"Accelerating the Adoption and Implementation of Proven Cover Crop Technologies in Hawaii"

Project Summary

In 2006 and 2007, with funding from the Conservation Innovation Grant Program administered by USDA- Natural Resources Conservation Services, large scale demonstration cover crop plantings of at least 6 acres were established at three farm sites on the North Shore of Oahu – a prime agricultural area for the state of Hawaii. The overall goal of the project was to accelerate the adoption of the cover crop practice as a Best Management Practice (BMP) for soil conservation on Oahu farms. Two Field Days were conducted which exhibited the ability of the cover crops to stabilize soil and suppress weeds. Cover crops planted were sunn hemp (*Crotolaria juncea*), oats (*Avena sativa*), buckwheat (*Fagopyrum esculentum*), winter wheat (*Triticum aestivum*), mung beans (*Vigna radiata*), and sunn hemp planted in combination with each of the other cover crops. Field sites were cooperator farms (Pioneer Hi-Bred International, Inc., Monsanto Hawaii, and Twin Bridge Farms, Inc.) in Waialua and Haleiwa. Sunn hemp in combination with oats or in combination with buckwheat was best at suppressing weeds while sunn hemp in combination with oats provided the best protective cover for the soil from wind and rain erosion. Sunn hemp alone significantly increased the amount of soil nitrogen at Monsanto Hawaii's site while sunn hemp in combination with oats increased soil nitrogen levels significantly at Pioneer Hi-Bred's Waialua farm site. Soil organic matter was improved significantly by the combination of sunn hemp + oats at Monsanto Hawaii's Haleiwa field and by oats planted alone at Twin Bridge Farm's Waialua farm. Per acre cost for the BMP was mostly less than the standard practice of bare ground fallow which does not contribute to soil improvement or conservation.

This project was highly successful in increasing the awareness of the benefits of cover cropping and facilitating its implementation on Hawaii farms. This was verified by a survey at the second field day where 79% of participants "agreed or strongly agreed" that they will adopt cover cropping practices.

The project was also successful in accomplishing all stated deliverables which included:

1) establishing three demonstration plantings of cover crop as a means of improving soil quality and controlling soil erosion
2) conducting two publicized Field Days for two of the demonstration plantings
3) developing educational materials and reports of the project results (educational materials and reports of project results, post this information on CTAHR's sustainable Agricultural Website, and article in trade publication Agriculture Hawaii).

Project activities during the period January 1, 2007 – July 31, 2007

A second Field Day was held on January 9, 2007 from 9:00am to 12 noon at Pioneer's demonstration site (Kemoo) in Waialua, Hawaii. This second Field Day was held approximately ten weeks after planting the cover crops. The goal of this field day was to have attendees observe the ability of the different cover crops to suppress weeds and also to demonstrate the proper stage for cover crop plow down. To publicize this field day, announcements were mailed to 75 farmers in the Waialua Farmers Cooperative and government/research personnel were notified via email with the distribution assistance of Hawaii Agriculture Research Center, Hawaii Farm Bureau Federation, USDA-NRCS, University of Hawaii Cooperative Extension Service and Sustainable Agriculture Research and Education Program. This field day was also publicized in the Honolulu Advertiser's TGIF section on Friday, January 9, 2007. A total of 46 participants attended this field day, not including one student intern, project principals and assistants. A poster with pictures depicting weed suppression by the various cover crops was displayed at this field day (see attachment A). Also, a flyer that listed results of pre-plant soil nutrient analyses and summarized effectiveness of cover crops in suppressing weeds and covering the ground (vegetative cover) was distributed to all participants (see attachment B). Field day participants walked through the cover crop plots to observe differences in the ability of the various cover crops to provide weed suppression and vegetative cover. An evaluation survey was distributed at the end of the field day to obtain feedback on the information presented and the impact on their likelihood of adopting cover crop practices. Over 50% (26) of the participants were from various agencies including: NRCS, Hawaii Agriculture Research Center (HARC),

USDA, University of Hawaii (UH), Oahu Resource & Conservation Development (Oahu RC&D) and the Soil & Water Conservation District which should be considered in the results to survey question #5. Thirty-four of the participants completed the Field Day survey. This second Field Day was quite successful, based on survey results (see attachment C). Respondents were very positive about the demonstration and the information presented.

After the second field day, post-plant soil nutrient analyses (total nitrogen, pH, calcium, magnesium, phosphorus, potassium, nitrates and organic matter (total carbon)) were received from the University of Hawaii. This data was analyzed to determine if there was any significant effect of cover crops on soil nutrients as compared to the bareground fallow practice. We were unable to retrieve some of the nematode data analyses from the University of Hawaii's Agricultural Diagnostic Services Lab therefore, impact of cover crops on nematodes could not be assessed. Results of the soil nutrient analyses were summarized and included in a draft article (see attachment D) submitted on June 1, 2007 for publication in the trade magazine "Agriculture Hawaii".

A slideshow (see attached file on enclosed cd) summarizing this project was presented at Pioneer Hi-Bred International, Inc.'s conference room in Waialua, HI on June 27, 2007 at 1:00pm. All attendees at the previous field days were notified of this presentation via email or mail. A total of 30 participants attended this slide presentation. A summary of this project (attachment E) is being submitted to the University of Hawaii's Sustainable Agriculture Research and Education (SARE) program for posting on their website.

Problems or constraints

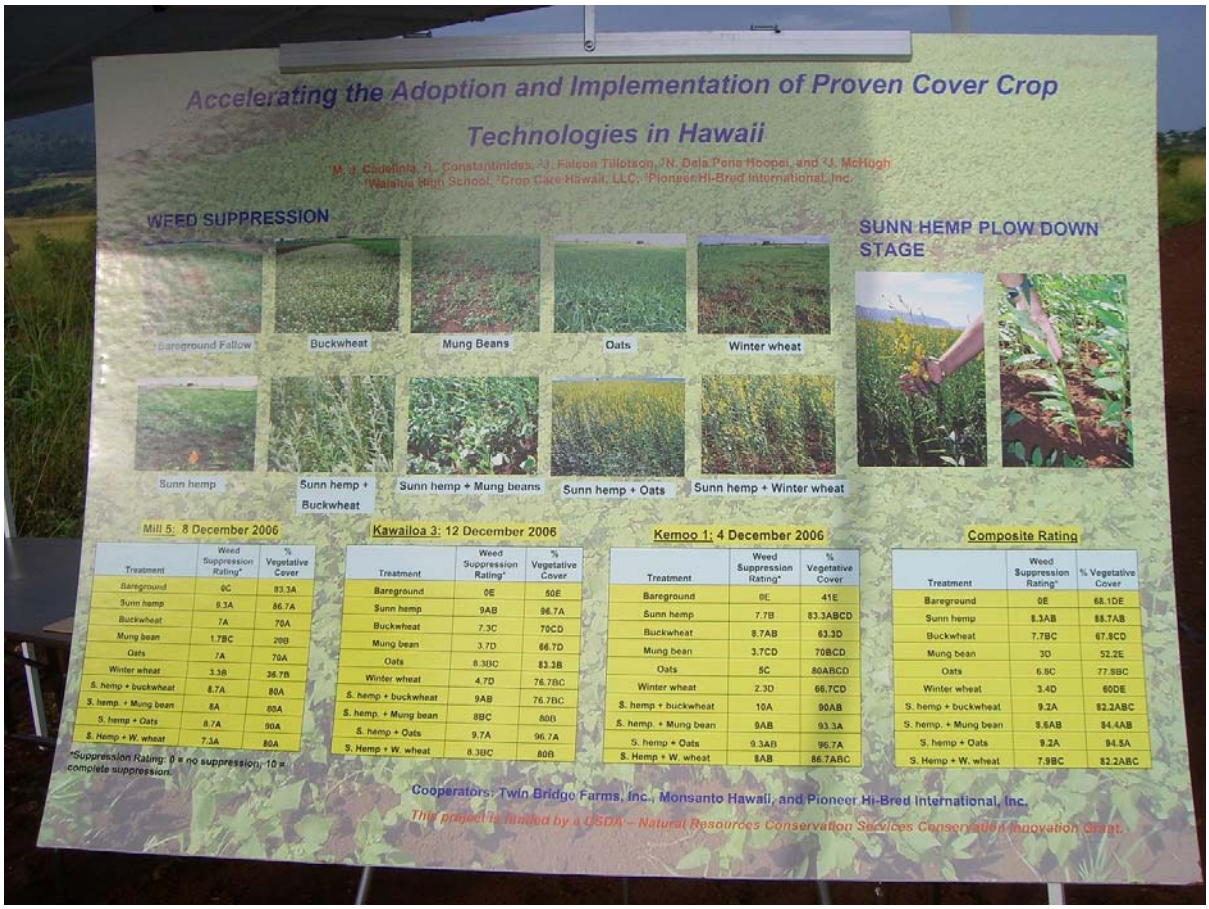
By the second half of this project, there was only one Waialua High School student remaining to assist with this project. As noted in our 6-month report this was due mainly to the current low unemployment rate in Hawaii. Despite this problem, Crop Care Hawaii, LLC was able to complete required tasks by committing more of their time to this project.

One of the main constraints to completing our data analysis was the inefficiency of the University of Hawaii's Agricultural Diagnostic Services Center. We had

submitted 6 soil samples for nematode analysis and only received 5 completed samples back. In addition, this lab was unable to process the soil samples in a timely manner. Some of the nematodes samples took over 4 months to process. This is a serious problem when considering time is of essence for farmers when they are relying on soil analyses for crop production decisions.

We have been pleasantly surprised that the lack of rainfall during the past year did not severely affect cover crop establishment and growth. However, low rainfall may have lessened the impact of cover crops on the soil nutrients. This is because adequate moisture is needed to decompose the cover crops to efficiently transfer plant nutrients to the soil. Therefore, although our soil nutrient results did show that cover crops can have significant effects on soil nitrates and organic matter, higher rainfall may have resulted in a more dramatic effect.

Attachment A
(Field Day #2 – Poster)



Attachment B
(Field Day #2 – Handout)

Accelerating the Adoption and Implementation of Proven Cover Crop Technologies in Hawaii

Field Day 2 – January 9, 2007

CURRENT PROJECT STATUS

- Kawailoa 3 and Mill 5 sites have been disked down.
- After disk down soil samples were collected from Mill 5 site for nematodes, soil fertility and chemistry, and soil organic matter.
- Mill 5 site planted to seed corn as of 2 January 2007.
- Kawailoa 3 site to be sampled on Wednesday, 10 January 2007 for nematodes, soil fertility and chemistry, and soil organic matter.
- Kemoo 1 site to be disked down as soon as possible. Minimum of 2 weeks after disk down until soil is sampled.

THE USE OF COVER CROPS FOR WEED SUPPRESSION AND GROUND COVER

CIG Cover Crop Project - Weed Suppression Rating

Mill 5 **Date Rated: 8 Dec 2006**

Treatment	Suppression Rating*	% Vegetative Cover
S. Hemp + Oats	8.7A	90A
S. Hemp + Buckwheat	8.7A	80A
Sunn Hemp	8.3A	86.7A
S. Hemp. + Mung Bean	8A	80A
S. Hemp. + W. Wheat	7.3A	80A
Oats	7A	70A
Buckwheat	7A	70A
Winter Wheat	3.3B	36.7B
Mung Bean	1.7BC	20B
Bareground	0C	83.3A
F=	**14.89**	**7.94**
P=	**0.0000**	**0.0001**

Suppression Rating: **0 = no suppression, 10 = complete suppression.**

CIG Cover Crop Project - Weed Suppression Rating

Kawailoa 3 **Date Rated: 6 Dec 2006**

Treatment	Suppression Rating*	% Vegetative Cover
S. Hemp + Oats	9.7A	96.7A
Sunn Hemp	9AB	96.7A
S. Hemp + Buckwheat	9AB	76.7BC
Oats	8.3BC	83.3B
S. Hemp. + W. Wheat	8.3BC	80B
S. Hemp. + Mung Bean	8BC	80B
Buckwheat	7.3C	70CD
Winter Wheat	4.7D	76.7BC
Mung Bean	3.7D	66.7D
Bareground	0E	50E
F=	**70.78**	**28.54**
P=	**0.0000**	**0.0000**

CIG Cover Crop Project - Weed Suppression Rating

Kemoo 1 **Date Rated: 4 Dec 2006**

Treatment	Suppression Rating*	% Vegetative Cover
S. Hemp + Buckwheat	10A	90AB
S. Hemp + Oats	9.3AB	96.7A
S. Hemp. + Mung Bean	9AB	93.3A
Buckwheat	8.7AB	63.3D
S. Hemp. + W. Wheat	8AB	86.7ABC
Sunn Hemp	7.7B	83.3ABCD
Oats	5C	80ABCD
Mung Bean	3.7CD	70BCD
Winter Wheat	2.3D	66.7CD
Bareground	0E	41E
F=	**24.10**	**5.85**
P=	**0.0000**	**0.0005**

CIG Cover Crop Project - Weed Suppression Rating

Pooled Data

Treatment	Suppression Rating*	% Vegetative Cover
S. Hemp + Oats	9.2A	94.5A
S. Hemp + Buckwheat	9.2A	82.2ABC
S. Hemp. + Mung Bean	8.6AB	84.4AB
Sunn Hemp	8.3AB	88.7AB
S. hemp. + W. Wheat	7.9BC	82.2ABC
Buckwheat	7.7BC	67.8CD
Oats	6.8C	77.8BC
Winter Wheat	3.4D	60DE
Mung Bean	3D	52.2E
Bareground	0E	68.1DE
F=	**62.76**	**8.18**
P=	**0.0000**	**0.0000**

Suggested Revised Planting Protocol

During drought periods the basic cover crop planting protocol (BMP) may be altered to achieve cover crop goals of soil erosion management and green manure. Suggested planting protocol revision:

1. Disk only ground that can be planted in one day.
2. Immediately follow disking with planting equipment and incorporate seed.

Additional Concerns and Considerations

1. When planting sunn hemp for on-farm seed production plant from mid-September through the end of December.
2. Decomposition of incorporated organic matter and release of N occur after soil moisture is applied.
3. Release of N from green manures can be a slow process. Not all N available immediately after disk or plow down.
4. Care should be taken that selected cover crops are not potential invasive species.

PRE-PLANT SOIL ANALYSIS

Mill 5 Pre-Plant Soil Data
Soil Type = Fill Land

Date sampled	Treatment	pH	EC	%N	%C	P (ppm)	K (ppm)	Ca (ppm)	Mg (ppm)
20-Sep-07	Bareground	7.9	0.52	0.17	4.94	110.0	663.7	7862.7	717.0
20-Sep-07	Sunn hemp	8.0	0.53	0.16	5.17	85.7	641.3	8131.3	656.0
20-Sep-07	Buckwheat	8.1	0.48	0.16	5.46	86.7	521.3	8150.7	671.3
20-Sep-07	Mung bean	8.0	0.53	0.17	5.32	101.3	555.0	8166.0	705.7
20-Sep-07	Oats	8.0	0.61	0.16	5.67	93.3	541.0	8318.0	686.0
20-Sep-07	Winter Wheat	8.0	0.55	0.16	5.98	99.7	530.0	8228.0	677.7
20-Sep-07	S. Hemp + Buckwheat	8.0	0.63	0.17	5.30	106.3	623.0	8021.3	718.0
20-Sep-07	S. Hemp + Mung Bean	8.0	0.54	0.17	5.61	104.0	554.7	8159.3	692.0
20-Sep-07	S. Hemp + Oats	8.0	0.55	0.17	4.87	128.7	630.7	7932.7	723.0
20-Sep-07	S. Hemp + W. Wheat	7.9	0.56	0.18	4.65	130.7	648.3	7901.3	711.7

Kawailoa 3 Pre-plant Soil Data
Soil Type = Lahaina Silty Clay

Date sampled	Treatment	pH	EC	%N	%C	P (ppm)	K (ppm)	Ca (ppm)	Mg (ppm)
13-Sep-07	Bareground	6.8	0.35	0.14	1.41	77.0	236.0	1537.3	556.7
13-Sep-07	Sunn Hemp	6.7	0.38	0.14	1.40	74.7	268.3	1491.3	549.0
13-Sep-07	Buckwheat	6.6	0.34	0.15	1.44	77.7	254.0	1447.0	569.3
13-Sep-07	Mung Bean	6.7	0.38	0.15	1.42	82.3	261.0	1550.0	554.0
13-Sep-07	Oats	6.7	0.38	0.14	1.40	87.0	252.3	1489.3	541.0
13-Sep-07	Winter Wheat	6.7	0.39	0.15	1.46	97.3	263.3	1588.7	564.7
13-Sep-07	S. Hemp + Buckwheat	6.8	0.31	0.15	1.51	95.0	292.3	1592.7	567.0
13-Sep-07	S. Hemp + Mung bean	6.8	0.41	0.14	1.39	99.3	246.0	1500.3	572.7
13-Sep-07	S. Hemp + Oats	6.5	0.32	0.14	1.42	83.0	265.3	1358.7	564.0
13-Sep-07	S. Hemp + W. Wheat	6.7	0.41	0.14	1.41	94.3	282.3	1561.7	536.3

Kemoo 1 Pre-plant Soil Data
Soil Type = Ewa Silty Clay Loam

Date sampled	Treatment	pH	EC	%N	%C	P (ppm)	K (ppm)	Ca (ppm)	Mg (ppm)
27-Sep-06	Bareground	6.4	0.32	0.13	1.49	135.3	295.7	1331.7	415.3
27-Sep-06	Sunn hemp	6.3	0.28	0.13	1.45	106.0	252.7	1181.3	419.0
27-Sep-06	Buckwheat	6.4	0.28	0.13	1.50	120.0	269.7	1337.3	430.7
27-Sep-06	Mung bean	6.4	0.30	0.14	1.47	121.7	262.3	1319.3	430.3
27-Sep-06	Oats	6.4	0.29	0.14	1.52	146.7	308.7	1386.0	440.0
27-Sep-06	Winter Wheat	6.6	0.32	0.13	1.50	90.7	277.3	1570.0	442.3
27-Sep-06	S. Hemp + Buckwheat	6.5	0.31	0.14	1.48	108.3	245.7	1390.0	420.3
27-Sep-06	S. Hemp + Mung Bean	6.7	0.33	0.13	1.50	83.3	240.3	1234.5	437.7
27-Sep-06	S. Hemp + Oats	6.5	0.28	0.13	1.43	133.0	276.3	1437.0	419.0
27-Sep-06	S. Hemp + W. Wheat	6.3	0.35	0.13	1.48	127.7	290.3	1304.0	438.0

WHO CAN I CALL IF I HAVE ANY OTHER QUESTIONS?

John McHugh (808) 341-0230
Lynne Constantinides (808) 265-2936

This project is funded by a USDA – NRCS Conservation Innovation Grant

Helpful Reference: Managing Cover Crops Profitably
http://www.sare.org/publications/covercrops/covercrops.pdf

Attachment C
(Field Day Survey Results)

Table 1. Field Day 2 Survey.

		Percent of Participants who:					
	Survey Question:	Strongly Agree	Agree	Disagree	Strongly Disagree	N/A	Eval = 75%
1.	The information presented at the Field Day was valuable and useful to me.	68	29	3	0		97
2.	The information and the data analysis presented were easy for me to understand.	76	24	0	0		100
3.	The cover crops demonstrated were of interest to me.	74	23	3	0		97
4.	I understand how the use of cover crops can benefit me.	82	18	0	0		100.0
5.	Because of the demonstration, I will adopt cover crop practices.	44	35	6	0	15	79
6.	This presentation was a good way to deliver information about ways I can improve my crops.	68	29	3	0	0	97
7.	I am looking forward to attending other Field Day events.	82	18	0	0		100

Space on the survey was provided for comments and participants offered these comments:

- Well done. Demonstration plots were explained well & seeing results in the field have more impact than seeing it on a poster or in a slide presentation.

- Upcoming field days & soon-to-be-delivered results will provide needed information before we initiate any larger-scale implementation of sunn hemp on-farm.
- Nice crowd of people. Well publicized. Need abstract and./or professional publication or promise to distribute. Need tables & summaries of costs for budget minded.
- Information was presented in an easy to understand form. I look forward to the next demonstration.
- Seed should be more available.
- Excellent tour. Good information.
- Very informative and educational.
- I totally enjoyed being here today and look forward to another one.
- Please keep this going & call me I will come to your field tour.
- Great job again!!
- Research has found perennial cropping systems to provide the same benefits in tropical environments. These should also be considered in comparison with rotational cover crops. Increased field preparations can be harmful to soil structure.

Success of the project is achieved when:

75% of attendees agree or strongly agree that the information was understandable and useful.

75% of attendees agree or strongly agree that they understand how cover crops can benefit them and were interested in the ones demonstrated.

75% of attendees agree or strongly agree that they will adopt cover crop practices.

With the qualification noted below, so far, we are greatly exceeding the evaluation criteria (See Table 2).

Table 2. Evaluation Results .

CRITERIA	Pct. Of Participants who Agreed
75% of attendees agree or strongly agree that the information was:	
UNDERSTANDABLE	100
USEFUL	97
75% of attendees agrees or strongly agree that they:	
UNDERSTAND BENEFITS OF COVER CROP	100
INTERESTED IN COVER CROPS PRESENTED	97
75% of attendees agree or strongly agree that they will:	
ADOPT COVER CROP PRACTICES	79

Questions 6 and 7 were included in the survey in an attempt to get feedback on the overall design of the project. These results were also quite positive and provide reassurance that the design of the project strongly supports the goals and objectives.

Attachment D
(Agriculture Hawaii - Magazine Article)

Covering Ground in Agriculture

John McHugh of Crop Care Hawaii, LLC explains the benefits of cover cropping at a USDA - NRCS field day.

"Essentially, all life depends upon the soil---"**Charles E. Kellogg, USDA Yearbook of Agriculture, 1938**. Soil is an essential resource for growing food. Without it, we have few options. Heavy rains and high winds in Hawaii frequently move soil from farms and other areas to nearby water bodies resulting in erosion, loss of precious topsoil, and non-point source pollution. If the soil sediment reaches the ocean it can also suffocate coral. The condition of murky coastal waters after a heavy storm is a familiar experience of surfers, divers and other beachgoers in Hawaii.

John McHugh has been involved in agriculture in Hawaii for over 30 years. During the past decade John has become concerned about the increase in farm acreage, throughout the state, that is left in bare ground fallow (without plant cover). Many diversified farmers use this practice between cycles of commercial crop plantings to control weeds and "rest" the soil from the demands associated with intensive production. Unfortunately, this practice elevates the risk of soil erosion, especially on steeply sloping ground. John and his business partner, Lynne Constantinides, of Crop Care Hawaii, LLC have made it part of the focus of their agricultural consulting business to reduce this risk by encouraging farmers to plant cover crops. To accomplish this goal Crop Care Hawaii, LLC has received a number of state and federal grants, since 2000, which have allowed them to work with local farmers in establishing a variety of plantings, in their own fields, in order to demonstrate the advantages and benefits of the use of cover crops in managing the challenge of soil erosion and improving soil quality. In 2006 a grant awarded by the United States Department of Agriculture - Natural Resources Conservation Service under the Conservation Innovation Grant program allowed Crop Care Hawaii, LLC to expand the scope of the cover crop field work and sustain the effort to encourage farmers to adopt the practice as a way of improving their bottom line while elevating the industry to the highest levels of environmental stewardship.

Farmers and government agency personnel examine cover crops plots prior to plowing down in Waialua, Hawaii.

Although the benefits of cover crops have been well documented, this latest effort addressed specific bottlenecks to adoption by Hawaii farmers. What works on the

mainland may not necessarily work here. For example, the price for shipping cover crop seed to Hawaii can be as high as four times the cost of the seed itself so, the economics of this practice is a concern to business-minded farmers. To engage the community in this effort, Waialua High School students interning with Pioneer Hi-Bred International, Inc. assisted with this project. Five cover crops (sunn hemp, oats, winter wheat, mung beans and buckwheat) were planted alone and in combination with sunn hemp. These plantings were examined to determine which cover crops were best at increasing soil fertility and organic matter, reducing plant parasitic nematodes, suppressing weeds, and providing cover to the soil during the inter-commercial crop cycle. Two field days were held in Waialua on the North Shore of Oahu and each was attended by over 34 farmers and government agency representatives. The first field day was held once the cover crops were established. Specific questions relating to the cost, planting and culture of the cover crops were addressed (Table 1).

TABLE 1. *Cost of Cover Cropping, and Availability of Seed.*

	BUCKWHEAT	TAM 405 OATS	MUNG BEANS	SUNN HEMP	CAUDILLO WHEAT	BAREGROUND
Seed cost/acre (estimated)	$48	$28	$26	$ 120	$24	N/A
Irrigation Requirements	None*	None*	None*	None*	None*	None*
Seeding Rate (lb/acre)	60	70	70	40	60	N/A
Seed Planting Method	1. initial soil disking 2. broadcast seed 3. light disk or harrow to no more than 2 in.	1. initial soil disking 2. broadcast seed 3. light disk or harrow to no more than 2 in.	1. initial soil disking 2. broadcast seed 3. light disk or harrow to no more than 2 in.	1. initial soil disking 2. broadcast seed 3. light disk or harrow to no more than 2 in.	1. initial soil disking 2. broadcast seed 3. light disk or harrow to no more than 2 in.	N/A 2 rounds of disking to maintain weed control
Time to establishment	7 to 10 days	7 to 10 days	7 to 10 days	7 to 10 days	7 to 10 days	N/A
Time to Plowdown (for green manure)	N/A	N/A	At green seed pod stage	6 – 8 weeks after establishment	N/A	N/A
Cost (field prep and planting)/acre	$70	$70	$70	$70	$70	$70
Herbicide application cost (equipment and material)/acre	N/A	N/A	N/A	N/A	N/A	$45
Seed Suppliers	Peaceful Valley Farm & Garden Supply (888-784-1722)	Douglass King Company (210-661-4191)	Asian Grocery (808-593-8440)	None presently however, local seed available soon. (808-341-0230)	Douglass King Company (210-661-4191)	N/A

*Irrigation is not used with the cover crop practice. Cover crops are planted immediately prior to the rainy season (mid-October 15 through mid-April 15).

The second field day was held shortly before disking down the cover crops. At this stage, field day attendees were able to observe the impact cover crops had on protecting

the soil and on weed suppression. Weed suppression was found to be significantly greater in all cover crop plots as compared to the bare ground fallow plots with the best weed suppression provided by sunn hemp in combination with oats and buckwheat. Percentage of the soil surface area protected by the cover crops was best when oats were planted with sunn hemp.

Soil samples were collected after the cover crops were disked down to determine their contribution to soil fertility and organic matter. At a planting in Haleiwa (Monsanto Hawaii) sunn hemp + buckwheat significantly increased soil organic matter while oats alone resulted in significant increases in a Waialua field (Twin Bridge Farms, Inc.). Additionally, sunn hemp planted alone and in combination resulted in increased soil nitrogen in Haleiwa and Kemoo (Pioneer Hi-Bred International, Inc.).

As a result of past and present efforts the adoption of the cover crop practice is increasing. The continued adoption and implementation of the method is essential to conserve precious top soil, minimize non-point source pollution, and otherwise place Hawaii's farmers at the forefront of environmental activism. Afterall, "all life depends upon the soil."

Attachment E

(UH – Sustainable Agriculture Website Posting)

Accelerating the Adoption and Implementation of Proven Cover Crop Technologies in Hawaii

Farmers and Hawaii agriculturists examine cover crops plots in Waialua, Hawaii at a Field Day held on January 9, 2007.

Crop Care Hawaii, LLC is a local agricultural consulting company that is dedicated to the establishment and adoption of sustainable agricultural practices. Since 2000 the privately owned business has been coordinating a series of on-farm cover crop plantings to demonstrate the use of cover crops as an easily implemented, cost effective, Best Management Practice (BMP) for soil conservation on Oahu farms. In 2006 and 2007, with funding from the Conservation Innovation Grant Program administered by USDA-Natural Resources Conservation Services, large scale demonstration cover crop plantings of at least 6 acres were established at three farm sites on the North Shore of Oahu – a

prime agricultural area for the state of Hawaii. The overall goal of the project was to accelerate the adoption of the cover crop practice as a BMP. Two Field Days were conducted which exhibited the ability of the cover crops to stabilize soil and suppress weeds. Cover crops planted were sunn hemp (*Crotolaria juncea*), oats (*Avena sativa*), buckwheat (*Fagopyrum esculentum*), winter wheat (*Triticum aestivum*), mung beans (*Vigna radiata*), and sunn hemp planted in combination with each of the other cover crops. Field sites were cooperator farms (Pioneer Hi-Bred International, Inc., Monsanto Hawaii, and Twin Bridge Farms, Inc.) in Waialua and Haleiwa. Sunn hemp in combination with oats or in combination with buckwheat was best at suppressing weeds while sunn hemp in combination with oats provided the best protective cover for the soil from wind and rain erosion. Sunn hemp alone significantly increased the amount of soil nitrogen at Monsanto Hawaii's site while sunn hemp in combination with oats increased soil nitrogen levels significantly at Pioneer Hi-Bred's Waialua farm site. Soil organic matter was improved significantly by the combination of sunn hemp + oats at Monsanto Hawaii's Haleiwa field and by oats planted alone at Twin Bridge Farm's Waialua farm. Per acre cost for the BMP was mostly less than the standard practice of bare ground fallow which does not contribute to soil improvement or conservation. The work will continue from 2007 through 2010 in another project funded by the USDA- Natural Resources Conservation Service Conservation Innovation Grant Program which will expand the effort statewide and seek to quantify the impact of the cover crops on the commercial crops which follow them as a means to encourage further adoption of the BMP.

Cost of the Cover Crop Best Management Practice and Seed Availability.

	BUCKWHEAT	OATS	MUNG BEANS	SUNN HEMP	WINTER WHEAT	BAREGROUND
Seed cost/acre (estimated)	$48	$28	$26	$120	$24	N/A
Irrigation Requirements	None*	None*	None*	None*	None*	None*
Seeding Rate (lb/acre)	60	70	70	40	60	N/A
Seed Planting Method	4. initial soil disking 5. broadcast seed 6. light disk or harrow to no more than 2 in.	4. initial soil disking 5. broadcast seed 6. light disk or harrow to no more than 2 in.	4. initial soil disking 5. broadcast seed 6. light disk or harrow to no more than 2 in.	4. initial soil disking 5. broadcast seed 6. light disk or harrow to no more than 2 in.	4. initial soil disking 5. broadcast seed 6. light disk or harrow to no more than 2 in.	N/A 2 rounds of disking to maintain weed control
Time to establishment	7 to 10 days	7 to 10 days	7 to 10 days	7 to 10 days	7 to 10 days	N/A
Time to Plowdown (for green manure)	N/A	N/A	At green seed pod stage	6 – 8 weeks after establishment	N/A	N/A
Cost (field prep and planting)/acre	$70	$70	$70	$70	$70	$70
Herbicide application cost (equipment and material)/acre	N/A	N/A	N/A	N/A	N/A	$45
Seed Suppliers	Peaceful Valley Farm & Garden Supply (888-784-1722)	Douglass King Company (210-661-4191)	Asian Grocery (808-593-8440)	Koolau Seed & Supply, Inc. (808-239-1280) Crotolaria Seed Specialists, LLC (808-341-0230)	Douglass King Company (210-661-4191)	N/A
Total Cost/A	**$135**	**$93**	**$92**	**$160**	**$88**	**$140**

*Irrigation is not used with the cover crop practice. Cover crops were planted immediately prior to the rainy season (mid-October 15 through mid-April 15).