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New York State Agricultural Experiment Station

10th Annual Northeast Buckwheat Field Day

August 25, 2004

New York Crop Research Facility, Batavia

Organized by Thomas Björkman
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Hosted by ACDS Research

Schedule

1:00 Introductions
1:15 Effect of 2004 weather on establishment and growth
Grower perspectives
1:30 Stem rot
1:45 Fate of late flowers: no second chances
2:15 Break
2:00 In field demonstrations: Plant population and nitrogen
2:30 Excess fertility
3:00 Human health

The season so far

Wet
Planting in many fields was delayed. Sometimes buckwheat was planted in fields that were originally intended for some other crop.

Field preparation is critical for buckwheat. Wet soils made that difficult.
Wet soils compact easily. A disk can easily create a compacted layer just below the seed that restricts percolation, and promotes seed rot.
Rapid germination is important, and happens best with shallow seeding. If the soil has big lumps, it is hard to cover the seed. Preventing the lumps is the key. Breaking up lumps that formed because the ground was worked too wet just increases the risk of crusting.

Buckwheat responds well to sufficient water. Their root system is designed for frequent rains or for deep soils that hold a lot of water. Where initial establishment was successful, this year could produce good crops.

Exploding seeds. When seeds are in the dough stage, rains can cause them to swell and split. The white starch is visible on the outside of a split and empty hull. It is now known how much crop loss results from this curious effect.

Stem rot. The season has brought high inoculum levels of the pathogen. In beans and cabbage it is known as white mold. It also grows well in ragweed. The high inoculum and good conditions for disease in buckwheat predict significant occurrence. (See next page)

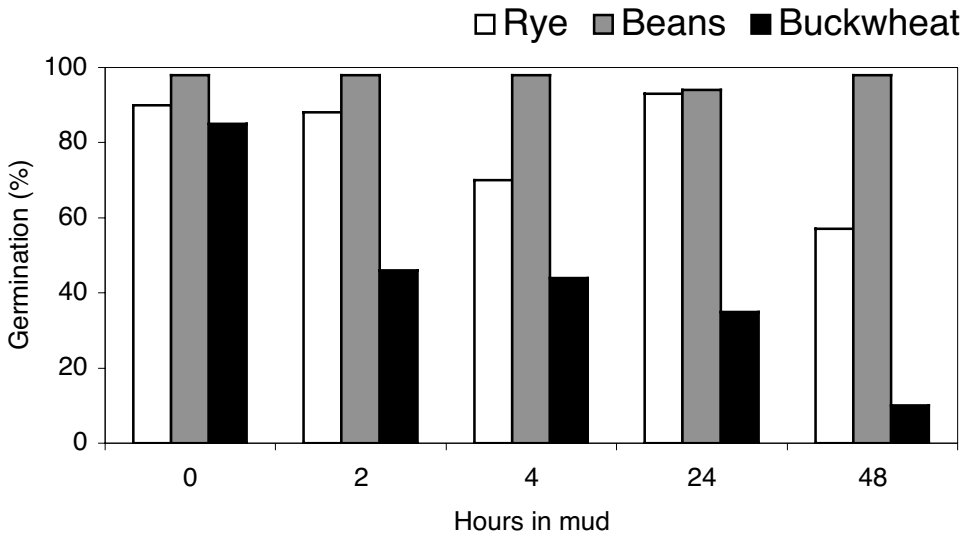
Not too hot
Heat blasting is a concern if the temperature is high during flowering. High temperatures cause the flowers or new fruit to abort. This year, early August has been temperate. The temperature has been in the low 70's. Only August 3 was about 85° with a low of 70. No crop should have been lost to this malady.

Seedling establishment.

Good buckwheat crops depend on rapid growth to the 4-leaf stage. By the time the plants are at the 4-leaf stage, the crop is more resistant for three reasons.

1. Seedling is much less sensitive to excess water.
2. The soil is protected from direct hits by raindrops.
3. The soil surface is shaded so weed seedlings are suppressed.

Buckwheat needs a good seedbed and moist, but not wet soil, with lots of air. Heavy rain in the two weeks after seeding buckwheat often have a devastating effect on establishment. Likewise, low spots in the field, or compacted areas will often grow poorly.



Buckwheat is much more sensitive to waterlogging than some other crops with similar seed size. Seeds of each type were placed in a mud bath for various periods to see how much they could take before germination was depressed. Buckwheat seeds did not even tolerate 2 hours.

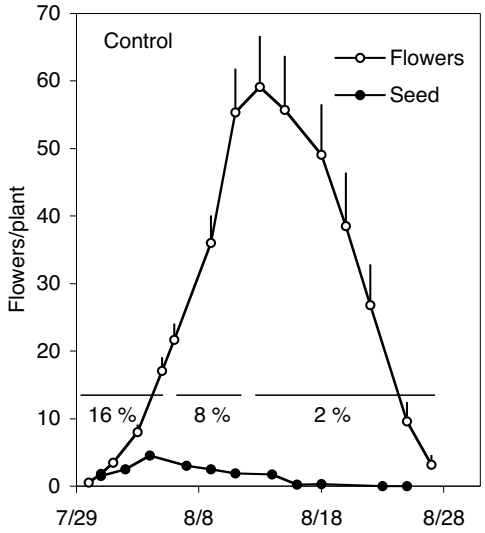
Stem Rot

Stem rot (*Sclerotinia sclerotiorum*) can sweep through a field near harvest. It begins as small brown spots on the stem. The stem then turns pale and dehydrated. Seeds fall off easily and eventually the stem topples. Once toppled, the plants are hard to find. The disease may never be discovered.

The rainy weather in 2004 has resulted in high inoculum. This is the same disease that is known as ***white mold*** in **beans** and **cabbage**. It grows well in **ragweed** flowers.

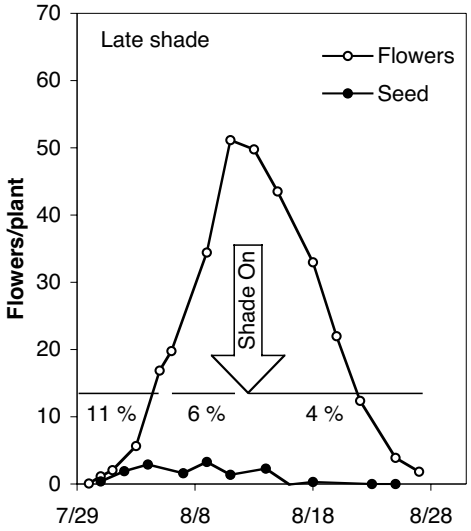
The remedy for the disease is timely harvest. The stems appear to weaken when the seeds are fairly mature. Leaving a field with this disease unharvested may result in substantial undetected yield loss.

The fate of late flowers



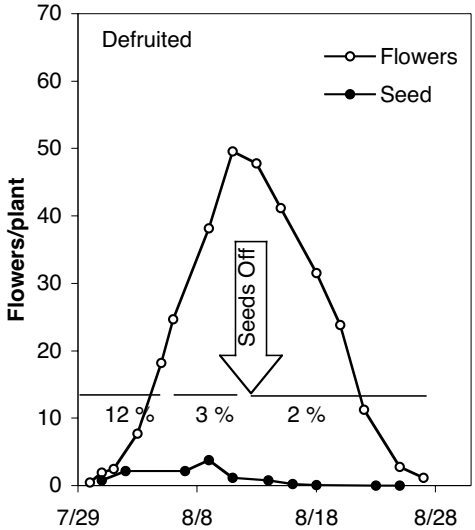
In 2003 we tracked seed production through the season to figure out the role of later flowers.

In plants that we didn't manipulate (control), seed set was highest early, then declined at the same time that more flowers opened.



If growing conditions turn bad, it's possible that the plant will abort recently set seed. We tested that by putting a shade cloth over the plots at the peak of flowering and keeping it on until harvest.

Shading did not cause the seeds that had just been set to abort (6% is not significantly less than 8%.) Keeping the shade on did not reduce seed set by flowers that opened after the shade cloth was on.



If early seeds are aborted (for example from heat) or eaten by animals, it would be useful if the late flowers would set seed to make up for the missing ones.

We tested that by removing all the fruit that had enlarged by August 13. That was 20 to 30 seeds per plant.

Removing the seeds did not cause the plant to compensate by setting more seed. The second half of the flowers are incapable of making seed, even when the plant is able to fill them.

Assessing seed set

The first flowers are on node 4 and 5. The higher parts of the plant grow out later. If there is light enough low in the plant, branches will form from node 3 and lower.

Under ideal conditions, there should be a lot of developing seed on the short branches on node 4 and 5. More seeds will form later on the upper clusters and on the upper parts of the branches.

Heat blasting early: dead flowers on node 4 and 5, but no seeds. New kernels developing higher and lower on the plant.

High abortion: There are many false kernels Seeds that will abort look lighter and more transparent than those that will fill.

Seed fill has just begun in a July 3 planting in Geneva. In Batavia, the planting was July 9.

For good yield, plants with one branch and reaching the canopy should make 30 to 40 seeds.

Timeline of seed development

4 days after pollination: tip of hull is longer than sepals.

10 days after flowering: The hull is full length, and show the first signs of swelling.

14 days after flowering: the seed is full size, but filled with mostly water.
18 days after flowering: the seed begins to turn brown.

Population

Buckwheat is able to adjust to considerable variation in plant population. In research trials, there has been little yield response to variation in seeding rate from 30 to 80 lb/ac. The range is likely to be smaller on any given farm.

Seed cost
Keeping seed costs down usually means trying to reduce the seeding rate. Smaller seeds can also reduce the cost for a given plant population. These factors are important mainly for raising cover crops or producing seed for local mills and cover crop use.

Plant growth

Branching
At high density, buckwheat produces only a main stem and one or two side clusters. At low density, buckwheat branches profusely. The difference in weight between an average plant in a normal field and an isolated plant in the same field can be 20-fold.

Lodging
At high density, the unbranched growth and low lignification of the stems make the plants more susceptible to lodging.

Small plants
In a low fertility field, plants that grow only 18 to 24" need a higher population to cover the ground. Covering the ground helps both with weed control and capturing enough light. It is usually worthwhile to correct the problem causing the plants to be so small.

Weeds

There are three ways that buckwheat helps reduce weeds.
1. Tillage in mid-summer harms perennial weeds.
2. Shading suppresses the growth of all smaller plants.
3. Allelopathy slows root growth of some weeds.

Early establishment is the key to suppressing weeds. Buckwheat must overtop the weeds to suppress them. Dry soil at planting slows buckwheat growth and can give weeds a head start. Cold, wet conditions after planting favor the cool-season weeds and inhibits buckwheat. Finally, an inadequate seeding rate, or gaps in the planting can allow weeds through. Weed seeds germinate under buckwheat, so the seed bank is depleted.

Nitrogen fertility

Buckwheat does not require much nitrogen. For many fields producing other crops, the amount of nitrogen is sufficient to produce a good crop.

Do you need more nitrogen?

Buckwheat may respond to nitrogen in fields that

- have not received nitrogen in a long time
- have very low organic matter
- just had a lot of crop residue incorporated.

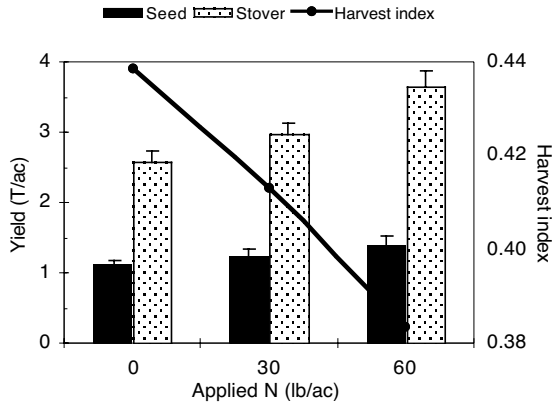
More fertilizer is likely to help if plants are consistently small enough to see soil from above, and seed rot is not to blame. 30 lb N per acre is likely to be enough.

What happens if you have too much nitrogen?

Excessive nitrogen results in rangy plants. Such plants have

- Low yield
- Uneven ripening
- Very difficult harvest
- More lodging
- More weeds

The field trials here has plots with 25 and 50 lb/ac nitrogen added. Ammonium nitrate was broadcast before planting. Look for differences in plant growth and seed set.



1997 Fertilizer trial. Weeds grew through the canopy in the 60 lb/ac trial. The slight increase in seed production did not pay for the extra fertilizer.

Buckwheat and human health

We read about health claims for various foods all the time. Buckwheat has been in the news recently. Here is a summary of the research that have come out recently. Most of the work is on rats because human trials are so expensive. That prevents doctors and nutritionists from making specific recommendations.

Diabetes

In adult-onset diabetes, a cofactor needed to sense the presence of insulin is a sugar alcohol called *chiro*-inositol. Insulin is your body's way of letting the various organs know that you have eaten enough. Buckwheat uses fagopyritol, an uncommon molecule based on *chiro*-inositol to allow the seeds to dehydrate without killing the embryo. Fagopyritol breaks down to *chiro*-inositol in the intestine. Early work suggests that it can help make diabetics' bodies respond to insulin.

High blood pressure

The phenolic compound Rutin strenghthens capillary walls to prevent microhemorrhaging caused by high blood pressure. Powdered buckwheat leaves are sold by SmithKline Beecham for this medical use in Germany.

High cholesterol

Buckwheat contains a protein that binds cholesterol, but is not digested. Cholesterol in foods, and even from the bloodstream are removed from the body on this protein.

Obesity

These three disorders are often associated with obesity. The complex carbohydrates in buckwheat are also helpful in slowing the development of obesity in the first place. Programs are being developed by nutritionists and public health professionals to introduce buckwheat to the diets of affected people.

Celiac

Celiac is a pathological response to gluten, the protein in grains that make doughs stretchy. The only treatment is getting gluten out of the diet. Buckwheat does not contain gluten, and can be a breadlike part of the diet. There are a couple of concerns. First, some people with celiac-like food allergies react to buckwheat as well. If they have been misdiagnosed, buckwheat can be a problem. Second, some buckwheat products, especially noodles and pancake mix, contain wheat as well. These foods are not safe for celiac patients despite "buckwheat" being prominent on the label.