Workshop Title: Plant Breeding and Seed Saving (Covering OP Corn and Cereals)

Speaker(s) & their titles: Jack Lazor, Butterworks Farm, Vermont

Executive Summary:
In this workshop, Jack Lazor describes his experiences with plant breeding and seed saving. He covers equipment needed, techniques employed, reasearchers he has worked with, and preferred varieties.

Detailed Notes:

Introduction
Plant breeding and seed saving are two entirely different undertakings. These two pursuits are mutually exclusive for the following reasons : In saving seed you want to grow the same crop the next year, so what you do is harvest, clean and store your seeds for the following season and do your best NOT to co-mingle them with other varieties. In plant breeding, though, it is hard to be a breeder *and* someone involved in production agriculture. In production growing, you want to get every last seed off the field. You don't want things falling on the ground or lodging or spoiling. But as a breeder you're putting pressure on your plants – you're stressing them out intentionally in order to make selections of the most resilient plants in the crop.

Margaret Smith is a corn breeder at Cornell University in Ithaca, NY. There are not too many corn breeders left. She came to Vermont and did a seed saving workshop on corn. One of the main concerns about corn is standability : how long can I leave it in the field beofre it falls over? OP (Open pollinated) corn tends to have that problem; they will fall over. Margaret checks for the stiff stalk gene by kicking the stalks and seeing if they fall over, and doesn't take seed from plants that do fall over. A production grower is not going to walk the fields kicking corn stalks over.

If you're making selections on certain plants, you're only going to save the ones that meet your criteria. Butterworks Farm is part of a program out of Cornell University for wheat breeding. They had a plot on the farm that was purposely planted with a low population so that the crop would have weed pressure. They went through field as it was growing and flagged the plants that had the broadest leaves and were growing most vigourously and not hampered by weeds.

Jack started out as a seed saver. He got his first seed cleaner in 1983. He could take grain that had mustard seed etc all mixed in and clean it out himself; it was revolutionary.

You want to choose your best field for producing a seed crop. What that means when you're harvesting is that you want to start with the best stuff first when your combine is

really clean. Jack uses gravity wagons to store grain. You want to make sure it is dry, good quality, a nice colour.

Cleaning Seed

If you are just putting grain in a bin, you can use a basic rotary cleaner, which is quick, but not the best. He uses a Forano 150, a two-screen fanning mill made in Quebec. Forano hasn't made seed cleaners for decades. An elevator takes the grain up to the top, then a de-bearder (which you can bypass) drops on to the screen. The screens are set by hull size, done is 64ths of an inch. You want the wheat to drop through the top screen, and anything that is larger will just run off the screen. To determine what screen, choose one you think is close, put it over a box, dump the grain on top, and shake. If a lot of grain does NOT go through, you need a screen with a bigger hole size. Once you know what size, get a smaller hole size for the bottom screen, so that grain does not pass through but weeds and dirt etc do. Screens have brushes or balls which help the grain to stay in contact with the screen. The fan is variable to blow up and out. It blows anything that is too light in weight out of the grain. The heavy grain falls to the bottom, then up an elevator to a bag, or another bin. Your #1 grain is this first, heaviest grain. For grains with higher bushel weights like soy and corn you need a bigger blast of air to clean that seed than you would with oats; barley is somehwere in the middle. If you want to be aggressive and have heavy test weight grain, then crank up the fan and more grain will come out into the #2 bag than the #1 grain.

Dealing with Weed Seeds

One of Jack's main problems is a lot of wild vetch in grain. What will happen is that if you have a seed that is similar in weight such as wheat or barley, it is difficult to separate vetch out.

Then you need an indent sizer. This is a large tube with indents, kind of rough like a cheese grater. The vetch seed gets stuck in the indents, but the wheat seed does not. It is very slow. Another way is to use a spiral cleaner. The round vetch seed goes right down the bottom and out ; the wheat seed goes out separately.

Gravity Tables

Q What about wild radish?

A If you have a cereal like oats or barley, you can use a gravity table to separate out wild radish or similar seeds.

There are lots of brands of gravity tables: Forsberg is made in Minnesota. Folks growing beans or trying to get splits out of beans could use this. A 10-horsepower motor in the bottom pushes air up while the table shakes back and forth. You can control air intake for volume as well as the shake of the table. The heaviest grain will migrate up to top of table, stones will go up against the board at the side. It doesn't sort seed by size, but by density. A wild radish seed pod won't be as heavy as a plump ripe kernel of wheat. You can also adjust the tilt of gravity table in several directions. It takes some time working with it to be able to use it well. Each different seed may take a couple of hours. The cost runs about $1000 for a used table; new can be $10-20,000. Oliver is a very popular make made in Ft Collins, Colorado. You've got 3-4 different blasts of air in different

places on the table. Another one is called Gustavson, perhaps. Gravity tables seem to be made by Scandinavians living in the Northern plains! There are a lot of used gravity tables around; could probably get a really good one for $5000 or less. It is a fairly essential piece of equipment if you want to do any amount of seed cleaning. If you have dry beans that have splits you want to get rid of, on the fanning mill, put the screen with crosswise slots, and you willl clean out a lot of splits.

Q Do you ever use your seed cleaner for a marketable crop?
A Yes, it goes through the fanning mill whether for human or animal consumption.

What happens with seed cleaners is that they lose parts. If you can find a seed cleaner it is probably worth paying more money if it comes with 30-40 screens. If you go to buy a screen, they are $125-$150 per screen to buy new from the Clipper company (if Clipper screens fit your machine). Clipper is A.T. Ferrill-Bloughton in Indiana (Phil Tipple is the seed cleaner expert). If you have a dirty seed crop, you can send him a sample and he will put it through his hand screens, then tell you what main screen to buy, so you don't have to guess.

Storing Seed
Having a really good rodent proof storage area is key. Shipping containers can be bought fairly inexpensively. You must be vigilant about closing the door, even if you leave for a minute. Once the mice get in you're done.

Commerical Seed Considerations
One of Jack's goals was to be as independent from the corporate sector as possible. To not have to buy seed each year was a life changing experience. You want a good fertility program so that you're getting a good product. Taking good care of your land pays in so many different ways: higher yields, better grain, better seed. What the commercial sector will tell you is that after 5 years your seed is going to get run down, which doesn't make sense in reality if you're selecting your best. The weather is most impactful in lower quality grains. The other challenge in buying commercial seed is that they're changing the varieties so often that if you find something you really like, you'll want to save it. If you find something that works in your microclimate and is reliable, you want to save it, as it may not continue to be available for purchase.

Plant Breeding - Wheat
Heather Darby (University of Vermont agricultural extension researcher) and Jack got a grant to grow varieties of grain that would do well in the Vermont climate. One benefit was going out to Washington State U to learn how to make crosses from Dr. Steve Jones who was the premier wheat breeder. He refused to breed GMO, which resulted in companies putting pressure on the University and he got thrown out. He only does organic breeding and does not want to work with monocrops, but with small growers everywhere. He grows the wheat plants out in greenhouses. A wheat plant has both male and female flowers in its head (pistils and stamens); in order to cross, you need to emasculate one of the two plants. Using magnification glasses, you cut the flowers down, pull out male flowers with tweezers, then take another plant shedding pollen, put

them both in a paper bag, and plants have sex in a bag. It is very difficult to see the detail to do it.

In the first year of Heather and Jack's project, they got just 100 seeds, involving 19 different heirlooms. There was a breeder in early 1900s named Pringle who developed three wheat varieties and one oat. Heather and Jack got germplasm from the seed bank and crossed modern varieties with the old. They had dismal success – just one seed. The next winter they sent some seed to Steve Jones and he made the crosses in his greenhouses. More power to those plant breeders from 100 years ago who did not have greenhouses to do the work!

During this project, Jack learned that he did not want to be a breeder, but a farmer with alliances to plant breeders. The project is now into its 7th or 8th year and things are looking promising. It takes 2-3 years to start to see things happening. Up until years 3,4, and 5 you are just continuing to make selections. This is what gives us Participatory Plant Breeding. Salvatore Cicarelli working in Syria would give farmers crosses, get them to grow them out, then report back to him on how they did. This approach allowed for more trials happening in more environments; some things doing better in some places than others.

For Jack, planting plots is done with a Carter seeder. It just rolls a furrow with pre-weighed seed dropping down to give precision work. You will very quickly learn which varieties you like. He got a grant for a plot combine. It is very easy to clean. You are only going to get 2-3 lbs of seed from each plot. The combine is very labour saving to get grain from multiple plots.

Taking the selection of best varieties to another level, Steve Jones has a bread lab with relationships with bakers so he works with them to choose varieties that are optimal for baking different breads.

Plant Breeding - Corn

For years Jack grew hybrid/pre-GMO corn. He bought a lot from Pioneer Canada, as he could get short season corn, but didn't like relying on Pioneer. For years he would try with different varieties of OP old corn, but didn't get satisfactory results. Frank Kutka worked with Margaret Smith, and developed Early Riser corn, a composite variety. He took 6 different sythetics (10 different inbreds on one synthetic). All bred on, then they saved seed for a couple of years – so Early Riser is not an old OP variety, but it is OP – it does breed true, and it has a lot of genetic diversity. Jack has been growing it for 10 years now and it does really well in Vermont. He is not selecting as aggressively as a breeder, but in year 2, a big snowstorm just before harvest knocked down half of the crop, so they went out and gathered the best ears from the standing stalks.

Jack feels that after 40 years of farming, he can grow his own seed and he can have relationships with plant breeders. There have been lots of failures, but some successes too.

Q How much distance for corn separation?
A Jack has an isolated field for corn. A good thing to note is that if you have any popcorn gene in your variety it will not accept GM pollen.

Q How much are plot combines?
A If you can find used, they are around $25,000, and new $75,000.

Q Comments on Blue River varieties?
A Jack grew some last year with long growing season but not a lot of heat, and got 100 ton. One thing he does not like about Blue River stuff is that it is a softer starch, lighter yellow colour that dents really deeply – almost sharp enough to cut your hands. Jack was not very impressed. It did not look as good as Early Riser, but Early Riser only yielded 2 ton, not 3 ton. Blue River is good for cow feed; you want soft starch. Flint and indian corn dries down well, but doesn't yield as well as modern dent. Early Riser is multi puropose: human or livestock.

Q Boston fan mill-hand crank, is it the same thing? Where would you get screens?
A Yes, and you can get screens through AT Ferrell. Not as much control. There are some Clipper cleaners – an M2 or M23 would be good. There is a place in Illinois called Commodity Traders International. They clean out old mills and buy stuff from farmers, so they are a good source of cleaning equipment. They are more expensive than they used to be because more and more people are doing this on a smaller scale.