Organic Farming Research Foundation

INFORMATION BULLETIN

Fall 2004 Number 14

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by Stephen Jones, wheat breeder, Washington State University

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THE NEWS AT OFRF

by Jonathon Landeck, Assistant Executive Director

Within less than a year, the number of folks who receive OFRF's *Information Bulletin* has increased by nearly 2,000. In particular, if you are a certified organic producer, we try hard to make sure our newsletter reaches you (free of charge), and over the past six months we've updated and increased the number of certified producers on our distribution list. If you are receiving the *IB* for the first time, welcome. We encourage readers to respond to the information we present and to take advantage of OFRF's programs.

Our increased outreach to growers is one bright light in a year of many ups and a few downs. We have been terribly saddened by the loss of our inspiring Board member and long-time organic farmer, Steve Porter, following a lengthy illness. At the same time, we have been pleased to welcome Colorado organic fruit grower, Steve Ela, as our new OFRF Board president. Two organic vegetable growers have joined our Board, Mac Stone of Kentucky and Drew Norman of Maryland. Our gratitude goes to Ron Rosmann who has left the presidency and the board after six years of service, and to Ingrid Lundberg, who also after many years on the board has left to pursue other interests. We owe much of our recent successes to their dedication and commitment.

2004 began with the first reported U.S. case of the dreaded bovine disease - Mad Cow - prompting sales of certified organic beef to surge nationwide. Soon after, at the 24th Annual Ecological Farming Conference in Pacific Grove, CA, OFRF's policy expert Mark Lipson made a plenary presentation on how a farmer-friendly, national political agenda might be achieved in the *Brave New Organic World*. Staff agronomist Jane Sooby moderated a fascinating session on organic plant breeding in the public domain by three-time OFRF grant-recipient, Dr. Stephen Jones (see cover story).

In February, OFRF endorsed a ballot initiative in Mendocino County, California, to ban the planting of genetically modified crops. Voters passed the initiative, which proceeded to catalyze other California counties to consider similar measures. Then OFRF teamed up with the California Alliance with Family Farmers (CAFF), the California Sustainable Agriculture Working Group (Cal-SAWG), and other groups and individuals in an effort to save the University of California's Sustainable Agricultural Research and Extension Program's (SAREP) organic initiative.

In March, our annual benefit luncheon at the Natural Products Expo West was a huge success, attended by more than 300 organic food advocates and highlighted by a $25,000 gift to OFRF from Organic Valley. Two weeks later, OFRF's Directors awarded $108,000 to eleven research and education projects out of 47 proposals submitted.

April and May were similarly eventful, beginning in Baltimore with the largest sit-down100% organic luncheon ever served, to more than 1,200 members of the International Association of Culinary Professionals. The event was followed by OFRF's attendance at the National Organic Standards Board meeting in Chicago. There, organic farming advocates challenged the National Organic Program to rescind a directive that would dilute enforcement of the national organic rule and certification standards, in particular for the growing organic livestock industry. Shortly after the meeting, pressured by OFRF and our partner organic farming advocates, the U.S. Secretary of Agriculture ordered that the ill-advised directive be retracted. Still, the brouhaha was disquieting. "We can't manage organic rules by uproar," OFRF's Executive Director Bob Scowcroft told

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OUR MISSION • To sponsor research related to organic farming practices • To disseminate research results to organic farmers and to growers interested in adopting organic production systems • To educate the public and decision-makers about organic farming issues

the San Francisco Chronicle. The NOSB meeting preceded OFRF's participation in the All Things Organic trade show at which Mark Lipson led a seminar on critical issues affecting the development of organic seed production.

Also in May, OFRF joined a fight in California to defeat a proposal backed by a slim majority on the state's rice commission to plant pharmaceutical genetically-engineered rice, also known as "humanized rice." The plan subsequently was rejected by the State of California and statewide rice growers. In June, through its Organic Research and Extension Initiative, the USDA for the first time ever requested proposals for research on key organic farming production and marketing issues. This milsetone followed years of work by OFRF to substantially increase federal support for organic farming research.

The U.S. House Organic Caucus and Senate Organic Working Group continue to grow thanks in to the tireless work of OFRF's Brise Tencer and our organic advocate partners around Capitol Hill. Their purpose is to inform and educate members of Congress on the issues affecting organic farming in America. The signs are positive for federal appropriation for organic farmers in the 2005 U.S. budget. In a difficult "no-new-money" environment, the House bill contains level funding for organic farming with a small increase for the National Organic Program. The Senate bill is similar. Overall organic research support has been essentially untouched by budget cuts.

In July, OFRF's Bob Scowcroft, Steve Ela, and Development Coordinator Don Burgett hosted our first benefit soiree at Pastures of Plenty farm near Boulder. We closed July with the release of the results of OFRF's *4th National Organic Farmers' Survey*. The survey results will be of interest to policy makers, research scientists and consumers interested in receiving a high definition picture of organic agriculture in America. That sums up our progress during the first half of 2004, and gives you an idea of the focus of our work for the rest of this year, next year, and beyond.

Breeding resistance to special interests

Evolutionary participatory breeding strategies maintain public ownership of research and support farmers' rights

by Stephen Jones, wheat breeder, Washington State University

This article is an abridged and edited version of a presentation by Dr. Jones at the Ecological Farming Conference, Pacific Grove, California, Winter 2004.

I work at a land grant university and consider myself a public servant. I'll use the term "land grant" frequently, and what I'm referring to are the colleges that were formed for the people and for the rural areas of the country. Before I go further I should say that the views that I express are my own personal views, and are not necessarily those of the land grant that I work for, Washington State University. In fact, a lot of times they're not even close. What I want to talk about is breeding for sustainable organic systems.

When I give a talk I like to go into the history of our program. I think the history is important—when I took the position at WSU I wanted to find out who was there before me, and what traditions I'm upholding. I am the fifth winter wheat breeder at WSU. The first was William Jasper Spillman, who showed up for work on July 1st, 1894. We were called Washington Agricultural College then, and Spillman was hired to improve the economic health of the wheat industry, and he did that. He started collecting varieties of wheat from around the world, and in about 1898 he realized that not one wheat had everything he needed, so he started making crosses. The first variety was released from WSU in 1905, almost 100 years ago.

Our campus has changed since then. If you look out my office window today you'd be looking at a tennis court, a parking lot and our basketball stadium. However, 100 years ago this same area was a wheat field, and you'd see technicians out there in the winter wheat program, doing exactly what we do today—pollinating wheat flowers.

When Spillman passed away in the 1930s, his ashes were spread on the WSU campus, and a stone was placed to commemorate him. The stone was removed in the 1950s and the site is where our new biotech building is going, at a cost of $38 million.

I want to talk about some important land grant issues but I also want to get into some positive things. I can spend all day talking about bad things in genetics and breeding and public service right now, but I also want to talk about some good things we can do for farmers.

Farmers have certain fundamental rights, and one of them is to plant back what they harvest. I think it takes incredible arrogance in our generation to do away with a right that's been around since the beginning of organized agriculture, which is about 10,000 years. That's what's happening right now, and it's happening *from* most land grant universities. Of course it's happening with corporations, but if you're a land grant with a wheat breeding program, odds are you're working with one corporation or another on herbicide resistant wheat. Every land grant that has a breeding program is working on types of wheats that take away farmers' rights to plant back what they grow. To me, that's hard to understand.

Researcher in the WSU perennial wheat greenhouse.

Why are land grants and public servants selling out? Well, you'd be surprised how many people believe things like we're going to cure Vitamin A deficiency through golden rice. Even though it's too idiotic to even talk about. What are the real causes of these deficiencies? Poverty and politics, it's as simple as that. I don't see how golden rice is going to fix that. But the PR campaigns for GMOs work, and people believe it.

For example, I gave a talk about biotech at a food coop in Moscow, Idaho a while ago, and when I got done somebody stood up in the back and said, "Why are you pro-starvation and pro-blindness?" Back then I was surprised by this—I just didn't know how to answer,

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but now I'm ready for that question. I found a good article to copy and keep in my pocket for people like that. Michael Pollan's "The Great Yellow Hype," in the *New York Times* Sunday Magazine, March 4, 2001. You can get this on the web—it's just a single page—put it in your pocket and hand it to somebody when they start talking about golden rice. He does a real good job of skewering the whole idea—the hundred million dollars spent, the 20 bowls a day it would require plus enough fat and balance in your diet to absorb it, and on from there.

I'd like to discuss the positive things that we're attempting to do as public servants working in sustainable agriculture. It's important to note that everything I talk about is from a breeder or geneticist point of view. I use wheat because that's what I work with. But we need many new plant and animal varieties for sustainable agriculture. This gets overlooked quite a bit. Sustainable agriculture funders have locked out breeders in the past, but we really have to pay attention to sustainable varieties and continue to improve them. This means working with low input conditions and local adaptation—as opposed to the widely adapted varieties that a lot of the international and private breeders work on—and durable resistances, superior competition with weeds and a host of other traits. You can pick your favorite.

OFRF-funded graduate student Kevin Murphy.

Our number one strategy in the winter wheat breeding program is to involve the growers. Our program has worked with them every year, for 110 years. The wheat growers in Washington State are 99.9% family farmers. They grow mostly soft white winter wheat.

One way that we work with our growers is we practice evolutionary participatory breeding. "Evolutionary breeding" was a term coined at UC Davis in the 1940s. It's basically getting variation into different parts of a field and letting natural selection occur, letting it act on the variation that is in the population. The key here is giving the growers the option of developing their own varieties. We like to call this "genetic anarchy," although that term gets misunderstood sometimes. In wheat you'd take an acre-size field that's a third generation and on, and the grower harvests it all, takes a sub-sample and plants it back each year. It's very simple. The farmer assists the natural selection—they can go out with a weed-eater and take out plants they don't like; they can flag plants they do like. If they don't like tall ones, they take them out. It's very easy to walk an acre of wheat after dinner and in a few nights you can go through your selection process.

We view our service at the university as creating variation. We can make the crosses in the greenhouse and put it in our field to increase. We can harvest with our little combines and get it up to a quantity that a grower can put in a drill, which is about a bushel or so, 60 or 100 pounds, an amount they can deal with. We use sickles when we harvest, we use stationary binders, we tie bundles, we do all that stuff, it's not a big deal for us to do that.

We have projects in place in five locations and we hope to have more. One of our favorite locations is our first one. He's a grower that came to us and said, "We want to get the granddaughters interested in farming, they're going to inherit the farm." So we told him, "Why don't you have them breed a variety and name it after you?" And he liked that. So, the oldest granddaughter took it on as a Future Farmers of America (FFA) project. She has the plants in the field right now, and this fall will be the first fall that she goes out with her grandfather after dinner and selects the plants. She is a freshman, and this is a project that will go on 10 or 15 years. It's working very well. She has a little notebook, she takes pictures, she really enjoys it. She came to the greenhouses and made the crosses herself. We do a lot of that in our program, bring a lot of school kids into the greenhouse.

Basically it's straight farmer participatory breeding except that we're adding a strong natural selection element to it. You need strong selection: you need disease, you need cold, you need drought. If you want it to emerge from eight inches deep, you plant it eight inches deep. You have to have some selection, otherwise you're wasting your time out there.

One thing we want to do is give growers varieties adapted to certified organic situations. So, we certified 11 acres on our 230-acre research farm in Pullman. We did that to go through the same hassles that the growers do, and to show the growers when they come out to the farm what it looks like. We did it so that we'd have to deal with upset neighbors, too, just like farmers do. Some of those upset neighbors on our farm were the other researchers, the farm manager, and other people in the department who thought we were just crazy. We are very proud that we have that 11 acres certified. We also have a goal in Washington that every university research farm put some acreage or some parts of an acre into certified organic. We have eight or ten research farms in the state and we want all of them to have certified acres on them to show what's possible.

We set up a breeding program specifically for organic. A lot

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of breeders say, "It's all the same, the best variety is the best variety." We don't know that, because the best varieties have not been selected under certified organic systems. Since about 1950, all of the selection in any wheat breeding program has been under very high input, chemical-intensive systems. Do we lose genes that we don't select for in a breeding system? Yes, we lose them just by chance. We feel strongly that if we have not selected under low input systems, we've lost genes favorable to that system.

What do we have in the way of genes, then, and what are we looking for? What we do have is yield—we can do yield very well. Our Washington wheats are very high quality, and we have multi-gene durable resistances that have lasted for 30 or 40 years. We have great diversity in our program in terms of wild wheats, old wheats, new wheats. What we're looking for are qualities that were in the lines that were adapted to the area prior to the fifties. We have found all 162 heritage varieties that were originally grown here, and all have been crossed to the modern varieties hundreds of times. These old wheats are beautiful, but a lot of them get very diseased and have traits that are not desirable, but we can improve them.

One nice thing about these old wheats, besides the beauty of them, are their names, like Power Club, Satisfaction, Blue Jacket, Gold Drop, Relief, Harvest Queen, Pride of Genessee, Triumph and Triplet. We grow all of these out in the field and we bring the growers out to see them. Some old growers—any grower over 70—will walk up to Triplet and say, "I hate Triplet. We grew it for one year and never grew it again. It itches like hell."

Sure enough, the records say Triplet lasted in production only about a year and we wanted to see what that was about. Under the microscope, we discovered that Triplet has huge spikes on the trichomes that are razor sharp. That's why it itches. We thought that was interesting. We like Triplet.

Historical varieties of winter wheat at the WSU-Pullman farm.

Something else we look at is the end-use qualities of these old varieties. There's a lot of folklore that they were all great—that they all made great bread and cookies and noodles and pizza crust. But that's not true. We have a quality lab on campus run by the USDA-ARS, and they make cookies and bread out of these old lines. Some loaves of bread made from these old wheats turn out like a brick. So we're trying to dissect the folklore as well.

I mentioned the 11 acres that we have certified. We're also on two certified growers' fields where we handle yield trials. The Jorgenson brothers are up in northern Douglas County in the center of the state just east of the Columbia River. Sara and Joe DeLong are about an hour out of Pullman.

We have traditional farmers that come to the university for a farm tour every year. Farmers are very surprised when they see a certified organic wheat field that looks like ours. Because it's as clean as theirs, it looks as good as theirs. We have beautiful looking wheat. They see our raptor poles and kestrel nesting boxes that work really well for gopher control, and they get interested in that. That's some of the value of having certified acreage on a university farm. Some of the older growers come up to me and say "Hey, I can do organic, that's all we did when I was a kid. We used to spring harrow, fall harrow. We can do that."


Certified organic wheat, Sara and Joe DeLong's farm.

The hills of the Palouse in eastern Washington are gorgeous, but they're also very steep. These hills are farmed in wheat and this causes some problems. One of them is gully erosion. The Palouse is some of the most fertile ground in the country and it's also some of the most highly erodible. How can we fix that? We could tell the growers not to grow there, or we can offer some solutions and techniques.

No-till is promoted as an option, however, we look at no-till as holding no great promise for the future—it's chemically intensive. One option is perennial wheat. What if we can have a wheat field that will hold the soil? Something that you plant every 5-7 years?

The thing about making wheat from an annual to a perennial—that is, making wheat from something that dies to something that doesn't die, isn't really that complicated. Why does wheat want to die? You can look at evolutionary reasons. It turns out the wild-type is the perennial and the mutant is the annual that was selected over the years as a high-yielding type.

We can work to make perennial wheats without recombinant DNA technologies. We can go to the wild species and we can cross these wild species directly to wheat. It's not that tough. We have a wild garden on campus, with perennial wheatgrasses, primarily. We bring them into the greenhouse because they're hard to work with. A standard size wheat might be about 3 ft tall, whereas wild wheat in favorable con-

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ditions can be more than twice that. That's where we get the perennial genes, cross it to annual wheat—it's a fairly easy cross, we can look at the chromosomes or we can just let the plants sort it out themselves. We plant them and select the ones that regrow.

Breeders like simple things and this one's pretty simple. When we first started we had a lot of folks saying that perennialism is a really complicated trait. We appreciate that, but we can dissect it down to "dead or alive." For now, we can forget drought hardiness, winter hardiness, dormancy, all that stuff. We now have "dead or alive" isolated to a region on one chromosome. This is fascinating stuff, a question of basic biology.

We're looking at perennial wheat as something that can be used as buffers and borders throughout a field. We're looking at soft white varieties because the quality is not so strict. We're looking at perennial chick pea as a companion crop. So, we're looking at perennial wheat as a tool in a grower's field at this point, as stream and watershed buffers, wildlife habitat—there's great interest in this type of plant for birds.

A lot of times, during more political discussions about breeding at public institutions, people ask, "What can we do?" The things that I think should be discussed are very simple. Biotechnology is about ownership. The argument doesn't go there enough. It stays on the environment and on food safety. But it's about ownership and ownership only. It's about having a gene, and putting it in a vessel, and selling that vessel to the grower, and making them buy it every year. To me, that's what biotechnology is.

So this is what I think about—you can say that these actions will be impossible to achieve, but I don't believe so. These include: 1) No patents on life. That would solve the problem, the story would be over; 2) Get corporations off of our college campuses. They came on very quickly and they're having undue influence in our universities. I don't think they should be there; 3) Repeal the Bayh-Dole Act of 1980. The Bayh-Dole Act allows public researchers to obtain patents and to get royalties from that. For example, if I were to put herbicide resistance into wheats, they could go on a million acres the first year, at least. Because of the Bayh-Dole Act, I would be the inventor of that wheat variety and by law I would get 40% of the royalties. Let's say the royalty was a dollar an acre back to the university, from Monsanto or BASF or whoever is at the other end of it. On average, I personally would get $400,000 a year on a million acres of production. This goes on at every public university and they're very proud of this. If you're interested in the Bayh-Dole Act do a Google search for five minutes and you'll find that big name schools' intellectual property offices just love to brag about it. You'll find some good discussions about it, too. But this is also happening in other crops and please don't think it isn't.

So if we don't work with corporations and take royalties, what sort of funding do we have? I hear a lot that we have to work for these corporations, because there's no other money, and that everyone's doing it. The university administration pushes that we need to work with corporations, that we can't survive as public scientists. But I have a list of funders for my program with over a million and a half dollars represented, and you don't see Monsanto and BASF among them. We're funded by the Washington Wheat Farmers, by Fund for Rural America, SARE, and OFRF. We have a special grant on perennial wheat from USDA, the Washington Dept. of Ecology for buffers and borders, and The Land Institute. We have a woman in Idaho that we've never met that sends us $25 a year. So we make raptor poles with it and send her pictures of them.

We have nine permanent staff in our winter wheat breeding lab at WSU. I hear that it's hard to get good grad students, but we don't have a problem with that, even in a place like Pullman. Matt Ardeburn is a PhD student from George Mason University. Kevin Murphy is the OFRF-supported Masters' student. Alicia Greco is a Masters student from University of Nebraska working on perennials; Doug Lammer is a post-doc, he comes out of medical school at University of Indiana. Jeron Chatlain is a masters student who comes from a wheat farm in the center of the state. Carrie Balow is a technician, she runs the field program; Meg Gollnick is a technician, she runs the lab program; Steve Lyon is the head technician, he runs the lab and field program together—he is an ex- hog and wheat farmer.

Members of the WSU winter wheat breeding program team.

We hire 10 undergrads in the summer. Abbey Kamerzell started working for us when she was a junior in high school. She was interested in doing an FFA project, and she took second in the nation in public speaking, competing against 40,000 students, talking about perennial wheat. Her brother is now in high school, and he is doing an FFA public speaking project on, "The University for Sale." We had another student, Theresa, who did her FFA speaking project on the Terminator gene. She had a mouthful of braces and pigtails and freckles. She started out by saying, *"Imagine…a gene…that tells seed…not to germinate. How un-American is that?"*

So that's who we have working for us, it's a very good group, and I think it's important that if you're taking political stands—and we feel we are—that we have a good group of people and true believers that work hard at what they do.

More on perennial wheat, farmer participatory breeding and the politics of pursuing research in the public interest...

EcoFarm Q&A with workshop participants and Stephen Jones

Q. *What are some of the arguments against perennial wheat?*

That it wouldn't yield enough—that's the main one. That it's a lot of quackery—that you can't make it a perennial. But it's fairly simple. We didn't invent perennial wheat. The Russians did it in the 1920s and UC Davis had a perennial wheat program for 20 years, until the early 1960s.

Q. *Would you comment on the oath from the plant breeders summit last year?*

In September 2003 there was a meeting in Washington, DC, called *Seeds and Breeds for the 21st Century*.* A few years prior, six or seven of us breeders from different universities got together with the concern that things are just getting out of control. So we formed this little group, and then RAFI-USA got involved and we had a meeting that had 100 invited participants: 25 growers, 25 researchers, 25 political folks and 25 activist or NGO people. The breeders got together and decided we would form a sort of oath—something public breeders can sign that says we won't receive extra money for what we do, and we won't take away farmers' rights. Not much has happened since because it's a touchy issue. But all of us there agreed we would sign something like that. The venue to get it out is what we're working on.

Q. *The politics of the positions you've taken are interesting. You've described the team you've built in your program. But what did you have to do to build a safety net among your colleagues and the political community?*

The positions are delicate, for sure. I've given many talks where by the time I get home I have a phone call or letter from someone who didn't like what I said. I've received letters from other land grant administrators to *my* land grant administrators about things. The safety net that we have in the program is the position itself, and I have tenure. But mostly, we do a good job at breeding traditional wheat. There is pressure continually from within the system to do herbicide wheat, no doubt about that. But our best strategy has always been the same, and that is to be successful: get grants, write papers, release varieties, have students, teach and do the things we're supposed to do. That's my strategy, and it's working so far.

Q. *Do you use genomics in your organic research?*

Using the definition of "genomics" as being sequencing and understanding the arrangement in the genes—yes, we do use DNA technologies. We clone genes, we use them as markers, we follow chromosomes, we break chromosomes naturally. We draw the line at transforming genes, and what a GMO would be defined as. For example we don't take a pig bladder gene and put it into wheat, but we do a lot of mapping and a lot of marker technology. We don't do GMOs, and we are very public about that.

Q. *Wes Jackson at the Land Institute started breeding perennial wheat about 20 years ago. How does your breeding work compare with what's going on there?*

The Land Institute is high on inspiration and brains but short on infrastructure. They're making progress, but we're probably a little ahead of them in terms of what we have in the field. Wes's ideas in natural systems agriculture, prairie agriculture, it's a great idea, but it's not going to happen tomorrow. What we're doing we think can happen soon, on a small scale. And then we're bringing in other crops for more of a polyculture. For our part of the country the main thing is moisture. It's hard for us to do cover crops, big polycultures and things like that. There's just not enough moisture.

Q. *Has working with growers facilitated adoption of newer varieties?*

We haven't done participatory breeding on a wide scale so far. There are about 2,500 wheat growers in Washington, and I talk to at least 800 a year, directly, in rooms like this, of two or 200. But I haven't gone into those venues and said, "Hey, let's all go and breed your own varieties." While some would be interested, it won't appeal to everyone. We're growing our traditional wheats in 25 areas throughout the state. These 25 growers are the ones we work most closely with, and it's within this group that we're doing participatory breeding. I envision it getting larger and even going out of state. It would be very simple for a grower from Kansas or California to call us and say, "These are the varieties that we grow in this area, can you make the cross, blow up 50 or 60 pounds for us and send it back?" We want to get into that type of service.

But the growers we work with are very excited about it. They like the idea of developing their own varieties, and they like it because for now, the U.S. is probably the most wide-open country in terms of wheat seed. In Canada, for example, you have to grow registered varieties of wheat, you can't just choose what you want to grow. It's like the cotton districts here, where you can only grow one kind of cotton. That's not true with wheat, and wheat growers really like that—your variety doesn't even have to have a name. The people that won't like it are seed dealers, the university and the corporations. Think about it, the farmer developing their own seed? Their own variety? That's not good, right? That's dangerous stuff. ❧

**Proceedings from the Seeds and Breeds conference are now available online from Rural Advancement Foundation Int'l-USA at http://www.rafiusa.org/pubs/Seeds%20and%20Breeds.pdf*

Special Contribution

Report from Rome: World Conference on Organic Seed Held at FAO Headquarters

by Zea Sonnabend

OFRF provided a mini-grant to help Zea Sonnabend attend the recent organic seed conference in Rome. This is her report on the meeting, which provides a perspective to readers on the global dialogue surrounding organic genetics and seeds. Zea works with the Ecological Farming Association in Watsonville, California and is widely known for her work as an organizer of the Ecological Farming Conference.

From the 5th to the 7th of July in Rome, the organic movement and the seed industry met for the first time on a world level to examine mutual challenges and opportunities in developing organic seed. The organic seed conference attracted some 270 participants from 57 countries and was jointly organized by the International Federation of Organic Agriculture Movements (IFOAM), an umbrella organization for the global organic movement, the International Seed Federation (ISF), which represents seed breeders and traders worldwide, and the United Nations Food and Agricultural Organization (FAO). It was the first conference jointly organized with NGOs and hosted on FAO premises.

The Conference focused on several key aspects of seed production and propagation, including economics, seed quality and diversity, and harmonization and regulation within the industry. About 60 presentations and 27 posters gave a broad overview of relevant topics. An evening tour of an organic farm near Rome with a delicious dinner at the farm's own restaurant was a high point of the event.

IFOAM president Gunnar Rundgren gave an opening address in which he stated that the conference was mostly scientific and not political. Rundgren stressed the need for harmonization in the organic sector, seed regulation in general, and the importance of respecting farmer's rights. His speech also highlighted the difficulties with organic seed legalities as they relate to the preservation of genetic diversity on organic farms. It became apparent, however, that there was a political undertone to the conference; while the three disparate groups (IFOAM, ISF and FAO) were trying to work together, there were topics and approaches that were apparently de-emphasized to please the portion of the audience who was not fully dedicated to the organic movement.

Relatively equal amounts of time were given to speakers affiliated with each organization. The people from the seed industry backgrounds emphasized that organic seed is harder to produce, that quality and yield are lower, and that the market needs to develop a critical mass before organic seed companies can be truly successful. The lack of harmonization between the organic seed standards in different countries is also a significant issue. From the production point of view, there are problems with diseases or pests in organic systems that can affect seed quality and be transmitted in the seed. A major problem is maintaining inbred lines for breeding purposes under organic field conditions, which tend to be less optimal for these often weak parent lines.

Speakers from the global organic point of view discussed the progress in their own countries of growing organic seed and developing suitable varieties for their needs. This included people from more developed countries like Spain, Italy, and Hungary which produce seed crops for sale in the rest of Europe and have significant preservation and breeding efforts going on in their organic communities. It also included speakers who work in developing countries on participatory breeding and seed preservation projects with farmers. Countries such as Cuba, Costa Rica, Argentina, India, Peru, and Egypt have efforts to improve or develop their organic seed resources.

A panel on the Co-existence of Organic and GM Agriculture was presented in which the Europeans suggested living with a 0.9% "Adventitious Presence" of GMOs as a tolerated detection level due to contamination in the environment. This acknowledges that some presence of GMOs may be unavoidable. Panelists from the developing countries of Uganda and Sri Lanka urged that the Bio-Safety protocol be followed and that the principle of the polluter paying should apply to GMOs. A representative on the panel from Monsanto recited a lot of platitudes about case-by-case determinations. The weak moderator from the FAO refused to acknowledge any audience comments in the question period that were critical of GMO proliferation around the world.

Participants at the conference from within the organic movement met alone prior to and after the conference to discuss important issues around organic seeds which couldn't be accommodated in the official conference program. Topics of discussion included seed exchanges, seed breeding, farmers' rights, and protection against invasive GMO technologies. Another chief discussion point was how organic seed regulation requirements create obstacles for farmers operating in local markets and/or living in developing countries. It was clear that there were many countries in the room who had not been heard from in the main agenda, and these countries have valid concerns, big challenges and interesting perspectives about the subject.

As a beginning to the collaboration between the FAO and IFOAM, this was an ambitious and generally successful event. As a true sharing of the issues around organic seeds, it was not that fulfilling. However, it created a foundation for future efforts.

TECHNICAL PROGRAM NOTES

by Jane Sooby, Technical Program Coordinator

INVESTIGATING THE SOIL AS A LIVING ECOSYSTEM

A sampling from OFRF's forthcoming *National Organic Research Agenda*

*The **National Organic Research Agenda** is being prepared for release by OFRF later this year. The agenda will summarize the most urgent research needs of the organic community as expressed in a series of meetings that OFRF's Scientific Congress on Organic Agricultural Research (SCOAR) held in 2000-2002. It also draws on recent scientific literature, Mark Lipson's 1997 report **Searching for the 'O-word'**, OFRF organic farmer surveys, and other sources. The following excerpt is from the chapter on soil science.*

Soil is more than an inert medium in which plants are rooted. It is a complex and vital ecosystem that provides habitat for innumerable species of bacteria, fungi, and other microorganisms, as well as for soil-dwelling macrofauna. Many cultures around the world and over time have recognized that soil is indeed living. This dark underground world is still largely a mystery to modern western science, but we know far more now about biological, chemical and physical processes that occur in the soil than ever before in history.

Soil life has resisted characterization for so long because fewer than 10% of the microbial species are culturable using traditional lab methodologies. Scientists have considered microbial communities as a "black box" whose precise identity is unknown, yet whose functional characteristics can be measured. While this is satisfactory for many situations, there are others—such as disease-suppressive soils—in which a more detailed understanding of the microbial community is desirable to reveal the suppressive mechanisms.

Farm ground that is transitioned from chemical to organic management undergoes very specific and measurable changes over time. Soil organic carbon levels, microbial activity, and water infiltration rates all increase (Clark et al. 1998). In organic farming, a guiding premise is that feeding the soil feeds the plant, and that building healthy soil results in strong, nutrient-rich crops that have an innate ability to fend off insect and disease attacks. While organic farmers have a keen interest in how their activities influence the soil, information on how soil-building practices relate to plant health and food quality is currently unknown. Some writers reduce the question to a simple matter of nutrient levels in soil determining nutrient levels of the plants grown in the soil (Cihacek et al. 1996). Though this equation is clearly part of the answer to how soil quality affects plant quality, the full answer is certainly more complex than this.

The great organic pioneer Sir Albert Howard summarized the interconnecting nature of these issues when he described an epiphany he had after 19 years of conducting research:

> *Improvement of varieties, increased yields, freedom from disease were not distinct problems, but formed parts of one subject and, so to speak, were members one of another, all arising out of the great linkage between the soil, the plant, and the animal.*
> (Howard 1947)

Attempting to explain these relationships opens up a broad frontier of research aimed at understanding how living soil communities influence plant development.

ECOSYSTEM STUDIES

Drinkwater (2002) advocates establishing long-term, ecosystem-level studies as well as conducting "reductionist" or component studies within the systems context. Systems questions in soil science include:

❖ ***How do nutrient cycling dynamics in the soil-plant system change over time under organic management?***

Long-term comparison studies show distinct changes in biological, chemical, and physical properties of organically managed soils compared to soils managed conventionally. It is accepted wisdom that the transition to organic production results in initially lower yields, until a rebound occurs and yields return to levels comparable to those before the transition. While many organic practitioners assume that this "transition effect" is due to increasing levels of organic matter over time, some researchers postulate that the change is related more to increasing farmer experience with organic management practices (Martini et al. 2003). Thoroughly documenting soil changes over time can help to answer these questions, and to generate management recommendations for the transition period.

Long- to medium-term transition studies are currently underway in California, Illinois, North Carolina, Ohio, Pennsylvania, Washington, and West Virginia. Some of the parameters being measured include soil microbial biomass and respiration, phospholipid fatty acid profiles, microbial community composition, soil moisture and nutrient levels. These data can generate multi-dimensional pictures of soil changes over time and help us understand nutrient cycling dynamics in mature organic systems.

❖ ***Do distinct soil microbial communities influence crop production in different ways?***
Phospholipid fatty acid analysis (PLFA) can generate soil "fingerprints" unique to the microbial community inhabiting the soil. By comparing PLFA profiles, scientists can distinguish different soil types and even determine which farming practices were used on a field. Researchers in California found that soil from organically-managed plots had higher levels of one group of fatty acids and lower levels of another group compared to soil from conventionally-managed plots (Bossio et al. 1998).

One of the challenges to answering this question is developing methodologies that adequately characterize soil microbial communities. In addition to PLFA, DNA analysis and community level substrate utilization (CLSU) methods are being fine-tuned (Widmer et al. 2001). Other scientists are using nematode community structure as an indirect measure of soil food web structure (Ferris 2004). Further developing microbial imaging techniques holds the potential to link agronomic functioning with microbial community structure. In the future, PLFA profiles could be used to help farmers make management decisions.

❖ ***Can induced systemic resistance (ISR), a phenomenon in which a plant's immune system is stimulated to resist pest attacks, be stimulated by cultural practices such as compost application?***
Many reports in the scientific literature indicate that plants receiving compost or compost tea applications have lower incidence of disease than plants not receiving the compost (Scheuerell and Mahaffee 2002). In other studies, scientists conducting genomic work on plants have uncovered complex cascades of metabolic release that are stimulated when plants detect specific molecules that signal "pathogen" to them. Is this protective mechanism somehow triggered by applications of compost and compost tea, or is a different mechanism involved that accomplishes the same result? What characteristics of compost and compost tea stimulate the plant immune response? Can composts and compost tea be "designed" to stimulate maximal plant immune response by manipulating feedstocks, preparation method, or microbial composition of the finished product? How and why compost and compost extracts enhance plant growth and stimulate disease suppression is still largely unknown.

❖ ***How does cover crop composition impact soil microbial community dynamics and functioning?***
While a vast amount of research has been done on the many roles that cover crops play in farming systems, little work has focused on the effect of cover crop species on soil microbial community functioning. Cover crops may be managed many ways, and are often incorporated as a green manure if a grower is using the cover crop as a fertility source. Legume species bring nitrogen into the system, while grasses bring high carbon levels. Some species such as rye are known to have allelopathic effects on plants growing after them, and are often managed to control weeds. Cover cropped soil organic matter levels can increase quickly or rise very slowly over time. Is rate of soil organic matter formation a function of microbial community response to cover crop species? How does a cover crop's C:N ratio affect soil organic matter formation? Can specific cover crop sequences or mixtures interact with soil biota to stimulate plant resistance mechanisms or influence nutrient uptake?

❖ ***How does soil quality directly impact livestock health?***
Deficiencies in soil nutrients are well-known to produce nutrient-deficient feed that causes specific diseases in grazing livestock. What is less well-known is how soil quality can be managed to improve livestock health beyond meeting the animals' nutritional requirements. Modern pasture consultants recommend that pastures be sown with a variety of plant species, including medicinal herbs and native plants to diversify the ecosystem and provide animals with potential sources of protection against internal parasites and access to micronutrients. Does diversifying pasture hold the potential to meet extra-nutrient needs of livestock? What other ways can the soil-plant system be managed to optimize livestock health? ❧

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POLICY PROGRAM NOTES

by Brise Tencer, Policy Program Associate

Interest in Organic Research Expands at USDA and on the Hill

A number of new fronts have recently emerged in the organic research world, resulting from growth in the organic industry, increased attention by the U.S. Congress on organic issues, and continued advocacy for such work by OFRF and many of our colleagues. Following are a few noteworthy happenings.

USDA AGRICULTURAL RESEARCH SERVICE (ARS) ORGANIC WORKSHOP

ARS National Program Leaders have been busy planning an Organic Agricultural Research workshop for January 2005. OFRF staff met with ARS and begun a dialogue on framing this workshop, which will be designed as a networking opportunity, and as a forum to discuss research approaches, identify research needs, and help define the direction of organic research at ARS.

OFRF IS AT WORK TO SECURE FUNDING IN THE ANNUAL APPROPRIATIONS PROCESS FOR ORGANIC RESEARCH, EXTENSION, AND MARKETING

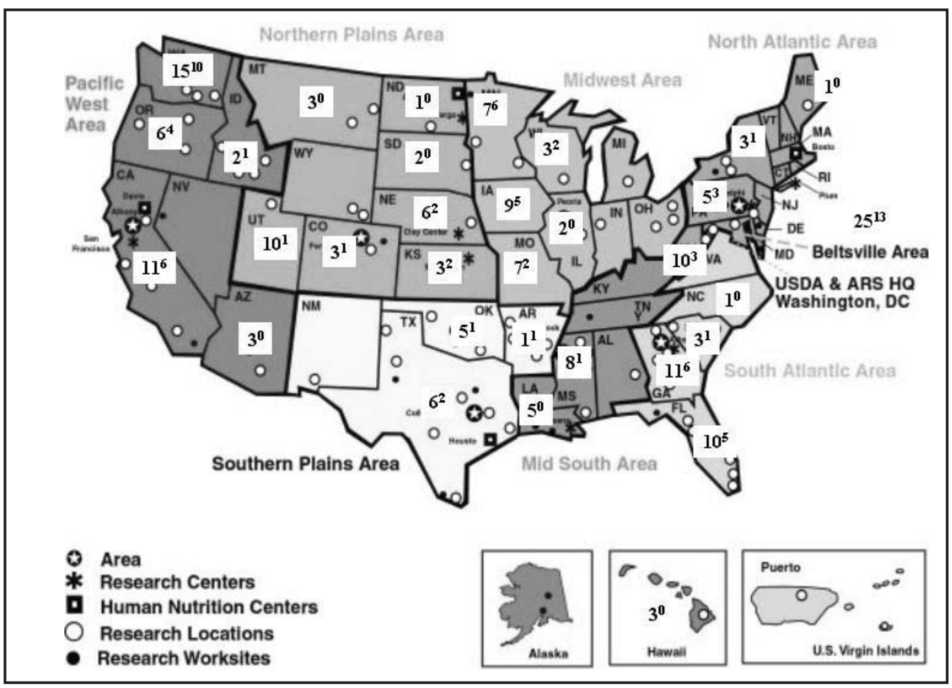
As Congress began preparing their appropriations priorities for the Fiscal Year 2005 Agriculture, Rural Development and Related Agencies Appropriations bill, OFRF policy staff worked to push funding for several key USDA programs identified as high priority to organic growers.

OFRF urges Congress to mandate that USDA-ARS create an Organic Set Aside of 1.8%.

Organic research expenditures at USDA ARS are growing but are still disproportionately small compared to the size of the organic industry. In 2003, USDA-ARS spent about $3.5 million on organic-specific projects, or about .35% of $1 Billion of the 2003 Fiscal Year expenditures.

ARS staff Carolee Bull, a researcher at the Salinas, CA station, recently conducted a survey to find out what ARS researchers are working on organic projects. She asked: a) whether they are conducting explicitly organic research; and b) were they interested in organic and/or did their research have implications for organic systems. The responses were surprising. An impressive 81 researchers responded that they are conducting research in explicitly organic systems. Another 107 researchers responded that they are interested in helping organic agriculture or think that their research benefits organic agriculture. Figure 1 shows the state-by-state break down of USDA researchers working on or interested in organic agriculture.

OFRF policy staff recently proposed to members of the Congressional Agriculture Appropriations Subcommittees that they include language in the 2005 appropriations bill urging "Fair share" funding of organic agricultural research. Based on relative market size (percent of US retail food sales), OFRF estimates there should be



Bull, C.T. 2003. Current state of the USDA/ARS organic research portfolio. ASA-CSSA-SSSA Annual Meetings, Denver CO November 2003 (A08-bull175733-oral).

Fig. 1. Results of organic research portfolio survey of USDA-ARS researchers. White squares superimposed on states show the number of ARS researchers for that state that indicated an interest in organic research (large number) and the number of ARS researchers indicating that they have worked on projects with an organic systems component (small number).

at least a 5-fold increase in the proportion of USDA-ARS resources allocated to organic, or 1.8% of their research budget (about $18 Million). The 2004 agriculture appropriations bill contained language stating, "Organic Research-The Committee supports ARS activities at appropriate locations to enhance research related to organic agriculture." We feel that Congressional intent should be further clarified by providing a specified amount of funding for organic research. Accordingly, OFRF requested that 1.8% of the USDA-ARS budget be set aside within the ARS FY'05 appropriations to be used exclusively on organic research at appropriate ARS locations, under direction of the National Program Staff.

USDA Cooperative State Research Education and Extension Service: Organic Transitions Program

The Organic Transitions Program is a competitive grant program funded through the CSREES budget, which funds research to help farmers surmount challenges of organic production and marketing. Extension agents and other information providers report an increase in number of farmers seeking reliable information on making the transition to organic production. Yet funding for organic research is minuscule in relation to the relative economic importance of organic agriculture. OFRF has asked the committee to increase Cooperative State Research, Education, and Extension Service (CSREES) funding for organic transition research to $4 million in 2005.

USDA Agricultural Research Service, National Agricultural Library: International Organic Research Collaboration

Some research topics have already been extensively studied outside the United States. In order to facilitate increased access to overseas research OFRF has requested that a new (still unfunded) farm bill provision International Organic Research Collaboration be funded at $500,000.

USDA Cooperative State Research, Education, and Extension Service (CSREES): Sustainable Agriculture Research and Education (SARE)

SARE funds farmer-driven research and outreach on profitable, environmentally sound farming practices, including organic production. SARE's solid track record, regional structure, and close links between research and outreach mean that farmers nationwide get reliable information they need on how to stay in business while being environmentally responsible. For 2005, OFRF is seeking $15m for SARE research.

Organic Production and Marketing Data Initiatives

Authorized by the 2002 Farm Bill, the Organic Production and Marketing Data Initiative states that the "Secretary shall ensure that segregated data on the production and marketing of organic agricultural products is included in the ongoing baseline of data collection regarding agricultural production and marketing." In 2004, $500,000 was appropriated to USDA Economic Research Service, partially fulfilling this authorization. The 2004 funding will begin the necessary work at ERS, but additional funding is needed. Furthermore, other types of data not within ERS' mission area should be collected through other USDA programs. Therefore, we seek support for three small appropriations specific to the appropriate agencies (ERS, AMS, and NASS), as follows:

USDA Economic Research Service: Collection and Analysis of Organic Economic Data

As the organic industry matures, the lack of collection and analysis of farm financial indicators for organic producers impedes further development of the industry. Specifically needed are data on long-term patterns of acreage, production, marketing, and farm financial indications, and the cost across regions. OFRF has requested that $1 million be appropriated to the USDA Economic Research Service to implement the "Organic Production and Market Data Initiative" included in Section 7407 of the 2002 farm bill.

ERS is beginning to work with the National Agricultural Statistics Service (NASS) on the collection of financial indicators in the organic dairy industry, with funding from the 2004 agricultural appropriations bill that OFRF and others advocated for. Also, they are working on an extensive survey of organic processors and handlers.

USDA Agricultural Marketing Service: Organic Price Collection

Accurate, public reporting of agricultural price ranges and trends help level the playing field for producers and are important to industry growth. Additionally, the lack of appropriate actuarial data has made it difficult for organic farmers to apply for and receive equitable federal crop insurance. USDA-AMS Market News is involved in tracking product prices, and shipping prices (including imports) but only systematically reports on organic prices for poultry (initiated in 2003). OFRF has requested that $1 million be appropriated to the USDA Agricultural Marketing Service for collection of organic price information.

USDA National Agriculture Statistics Service: Organic Producer Survey

The mission of USDA's National Agricultural Statistics Service (NASS) is to provide timely, accurate, and useful statistics in service to U. S. agriculture. Each year, the NASS conducts hundreds of producer surveys and prepares reports covering topics such as production and supplies of food and fiber, prices paid and received by farmers, farm labor and wages, farm aspects of the industry for U.S. agriculture; most of these data types are not segregated for organic agriculture. OFRF requested $500,000 for the USDA-NASS to collect segregated organic data.

Tomato foliar disease management using OMRI-approved materials

Summary

Tomato foliar and fruit diseases are present to some extent in the Northeast every season. During wet seasons defoliation and fruit infection can cause yield and quality losses even in fields with good rotations and cultural practices. Seven OMRI-approved disease management materials were tested against fungal pathogens of tomato on a certified organic farm in western New York. Materials were selected based on their proposed efficacy against fungal pathogens or ability to strengthen plants and support disease resistance. This third year of materials trials provided favorable disease conditions following two trial years with dry summers and low disease pressure. In this wet year, the Champion WP treatment reduced foliar symptoms significantly compared with the untreated control. However, when results from all three years are considered, the Plantshield drench showed promise under low or moderate disease pressure.

Tomato field with flagged treatment plots at Porter Farms, located in upstate New York. Porter Farms is a 500 acre organic mixed vegetable, field crop and livestock operation.

OFRF supported the third of three years of trials investigating the use of various materials to control fungal diseases of tomatoes on a certified organic farm in upstate New York. Tomato foliar and fruit diseases such as early blight, Septoria leaf spot and Anthracnose fruit rot are present to some extent in the Northeast every season. Seven materials were selected for testing, all approved by the Organic Materials Review Institute (OMRI).

Several of these materials had been tested previously in studies at university-based research farms. However, in the university farm studies the materials performed poorly, possibly because high disease pressure on research farm fields overwhelms the effects of botanical or microbial products. It was determined that well-managed organic farm conditions with good rotations and cultural practices would be more suitable. The idea for the trials came from a grower who had tried a drench and foliar treatment of Plantshield on his own and found them effective.

During the first two years of this study on Steve Porter's organic farm, both growing seasons were very dry, with a total of 7.5 inches of rain falling during the months of June through September 2001, and 7.7 inches falling during June through September 2002. Disease pressure was not high, and early blight (*Alternaria solani*) was the only foliar disease observed in both trials. However, a treatment involving a drench of Plantshield resulted in the lowest disease levels in both trials. A foliar treatment of Plantshield did not produce significantly different results from the control in either trial, indicating that the drench component of the treatment was providing the effect. Still, the dry conditions made it difficult to say with confidence that any of the products would provide adequate disease control during a wetter season. A wetter season with more disease pressure was hoped for to test the materials for a third season of trials.

OFRF project funding: $5,660 **Awarded:** Spring 2003 **Project period:** 1 year (2003)

Principal investigator: Abby Seaman, New York State Integrated Pest Management Program; Geneva, New York. tel: (315) 787-2422 email ajs32@cornell.edu

Collaborators: Helene Dillard and Ann Cobb, Dept. of Plant Pathology, New York State Agricultural Exp. Station; Steve Porter, Porter Farms (certified organic)

Project location: Porter Farms, Elba, New York (certified organic)

Additional support provided by: AgBio, Bioworks, Certis, and Global Organics supplied products for this trial.

Report submitted: July 2004. The complete report is 4 pages.

Complete project reports are available by mail from OFRF or at our website at www.ofrf.org.

Description of materials tested in 2003

Materials tested were four commercial products registered for disease management on tomatoes: Plantshield, Mycostop, Trilogy and Champion WP.

Also tested were three materials thought to strengthen plant health and disease resistance through either soil or foliar application: $CaCO_3$, SW-3, and Humega.

- **Plantshield** is a formulation of the beneficial fungus *Trichoderma harzianum* labeled for foliar and soil drench applications.
- **Mycostop** is a formulation of the beneficial actinomycete *Streptomyces griseoviridis* labeled for seed treatment, potting soil amendment, and drench applications.
- **Trilogy** is a neem oil extract labeled for disease and mite control on a variety of fruit and vegetable crops.
- **Champion WP** is a fixed copper fungicide widely used for control of fungal and bacterial pathogens.
- **$CaCO_3$** is hypothesized to provide high calcium base saturation levels to the soil, supporting plant resistance to insects and diseases.
- **SW-3** is a cold processed homogenized kelp product that is advertised to maximize plant growth and root development through the action of macronutrients, trace elements, cytokinins, and betaines.
- **Humega** is a liquid humic acid derivative that is advertised to increase the availability of micronutrients, promote soil aeration and water penetration, and enhance the photosynthetic rate of plants.

Methods

Tomatoes of the variety Daybreak were transplanted into black plastic with trickle irrigation on June 17. The field rotation for the previous two years had been barley underseeded with clover, followed by a year of clover hay.

Foliar application of OMRI-approved materials using a backpack sprayer.

Composted chicken manure was broadcast over the field at a rate of 1 T/A, and an additional 1.5 T/A was rototilled into the beds before the plastic was laid. Between-row spacing was 6 ft. and in-row spacing was 18 inches. Plants were not staked. Plots consisted of 15 ft. of a single row of plants, and blocks were in adjacent rows. Treatments were replicated four times and randomized in a complete block design. Fungicides were not applied to the plants surrounding the trial until mid-September, when late blight was found in the trial.

Plants in plots receiving the drench treatments were drenched three days after transplanting with approximately 4 oz. of solution per plant, enough to saturate the root ball. This treatment is comparable to a grower drenching the flats of plants before transplanting. Foliar treatments were applied with a CO_2 backpack sprayer and 38-inch handheld boom with three Teejet 8002VS nozzles at 19 inch spacing, at the equivalent of 60 gallons of water per acre. Each foliar treatment was applied four times, at approximately two-week intervals, starting on July 25 and ending on September 3. Each plot was visually rated as percent of the foliage with disease for six consecutive weeks, starting August 21.

Table 1. Treatments and application rates of OMRI-approved materials, and percent foliage infestation on 9/17/03.

Treatment	Rate	Percent foliage infected on 9/17/03
Plantshield soil drench at transplanting	10 oz/100 gallons	4.25 ab
Mycostop soil drench at transplanting	.01% suspension	13.00 a
Trilogy foliar application	1% solution	6.50 ab
$CaCO_3$ soil drench at transplanting	100 lb/A (9.4 g per plant)	12.50 a
SW-3 seaweed soil drench + foliar application	Drench 1:200, foliar 2 qt/A	6.75 ab
Humega soil drench at transplanting	40 gallons/A	7.00 ab
Champion WP foliar application	4 lb/A	1.50 b
Untreated control		12.13 a

Means with the same letter are not significantly different at $p = 0.05$.

Results

As we had hoped, the 2003 growing season was relatively wet and cool, with 12.7 inches of rain falling during the months of June through September. The weather was more favorable for foliar diseases than in the previous two years that tomato disease management trials had been conducted. The first disease symptoms appeared the week of August 28, and were diagnosed as Septoria leaf spot, caused by *Septoria lycopersici*. Septoria was the predominant foliar disease in the trial. Early blight (caused by *Alternaria solani*) was also seen at low levels, and late blight (*Phytophthora infestans*) was discovered in one of the control plots on September 10. Late blight infections were not distributed evenly across the trial, and spread relatively slowly from the point of initial infection. On September 24 we rogued out many of the infected plants to slow inoculum production and spread into the rest of the field. For the last two observations, Septoria leaf spot, late blight, and early blight were rated together.

Only the Champion WP treatment reduced foliar symptoms significantly compared with the untreated control. Plantshield, Trilogy foliar application, SW-3, and Humega were statistically equivalent to Champion, but not better than the check. The Plantshield drench treatment, which had significantly reduced foliar disease levels in both previous trials (in which early blight was the only disease present), was not significantly different from the untreated check when Septoria leaf spot was the predominant disease, although disease levels in this treatment were the next lowest after the Champion WP treatment. Levels of disease in the Mycostop and $CaCO_3$ treatments were very similar to the untreated control. Disease levels in the Trilogy, SW-3, and Humega treatments were intermediate.

Discussion

When results from all three years of trials are considered, the Plantshield drench treatment would probably be worthwhile given its ease of use and low cost, and significant disease reduction under low or moderate disease pressure when early blight is the predominant disease. Growers should be aware that this treatment is less effective against Septoria leaf spot and late blight, and monitor fields carefully when weather conditions are wet. The Champion WP treatment was very effective against Septoria leaf spot, and no late blight was found in the Champion treated plots. Growers may want to reserve fixed copper products for use under high-pressure conditions to minimize possible phytotoxicity, prevent buildup of copper in the soil, and fungal resistance development from repeated long-term use.

Look for future NE methods & materials trials through the Northeast Organic Network (NEON)

Project wrap-up with Abby Seaman, NYS Integrated Pest Management Program

Q. You decided to conduct this project on a working organic farm. How did things go from a research perspective?

Porter Farms has been a great place to do research because you have enough of one variety to do replicated trials. Many of the organic vegetable farms in New York are too small to do this kind of work. The Porters are used to us working there and things went really well.

Q. Are you doing any further work on using materials for disease management in tomatoes?

Not presently. The reason I got into this was I had SARE funding to do some applied research. Materials efficacy trials aren't my primary area of interest, although this one turned out very well. Other researchers in our region have moved into this kind of work who I think are much better at it, out of the Experiment Station in Geneva. They are also in process of putting together fact sheets about pests and organic methods and materials for management, which will be put out through the Northeast Organic Network (NEON). Their website and project are based at Cornell University. People can find out more about their work at www.neon.cornell.edu.

Q. Do you have other organic projects that you're working on now?

I'm working on organic management of potato leafhopper. Organic potato yields in this one area of the state are 20-40% below conventional. There's a particular region that gets a lot of leafhopper, and damage is attributed to the hoppers. The foliage gets what's called "hopper burn" from feeding pressure. In the future, I'd also like to look at trap cropping for striped cucumber beetle in organic systems.

Sorrowful note to a successful project

This project took place at Porter Family Farms in upstate New York. We're sad to report that we lost Steve this summer to a long-term illness. Steve was a standing member of the OFRF board of directors. He served on the OFRF board for five years.

Board president Steve Ela shares these words about our friend Steve Porter: "Hard work and the desire to explore a better way to do things marked Steve's time on the OFRF board. Steve didn't just "serve" on the board - he served the board of directors, the organization, and by extension the nation's organic farmers who make up our primary constituency. Steve was always trying to find new ways to promote the organization, whether it meant taking time off to make a day's drive to speak at Farm Aid or by distributing flyers through his farm's Community Supported Agriculture newsletter. He wasn't afraid to float a new idea at Board meetings and then work hard to make it better. His energy and work ethic were remarkable. Even while helping his family run a large farm, something that can be all-consuming, he devoted a significant amount of time and energy to making OFRF a better organization."

Steve Porter (right) at Farm Aid 2002 with Matthew McConaughey (left).

Thanks, Steve. We miss you.

Weed management strategies in Northeast apple orchards

Summary

The goal of this project was to determine whether living mulch cover crops or shallow cultivation reduce weed competition and increase apple fruit size. Results showed that a cover crop of Dutch white clover alone reduced weed growth. Clover was more effective than shallow tilling once in a season with heavy weed growth, but was similar in effectiveness in a year with little weed growth. Annual rye or rye mixed with clover did not reduce weed growth. Shallow tilling once in late spring reduced weed growth in a season with little weed growth, but not in a season with heavy weed growth.

Shallow cultivation with a weed badger at Ricker Hill Orchards in Turner, Maine. Ricker Hill is a 600-acre orchard with a 100-acre organic block. The farm is 200 years old, owned and managed by several generations within the Ricker family.

Organic apple production is increasing in the Northeast, but production is limited by a lack of effective weed controls. Apple trees are poor competitors for water and nutrients. When weeds are not managed, reductions in yield and fruit size occur. Current strategies include mulching, flaming, cultivation, living mulch, cover crops and mowing. Each method has disadvantages that determine whether growers will adopt them:

- ❖ ***Mulching*** has not been widely adopted by large orchards because of high cost.
- ❖ ***Flaming*** is potentially hazardous and inconsistent in weed control.
- ❖ ***Straw mulch*** controls weeds and favors tree growth compared to living mulch, but creates a favorable environment for voles and potential increased tree loss to Phytophthora root rot.
- ❖ ***Cultivation*** in the tree row requires special equipment, but is effective at reducing weed competition. Tillage generally increases yield compared to living mulches. However, erosion, soil compaction and loss of organic matter are disadvantages, particularly with clean cultivation. In-row rotary tilling is shallow and done only under the tree row, so these disadvantages are likely to be less severe than with clean cultivation.
- ❖ ***Mowing*** alone is not effective because when present grasses remain very competitive with the apple trees.
- ❖ ***Living mulches*** vary in effectiveness at weed management and competition with apple trees:
  - *Low-growing broadleaves* are less competitive with apple trees than tall broadleaves or grasses, but studies show tree growth is less than with mulch or cultivation.
  - *Grasses* compete effectively with weeds, but can also reduce yield and tree growth of apple.
  - *Legumes* can increase tree nitrogen which may be useful in sites that are low in N. However, not all legumes are appropriate as living mulch as demonstrated by *crown vetch* which reduced tree growth in a New York trial. Dutch white clover (*Trifolium repens*) has not been tested for weed management in organic orchards.

OFRF project funding: $2,245 **Awarded:** Fall 2001 **Project period:** 2 years (2001 and 2002)

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Report submitted:	February 2003.
	Complete project reports are available by mail from OFRF or at our website at www.ofrf.org.

Methods

In the first year of the trial, five different weed management strategies were compared:

1) Mowing (control);
2) Dutch white clover living mulch (*Trifolium repens*);
3) Annual rye living mulch (*Secale cereale*);
4) Dutch white clover and rye living mulch; and
5) Shallow cultivation under trees with a weed badger.

In the second year, three strategies were compared:

1) Mowing (control);
2) Dutch white clover living mulch; and
3) Shallow cultivation under trees with a weed badger.

In 2001, weed management treatments were established June 14 in an orchard of Bisbee Red Delicious MM111 trees, planted in 1983 at a spacing of 5' X 16'. Trees were trained to a Y-trellis. Prior to establishing treatments, mowing was the only weed control strategy. Each plot had four trees with a guard tree between each plot.

Each year, to prepare seed beds a weed badger was used to till a two-foot band on both sides of the tree row. Three passes were made on all plots and seeds were sown immediately following cultivation. Annual rye and white clover were each seeded at a rate of 156 lbs/acre in 2001. In 2002, clover was seeded at a rate of 270 lbs/acre. The rye was raked to a shallow depth. The treatments were replicated eight times in a randomized complete block design in 2001 and six times in 2002.

Measurements included soil water potential, nutrient in samples of both soil and apple leaves, weed biomass, and fruit samples to measure fruit size, fruit color, starch index (an indication of maturity) and insect damage.

Project Results & Discussion

In 2001, the season was dry from June through harvest, so establishment of clover and rye was sporadic. The season of 2002 began with sufficient rainfall, and clover was well established, but between July and September, there was little or no rain.

Shallow tilling once reduced weed biomass compared to the control in 2001, but not significantly in 2002 (Table 1). Weed growth was much greater in 2002; tilling once was not sufficient to control weeds that season. By harvest, weeds grew back and were as numerous and as tall as in control plots. Shallow tilling should be done three times in the growing season to have maximum benefit for tree growth and fruiting. Shallow cultivation was done once, but the grower was not able to repeat this since it required labor and the use of a tractor that was also needed for other jobs. This may be a limitation of the use of shallow tillage. Clover reduced weed biomass in both seasons and was more effective than tilling once in 2002, the season with heavy weed growth. Rye grass and rye grass mix with clover did not significantly reduce weed biomass and were not tested again in 2002.

Soil water was highly variable between the different plots but was not affected by ground cover. Fruit size, measured by weight, fruit color, maturity, and level of insect damage were not affected by any treatment.

Table 1. Weed management effects on above ground weed biomass in 2001 and 2002.

Treatment	Weed biomass (grams/0.25 m^2)	
	2001	2002
Control	47	127
Tilled once	25*	98
Clover	25*	63
Rye	36	--
Mix	36	--

* Indicates that the treatment had a significant effect compared to the control.

Conclusions

A living mulch cover crop of clover reduced weed growth. Clover consistently reduced weed growth in both years. To establish the clover required as much input from the grower as shallow tilling. However, it has not yet been determined if the clover will sustain itself in following years or will require reseeding. A living mulch of annual rye or rye mixed with clover was ineffective in reducing weed growth.

Shallow tilling once in late spring was also beneficial in a season with little weed growth, but not in a season with heavy weed growth. Shallow tilling may provide more consistent weed control if done more frequently, particularly in years with heavy weeds, but also requires investment in special equipment.

"I'd try another trial"

Project wrap-up with Renae Moran, University of Maine Highmoor Farm, and Peter Ricker, Ricker Hill Farm

Q. ***What has been the traditional method of weed management in the organic orchard at Ricker Hill, and how did you select Dutch white clover for this study?***

PR. Our strategy pre-trials and presently is to mow.

RM. They were having trouble getting the control they want, so they asked me to do this study. I'd read a book that highly recommended Dutch white clover because it's low-growing, but didn't know of any field research. That's why I tried it.

Q. ***One question at the close of the report is whether the clover would sustain itself in subsequent years or require reseeding.***

PR. It didn't sustain itself, but we've also had a couple severe winters. We worked at it fairly extensively, but didn't have great luck keeping it going. It was labor intensive.

RM. Every now and then I walk down that row, and have found that grass shades out the clover. There's not much clover. If mowed it would survive a lot longer.

Q. ***Would you continue using any of the weed control methods from this project?***

PR. No, not on whole 100 organic acres. The labor is too much. The clover was successful, it did fairly well for that year. The weed badger is time consuming and a delicate process in the trees. In setting up the clover planting and seeing it through, it did the best of anything for that year. But for the long-term, none of them were able to overrun the orchardgrass. The downfall of doing this on a working farm, it doesn't always get the highest priority and day-to-day maintenance. But it was a worthwhile project. I'd be willing to try another trial.

Long-term organic farming impacts on soil fertility

Summary

Very few long-term organic farming studies exist, especially in the central Great Plains. This study evaluated the effects of organic farming on soil fertility in the semi-arid climate of Northern Colorado over the periods of five to fifteen years. Data was gathered from annual soil tests from Grant Family Farms (GFF), the largest organic mixed crop farm in Colorado, located in the Great Plains in Northern Colorado.

Soil test data from twelve fields, 17 to 50 acres in size, was compiled and analyzed for changes over time in soil chemical properties for ten soil fertility components. The number of years of data per field ranges from to five to twelve over the period of 1985 to 2000. Soil tests revealed a significant increase in P, K, SOM, Zn, Fe levels in 33% of the fields. Soil pH decreased significantly in four fields. P reached a level that could be an environmental risk if soils are not managed carefully. NO_3-N and Cu did not change significantly over time in organic production in any of the observed fields. Overall, there was an observed increase in soil fertility components over time in organic production.

Field in organic wheat at Grant Family Farms in northern Colorado. Grant Family Farms is the largest vegetable and mixed crop organic farm in Colorado.

The objective of this project was to assess the impact of the transition of Grant Family Farms (GFF) from a conventional to an organic farm on soil fertility components. The changes in the following fertility components over time in organic production were evaluated: pH, electrical conductivity (EC), soil organic matter (SOM), nitrate (NO_3-N), phosphorus (P), potassium (K), zinc (Zn), iron (Fe), manganese (Mn), and copper (Cu). Only a few long-term studies examining soil fertility have been conducted on organic farming, and none has been conducted in irrigated organic systems in the central Great Plains. This study evaluated the effects of organic farming on soil fertility in the semi-arid climate of Northern Colorado over the periods of five to fifteen years.

Materials and Methods

Study site

Grant Family Farms is located in the Great Plains just east of the foothills of the Rocky Mountains north of Fort Collins. It has a semi-arid climate averaging about 13 inches of precipitation per year. The alkaline soil's texture varies from clay to clay loam and sandy clay loam.

Farming system description

From 1971 until the mid-1980s, some fields at GFF were farmed organically, and the others were farmed conventionally. During this period, practices that are now considered sustainable were employed on conventional fields, but commercial fertilizers and chemical pesticides were also used. GFF employed the following practices prior to transitioning to organic production: crop rotation, crop cover to avoid wind and water erosion, green manures, dairy manure applications to reduce fertilizer needs, and contour planting on steeper sloping fields. By the mid-1980's, all fields were farmed using fully organic practices. GFF has a goal of using a green manure, on average, two out of every three years and aims to apply aged dairy manure (usually in the fall) once every three

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Complete project reports are available by mail from OFRF or at our website at www.ofrf.org.

years. Occasionally, depending on the soil analysis, there is also a green manure grown in years receiving manure applications. Green manures are planted at one of three times depending on the crop rotation: spring (March-June), summer (July-October), or fall (October-March). Generally, a vetch/rye mix or Austrian pea/rye mix is used for over-wintered green manures, and oats or field peas are used for spring and summer. The tillage methods employed by GFF include plowing to turn under the cover crop or manure. Center pivots are installed in each field for irrigation.

Soil Sampling and Analysis

Generally, soil tests were taken in the fall after harvest and before any winter green manure plantings or dairy manure applications. Soil tests, conducted at Colorado State University (CSU) Soil, Water, and Forage Testing Laboratory were based on pint-sized soil samples taken by GFF. Soil probes were taken from each field, numbering 15-20 per 20 acres, or approximately one core per acre. The sub-samples, taken from the top 12 inches of soil, were collected and thoroughly mixed.

The samples were then tested for soil fertility components. Soil pH and EC were measured in a saturated paste, using a pH meter and a conductivity meter. The Walkley and Black (1934) method was used to determine percent SOM. Available NO_3-N, P, K, Zn, Fe, Mn, and Cu were extracted using ammonium bicarbonate-DTPA. The NO_3-N was then auto-analyzed using the zinc reduction method; the molybdate blue method was used to measure available P, and K, Zn, Fe, Mn, and Cu were analyzed using a spectrophotometer and inductively coupled plasma.

Data Compilation and Analysis

Data was compiled from GFF archives of CSU soil analyses dating from 1985 to 2000. There are multiple samples for some years, but not every year is represented in each field. The initial samples from the time (1970s) the Grants started farming the respective fields provide a point of comparison, but were not included in the data analysis. The number of samples (n) per field ranged from 5 to 20. Soil fertility components were evaluated as a function of years in organic farming. The data for each of the twelve fields was analyzed.

Results and Discussion

Soil test results for the twelve fields over time are shown in Table 1, presented as a statistical regression of soil properties as a function of time in organic farming. Examples of data from individual fields are shown in Tables 2 and 3: Table 2 presents a comparison of nutrient levels in Field 2 under conventional and organic practices from 1972 to 2000, and Table 3 shows the raw soil test data for Field 3 from 1985 through 2000.

❖ **pH decreased significantly ($p<0.05$) in four (33%) of the fields over time in organic production.** Baseline pH levels before organic practices began ranged from 7.9-8.1; these numbers changed to 7.6-7.9 in the last year analyzed. The four fields that showed significant decreases in pH also increased significantly in available P, K, and Fe.

❖ **Electrical conductivity (EC) increased significantly ($p<0.05$) in two fields (17%) over time in organic production.** EC reached detrimental levels in some years for sensitive vegetable crops like lettuce, onions, carrots, and beans, all of which GFF cultivates. However, levels remained within the satisfactory range for some field crops. Manure applications did not cause a detrimental increase in soil salinity.

Table 1. Statistical parameters from regression of soil properties as a function of time in organic production.* Shaded cells identify values that are highly significant.

Field ID #	# Years represented	n (#samples)	pH P	EC P	SOM P	NO_3-N p	P P	K P	Zn P	Fe P	Mn P	Cu P
1	11	17	0.061	0.023	0.033	0.611	0.0002	0.0008	0.924	0.004	0.089	0.682
2	12	20	<0.0001	0.003	0.020	0.120	<0.0001	0.002	0.0002	0.006	0.105	0.473
3	12	12	0.009	0.07	0.013	0.484	0.0007	0.0003	0.578	0.004	0.054	0.094
4	10	10	0.005	0.184	0.460	0.775	<0.0001	0.005	0.679	0.009	0.694	0.9426
5	9	12	0.040	0.099	0.049	0.056	<0.0001	0.0014	0.0001	0.013	0.003	0.886
6	10	11	0.640	0.368	0.215	0.350	<0.0001	0.026	0.0001	0.100	0.135	0.738
7	5	5	0.780	0.426	0.740	0.543	0.700	0.111	0.693	0.810	0.583	0.694
8	8	8	0.229	0.880	0.870	0.390	0.001	0.001	0.005	0.863	0.320	0.642
9	8	13	0.230	0.191	0.959	0.099	0.003	0.105	0.021	0.223	0.330	0.487
10	5	9	0.206	0.120	0.538	0.287	0.003	0.055	0.937	0.424	0.0098	0.940
11	7	7	0.590	0.640	0.320	0.937	0.0098	0.105	0.818	0.245	0.527	0.876
12	6	13	0.111	0.058	0.287	0.821	0.004	0.015	0.794	0.136	0.215	0.776

* Organic practices began in 1983 for Fields 7 and 8 and in 1985 for all other fields.

❖ **Soil organic matter (SOM) increased significantly ($p<0.05$) in four fields (33%) over time in organic production.** According to previous studies, SOM increases very slowly and may take several years to detect. GFF soil testing revealed a very slight increase of SOM (<0.10 %) per year in organic production. The SOM levels remained in the medium category (1.5-3.0) with a few exceptions where SOM was exceptionally high. These high percentages may be attributed to the timing of soil sampling. SOM levels fluctuate throughout the growing season, depending on precipitation, microbial processes, dairy manure and green manure incorporation. Multiple samples must be taken to accurately measure changes over time in SOM content.

❖ **P increased significantly ($p<0.05$) in every field but one (92%) over time in organic production.** Available P levels increased significantly over time in 11 of the fields to high (12-15 ppm) and very high levels (>15 ppm) for crop production. In the 1970's, Fields 2-6 level ratings were very low (0-3) to low (4-7 ppm) and increased to very high (>15 ppm) for crop production over time in organic production. High levels of P in erodible soils (steeply sloping, uncovered) can be a serious environmental risk. Grant Family Farms uses cover crops and contour planting for the steeper sloping fields to avoid soil erosion; however, most of the fields do not have steep slopes and all fields have good permeability rates.

❖ **Available K increased significantly ($p<0.05$) in eight fields (67%) of the fields.** Clay soils in Colorado are not prone to K deficiencies, and additions of dairy manure and green manure to the soil replace K that is depleted by crop use. The average K content of dairy manure (Table 4), according to analyses of 51 samples from different sources, is 1.45 %, with a range of 0.19% to 3.37%.

❖ **Available Zn increased significantly ($p<0.05$) in five fields (42%).**
❖ **Fe increased significantly ($p<0.05$) in five fields (42%).**
❖ **Mn increased significantly ($p<0.05$) in two fields (17%).**
❖ **Cu did not change significantly ($p<0.05$) over time in organic production in any field.**
Many micronutrients are least available in basic soils. However, dairy manure can contain substantial amounts of micronutrients (Table 4). Zinc deficiencies occur mostly in basic soil, but solubility can increase 100-fold for each unit that pH is lowered. The Zn content of the manure as well as the drop in pH are likely explanations for the significant available Zn increase in Fields 2, 5, 6, 8, and 9. Four of the five fields in which Fe increased significantly ($p<0.05$) also decreased significantly in pH. Fields 3 and 4 increased from marginal levels to adequate levels of Fe over time in organic production.

❖ **Nitrate nitrogen (NO_3-N) did not change significantly over time in organic production in any of the test fields.** Nitrate levels fluctuate radically throughout a growing season and are highly dependent in the crop grown that season prior to the fall soil sample. As such, nitrate measurements do not accurately reflect N reserves in the soil. More complex measurements are needed to accurately reflect soil nitrogen dynamics.

In summary, annual soil tests revealed a significant increase in P, K, SOM, Zn, and Fe and decreased in pH levels in 33% of the fields. Available P reached a level that could be an environmental risk if soils are not managed carefully. Using cover crops and planting on the contour, as GFF practices, will help prevent loss of P from the site into water sources. Application methods should minimize the time in which the P is exposed on the soil surface.

Soil pH decreased significantly in four fields. The drop in soil pH is due to an increase of H^+ and Al^{3+} ions in the soil solution and may partially explain the increase in available micronutrients (Zn, Fe, Mn). Manure also contributed to soil

Table 2. Comparison of nutrient levels under conventional and organic practices in Field 2.*

	Conventional		Organic	
Year	**1972**	**1979**	**1985**	**2000**
pH	8.1	8.3	8.2	7.9
EC	0.6	0.8	0.5	1.3
OM	2.6	1.5	2.3	3.0
NO_3-N	5.0	3.0	17.5	33.6
P	1.0 vl	1.0 vl	4.7 l	31.9 vy
K	226.0 vh	154.0 h	237.0 vh	357.5 vh
Zn	1.3 mg	0.8 l	1.0 mg	2.3 a
Fe	4.3	5.5	8.0	14.0
Mn	0.8	0.6	1.9	3.6
Cu	2.4	0.10	2.6	2.9

*vl=very low, l=low, m=medium, h=high, vh=very high, a=adequate, mg=marginal

Table 3. Raw soil test data for Field 3.

Yr	Yrs in Org. Prod.	pH	EC Mmhos/cm	% OM	NO_3-N ppm	P ppm	K ppm	Zn ppm	Fe ppm	Mn ppm	Cu ppm
1985	1	8.3	0.5	2.4	20.0	4.2	232	0.9	6.0	1.1	2.5
1986	2	8.1	0.7	2.0	48.0	4.5	243	0.9	6.6	3.1	3.0
1987	3	8.3	0.4	2.3	12.0	4.2	222	0.7	6.4	1.6	2.2
1988	4	8.2	0.6	2.0	15.0	3.8	274	0.8	10.7	3.8	2.8
1989	5	7.9	0.6	2.5	44.0	9.5	288	1.5	10.6	2.6	3.3
1991	7	7.9	1.2	2.3	32.0	13.1	366	13.4	6.4	2.0	2.5
1995	11	8.1	0.5	2.4	20.0	26.5	399	2.2	8.7	1.8	2.4
1996	12	8.0	0.5	3.7	25.0	57.7	507	4.0	26.6	4.6	3.3
1997	13	8.1	1.1	4.0	21.0	42.4	552	3.3	17.9	5.9	5.0
1998	14	7.9	1.2	2.8	28.9	35.1	471	2.5	14.9	4.0	2.6
1999	15	7.8	0.7	2.9	31.0	34.0	550	2.6	16.8	3.7	3.7
2000	16	7.8	1.2	3.0	9.2	28.0	364	2.7	20.1	3.2	3.5

micronutrient levels and organic matter increased the buffering capacity of the soil, lowering pH. Mn increased significantly in only two fields, while Cu and NO_3-N showed no significant changes over time in organic production. Salts measured by EC reached problematic levels for some vegetable crops in some years.

Based on the evidence provided by soil analyses, organic farming practices increased soil fertility levels over time in organic production.

One constraint of this study is the limited number of data points per field. Sampling numerous times throughout the year would more accurately reflect soil nutrient levels.

Table 4.Dairy manure EC, OM and nutrient levels based on a wet weight basis.*

	EC mmho s/cm	OM %	NO_3-N mg/kg	P %	K %	Fe %	Mn %	Cu %	Zn %
Avg.	17.8	17.5	60.1	0.38	1.45	0.37	0.01	60	95
Min.	1.5	10.1	0.1	0.11	0.19	0	0	0	0
Max	29.5	29.0	673.9	0.83	3.37	0.97	0.02	187	162
N	18	9	33	51	51	40	40	38	38

* Source: Jessica Davis, Colorado State University. Minimum, maximum and average values for some dairy manure contents based on samples taken from various sources in Colorado.

"We can say that soil P increased at a particular rate"

Project wrap-up with Jessica Davis, Colorado State University

Q. ***One of your research hypotheses was that organic farming practices not only build soil fertility, but also that fertility reaches an equilibrium at some point. Based on this data, can you make any statements about soil fertility reaching an equilibrium?***

While we can make a positive determination that soil nutrients increase in organic systems based on evaluation of this data, we did not get to the point of seeing equilibrium. Grant Farms is continuing to build fertility in spite using soil-building practices for 30 years. That is surprising. Eventually it must reach an equilibrium but they're not there yet.

Q. ***As a researcher, what to you were the most important results of this project, in terms of the results or the process?***

We can say some things that have not been reported before--especially that soil P levels increased at a particular rate.

Q. ***Your pre-project emphasis—that organic systems are fertility-building—contrasts a bit with the emphasis in your project results where you warn that P and EC are approaching high levels in some fields. It seems that the tenor of results is somewhat more cautionary.***

Perhaps a bit, but if so it's for a number of reasons. We'd recently done another study with organic apple growers on the west slope where we saw manure applications leading to elevated salt levels. Increasing soil fertility is inevitably going to increase soil salinity, because all soil nutrients are salts. So this is to be expected. However, these salts are not the same as sodium salt—we determined that sodium did not increase over time on this farm. EC levels--the test that measures "salts" overall, were high in two fields yet still within tolerable range for most crops, well under 2 mmhos/l. But because the Grant farm produces lettuce, beans and other crops that are particularly sensitive to salts, it is worth taking note of.

A lot depends on the system and what you're producing. This influences what you say about the results. So while salt levels went up it doesn't negate the value of increasing fertility levels, it just adds a little cautionary note to the results.

Q. ***You connect rising P levels over time to dairy manure applications. Does it matter what source P is from as to whether it is more or less detrimental?***

The key problem with P is runoff. If you have P that was applied and also increased soil organic matter, you would expect that it would increase infiltration and reduce the runoff rate. But we did not measure for that, so we can't say anything about that in this study. However, a CSU graduate student has recently compared--and this is all new data--applications of organic raw dairy manure, composted dairy manure and vermicomposted dairy manure, all from the same source. Results showed that there was no difference in yield or P uptake to the plants. However there was less P runoff with the composted and the vermicomposted dairy manure applications. The study actually used simulated rainfall and collected the runoff. Prior to this, conventional wisdom is it did not matter what source P is from. These results say it does make a difference. Now the question is why.

Q. ***About the P levels shown—from the soil tests I'm familiar with those levels don't appear very high.***

This is important! Data for P is not all the same. It depends entirely on which test you use. And different labs use different tests. This is a big issue. CSU uses the AB-DTPA test for phosphorous which is appropriate to alkaline soils. The take-home message is to use that test or an Olsen-P test for alkaline soils. In acidic soils you can use a Bray test, or several other P tests that are fine for acidic soils. But the levels for each test are different. A Bray P-1 of 120 ppm is very high, but under AB-DPTA, 40 ppm is very high.

It's important for farmers to be aware that local labs are better, and are more appropriate. In the organic community people often want to use labs with similar values, and will send their soil samples across the country for testing to a lab that they like. I've seen over and over again that recommendations come back looking really weird when people do this.

Q. ***After evaluating this data do you have particular advice for farmers who want to engage in long term fertility monitoring of this nature?***

Keep good records. It would be great if more producers would do this. It really was a gold mine. If other farmers have long term records they'd like to share I'd be happy to do the statistics.

Fertility analysis of organic strawberry systems: effect of cultivars and mycorrhizal inoculation

Summary

Plant tissue analysis has been used as a tool for monitoring nutrient status of conventional strawberries. However, no research has been conducted on a tissue test for organically grown strawberries. The main goals of the study were to 1) demonstrate the relative N performance of standard California cultivars grown under organic management, 2) determine if a commercial arbuscular mycorrhizae (AM) inoculant could provide mineral nutritional benefit, especially for phosphorus, and 3) provide information that will aid organic strawberry producers in fertility management.

Experiments were established in two organic farms on the central coast of California. Leaves of five commercial strawberry cultivars grown with or without AM inoculation were sampled. Total nitrogen (T-N) nd total phosphorus in leaf blades, and nitrate-N in petioles were analyzed. Regardless of the growth stage, we found significant differences in T-N in leaf blades and nitrate-N in petioles among cultivars. Positive correlations of N status and total fruit yields were found across cultivars. The most significant correlation was observed between T-N in leaf blades in the early flowering stage and the total fruit yield. This suggests a potential use of T-N in leaf blades rather than nitrate-N in petioles as an indicator for N status in organic strawberries.

AM inoculation did not demonstrate any significant effect on total phosphorus in leaf blades and N status of strawberries. Total P in leaf blades was sufficient throughout the growth period despite cultivar and field, reflecting sufficient soil available phosphorus levels of the fields. This might explain the ineffectiveness of the AM inoculation in these experiments.

Yield and quality of strawberry fruits are strongly affected by the plant's nitrogen status. Nitrogen deficiency reduces leaf area, root mass and fruit size, and excessive levels of nitrogen can lead to soft fruit, delayed ripening, lower yields, increased powdery mildew and increased mite pressure.

A systematic plant analysis conducted by A. Ulrich in California in the 1970s showed that strawberry cultivars differ in their ability to utilize nitrogen, primarily because of differences in growth habit, or differences in fruit production and foraging power of the roots for soil nitrogen. Five hundred ppm petiole nitrate was determined as the critical concentration for optimum growth in all cultivars. No such research has been conducted to identify critical nutrient levels for current strawberry cultivars under organic management.

Along with plant analysis, nitrate sap tests are used widely for fertilizer recommendations of many crops in California. Previous studies in organic crops have shown nitrate content in fresh sap of root tissue in organic onions, as well as petiole nitrate levels in organic processing tomatoes, to be significantly below levels in the same crops under conventional production, even though yields were similar. In these cases total nitrogen (T-N) content appeared to better correlate with crop yield than nitrate (NO_3-N) content. Some evidence suggests that there is a greater availability of ammonium compared with nitrate in organic systems, which would be consistent with cases in which tissue nitrate testing underestimates plant N status. It is therefore important to evaluate whether total nitrogen or nitrate leaf tests can provide a good indicator of crop nutrient status in organic strawberries.

Objectives

The primary objective of this project was to demonstrate the relative nitrogen performance of standard California strawberry cultivars under organic management. In addition, this project also evaluated whether a commercial arbuscular mycorrhizae (AM) inoculant could provide mineral nutritional bene-

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Complete project reports are available online at www.ofrf.org, or by mail by contacting OFRF.

fit, especially on phosphorus, to the cultivars being tested. Overall, the project objective is to provide information that will aid organic strawberry producers in fertility management.

Methods

Cultivar performance was evaluated at two certified organic locations. The sites were located in Salinas (USDA/ARS Spence Organic Field, Salinas) and Santa Cruz (UCSC Organic Farm).

Cultural practices

Santa Cruz Field: 25 tons per acre of compost was applied in September. Broccoli residues were incorporated late September, and strawberries planted November 20 and black plastic mulch was applied. Fruit harvest started April 18 and ended on June 25.
Salinas Field: 25 tons per acre of compost was applied in September. Strawberries were planted in November and black plastic mulch was applied. Fruit harvest started on April 11, and ended July 26. Organic liquid fertilizer (7-0-0) was applied at a rate of 6 gallons/acre per week starting the week of June 25, for three weeks.

Ten cultivars were evaluated for yield and mycorrhizal infection. For nutrient analysis, five cultivars, Aromas, Chandler, Seascape, Pajaro, and Diamante were sampled. Aromas and Seascape represent newer cultivars that consistently showed high performance in a previous year of cultivar experiments. Chandler is an older and well-known cultivar among organic growers. Pajaro was chosen as a low performance cultivar in a previous experiment. Diamante is a newer cultivar and the most widely planted cultivar by conventional growers.

At the time of planting, plants from each cultivar were dipped in either a microbial treatment or a control and planted. The microbial inoculant was a commercially available mycorrhizal inoculant (BioBlend RD, Soil Technology), which consists of seven vesicular arbuscular mycorrhizal species.

Results and Discussion

Strawberry Growth and Fruit Yield. In the Santa Cruz field, damage brought about by a combination of garden symphylans and Verticillium wilt caused major yield reduction. There was no statistical difference in the levels of damage among treatments. Strawberry plants in the Salinas field had no major diseases or pest problems.

The fruit yield of each cultivar differed significantly: Seascape and Aromas had the highest marketable fruit yield in Santa Cruz and Salinas, respectively. Pajaro's fruit yield was the lowest in both fields.

Nitrate (NO_3-N) Content in Petioles. NO_3-N content in petioles was high in March (673-3960 mg N/kg), decreased in May, and remained low in July regardless of field and cultivar. In May and July, NO_3-N content (mg/kg) was higher in the Salinas field (155-1660) than in the Santa Cruz field (167-669), probably reflecting the plant damage in the Santa Cruz field and the supplemental N application in the Salinas field. At each growth stage, a significant difference in NO_3-N content was found among cultivars but not in the mycorrhizal treatments and the interaction.

Average NO_3-N content during the three sampling periods was in order of Aromas > Seascape > Chandler > Diamante > Pajaro despite field. Pajaro consistently showed the lowest NO_3-N content and was significantly lower than Diamante in both fields.

Total nitrogen (T-N) Content in Leaf Blades. T-N in leaf blades was 2.6-3.5% in March and decreased to 1.7-2.8% in May and July in both fields. Again, at each growth stage, cultivar treatment was significantly different but mycorrhizal treatment and the interaction was not.

In cultivar treatments, average T-N content was in order of Seascape > Aromas > Diamante > Chandler > Pajaro regardless of field. In Santa Cruz, leaf T-N in Seascape was significantly higher than the rest, and leaf T-N in Pajaro was significantly lower than the other cultivars. In Salinas leaf T-N in Seascape and Aromas was not significantly different though the two cultivars had significantly higher leaf T-N than the others did.

Correlation between Petiole NO_3-N and Leaf Blade T-N Contents. T-N in leaf blades showed a significant correlation with NO_3-N in petioles.

Correlations between N Status and Fruit Yield. Positive correlations of N status and total fruit yields were found across cultivars in each site at different stages. The most significant correlation was observed between T-N in leaf blades in the early flowering stage and the total fruit yield ($P < 0.001$). This correlation was consistent across fields, whereas correlations of NO_3-N in petioles in the same stage and the total fruit yields differed between fields.

The interpretation of this result, however, requires consideration of the following factors: the fruit yield level, N application rate, and the effect of N status on fruit yield. A typical fruit yield of organic strawberries in this area is about 1,000 grams/plant of fruit for 6-7 months of harvest. Compared to that level, the fruit yield in this experiment was low even for Aromas in Salinas (about 300 grams/plant), though with a shorter harvest period.

Total N application rate in this experiment was about 300 lbs/A, and mostly from compost which is slowly mineralized, whereas a typical organic grower applies a similar amount of total N but 1/3 of it is usually from relatively soluble fertilizers (i.e. blood meal, liquid organic fertilizers). Therefore, this experiment can be seen as N performance of strawberry cultivars under compost-based, low-mineral N production. If we adopt the tentative critical level of T-N 2.8 %, all cultivars were under the critical level in May and July in both fields. In light of the low fruit yield, it seems reasonable to say that all cultivars were N deficient since sometime after March.

Total Phosphorus (T-P) in Leaf Blades. T-P content in leaf blades ranged from 0.25% (Chandler in July in Santa Cruz) to

0.48% (Aromas in March in Salinas) across all sampling stages and treatments. In both fields, cultivar treatment was significant but mycorrhizae treatment was not. Among cultivars tested, Aromas showed the highest T-P content in both fields but the rest of the order was not consistent between the fields.

Comparing with Conventional Critical Levels. NO_3-N content in petioles, and T-N and T-P content in leaf blades from this experiment were contrasted with the conventional tentative critical levels established by Ulrich et al. In evaluating N status, we found a discrepancy between critical levels of NO_3-N and T-N. According to the tentative critical level for NO_3-N in petioles (500 ppm), the plant N status of Aromas and Diamante in July grown in the Santa Cruz field were still above the critical level. On the other hand, the T-N tentative critical level (2.8%) indicated all cultivars were N deficient in May and in July despite the field. For T-P in leaf blades, all samples contained T-P in well above the tentative critical level of 0.1% tentatively suggested by Ulrich et al.

Discussion

N performance of Five Cultivars Grown in Organic Systems. Each strawberry cultivar had a unique N response and performance, and N performance diversity reflects the differences in foraging capacity of the roots for soil N, or growth habit under given environmental conditions. We compared N performance of the currently available five strawberry cultivars grown under organic management. Both NO_3-N in petioles and T-N in leaf blades showed significant differences among cultivars tested. As a general trend, Aromas and Seascape are the two cultivars that always showed the highest N status across the growth stages and fields, followed by Chandler and Diamante, while Pajaro consistently showed the lowest N status. This finding may be useful information for growers in terms of N fertility management. For example, Chandler and Diamante are likely to require more N than Seascape and Aromas to obtain a similar N status, and probably also to obtain a similar fruit yield.

T-N in Leaf Blade as a Better Choice for Organic Strawberries. We found T-N in leaf blades to be more consistent across fields than NO_3-N in petioles in terms of correlation with the total fruit yield. In addition, though the correlation between T-N in leaf blades and NO_3-N in petioles was highly significant, the residuals seem too large to use NO_3-N to predict T-N. Therefore, it appears that T-N in leaf blades may provide a better indicator for N status in organic strawberries. The difference between fields might be caused by difference in soil N dynamics and/or in other environmental factors' effects on plants (i.e. temperature, irrigation regime) between the two fields.

T-P in Leaf Blades and Mycorrhizae Application. We did not find any significant effect of mycorrhizae application on the P status in strawberry leaves or on fruit yield in this experiment. In light of T-P content in leaves and soil Olsen P level of fields, it seems that high P fertility of the field soils provided sufficient P to strawberries, which might diminish the role of mycorrhizae. In general, the longer the history of organic farming, the higher the available P in soils. This is especially true at the farms that applied manure-based composts. This may restrict effective use of mycorrhizae amendments in organic farms unless inoculum is applied in small plant cells at nurseries.

Future Studies

Typical organic strawberry growers apply significant amounts of commercial organic fertilizers that are more soluble in form. Such practice has been criticized as "high input" organic agriculture that may not convey environmental benefits that organic farming can provide. Therefore, future studies should demonstrate 1) sufficient leaf blade T-N level of organic strawberries, 2) improved nitrogen use efficiency in organic strawberry production, and 3) environmental impact of organic strawberry production. Field trials that evaluate impacts of diverse N rates and N sources on the plant N status, the soil N status (including N leaching potential), the fruit yield, and their interactions in organic strawberry production are needed.

OFRF funding leads to further support

Project wrap-up with Joji Muramoto, UCSC CASFS and Carolee Bull, USDA-ARS, Salinas

Q. ***Re: the low strawberry yields at both sites, the UCSC yields are explained by problems due to symphylans and Verticillium, but the low Salinas yields were not explained.***

CB. I can explain that. We had a bit of difficulty with plot management--we believe yields were lower due to lack of farmer experience and timing of management practices at the site.

Q. ***What was the most important aspect of this project for you as researcher(s)?***

JM. That we found a correlation between cultivars with the highest yields--Seascape and Aromas--and measurements of highest total nitrogen in leaf blades. This is interesting.

Q. ***Are you doing any further or future work on this or a similar topic?***

JM. Right now I'm working with other growers who are supplying much higher levels of N and they are doing very well. We're working to establish sufficient N level in organic. We just got a grant from USDA-CSREES for the next four years to look at fertility in strawberry/vegetable rotation systems. This project will start next fall and we'll be working with four different organic growers, looking at different things, such as ways to better synchronize nitrogen supply and nitrogen uptake. For example, plastic mulch application varies, whether producers do it post- or pre- plant (this goes for conventional producers, too). We're finding less loss of nitrogen with pre-plant mulch.

CB. It's important to note that OFRF funding really helped towards getting that CSREES grant--it funded the preliminary work that made this USDA grant possible.

Further information about Joji's work in organic strawberries can be found at www.agroecology.org. Click on "people" and then "Joji Muramoto." Three posters are available on this site:

1) *Indicators of soil health in an organic strawberry-vegetable rotation system*;

2) *Maintaining agroecosystem health in the conversion to organic management of a strawberry-vegetable rotation system*; and

3) *Maintaining agroecosystem health in the organic management of a strawberry/vegetable rotation system*.

Small-grain cultivar selection for organic systems

Summary

Our objective was to identify hard red spring wheat, barley and oat cultivars that are adapted to environments managed organically in the northern Great Plains. Thirteen spring wheat and 10 oat cultivars representing a diverse pedigree were included in adaptation studies at two Minnesota and two North Dakota locations in 2002. Seed lots produced under both conventional and organic management were included for two wheat cultivars at all four locations and for two oat cultivars at two locations. Five barley cultivars also were compared at one ND location. Grain yield and quality of modern small-grain cultivars were better than or equal to grain yield and quality of older cultivars at each location. Crop performance differed when two seed lots of the same cultivar were compared for both wheat and oats. Results of this preliminary study support the hypothesis that grain yield and quality may be maximized when modern rather than older commercial cultivars are grown in organic environments. The value of using high-quality seed lots for superior small-grain crop performance also was reinforced in this project.

Organic wheat and oat variety trials near Richardton, North Dakota.

The development and selection of modern small-grain cultivars generally occurs in environments where synthetic fertilizer and pesticides are used to minimize nutrient deficiencies and pests. Many organic producers of small-grain crops would prefer to have access to modern cultivars that have been selected for organic environments, but such cultivars are not available. Also, some producers grow cultivars developed prior to the widespread use of synthetic agri-chemicals, with the belief that older cultivars are adapted better to organic environments. However, results from adaptation studies in conventional environments indicate that old cultivars generally do not perform as well as modern cultivars.

Organic producers expressed the need for cultivar adaptation studies to land grant scientists at North Dakota State University (NDSU), beginning in 2000. In response, a limited number of modern spring wheat and oat cultivars were compared in Minnesota and North Dakota in 2001, and the effort was formalized under this project in 2002.

Objectives

The objectives of this project were to:

- ❖ Determine whether modern spring wheat, oat and barley cultivars are better adapted than old cultivars to organic environments;
- ❖ Determine if natural adaptation occurs after small-grain cultivars are introduced into organic environments;
- ❖ Identify growth traits and agronomic characteristics that result in superior cultivar performance in organic environments.

Materials and Methods

Fourteen to 18 cultivars of hard red spring wheat were included in field experiments in certified organic fields on farms in western Minnesota and in south central and southwestern North Dakota. Thirteen of the cultivar entries occurred in each field experiment. Organic seed lots of two wheat cultivars (Stoa and Parshall) were included and compared with conventional seed lots of the same cultivars. Three cultivars were

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Cooperating growers: Duane Boehm, Richardton, ND (certified organic); David Podoll, Fullerton, ND (certified organic); Lynn Brakke, Comstock, MN (certified organic); Pat & Jim Todahl, Fertile, MN (certified organic).

Report submitted: June 2003. The complete project report is 20 pages, including 10 data tables.
Complete project reports are available online at www.ofrf.org, or by mail by contacting OFRF.

released prior to 1970 and were considered old cultivars for purposes of this study; the remaining 10 cultivars were classified as modern.

Similarly, 10 to 13 oat cultivars were included in field experiments at the four locations and 10 of the cultivars occurred in each of the experiments. No oat cultivars released prior to 1970 were included because sufficient quantities of seed lots of older cultivars could not be obtained. Organic seed lots of two oat cultivars (Hytest and Otana) were acquired and were included in field studies along with conventional seed lots of these same two cultivars at the two ND locations.

Five barley cultivars were compared in a field experiment at the Richardton, ND location. As with oat entries, barley cultivars released prior to 1970 were not included because seed lots of older cultivars were unavailable. All of the barley seed lots included in the field experiment were produced under conventional management.

Seed beds were prepared by cooperators following standard organic practices on each farm. Treatments were established by sowing wheat and barley entries at 1.6 million pure live seed (PLS)/acre, and oat entries at 1.4 or 1.6 million PLS/acre.

The field experiments were established between May 14 and 27 at all sites. Grain was harvested from plots between August 13 and 23. Data collected included seedling emergence, vigor, plant height at maturity, yield, grain protein concentration, days to crop emergence, plant height at various growth stages, and dry matter of small-grain crops and weeds.

Results

Wheat

Seedling Numbers. Results for wheat experiments are shown in Table 1. A consistent trend between the era of cultivar development and crop seedling numbers did not occur within the three locations where seedlings were counted.

Differences did not exist in seedling numbers when the organic and conventional seed lots of the cultivar Parshall were sown.

More seedlings resulted when the organic seed lot of Stoa was used compared with the conventional seed lot at all locations. *The data suggest that seedlings from seed lots of old cultivars can be as numerous as seedlings from seed lots of modern cultivars.*

Seedling Vigor. Seedling vigor was equal or greater for the modern cultivar Gunner compared with other cultivars at each of the four locations, along with Parshall when the organic seed lot was used. Seedling vigor of Gunner and Parshall generally was superior to seedling vigor of the old cultivar Red Fife.

Differences in seedling vigor generally were not detected between Gunner and Parshall and the old cultivar Waldron. Vigor of Waldron seedlings was superior to the modern cultivar Glupro at three locations. *These data demonstrate that a consistent trend on seedling vigor was not detected by the eras of cultivar development represented in this study.*

Seedling vigor was greater when the organic seed lot of Parshall was used compared with the conventional seed lot of Parshall at only one of the four locations. Greater seedling vigor occurred when the organic seed lot of Stoa was used compared with the conventional seed lot at three of four locations.

Plant Height. A consistent trend in plant height for the era of cultivar development was not detected for cultivars considered to be tall- statured. *The data indicate that plant stature classification of cultivars may not be consistent in all environments.*

Differences in plant height were not detected between plants using different seed lots of the same cultivar. For example, plant heights were similar for the cultivar Parshall established using

Table 1. Development and selected traits for thirteen hard red spring wheat cultivars included in adaptation trials, and average results for plant stand (Stand), seedling vigor (Vigor), mature plant height (Height), grain crude protein (CP), and grain test weight (TW) across four fields managed organically in 2002.

Development and selected traits					Stand and harvest characteristics across four locations					
Cultivar	Origin	Yr of Release	Plant stature	Maturity	Stand -no/ft^2-	Vigor[A]	Height -inches-	Yield -bu/ac-	CP -%-	TW -lb/bu-
Alsen	NDSU	2000	semi-dwarf	mod. early	27	6	26	26	16	57
BacUp	UM	1996	medium	early	29	5	27	22	16	58
Chris	UM	1965	tall	mod. late	26	4	32	20	16	56
Coteau	NDSU	1978	medium	medium	29	6	29	19	16	55
Glupro	NDSU	1995	tall	mod. late	23	3	32	16	18	54
Gunner	AgriPro	1995	medium	medium	29	7	28	23	16	58
Ingot	SDSU	1998	semi-dwarf	early	27	6	29	27	15	58
Parshall-C[B]	NDSU	1999	medium	mod. early	28	6	29	28	15	58
Parshall-O[B]	same	same	same	same	29	8	27	30	15	59
Red Fife	Canada	1840s	tall	mod. late	26	4	34	13	15	55
Reeder	NDSU	1999	semi-dwarf	mod. early	25	5	26	27	15	56
Stoa-C[B]	NDSU	1984	medium	mod. early	30	5	30	29	15	56
Stoa-O[B]	same	same	same	same	33	5	30	29	15	56
Waldron	NDSU	1969	tall	medium	33	7	31	24	16	55
Walworth	SDSU	2001	semi-dwarf	mod. early	27	6	26	31	16	56

[A] Poor seedling vigor = 1; very vigorous = 9. [B] C = conventional seed lot; O = organic seed lot.

the organic seed lot and the conventional seed lot. Similarly, differences in plant height were not detected when Stoa was established using the organic seed lot and the conventional seed lot. *These data suggest that plant stature may be less sensitive to differences in seed lot quality than the other agronomic traits considered in this project.*

Grain Yield. Highest grain yields generally occurred with modern cultivars compared with old cultivars. For example, Parshall produced more grain than other cultivars at Comstock when the organic seed lot of Parshall was used, except for Ingot and Walworth.

Walworth produced more grain than other cultivars except for Parshall at one site. Stoa produced higher yields than other cultivars at Richardton when the organic seed lot was used, with two exceptions. The old cultivars Chris, Waldron, and particularly Red Fife produced low yields relative to some of the modern cultivars at these three locations. Yield differences were not detected where Parshall was established with the organic seed lot compared with the conventional seed lot at three of the four locations.

More grain was produced when the organic seed lot of Stoa was used compared with the conventional seed lot at two locations. *These data indicate the importance that seed lot selection can have for grain yield of a cultivar, even when other agronomic factors like plant stature may not be affected.*

Protein. Protein was of equal or greater concentration in grain of Glupro compared with grain of other cultivars at all four locations. Glupro was released by NDSU in 1995 because of its very high protein concentration. Protein concentrations of grain produced by old cultivars were comparable to concentrations of grain produced by several modern cultivars at each location. Differences in grain protein concentration were not detected between organic and conventional seed lots for both Parshall and Stoa.

Test Weight. Differences in grain test weight were detected among cultivars at each of the four locations. Consistent differences in grain test weight were not detected between the eras of cultivar development that were represented. Differences were not detected in grain test weight when the organic seed lot of Parshall was used compared with the conventional seed lot. However, heavier test weights occurred at two locations when the organic seed lot of Stoa was used rather than the conventional seed lot. *These data indicate the importance that seed lots may have on grain test weight of a cultivar in some instances.*

Oats

Oat cultivars differed in agronomic traits across the four locations included in this study, except for seedling vigor. (Data for oats are not shown but are available in the complete project report.)

Seedling numbers of the cultivars Hytest and Wabasha were equal to or greater than seedling numbers of other cultivars at all four locations. Seedling vigor also was equal or greater for Hytest compared with other cultivars, except at Richardton where Buff and Richard seedlings were more vigorous. Consistent trends in seedling numbers and vigor were not detected between organic and conventional seed lots of oat cultivars at the two locations where comparisons were made.

Plant height was equal or greater for Youngs compared with other cultivars at each of the four locations, even though Youngs is rated as having medium plant stature. Plant height differences generally were not detected between plants established with organic and conventional seed lots of the same cultivar.

Grain yield was equal or greater for Leonard compared with other oat cultivars at three of four locations. Morton produced equal or greater amounts of grain than other cultivars at three locations. Lowest grain yields were produced by the hull-less cultivar Buff at both locations in North Dakota. Differences generally were not detected for grain yield when using the organic seed lot compared with the conventional seed lot of the same cultivar.

Grain test weight was heaviest for Buff at all four locations. Grain test weight of hull-less oat cultivars generally is heavier than the test weight of grain produced by hulled oat cultivars. Hytest generally produces grain with a heavier test weight compared with other hulled oat cultivars, but differences in test weight were not detected between Hytest and some other hulled cultivars at each of the four locations. Differences in test weight were not detected when using organic and conventional seed lots of the same cultivar at locations where different seed lots were compared.

Barley

Data for oats are not shown but are available in the complete project report.

Seedling numbers were greater for the two-rowed cultivar Conlon than for six-rowed cultivars, except Lacey and Robust. Seedlings of Conlon were more vigorous than seedlings of Drummond and Legacy.

Plant height differences were not detected between cultivars even though Conlon generally is shorter in stature than the other cultivars included in the study.

Grain yields were similar between Conlon, Lacey, Robust, and Drummond. Less grain was produced by Legacy than by Conlon, Lacey, and Robust.

Test weight was heavier for grain produced by Conlon compared with the other four cultivars. Test weight generally is heavier for grain produced by two-rowed cultivars compared with six-rowed cultivars.

Conclusions

Consistent trends in agronomic traits were not detected among spring wheat cultivars developed during different eras that were represented in this project, except for grain yield. At both MN locations, greatest amounts of grain were produced by wheat cultivars released in or after 1999. Conversely, the old cultivar Red Fife generally produced low yields. These data do not support the hypothesis that old cultivars are better adapted than modern cultivars in organic environments. Seed lots for cultivars released prior to 1960 were unavailable at the quantities needed for this project, except for Red Fife. Field studies that include cultivars developed prior to 1960 in addition to Red Fife are needed to verify our preliminary observations that agronomic performance is equal or superior for modern wheat cultivars compared with old cultivars in organic environments.

Organic and conventional seed lots of two wheat and two oat cultivars were included in this study. A consistent trend in agronomic traits with the type of seed lot used was not detected across cultivars for both wheat and oats. For example, agronomic traits for plants generally were similar between the organic and conventional seed lots for the wheat cultivar Parshall and the oat cultivars Otana and Hytest. Conversely, agronomic traits generally were superior when the organic seed lot was used compared with the conventional seed lot for the wheat cultivar Stoa.

Plants that developed from the organic seed lot of Stoa may represent a population that is better adapted to organic environments than plants that grew from the conventional seed lot, since Stoa is heterogeneous in genetic composition compared with many other modern spring wheat cultivars (S.S. Jones, personal communication, 2003). Previous research has demonstrated that natural adaptation in wheat populations can occur when heterogeneous populations develop under different production strategies. However, attributing the differences in agronomic traits to genetic heterogeneity in Stoa is confounded by the differences in quality between seed lots that were observed. Kernels were larger and more vitreous in the organic seed lot compared with the conventional seed lot, probably because of environmental differences between sites where the two seed lots were produced. Additional field experiments should be conducted to determine if agronomic traits of Stoa generally are superior when organic seed lots are used compared with conventional seed lots in environments managed organically and, if so, why.

A consistent impact of crop seedling numbers, seedling vigor, and plant height on grain yield was not detected in this project for wheat, oats, or barley. Results of this project suggest that additional growth traits and combinations of various traits should be considered in field work to identify those factors that affect agronomic performance of small-grain cultivars in organic environments.

"The primary question answered..."

Project wrap-up with Patrick Carr, NDSU Dickinson Research Center

Q. *OFRF funded the first year of this study, but you will have two more years of results at the end of the 2004 season, is that right?*
Right. The 2004 season is our third and final year for these cultivar studies.

Q. *In this first-year report, the first project objective (whether old or newer cultivars perform better) is the most thoroughly discussed. Other project objectives might have benefited from the additional years of data. So, over these two additional years, have you been able to determine whether natural adaptation occurs after small grain cultivars are introduced into organic environments?*
We may have been a bit optimistic at our ability to determine that in a definite way at the outset of the project. Yet, we may be able to say that results lend some support to this hypothesis. In one wheat variety, Stoa, the organic seed lot did tend to perform better. Steve Jones at Washington State University found Stoa for us, and said intuitively that made some sense, because it is a somewhat more genetically heterogeneous [mixed] variety than other modern varieties. If a population has a wide range of genes, and they're put in a particular environment, there's an opportunity for selection for genes that will work well in that environment. In the organic seed lot of Parshall, we did not see any difference between organic and conventional. This makes sense because Parshall is a more homogeneous variety. But we simply can't say one way or another about an adaptation trend based on these results.

Q. *Another objective was to identify growth traits and agronomic characteristics that result in superior cultivar performance in organic environments.*
The hypothesis that there are particular growth traits that allow plants to perform better under organic conditions has not been supported. Not one of the many traits we've looked at have had an effect on crop performance--in terms of *yield*. Examples of traits included were: early vigor, emergence, vigor at various growth stages, canopy closure, how the leaf was oriented, size of leaf, leaf height, maturity, and light intercepted by the canopy. We worked directly with growers to identify the traits that we might look for—the ideas came right from the growers. But it's interesting, as the producers became disappointed that no traits correlated closely with yield, they also said that they probably could have told us that…kind of an intuitive post-project response.

Q. *What was the most important result of the project, for you as a researcher?*
The primary question answered is the short-term one: which of the modern wheat varieties we tested is best adapted to organic environments. That was Stoa.

Q. *Will you continue organic systems cultivar work in wheat, oats or barley after this year?*
We're not planning to, largely because the organic growers we work with say they think they've gotten the information that they're going to get from this project. However, Deon Stuthman, who leads the Oat Breeding and Genetics Research Project at the University of Minnesota, is continuing work in organic oats. He is one public breeder who evaluates his germplasm in organic environments. So, although this project won't continue, Deon--who was supportive of this project and provided our oat varieties--will continue this work. I know of no other continuing organic wheat (HRS) breeding efforts going on in the midwest.

Q. *When do you expect to have the results of all three years available?*
I'll be taking on reviewing and publishing the results on wheat, and Paul Porter will take on oats. We hope to do this in the fall and have something for the Northern Plains Sustainable Agriculture Society meeting in February, 2005.

Participatory evaluation and demonstration of organic production system in Southwestern Louisiana

Summary

Through a participatory approach, an organic production demonstration project was established on a University of Louisiana at Lafayette research farm in southwestern Louisiana in 2002. In 2002 and 2003, weed control strategies were identified and evaluated in tomatoes and corn in research farm demonstration plots. The main benefit of this project was establishing organic research plots in Louisiana, and in bringing the organic community together in supporting organic research. In addition to weed control strategies, appropriate disease and insect management strategies, networking and communications were determined to be critical for successful organic production in southwestern Louisiana. One organic farming field day and two in-state organic farming tours were organized.

A one-quarter acre organic farming research and demonstration project has been established at the 600-acre UL Lafayette research farm, located approximately 16 miles southeast of the main campus. Managed organically for five years, the site was certified organic by the Louisiana Dept. of Agriculture and Forestry in 2002.

Participatory research provides an opportunity for farmers, extension agents, researchers and other stakeholders to design research projects that produce management strategies that are more readily accepted by the local farming communities.

Our objective was to establish a participatory research approach in establishing an organic production demonstration system. Research topics were identified at a workshop held in August 2001, where 70 individuals, representing the Organic Farming Association of Louisiana, extension service, UL Lafayette, Louisiana State University (LSU), and organic production industries participated in discussions and planning. Weed management was identified as a major problem in organic production systems, and an organic farming demonstration project was designed to evaluate weed management treatments.

In 2002, four weed suppression treatments were established in demonstration plots planted to tomatoes: hay mulch, red plastic mulch, propane flame burning (flaming), and a mechanical treatment. In 2003, an additional four weed treatments were established in plots planted to sweet corn: hay mulch, living clover mulch, a Three Sisters cropping system of pole beans and zucchini squash added to corn plots, and a mechanical treatment.

While the 2003 corn crop failed due to high rainfall, weed pressure and competition from foragers (possums and raccoons), in the 2002 tomato crop, percent weed cover in hay mulch and flaming treatments was consistently less than 30% throughout the growing season, while weed pressure in the red plastic mulch and mechanical cultivation treatments was as high as 90% toward the end of the cropping season. Hay mulch-treated plots had a significantly higher amount of aboveground tomato plant biomass at harvest.

A field day was conducted at the demonstration farm in July 2002, and tours to certified organic farms in the region were conducted in June and August 2003. Ninety-one percent of tour respondents said they would like to visit additional organic operations, and virtually all participants identified farmer networking efforts as crucial to the success of organic farming.

OFRF project funding: $6,800* **Awarded:** Fall 2001 **Project period:** 1 year (2002)

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Cooperating investigators: Jackie Carlisi, Horticulturalist/Collaborative Resource Facilitator and Mark Simon, Farm Supervisor, Dept. of Renewable Resources, University of Louisiana at Lafayette

Cooperating growers: Bryan Riche, Carencro, LA; Shane Dorrell, Breaux Bridge, LA

Report submitted: February 2004. The complete project report is18 pages.

Complete project reports are available online at www.ofrf.org, or by mail by contacting OFRF.

* $6,800 was awarded to this project; investagors returned 10% of funding which was not needed for project completion.

Your Gifts, Large and Small, Keep OFRF Going

As you have seen in the previous 30 pages, OFRF has had another productive year supporting organic farmers' research and information needs. Many, many gifts of all sizes make this work possible—over 7,500 donations since 1990, in fact. Here, we want to acknowledge one of the largest as well as the smallest.

OFRF Receives $100,000 in First Major Bequest

Earlier this summer OFRF received a $100,000 bequest from the estate of Arie Kurtzig. Mr Kurtzig, who passed away in the fall of 2001, was a long time supporter who, unbeknown to our Board and staff, had made provisions for OFRF in his will.

"Arie regularly shared with me his interest in supporting a more academic treatment of organic agriculture. He was very interested in the science of organic farming and the peer review process that goes along with its publication," said Bob Scowcroft, OFRF's Executive Director.

"Arie believed in organic farming research, and I'm sure he saw this bequest as an investment for the future," Bob added. We hope our future grant awards and the publication and discussion of the research results will honor Arie's gift and memory."

Small Gifts Make Change

In our last *Information Bulletin* we were happy to acknowledge those who had made recent gifts of $100 or more to OFRF. That support is very important, allowing OFRF to grow its programs in support for organic family farmers. But small gifts are just as crucial to our work.

First, "small" is relative. For tracking purposes here we mean a gift under $100, but we know that $50 is a *very* generous contribution for many of our friends. As such, a $20 gift means a lot to us coming from a student, a grower in the middle of a drought, or someone who writes "I wish I could do more, but this is all I can give now." It is a vote of confidence in our work, which makes us proud and motivates us to keep doing what we do.

Small gifts also impress larger givers. Foundations and other major donors often measure the worthiness of a nonprofit in part by the breadth of support demonstrated through small gifts. Like a candidate gathering signatures to support a run for office, nonprofits must show that they are valued by their community in order to be taken seriously. While there are many ways to measure such support, the total number of donors is a common and important yardstick. A $10 donation counts as much as a $1,000 one in leveraging a major grant this way.

Finally, and most important, they add up! Never underestimate the potential of giving in community. In the last year alone, OFRF has received 430 small gifts totaling $17,211. That is enough to pay all of the costs of this issue of the *Information Bulletin*, including mailing to every certified organic farmer in the country. This is a key part of our mission, and 430 of you have together made it possible.

That number is also significant in another way: $17,211 represents 1.9% of our total revenue during the past year. Organic policy and consumer advocates will notice that that's about the same as organic food and farming's portion of the total U.S. agricultural economy. To some of the big players in industrial agriculture, it is an irrelevantly small percentage. But those of us in the organic community know what our 1.9% of U.S. agriculture is doing on the ground—changing the American farm landscape and giving people healthier food and fiber choices. And it's growing.

--Don Burgett

Vote OFRF!

From now until December 31st, **Working Assets customers** get to choose how to divy up the 2004 Donation Pool. Your votes helped garner over $100,000 for OFRF in 1998, 2000 and 2002. Let's do it again! Vote with your bill or online at **www.workingassets.com/voting**.

I want to help OFRF keep organic farming growing!

Name *(as it appears on credit card)*: ____________________

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Phone: ____________________ Fax *(optional)*: ____________________

Email *(optional)*: ____________________

Credit Card #: ____________________

Expiration Date: ________ / ________ Amount: $ ____________ ❑ Visa ❑ MasterCard

Signature ____________________ ❑ American Express

Just send us this form with a check to "OFRF" *or your credit card information ... or* ***donate online through our secure server at www.ofrf.org***

(Your billing information will be kept strictly confidential.)

OFRF would like to report all donations publicly. **Please check here if you prefer to donate anonymously** ❑

Organic Farming Research Foundation ~ PO Box 440 ~ Santa Cruz, CA 95061 ~ 831.426.6606 tel ~ 831.426.6670 fax

PROJECTS FUNDED

OFRF Projects Funded Spring 2004

The following grants were awarded at the OFRF Board meeting in March 2004.

Total in competitive grants awarded: $108,098

Fresh and postharvest assessment of nutritional quality of organically- and conventionally- grown lettuce and other salad greens, year 2.
Edward Carey, Kansas State Research & Extension Center, Olathe, KS $8,000

Public breeding for organic agriculture: screening for horizontal resistance to late blight in tomato.
Matthew Dillon, Organic Seed Alliance, Port Townsend, WA $10,068

Detecting and monitoring human pathogens in vermicompost and compost tea, year 2.
Allison Hornor Cornell University, Ithaca, NY $8,203

Breeding an open-pollinated vegetable variety in organic systems, year 2.
Molly Jahn, Cornell University Ithaca, NY $13,426

Organic dairy farming education project.
Lamar Janes, Community Conservation, Inc., Gays Mills, WI $4,000

Development of wheat varieties for organic farmers, year 3.
Stephen Jones, Washington State University, Pullman, WA $13,472

Comparison of quality characteristics in tomatoes grown by organic and conventional practices, year 2.
Alyson Mitchell, University of California, Davis $9,496

Trial of beneficial microbial seed treatments in organic farming systems.
Anusuya Rangarajan, Cornell University Ithaca, NY $5,429

Evaluation of frost-killed cover crop mulches for organic no-till production of spring vegetables on small farms.
Mark Schonbeck, Virginia Association for Biological Farming, Floyd, VA $8,600

Longitudinal comparison of milk composition, quality and conjugated linoleic acid levels among three different management systems.
Linda Tikofsky, Cornell University Ithaca, NY $14,134

OFRF awards grants for organic farming research and education projects two times per year. Grant application deadlines are July 15 and December 15. Projects may be farmer initiated, and/or should involve farmers in project design and execution and take place on organic farms whenever possible. OFRF considers funding requests within the range of $1,000 to $15,000.

Procedures for Grant Applications may be obtained by contacting our office at tel. (831) 426-6606, or visit our website at www.ofrf.org.

For additional application support, OFRF publishes an **On-Farm Research Guide**, and OFRF **Technical Program Coordinator** Jane Sooby is available to answer application questions by phone or by e-mail at jane@ofrf.org.

Evaluating the effects of pastured turkey production on parasite levels, fly levels, and pasture fertility on an organic dairy farm.
Adam Zimmerman, ShoreBank Enterprise Pacific, Ilwaco, WA $13,270

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