Proceedings of the Third Annual Northeast USA Rice Conference

August 4, 2012

9:00am – 4:00pm
Akaogi Farm
Westminster West, Vermont

The Third Annual Northeast USA Rice Conference is a collaboration between the McCouch RiceLab at Cornell University and Akaogi Farm. It is funded in part by the National Science Foundation.

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Acknowledgements

- Thank you Takeshi and Linda Akaogi for hosting the rice conference once again.
- Thank you Susan McCouch, Sandy Harrington, Naomi Duguid, Glenn Roberts, and Anna McClung for speaking at the conference.
- Thank you Sjon and Elysha Welters, Josh Brill, Paul Kile, Michael Pill, and Jenny Thorne for participating in the Farmers Exchange portion of the conference.
- Thank you Linda Akaogi, Tatiana Schreiber, Anya Akaogi, Kathryn Blackley, Janelle Jung, Hyunjung Kim, Moni Singh, Grace Yu, and Jen Spindel for volunteering at the conference.
- Thank you Chris Knight for collecting audio and video footage of the conference for the website and conference proceedings.
- Thank you Kanha Sengaloun, Tristan Toleno, Sean Harrington, Ismail Samad, and Shital Kinkhabwala for providing ethnic rice dishes for the conference lunch.
- Thank you Tim Merton for hosting the reception Friday night for our out of town guests and conference speakers.
- Thank you Luc Bodin for providing a delicious meal for the Friday night reception.
- Thank you Gordon and Mary Hayward and Bari and Diane Shamas for hosting out of town guests and conference speakers Friday night.
- Thank you Putney Public Library for loaning us a projector screen for the conference presentations.
- Thank you Anson Mills and the USDA for sponsoring Glenn Roberts and Anna McClung's travel expenses.

Mia Murphy
Outreach Coordinator

Agenda

8:00-9:00am	**Registration**
9:00-9:10am	**Introduction** Mia Murphy
9:10-9:40am	**NSF Grant and Cornell Rice Research** Susan McCouch
9:40-10:10am	**Breeding of Purple, Aromatic Rice for the Northeast** Sandy Harrington
10:10-10:20am	**Break**
10:20-11:05am	**Rice Cuisine and Culture: An International Perspective** Naomi Duguid
11:05-11:15am	**Break**
11:15am-12:00pm	**Carolina Gold Rice and the History and Culture of Rice Farming in South Carolina** Glenn Roberts
12:00-2:00pm	**Lunch** 12:00-12:30pm Chefs' Presentation: menu and cultural background 12:30-1:30pm Lunch 1:30-2:00pm Rice Paddy Tour: Takeshi Akaogi will be available to answer questions at the rice paddy site
2:00-3:00pm	**Farmers Exchange** Sjon and Elysha Welters, Josh Brill, Paul Kile, Michael Pill, and Jenny Thorne
3:00-3:45pm	**Breeding and Development of Seed Stock for Organic Rice Production** Anna McClung
3:45-4:00pm	**Closing and Group Photo**

Speakers

Susan McCouch
Susan manages a large NSF-funded project on association mapping in rice and is a professor in the Department of Plant Breeding and Genetics at Cornell University. She spent 5 years with the International Rice Research Institute (IRRI) in the Philippines before joining the Cornell faculty in 1995. She is well known for her pioneering studies on molecular mapping in rice and the development of genomics-based platforms to explore the extent and distribution of natural variation in rice germplasm. Her early work demonstrated that low-yielding wild and exotic *Oryza* species harbor genes that can enhance the performance of modern, high-yielding cultivars. More recently, her lab has utilized genome wide association mapping to explore the genetic architecture of complex traits in rice and provided new insights into the genetic basis of transgressive variation, with immediate implications for rice improvement.

Sandy Harrington
Sandy is the Compliance Coordinator in the McCouch Laboratory at Cornell University. She received her Bachelor of Science in 1990 from St. John Fisher College and her Master of Plant Breeding in 2001 from Cornell. She has been with Susan's program for 19 years, as a technician, graduate student, Lab Manager, and Compliance Coordinator. She currently coordinates permitting of imported and exported rice in the McCouch program, coordinates greenhouse activities and works with the database group on a LIMS system to organize program resources and data.

Naomi Duguid
Naomi, traveller, writer, photographer, cook, is often described as a culinary anthropologist. She is the co-author of six award-winning books of food and travel: Hot Sour Salty Sweet: A Culinary Journey Through South-East Asia; Seductions of Rice; Flatbreads and Flavors; HomeBaking; Mangoes and Curry Leaves; and Beyond the Great Wall: Recipes and Stories from the Other China. The books explore home-cooked foods in their cultural context, with recipes and photographs as well as stories. Her latest book Burma: Rivers of Flavor celebrates the food cultures of Burma in recipes, stories, and photos, and was published in October 2012. Naomi is a contributing editor of Saveur magazine, has a bimonthly column "Global Pantry" in Cooking Light magazine, writes a weekly blog, www.naomiduguid.blogspot.com, and conducts intensive cultural-immersion-through-food sessions in northern Thailand each winter (www.immersethrough.com).

Glenn Roberts
Glenn's long career in historic restoration and hospitality design led him to sell everything he owned to found Anson Mills in 1998 in Charleston, South Carolina. His mission: to reintroduce ingredients of the Antebellum Southern pantry of the historic architecture he loved. He chose to grow and mill organic heirloom rice, corn and wheat for chefs in the Southeast. These ingredients are fundamental to the fabled Antebellum Rice Kitchen cuisine of the Carolina and Georgia Lowcountry. Today Anson Mills produces artisan organic heirloom grain, legume, and oil seed ingredients for chefs and home cooks worldwide, and provides pro bono seedsmanship to the growing community of rice farmers along the Southern Atlantic Coast and organic landrace cereal systems farmers throughout the United States. Glenn is a founding member of the Southern Fellowship of Farmers, Artisans and Chefs, president and CEO of the Carolina Gold Rice Foundation, recipient of the Artisan of the Year Award from *Bon Appetite* Magazine and recipient of the *Food Arts* Silver Spoon Award.

Anna McClung

Anna has 20 years experience in rice breeding and has developed 16 long grain rice cultivars. She has participated in team research to develop genetic markers for disease resistance and grain quality traits that are now being widely used by US breeding programs and in marker assisted selection. She is responsible for evaluating the Jefferson/*O. rufipogon* NILs in various field trials throughout the southern US to determine the impact of wild species introgressions on yield, yield components, agronomic traits, grain quality, and disease resistance. Promising materials identified in this research will be directly released to breeders as germplasm or further crossed to pyramid yield genes into new genetic resources.

The following proceedings are an edited transcription of the conference. Some of the text may be difficult to understand without the accompanying images from the presentations. Videos of the presentations, which include the PowerPoint slides, are available at www.ricenortheasternus.org.

Proceedings

NSF Grant and Cornell Rice Research: Susan McCouch

This is always one of the highlights of my year because, although I travel extensively and I see rice in areas where everybody seems to know how to grow it and they are committed to their particular types of rice, this is a community that is more open to new ideas than almost any rice community I know. I think we have an opportunity to engage in a kind of experimentation and learning process that is very exciting. This openness is going to be a requirement of more and more groups to keep up with climate change and all the challenges and opportunities that it brings. There are a lot of different pressures faced by the agricultural community, but I think challenges also open up new opportunities. If people are really alert and watching and thinking about how they can do things differently, and are open to exchanging information, they can learn quickly.

The Akaogis have become good friends of ours and we look forward to coming to Vermont each summer to see the rice in the field, and we also look forward to having them visit us at Cornell at least once a year to taste the fruits of their labor. I hope we can extend that conversation because one of the things we are trying to do is to have taste tests of some of the rice that many of you are able to grow. We will be talking a little later this afternoon about how we might want to organize a slightly larger taste test in the future and what makes rice grown in this part of the world special.

Thanks to NSF for helping to fund this conference. The funding comes through a grant that I have from NSF to study rice diversity. I will tell you a bit more about it in a moment. I first want to say that I really enjoy working with Mia who has done all the organization for the meeting this year. And she has had a major event in her life. She had her first baby and that is another breeding project. Yesterday I met Torin for the first time. That is her F1 and we are very happy to know him. Thanks to all of you for coming.

This conference is part of an NSF funded research activity in my lab. Our research focuses on characterizing and utilizing rice diversity for plant improvement. If you would like to learn more about what we are doing, you can check out our project web-site -- I will show you where to go online at the end of my presentation. On our project, we have three objectives. One, is to better characterize and utilize what we call natural genetic variation, meaning traits or characteristics that are found in land races or early cultivars, or sometimes in wild species, that we can breed into cultivated forms of rice. Two, is to enhance the adaptation of rice varieties to different ecological niches. This environment in Vermont would be one of those niches. You will hear more from Sandy Harrington about some breeding that is going on to specifically develop new varieties of rice for this eco-niche and for different rice production systems. The organic rice production system is not a single environment, the SRI system is not a single approach, and of course what we call traditional agriculture is not a single thing either. We are mixing and matching and experimenting with what works. Three, is to promote awareness of the diversity and the cultural, biological, and culinary traditions that go along with different kinds of rice. What makes working in agriculture so exciting I think is that you get to eat the product of your labor.

One question is how have humans shaped the diversity of rice? This is one way in which the breeding community thinks about the process of plant breeding. It starts with natural variation in the form of a wild species and humans select on it. They select based on their own preferences, what they like, what they find acceptable, or just what grows in the environments in which they live. At the genetic level, human selection is no different than the process of natural selection. And human, or artificial selection, which is choosing what is going to provide seed for the next generation, is the simplest form of plant breeding. You impose selection. The next level is designing the crosses you make. In nature, crossing occurs between individuals that happen to be next door rather than because one is brought in on purpose to try to bring about a new genetic combination. In our lab we make controlled crosses and we look at the variation in the offspring at many levels.

Humans have adapted different rice varieties to different environments. Rice is naturally aquatic and it is the only major crop plant in the world that can grow in standing water. That is why we are trying to bring rice into ecosystems that are naturally wet in this part of the world. We are not trying to bring water to dry land. We are trying to bring rice to wet, low-lying domains of your farms or fields where you cannot grow anything else. In many parts of the world, soil is flooded continuously. The rice plants that do well in those systems have different root structures and different developmental patterns that those that grow best on dry land. A flooded soil is very different both chemically and microbially than a dry soil or an aerated soil. You will hear more about wetting and drying systems, where they go back and forth between these two.

This is the traditional flooded paddy system. It produces about 80% of the world's rice right now and represents less than half of the rice area. There is a lot more area that is not permanently flooded but yields are lower so it produces a lower overall percentage of the world's rice. This is an extreme case of upland rice, like in the Saraho of Brazil where they plant it and they don't weed and they don't fertilize and they don't apply water. They do nothing except come back at the end of the season and harvest the rice. It is what we call low input and it has converted vast acreages in Brazil into rice producing regions. This is dry land rice. It is also produced on dry land in parts of Africa where there is little water and there are a lot of acid soils. There are many other constraints as well. I want you to realize that rice is not always grown in flooded paddies.

Here is an extreme case. I think it is a little hard to see. This person is a breeder. The water level is here. This is what we call deepwater rice. I don't know if you followed the floods in Thailand last year, but about three quarters of the country was flooded. I mean flooded! Typically in an average year about 30% of Thailand floods and they have developed these deepwater rices, which elongate with rising water. They sow them in soil before the floods and they grow with the rising water. People go out in boats and harvest the crop off of the surface of the water. They are floating rices in a sense. They can elongate 10 inches a day and they only elongate when the water is rising. They have a genetic capacity to interpret the difference between a flash flood and constantly rising water and they only grow if it is constantly rising. The problem with these rices is that once they grow, they can't shrink. If the water level falls, they will fall over. Normally because this is a habitual thing in that region of Thailand, it floods and it stays flooded and they go out and harvest in boats. Some people actually put the seed in a clutch of mud and drop it and that is how they plant the rice so the seed will sink and be able to take root. There are different ways of dealing with rice and water. Hydrology is one of the major issues that influences what rice you plant. How these systems work is very exciting to those of us who work with rice. Some of the genetics are now known. Some of the genes that turn on the pathways that tell the rice to elongate were cloned about a year and a half ago.

It is a hormonally regulated system. It is basically the same system that tells the plant to grow normally except it is responding to an external rather than internal signal.

Then we have varieties adapted to high altitudes. This happens to be a picture from the Philippines, but in China, India, Philippines, and of course all over the Andes mountains there are terraced hillsides. Terraced hillsides are a very classic way of extending the growing area. What is amazing about the rice terraces in the Philippines is that the rainwater is coming down and all of this water is managed so that one paddy never floods another. This is a very elaborate irrigation scheme that gives people access to water in a very regulated way. The rice is hand transplanted into these paddy systems and they have a number of very interesting problems. The number one problem they have is earthworms. The only reason I mention this to this group is because many people in organic agriculture think earthworms are just inherently good, but the earthworm that is found in the paddy system in this part of Banahue, Philippines is about a foot long. It is about this wide and it drills through the paddy and makes holes in the dikes. The water floods out and then the dikes are destroyed. This was an introduced pest and it has become endemic. It is very, very problematic and nobody has any way to deal with it other than management. I like to mention things that are interesting about different environments and things we sometimes take for granted.

Here we are. This was from last year's conference. Many of the temperate varieties that seem to do really well here are coming from Hokkaido, Japan where there is an equivalent zone of adaptation. They can be grown here in Vermont, New York, and other places in the temperate zone. You can talk to Ogi [Takeshi] and other people who have tried different varieties. California, which also grows temperate rice, uses varieties that are not as well adapted to this zone. They don't flower, they are not as early, etc. There are a lot of interesting things about adaptation. We also see that there are unique flavors, textures, aromas, that people really want in the rices they grow. Sometimes they know *a priori* what they want. Sometimes they come back to it afterward and say I really like that rice. I don't know why, but I really like that rice. We are working in both directions, forward and backwards.

I showed this slide last year and I just want to say we work a lot with variation at the DNA level. We look at what makes one rice different from another. It does not mean we do genetic engineering or make transgenics. It means we look at the DNA that makes any one of us different from anything else, and we try to understand genetically why certain things grow well in one environment. Each rice variety has its own unique DNA pattern and its DNA pattern is the song that gives it its own identity. There is something about working at the DNA level that makes many people start to feel queasy because it is unfamiliar. Our lab works at the DNA level to understand genetics. These are DNA fingerprints. Each lane in this gel is a different rice variety. These two have the same fingerprint at that locus and these share that one. This is a sample of *Oryza glaberrima*, which is the domesticated form of rice cultivated in West Africa. When I first went into a molecular biology lab and somebody put something like this on the screen and started talking about it, this is what I was thinking. I thought, oh how interesting, humans have this odd way of representing how we understand the world – in black and white symbols. How do we understand the world? Well we understand the world by identifying things that are similar and we document them in different ways. This view basically allows us to understand what is similar and what is different. We correlate things that have the same genetic profile at certain loci and match them with how they behave. That is part of how we understand how these things work.

We are also very interested in the rituals associated with rice and rice production. This is an offering. This particular statue was in Bali, Indonesia. Every day at sunrise and sunset they make offerings to this God for their harvest, and it is very normal. There is no ceremony about it. They leave their offering and they go work in their paddy. These are the very traditional ways in which fertility rites, gods of fertility, gods of the harvest, and offerings have all been integrated into different social systems. We all in some way have inherited that respect. The respect for what makes one cycle give rise to the next. We just don't always practice it.

I am going to end by saying if you want to learn more about the project we work on, please visit our web-site. We are a fairly large lab of about 20 people. We are training somewhere between 6 to 10 graduate students, PhD level students, and we have staff and visiting scientists, people coming from all over the world. We work very closely with the group in Stuttgart, Arkansas, which is our National Rice Research Center. Anna is representing them today and she will tell you more about that Center. Arkansas is the heart of rice production in the United States and 60% of US rice is grown there. We are able to grow out trials and do many things in a large scheme in that subtropical environment.

We are also working quite closely here with this group because we really enjoy it, we really like it, and the NSF seems to think it is something worth looking at because they like the experimental nature of it. They really like the idea that people are trying new things. You guys are all on the radar screen. If you go into our rice diversity site, www.ricediversity.org, and you click on education and outreach, a menu will open up and you can scroll down to Rice in the Northeast Project and it will open up a screen that looks like this. If you had not found it before you can find it now. You can click on this year's conference and this was last year's and this was from previous years. This gentleman behind you is video taping everything. If you miss the conference or want to share it with someone, you will be able to go online and get streaming video of all the presentations here today.

You now have the proceedings that have been written up, which are transcriptions where Mia has carefully documented what has been presented and shared. She is going to try to document that today. I tell you that because I think it is very important that the role you play is bigger than the number of people in this room. The way in which your voices will get out to the community is potentially quite great and you can help catapult this as well. You can share this site with other people. Erika, who is in the back of the room, spoke last year. She spoke about SRI. There is a beautiful presentation that Takeshi did last year, which is much more lovely on a screen in a dark room than it was in this room. The color wasn't quite as good. We had some really interesting talks last year about amphibians, dragonflies, and some of the other creatures for whom a rice paddy is the ideal environment in which to live. We are interested in the way in which the paddy gives us rice but also the paddy gives us many other things. Trying to be aware of that and to take pleasure in those things around us is important. With that I think I will end and say thank you to the group that comes together each summer. All of you make these rice conferences exciting for us and I look forward to sharing with you over the course of the day.

Audience: What has been done to identify or to estimate the number of acres in the Northeast that is suitable for rice production?

Susan: I would say that question should be put on an agenda item because I don't think we have even attempted it. It is an interesting question. It is really related to small low-lying areas on different farms and that would be a wonderful way of going about it. I remember the very first year, Mia may want to comment on this, but we had the Commissioner of Agriculture from Vermont and several people from the Water

Conservation Department here talking to us about land management in the state. We are interested to work with all of you on the stateside to try to ensure that this whole thing is a way forward in an ecologically responsible way. Anything that you can do to help us and to help people find out what they can do with low-lying spots on their farm.

Audience: It would be interesting to see if rice could play a role in flood mitigation. It would be interesting to see which areas of the state are most prone to flooding that would be suitable for rice because we just experienced this terrible flood last year. Are there particular areas where rice could actually play a role in helping enhance the floodplain around certain rivers?

Susan: Often wetlands are seen as an impediment to development in many peoples' minds and one of the ideas was to blend the conservation of wetlands with concepts of humans interacting productively with those wetlands. In some cases that would enable us to think about using those wetlands in a rotational scheme with rice. It is a very interesting question and problem and it depends very much on each situation. I do know that floods like the one you experienced with Hurricane Irene, there is no rice that would tolerate that. It is more the management of water and I think that is what you are thinking about, the longer-term.

Audience: Last year after the flood, everybody was talking about what kind of crop would grow in these areas that are so flood prone. We may lose that year's crop but you would have utilized the land in a way that keeps it from being developed in another way.

Audience: I have a question about growing rice in areas that have already been designated as wetlands. I am from New York state and a farmer near me has quite a lot of land that is actually designated as official wetlands and he doesn't know if he is allowed to grow rice in it. I didn't know if you know whom one would ask. How one would find out.

Mia: You would ask whatever your state department of environmental conservation is. You can't grow rice in wetlands first of all and it is not a very suitable environment for rice because you need to be able to control the water. Wetlands tend to be fed by groundwater and the colder soil is not that suitable for rice. Rice needs as much warmth as it can in the Northeast to mature within the short growing season. Wetlands are not a suitable environment and we don't want to be destroying already protected wetlands.

Audience: I was worried about that. I was also thinking that you don't get the benefit against weeds because you already have a whole bunch of crops that are growing in that wetland soil, which is what I told him at the time but then I kept puzzling over are people actually using wetlands.

Mia: The target is more low-lying areas that are kind of wet, that are already agricultural land (pastureland or cornfields), that aren't inundated with water throughout the entire season but you can bring in moisture through a reservoir or something like that and then create a paddy. It is not a wetland to begin with.

Breeding of Purple, Aromatic Rice for the Northeast: Sandy Harrington

Thank you so much for having me here. This is the first time I have been able to visit the farm and I am thrilled to be here finally to see it in person. It is much more beautiful than I even imagined from the pictures. Thank you for having me. We have been working on this for a couple years now and I was thrilled last year when the Akaogis visited and we decided we would like to do a little breeding project because I love breeding projects to begin with. We would like to transfer some interesting traits like aroma or color into some of the favorite varieties here. I will tell you a little bit about how we would like to do that.

I want to start by saying "we" or "I" in my presentation does not necessarily mean me. It definitely means Susan, who you just heard from as well, guiding the project. Most of you know Gen Onishi who is our resident rice farmer at Cornell. He is actually doing the breeding of this rice. This is Ize Imai who is a Postdoc in our lab until two weeks ago when she moved away. She had been handling the marker work for us in the laboratory. Today we have brought Kathryn Blackley who will be replacing Ize for a year or so and will continue with that marker technology. Kathryn is a recent Cornell graduate so this is a fun learning experience for her too on a distinct project with distinct genes to focus on. This is me, obviously. I do characterization of the seeds we want to use, make sure the lines are pure. We are developing a database to catalog all of our seeds at Cornell, which I work with. I think I am the designated spokesperson.

The first thing I want to say, Susan touched on briefly, is how do genes move between plants and nature. Obviously they move by wind or insects. We all know that. See this nice black stigma sticking out of the rice spikelet. You don't often see that in nature anymore because cultivated rice only out crosses about 1-2% of the time. Here is a lovely rare picture of a bee pollinating rice. In the laboratory we manually re-create this by cross-pollination where we remove the male parts of the plant in an emasculation process and bring it together with other pollen. The other method in nature is gene transfer by microbes and viruses, a naturally occurring transgenic if you will. I think we have all seen the trees with the big lumps on the side, the crown galls. This is caused by a soil bacterium called *Agrobacterium tumefaciens*. It transfers genes into the trees' DNA and creates this crown gall. When scientists figured out how that worked, they were able to make it work using *Agrobacterium* in a laboratory to transform plants and create modified organisms in a natural but not greenhouse setting. We are not going to do that in this project. We are going to focus on the cross-pollination method.

This is a quick preview of what we are trying to start here. We are going to use a purple fragrant rice and a white fragrant rice and cross them to the Akaogis' favorite variety. The purpose is to take Yukihikari, which the Akaogis have recommended as the variety that they think produces well here and sells well for them here, and try to create a unique marketable product or two for them. Yukihikari is a temperate japonica, as Susan said, from Hokkaido with a short growing season and cold tolerance, which is absolutely necessary here. In comparison to the others, it has a shorter grain, it is rounder, and cooks a little bit chewier than the Della variety that we are going to use. We will call it the recurrent parent. The circle I have just shown, this is without the hull on. It is still a nice white, normal color for rice. The second variety, the first donor parent, will be Della. This is one that Anna McClung helped us choose. It has high fragrance content in it and it is also a different shape. It is a variety introduced kind of as a novelty in 1971 for its aroma in Louisiana, I believe. It cooks up drier and flakier than the Yukihikari that you have here and the grains, when dehulled, are white but are the long slender grains. The last variety doesn't really have a name so I named it for

my purposes. I call it PSA rice because it is purple, sticky, and aromatic. This is lovely in the greenhouse, not in terms of its physical appearance, it is a very tall and spindly plant, but when you walk by a bench full of these plants you can smell the fragrance right from the plants. I don't know if you can do that with Della. I haven't experienced it but this is very, very noticeable. This cooks a lot stickier and has the dark purple that we are trying to breed in.

The method that we are going to use, the breeding scheme, is called the back cross conversion. I don't know if all of you know what that is so I will go through it briefly. What I want to say is that each of these boxes represents a single individual, a plant or a seed. That is important to remember here. We would cross a donor parent to a recurrent parent and the result is an F1, like Mia's F1. As with her F1, every individual gets half of each parents DNA and we don't know which half. It is random. Every seed will be half of each parent. In the next step if we cross it back, this is the back cross, to the parent we want it to look most like then we reduce the amount of donor DNA to one quarter now. This is called a BC1F1 seed. We can back cross as many times as we want. You are going to see that every generation cuts in half the amount of donor DNA that remains from the original donor plant. By the BC3F1 we only have a 16th of the DNA from our donor left in any individual, however that DNA without selection is totally random. Who knows what we will get.

I would like to give a quick example of how we select so it is not so random. I will use purple seed color as an example here. When we make the first cross each parent will provide one allele, which is a single dose of a gene. We always get two doses. Every seed that is produced will be purple because the purple is dominant over the white color. If we back cross that, half of the seeds will be white because we will get a donation of a white allele from the recurrent parent always and half the time we will get a donation of that white allele carried by the purple F1 seed. The other half of the time we will go back to our 50/50 ratio and one white dose will come from this parent and one purple dose from the other. Half of the seeds that are produced in the BC1F1 generation are purple and half will be white. It is easy to select for color once the seeds are set but we have limited space in our greenhouse and we would like to get rid of the plants we don't need to conserve space and resources. What we use are the gels that Susan was talking about. This is an agarose gel. Agarose is made of seaweed and it creates a mesh, a matrix if you will, in which DNA will migrate when a charge is applied to it because DNA holds a negative charge on its molecule. We apply a charge and DNA is pulled depending on its size through this agarose gel. It feels like jelly. You can pick it up and wiggle it around and there are wells at the top where you load a little DNA sample. If the first lane represents the size of the band for the PSA purple rice and the second represents the white Yukihikari, which is the re-current parent, these are the offspring. You can see that the ones that turn out white, half of them, have only one size DNA that ran through the gel. The others that appear purple have a band from both parents. We have numbered the plants very carefully and we can toss out the ones that have the white allele because they aren't going to help us. We are going to choose these and only carry these on. We can continue and back cross as many times as we want as long as we run that gel every time to make sure we have retained the purple seed allele. When we want to set this for the Akaogis to provide a field line, we need to make sure that we have two doses of purple so that it breeds true for them when they plant it in the field the next year. We have to allow self-fertilization, which means we do nothing but plant it. It will fertilize itself within the seed. When we allow that to happen, the seeds segregate for us. 25% of the seeds we get will be white because they are going to get a dose from the recurrent parent as well as that white dose, but 75% will look purple so we can't choose just by eye. This is where we have to use molecular markers. We can actually do this when they are only three weeks old so it saves us a lot of time and effort in the greenhouse. See the PSA has its higher band, the Yukihikari has its lower band, but in the offspring

now you see three different choices instead of two. This band is from the Yukihikari white. We know we don't want that one. These three are all purple. We have half-and-half, a dose from each parent. We can get rid of those too. Now we have one that only has the same DNA size as the purple parent and if we choose that every time it is replanted, it will always produce a purple seed. That is the final step before it goes to field trial and only 25% will.

The crosses we are going to use here are as I said before, Yukihikari by Della, the long white aromatic variety. The traits we want to transfer in that cross are the aroma, which is a gene located on chromosome 8, grain length and grain width, length is on chromosome 3 and width is on chromosome 5. We can select different sizes and shapes of the rice to make available. If people prefer a longer grain or a fatter grain, we can hopefully provide variations for people to choose from. It just gives more variety but we will always bring the aroma with it. The second cross is the purple. That also has the fragrance, same gene, on chromosome 8. I simplified a little when I did my example because purple pericarp is actually controlled in this case by two genes working in concert, one gene on chromosome 4 and one gene on chromosome 1. It makes it a little more complicated to choose that than I had previously shown.

Manual cross-pollination. You will see that there is a star in this. It is a local movie star and you may recognize by the time we get done who it is. This is a spikelet of rice, six anthers, which are the male parts, two stigmas, which are the female parts. If you cut that open, you can see inside, the lovely yellow anthers that aren't quite ready to shed their pollen. We need to remove the male parts without damaging the stigma. There are three ways to do this. You can use forceps and pull out six anthers on their filaments and it is kind of tedious. You can also dip these into hot water but if your water is off temperature by a degree or two you will also kill the stigma. It is not as easy as it sounds. We use a method called vacuum emasculation and it sounds really cool. It sounds like you are being really mean. This is where we start. See the famous fingers. We need to cut every single spikelet open on a panicle before we can do this process. In the magic hands is the little tiny vacuum tip. Using just a little pressure, pulling and you suck every one of the sets of anthers out from each spikelet. You can also suck out the stigma (and you can ask me how I know that!). You can do it easily. This is not as easy as it sounds. It takes years of experience. We end up with a fully emasculated spikelet. Every spikelet on that panicle must be completely emasculated or we can end up with self fertilized seed and not be aware of it.

This is what our vacuum emasculater looks like. It is a toolbox in which a vacuum pump is installed with a battery and a piece of hose and this is a pipette tip from our lab. We have actually shipped these to three countries in Africa and it's not easy to ship a toolbox with a battery and wires in it. A lot of diagrams have to go with it.
Susan: Then the inspector says, "What do you use it for?" and you say, "To emasculate."
Sandy: They don't like it. By the third time we got it down but it has been challenging.
There are directions to build this on our website if you are interested in looking at that.

When every spikelet has been emasculated and it is essentially now a female, we move in a plant that is both male and female, but we are going to refer to it as the male plant. We put them in proximity to each other. This is the pollen extruding and that's when it's ready to fertilize and drop onto the female. Once those are together we put a wax paper bag over them so nothing else can float in. This is what that actually looks like in the greenhouse. We tie it with twist ties from the grocery store. You need to tap the bag every 30 minutes for about three hours a day, for about 2 to 3 days. When I first learned this technique, I didn't know that and I got about one or two seeds on a panicle. Then I

realized that you need to actually move the pollen off and shake it around because the pollen isn't ready on the panicle all at the same time. You need to continuously do this. Gen can get about 150 seeds from one panicle sometimes. There is our famous actor in his acting garb and he is not just wearing those glasses because he looks cool. It is a magnifying headset that we use because this is really tiny and tedious to do. Right now we are working on this 3-4 hours a day in the greenhouse. When I say that you need to bring the plants in proximity to each other it is not as easy as it sounds because they are wildly different sizes. The Yukihikari is not a tall plant nor is the Della but the PSA can be this tall sometimes. We need to stack the plants together and manipulate them so that they can actually be in the position where they can fertilize each other.

I come back to what I showed you in the beginning and this is what Gen was able to accomplish last year in our greenhouse. We are very proud it. It is the first purple cross that we have made. These are F1 seeds that are growing. We call them naked seeds when they grow like this out of the panicle. He has planted them this year. We started this in November. These were harvested in February. There is Gen admiring. I love the picture. These are the F1 plants that we have planted and we are in the process of doing the back crosses right now to the Yukihikari. Another challenge that we have faced is the wildly different growing season length so we have to stagger plant. We will plant the parents weeks ahead of time, every week or every few days, trying to get them to flower at the same time because they don't normally do that. Some of them are also under a short day treatment to also alter flowering times. Luckily the Della by Yukihikari was pretty good timing, but the PSA-Gen just caught the edge of it on some of them. We were really lucky that he was able to do that because it is a much longer season rice.

Our goal is to provide several lines for field trial by 2015 to the Akaogis. Our other goal is to interact with all of you and show you how markers can help you select, move nature along at a little bit faster pace than it might normally, as well as to train young scientists like Kathryn in how to use molecular markers in breeding programs. This has been a wonderful project to get out into the community and it has been a lot of fun. We have a good time with it and the Akaogis are wonderful. They have brought a whole new aspect of rice farming to us. Thank you very much.

Michael: There won't be any seed, even at the Akaogis, until 2015. The only way I ever knew of to get seed, and maybe it is my own ignorance, is Christian Elwell got me started three years ago. Now with 1000 ft², I am hoping to get enough to provide seed for 10,000 ft². Reading the Farmers Exchange it looks like other people have been able to get seed from Cornell or the USDA.

Sandy: We actually don't provide seed too often anymore and if we do it is a very small amount. The Akaogis even ordered their own from NSGC (National Small Grains Collection) when they first started. You will need to amplify the seed first to start. When we grow rice, we grow very small amounts as well so if we do share seed it is about 10. It is nothing. There is no source at this point for a noncommercial farmer to grow rice here in this area. I think that is one of the topics we are going to talk about today, a farmer seed exchange so you guys can get up and running. We don't have the facilities to grow that much rice and I know NSGC only provides about 10 to 20 seeds as well.

Mia: We gave you a handout with a summary of the farmers in the Northeast who have been growing rice for more than a year and on it we asked them if they would be willing to provide seed. Most of them are willing to provide seed so there will be this community of farmers in the Northeast where you can distribute seed among

yourselves. We are trying to think about that more and more because finding seed is one of the big issues. We recognize that.

Anna: Just to make it clear the USDA does provide seed for free from the USDA world germplasm collection but it is usually for research purposes so it is just a small amount. Of course I am working primarily with southern material, but if we were to come up with a variety that we thought might work well here, I would be glad to try to work with you to develop some larger quantities to help you get started assuming the initial seed increase could be produced in our environment. I have done that with other business ventures. It is really more a matter of identifying what is going to be the most suitable for the Northeast, not that we would be producing a large number of varieties, but something that would be broadly useful.

Michael: Does that mean we could get seed from you either to start in buckets and try and grow enough of our own or maybe even enough for 1000 ft². If we go to 5,000 ft² and 10,000 ft² we are going to have the test plot and it would be nice to try something else there next year.

Anna: That is what we do. We produce the seed and distribute it. And again it is just a matter of making sure that we produce the varieties that you are interested in and that I think is the first step. We have 18,000 varieties in this country so which one do you want?

Michael: Varieties that can grow in the Northeast on dry land and be harvestable by the time winter comes. Although I appreciate all the science, as an old geezer I am looking for some thing to help me actually retire someday. The thing I have already learned about rice, and a couple of the farmers down in the Pioneer Valley, Massachusetts, is compared to corn you can make a fortune off this stuff. There is a niche market. We have been offered two dollars a pound for at least several hundred pounds of good, organic, locally grown brown rice. I am assuming at some point what this is all about is people being able to do it as part of commercial agriculture.

Josh: We got our 5 or 7 grams from the USDA of Hayayuki and our 10x10 plot was super, super fertile so we got 16 or 18 pounds of rice from that. We had plenty. We planted up almost an acre. We went from that 5 g to an acre in one year. If you have the space to grow out, it goes fast.

Michael: We have 10 acres that is too wet to be a good hayfield and so far at least what the 1000 ft² shows is that land that is too wet for much of anything else seems to be good stuff for rice.

Audience: How many pounds did it produce?

Josh: It was about 18 to 20 pounds. We didn't weigh it all, but that is what it seemed like. That is about 6000 pounds per acre if you extrapolate it out and that is on the higher end. It was just because it was a small plot and we could manage it intensively.

Susan: That is higher than the global average so you are doing very well.

Josh: This year we are not anywhere near that.

Susan: No disease pressure and almost no pest pressure. You guys have the perfect environment, cool nights.

Sandy: The Akaogis have trialed several varieties here. You can ask them about that too. What does grow?

Takeshi: Well actually that information is on the website. There is information about all 50 varieties we trialed here. Go to the website and select what you are interested in and get seed from the USDA and try 100 seeds. Next year you will have enough seed to fulfill all of your needs.

Rice Cuisine and Culture: An International Perspective: Naomi Duguid

This group seems to be loaded with people who know an awful lot about rice, from its invisible guts to its external habits and habitats, and who have worked intimately with rice. I hope that you won't feel I have wasted your time because I want to take you on a bit of a tour, a visual tour.

This is Tirta Gangga, in northeastern Bali. This is peoples' idea of a rice landscape. When Susan started to show her images I thought, oh my gosh, she is going to take us to Banaue and everywhere and I should just go home. The amazing thing about rice is that it grows in so many different environments. We have rice out here, we have rice in Bali, but there is rice in all sorts of different environments grown in all sorts of different ways. The thing about Bali, just as a digression, is that because it is very near the equator there are no seasons really. There is a time of year when there is a little more rain but they get their water from the mountains and they manage it as Susan described. Water comes down and there is very strict social organization because everyone has to agree on maintenance and rice water management. Because there are no seasons, there are environments where you can see in the same visual, rice being planted and rice being harvested depending on the different farmers. It is an extraordinary thing. If you are a rice junkie and I assume at some level you all are, a trip to Bali is not a bad thing in January or whenever because it is just so extraordinary as a rice environment.

Rice. I wanted to remind us because when you look at it closely it is really kind of remarkable. Of course all of you scientists know all of this, but when you investigate them closely they look very different. These are mostly Mediterranean rices. There is a rice plant, a poor dry little rice plant. This picture is taken in the Marche in Italy where there is a guy, a scientist, who is an obsessive, but all of us have to be at some level. He is growing dry land upland rice because there was a history, a tradition, of growing dry upland rice in the Marche but it ended about 100 years ago. He wants to revive it. This is what it looks like. Rather sad in the ground very early on, just like your reseeded lawn or your reseeded grass. It is barely coming up, if you can see it.

There is also dry land rice cultivation in other places. This is actually in Assam. This is dry plowing. This is a guy plowing under a rice paddy in Assam. Can you picture it? It is the northeastern lobe of India if you skip over Bangladesh, up there in the Brahmaputra Valley. This is plowing in the rice crop from last year. The rice has been cut and then there is this ratoon crop coming up, secondary growth, and he is plowing it in. This is in Guizhou, in China. This is step one. I like images of plowing so I have a few more to look at. This is Bali again. Here it is not the ratoon crop. It is general grassiness and I don't know if it was deliberately planted or not. Anyway, he is plowing it in. This is, of course, paddy rice. This is Goa. See over there? There is already the nursery of the new rice plants that are going to be going in here. The ground is still lumpy so what they do then is, they smooth it. He is standing on a board, like a stone boat sort of thing, and he is smoothing it. This is in southern Yunnan and again there is the nursery rice that is going to go in. It is like with everything else, the more care you take in theory the less loss you will have.

Here we are transplanting. This is in Goa. It is flooded to whatever depth. You guys will discuss these questions of what depth is ideal for keeping back this and that or for the soils' microbial structure. This is uprooting the nursery plants. This is in Laos. This is actually an interesting location because there is a spring. It is near Luang Prabang in North Central Laos. This is actually not

monsoonal flooding. This is a crop happening in late January and so they were able to get a second crop here. Then they have a monsoon crop later. This is in Karen State in Burma and again these are quite tall nursery plants. I was really surprised that they let them go that late before transplanting them. Here they are working in Karen State, which is sort of South. It is on the lower Salween River. It is South of Rangoon on the part of Burma that borders Thailand. This is in Bangladesh, transplanting. These are again quite tall nursery plants and look at her posture. This is the labor of transplanting. Most often done by women in my experience. This is in Bali again.

There are other ways of planting rice of course. Any guesses on where this picture is? It is pretty hard to parse. This is in the Ebro Delta in Spain. This is a guy, well a group of them but this guy was the one doing the work. This is a guy who had the bad luck of having a planting fail. I don't know for what reason. They planted this and flooded it and they had a germination failure and he is having to hand broadcast seed. He is just walking back and forth, back and forth, as they used to do until recently there. There he is looking a little hard done. The seed had been soaked over night and he was picking up lots of it at the side and then doing a walk back and forth, pass back and forth, and picking up more.

We are now moving into rice landscapes. This is in Bangladesh in early rainy season. Here is the transplanted rice and here is the flooded land in late June, at the very end of mango season. If anyone is going to Bangladesh I recommend the last two weeks in June. Well really, mangoes in Bangladesh are incredible.

Any guesses on where this is? There is a bird. There are rice plants. It is a large area. It is in the Po Valley near Vercelli, which is where the Borso Del Riso (rice exchange) is. Where people bid on rice futures and so on. That is the heart of rice cultivation there.

This is in southern Senegal. I don't know if you can picture Senegal in West Africa. South of Mauritania is Senegal and it kind of looks like an open mouth with the country Gambia inserted in the middle. The Senegal River flows through the north, comes out to the sea in the North. The southern area is called Casamance and that is an area that has been indigenously rice cultivation for a long time. They used to grow the *glaberrima* (*Oryza glaberrima*) that we saw the spectrograph of but now they grow Asian varieties of rice. They are not self-sufficient in rice so they also eat millet. Rice is their heart crop and millet is their sustaining crop. They eat millet for breakfast, usually in the form of large balls, but rice is their main meal, their preferred crop.

This is their dry season again. Like that Luang Prabang picture, there was a spring. I am walking through this red, dry landscape and they just rely on rainfall generally for their rice. They have these low walls between different peoples' patches of rice to manage the water and hold the water in. The patches tend to be very small, smaller than here even. Here there is a spring so she is watering the rice. They are out in the rice again in Casamance near a village called Marsassoum and she is weeding. This is to remind you of the different places we can be. Look at how dense that is.

Now we are in Bali and we are about the stage that the rice is here, maybe about a week behind. There are ducks paddling around, fertilizing, eating grubs, and taking care of things. You are going to get rid of the ducks before the rice heads because the rice is for you not for the duck. The duck is helping you. The duck is not there as a co-consumer. You are going to eat the duck. The duck is not going to eat your rice. This is a picture of somebody in Guizhou who's been cleaning duck scum off a flooded area before they plow. She is a Dong woman. The rice is growing and it is funny to be

showing this picture and have the rice out here and be in Vermont. I find it really fabulous. Usually if I am showing these shots in North America I say, "We are thousands of kilometers from rice." Well, no we aren't. This is in Yunnan, near Dali, near Lake Erhai. The rice is ripening in Bali. These are new varieties of rice. The traditional variety of rice is tall. This is new crop rice.

Harvesting. This is in Bengal and these are Bangladeshies harvesting and threshing. This is in Assam. There are many ways of threshing. Why are we threshing, because the rice is harvested on the straw. The rice is heavier than the straw, which is lucky because the animals are eating the straw and the rice is dropping through.
Jim: They are threshing by the animals just walking on the rice?
Naomi: Yes. Percussion.
Here we are drying the rice and here is selling the rice in Bengal.

Now this is rice as food. These are rice rations. These are people who work on tea plantations and this is rice being used as payment. They are collecting. They have chits and they are going to be picking up rice and some wheat flour, some atta flour, and some oil.

Harvesting rice in Vietnam. Harvesting in Thailand. It is a little bit taller. That is sticky rice. Then threshing by hand. This is in Bengal. We were talking about threshing, beating it. There are a few threshing sheds in South Carolina still, in some of the plantations. I was at Mansfield Plantation and they had a house on legs and the threshing took place above. There was a hole in the floor and they banged it on the floor and the rice dropped through. They still had to winnow to clean the rice.

Now this is because if they were to carry this home they would lose a lot of the rice on route. For reasons the scientists can tell you, some rice grains detach easily and some hold on more tightly. This is one where they need to thresh it in the field. Here in central Vietnam she has a foot treadle thresher. This is rice that has been threshed in Guizhou. There is the straw. There is the rice. It still needs cleaning though. It needs the straw cleaned out of it. Here she is winnowing in Burma, catching the wind. It is fairly clean. She is just getting the last bits of dust out of it but this is still at harvest time. She will do this again later at home. This is a preliminary one because they are going to weigh the bags and they want the bags to be fairly honest. There she is cleaning up the last bits. Winnowing is more than a one step process. There they are picking up the last grains. There it is going home. This is in the Shan States in Burma not that far from Taunggyi. There are the bags of rice and the oxen and there are the stacks of straw.

This is in Bengal, walking the straw home. It will be used for various things; either bedding or it might be used to pad the roof. This is near Diamond Harbor in Bengal. Drying the rice. This is in Bangladesh. This is a portrait of ripe rice on the straw. It has been cut. I took this in Senegal. The people there keep the rice on the straw until they are going to prepare it and cook it. They store it under the eaves where the smoke from the cooking fire collects. It doesn't get smokey tasting but it keeps some of the bugs out. It is also where their beehive is too. It is kind of interesting. There it is with the grains on the straw. The same kind of thing happens in Bali with the old crop rice. Remember the new crop rice was low and I said, "Look how low it is with the kid bicycling?" This is old crop rice, traditional rice, so it is right up to their armpits. You see they are cutting it high. They are not bending over. They are going to leave long straw in the field.

This is in Bali. She has got a knife here and there is just a little end of it sticking out here. Remember the picture Susan showed of the offering that people make. There is a whole structure of offerings

each day for the rice god and goddesses, the entities that take care of the rice crop. It is also true that the rice itself is alive and is going to be afraid if it sees the knife coming. When they are harvesting in Bali, traditionally they hide the knife. They are cutting it and putting it in their other hand and then they make a bundle. Then they carry it home on the straw. This is traditional rice. Of course it has a longer growing season so they can only get two crops of it a year, sometimes only one. With the new rices they can get three or four but there are complications. People prefer the taste of this, it is the taste they know. If you have rice that stays on the straw, then you hang it on the straw. That is what I have seen in Japan as well. In Miyama, I saw this hanging in the field air-drying.

This is in Guizhou, which is in southern China. If you can think of where Guangzhou is. If you go inland from Hong Kong a long way that is sort of where it is, north of Vietnam but without a border with Vietnam. I just found this incredibly beautiful, hanging looped across. In the same way they dry millet in Japan or millet here or corn, the rice. This is in Japan, in Miyama, rice in its bags in a farmhouse.

I am mostly interested in domestic rice production and local rice production. That is why what people are aiming for here, in terms of a local distinctiveness, seems to me really vital and important that you develop an identity and a sense of place. If you are a rice eater, you have a sense of place from the rice you eat growing up. There is also commercialized rice production of course. Where would we be without it? Most of what I am talking about is very locally focused, rice grown and eaten within a close radius. This is an old machine. It is blurred because the machine is moving. This is a rice-sorting machine that dates from about 1910 and is being used still in Italy. It is a lovely thing, all made of wood. This is rice again as aid, in large quantity. This is rice in Bogole. In the delta in Burma, a year after the cyclone Nargis. This had been rice from somewhere else shipped in to feed people.

Commercial rice production. The other thing I wanted to say about commercial rice production is shipping. This is from Saint George in South Carolina where there is a rice museum. This is a reminder of several things. First of all, people got rich on other peoples' labor. We know about that, but who were the people? They got rich also on other peoples' knowledge. It wasn't just their labor. The people who knew how to grow rice and manage the water were of course the people from Africa. It is the same in southern Senegal. When the tide comes in, it pushes the river water up. If you know how to manage it, you have sluice gates and you let the river water in before the salt water reaches you and then you close them again. This is all very sophisticated water management and the slaves who had higher value were the ones from the rice growing area because they knew how to do that. It was not some white guy from France or England, right, who knew how to do that.

Now we are into processing rice. This is parboiling in Bengal, in a rural family way. Do you know what parboiling is? Some nods, some no's. There are all sorts of scientific ways of doing it but this is how it developed in India. It is in the husk still. It is not polished at all. They boil it, cool it, air it out, and dry it. Then after that they take the husk off and they might polish it. The consequence of doing that is that the starches are gelatinized, they have softened. The starch crystals are gone. They have turned into a liquid (semi-liquid gel). When it cools they harden but they no longer have the crystal structure. They are one hard thing. They are glassy. Actually parboiled rice takes longer to cook because there is no longer an easy entry for the water. What karat transmits heat? Water. The water has to penetrate it. The water has a harder time penetrating it once it has been parboiled. Am I making any sense to you? Then it has a terrible smell, but it doesn't have a terrible smell for people who grew up with it. For them that is the aroma of satisfied hunger. It smells good. In the same way

it is true for some people that the smell of cooking garlic is not good. For us the smell of cooking parboiled rice is bad, but for people who grew up with it, in Sri Lanka, in Bengal, it is delicious.

Sjon: Why do they do that?

Naomi: Because actually it keeps better. It is harder so it is more insect resistant. I don't know if this is true, but this is certainly the belief and probably the experience. It was developed a long time ago in India. The other thing and who knows if they knew this but it turns out that when you parboil, again the scientists can correct me about the details, some of the nutrients from the bran go into the endosperm. It is in fact more nutritious than non-parboiled rice. Again, counter intuitive. You might think that you have cooked something out of it. No, you have actually cooked something into it or transformed it in a way that makes it more nutritious.

This is in Bangladesh. This is a commercial operation parboiling a lot of rice. Still fired by the rice bran and rice husks.

Processing, we are pounding the rice. This is a Hmong woman in northern Laos and she is cleaning the husks off the rice and she is also polishing it. This is in Senegal. There is the mortar. It is very tall. The mortar is like this. A big wooden hollow thing, same as you would see in Banaue, in the Philippines, and there is the pestle. No joke about the big pestle. Usually they do *a deux*, two people doing it. Bang bang, bang bang, bang bang. It takes a while. This is how they turn their millet into flour. It is all a lot of labor. After they have polished it, they still winnow it again because they want to get extra chaff and stuff out.

This is in northern Laos. This is all about taking care and having respect. This is not a pile of rice on the side of a plate. This is rice that somebody has put all that effort into. In this case, this woman has put her effort into her rice and now she is going to wash it, thoroughly. This is in Senegal, cooking it over a stew.

Sjon: The pounding is to take the hull off?

Naomi: You take the hull off and then you clean it because there is straw and junk. You put it back in and pound it again. Of course it is not going to be a perfect polish and you are going to get some broken grains. It actually becomes like what the Italians' call semilavorato, somewhat brown, and that of course has more nutrition. When it is perfectly polished and you have a lower percentage rice, there is less nutritional value. There were in Malaysia, for example, nutritional issues when people didn't have much else to eat and moved from their hand cleaned rice to commercial rice.

You can cook rice in various ways. You can cook it like that in steam or a limited amount of water. You can also cook it like this, in Bengal, cooking it like pasta. Throwing it into a big pot of boiling water and then lifting it out. The higher amylose rices handle this better. Or you can cook it paella negra. This is with squid ink. This is in Catalonia, Spain. Here is a guy pounding garlic with olive oil to eat with that, just to remind you of different cultural contexts.

Sticky rice. Thai sticky rice steamed like this. It has been soaked before. Why, because it is very low amylose. Amylose is what makes rice stronger. Rices with high amylopectin, which makes it stickier and softer, are also called sweet rice or glutenous rice. There is no gluten. It just means it is sticky. It is a descriptor. It has to be soaked in water so the water is inside it already and then it is steamed. The water transmits the heat because the rice has taken it in already. If you boil it, it goes to mush. When it is steamed, you get this fabulous texture where it is sort of like bread. You just pull a piece off in the same way as separating crust from bread. It is not sticky on your hands. It is just

extraordinary. Also, there is black sticky rice in there to look at. In northern Thailand classically, in the country, a lot of people mix about a handful, a sixth, of black rice with the white when they soak it. The stain comes out of the bran and dyes the whole thing a kind of purple. The darker rice stays a little darker. There are dark dots and then the whole thing is steamed together. Then it is this gorgeous sort of pale and dark purple mass that is making me hungry to think about.

Sjon: How long do they steam it?

Naomi: Once you soak it, it only steams for 25-30 minutes.

Elysha: Without a lid?

Naomi: Without a lid. That is the thing. I am just a stupid, superstitious person so I usually put something on top but that is just dumb. My Thai friends think I am just crazy. What is my problem?

Then you use that sticky rice to eat with. This is a hand with a piece of sticky rice and he is lifting it, he is using it like a piece of bread to scoop something up. This is in northeast Thailand again, picking up yummy things with rice. It is an entirely different way of eating. You eat with your hands. It is very sensual and it is also very delicious.

This is mochi, but mochi Lisu style. Lisu are one of the groups that live in the mountains, that came down from China. There are still a lot of them in China, but they are also in Thailand. This is of course New Year's, which is when you make sticky rice. They are taking cooked sticky rice and pounding it. This is a huge mortar. This is the working end of it. Remember that woman that was doing this with her foot before to clean the rice? This is a huge version of that. That is the end and then there is this long, long thing. There are about four people standing on it and jumping up and down because it is New Year's. It is an exciting time for everyone. This is a mixture of black and white sticky rice pounded and then being grilled. This is a mountain thing but it is in a tribal people market called the Haw Market in Chiang Mai. You can of course cook sticky rice in bamboo. It steams itself in the bamboo and then you peel that bamboo open and eat it.

Jim: How would they eat that sticky rice they were grilling? Would they eat it with something or some type of dip?

Naomi: I just eat it in hand, greedily like that. It is a bit of a sweet treat in a way. It is not sweetened but it is a treat and stretchy. It is a form of mochi.

This is the classic black sticky rice with coconut milk. This is a street vendor in Bangkok, morning food. She has got it on a banana leaf and she's folding it up. The person will take it away for lunch. Rice in other guises, leftover rice. You can do this with sticky rice or with low amylose rices. It is easier with low amylose rice because they have got some stickiness to them. They dry them in the sun here in Laos and then they can fry them and they puff up. They are completely fabulous.

Puffed rice. This is widely used in Bengal and Bangladesh. This is a picture taken in Karnataka, which is the state south of Goa, on the west coast of India. Rice noodles. This is rice soaked, ground, kneaded into dough, and put into a cloth container with a wooden thing at the bottom. She has hauled the wood, she has hauled the water, she has the water boiling, and then she is extruding them. This is how you make rice noodles. The best rice noodles are when the dough is left to ferment a little bit so it has a little extra flavor. Now of course there is a semi-mechanical way of doing it where they make the dough in a machine because it is a big batch for selling. Then there is a gizmo with a pump and people have the water over a wood fire. This is outside Chiang Mai and it is still going on now. They hold the pump, they push down on the button, it goes "mrrwww", and extrudes it. They create great volumes of them and then sell them in the market for pennies. This is a Tai Lu woman, in northern Laos right up by the Chinese border.

Here is another version of rice noodles. It looks like rubber drying, if anybody has seen rubber plantations. Those are sheets. Those have been steamed. They take the batter and put it in a tray. This is a technique that traveled from China down and this is in northern Laos. This is a Tai Lu woman.

Jim: Is this more of a sticky rice type? I can't imagine rice creating this kind of flour where it would adhere like that.

Naomi: They just soak the rice and grind it. They don't even start with flour. You can do it with flour. When you do it with flour, it is best if you add a little tapioca flour. It gives it a little resilience and it also gives it a nice little bite, but classically no tapioca.

It is amazing what steam will do to a surface that is all I can say. You have to oil the surface, then you put it in, and put a lid on. You can do it at home. You can float it in water. You can use a tray and float it in water. It is the easiest thing. Then you lift it out, peel it off, and then you hang it somewhere or you cut it up and say, "Wow, I did this!" You cook it right away and congratulate yourself. This is a lot on noodles, but it is interesting isn't it?

These are rice noodles. They are hand formed. They look like little bullets. This is in a market in Guizhou. I figured out how to make them. I watched her and watched her and have a recipe for it in another book called Beyond the Great Wall. It is just straight rice flour, very interesting. It does work with a tiny bit of oil in the mixture. You look at that and you think why would anybody make a thing that shape, is it about the cooking? It turns out your palm has a hollow in it and if you take a ball in your palm and rub it back and forth, this is what you end up with. Sometimes there are just practical explanations. A noodle stand in China, in Yunnan.

Now to Japan. This is right near the Inari Shrine outside Kyoto, which is where there is a ritual crop of rice grown. It is an offering. I cannot do all the layers of meaning, but it is a really important rice area. If you are in Japan, you should go to the Inari Shrine just because I am assuming we are on the rice fanatic page.

This is a woman of a certain age. She has rice and she is laying it on fish and the whole thing is being wrapped in a leaf. This is something that happens in this Miyama area, in these mountains inland from Kyoto. It is one of three that I have heard of, but the only one I have seen, versions of an early, early kind of sushi. Why are they doing this? They do it because it gets wrapped in the leaves, stacked in a barrel with a weight, ferments, and then it is food ready to eat at harvest time. The women love it because it is associated with not having to cook. They have made it ahead, but then it is there. It tastes like cheese. Actually for most Japanese, it is just gross. For the people in the valley for whom it is their thing, it is wonderful. A younger woman said to me, "It was really hard. I married into this valley and the first five years I couldn't even be in the room. I could help with the preparation but I couldn't be in the room with the thing itself. The next five years I could serve it to my husband and the third five years I now eat it sometimes and I know that I am working towards loving it." It was a fascinating thing because the smell of it was so much like cheese. When you think about natto and other things in Japan. She had no problem with natto, no problem with those other things, but there was a particular cheesiness to this rice dish that was difficult for her. For me as person who likes cheese, it is not because I am special, it is just because it is actually much closer to my aesthetic than it is to hers. It is very interesting.

Japanese kids at school. Since MacArthur, since World War II, they have had wheat flour in their school diet. They have pan meals, bread meals, and rice meals (gohan and pan). Which do they

prefer? I talked to the class and they prefer their rice meals. They have rice but they have milk. It is modern Japan. The rice is all dished out and then eaten at the desk. They say a prayer. These are kids in Sarawak, up the Red Jiang river. They are also rice eaters but their rice is grown by slash and burn agriculture, swidden agriculture. Their parents are going and clearing a bit of jungle, until the recent dam construction, and then growing rice and harvesting it. It has low yields and is dry land rice cultivation.

Rice is eaten, offered to Monks in the morning, in Laos. That is sticky rice. She is picking up a clump of it and putting it in their baskets. Rice in Senegal. It is flavored, steamed, and served with vegetables on top of it. Dirtying the rice in Japanese terms, but in Senegal flavoring the rice. Risotto a la Birra in Vercelli in Italy. A very dirty rice, completely delicious, and cooked with a dark beer. I know it sounds weird but it is unbelievably good.

This is a Gujerati Thali. There is clean correct rice in the middle and all sorts of things that you would eat with your hands to combine it with, all very vegetarian. The Gujerati palate is a slightly sweet palate. Then back to rice again. This is all Japanese rice, all from Miyama. Here is the whole rice, this is semi-polished, and then the white. The whole rice had the husk on it. You could plant this and it would grow, in theory. This has had the husk taken off it and a little bit of the bran, but not completely, and this is polished, polished.

I hope this helps take you somewhere and I hope it makes you appreciate what is here.

Jim: I am curious about the rice polishing. I imagine most of the nutrients are stripped off?

Naomi: Well again, the scientists can be more exact about this. I used to know the numbers but basically there is the bran and the germ. It is just like talking about wheat in a way. The endosperm still has protein in it. I mean white rice is 8% protein or something like that. It is very digestible. It is very usable so we don't waste any of it. We are missing various nutrients and that is why parboiled rice is such a brilliant thing if you can get past the smell of it. There is a parboiled rice from Louisiana called popcorn rice because it has a bit of a buttery, popcorny smell and you can kind of tune out that other funny smell that Randy was talking about. The strongest smelling parboiled rices I know are from Sri Lanka. If you go to Sri Lanka, the food is very interesting, very good, very diverse, but if you smell a really funny smell that is what it is. It is not the food. It is just the rice. It doesn't taste of that. It is just like Limburger or like durian. It is a smell. It isn't the taste, but it is pretty hard to get past. It is fascinating.

Audience: Uncle Ben's is also parboiled.

Naomi: Uncle Ben's of course is parboiled. Then what they had to do because it takes longer to cook, remember I said it makes it harder, is process it some more. It had a nutritional reason. It gave people more nutrition but they didn't want them to have to cook it longer. Then they messed with it some more. Now it has no taste and no smell but it is white stuff on the plate and for some people that is their home taste of rice. We all have our home taste and it is really important to respect what that is. It can be the person eating Sri Lankan rice that you don't want to be in the room with while it is cooking or it can be the person eating Uncle Ben's that you don't see the point of, but for each of them it is their heart rice. I didn't grow up with rice but I became a rice lover that is why my book on rice is called the Seductions of Rice. I

got seduced into being a rice eater fully. My first heart rice was a Japanese style rice grown in California and I tend to buy Kohoku Rose because I have always bought it and that is the one I know. I know I am told there are all sorts of others. Thai Jasmine rice is my other heart rice and I am also always happy to eat Thai sticky rice and so are my kids. If you have children who are not inclined to eat or who might be picky or something, well first of all don't argue with them about food in general but also feed them white sticky rice. Then turn your back and let them pick it up. It is really an interesting thing. You soak it first and then steam it and you don't have to worry about measurement. There is no measuring, no cups. You just wash it completely, soak it, steam it, and you don't have to think about anything more, which is a real boon for people who tend to be approximate like me.

Sjon: In your experience is the rice that people tend to eat semi-polished because they do it themselves? It is never the white rice that we would buy?

Naomi: Many people are getting their rice polished commercially. We are talking very rural areas there in Senegal. Most people are not laboring. To clean the rice for six people she is doing it all at once with two pestles. I was working with one and her daughter was with the other. It took about half an hour. You are not going to choose to do that if there is an option. This was a village with no electricity where the salt came from people gathering sand and water at the edge of the tidal river and then boiling it down until they had salt. We are talking basic. In most places you are going to have somebody with a generator or a machine and there is going to be some kind of rice polishing. I wanted you to understand that this is where all of this comes from. It comes from a tradition of people doing things by hand and then trying to figure out ways to use fewer calories to get their calories. This is the equation that people living at the margin have to think about very, very seriously. There is a calorie equation and eventually there is a cash equation, if they start coming into a cash economy. Those equations are very tricky. Those are some of the things that I think Susan and the scientists are trying to deal with in terms of figuring out how to bring things along. They want food security, they want sustainability, but they also want people to like their rice, to stay anchored in their rice, and these are all tricky. The interest of the farmers and the interest of the consumers, when consumers and farmers aren't the same people, sometimes diverge and become an issue.

Audience: What if you wanted purple rice, where would you go?

Naomi: It is absolutely around. You could mail order it. Probably your best bet to start with, if you don't have a person you can send to Boston, is to mail order it from Kalustyan's in New York City. Kalustyan is an Armenian name. It is a store on Lexington at about 28th and it was started by Armenians. It is now run by a guy from Bangladesh who is fabulous. He has lots of rices, he does mail order, and he is not pricey. That would be a way of doing it. I have some black rice in my car. I just brought a bunch. Those samples are just things that I had in my cupboard and bought down the street where I live in Toronto, but I live in downtown Toronto. In a big city you will find it. It looks black. They will call it black rice but it is a purplish color and that is the color that comes out of it when it is soaked with the white rice. You can cook it on its own and then it is chewy. It is a brown rice. The black rice will hold on its own so you can cook it in water. It is about two to one, two water to

one, but don't worry about it because it is very forgiving. It takes about 45 minutes on its own.

Carolina Gold Rice and the History and Culture of Rice Farming in South Carolina: Glenn Roberts

It's great to be here and I'll be brief. I think the fairest thing to state right up front is that my family was a Geechee family. My mother grew up on the Sea Islands of South Carolina and there rice is breakfast, lunch, and dinner. The only alteration is for breakfast you had rice and peas, which are Sea Island little red peas, cow peas, and for dinner if you were very poor, you had peas and rice. You change the name but it is the same food. This is evidenced by the fact that you judge the viability of rice culture by what is on the rim of the cast iron pot over decades. If you find a cast iron pot at a garage sale in the Sea Islands that has a red ring in it, you know that was a real Geechee family. Anyone ever heard the term? It means rice with every meal and the term is African in origin. In my household with my Geechee mom, I was never allowed to cook rice for anyone in the family but our pets. Our pets had rice for breakfast, lunch, and dinner and so did we. I was the pet cook, which is why I am standing before you today not as a chef.

I had a real dumb idea, in retrospect, but I thought it was brilliant when I started. I was doing a dinner for the Smithsonian in Savannah, Georgia at a property that I had just built. I used to build hotels from historic properties. I would convert them into inns and hotels. I had this beautiful hotel and it was a Smithsonian tour so the whole board was there in bound and they had paid two thousand bucks a head for a dinner. I had gotten what I thought was ready-to-go Carolina Gold rice, having no idea what the hell that is. The guy at the Smithsonian told me that they wanted to have a Carolina rice dinner and they also wanted to have red rice. I sent him a recipe with ketchup in it and god knows what else and he said, "No, no, no. You need to go back and read something. You are an idiot." He said, "For two thousand dollars a seat, I want a historian in on this." I started talking to people that knew something about rice culture besides my mom, who actually had never made red rice at home much. It was a celebratory dish and I never got to watch her. She didn't let people in the kitchen with her when she was cooking because she was an hotelier and that happened at work. It was a private exercise for her at home. I didn't grow up at the side of my mother like so many chefs did learning all these fabulous dishes. I had them at the table though. We were so Geechee, by the way, I don't know whether anybody in here is old enough to remember that Sunday night was only dessert. At seven o'clock, nothing else served but dessert. It was a wonderful upbringing.

I am doing this dinner for the Smithsonian and they have asked for red rice because it is in Savannah and Savannah is known for red rice. We were just talking about another red rice that will come up in just a second. My friend, Dr. Richard Schultz, was growing for the Church of the Holy Trinity Episcopal church, for the mission, Carolina Gold rice. I had no idea how extraordinary that was. He had gotten the seed originally from Charles Bollich. He said it was from China and I thought he meant China by the way. I said, "Ooh, Chinese rice from Carolina. How cool!" The saying in Charleston is, "we eat rice and worship our ancestors." That is the same thing that happens in Asia. There is no difference at all. By the way, where is the highest rice per capita consumption on the east coast? Charleston, South Carolina. I cheated. I had all this wonderful culture in front of me and had no idea what was going on. "Ooh," I said, "Carolina rice from China." and I sent that back to the Smithsonian. It came blazing back on fire and he said, "Please let me speak to somebody that has a brain." Dr. Richard Schultz is very educated thank god. He is a Princeton grad. Charles Bollich had

been kind enough to blow up enough seed for Richard Shultz to ruin it. Let me repeat that. I am going to come over here and repeat it because my message today has to do with how grateful I am there is such a thing as pure seed. Charles Bollich worked for three years to get enough Carolina Gold rice seed so that Dick Schultz, who has a postdoc in ophthalmic surgery and is a historian and a bona fide good one, could ruin it. What did he do? Richard planted this rice: rice to rice to rice to rice and rotated out. Every year he grew rice and it was for a mission. It was for a good cause. You could get a little bag from the Church of the Holy Trinity and it was killer. It was very good rice. All of a sudden, there was less rice and as I am coming in with my Smithsonian dinner, there is less rice. I call them up. By the time the Smithsonian gets the history straight, and Richard weighs in, thank god, there wasn't any rice left. He only had a little bit of seed stock. I didn't even know what that was. Here is the lesson. He sends me what is left of the rice he is not going to have to plant. I thought that was odd. Why do you have to save rice to plant? What do I know? I am in Gucci's, a really expensive suit, for a two thousand dollar dinner with seventeen guests from the Smithsonian. It is four o'clock in the afternoon, the rice comes in, we are going to cook it, and there are little black things crawling all around it and there are little red things in there. Not only black things, there are red things. Isn't this supposed to be white?

That was a disaster but we did get the rice cooked. We had to pick the weevils out and pull all the reds out, the dishwashers and me. I was supposed to read the history presentation to the guests. I never made it out front. I turned into a melting sweat blob. I went out, burnt my shoes and my suit, sold my Lexus, and decided to be a rice farmer. The little red things were weedy red. Why? Dr. Schultz did something no one had done in a century. He repatriated a lost rice. It was not in production when he started. That was 1983, I believe. H was growing it on the same land. Fast forward twenty years. I just spent about eighteen thousand dollars on those same fields myself. I am now farming those same fields. My first view of Carolina Gold was weeded up with reds in that field that I am using now. The weedy rice that is red has no dormancy. It will be there forever. I have had fields blow up after they haven't been farmed in a century. First year there are a few reds, second year a lot, third year, boom, it is all red. What is this conference really about? Pure seed. If you are going to be in business, which we do culturally first, then we bleed a lot to grow rice. Stoop labor didn't go out of fashion yet, did it? Last but not least, if we are going to do it we have to have pure seed. Had I not met marvelous Dr. Anna McClung, I wouldn't be standing here today. My idea was to grow corn. Make a lot of money because I knew a lot of chefs and they were going to buy my corn and grits. Then I was going to grow rice with the money I made from the chefs. That is actually still true today but had I known what I would have to go through to get here, I am not so sure I would have done it.

This was my first conversation with Anna. You probably don't remember. "Dr. McClung, hi, I am Glenn Roberts. I am over here in South Carolina." and I can hear the eye roll in the background and oh god, South Carolina, oh no, weedy rice. "I need to know how to grow rice." She sends me the pamphlet, which I still have on the wall that says how to grow rice. I call her back and said, "Ok, I need the rice." She said "What?" I start noodling her and she says, "Glenn, it lodges." And I said, "What's that?" That is how stupid I am. "If you put too much nitrogen on it, it grows up and falls over, on its own. It doesn't even need wind. If you plant it too close, it grows up and falls over. In a big storm it blows down." It is kind of hard to be in business with rice that is flat. You cannot pick it up with a combine. Every two feet pick it up, cut it, back up, pick it up again, and cut it. You might as well do it by hand. I learned immediately what lodging meant. Anna told me, she was actually very nice, she said, "Plant the seeds at least the distance by your hand." That is how far she had to go to get me into business. "You know you put one seed there, put your hand down, and put the seed in

the next one. Or better yet Glenn, plug it and then transplant it. Then you will know where you are putting it. You won't have to guess where the seeds are." I started to plant and I got lost with the seeds. I called her up and said, "I don't think I have enough seeds."

Having said this first thing, brought to you by seed purity, in order to do what I do now, since 1998, you have to either know an extremely competent breeder and seedsman or become one yourself. Takeshi, we all know it is difficult. To become one yourself is always helpful because it speeds conversations to be able to understand and appreciate the long line of starting with pure seed that goes through some kind of certification, eventually. That means a human being is rouging the seed plants. Taking out everything that is not characteristic description, the way the plant is supposed to replicate, even to root structure. You don't know where your next thing is coming from if you are actually trying to get to scale. Scale meaning mid-scale farming. After all this time, we just put a seed house together. That doesn't mean we are seedsmen, but that means we have the equipment to do it. A gravity table, color sorter, big six stack clipper cleaner, that sort of thing. In the field we have to have these routines in order to do wheat, buckwheat, whatever. Having said that, a long-term plan that gets support for seed health, because there are seed-born diseases, that doesn't allow somebody to come in and pass out stuff that has got weedy rice in it. Weedy rice has no dormancy so you are out there trying to figure out what you are growing and you have got a weed that won't ever go away. What was the number one thing for weedy reds? Non-selective herbicide, paraquat. That sounds like Vietnam and that still is not totally effective. You still need to skim the surface for years with beans and stuff. Seed purity is number one.

How did Anson Mills survive over the fifteen years we have been doing it? We are doing three million a year and have about sixty farms now. Ninety percent of what we do is give seed away. Over fifty tons last year. We give it to both farmers who are in production and new farmers at all different levels, from tons down to a couple of pounds. It is not all rice. It is all the crops that go with rice. The second thing today, in marketing and culture, is that it is just not rice. You have to rotate your land out. If you have got paddies you have built and you keep growing rice to rice to rice in them, up here, you are going to start to disease up in year three, maybe even sooner. It is certainly not going to be the healthiest thing in the world for you.

Audience: What if you put in a cover crop in over the winter?

That is the perfect point. Our first rice farmers in South Carolina were from Italy. The seed they planted most likely was Nostrali, which is one of the main production rices from the 1400s forward in the Po Valley. I guess you would call Nostrali the father of Vialone Nano, which is an elite sort of porridge rice. We know of it in risotto cookery if you go to really elite restaurants here, but pretty down and dirty restaurants in Italy where farming traditions still reign. The Italian government came together in 1937 and the decade prior, it took ten years, and cleaned up all these old rices so that they would survive through the 20th century. They created Arborio and Carnaroli and Vialone Nano out of rices that preexisted. We have that heritage from our Italian rice farmers who brought in rice. The winter crop was wheat and that was any of the Farros and any of the Italian macaroni wheats. Then we had Huguenots that came in and took it away from the Italians. Those French people brought in Huguenots wheat and brought in rice culture from Spain. Go figure, I don't see any Bamba in any of the literature though by the way. The whole progress starts with Italian rice growers in 1675 that becomes African by 1710. The Italians are gone in horticulture and their methods too by probably 1740. In 1730 you have Sephardi coming in. That invasion was wonderful. You have the Germans coming in somewhere around 1710 and doing wheat culture by 1730, then coming back down and bringing the wheat culture into the rice fields for rotation by 1750.

By the Revolution, we were doing scientific farming. After the Revolution, the New York Agriculture Society was formed. The second one was the South Carolina Agriculture Society. All those journals are still intact. They talk about how to handle landrace rice. What is not clear in those journals, until you read really closely, is that the seed protocol for all of those rices was huge. You remember where they had a seed area in Naomi's presentation. In South Carolina, they would have to cut pure Cypress, untainted swamp, for seed production every year. They had seed bio-security centers in modern parlance. Every hundred miles scattered throughout there was a big expensive seed effort and seed caches to store three years of seed.

How many people know about ageing rice? We don't know about it in America because we don't think about seedsmenship in America. Our motto at Anson Mills is, "We are two hurricanes away from oblivion." We get one in South Carolina and one in Beaumont, Texas and we are out of business. We save tons of seed back every year, refrigerated, so that we can replant. One of the serendipitous things that happens when you save see, is you start to understand the seasonality of cereals, which is fabulous. You start to understand new crop rice and how wonderful that is, which we don't have the designation in this country. You start to understand ageing rice because you have it. Does the rice taste different at three years than it did at year one? Of course it does. If you happen to be storing it with wild bay to keep bugs off of it, it is perfumed. That is kind of interesting. You go back in the literature and you see every once in a while punches of seed rice going as a late rice to Europe at really high prices. Called laurel aged rice. That was excess seed stock and that was marketing too. As Anna is want to say. "Anna, I love this rice." "Yes, Glenn, but marketing is the only thing that gets it done." You have to market.

That is one nuance of something called the Carolina Rice Kitchen. The Carolina Rice Kitchen is the body of cuisine that goes with the farming system that is associated with hidden gardens (slaves running off and growing their own stuff), then market farming of rice, and last but not least, the elite in arcane gardens. That led to things like, after the Civil War, it took ninety days to catalogue the plants at Seabrook Plantation by the Union troops. Ninety days. They never even made it to the main house. There were over a hundred acres of exotic plants, Palm Kale, everything. What we have done is we have mined the Carolina Rice Kitchen. We have mined the farming and the farming journals. We have mined the process of rice and seedsmenship. We have put it all together and dumped it into the lap of a bunch of chefs, then tried to retranslate it back to the American public. Mostly we haven't done a good job on the retail side, but we do have four thousand, chef clients and we are doing really well, knock on wood.

By the way, you probably know this if you are in the food industry, there is no recession in the food industry. Period. We are up 130% over last year for whatever reason. I don't know. We actually did not market that.

They got all the permits at Orton Plantation. They are all done. It was in the Raleigh News and Observer last week. There are 370 acres mitigated down to 305 of rice fields that the 336th wealthiest man in the United States is just going to throw money at until he sees rice growing. That is huge.

Susan mentioned global climate change. I do work with the Hopi, Navajo, and the Pima. They have said we have all seen this before. It is in our stories. When they say they have seen it, it means they have a story for it. This is not new to them. If you think about having to plant corn. They have to go five feet down to plant it to get to the seep water. They can deal with climate change.

In our view, this is liable to be tropical up here someday, but in the reality view, we don't know what is going to happen because it is change. Change means you have to have rice that is suited to the area you grow it. I cheated. We already had a rice culture. We had all the histories. We knew what we were supposed to plant and Anna had the genetics. She knew how to get it to us so that we could actually count on it year in and year out if we were spread out enough. That has to happen up here too. You have brethren in this effort. SARE (Sustainable Agriculture Research and Education) is funding the wheat people up here. You should probably do some talking with them. They are centered in Deerfield, Massachusetts, SIT (School for International Training) and Unity, Maine. That does not include New York, unfortunately.

The ideas for marketing any cereal, obviously work for any cereal. One of the best ideas for marketing is to market the entire farming system. In the age where everybody wants to understand farming, they are really hungry to understand. As our good friend brought up, what goes with the rice. What legumes go with rice? If you are doing rice up here, then legumes are going to go with it. They will sell just as fast and I think ten dollars a pound is super reasonable for seeing what I am seeing out here. There is just no other place like it. Period. Find me one. This is so cool. Questions?

Michael: There is a couple in Amherst named Ben and Adrie Lester who have what they call Wheatberry Bakery and they have a grains CSA, (community supported agriculture). We have been members for several years and as near as I can figure out, they are getting three to four dollars a pound, at least three dollars, for things like wheat and spelt. They have offered us two dollars a pound if we can come up with enough brown rice that they can have some for their members, but how else do people market? It seems like what you have described is what I would call a niche market. People who will pay premium prices for locally grown grain that they know where it came from and preferably organic. What other marketing methods are there that can help turn this from experimental, isolated efforts into a business that hopefully people can live off of?

Glenn: That is fabulous. Sommerset Mill in Maine is a really good example of how you draw all infrastructure and sourcing together, but not the seedsmenship, which is why I said it first. You draw everything together. They are hugely successful. They have the Kneading Conference. I don't know if you have heard of it, but three thousand people show up to have flatbreads in a field. Twenty eight hearth ovens going to town out there. The best bakers in New England are all out there doing it in Skowhegan, this time of year. They just had it I guess. They have Kneading Conference West now. I was there for the first or the second one. I could tell they were going to pull it all together. Steve Jones stood there, he is a wheat breeder and well known for his work in landrace wheats in the Pacific Northwest out in Washington. I was in the audience going, "Yes, yes, yes!" I was like whistling because I am a groupie for scientists. Everybody else is going, "What is this guy talking about? He was talking about plant pathology, he was talking about fusarium, and post-harvest handling. The answer is to pre-sell a CSA and capitalize a mill, which is what they did. Have central processing to start with and then everybody else can do what a guy in my crummy old mill town did, which is Columbia, South Carolina back in the 70's during the 60's hippie era. He actually had a huller and paddy rice. I think it was steamed and sterilized so we could do it legally, but you could go in and hull your own rice right there in the shop just like in Asia, which is very cool.

Michael: That is a good question because we haven't grown enough in three years to have anything more than seed. One thing I worry about is hopefully when and if we get to the point of being able to sell, how do we do the hulling? I read on the internet about machines far away in Asia, but I don't know. I think there is one here.

Glenn: You pre-sell your CSA. It is done all over the United States. People will invest in you. It is crowd sourcing. You just put up on the web, just pick one of the sourcing things, and you will get showered with money because you have a history of trying to pull this off.

Michael: Where do you get a small-scale hulling machine?

Glenn: They are everywhere, everywhere. I shouldn't start plugging companies. I have been treated really well by my Japanese rice engineers. I do not speak Japanese and I have a friend who is a horrible stoner, excuse me, but he translates if it is earlier than noon, which is difficult time zone wise. He is not capable of translating after noon. Mostly he is in the Whataburger parking lot saying this is the best meal I have had in my life. That is when I hang up the phone. But he is brilliant. He has worked for every big mill in the Sacramento Valley and knows everybody personally. By the way, everybody in this room is a vertical learner because you wouldn't be here if you weren't. If you want to get very successful, talk to the best people that you admire. Just call them up. I called up Jessica Lundberg at Lundberg Rice. I didn't know her from Adam. I said, "I am flying out. I have a meeting with you." She said, "Who the hell are you?" "I am Glen Roberts. I am flying out to talk to you." She said, "What do you do?" I said, "Nothing. I just want to talk to you." I kept saying it and she finally said, "Oh hell, come on." I got to spend two weeks with her. Lundberg's rice engineer grows the best pinot noir grapes in California. They have got the coolest rice engineer in the state. There are lots of practical ways to get to this and then the other is to travel.

Naomi: Also, you want to get the word out in terms of turning it into a hot thing. You got your local stuff but there is a limit. People who do CSA buying often are local people who don't have loads of money. It is worth thinking about the elite thing too because that word filters down from the top. You talked about chefs and it is actually the chefs and I am not saying that everything should work from the top down but it really helps if you have chefs. Chefs in this area, down to Boston to New York, if they know there is locally grown organic rice, it turns into this special, incredible thing. Then they say, whoa. They put it on their menus in their way and they say to you, the diner, coming in for your treat big meal, or to their regulars who regularly spend that much money, I have got this incredible thing. It is very special. I have a limited amount. It is like truffles or something. There is a season for it because I am going to run out of it. They do this whole thing that pumps you up. You have the rice and you have tasted it and its distinctiveness. Then you say to your friend, I have this incredible rice. Your friend is also going to talk and then the word gets out. Then Saveur writes an article about it and they say there is this incredible thing going on. No, but seriously, the editor of Saveur said to me, "Well if you are going to this rice thing, what does it taste like? I said, "I don't know. I will see." "I am sure it is fabulous but we can't write about it until we can get some for our kitchen to test it and taste it and photograph it so then we can come up and do a story." I am just saying that is the kind of thing that long term helps you with your marketing. If it is in your magazines, then your CSA people are going to say, "Oh wow, in my backyard, I can get some of that?" Ok, I am prepared to pay a premium for it

because it is special to taste it. That is how you have to do it. Otherwise you are doing the heavy lifting. You need the leverage of some kind of national media and the rock star thing really does help with these specific agricultural things.

Glenn: You know who the next rock stars are in the food industry? Did Southern Living call you [Anna McClung] last week? Donna Florio is going to call you. Anybody know what the Nordic invasion is? Twigs and berries from Denmark, Noma. Oh boy, I found some moss on the beach, let's eat it. That is what I call it. Bob Kincade, Boston guy, coined the term "Twigs and Berries." This foraging movement had a life for people my age in the 1970's. Kincade named it the "Twigs and Berries Movement" and it was passed around to all the cool chefs at the time. There is a twigs and berries forager. Somebody comes rolling in from the woods and he is covered in ticks and everything and says, "Here are the mushrooms!" That is the twigs and berries thing. Everybody know who Harold McGee is? Harold McGee, food scientist, right? What is the Nordic invasion? It is the foraging movement clashes with food science. What is the out fall? The seedsmen, the breeders, the scientists, are the next rock stars. It was chefs, then it was millers, then it was cocktail people, and then it was butchers. We are just coming off of that one. Don't you love these culinary fashions? I am so old I make myself sick. I always get asked, "Well, what do you do about ADM?" They know it doesn't work. They are working on this as hard as we do. They really do know it. Well, what about CISCO? Well CISCO knows it doesn't work too. They are working on this really hard too. The salons and TED. One of the big deals that TED in Aspen right now just finished was a salon from the James Beard Foundation. They went around the country filmed three hundred small producers trying to get a bead on what to do next with the food system. Everybody is working on it. They have been looking. They are looking harder. When I went into business with rice, somebody heard I had gotten some rice equipment. You know my first visit was from Archer Daniels Midland in a Gulf 4, I think back then or 3. They flew into Charleston and asked if they could hull some GMO rice that they were working on a co-op with Syngenta. I was thinking, "How the hell do you guys know this?" They know everything because they are really smart and they have to deal with the same stuff we are talking about here. There is no divide. Everybody is thinking, "Oh wow, there are three green spots in four thousand acres right now in Yale, Illinois." My three corn fields. Everything else is brown. In Columbia, South Carolina I harvested maize last week. Everybody else cut it in. Three thousand acres around me, brown. Why? Because it is bred for more water than it got. My stuff is landrace, drought tolerant. It is used to it. I took Dan Barber, speaking of chefs, to this lesson, commercial soy, commercial soy, commercial soy, hundred acre fields non-irrigated and then my Sea Island Peas, seventy acres. The commercial soy fields were brown, brown, and already turned in. Our pea field was still green and we are picking them. Everybody knows this. There is no division. There used to be this big scientific barrier. There isn't one. Anna was a pioneer and Susan was a pioneer in breaking this stuff down. The generation before them, austere scientists, wonderful people, but frankly I am intimidated by all of them because they know more than we know. If you ask a question you are going to get a real answer. If you don't do your homework you are screwed. That is my advice to you. Do your homework, read, read, read, read, read.

Michael: One thing I learned from Ben and Adrie Lester at Wheatberry Bakery though, is generations before that, for thousands of years, they have been collecting types of

rice seed. What they tell me is that in isolated European valleys the peasants spent centuries picking the best plants so they would have the most disease resistant, fastest growing, drought resistant seed for their particular area and apparently that may go back to the Middle Ages.

Glenn: It goes back to antiquity. One thing to add to that is flavor. They picked for flavor.

Michael: You mean the difference between your tomatoes or mine or what we would get in the grocery store?

Glenn: Or my wheat and yours. What all this pre-supposes, what we assume in thinking about what happened before industrialization, is we have a neighbor to talk to. This is testimony to the fact that there can be neighbors, Takeshi, how cool. But, we don't have neighbors yet. If my wheat went down 150 years ago, my neighbor got a crop. He got a rain strip that I didn't. I droughted out. I am cool. Now the smallest commercial farm is three times the size of any farm in the old days except for the plantation system and they were run like small farms. Everybody had a task. You had mentioned about slavery. Standing over the water on top of the mirror with 100% humidity, there is a way to grow up and be a real human being. It is crazy. If you haven't done it, I suggest you try. You should do it. It gives you really great appreciation for where all this came from. First it was the Irish and Native Americans by the way, there were no blacks in the first rice fields in my area, then we started getting serious about production and they brought in tons of rice slaves. They were called rice slaves because they knew how to grow rice.

Sjon: How do we deal with climate change because it's going faster and faster and faster? Do we have to change our seed in ten years?

Glenn: Well, here is one of the things that Susan and Sandy touched on. They have got some short rice. They got a tall rice. There is a lot of landrace history in the taller one and the short ones, by the way, because all of the bred rices come out in natural breeding. We are not talking about gene jockeys. All the best rice geneticists have to do both now, by the way, so they know this stuff inside and out. It is really cool. The gene jockeys can create anything but in natural selection you can breed down over time. Gene jockeys can work much more quickly. You will hear about this more later today. But the tall purple sticky rice, that is a landrace rice. Tons of front line genetics from antiquity and probably six thousand years. It has been around that long, probably. A lot of genetic history is there and the selections that are being made include that information in the selections, and that is a lay term. I am not a geneticist, as everybody knows. I can barely drive a car.

Sjon: Do you know if the seeds adapt to climate changes?

Glenn: They always have but they have interacted with humans to do that as well. There is no such thing as a farmer that is not a breeder in a landrace system, if they want to survive. My point being, prior to industrialization, there were farmers that ate and there were farmers that only ate because there were farmers that ate. Some people are talented at this and by the way, what gender are they? They are women, without exception. I don't know what it is about guys and genetics, but it just doesn't happen.

Susan: They were the hunters and we were the gatherers.

Glenn: I think they were just malingerers. "Hey, where is the wine?"

Jim: I enjoy drinking beer and I am fascinated watching the beer industry. My grandfather was vice president of a beer company that is no longer around, but now interestingly there are all these small micro-breweries popping up. The only part of the industry

that is really growing is the small brewers. I am wondering if the other big guys are looking at that and saying holy crap?

Glenn: This is terrific. This is perfect. In thinking about marketing Jim, this is killer. You have to look at everything and honestly in order to market you have to become a brewer. It is in your bones, good. Not to brag, but I will. Anson Mills just released a Dogfish Head Brewery Positive Contact beer. It has all our grain inside. David Chang was the brewmaster, along with Sam Calagione and Mario Batali. When you are talking about chefs and your connection with chefs, if you tell these guys over and over again long enough, "Hey this is the oldest grain in the world." They use Farro, an Italian accession of Triticum Dicoccum. A nice one. There isn't that much left in the seed bank in Italy, but it is a nice one and we grow it. We slow roasted it and then Sam dropped it into the vat, right near the end, in the boil and then they put in a bunch of other goo gaa. I haven't had the beer yet, so I don't know whether it is any good but it is selling like hot cakes. It was like 200 bucks a set. It comes with a boom box album. It is beach party beer so it comes with an album and something else, I forget. It comes in a four pack. You have to be careful with the brewery industry. Cacao Prieto, I told them about one of my red corn seedsmen. They called him up and they offered him 12 dollars a pound. He hadn't been with me that long. He sold out his entire seed stock and the production. He had it sitting there so he sold his reserve. Twelve bucks a pound, I would do it, almost. Luckily we had other seed stock. The brewery industry is a wonderful thing and it is also a grain hog. The best artisan brewers are willing to pay anything. They are willing to pay three times market in New York for Brooklyn Brewing. If you have got good wheat, it is worth three times as much by the ton in a bag. They got to have it in a bag. I don't know why that is. They can't take it in a ton quantity in a tote or anything. It is a huge, huge market and it is growing unabated. Crowd sourcing these marketing ideas, by the way. In California, Community Grains, they went from zero to five thousand overnight. They were in every Whole Foods in northern California in their first year. They had no production. They got all their farmers in a row. They centralized their marketing. Boom! They went as a region. Regional identity is important. I use that. All my farmers understand our food ways, our culture, where we came from so we are all saying the same message. It is unified. This is Carolina food. It deserves to be around. I don't care whether you like it or not. This is what we used to grow. We can get better. Thanks.

Lunch

Lunch included various ethnic rice dishes prepared by local chefs: Kanha Sengaloun (Anon's Thai Cuisine), Sean Harrington (Runner Stone Market and Cafe), Ismail Samad (The Gleanery), and Shital Kinkhabwala (Shital's Indian Vegetarian).

Farmers Exchange: Sjon and Elysha Welters, Josh Brill, Paul Kile, Michael Pill, and Jenny Thorne

Mia: What I wanted to do for the Farmers Exchange is to talk with the farmers on this handout. There is a handout here with a summary of the farmers who have been growing rice for more than a year in the Northeast. They have had a little bit of

experience, successes and failures. They can talk to you about that. I want to have those farmers who are present who are in this handout to come up. I will talk a little bit about the farmers who are not here and then there is a slide for each of the farmers that are here and they can talk for a few minutes and that should take about a half hour. Then the second half of the Farmers Exchange will be more of an interaction. You can ask the panel of farmers here questions or they can ask members of the audience questions and we will have it interactive like that.

I will talk first about Erik Andrus. He is in the Champlain Valley of Vermont, further up north. His farm is called Boundbrook Farm. He actually came to the last conference and talked a little bit about what he is doing because he is trying to grow rice along with raising ducks. He is trying the farming technique that Naomi talked a little bit about and other people have talked about, which is more common in Asian countries. Last year he had about one acre. This year I think it is about two and a half acres and he wants to do up to five acres. He is probably the biggest operation we have right now in the Northeast. Unfortunately he couldn't make it today, but on this handout you have all his information so at least know a little bit about him and see some photos. You can contact him.

Next one I have here is Christian Elwell. He is the owner of South River Miso, a miso company in Conway, Massachusetts. He has been growing a variety of rice called Duborskian for 29 years actually. He has been growing mostly dry land, but the last few years he has been trying to do paddy rice and that has been really exciting for him. That is his small paddy up there on the top left.

I didn't get any photos for them, but Glacial Till Farm, in Bradford, New Hampshire. Brian and Leah Carter, which I guess they couldn't make it today, but information about their farm is on the handout so you can read a little bit about them.

The next few slides, each of you will have a slide. I thought each of you could just talk briefly about your farm with your photos up there. I will turn it over to you Jenny.

Jenny: This is my first year growing in Vermont and I am up in the Northeast Kingdom at about 1500 feet. Last year I had just a couple of the baby pools and a much smaller paddy and I had a lot of undeveloped seed. I did get some seed that was viable, but I ended up with a lot of undeveloped seed. Two years before that I grew down in Amherst, which was easy compared to being in Vermont. That is the bottom picture where the rice is lodged. That was after Irene came through and that was the day I harvested. It was pretty much laying flat but I had a really good harvest and ended up with pretty close to 20 pounds from a 50 square foot paddy that was constantly wet. Then this year I have just this small paddy. I am hoping next year to expand and add more water, but the water I have comes from my pond or rain and I really haven't had to add much water because the clay base is so solid nothing is draining away at this point. I haven't done very much research at this point. I am just planting the rice and then growing it so I don't have as much knowledge as most everybody else I have listened to today.

Susan: What date did you transplant out into your paddy?

Jenny: This year I transplanted out on June 10th.

Susan: Is it heading now?

Jenny: It is. It is probably four to six panicles per plant at this point but it looks like there is more coming. It is not as dense as when I look out here, at all.

Susan: What variety are you growing?

Jenny: It is a Hayayuki. In the past years I have planted two plants together and this year I really planted just one and really tried to space them about a foot apart. Much less dense than what I have done in the past.

Josh: In that upper left picture that is the top three, or there are four in that picture but the top one is dried off because we didn't have enough rice to plant. We did a late planting because we had to build a new greenhouse to start all the seedlings in and then we had 50-75% of our seed eaten by chipmunks so we had to replant again. If anyone needs to know how to catch chipmunks I can tell you how. It is not pleasant. This year we probably ended up with enough rice seed to do three quarters of an acre. The paddyies, once we really going, will be just under an acre of production. We have a spring fed pond and a small stream that we feed off of. These three paddies here, we basically keep flooded because they have established amphibian life in them already so we are trying to keep that population happy. In the bottom two we have been doing on-demand flooding. We have really terrible soil right now. Last year's test grow out,plot looked like what is out here, but this year we have spots that look really good and spots that are much more stunted. It has to do with not really having enough irrigation set up for the drought and not really having any good organic matter. Our soil was drying out a lot faster than what we would have liked. That is Meadow, my partner, in the bottom picture, and that was one plant from last year that we harvested in mid-September. I don't know exactly what date it was. We are also in the upper right picture. There is a little bit of some Azola growing, which is the water fern we are trying to also produce in the paddies. This year we don't have enough phosphorous so it is not growing as well as it did last year. We are growing that as supplemental feed for our animals and a nitrogen fertilizer for the rice and for our market garden.

Sjon: This is our fourth year growing rice. We started four years ago with thirty seeds that we got from Takeshi. The first year we grew 30 plants, a very small plot. The year after that we did a plot that was 8x10 and we grew about 150 plants in there. It did well and we got some nice seeds from that. At that time Takeshi and Linda visited and they said we could pack more seeds in it so we went to 380 seeds, plants actually or hills I should say, on the same plot and we also put a little bit more fertilizer on it. We did get a good yield and it grew abundantly but the plants grew a little bit too fast. You could see it in the stem where it was growing where it wasn't supposed to grow. We had some problems with lodging but all the rice was very good. This year we built three paddies of this size about a thousand square feet. We have about a thousand plants in each paddy. One problem or challenge that we have right now is, as you can see, it is not totally level. When you make a paddy this size you really get into that issue of trying to get it level, which will be solved over the years. The paddy is not going anywhere so over time we will get it leveled out. Some of the plants are always in at least this much water and sometimes this much water and other plants

just have little water or no water. Because we have that, we will be able to see at the end of the season if it has made a difference in how the plants are doing. I am curious to see what we will get out of it. We are mostly growing the Hayayuki variety and we do have an Arborio from Stuttgart and Texas and we are doing some of the Bhutanese red rice. The Bhutanese red rice is doing nice but it is not heading yet. The Stuttgart and Texas varieties, a few of the plants are starting to head but they are much larger than the Hayayuki. Hayayuki is definitely heading at the moment. One other thing was that the two upper paddies we planted around May 26th. Then because we wanted to stick to a biodynamic seeding calendar, taking into account which sign the moon is in, we had a window of three days to plant the upper two paddies. We ran out of time so we waited for a week until the moon was in the right sign again and planted the lower paddy, which also means that one of the paddies is a week behind. It is kind of nice also to see how that compares to the other two paddies. We actually are doing a few experiments at the same time at the moment. One thing I also notice is that I really would like the paddy to be flooded all the time because you get the frogs moving in and then you try SRI and the frogs move out again. There are mixed feelings that we have about it.

Paul: I have a paddy of about a thousand square feet. I have about a thousand plants in there. This is a picture from this spring and that was some of my crop from last year, Akitakomachi, a cold tolerant, hanging and drying. That is it growing in August, I think, last year. This spring the paddy is completely full. Last year was my first full planting. I planted four sections and I put in Matsumae, Yukihikari, Hayayuki, and Akitakomachi. I tried several methods, one I did not weed at all, two I put in clay ball method with Fukuoka method, I didn't get any germination from them, and I transplanted the others. One of the transplants in the non-weeded section I didn't get any rice out of at all so I ended up with only one of four sections giving me the Akitakomachi. It grows under a canopy of Maple trees so it only has partial sun. I calculated approximately 1200 pounds per acre with that. This winter I put in amendments of seaweed and turkey manure and worked that in and I have what I think is a really excellent crop coming. I have Akitakomachi, Duborskian, and Zhe 733. I put the Zhe 733 in two weeks later than the others. I started my rice in trays April 1st and May 1st transplanted it into the paddy. The Duborskian is already about 4 feet and is heading up really well. All the plants are heading up. The Zhe 733 is running a little late on the heading up, but all the plants are heading up. It looks good.

Michael: I think what you are looking at is 1200 square feet with a thousand plants and is completely the offspring of what the Akaogis have been doing here. We live in the hills of Franklin County, Massachusetts in a town called Shutesbury at the bottom of a hill. Our 4 acres of land, a lot of it is wet and it is difficult to grow anything. My son, when he was a grad student at Yale Forestry and Environmental Studies, told me about Akaogi Farm and told me to get on the website and find out about what they were doing. That was close to four years ago now. Then, the next spring, my son took me to a seminar that Christian Elwell gave on rice at the Small Farmer Institute. I just found out the Glenn Roberts helped fund that, which is good. Christian gave me 7 Duborskian rice seeds. By the time the next winter had passed, the Akaogi website had the 2009 conference proceedings and I learned some stuff

from that. To this day, I do not know what ate those 7 seeds but when I called Christian up and cried he told me to come up to South River Miso, where I saw what you saw in the photos, and he gave me a five gallon pail with rice in it. That got us a couple hundred seeds and I kept coming back to the Akaogis' website for inspiration. As you might expect in Shutesbury, Massachusetts I hear, "What is that weed you got growing in that bucket Mike?" Especially the next year in 2011, when I had 18 buckets in my driveway, 9 of which produced seed. The others were too late. It was the same thing, "Rice, New England? I kept saying, "Yes, go to the website. People named Akaogi are doing this stuff and I think Cornell has something to do with it." Then I came to the seminar last year. The seminar last year was really a watershed because instead of being not so sure, have I fallen into some kind of crackpot, you know, crazy scheme? Seeing all these people here and seeing the Akaogis' setup persuaded me, yes this was really something. My wife, god bless her, went along with buying 25 acres of very wet farm land in South Deerfield, Massachusetts. You see that is how we got the land at a price we could afford. The guy who was selling it says, "You want this damn swamp? Half of it will barely grow corn, the other half will grow hay unless the fields are too wet to mow, which happens half the time and then there is this damn spot," which is what you are looking at. He says, "Nothing ever grows there. We can't grow corn. We can't grow hay. It is way too wet!" See the hill in the back? The guy who has been farming it for 10 years, who has rented it, who is a third generation farmer on that hill, believes there are springs. This past July, as near as we could tell, the water table never got lower than six feet below the surface because there is a stream down one side of it, probably centuries old drainage swale. The houses in the area have mounded septic systems. If anybody knows about septic systems, if you have a mounded septic system that means the water table is too high to bury the septic system. I just kind of put two and two together and thought it makes sense from what I learned here last year and off Akaogis' website, and from what some the Cornell people were saying last year that land that is too wet for most anything else might be really good for rice. That is where dumb luck came in because I learned here today that apparently something you don't do is take seedlings and just put them in un-irrigated ground. That is what we did and apparently it was so wet we got away with it. Then we made a basic mistake, we thought oh, in the drought the weeds won't be a problem. Well my son, his fiancé, and I, and some folks called Many Hands Farm Corps, who help small farming people in the Amherst area, by the time we weeded it, it was a good thing I had grown rice in buckets. I could show everybody the difference between a rice plant and a grassy weed because you could not find the rice plants. What you are looking at there and I don't know if you can see it and I just learned today you call them panicles (the little things with the seeds that come up out of the stalk of the plant), they are just beginning to come up. Now last year in Shutesbury, I harvested the seeds that grew these plants on October 23rd. That is at an elevation of 1200 feet. This is at an elevation of 200 feet, down in the Pioneer Valley in South Deerfield, Massachusetts so I am praying that we will get enough seed. If you can see in the upper left, you see where there are trees and a little grove of grass, that is the wettest part of the hayfield. If we can grow 5-10,000 square feet out there I would like to do it. I am indebted to both Anna McClung and Susan McCouch. Good lord willing, what we are going to do here next year is divide this 1200 square feet into ten plots. If I can get seeds from Anna, we will grow the Duborskian again and nine

other kinds. What they have explained to me is a little bit of science, which I sorely need here so we can see what variety will grow best. I hope that isn't too long but I figured I needed to be honest. Somebody up there must like it. I believe what people were saying about rice spirits because wherever they are they must be saying I want you to be able to do this.

Mia: It was great to hear a little bit from each of you and I know we have almost a dozen farmers that have been growing rice for more than a year now. I have heard of others that this is their first year and they are having success so it will be exciting in the next few summers to hear stories from others that have been trying. I know there is a bunch of people who haven't contacted me or I haven't contacted that are doing the same thing. It is exciting I think to hear about everyone else that is involved in this effort because it isn't just this farm now. There are so many others that are helping out and experimenting and learning from the results on their farms. That is why we put together a handout so each of you could get some information about the other farmers.

Audience: Do you use machinery or do you do everything by hand?

Jenny: I had a tractor that helped me dig out the paddy but that is it. I don't have any machinery at this point, which is why I am as small as I am.

Paul: I made a small bicycle powered thresher last year but I am just going to do it by hand. I do everything else by hand.

Michael: This is what my immigrant grandpa called "school of hard knocks." Our plants are about 8 inches apart so all we could use were small hoeing tools or with me, I was down on my hands and knees so I could be sure to find the rice plants and not pull them. This is called a row hoe. I have a bunch of copies of a 1932 ad for it. It was made in the late 19th century when they had wooden handles and cast iron sides. This is a 1950's one, galvanized steel handles and pressed steel sides. Keep in mind by the end of World War II a third of the vegetables in this country were grown in home gardens. When I was a kid in the 50's everybody had a garden. Everybody canned. My wife still does. There was a tremendous amount of effort and manufacturing that went into hand powered, high-speed tools like this thing. I want to also thank Erika and Randy and some of folks that have been explaining SRI to me because next year we are going to plant these rice plants at least a foot apart. Last year, I think it was Erika, who had pictures of something called a cono weeder. When I got on the website and found out that I can order them from Indonesia. This does much the same thing. This tooth wheel mulches the ground. You can either cultivate it with teeth or cut the weeds if you turn it over and this blade can be sharpened. This is good old Yankee technology that was made for decades and it died when the backyard garden died. I probably have a half a dozen of them, all different brands. Sears made one. Other companies made them. You can buy them on Ebay for somewhere between 50 and 150 dollars depending on the condition and the type and shipping is 20 or 30 bucks. Has anybody ever heard of a wheel hoe? Planet Jr? Ok, this is the wheel hoe concept. In other words, you can do with a wheel hoe or a wheel tool like this, you can weed a row in a fraction of the time it takes you to do it with a handheld tool. It is productivity for the small grower and if we are going to have instead of 1000 square feet, 5-10,000 square feet, I think this is going to be a key to being able to do it in a cost efficient way. And again, I am sorry to talk

for so long but I think stuff like this, decades ago everybody knew about it and now it is lost. Look up on the internet, Planet Jr or wheel hoe. Valley Oak Tools makes them and it is a hundred to hundred and fifty year old technology that is the key to what I think we are trying to do here.

Mia: I don't know if anyone else is using machinery?

Sjon: We have a polishing machine that I want to see if we can also use for hulling.

Mia: I know my parents have a pedal thresher here and we have a generator-powered dehuller and then I know Erik has some equipment. He has a much larger scale and use horses so he has a combine, harvester/thresher that he is using.

Jenny: He said he had a transplanter as well.

Josh: Did he get it to work?

Jenny: I haven't talked to him since. I think it did work.

Sjon: I was wondering why his lines were not straight. There was a rope there and it went like this. If he has a machine he must have gone around a rock.

Michael: I have been worried if we get beyond the 1000-1200 square feet am I going to have to buy a transplanting machine, like a pedal powered transplanting machine from China? What Glenn Roberts was explaining to me is if you did like what we did you are growing what he calls plugs, like little seeding in like little cells in trays, he tells me there is small scale machinery that is used for planting all kinds of vegetables and that can apparently be used for rice. Needless to say, that comes across to me as a godsend both for the notion, for ready availability, low cost, being able to maintain it, and get spare parts. Clearly when you start getting up into a quarter of an acre say, you are not going to be able to pull weeds by hand and you are not going to be able to plant by hand like we did this year.

Jim: I wanted to share our operation. We are a little more mechanized. We are also just getting started. Last year I grew three beds, roughly 240 feet long, and they were not mulched at all. It was Duborskian rice solely and watering was our main problem, that and weed pressure was a problem. I weeded them, I think twice, fairly intensively but the weeds kept coming on. When it came time to harvest, because they really hadn't had much water, I plucked about 20 pounds by hand and put it in a high tunnel only to find the sparrows had eaten them in about five days. I happened to have just a little bit left over that I had on my desk and that I used this year for doing our beds. This year we did it a little differently. We have a silt loam. We started out with about a 1% organic matter. This field is probably now averaging about 6% organic matter from the amount of compost, leaf mold, we have added as well as organic mushroom soil and also a cover crop of legumes and buckwheat and rye. I asked the guys to go out and pull a bed and pull two beds for the seeding and to power harrow it. A power harrow is a piece of equipment like a rototiller but it doesn't turn this way it turns this way. I asked them to power harrow in two inches of leaf mold in the top of the bed to get a lot of organic matter level in and build up the organic right there toward the surface. They just laid down one inch of compost and didn't power harrow it in, which wasn't the best. After that, we laid down a layer of plastic on the beds. We have a Rainflow transplanter. If anybody is into vegetable growing, everybody who is into smaller scale vegetable growing is using Rainflow transplanters. I think you can get it from Market Farm Implements in Pennsylvania. It is a lower quality of transplanter. It is not as comfortable as some of the expensive transplanters. You are doing a little more leaning to get those plants in the ground,

but it absolutely does the most phenomenal job of getting that transplant in and getting it off to a good start. It is filling the hole with water as you are planting, as most transplanters do. This thing has a big tank on it and water is trained into each one of the wheels that are designed to catch the water and feed it into the hole. The transplanter basically punctures a hole through the plastic. You simply are just dropping these transplants into the ground as fast as you can go. To look at it, you think that it is just a mess, but then you go back and it is absolutely perfectly seeded in the ground. The transplants were only 16 days old and I did them in, I think, 288 cells, little plugs, with Erika's ideas of trying to get a plant in the ground to minimize transplant shock and get it in really young and maximize the tillering. It was very successful. There were a couple of instances where the plants failed. One other mistake we made was, my guys only put one drip line in toward the center of the bed and I wanted them to put two in it. I think we haven't had quite as much water as I would have liked in the beds, especially early on. We went through all of July and it was basically dry. We have just finished drilling a third well on our property and we have recently had some rains. Some of the later booting plants are doing quite well.

Susan: So you don't flood then?

Jim: I can't. I have a real limitation on water. Well now we are up to about sixty gallons a minute, which for our size operation may still be pushing it. I think we will do fine with 60, but there is a limitation on water. We were pumping our wells dry, having to wait till they would refill, and start watering the next day. It just got so dry we couldn't keep up.

Susan: So you use drip irrigation and you mulch on top of the drip irrigation?

Jim: The plastic layer will drop a line of drip tape as it is covering the bed. You are laying down that drip tape as you go. Two drip tapes. Our beds are about 40 inches wide. We did three rows each about twelve inches apart and our spacing within the row is twelve inches also. Basically we went with a stock Rainflow, which gives you a choice of either six inches or twelve. We went with twelve with the idea to see if we could max out our tillering.

Audience: Is it a single plant in each of your transplants?

Jim: Yes, we went with single plants and we easily have 40 tillers in some of the varieties. The Duborskian didn't tiller quite as much. I would say maybe 20. But the Arborio rice was quite dramatically tillering and also the Zhe 733 tillered very well also. There is a mystery rice which I have to ask Takeshi what it is. I got it from someone you gave it to and would much appreciate it if you could identify it. That headed up very, very, early and seems to have done okay. That mystery rice booted back in mid-June, the Duborskian, two weeks later, and the Zhe 733 booted up probably a couple weeks after that. Right now as we speak the Arborio has started to boot and has been booting for probably about a week or so.

Susan: When did you transplant?

Jim: We transplanted out early May. I think it was May 2nd.

Susan: You are a month ahead of most people.

Glenn: What part of Pennsylvania are you in?

Jim: Actually this farm is in Jersey, right around Princeton, central Jersey.

Audience: What is the town?

Jim: It is called Pennington. You can see our farm very well if you go to GoogleMaps. You can see all the high tunnels, and the barn. It is all pictured very accurately.

Audience: How are you going to harvest?

Jim: Actually I am not there yet, but it is very likely this year. I love Takeshi's piece of equipment out there and I would love to have one of those. I don't know that we will get one this year. I think probably we will use some of the ideas I have seen online. You just get a weed wacker and put a cradle on it and put a blade on it. We will go through and lay the plants down, tie them up, and we have 12, 200 feet long high tunnels. Well actually, I think I will probably put it in my nursery because we don't want the sparrows getting it.

Michael: Have you seen the scythe with the cradle?

Jim: It is like a scythe but you are using a weed wacker.

Michael: A weed wacker, you have to swing right?

Jim: It is the same principal and it works brilliantly if you look at it online.

Michael: Like the ancient scythes with a grain cradle in it?

Jim: Yes. My guys are pretty good in the shop. They can weld something together for me and it will just lay it all down I think. This year, again, water was a problem. We probably had some limitation in our yield from the lack of water, especially with Duborskian. Next year I hope to expand it. I am excited at the existence of a product called Biotello, I think? It is a non-GMO corn based plastic that completely biodegrades. It doesn't need UV action at all. It just biodegrades in your soil. I don't know if I would do this idea if it weren't for that stuff. It costs anywhere from 400 to 600 dollars an acre but I think that is probably reasonable if I can get $10.00 a pound. Biotello, it is European. It has been certified organic in Europe as well as Canada.

Audience: NOFA New York allows it.

Josh: In Vermont you are not allowed to use it yet.

Audience: It sounds like you are suitable for vegetable growing and I wonder why you do rice?

Jim: First of all, I was into to macrobiotics for a lot of years so that brings me in that direction. The other thing is, I heard Wes Jackson talking a while ago and he was speaking to a group of sustainable farmers but they are all growing vegetables. Calorie wise, the vast majority of our calories are coming from completely non-sustainable breadbasket farms. Of course, he is doing this whole thing at the Land Institute with polycultures of perennials. I took that to heart. Also, to me, it fits in nicely with the rotation. It is a very different type of crop and I have the equipment to grow it because I am a vegetable grower. I have a bed former, I have a plastic layer, and I have a transplanter. All I need now is to be able to harvest it and process it and none of that equipment seems hugely expensive. I am kind of wondering now how many other vegetable growers are out there like me doing twenty acres plus, that might also be interested in this.

Takeshi: Last week I went to Maine for the Bread Conference. I met a guy from New Hampshire who is growing wheat and he bought a small combine which works for wheat and rice. We have his contact information so you can contact him. He said he is very happy to share with other growers.

Mia: Machinery is the number one question from all the farmers that we got. You get to a point and you need some kind of machinery to process or plant. As part of my role, I want to get that information to you guys.

Glenn: On Jim's level that combine is most likely an AC72, or 60 or 50, a tiny one.

Takeshi: I thought he said it was a Chinese one.

Linda: The caterpillar has got tractor treads.

Glenn: Oh, it is its own machine.

Takeshi: It can go in a wet field too, if needed. He said he is a wheat grower and he doesn't need it in September and October. Maybe you can contact him and use it. He is in New Hampshire.

Glenn: Jim there are plenty of AC72s in your neighborhood. It is just a full combine. You use your 30 horse tractor with it.

Jim: Would it work in a bed system? How wide is it?

Glenn: It is not that wide. The pickup is like 5 feet. You can get them down to three feet.

Jim: Tractor pulled or self-propelled?

Glenn: Tractor. They are cheap and they will never break.

Jim: Allis-Chalmers? It is like a wheat combine?

Glenn: It is a small grain combine, for rice, wheat, whatever. The 50, 60 and 72 are the main ones. The 60s are the smallest pickup, I think.

Jim: But with a combine like that you have to dry the rice afterwards.

Takeshi: It will harvest and thresh, and you will get it in a bag, but you have to dry it. But if you wait and you are lucky, you might be able to harvest it dry in the field.

Glenn: Takeshi is right. You can take it right to field ripening as long as you are doing smaller acreage and you won't get shatter and you will get better flavored rice too. You are trying to emulate hand harvest, but if you get rained out, then you can get shatter and your rice is falling on the ground while you are trying to cut it with a machine.

Erika: For the SRI rice system that has been developed for small-scale farmers, there is more and more demand for mechanization, which we are starting to look into. The special mechanization would be for transplanting and precise spacing or also direct seeding, which may also be applied to other crops like wheat. When we look into where to get the machinery from, we realize that actually the rice industry doesn't really provide the machinery and that more and more ideas come from vegetable farmers. Today confirms again that the mechanization that is being adapted to the SRI system is maybe already developed in vegetable farming. It is an interesting combination of factors.

Jim: We used 288 plugs and it gets rather tedious to be filling all those with single soaked grains. I did a few of those trays just to make sure in case the plants wanted that kind of care. With the rest of my Duborskian, I didn't tell you this, but with the Duborskian I had the most seed and I basically broadcast on some 10x20 open trays. I didn't notice any transplant shock difference between the cells versus the ones I was just tearing out of the soil. There really was no difference at all. The Rainflow does such a nice job. There is one issue I would see occasionally where a plant might have been a little bit shorter and it didn't quite get above the plastic. It might have suffered from not getting enough light and might have failed. That happened very insignificantly. Also we put down a hundred pounds an acre of blood meal to feed the grain. Other than that it was just the leaf mold.

Josh: Erik was explaining how he seeds his stuff. He was saying he got a seed spreader that is designed for spreading wet grass seed. He has his flats set up just with dirt and then he has it rigged so that he can spread the seed and move as he is doing it over the flats. It looks like a regular grass seeder but it is designed to have wet seed instead of dry seed. Then he just goes across his flats and then he does it again. He has another one that just spreads dirt over the top of it. I think that is how he does it. I think that is how we will do it too, no more cells just in flat trays.

Jim: I think probably if you measure out volume wise what is optimal and you probably just got to trust your eye. We do micro-greens too and that is pretty much how we seed it. With micro-green trays, everything is by measurement and we have done this over years and we have found what is optimal. Assuming the seed size stays the same, it works very well for us. I think for rice you can probably just measure and seed. We use a little seed packet, which works very nicely as long as it has a nice flow. It has to have a little bit of a wag to it. This is the science of broadcasting to a tray.

Glenn: Jim, as you move forward you will end up with airplanes doing this for you.

Elysha: How we seeded is one plug at a time. We were really measuring. After two or three trays, we were thinking, we aren't going to do this anymore. The ones we did spend the time with are the best plants though. They are the best plants.

Jim: The ones that you gave the most care? That is the thing about the Rainflow transplanter. With that water going in, you look at that transplant and it looks perfect. It looks like it was there; like you direct seeded it and the grain just came up. That is the nice thing about that transplanter. The first year, I hand transplanted a row. That is all I could do and I had to wait. Meanwhile, the transplanter was delivered to us and my guys put it together. We got it in the field a week or so later and we did the second seeding. Long story short, the second seeding, even though the transplants were much more stressed, they looked like they were half dead, because of the watering that the transplanter did and how it really got the plants in there, those plants did much better than the first batch.

Audience: Do you transplant with fish emulsion?

Jim: We didn't this year. Wait a minute, let me think. They might have put some in, but not much.

Takeshi: Was the soil temperature different between the first planting and the second planting? Two weeks sometimes makes a huge difference.

Jim: I don't know.

Audience: I didn't know you were supposed to soak rice seed. This is all news to me so I did all my rice seed dry this year and I had very excellent germination, over 95%. I didn't get my seed until the first of June. I put them in and they were all up and like two inches high by 18 days. It was outside in my transplant garden because it was already way past frost. It was a month later than I would have started them had I had them sooner. I was a total innocent so I guess I am asking a question because I started with dry seed and watered the heck out of my flats. I want to know what is the evidence that they have to be soaked? How long are they supposed to be soaked for and would something better have happened that I don't know about yet?

Jim: One reason I soak them and I imagine maybe other people do too, is I am getting rid of some of the seeds that are not viable. They will just float off and I can pour them off.

Glen: The other reason you do soaking is to pip the seed, which gives you a jump but if you are bedding them with plastic there isn't nearly the pressure. It does give you a jump. That is why they fly it on pipped. Dump a whole ton in the canal, boat it out, drain it, dump it in an airplane, and go fly it on to broadcast.

Takeshi: I think one thing you didn't mention was how uniform your germination is. No matter what you do, 90-95% will germinate. The question is how uniformly they come out, all at once or sporadically.

Linda: Which variety did you use?

Audience: I have yet to find out what variety it was. It is a mystery variety. I have to write to the guy who sent it to me. He was giving it away on the permaculture listserve because he couldn't plant it himself and he felt bad because he was given the seed and he was supposed to keep it going. He was looking for a home for some of it from what he had grown the year before. I had been wanting to grow rice for a while and I didn't have a clue what I was doing and I thought it was a great opportunity to get started. I knew he had grown it in western Massachusetts so I knew it would be viable. I knew he had grown it in a wet situation and I knew I wanted to experiment with wet and not dry and so I just went for it. Now I am looking for what kind do I really want to be growing because this has been so much fun. I really don't know. I have no idea what kind of rice it was.

Sjon: How is it now?

Audience: It hasn't done anything weird.

Sjon: Has it headed yet?

Audience: Yes.

Audience: What has been your experience in setting up your beds to get them reasonably level, especially the ones that are water beds? How do you do it?

Jim: I am not growing in paddies. I am growing in raised beds.

Sjon: You need an old guy running your excavator who has developed an eye over the years. There is really a difference.

Paul: We used water and leveled it by hand.

Josh: On the big one, to make our terraces we went out and did contour lines and then we made a bench grade across the top of the paddy, which is a level line that we want the rest of the paddy to be on. Then we set up a laser level and the excavator, who was a really good excavator, and me with the marker went from that bench grade and I would check as he went. Then you can fill it with a little bit of water have him puddle it and then you get that small amount of precipitate come down. You can smooth it out like we saw in the picture with the mules. On the small one we just used a board with a level. We tried one with a dozer and you have to be really, really, good if you want to try and make it uniformly level. We didn't till it, I think you guys till it too, is that part of the mechanism? When you first made it level?

Takeshi: The very, very first one I did by hand. I had to till it first so it was easier to work with but that isn't necessary. I think Erik had a good contractor. He used a laser and bulldozer. That is how they do it in California and I think in Arkansas too. We need one good contractor for the Northeast.

Erika: You have to be careful about what you are running into in terms of the different parts of the soil. It may be better to start out with smaller beds so you don't have to level that much and you can be more careful about your soil layers.

Josh: Depending on who your excavator is, they have magnetic mount lasers for bulldozers and for excavators.

Erika: I am very happy to hear about the wheel hoe that was mentioned. Last year I showed the cono weeder, which was developed for irrigated paddies. I just wanted to point out that the wheel hoe works better in non-irrigated environments. I think also within the SRI system, in India people are starting to redesign implements that look like yours, which I haven't seen before. There are also mechanized weeders for irrigated paddies.

Michael: This has a toothed wheel. I have seen them with straight blade wheels. The blades are offset. In other words, as they go around they don't go like this. This end is hitting the dirt first and then this end kind of digs into it, so there is that design element. They were made with three and five teeth. I have got one by this company where somebody took off the back two teeth so they only had three. They are also made with side wire things shown in this 1932 ad to keep the plants pushed aside. There were a lot of design variations from what I have learned. It is not the kind of thing I have ever been able to fool around with very much, but you folks may be able or know of somebody. What is really interesting is not needing to invent the wheel again. They are sold on Ebay. It was simple cast technology they could make them anywhere in Asia and they had many, many, different attachments that would screw on. This was just one specialized tool.

Paul: I just wanted to say there are several groups of rice growers that aren't represented here, unless there is somebody here from the Plymouth Rice Co-op in New Hampshire. Steve Whitman has a rice paddy and then I also helped him set up terraced rice paddies at D Acres in Dorchester, New Hampshire. They have their first rice crop. They are an about 180 acre, permaculture, nonprofit organization that does community teaching.

Takeshi: I would like to make one comment. We are talking about surface smoothness or flatness. You have to also think about what is under the cultivated soil, the subsoil, because that part of the soil is related to holding water. It is connected by root systems, which developed previously. The roots will die when you bring back the topsoil. Then if you fill it with water, the water will flow down through the root channels. If you don't have good clay soil, remove the topsoil and make the subsoil flat. Rototill the surface, 4-6 inches, as much as you can and pack down again with a caterpiller or some other heavy equipment. Seal all the holes and then bring back the topsoil. This makes a huge difference for the soil's ability to hold water. You will be able to grow rice with half the amount of water. It makes a huge difference. If you have the chance to construct a paddy by yourself be careful with the subsoil and make it as flat as possible. Use big machinery to smooth it down and destroy all the channels. Go as deep as you possibly can, usually 4 inches, 6 inches, but it depends.

Breeding and Development of Seed Stock for Organic Rice Production: Anna McClung

Thank you. It is really fun to be here. When I go to growers meetings they are usually very quiet, they have their barbeque lunch, and then they go home. I am really excited to have this interaction with people that are really interested in every facet of growing rice. Arkansas is a very long distance from here and much of my career in rice has been focused on southern rice production so there might be a few things that cross over I hope, but it is going to be quite a stretch. Hopefully there will be a few things that you can glean from our experience that might be of some help to you. I wanted to put up this little picture that Naomi had mentioned about the winnowing house from South Carolina. This is an example of one of those. If you are looking to thresh your rice, this would be one way to do it. I have talked to several people about what they would like me to talk about and I have heard like seven different topics. I am going to do a little bit of several of them and hopefully get to where we want to be.

First of all, if you don't know anything about the Agricultural Research Service, we are a component of the US Department of Agriculture. We are the only research organization within the USDA. We have the Economic Research Service, the National Agricultural Statistics, and then the NIFA group, which provides grant funding to universities and also supports some extension activities. We are the ones that really do agriculture research for the USDA. Within the United States we have about 2000 scientists within our agency. We are really proud we made it to a one billion dollar budget before they cut us a little bit. Then they gave us a little bit back so we are still at about a one billion dollar budget, which is very small as you know for anything in the US government. We are located in what is called the southern plains region, which encompasses Texas, Arkansas, Oklahoma, New Mexico and Panama, to really make sure it is southern. If you are not aware of where rice is grown in this country here is a map. We don't have a dot yet up here in the Northeast, but we obviously need to change that. You can see that rice is grown up the Mississippi River. There used to be a lot along the Gulf Coast, Texas and Louisiana, and of course over here in California.

The gene pools are quite a bit different. The materials that are in the mid-south area are what we call tropical japonica material, a little bit more tropical. The material over in California is a temperate type of material and it tends to be mostly the medium grains, whereas in the central part of the United States, it is the long grain material primarily. It used to be that there was a lot more acreage here along the Gulf Coast. What we have seen over time is that it is essentially moving north, very far north (joking about the interest in growing rice in the Northeast), and now we are into the boot heel region of Missouri. One of the drivers of that is urbanization for one thing, and along the Gulf Coast there is a lot of industrialization there. Hurricanes, which Glenn mentioned, we frequently have in that area. There is a lot more rural area as you move further away from the coast so we are seeing a gradual movement of rice a little bit further north.

One of the biggest issues facing the rice industry's sustainability, is access to water. In Arkansas, most of the irrigation is done through underground pumping and they have aquifers that are not being recharged. This is a huge issue facing the industry that up until about two years ago they pretty much have had their blinders on, just hoping it was going to go away but it has not. This is really something that we are faced with looking at, as researchers. How do we deal with these new stress factors coming into the production area of the mid-south?

This is where I work, The Dale Bumpers National Rice Research Center. It is called Stuttgart, Arkansas, and was settled by Germans. We are very proud of it. We have a very lovely center and we use it to the fullest capacity. It is all about rice, completely focused on rice. We have a number of scientists there. Our full staffing will be twelve scientists. Right now we have three vacancies. We have a genetics group. My area of research has been in breeding. Dr. Yan here is in charge of the germplasm collection. All the rice varieties you folks ask for from the USDA, he is the one responsible for growing them, producing the seed, taking notes about them, and characterizing them. Dr. Eizenga is working with Susan McCouch and myself and she is involved with making wide crosses with wild species. Dr. Pinson is working on molecular genetics. Dr. Chen and Dr. Bryant are working on grain quality issues, both nutritional and cooking quality. Then we have a molecular genetics group, Dr. Fjellstrom and Dr. Jia. At this point, one physiologist, Dr. Gealy. He is working in weed physiology. You can see within this one building we have, hopefully, a critical mass of people to address the issues facing the rice industry from many different directions.

Who do we serve? We serve, of course, the tax payer and that tax payer can be a consumer of rice, a producer, a miller, or a processor. Mostly the people that are the direct beneficiaries of the research

that we do are actually other researchers. We really try to do some basic research that feeds into the extension and the university researchers. At times we have opportunities where we can work, like with Glenn, directly with seedsmen and with farmers for unique opportunities where maybe we can develop some things that will work for them. I have worked extensively with Uncle Ben's, Mars Food, over the years and have worked with them to develop varieties for their particular processing. Although our research is a little bit more basic, not as basic as Dr. McCouch's work, we are really trying to influence other researchers mostly. Very simplistically, we are doing that by focusing on utilizing the natural genetic variation that occurs within the rice gene pool. At this point we are not doing any GMO research at our center. What we are trying to do is assess the genetic diversity that does exist, understand what traits would be beneficial to our growers, and then develop genetic markers that are linked to those traits. Ultimately, we want to use those markers and that trait information through a process called marker assisted selection to develop new rice varieties or new breeding materials for other breeders and ultimately develop rice cultivars that can be commercialized.

The USDA has a large germplasm, a genetic resource center, and we are responsible for the curation of the rice genetics material. We have about 18,000 rice varieties in this collection. This is a picture of the grow-out of one of Dr. Yan's fields in Stuttgart. He is responsible for growing out this material, regenerating it, making evaluations on it, and then providing that seed for distribution. That seed then goes to Aberdeen, Idaho where it goes into storage. When you go online and you go to the GRIN network and order some seed, it comes from Idaho, but it actually came from Dr. Yan's lab in Stuttgart to begin with. There is a backup storage, long term storage, for all of those seed accessions in Fort Collins, Colorado. If we were to have some sort of disaster, we would not lose these valuable genetic resources. Those genetic resources come from all over the world. Rice is not indigenous to the United States and we have gotten a lot of our collection from China and Southeast Asia, but we have really been fortunate to be able to cover many different areas across the world to access this genetic diversity. Naomi's presentation showed the many different growing environments that rice can be grown in. We try to have access to that material so we can explore the genes that are in those materials and be able to utilize them.

These are a couple of examples of how that diverse genetic collection has been used to develop some new rice varieties. This is an example of a variety called Tetep, which came out of Vietnam and was brought into this country in 1978. It was used in making some crosses, actually in Arkansas by the University of Arkansas, and they were able to introduce a very powerful disease resistance gene from this source that came from Vietnam. That disease resistance gene then ultimately ended up in a whole set of other varieties. All of these varieties have this gene and they have very broad spectrum resistance to this disease called Blast. It is called Rice Blast. It is found just about wherever rice is grown in the world and as you can see when it hits the panicle it actually blanks out the entire panicle. It is a very devastating disease. Here is another example where we have used some materials from the collection. There was a variety that was grown in Mexico called Jojutla. Uncle Ben's (parboiled rice company) was down in Mexico and they said, "We had some of the best rice down there. We sure would like to grow that up here in the United States." Well that variety wasn't at all conducive to being grown in the Southern US and so a series of crosses were made by Dr. Bollich at Texas and he came up with the first rice variety called Newrex, which had a different cooking quality to it so that when it was parboiled the grains were nice and individual versus kind of mushy. Also, when they went through this parboiling process they didn't lose as much starch in the water so there were less starch solids lost and the appearance of the grain was much nicer. That gene that came from that variety out of Mexico ended up in all these other varieties and is actually the gene that you

find in Campbells Soup which contains rice and some of these other different products you see here. We are very fortunate to be able to have this collection and we are trying to mine it for these very valuable genes.

I mentioned the molecular markers. What we are trying to do is identify genetic markers that can be linked with traits. One way I can present this is if you think of the chromosome in the rice plant as essentially a series of boxcars of a train and we are trying to put flags on certain boxcars. Some boxcars we want and some we want to get rid of. Just like in a train station, you go in and you want to get rid of some and line some others up. That is what we want to do in breeding is to put markers with certain genes that we are interested in keeping and then use those markers to realign those into a new cultivar that would be improved. The other very interesting thing that these genetic markers have enabled us to do is that we are able to make even wider and wider crosses. Many of the 18,000 different cultivars that are in our collection really haven't been utilized by the breeding community. The reason is, although they have good traits in there, they also have a lot of things we don't want. When the breeders have tried to make these simple crosses and make selections, they feel like they lost more ground than they gained. Thus, time breeders have not utilized that material. Now that we have these genetic markers we are able to go in and essentially surgically remove the trait we want, because we have a marker linked to it, and move it into to the new cultivar of choice. Not only have we been able to use this genetic diversity from different rice cultivars, we are now at a point where we can actually start utilizing other species of rice. Just like the weeds in any of our gardens, they are very vigorous. Why do they always grow the best versus the thing that you want to grow, right? They have good disease resistance, good insect resistance. These other species of rice also have some of these very beneficial traits and these genetic markers are enabling us to capture those traits from them. You can see how fun it would be to try and make a cross between something like this and one of those cultivated rice species. The sort of progeny you might get out of it would not be very desirable. Having the markers will help us utilize those materials more effectively.

This is actually a picture of some of the work I am doing with Susan, that we have worked on for a number of years. We used a rice variety from an Aus background. It is a weedy species. There is nothing a breeder would like about it. We crossed it to a variety called Jefferson and using these genetic markers we have been able to move certain chromosomal regions into the cultivar Jefferson. We have now found that some of these little pieces of chromosome, when they are moved into the cultivar Jefferson, have resulted in a 20% yield increase. This is just proving that something that is really kind of ugly, and only its mother would love it, can actually have a lot of impact in terms of yield potential too.

I am going to switch to some organic rice research. Unlike many of you folks here, the reason why I got interested in organic rice research was I was seeing our conventional rice farming in Texas starting to die out because they couldn't be competitive. I was looking for ways to try and find new markets for our farmers that would essentially ensure them a good price and that they could be economically sustainable. Probably about ten years ago, I started working a little bit in organic rice research. At that point I was in Beaumont, Texas. What we have seen is this steady demand for organic rice. Even though we produce a lot of conventional milled white rice, sometimes it is hard to find markets for that. There is a constant demand for organic rice, whether that be brown or milled rice or even rice flour. We are seeing rice being used to make rice milk and various sorts of drinks and all kinds of unique products.

Probably within the United States, at a maximum, we are looking at about 50,000 acres of organic rice production. At least half of that is in California. In Texas we have had up to about 40% of the organic rice acreage, at times. One of the reasons why we are seeing an increase in organic rice in Texas is because we are actually seeing a decrease in conventional rice farming. Rice farming in Arkansas and other places is actually more stable. They are having higher yields, less problems with hurricanes and that sort of thing.

On the Texas Gulf Coast there is a lot of fallow land that is rotated with cattle. What that means is, on the good side, there is land that has been out of rice production for a number of years. You can quickly go into organic or claim it is organic for one thing. The other thing, because it is on rotation with cattle you don't have a lot of rice around you that is being applied with pesticides. It is a lot of protection for the growers of organic rice. We are seeing that farmers that used to be conventional are now converting to organic, so very different from you folks. You are organic to begin with. We have been trying to develop information and technology that will help them make that sort of conversion. The other thing is, organic rice is always grown under contract. The farmer goes in and knows what price he is going to get for his rice, versus being out there on the open market. That is another risk reduction for them. We have seen in recent times when we have spikes in fuel prices and the cost of fertilizers and the cost of the various sorts of pesticides they have used. They can actually have a much higher return per acre under organic. That is where we are seeing a lot of interest, is in the money that is associated with organic production.

What we are trying to do in the short term is develop basic knowledge about production practices that will help rice farmers in the Gulf Coast area. There are all sorts of fertility amendments that are being sold to farmers., Which ones of those are snake oil and which ones of those actually have value to them? Weeds, of course, are the biggest issue in terms of any organic production. We also have found that we are seeing diseases in organic rice that we don't typically see in conventional farming. How do we deal with those?

Long term goals. I would actually like to have a breeding program to develop rice varieties that are particularly suited for organic production. There are some materials in our collection that are called allelopathic. They have a natural ability to prevent weeds from growing around the rice plants. These have been documented to have a definite affect in terms of barnyard grass and duck salad weeds. I hope that we can eventually identify genetic markers for that trait and put it into varieties that our growers are interested in producing. I think for someone to be an organic farmer, I don't need to tell you guys this, you are not just going to be farming rice. It is going to be in a system. For large tracts of rice land down in the Gulf Coast, what would be the other organic crops they could move into the system to help sustain the production practices and sustain the quality of the soil for organic production? One of the big challenges in that situation is many of our organic farmers are actually tenant farmers. They don't own the land. I think what they are doing is going wherever they can find fallow land, that can be certified as organic, and planting rice there because it doesn't have weeds or other problems with it. For the long term, I think you have to actually invest in the land, as you folks are all doing, to actually build up the soil. I think this is going to be one of the challenges for organic rice production in our area, to have farmers who have control over the land and are willing to make those sorts of investments.

What I have seen in my work is that you just can't get enough organic fertilizer available to the rice plant (as compared to conventional) and so we started looking at organic amendments. We started looking at what would be some cover crops that might help build that soil. I will show a little bit of

work on that. We are also looking at fertilizer amendments. What different sorts of cultivars would be the most productive? We are looking at varieties that are not only what we call conventional medium grains and long grains but also some of these specialty varieties that are aromatics or waxy rices or colored rices. We are looking at some green manure crops and various seeding methods and disease management.

I had done some work quite a few years ago where I was looking at organic production methods versus conventional, using half of the nitrogen that a farmer usually would use and 100% of what the farmer would usually use. Under organic management, what we are seeing is the plants are essentially nitrogen stressed. They don't have as much nitrogen as you would expect in a conventional system where they are essentially just dumping (large amounts) fertilizer on the crop. As a result, under organic, the plants mature a little bit earlier and they tend to be shorter. On the good side, you actually see less lodging. The plants don't fall over because they are not so top heavy. We also see that you can have a lower milling quality. The good news is that if you are looking at a brown rice market, you are not as concerned about the milling yield so that wouldn't be as big a factor as it would be with conventional milled rice. Out of this we have learned that you are going to have weaker stands. That may be because we are having more seedling disease that we are not even aware of and so we are recommending higher seeding rates. It is also going to be an earlier harvest. If that is the case, you can probably plant what would otherwise have been a little bit later maturing rice varieties. The plants are going to be shorter and less susceptible to lodging so you have the flexibility of using materials that would have been otherwise kind of tall. We are seeing that the diseases Blast and Sheath Blight, which are very common in conventional production, we don't really see under organic management.

Here are some of the different products we have looked at: AgriRecycle, Maximum Compost and Nature Safe. This is looking at one variety, Presidio, which is one that is being used quite a bit in Texas for the organic market. We looked at different rates of application of those products. You can see the product called Nature Safe, essentially you see a linear progression where the more nitrogen or the more of the product you put on, the higher the yield goes up. Whereas this product here, the Maximum Compost, regardless of how much fertilizer you put on it, it didn't really respond. Back to this nitrogen stress issue, we want to do things to make more fertilizer available to the plant to maximize yield. These are all organic products. Here is another set of three. The Rhizogen is another one where the rice continues to respond to increasing applications of it, as do these others too. As we went into the next level of our study we focused at this next set looking at Rhizogen and the Nature Safe. Here we are looking at different rice varieties and these are varieties that are adapted to the South so you are not going to be that interested in them for the Northeast. Under the maximum level of Nature Safe, this is over three years of work at Beaumont, there is huge difference in yield that we see in different rice varieties. You have a few rice varieties that have low yield and you just need to continue to look for the right one because hopefully you will get one of those that are very responsive in your environment. These varieties have the highest yield potential, at least in our southern area. They come from southern China and we call them indica rice varieties. They are very responsive to the nitrogen inputs. These two rice varieties here (on the graph), these are ones that have allelopathy, the weed competition aspect, so they did pretty well. Presidio, (ranked in the middle of the graph) this is one being grown right now commercially for the organic market quite a bit. This shows there is potential for identifying other rice varieties that have higher yield potential.

I will also mention that we are seeing diseases that we don't usually see in our conventional fields. Here is Brown Spot. We typically say these are minor diseases under conventional production, but

we see them quite frequently in organic production. See these round, dark blotches forming on the leaves. They also can form on the panicle. The main effect is that it is going to reduce the yield a little bit. Here is another one, Narrow Brown Leaf Spot. It is the same sort of thing except the lesions are little brown boxes.

Audience: Is that a fungal disease?

Anna: Yes, it is a fungal disease.

Not only will it reduce yield a little bit, it will also cause the plant to dry down faster. It causes the grain to dry down faster and reduces the milling quality. This shows that with increasing nitrogen application, using organic fertilizers, that the level of the Narrow Brown Leaf Spot disease decreases. If you are under really nitrogen stressed conditions here, you are going to have high levels of that disease. This just reinforces that it is important to improve the soil nutritional quality in an organic system.

This is where we have moved into looking at various different sorts of cover and green manure crops. Again this is very far south from you folks. We have looked at some things for winter cover crops. This is actually a Sudangrass being grown in the summer as a plow down. This is one that Glenn suggested I work with, Elbon Cereal Rye. This is an example of in our fields. It is a heavy clay soil and drainage is critical because all these other sorts of green manure crops can't tolerate much standing water. We tried this for a couple of years in the fields that we had. You can see where we have some wet spots, we had horrible stands. Where it was dry, we got pretty good stands. In those areas of good stands, with the cereal rye, it looked like we didn't have much weed pressure (cereal rye has been associated with allelopathy). We went back in and we laser leveled our field, smoothed it out, so we didn't have those wet spots. This is an example of some of the green manure crops we tried in the summer, of course in our area, Sorghum and Sudan Grass were very productive.

I will touch on a couple of our winter cover crops. This is a ryegrass that we planted in October, then grew through the winter, and then plowed down in the spring. We have pretty good stands and good cover. The thing about these cover crops, in addition to the fertility they are going to bring, we are seeing good control of our weeds. One of the most spectacular has been this white clover. This is a fallow field versus one where we had seeded the clover and you can see we got really good growth. It is slow to take off in the winter but then comes on kind of late in the spring. This is one of the problems. Can you get it planted and growing long enough to get the nutrient value before you have to plow it down. It is a pretty tight turn-around time if you are trying to do it in the winter and have rice the following summer. This is showing where we let that clover continue to grow another season. We really were getting good weed control. I was really pleased with this. Particularly in the area where we have cattle, we were thinking if we had growers who wanted to graze their cattle on the clover. They could plant it in the fall, graze their cattle on it the next year, let it go through the next winter, the following spring would be a plow down, and then they could plant rice.

This is some of the work we have done where we have looked at the effect of these green manure crops compared to conventional management. The first time I started looking at some of these numbers I didn't really want to present them because I didn't believe them. What we are seeing is that we are getting higher yields starting to develop. At first, in 2009, the conventional and organic were pretty similar. They were pretty similar the next year and then the next year we saw quite a jump. This is averaged over about 20 different rice varieties. This is using the Nature Safe following the clover plow down. This is being done on a station that has been in rice production for about 100 years. We are working in an area that has been managed organic for about 5 years. I am hopeful that we are starting to see some effects from organic management and our green manure plow-downs.

In organic you hear about minimum-till or no-till so we tried that. We tried to go back into our clover field with a minimum till and drill seeding the rice. We observed a new problem or another problem called Straighthead. This is a problem that in the past has been associated with arsenic compounds from pesticides that have been used. It is a physiological disorder. The panicle develops but the seeds don't fill, so the panicle stays straight. We found that when we tried to use no-till and drill right into the clover, we got very high levels of this. This is an example of where organic management of rice is going to be very special compared to some other crops and you get problems you wouldn't expect in other instances. This is an example of rice varieties that is resistant, Cybonnet. Cocodrie, which is a widely grown cultivar in the South, is very susceptible. You can see the panicles just standing straight with no grain forming on them. This is looking at the same set of rice varieties but they are drill seeded directly following no-till. At the very far right there you see the variety Cocodrie and the reason why the yield is so low is because of Straighthead. This, again, shows that there is a wide diversity of varieties that have resistance to this disease. If you are going to have that kind of management you have to match it with the right rice variety.

This is, of course, all experimental plot work. It is not on farmers' fields. This is a heavy clay soil and it is cultivated. This is our little experimental planter. That (field plot picture) was all drill seeded. This is where it comes up. You can see the different plots. Each one of those plots will be different rice varieties. You can't really see it here in this picture too much, but in this one actually, there is a lot of weeds. This was actually a field that was previously fallowed. We just drill seeded it. This is the one that was following clover. What you should be able to see is that there is less weed pressure in this field than the previous one (following fallow). Later on in the season, this is how that fallow field looked getting inundated by weeds. Again, this shows that cover crops help us in some of the weed management. These are those fields this year. We have had really heavy Duck Salad infestation. That is usually not a problem, but when you have a lot of open water, particularly where you have experimental plots like this, it can be a problem. It doesn't really affect yield so much, but it certainly doesn't make it look very pretty.

Jim: That difference you saw with cover crop with regards to weeds, is that more of an allelopathic effect do you think or something else?

Anna: I guess I am thinking it is just weed suppression, suppression of the weed seedbed but I don't really know.

Audience: When you are looking at the weeds that came up after the system had been flooded, how many months later was it after the flooding?

Anna: It is about 30 days.

Audience: I was thinking that in the South you probably have a longer season for roots to grow.

Anna: We do and we are talking about (considering) directly planting pipped seed.Everything you can do to get one notch ahead of the weed growth because it is so warm. The weeds are growing also and they respond to nitrogen just like the rice does so the more nitrogen you get out there, the more they are likely to grow too.

This is actually one of our yield plots. It has a lot of barnyard grass all the way through it. This is from South Carolina. We have a little Southern SARE Grant that we are working on in conjunction with our folks in Clemson. We got notified very late that we were going to be funded to do this research in South Carolina, so I went there and took a look at the fields this spring. They were about this tall in grass and I am like, "You want us to plant rice in there?" I thought there is no way that we are going to be successful planting rice in there. Hal Hanvey (research technician) went in there and he cultivated it and made the beds like you folks were telling about. Then what we wanted to do

was to use a water seeding method. He set up these little barriers in each one of those little troughs that are going to hold different rice varieties. I was not hopeful at all that this was going to work but he did a good job.

Glenn: By the way Hal does that stuff with a bulldozer. He is good. His berms (levees) don't blow. He can do it for two acre fields and they will hold.

This is after he has flooded it. We sent him 8 or 9 rice varieties. He took that rice in a cloth bag, he soaked it for 24 hours, and let it drain for 24 hours so it is what they called pipped. It has a little bit of a shoot and root coming out. Then he dribbles that rice into these flooded beds. We have done the same thing in Texas and this is where we have gotten our best stands and best results is with water seeding. The problem is it is very labor intensive. My guys call this feeding the chickens, dribbling the sprouted seed in each one of those forms (plots with barriers around it). Each one of those forms are different rice varieties. This is back at Hal's place and you can see the rice is starting to come up through the water. This is a few weeks ago. We have excellent stands. Essentially no weed pressure or very little weed pressure. They did an excellent job for the first time out of the chute in South Carolina.

This is an example of one of our organic fields. This was drill seeded there in Texas. We have also looked at these two rice varieties. These two varieties here have red bran. This is the stuff (red rice weeds) Glenn wants to get out of his field. One of my colleagues, Ming Chen, our cereal chemist, is looking at the antioxidant capacity of some of these pigmented rice varieties. Just like blueberries and red wine, that we are supposed to be eating and drinking, she is looking at the antioxidant activity of these red bran rices. It has very high levels compared to these others here, which are typical brown rice. I just mention this to you because I think there is going to be a marketing opportunity for these colored rices, not only because of the appearance and taste but the health beneficial effect associated with some of these.

Audience: I am noticing that one of the conventionals are running higher levels of antioxidants. Is that correct?

Anna: This one here (comparison of conventional production vs organic production of different cultivars on antioxidant content) is what we would call not significantly different. There is a little bit of a trend and the other one, yes it was. That may be, again, related to the productivity or the growth of the plant (under conventional management). I don't really know. Maybe back to the nitrogen availability?

She also looked at these for vitamin E. This is in the brown rice. In this case the brown rice is red. This is actually the Jefferson/Oryza rufipogon line that came out of the cross I worked on with Susan McCouch with the wild species. That is a red rice line that has a higher vitamin E content.

To summarize, what we see in organic production in general is decreased milling quality and increased whiteness when it is milled. That is partly because you see a little bit more chalk in the (organic) rice. We have actually done some mineral analysis and saw no difference in mineral accumulation between organic versus conventional. There was a little decrease in protein (under organic); again this gets back to the nitrogen stress. We see no negative impact on cooking or sensory properties. Even on the aromatic rices, there is no big difference (in aroma) and, in some cases, in the colored bran rice varieties we see some health beneficial compounds. Organic management, in our hands, has been nutrient stressed (due to low nitrogen levels in organic fertilizers). We need to be looking at green manure crops (to increase soil nutrient quality). If we are going to be using plow downs, we need to do it early enough so the organic matter has enough time to break down and we don't get into a situation where we are going to see some straighthead disease.

Leveling the fields, we think, is really critical for uniform water control and also if you are going to have green manure crops because some of them aren't tolerant to water ponding. In our area, we try to delay the planting as long as we can so the rice has a better competitive advantage over the weeds that are coming through. We recommend water seeding. We have gotten our best stands with that and using almost a doubling of the seeding rate as we would otherwise in conventional (drill) seeding situations.

Sjon: You talk about late planting. Do you mean you start to plant it when it has four leaves or five leaves?

Anna: We are not as industrious as you folks. We don't transplant. What I am saying is a later planting date in the season when it is warmer. Whether that is being done with water seeding, where the seed is already sprouted, or through direct drilling, like you would a wheat crop.

Elysha: What does your organization do to protect organic farmers from Monsanto, GMO rice and how do we keep GMO out of the rice?

Anna: I don't know how long it is going to exist, but right now the rice industry wants to keep GMO out of the rice. At this point Europe is not accepting any rice that would be GMO and they (the US rice industry) don't want to lose the European market. As other countries start developing GMO rice, there is going to be more and more pressure for that to happen within the US.

Elysha: Your organization is the USDA?

Anna: Yes.

Elysha: Is there any feeling that we need to protect the organic farmers or you don't really talk about that?

Anna: Over the last several years there has been pressure from the organic industry to the USDA in general. They say, "Why aren't you doing organic research? If we are 10% of the acreage, why aren't we getting 10% of the funds?" That is essentially what they have said. It used to be organic (research) was for other people, but we are seeing more and more of that starting to take place within our agency. There was a time when I was actually told (by farmers), "I don't want to ever hear the word organic because we are not interested." I would say, "There are a few (organic rice) farmers out there." and they say, "Well, you go talk to them but don't talk to me about it." That has transitioned over time (and there is more interest in organic rice).

Elysha: That is getting better so organic is going to be infiltrating the USDA?

Anna: Like I said, in Texas the economics have caused the conventional farmers to change because they are not competing (for various reasons). They are looking for other ways to be rice farmers still. This has been an opportunity for them. If I say organic in the state of Arkansas they are like, "What are you talking about?" There is really not much opportunity for organic rice in Arkansas because there is so much (conventional) acreage. Half the country's rice is produced in Arkansas and it is all conventional.

Audience: Following up on that, it seems like your data there that shows that yields have increased after three years of organic management would be really important to get out to people. I am wondering if you are going to do further research to figure out why that is, in terms of changes in the soil, the microbiology, for example, because that is a huge part of what makes organic production work.

Anna: Exactly. I am fortunate that we were able to get a small three year grant from SARE to continue the research at Beaumont, even though I am now in Arkansas. I am working with a pathologist and a soils nutrient person. It is still very competitive (to try to get grants) and we have to really try to gather money as we can, but we do have people who are interested to work together as a team. It is very complex and we don't know the mechanisms (for optimizing production under organic management).

Glenn: One of the things you can do and I don't know whether this is allowable up here, but where I am you can go to your local research facility or ARS or whatever and say what you want. They have been really kind to me over the years and they are mandated to offset organic acreage at all the ARSs. What they do with them is their business but when you make it worth their while and they know that you are actually going to do something and not just show up and leave again, they have been very supportive. Like in this particular instance, I was Hal's tech in that picture. I hammered all his stakes.

Anna: I just want to put one picture up here. This is a water management scheme we call it row rice and it has been used in Arkansas to save water. They are using it on land that has a pretty dramatic slope. If you were to put rice into that land you would have to put a lot of cross levees to be able to manage the water. Of course it is not organic, but what they are doing is essentially using the vegetable type of (production) system like you were talking about before. You have a bed, four rows here that are probably 7 inch spacing, so 28 inches there and that is a bed there. There is a furrow on either side in this sloped land. They run water down through those furrows and it permeates through the bed and then they catch the water at the other end and manage to run it back around so they don't lose their water. Of course they are using herbicides in this type of situation for the weed control but this gets back to the water issue I was mentioning, which is really very critical for conventional rice production. They are going to have to come up with better ways to better manage their water resources. This is one of the ones they are looking at.

Sjon: What would you recommend for a cover crop in the winter here in the Northeast because we harvest by the end of September and there is not really much time to get anything going anymore.

Anna: That is one of the problems, finding something that can tolerate those heavy wet soils and I am not that familiar with those sorts of situations up here. It might be the kind of thing where you really have to be in a longer term rotation where you can actually establish it in the summer and let it go through a year.

Audience: Maybe two years of rice production and then a year and a half of cover cropping. I am wondering about the co-cropping where you can grow something that will fix nitrogen with the rice at the same time.

Anna: A lot of crops don't do well when it is wet. That is the other problem with that.

Sjon: In the beginning of September you don't have water in the paddy anymore but then you can't seed because you still have to go in a few weeks later to harvest everything. You would trample the young seeds.

Northeast SARE Funded Rice Research: Laura Birmingham

Mia: There is one more thing that I wanted to mention which I forgot to do earlier. Along with all the support we are getting from Cornell with rice, we have connections to Anna and the South through Susan. We are also starting some rice research at the University of Vermont (UVM). Laura, do you want to say a few words?

Laura: Hi, my name is Laura Hill-Birmingham. I am at UVM and I am in the Plant Biology Department. I am a lecturer and a research associate, so my main job is to teach but I still have held on to my research program. I made the jump to rice just this year and got a Northeast SARE grant to work with two farmers in Vermont, Ben Falk who is in Moretown and runs Whole Systems Design research farm and John Mack. John owns a 160 acre farm in Shelburne, Vermont. In the Champlain Valley. We are doing rice trials. In Shelburne, we are growing rice in buckets. We are learning a lot from Erik, who is in Vergennes, right down the road, in setting up and establishing paddy systems there in the Champlain Valley. Ben has terraced rice paddies. He is on a pretty steep slope and it is more similar to Josh's setup in Tinmouth. We are growing four rice varieties. We are growing Hayayuki, Matsumae, Akitakomachi, which are all grown here, and then a California strain called M-202. The crux of our experiment is to see how these four different varieties can tolerate varying water levels. We are simulating drought, and then we are simulating lower water levels, saturate soils but not flooded, and then we are doing our control group, which is standing water. The results are showing that at least these four varieties are not doing very well at all in the low water conditions. They are very stressed. They are not forming panicles and they are yellowing. The saturated water condition is doing quite well and the control group is doing the best, but it will be interesting to see if there are differences between the saturated water and the standing water. If there are not that means we can use less water and still get a similar grain harvest. Our Akitakomachi is just flowering. M-202 has yet to flower. Hayayuki and Matsumae started to flower around the Fourth of July, or head rather. I am learning new terms. I think that we are going to get a good harvest. I have a website and I have business cards if anyone is interested. I am happy to disseminate any results and it will come out in a Northeast SARE report. I am sort of a novice to the rice system so I have learned a lot.

Mia: It will be great to hear how things turn out and we will definitely connect and maybe have that information available on the website as well. It is nice to hear about new research going on.

Closing and Group Photo

After the final presentation, participants dispersed to talk in small groups with speakers and others in attendance. A majority of the participants were able to be present for a group photo.

Third Annual Northeast USA Rice Conference Group Photo

Appendix A: Farmers Exchange Handout

South River Miso Company, South River Farm

Conway, Massachusetts
Christian Elwell
christian.elwell@gmail.com

How many years have you been growing rice? 29

How many years have you successfully harvested mature rice? 29

List all rice varieties you have grown on your farm (please indicate which varieties matured successfully and which did not): Duborskian

Source of rice seed: Dr. Peverly, Cornell University, 1982

Are you willing to distribute rice seed? Yes

Dry land or paddy rice? (Rainfed or irrigated? Type of irrigation?) Can be grown both ways. Irrigation for paddy: water pumped from river into holding pond, then gravity feed to paddy.

Direct seeding or transplanting? Mostly transplanting. Have done some direct seed.

Sowing or Transplanting date(s): Transplanting date: May 20. Sowing date direct seed: April 15.

Harvest date(s): September 15

Square feet/acres in rice cultivation: about 934 square feet

Site characteristics (elevation, soil type, water availability, etc.): elevation about 620 feet, good garden loam with clay sub soil, water available for paddy.

Average yield (lbs/acre) of paddy rice (husk attached) and/or brown rice: actual yield, 2011: 157.6 lbs paddy = 117.2 hulled brown rice. Per acre yield: 7347 lbs paddy, or 5463 lbs brown rice per acre.

Describe any successes and/or difficulties: No major difficulties. This variety has adapted very well to site. Glorious!

Additional Information: Please see 50 photos, seed to harvest, http://www.facebook.com/media/set/?set=a.149586971751031.25700.129763303733398&type=3

Boundbrook Farm
Vergennes, Vermont
Erik Andrus
erik@goodcompanionbakery.com

How many years have you been growing rice? This is our 3rd season.

How many years have you successfully harvested mature rice? 2

List all rice varieties you have grown on your farm (please indicate which varieties matured successfully and which did not): Hayayuki, Matsumae, Hokkai, all successful

Source of rice seed: USDA

Are you willing to distribute rice seed? Yes

Dry land or paddy rice? (Rainfed or irrigated? Type of irrigation?) paddy

Direct seeding or transplanting? Transplanting by machine

Sowing or Transplanting date(s): June 1st

Harvest date(s): Depends on variety, August-early Sept.

Square feet/acres in rice cultivation: 2.25 acres this year

Site characteristics (elevation, soil type, water availability, etc.): lowland clay farm with a 200,000 cubic foot reservoir for irrigation on site.

Average yield (lbs/acre) of paddy rice (husk attached) and/or brown rice: too early to say for sure

Describe any successes and/or difficulties: On the plus side we have a good setup now to irrigate with wind power and have mastered the mechanical transplanter. Last year we had problems with inadequate field preparation and this year we had a little trouble with seed rot in the cold late April/early May weather. On the whole things are going well.

Additional Information: Please see www.vermontrice.com.

Center for Natural Living
Cabot, Vermont
Sjon and Elysha Welters
swelters@gmail.com

How many years have you been growing rice? This is our fourth year.

How many years have you successfully harvested mature rice? All three previous years.

List all rice varieties you have grown on your farm (please indicate which varieties matured successfully and which did not): Hayayuki three years, this year we are also growing Bhutanese red rice, and Stuttgart and Texas variety from Anna McClung.

Source of rice seed: USDA

Are you willing to distribute rice seed? Yes

Dry land or paddy rice? (Rainfed or irrigated? Type of irrigation?) Paddy rice, irrigated from pond situated above the rice paddies.

Direct seeding or transplanting? Transplants at two-leaf stage.

Sowing or Transplanting date(s): May 23, 24, 25 and May 30.

Square feet/acres in rice cultivation: Three paddies of approx. 1000 sq.ft. each.

Site characteristics (elevation, soil type, water availability, etc.): Elevation 1320ft, plenty of water available.

Average yield (lbs/acre) of paddy rice (husk attached) and/or brown rice: Unknown as of yet.

Describe any successes and/or difficulties: So far pretty good results. Had some problem with lodging because of overuse of organic fertilizer.

Breezy Meadows Orchard and Nursery
Tinmouth, Vermont
Josh Brill
Josh@BreezyMeadowsOrchards.com

How many years have you been growing rice? 2

How many years have you successfully harvested mature rice? 1

List all rice varieties you have grown on your farm (please indicate which varieties matured successfully and which did not): Hayayuki matured last year.

Source of rice seed: USDA

Are you willing to distribute rice seed? Yes

Dry land or paddy rice? (Rainfed or irrigated? Type of irrigation?) We use a pond and stream to gravity feed paddies.

Direct seeding or transplanting? Transplanted

Sowing or Transplanting date(s): Last year May 20th. This year June 1st-10th.

Harvest date(s): Last year Mid September.

Square feet/acres in rice cultivation: We have 38000 sqft of paddy probably ¾ of an acre planted this year.

Site characteristics (elevation, soil type, water availability, etc.): 1400ft, Clay-Clay Loam, Spring fed pond and small brook early in the year we did not have pipe running from the brook and had to stop using the pond because it was so low, and a southwest exposure.

Average yield (lbs/acre) of paddy rice (husk attached) and/or brown rice: Last year in our 12x12 grow out paddy we yielded around 18 pounds, which comes out to 6000 or so lbs per acre. This year will be a lower yield per acre because of fertility and timing issues.

Describe any successes and/or difficulties: Chipmunk population is really high around us this year and they ate about half of our rice starts. We had to start a second round of seeding which definitely set us back a bit. We also expected the pond to have a more continuous flow but this year's low rain slowed the spring down significantly. The brook is now hooked up which has taken up the slack from the pond. We are definitely are not going to have a bumper crop in this first year of real production. With fertility that was lower than we expected, the lack of water and late start we are looking at lower yields then what we would like. We are looking forward to watching our skills and our paddies improve with time. Our big success so far was getting our paddy building project funded using the crowd funding site Kickstarter. We were able to raise enough money to buy survey equipment and pay an excavator to build our 7 paddies.

Glacial Till Farm
Bradford, New Hampshire
Brian and Leah Carter
glacialtillfarm@yahoo.com

How many years have you been growing rice? 2 years

How many years have you successfully harvested mature rice? 1 year

List all rice varieties you have grown on your farm (please indicate which varieties matured successfully and which did not): Hayayuki, Fusayoshi, Kaoriwase, Norin9, Norin11, Akumuro, Nakarawada. All matured, but Fusayoshi very late

Source of rice seed: USDA

Are you willing to distribute rice seed? Perhaps

Dry land or paddy rice? (Rainfed or irrigated? Type of irrigation?) Paddy, irrigated from hose

Direct seeding or transplanting? Transplanted

Sowing or Transplanting date(s): May

Harvest date(s): October

Square feet/acres in rice cultivation: under 100 sq ft

Describe any successes and/or difficulties: Early heat caused all but Fusayoshi to flower prematurely.

Additional Information: I should note that both Norin 9 and Norin 11 are about a third shorter in height than the others I grew, and produced equally well. I don't know if this would be a significant advantage or not, but I had less fear of them getting blown over when Irene came last year.

Bluegrass Sustainable Agriculture Project

Middletown, Rhode Island
Paul Kile
pkile2002@yahoo.com

How many years have you been growing rice? 3

How many years have you successfully harvested mature rice? 3

List all rice varieties you have grown on your farm (please indicate which varieties matured successfully and which did not): Akitamachi (Susan McCouch lab) was the most successful last season, my first in paddy. Duborskian looks the most robust this year obtained from Christian Elwell of South River Miso. Also have Matsumae, Yukihikari and Hayayuki from the USDA that I grew in buckets.

Are you willing to distribute rice seed? Yes

Dry land or paddy rice? (Rainfed or irrigated? Type of irrigation?) Paddy, rainfed.

Direct seeding or transplanting? The direct seeding has failed. Transplanted varieties matured.

Sowing or Transplanting date(s): Planted in trays April 1, transplanted May 1.

Harvest date(s): Last week of September.

Square feet/acres in rice cultivation: 1200 sq feet.

Site characteristics (elevation, soil type, water availability, etc.): Sea level, vernal pond soil/mud. Water flows into vernal pond based on rainfall. Average 45 inches annually. Use rain barrel collection off house and basement sump pump to supplement water in paddy. Paddy is located under a canopy of elm trees and gets only partial sun.

Average yield (lbs/acre) of paddy rice (husk attached) and/or brown rice: Calculated yield was 1200 lbs/acre unhulled.

Describe any successes and/or difficulties: Had to add supplemental water in July due to lack of rainfall. I believe yield would have been much greater with full sun.

Simcha

South Deerfield, Massachusetts
Michael Pill
mpill@verizon.net

How many years have you been growing rice? Since 2010; 2012 is the third year.

How many years have you successfully harvested mature rice? We harvested rice in 2010 & 2011. It is not yet harvest time for 2012, but as of the end of July our plants are beginning to flower so we hope to harvest mature rice this year.

List all rice varieties you have grown on your farm (please indicate which varieties matured successfully and which did not): Duborskian upland rice, originally from the Ukraine.

Source of rice seed: Christian Elwell, South River Miso Company, Conway, MA

Are you willing to distribute rice seed? Not yet; as of 2012 we have only enough seed for our own needs. Next year we hope to expand from the present 1000 square feet to 5000-10,000 square feet on the same field.

Dry land or paddy rice? (Rainfed or irrigated? Type of irrigation?) Dry land, no irrigation. This year (2012) we are growing a 1000 square foot plot of rice in the wettest part of a wet farm field. This 1000 square foot area is so wet that historically neither corn nor hay would grow there. Seemed like a good spot for rice. Even in the July, 2012 drought the soil was moist. We believe the area is kept wet by a combination of a high water table in the area and one or more springs fed by runoff from a nearby hill.

Direct seeding or transplanting? Transplanting

Sowing or Transplanting date(s): Transplanted in late June, 2012.

Harvest date(s): In 2011, harvested rice October 23 to get as much mature seed as possible. This year will harvest earlier if seed matures earlier.

Square feet/acres in rice cultivation: 1000 square feet

Site characteristics (elevation, soil type, water availability, etc.): Elevation is 150-200 feet above sea level. According to the U.S. Department of Agriculture Soil Survey for Franklin County, Massachusetts (1967), the soil type in the part of the field where we are growing rice in 2012 is DfA, which is "Deerfield" soil. It is listed as Class IIIw farmland in the Soil Interpretation Supplement to the Soil Survey of Franklin County, Massachusetts, published by the U.S. Department of Agriculture Soil Conservation Service (March, 1986), which states (at page 9) that "w shows that water in or on the soil interferes with plant growth or cultivation …." This wetness, excessive for some crops, hopefully makes the land suitable for growing rice. The water table in this area is so high that nearby houses have mounded septic systems. There is a stream (a branch of Bloody Brook) along the west side of the field. What appears to be a combination of a natural intermittent stream and an old drainage ditch runs through the field. Even during the drought of July, 2012, the water table on this

land was within a few feet of the ground surface.

Average yield (lbs/acre) of paddy rice (husk attached) and/or brown rice: I have no idea. In 2010 & 2011 I grew rice in buckets to build up a stock of seed. This year's 1000 square foot test plot is the first planting in a farm field.

Describe any successes and/or difficulties: Because field has a high water table it was plowed late and rice seedlings were not transplanted until late June. The seedlings were started in a greenhouse at the end of April to be ready for transplanting by the beginning of June, so by late June they were root-bound in the greenhouse. Drought in July led us to assume mistakenly that weeds would not be much of a problem. By the time we weeded the field on July 27, 2012, weeds were choking out the rice plants. Plants seem very small as they begin to flower. We are concerned that drought and weeds have caused stress to the rice plants.

Additional Information: Because I (Michael Pill, the landowner) work full time, I hired Ryan Karb (email manyhandsfarmcorps@gmail.com) of Many Hands Farm Corps, 8 Bray Court, Pelham, MA 01002. Their web site is at manyhandsfarmcorps.com. Ryan and the people of Many Hands Farm Corps planted the rice seeds and nurtured the rice seedlings in their greenhouse in Amherst, MA. They transplanted the seedlings to the farm field in South Deerfield, and have taken care of them since. If you want to grow rice in the Amherst-Pelham area, I recommend contacting Ryan Karb and the Many Hands Farm Corps.

Fox Crossing Farm
Greensboro, Vermont
Jenny Thorne
jennyt@wirelessvt.net

How many years have you been growing rice? 3

How many years have you successfully harvested mature rice? The last 2 years.

List all rice varieties you have grown on your farm (please indicate which varieties matured successfully and which did not): Christian Elwell's for 2 years. This year Hayayuki in the paddy and the 2 varieties of an arborio from Anna McClung

Source of rice seed: First seed came from Christian. Hayayuki was 2 slightly different variations from USDA.

Are you willing to distribute rice seed? Sure

Dry land or paddy rice? (Rainfed or irrigated? Type of irrigation?) My Paddy rice is irrigated with water from my pond when necessary. I have a solar pump. But so far this summer mostly rain fed.

Direct seeding or transplanting? Transplanted

Sowing or Transplanting date(s): I sowed in the end of April and transplanted around Memorial Day but this year June 10th

Harvest date(s): Mid September the last 2 years

Square feet/acres in rice cultivation: 12'x25' this year is the largest

Site characteristics (elevation, soil type, water availability, etc.): I live at about 1500 ft my soil is clay with nice top soil about 6 inches or so. Right next to my pond. I use old composted manure.

Average yield (lbs/acre) of paddy rice (husk attached) and/or brown rice: Last year in my 50 square ft paddy in Amherst I harvested 17 lb of over polished rice.

Describe any successes and/or difficulties: This is my second year trying to grow in Greensboro. Last year I planted later, had a very small paddy and 2 baby pools and harvested my seed stock for this year there was a lot of immature seed. Last year was very wet and cooler. In Amherst, MA it was so warm and the season longer with gravity irrigation pulled right of a tiny year round stream. My rice was very mature when harvested.