45, 85, and 87%, compared to flaming, red plastic mulch, and mechanical treatment, respectively. In addition to weed control, appropriate disease and insect management strategies were determined to be critical for a successful organic tomato production in southwestern Louisiana. In 2003, four weed suppression techniques: hay mulch, mechanical cultivation, Three Sisters Cropping system , and living clover mulch were demonstrated in organic corn. One organic farming field day and two instate organic farming tours were organized.

Introduction

Several researchers (Francis et al., 1990; Murray and Butler, 1994; Poudel et al., 2000) have suggested farmer participatory research methods for problem identification, research design, and implementation of research results in developing production strategies for enhancing agricultural sustainability and environmental quality. Participatory research approaches provide an opportunity for farmers, extension agents, researchers, other stakeholders in the community, and policy makers to design research projects that tend to produce management strategies that are more readily accepted by the farming communities. Participatory approaches provide mutual learning between farmers and the researchers. However, participatory research may be time-consuming and requires significant efforts from the researchers and farmers to make it successful (Poudel et al., 2000).

Participatory research approaches can significantly influence the development of production systems in areas where growers face low crop yields and a large number of production challenges. Hot, humid summers and heavy rain events are major constraints in the vegetable production region of southwestern Louisiana. Annual rainfall in this region averages 1524 mm and daytime temperatures during the growing season include a maximum of 40° C. Our objective in this project was to establish a participatory research approach in establishing an organic production demonstration system and evaluating organic production techniques with the communities, students and other stakeholders in southwestern Louisiana.

Participatory research design, implementation, and demonstration

In order to identify research issues and establish an organic farming demonstration project in southwestern Louisiana, a workshop was held on 7 August, 2001 where 70 individuals, representing the Organic Farming Association of Louisiana, extension service, UL Lafayette, Louisiana State University (LSU), and organic production industries, participated in discussions and planning. Speakers represented Georgia Organics, Louisiana Organic Association, Farmers Cooperatives, Baton Rouge Economic Development Authority, and regional producers. Several presentations were delivered including, "*Going Organic- Where the Risks Lie*", "*Fertility Management*", "*How to Market Your Organics*", and "*Biological and Botanical Control of Insect Pests*". The one-day workshop brought several issues to the table (Table 1) and helped to shape the organic farming project. Based on the discussions and suggestions from workshop participants, weed management was identified as one of the major problems in organic production systems. Weed suppression had been reported as a major challenge in other organic production systems (Daugovish et al., 1999, Poudel et al., 2002). As a result of this expressed research need, an organic farming demonstration project was designed to evaluate weed management treatments.

The organic farming research and demonstration project was established at the UL Lafayette research farm in 2002 (Figure 1). The UL Lafayette research farm, located approximately 16 miles southeast of the main campus, was established as a 600-acre Model Sustainable Agricultural Complex (MSAC), located in St. Martin Parish. At the MSAC, a number of projects are currently underway to address soil and water conservation, mitigation of non-point source pollution, management intensive grazing, dairy waste treatment and recycling, composting, and aquaculture. The selected site for the organic production system study had been maintained for more than five years with organically approved practices which included cover crops, such as crimson clover and soybeans, and avoidance of synthetic fertilizers and pesticides. The site was certified organic in crop year 2002 by the Louisiana Department of Agriculture and Forestry.

Crop production and soil and plant biomass sampling

Selected soil characteristics were ascertained at the beginning of the experiment on 19 April 2002 (Table 2). Soil samples were taken at a depth of 0 to15 cm and were analyzed for particle size by pipette (Gee and Bauder, 1986), total carbon and total nitorgen by combustion gas analysis (Pella, 1990a, b), and pH in 1:2 soil : water. Bulk density was determined using the core method (Blake and Hartge, 1986). After soil sampling, respective plots were amended with compost at a rate of 8.96 t ha^{-1} on a dry weight basis. The compost consisted of locally generated feedstocks, including sugarcane bagasse, horse manure, filter press mud, boiler ash, and haylage. Two 48.6 m x 3 m x 1.5 m-windrows were built, and the feedstocks were inoculated with Advanced Compost Systems Compost Finisher (Midwest Bio-Systems, Tampico, IL). The finisher consists of microorganisms that aid in the breakdown of carbons in the composting process. The food sources in the finisher are not genetically modified organisms. Windrows were monitored daily for temperature, moisture, and carbon dioxide levels to determine appropriate time of turning with the Aeromaster Compost Turner (Midwest Bio-Systems, Tampico, IL). A stable, finished compost was produced eight to ten weeks after inoculation.

Tomato seeds (cultivar Celebrity) were broadcast into a tray containing peat moss and vermiculite mix (50% peat moss and 50% vermiculite) on 7 March, 2002. After two weeks, seedlings were transplanted into cell packs containing equal parts peat moss and vermiculite.

Transplants were fertilized with Arbico Ion 2000 with an analysis of 10-45-10 every two weeks (Arbico, Tucson, AZ). On 25 April 2002, six-week-old seedlings were transplanted into 120 cm rows at a 60 cm spacing within rows. Tomatoes were foliar fed with a liquefied fish emulsion (Agro-K, Minneapolis, MN), with an analysis of 5-2-2 (N-P-K), at a rate of 18.7 L ha^{-1}on 6 June 2002.

Four weed suppression treatments with one replication each were established within the demonstration site: hay mulch, red plastic mulch, propane flame burning (flaming), and mechanical treatment. Each treatment plot measured 15.2 m x 6.0 m separated by a 6.0 m-border of fallowed land. Each plot consisted of five 1.2 m wide rows. Two randomly assigned plots were mulched with 1 ml-thick SRM red polyethylene mulch (Ken-Bar, Reading, MA) on 24 April 2002. Organically grown Bahia (*Paspalum notatum*) hay from the MSAC was applied to two randomly assigned plots at 25 t ha^{-1} at a 127 mm-depth before tomato transplanting. In mechanical treatment, weed control was practiced with bedding disks on a 68-horsepower Kubota tractor which cultivated soils from furrow to ridge tops. Cultivation did not include soils between plants within the rows. Last cultivation occurred prior to staking on 3 May, 2002. A hand-held propane flame burner, locally designed by MSAC staff, was directed at between-row weed populations on the following dates: 23 May, 6 June, and 18 June 2002. The flame was applied with 6.5 L of propane at a constant rate of 120 psi for 45 min in each plot.

Tomato hornworms (*Manduca quinquemaculata*) were managed with *Bacillus. thuringiensis aizawi* (Bt) (Certis, Columbia, Maryland), applied at a rate of 9.6 L ha^{-1} on 12 June 2002. Within four to five days after spraying, several hornworms were found shriveled and dying from Bt toxins throughout the plots. In an effort to control the leaf-footed bug (*Leptoglossus phyllopus*), green stinkbug (*Acrosternum hilare*), and brown stinkbug (*Euschistus servus*), diatomaceous earth (Peaceful Valley Farm, Grass Valley, CA) was applied at a rate of 24.6 kg in 410 L of water per hectare on 11 July 2002.

Drip irrigation tape (5 ml, 151.4 L per hour) was installed for all weed management practices. All tomatoes were staked on 3 May 2002 with 2.5 cm x 2.5 cm square Cypress wood stakes and secured with baling twine as needed to support the vines. Tomatoes were hand-harvested on 3rd, 5th, 9th, 18th and 23rd of July, 2002. Tomato fruits were harvested, graded (marketable fruit, secondary fruit, and damaged fruit), and weighed for yield determination from the interior of each plot to avoid any edge effect.
After tomato seedlings were transplanted, percent weed cover was estimated visually once a month. Weed populations were determined to species name. Following the final harvest of tomatoes, aboveground plant and weed biomass were collected from a 1.82 m x 1.22 m-wide area at two locations from each plot. Biomass was air-dried and then placed in a drier at 60 °C for 72 hr.

Demonstration plots were cultivated and arranged in ridged rows following the termination of the tomato crop. Crimson clover (*Trifolium incarnatum*) seeds, cultivar Dixie, were planted in October 2002 at a rate of 22.42 kg hectare to all plots including fallow land in between the plots and on headlands. Seeds were inoculated with *Rhizobium leguminosarum biovar trifolii* prior to planting.

On 16 April 2003, corn (*Zea mays*) seeds, cultivar Silver Queen, were directly sown into all plots at a rate of two seed every 30 cm with a row to row distance of 1.2 m. Four weed suppression treatments with one replication were established within the demonstration site: hay mulch, living clover mulch, Three Sisters cropping system and mechanical treatment. Each demonstration plot measured 15.2 m x 6.0 m separated by a 6.0 m-border of fallowed land. Each plot consisted of five 1.2 m wide rows. Organically grown Bahia (*Paspalum notatum*) hay from the MSAC was applied to two randomly assigned plots at 25 t ha^{-1} at a 127 mm depth prior to direct seeding. In the living clover mulch treatments, a 12" wide swath in the row ridge tops was cleared with a string trimmer prior to planting. The corn seed were essentially planted in a no-till arrangement. The term "Three Sisters" referred to the companion planting of corn, beans and squash and was primarily used by Native Americans throughout North America. Corn provided support for the beans to climb. Beans were a source of fertility and the squash provided a living mulch for weed control. Squash (*Cucurbita pepo*), cultivar Zuchini Elite seeds and pole bean (*Phaselous vulgaris*) cultivar Kentucky Blue Pole seeds were direct seeded on May 5 2003. Three squash seeds were planted every 1.82 m on each side alternating sides of the ridge. Three bean seeds planted collectively and equidistantly between corn plants. In the mechanical treatment, weed control was practiced with bedding disks on a 68-horsepower Kubota tractor that cultivated soils from furrow to ridge top until layby. Two soil tensiometers, 30.48 cm long, were installed in each plot to monitor soil water potential during the growing season.

At seeding, soil was treated with Hytech liquefied fish fertilizer (Agro-K, Minneapolis MN) 5-2-2 at a rate of 9.3 L per hectare and Zinc Dextro-Lac (Agro-K, Minneapolis MN) micronutrients at a rate of 1.17 L per hectare. On 16 May 2003, Symspray 10X (Agro-K, Minneapolis MN) 0.5 % calcium was foliar applied at a rate of 1 L per hectare. In the same tank mix, Hytech liquefied fish fertilizer at 9.3 L per hectare and Vigor Cal (Agro-K, Minneapolis, MN) 5.0% calcium at 5.6 L per hectare were added. At the green silk stage, the following products were foliar applied: Agro-Best Potassium (Agro-K, Minneapolis, MN) 6% soluble potash at 9.3 L per hectare, Vigor-Cal, and Manganese (Agro-K, Minneapolis, MN) 5.0% Manganese at 2.8 L per hectare.

Insect pests observed on corn crop included the *Spodoptera frugiperda* (army worm), *Diabrotica undecimpunctata howardi* (spotted cucumber beetle), *Euschistus servus* (brown stinkbug), *Acrosternum hilare* (green stinkbug), *Philaenus spumarius* (spittle bug), *Heliothis zea* (corn earworm), and *Aceratagallia sanguinolenta* (clover leafhopper). Beneficial organisms observed included immature and mature stages of *Hippodamia convergens* (ladybugs) and a variety of spiders. Insect pests pressure was high and very difficult to manage due to daily rainfalls. However attempts were made by spraying Pyganic ED on 23 May 2003 and 16 June 2003.

Weed suppression effects

In tomato crop, percent weed cover varied greatly among the four weed management techniques (Table 3). Percent weed cover in hay mulch and flaming treatments was consistently less than 30% throughout the growing season, while weed pressure in the red plastic mulch and mechanical cultivation treatments was as high as 90% toward the end of the cropping season. Several major weed species, including crabgrass (*Digitaria sanguinalis*), yellow nutsedge (*Cyperus esculentus*), smell melon (*Cucumis melo* var. *dudaim*), tall morning glory (*Ipomoea purpurea*), spotted spurge (*Euphorbia maculata*), bermuda grass (*Cynodon dactylon*), spiny buttercup (*Ranunculus muricatus*), curly dock (*Rumex crispus*), common purslane (*Portulaca oleracea*), and white clover (*Trifolium repens*), were identified in the research plots. These weeds are commonly found in both cultivated and uncultivated fields of southern U.S. Coastal Plains (LSU, 1969). The higher weed populations in the red plastic mulch and mechanical treatment (Table 2) were reflected in the greater amount of aboveground weed biomass at harvest in these treatments (Table 4). Weed suppression was greater in the hay mulch treatment, where significantly lower aboveground weed biomass developed compared to plastic mulch or mechanical treatment. Schonbeck (1998) also reported excellent weed suppression with hay mulch in tomato plots, and Shonbeck and Evanylo (1998) reported a positive impact of hay mulch on soil organic carbon and nitrogen. In this study, hay mulch-treated plots had a significantly higher amount of aboveground tomato plant biomass at harvest compared to red plastic mulch, flaming, and mechanical treatment (Table 4). Because there were greater aboveground tomato plant biomass at harvest in the hay mulched plots, we expect that additional nutrients from hay mulch may enhance plant growth as well as suppressing weeds.

Studies have indicated that red mulch increases soil temperatures by 4-6 ^{O} F and improves field grown tomato yields (Kasperbauer and Hunt, 1998).

In corn crop, several weed species were identified in all plots including crabgrass (*Digitaria* s*anguinalis*), yellow nutsedge (*Cyperus esculentus*), smell melon (*Cucumis melo* var. *dudaim*), tall morning glory (*Ipomoea purpurea*), spotted spurge (*Euphorbia maculata*), bermuda grass (*Cynodon dactylon*), spiny buttercup (*Ranunculus muricatus*), curly dock (*Rumex crispus*), common purslane (*Portulaca oleracea*), and white clover (*Trifolium repens*). The growing season was punctuated with many environmental conditions that highly influenced weed population and the effect of the treatments. High incidence and amounts of rainfall were the predominant factors in negating the effects of the Three Sisters planting arrangement. Planting of the squash and bean seeds was not timely to compete with the emerging weeds. To successfully compete with aggressive weeds, planting of squash and beans seeds can coincide with the planting of sweet corn. Weed suppression was equally challenging in the mechanical cultivation treatment. Due to heavy rainfall, it was virtually impossible to cultivate with equipment. In the hay plots, many corn seeds were unearthed and consumed by opossums and raccoons rooting for food under the hay. Reseeding was practiced only to have the seeds once again unearthed and consumed. It appeared that seed emergence was very slow and poor in the living clover treatment. Competition for water early on in the growing season may have influenced the overall stand.

Crop performance

There was a trend towards higher average tomato yield on red plastic or hay mulch compared to flamed or mechanically treated plots, and more than two third of tomato yield in each treatment consisted of damaged fruits (Table 5). Conventional tomato yields reported by the Louisiana State University Extension Services ranged from 22.4 – 44.8 t ha^{-1} (LSU, 1998). Tomato spotted wilt virus, southern blight (*Sclerotium rolfsii*), blossom-end-rot (physiologically induced), and gray mold (*Botritis cinerea*) were identified in this demonstration site. Green stink bug (*Acrosternum hilare*), brown stink bug (*Euschistus servus*) leaf-footed bug (*Leptoglossus phyllopus*), spotted cucumber beetle (*Diabrotica undecimpunctata howardi*), tomato fruit worm

(*Heliothis zea*), hornworm (*Manduca quinquemaculata*), and aphids (*Myzus persicae*) were observed in high numbers on tomato plants. These are common insects and diseases found in tomato crops in the southern United States (Sorensen and Baker, 1983). Natural enemies observed in the plots included immature and mature stages of *Hippodamia convergens* (ladybugs), *Chrysoperla sp* (green lacewing) and evidence of parasitized aphids (Family Aphididae, Order Hemiptera). Despite the application of organically approved treatments, insect pest pressure remained high.

There was no harvestable corn crop due to several reasons including pest and diseases, heavy rains and flooding. Weed competition was another reason for crop failure. The tensiometer readings (data not shown)were generally less negative for hay plots and were more negative for Three Sisters Cropping system plots indicating that hay mulch conserved more water while water demand for Three Sisters Cropping system was higher. The higher demand for water in Three Sisters Cropping plots is believed to be due to greater plant densities in these plots.

Role of participants in evaluation of project

On July 16, 2002, UL Lafayette hosted an Organic Farming Field Day. More than 50 people participated in the field day, including representatives of the Louisiana Organic Association, LSU, local farmers, and other stakeholders. Research plots, production/management techniques and problems encountered in the organic tomato production system were discussed with the attendees. The field day also included farmer presentations, followed by a round table discussion, where consensus was reached on the need for increased research in insect and disease management in organic tomato production (Table 6).

Organic farming tour

Participants of the previous workshop and field day expressed an interest in visiting established certified organic growers to further address the concerns and issues of organic farming in Louisiana. Two organic farmers' tours were organized to demonstrate the challenges and successes of organic farming. County agents in Louisiana and Mississippi and the certifying organic representative from the Louisiana Department of Agriculture and Forestry were sent electronic notices. These individuals forwarded this information to their interested constituents. Registration for the first tour was limited to 25 individual but because of the overwhelming response an additional bus was commissioned to accommodate all the participants.

On 26 June 2003, 43 individuals from Louisiana and Mississippi gathered at Hamilton Hall of UL Lafayette and boarded two university buses at 7:30 am for the first tour. The first stop was at the five-acre Berry Sweet Farms, 5110 Brown Rd, Ethyl, LA owned by Mr. Cliff Muller. This was an organic blueberry and blackberry farm that had both pick your own or will pick to sell. The second stop was Cranes'Run Farm in Norwood, LA owned by Gerd Oppenheim. A variety of crops were grown including tomatoes, fruit and nut trees and blueberries. The third and final stop, known as Equi-Terra was located on Muse Lane, in Clinton, LA. Paul Davidson, owner, enthusiastically demonstrated his draft horses cultivating and preparing his land for planting.

The second tour was scheduled for 9 August 2003. Eighteen participants visited two organic growers and two retail organic outlets. The first stop was Windy Wood Farms located at 81540 Hwy 1082 in Bush, LA and proudly owned by Neure Beatrous. A variety of vegetables were grown but this operation was distinct from others in that cover crops were the sole source of soil fertility. Next stop was Vintage Gardens located in the garden district at 5700 Loyola Avenue, New Orleans, LA. This operation was not only organic operation but also a horticultural therapy setting for developmentally disabled individuals. Two very unique retail operations were visited to compare volume and extent of regionally produced commodities. Eva's is a small organic foods retail outlet located at 4601 Freret Street, New Orleans, LA, that markets only regionally generated produce. The last stop in New Orleans was an enormous corporate owned retail outlet called Whole Foods, Inc. located at 5600 Magazine Street, New Orleans. Although Whole Foods exclusively markets only organic products, fresh produce is shipped in from national and international growers.

Evaluation forms were distributed at the end of the tour to collect feedback from the participants. Both tours had the same evaluation questions. The results are summarized in the same box below.

Box 1. Frequent responses from Organic Farming Tour participants, June 26 and August 7, 2003.

1. Participants observed following organic farming practices: small farm operation, cover cropping, raised beds, plastic mulch for weed control, trap crops, crop rotation, organic fertilizer such as crab meal, horse powered gardening, no-till, organic pesticides, efficient landuse, livestock integration, direct sales, retail and wholesale, non-use of inorganic fertilizers and pesticides, mechanical pest control, green manuring, composting, deep tilling, market evaluation, and the practice of you pick them.
2. Participants listed following practices in response to the question what was most applicable to your operations: pest and disease control, knowledge of organic fertilizers and pesticides, new varieties, crop rotations, plant and pick, cover crops, trap crops, and deep tilling to control weeds and improve soil.
3. In response to a question do you feel your perceptions about organic farming has changed, 78% responded "Yes" and remaining 22% responded "No". Some of the responses from those who responded "yes" were as follows: "I need to fertilize more and attack pests more, and have more soil amendments", "I have always believed on organic gardening", "Everytime I view organic farming with my own two eyes, it makes me more of a believer", "I think organic fertilizers make the movement easier to maintain", "Yes, it has changed, especially in gaining more information on how to control insects", and "I became more informed and educated on organic gardening".
4. In response to a question would you like to visit other organic operation, 91% said "yes". The following are the operations that the tour participants wanted to visit: organic herb and lettuce production; organic farms where composts are produced; retail organic operations; larger organic operations, harvesting/handling techniques, packaging for sale or shipping; organic animal production, and free range organic chicken production.
5. Do you feel networking with other organic farmers is beneficial? Everybody say "yes", and many of them mentioned that it is crucial for the success of organic farming. Marketing of the products, sharing ideas and inspiration were the benefits of networking emphasized by some participants.

Conclusions

Organic crop production in southwestern Louisiana presents a tremendous challenge due to the hot, humid climate, high incidence of many diseases and pests, and frequent rainstorms during cropping season that can damage crops. Specific needs identified through this research for successful organic crop production in southwestern Louisiana include effective weed control measures, integrated insect and disease pest management techniques, and appropriate cropping sequences that may mitigate pest problems. Hay mulch was shown to provide effective weed control in organic tomato and corn production in this demonstration project. Further research on improvements in soil fertility and pest management effects from hay mulch will include an analysis of soil nutrients and weed seed bank additions from mulch applications. Design, implementation, and evaluation of organic production systems through a participatory approach is a very effective tool for including farming community problems and interests. Organic farming tours and field days appear to be very effective way of information sharing between farmers, scientists and other stakeholders.

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Table 1. 2001 UL Lafayette Organic Farming Workshop round-table responses on organic farming problems and recommended solutions in southwestern Louisiana.

Problems	Recommendations
Soil fertility	Amend soil with locally generated organic amendments and allow time for reaction. Foliar feed with OMRI approved products; Be sure to have your soil tested.
Weed management	Use living and organic mulches, flaming, minimum tillage; use the three sisters cropping system or some form of multicropping; use weeder geese but must remove geese 60 days before first harvest.
Marketing of products	Contact local Chamber of Commerce for farmers market; contact local county agent for possible venues; once certified, use organic certification label as a marketing tool
Organic certification process	Contact Louisiana Department of Agriculture and Forestry for details
Insect control	Introduce beneficial insects; use trap crops; minimize use of harsh certified organic products; encourage native beneficial insects by protecting their habitat; be able to identify insect pest so appropriate measures can be taken

Table 2. Selected soil characteristics (0-15 cm depth) at the UL Lafayette organic farming research and demonstration project organic tomato production site, 2002.

Soil property	**Value**
Sand (%)	59
Silt (%)	27
Clay (%)	13
Total C (%)	1.47
Total N (%)	0.12
pH	6.95
Bulk density (g cm^{-3})	1.33

Table 3. Average percent weed cover in flamed, red plastic mulch, hay mulch and mechanical cultivation treatments in the organic tomato production siteat the UL Lafayette organic farming research and demonstration project, 2002. (n=2)

Treatment	**Weed cover %**		
	May 17	**June 20**	**July 2**
Flaming	33	50	59
Red plastic mulch	6	70	90
Hay mulch	2	6	8
Mechanical cultivation	6	85	100

Table 4. Average aboveground weed biomass (dry weight) within red plastic mulch, flaming, hay mulch and mechanical cultivation treatments at the UL Lafayette organic farming research and demonstration project, 2002. (n=2)

Treatment	Weed biomass (t ha^{-1})	Tomato biomass (t ha^{-1})
Flaming	0.67	1.19
Red plastic mulch	2.47	1.75
Hay mulch	0.37	2.67
Mechanical	2.75	1.13

Table 5. Average tomato fruit crop yields under different weed management treatments in organic tomato production at the UL Lafayette organic farming research and demonstration project, 2002. (n=2)

Treatments	Marketable	Secondary	Damaged	Total
		$t\ ha^{-1}$		
Flaming	0.7	1.1	4.6	6.4
Red plastic mulch	1.3	1.0	7.1	9.4
Hay mulch	0.6	1.8	6.7	9.1
Mechanical	0.2	0.5	4.3	5.0

Table 6. 2002 UL Lafayette Organic Farming Field Day round-table responses on organic production evaluation recommendations and future research needs for organic farming production in southwestern Louisiana.

Recommendations For evaluation and demonstration project	Identification of future research
1. No drip tape in flaming treatment. Flaming burns drip tapes	Possibly use subterranean or flood irrigation
2. .Stakes used for support inhibited mechanical cultivation	Use determinant types of tomatoes
3. Too few commercial growers	Invite aspiring gardeners enrolled in 4-H programs
4. Stink bug and leaf footed bug population difficult to put in check	Use diatomaceous earth or wood ashes; plant trap crops such as sunflowers or purple hull peas
5. Soil deficient in nitrogen after planting	Side dress with bloodmeal or foliar feed with fish emulsion
6. No marketing outlets	Consider growing gourmet or unusual crops; develop a pick-your-own operation

Table 8. Average aboveground weed and corn biomass (dry weight) within hay mulch, living clover mulch, Three Sisters cropping system and mechanical cultivation treatments at the UL Lafayette organic farming research and demonstration project, 2003. (n=2)

Treatment	Weed biomass ($t\ ha^{-1}$)	Corn biomass ($t\ ha^{-1}$)
Hay mulch	2.49	3.67
Living clover mulch	3.95	0.86
Three Sisters	4.03	2.67
Mechanical	4.17	1.91

Figure 1. Organic Farming Research and Demonstration Plots at UL Lafayette research farm in St Martin Parish, Louisiana.