

Northeast Sustainable Agriculture Research and Education Program Farmer Grant Final Report

1. Project name and contact information

Introducing Rice as a Commercial Crop to the Northeastern USA, FNE08-624

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2. Goals

Rice is a new crop to this area and basic cultural information is not yet established. Overall goal is to introduce rice as a commercial crop to the northeast USA.

Our goals for 2008 are:

1. Preliminary evaluation of varieties that have a potential to produce seed at Akaogi Farm
2. Production comparison of three varieties selected from our 2007 experiment.
3. Two workshops, a presentation, and an article for growers and community members.
4. Write a basic organic crop management manual and prepare seeds of selected varieties to distribute to interested growers.

3. Farm profile

We have been farming for 27 years, 22 years at our current 10-acre farm (a part of the Earthbridge Community Land Trust) in Westminster West, Vermont. We farm organically and sell our produce only to local markets (CSA, Brattleboro Area Farmers' Market, local coops and restaurants). Since 2002, Vermont Organic Farmers (VOF) has certified us as organic. We sell vegetables, fruit, honey, and eggs.

We have designed our farm landscape ecologically by putting a buffer zone on the North and West border and planting various trees for windbreaks and wildlife. Next to the buffer zone, we located fruit trees (apple, peach, plums, pears, grapes, and quinces). Then, in the Southeast section, we have 3 greenhouses and the vegetable fields. We also have 100 laying hens and 6 beehives.

Across the middle of our farm we have a wetland and adjoining it is marginal land that we could not use for the production of traditional fruits and

vegetables. In the marginal land, we came up with the idea to try to grow rice, which is well suited to grow in waterlogged soil. Our intention is to have no impacts on identified/protected wetlands and to enhance marginal lands as wetlands for wildlife and other values. Also, we can use wastewater from the vegetable washing station to recycle as irrigation water for the rice production. We built a small rice paddy in 2006 and two larger paddies in October of 2007.

4. Participants

Technical advisor – Kevin Kaija, Vermont National Resource Conservation Service (NRCS) agronomist. He visited our farm once a month from April-October 2008 to observe our progress. He brought us three thermometers that we used at the west end of paddy #1 at different depths to measure soil temperature. In the spring he sampled the soil and did a particle size analysis; we have not received the results yet. Also, he agreed to produce a map that shows potential areas for rice production in Vermont. The map includes three factors: soil type, heat unit, and irrigation water. He is now working with soil specialist Caroline Alves and Martha Stewart of the Vermont NRCS.

Collaborators – Professor Susan McCouch, head, and Gen Fumio Onishi, greenhouse manager, of the Rice Research Lab of the Department of Plant Breeding and Genetics of Cornell University were the collaborators for this project. They are experts on rice. Gen Fumio Onishi was a rice farmer in Japan for 20 years prior to coming to the USA. Susan McCouch is a rice geneticist who specializes in breeding rice for adaptation to particular environments.

They sent us a copy of two books (in Japanese) on rice growing and breeding in Hokkaido, Japan, to use as a basis for our project. We communicate regularly with them by e-mail. In September, Gen Fumio Onishi visited our farm for the workshop. In December, we visited them in Ithaca NY to discuss the overall performance of our project and find out problems to investigate or improve for future projects. Also, they reviewed the basic crop manual.

5. Project activities.

1. Preliminary Evaluation (see #6 “Results”)

We received seed from the National Small Grains Collection, (NSGC). in Aberdeen, Idaho, and the Genetic Stocks - Oryza (GSOR) Collection of the Dale Bumpers National Rice Research Center in Stuttgart, Arkansas. All the varieties were the Japonica type except one Indica type. The Japonica types were mainly from Hokkaido, Japan, plus 2 from Italy, 2 from Korea, and one from California.

We evaluated a total of 31 varieties.

2. Production Comparisons (see #6 “Results”)

We selected three varieties from 2007 and sowed seed and then transplanted them about two weeks apart in each of the two fields. Each field was divided into six sections so each of the three varieties were planted with two replications. We skipped one row between each of the 6 sections. We kept data on weather, soil temperature, observations, yields and took weekly pictures.

In the fall we built a drying greenhouse to dry the harvested bundles of rice and purchased a foot-powered thresher to thresh the rice. The rice was harvested, dried and threshed.

3. Workshops, Presentation, & Article (see #11 “Outreach”)

4. Basic Organic Crop Management Manual and Seeds of Selected Varieties (see #11 “Outreach”)

5. Wildlife Observations (see #6 “Results”)

We did these observations by ourselves, since we were not able to find a wildlife biologist to help us.

6. Other Events

- April 10, we attended an “Innovations in the Vermont Soil Survey” workshop at White River Junction. We needed more information about soil types in order to make soil recommendations for rice growers. We talked to several officials there. In the spring a soil specialist sampled the soil and did a particle size analysis. We have not received the results yet.
- In May, the Westminster West Elementary School (grades 1-4) visited our farm and brought back seedlings to grow in containers at their school. During the summer they took turns to take care of the rice plants. In the fall we visited their class and worked with the students to thresh and de-hull the rice with them.
- In June, Arlen Lancaster (NRCS Chief) visited our farm from Washington D.C., along with local NRCS staff.
- In June and July, we had two open farm days for members of the community.
- July 2, we visited Pete Gianforte’s farm in Cazenovia, NY. He was planning to make a 5-acre rice paddy and asked us for some advice
- Late July, Yolanda Chen, entomologist, former researcher at the International Rice Research Institute (IRRI), and now at the University of Vermont, came to visit our farm. She instructed us on how to collect

insects and store them for later identification.

- Roger Allbee, the VT Agriculture Secretary, visited our farm twice (August and October). The second time he brought with him Job Serebrov, Senior Counselor to the General Counsel and Senior Advisor to the Secretary for Natural Resources and Environment, from Washington, D.C. Mr. Serebrov suggested that he will work with the Chinese government to get newly released rice varieties for us to trial. Since then, Job Serebrov, Roger Allbee, Timothy Schmalz, State Plant Pathologist, VT Agency of Agriculture, and Arnold T. Tschanz, Senior Risk Manager, USDA APHIS PPQ PRIM, have been processing the importation of seed from China and Korea. We recently learned from the USDA contact in China that the varieties that are approved for export by the China Ministry of Agriculture do not include any *Japonica* species. Also, we learned from the USDA Plant Germplasm Quarantine Program in Beltsville, Maryland, that they have received seeds of 5 Korean rice cultivars that will be entered into quarantine in March. When the quarantine process is complete, about 8 months, we will received a small amount to trial.
- In October, we gave a presentation at the Upper Valley Food Coop's annual meeting about growing rice in the Northeast USA.
- We were invited to and agreed to present at two winter conferences: the NOFA-New York Winter Conference, Jan 23-25, Rochester Riverside Convention Center, Rochester, NY and the NOFA-Vermont Winter Conference, Feb. 14 & 15, Vermont Technical College, Randolph, VT.

7. Weather station

Late March, we ordered and received a Vantage Pro wireless weather station. Due to technical problems, it only recorded monthly high and low temperatures. We found the problem and are able to use it for the next season.

6. Results

We used the following books as base information for the project.

- *Rice Breeding Research, Hokkaido – A 125-Year History* by Dr. Toshiro Kinoshita, 2003 (in Japanese)
- *Hokkaido Agricultural Technical research History, 1981-2000* by Dr. Toshiro Kinoshita (in Japanese)
- *A Farmer's Primer on Growing Rice* by Benito S. Vergara, International Rice Research Institute, 1992
- *A Primer on Organic-Based Rice Farming* by R. K. Pandey, International Rice Research Institute, 1991

1. Preliminary evaluation of varieties that have a potential to produce seed at Akaogi Farm

In Paddy 1, which is the first paddy we built in 2006 (625 sq. ft.), we trialed 31 varieties. We selected 25 varieties that produced seed at our farm .

We soaked the seed in water from 4/13-4/19. We sowed the seed in plug trays between 4/19-4/21. We transplanted the seedlings in paddy #1 on 5/18. We started harvesting on 9/16 and stopped harvesting on 10/2. The three varieties left in the field did not mature before a hard, killing frost on 10/7.

For fertilizer we used Cheep Cheep (4-3-3) and applied 25 lbs. on 5/20, which is at a rate of N = 70 lb/acre.

PRELIMINARY EVALUATION – 31 VARIETIES

	Variety Name	1st Heading	Stem No.	Harvest	Lodging	Sterility	Shattering	Overall Rating
1	Shiokari	7/6	34	9/16	4	1	1	1
2	Kiyokaze	7/6	27	9/16	3	1	1	1
3	Kitakogane	7/10	24	9/16	3	1	1	1
4	Kaoriwase	7/11	15	9/16	3	2	1	1
5	Hatsumurasaki	7/11	20	9/16	2	4	1	4
6	Hayakaze	7/11	29	9/16	3	1	1	1
7	Hayayuki	7/11	24	9/16	3	1	1	1
8	M-16	7/11	19	9/16	2	3	2	2
9	Kitaake	7/12	31	9/16	2	1	1	1
10	Yukihikari	7/13	26	9/16	3	1	1	1
11	Ishikari	7/13	25	9/16	2	1	1	1
12	Kuro mochi	7/13	24	9/16	2	1	1	1
13	Kurikara mochi	7/16	37	9/16	4	1	1	1
14	Takachikuromomi	7/16	37	9/16	3	1	1	1
15	Ebisu mochi	7/17	47	9/16	2	2	1	3
16	Tomoyutaka	7/17	32	9/16	2	1	1	1
17	Akage	7/17	42	9/16	3	2	1	3
18	Matsumae	7/18	33	9/19	2	1	1	1
19	Yuki mochi	7/20	48	9/16	2	1	1	1
20	Duborskian	7/22	23	9/19	3	1	1	1
21	Shimahikari	7/25	40	9/30	1	1	1	1
22	Murasaki	7/26	29	9/19	3	4	1	4
23	Purpleleaf	7/31	20	9/20	1	4	1	4
24	Allorio	7/31	31	9/20	4	2	2	3

25	Umbonbyeo	8/7	41	9/29	1	1	1	1
26	Namweanbyeo	8/7	32	9/30	1	2	1	3
27	Goldleaf	8/8	36	-	-	-	-	5
28	M-201	8/11	48	10/2	1	3	1	3
29	Akitakomachi	8/12	41	10/2	1	3	1	3
30	Sasaminori	8/12	38	-	-	-	-	5
31	Koshihikari	Late August	52	-	-	-	-	5

Definitions Used in the Table Above.

1. Stem No.: the stem number at 1st heading, taken from an average of 3 plants. This helps to figure out ideal stem density per area for each variety.
2. Lodging – scale from 1 to 5: 1 = no problem, 2 = 1-2 hills start leaning, 3 = more than 1/2 of the plants are leaning – some are 45 degrees or more, 4 = all are 45 degrees or more leaning, 5 = flat to the ground.
3. Sterility (visual estimate of sterility of spikelet) – scale from 1 to 4: 1 = less than 10%, 2 = 10-25 %, 3 = 25-50%, 4 = 50% or more.
4. Shattering – Scale from 1 to 3: 1 = no problem; 2 = medium; 3 = bad.
5. Overall Rating, ranked according to performance in this area - scale from 1 to 5: 1 = excellent, 5 = unsuitable.

2. Production comparison of three varieties selected from our 2007 experiment.

The three varieties, Hayayuki (early), Yukihihikari (mid early), and Matsumae (late), were planted in Paddy 2 and Paddy 3 (net planted area of 3,479 sq. ft.) approximately two weeks apart.

For fertilizer we used Cheep Cheep (4-3-3) and applied it at the rate of N = 70 lb/acre.

For the first planting (Paddy 2), we soaked the seeds on 4/2; sowed the seeds into plug trays between 4/12-4/13; and, transplanted seedlings between 5/6—5/7.

For the second planting (Paddy 3), we soaked the seeds on 4/19-4/25; sowed the seeds into plug trays on 4/25; and, transplanted seedlings between 5/25—5/27.

We weeded on 6/20 and 7/4.

1st Heading for first planting: Hayayuki: 7/8 Yukihihikari: 7/11 Matsumae: 7/17

1st Heading for second planting: Hayayuki: 7/9 Yukihihikari: 7/14 Matsumae: 7/19

We harvested on 9/17 – 9/20; threshed on 10/20-10/22; and weighed the rough rice on 10/23, 10/26.

VARIETY DEVELOPMENT COMPARISON
Stem Number (average of 3 plants) and Date of 1st Heading

	5/25	6/1	6/8	6/15	6/22	6/29	7/6	7/13	1 st heading
Hayayuki	2.3	3.0	5.6	11.0	13.6	19.6	23.6	-	7/11
Yukihikari	2.0	3.0	5.3	11.3	17.0	22.6	26.0	26.3	7/13
Matsumae	2.0	3.0	5.0	12.3	17.3	24.3	29.0	33.3	7/18

PRODUCTION COMPARISON OF THE 12 SECTIONS

	Section	Area in Sq. Ft.	Rough Rice Lb/-section	Lb/acre
Early Transplanting Paddy 2 Transplant: 5/7 Harvest: 9/17-20	Hayayuki – 1	242	25	4,500
	Hayayuki – 2	242	30	5,400
	Yukihikari – 1	242	37	6,600
	Yukihikari – 2	242	36	6,480
	Matsumae – 1	242	51	9,180
	Matsumae – 2	242	32	5,760
Late Transplanting Paddy 3 Transplant: 5/25-27 Harvest: 9/18-19	Hayayuki – 3	360	40	4,840
	Hayayuki – 4	320	37	5,036
	Yukihikari – 3	288	33	4,991
	Yukihikari – 4	403	57	6,160
	Matsumae – 3	304	36	5,158
	Matsumae – 4	352	53	6,558
	TOTAL	3,479	467	AVG. 5,847

NOTE: If you are interested to estimate the weight of brown rice; generally, the weight of the husk is between 15-30% the weight of the rough rice.

In 2008 Paddies 2 and 3 produced a total of 467 lbs. of rough rice . The average yield of rough rice for the 12 sections was 5,847 lb per acre, the lowest was 4,500 lb. per acre, and the highest was 9,180 lb. per acre. Our average is less than the average yield of California (8,500 lb per acre), but similar to those of Hokkaido, Japan, and more than two times that of wheat.

3. Wildlife Observations

In 2008 we observed: increasing numbers of the five species of frogs, which we identified in 2006-07, increasing numbers and additional species of dragonflies and damsel flies, and additional species of birds including a pair of Canada geese, a pair of wild ducks, killdeer, a sandpiper (sp.).

In preparation for harvesting the rice we drained the rice paddy in the middle of September. At that time, there were still many green frog tadpoles there. We moved most of them into the "swale" on the side of the rice paddy. We consulted with Charles Johnson (former Vermont State Naturalist, author, and wetlands ecologist), Nona Estrin (naturalist, natural history artist, and author) and Jim Andrews (herpetologist, author, Middlebury College) and are working with them to solve this problem.

7. Conditions

The factors that we think are critical to rice growing in the northeast USA are: amount of sunshine, ability of the soil to hold water, and a reliable source of water

In the fall of 2007 we designed (with the help of the NRCS) and built (with a contract by a local contractor) a rice paddy system. The definition of a rice paddy is a shallow pond with a flat (leveled to a grade of +/- 2" ideally) bottom that can hold water 6-8" deep, provides for control of water depth, and is able to drain completely. This rice paddy system consists of a warm up basin (pond), one small paddy, two larger paddies, and pipes from the source of water to the system. The whole system was designed to conduct the water by gravity.

Paddy 2 and 3 were constructed in the fall of 2007 using heavy equipment and a laser level. In order to construct it, the sod was removed and the topsoil moved aside. Then the subsoil was leveled and the topsoil spread out to level. In the spring we leveled the paddies to a difference of +/- 2" using hand tools. Even so the depth of the cultivated soil has some variation.

Our farm is located in southeastern Vermont at Latitude 43 degrees N. It is approximately 5 miles west of the Connecticut River and 900 feet above sea level. Even though we are in southeastern Vermont, because of our elevation, we are colder than the other locations that we monitor such as Burlington, Vermont and Ithaca, New York.

Weather – Monthly Highs and Low and Last and First Frosts for 2007 & 2008

2007 – starting June 19, data from min/max thermometer, temperatures in degrees Fahrenheit

	High	Low
June	94	44
July	94	43
August	96	38
September	92	32
October	84	24

Last Frost: 5/22

First Frost: 9/16 (32°F)

2008 – starting May 1, data from Vantage Pro weather station, temperatures in degrees Fahrenheit

	High	Low
May	81	32
June	94	42
July	88	50
August	84	44
September	87	34
October	70	21

Last Frost: 5/5 (32°F)

First Frost: 9/19 (34°F)

Condition of Seedlings –

1. First Planting – Two weeks after we sowed seeds into plug trays, the seedlings showed signs of yellowing and wilting. Later we identified the yellowing problem as a lack of nutrients. The wilting problem is related to temperature and moisture. The first planting was weakened and growth was delayed.
2. Second Planting – Seedlings of the second planting grew well.

8. Economics N/A

9. Assessment

The last 3-year's of experiments comprise proof of concept that rice can be grown productively in the northeast USA and has the potential to become a commercial crop.

Also, we realized that in order to develop a sustainable rice growing system we need to focus, not only on the agronomic aspects, but also on the wetland wildlife and watershed management aspects.

Next steps include:

- Expand the preliminary evaluations.
- Expand the production comparisons, include taste comparisons,
- Initiate the establishment of satellite experiments throughout the Northeast USA and establish a network of experts in the three aspects of a sustainable rice growing system.
- Investigate and document the wildlife species inhabiting our rice paddy.
- Identify aspects of watershed management relating to a sustainable rice growing system.
- Start a breeding program.
- Evaluate the marketing potential of rice and rice products in our area.

10. Adoption **N/A**

11. Outreach

1. Two-Part Workshop at our Farm (May and September)

“Introduction to Growing Rice in Vermont”

Sunday, May 11th, 1-3 p.m. (a sample report sheet attached). We explained rice production in general, showed our rice paddy, and also explained how to grow rice in a five-gallon container. We supplied the participating growers with seedlings of a selected variety (Hayayuki) to take home and plant in a five-gallon container and an observation report sheet to be returned at the end of the

season. Locations were throughout the state of Vermont, Hudson Valley, New York, and Cambridge, Massachusetts. Milton was the northern most location in Vermont.

Sunday, September 7, 3-5 p.m. 24 people attended. We reported on the progress of our rice; the participants reported the results of the rice they grew in buckets. Gen (Fumio) Onishi, greenhouse technician of the McCouch Rice Lab of the Department of Plant Breeding and Genetics of Cornell University visited our farm during this time and worked with us for this workshop. He reported on Hokkaido agricultural history.

We received nine observation report sheets at the end of the season. Generally, the rice in all the locations grew well except in areas not exposed to a full day of sunshine, even when to the south of us.

2. Article

“Could Rice be Vermont’s Newest Grain Crop?”, written by Cheryl Bruce of Vermont Organic Farmers.

We worked with Cheryl Bruce on an article for the Northeast Organic Farmers Association of Vermont’s (NOFA-VT) newsletter “NOFA Notes” that went out in late July (a copy is attached).

The Maine Organic Farmers and Gardeners Association (MOFGA) also reprinted Cheryl Bruce’s article in their newsletter

3. Presentation at the Northeast Organic Farming Association (NOFA) Summer Conference.

We gave a slide presentation at the NOFA Summer Conference August 10. About 35 people attended. We passed out copies of Cheryl Bruce’s article to the attendees.

4. We wrote a basic growing manual and readied the seeds of selected varieties to distribute to interested growers late February-April (a copy of the manual is attached). This manual is not comprehensive growing manual but focuses on those aspects of rice growing that are particular to the northeast area based on our experience. This manual is meant to be used with *A Farmer’s Primer on Growing Rice* by Benito S. Vergara (International Rice Research Institute, 1992). For distribution, we made a total of 250 packets of selected varieties of seeds and made 100 copies of the manual. Information regarding how to request these is posted on the NOFA-VT website (www.nofavt.org).

12. Report Summary

Rice is a new crop to the northeastern USA. For the past 3 years we have been experimenting with growing temperate rice in the northeastern USA. We

increased our paddy size from 625 sq. ft. to 4,320 sq. ft., identified 25 varieties that produce seed at Akaogi Farm and produced an average yield of 5,847 lb. per acre using three varieties selected from 2007.

This 3-year experiment comprises proof of concept that rice can be grown productively in the northeastern USA, and has the potential to become a commercial crop.

We realize that in order to establish a sustainable rice growing system, we need to focus not only on the agronomic aspects but also on the wetland wildlife and watershed management aspects.

During Phase 2 of this project we will encourage other growers to start satellite experiment through the northeastern USA.

Linda Akaogi

2/16/09