Summary

In summer 2011, we demonstrated how cover crops might be killed mechanically to reduce tillage and provide a mulch cover for growing fall pumpkins. This demonstration did double-duty as an observational trial for pumpkin varieties, many of which are heirlooms. Observations and results from the trial follow.
Background

Much of the criticism leveled at organic agriculture for decades has lost traction. Now that serious research is being done, we’ve learned that organic yields are competitive in many, if not most, crops; that organic food quality and safety is usually better; and that organics pose fewer hazards to the environment.

That said, one remaining weakness in most organic systems is the over-reliance on tillage and cultivation. Every time we apply steel to invert, mix, and pulverize the soil, our heroic efforts to protect against erosion, and to grow soil biology and organic matter, are set back a notch. Organic management, then, becomes a matter of compensation—using cover crops, composts, and manures to repair the damage we do through tillage.

Conventional agriculture has made advances with no-till farming methods that reduce tillage and cultivation. However, these systems are highly dependent on pesticides and, in recent years, have become increasingly bound up with crops genetically engineered to withstand over-the-top herbicides.

Advances in reducing tillage have been slow to emerge in commercial organic production. This is the logical consequence of little or no investment in such research until recently. On the other hand, organic gardeners have long-known how to reduce cultivation by mulching with organic wastes like straw, old hay, leaves, and grass clippings. These materials are usually hauled in from elsewhere, but certainly do the job!

It is only in the past few years, however, that we have heard much about “killed mulch” systems. For many crops, killed mulches may be an answer to the excessive tillage dilemma.

Mechanically Killed Mulches—The Concept

The new strategies for reducing tillage and cultivation in organic systems frequently revolve around cover crops that are mechanically killed and left in place (in situ). The killed leaves and stems cover the soil and provide a moisture conserving and weed-suppressing mulch. This is accomplished without disturbing the roots or the soil, which slows mineralization and leaves intact soil microbial communities.

At Kerr Center, we are experimenting with two means for mechanically-killing covercrops—the roller/crimper and the sicklebar mower. The roller/crimper is a heavy cylinder with strip steel protrusions welded to the outside in a chevron pattern. When dragged or pushed over a cover crop, the crimper/roller lays it down and breaks the stem at several points, leading to plant death. We have had mixed results with this implement so far, but are still learning how to use it.

By contrast, we’ve had much more experience with sicklebar mowing and find it reliable for killing a wide range of cover crops, when well-timed. Therefore, we used a BCS-mounted, sicklebar mower for our demonstration.

Sicklebar mower mounted on a BCS tractor.
About the 2011 Demonstration

The site for this trial was field A-3, on Kerr Center’s Cannon Horticulture Project. We established the Cannon Project in the fall of 2007 and finally achieved certified organic status in June 2011. The site features a loam soil with moderately-poor drainage. It has organic matter levels around 3.1% and a pH ranging from 6.6 to 7.0. While native phosphorus and potassium levels on these soils are low, compost applications in 2009 improved the phosphorus status considerably and potassium, moderately.

The previous crop, in 2010, was sweet potatoes, followed by a winter cover crop of grain rye, Austrian winter peas and hairy vetch. We prepared the plot area by bushhogging the winter cover crop and tractor-rotavating March 24th. We rototilled using BCS equipment on May 17th. On May 18th, we planted three summer cover crops in separate blocks for the demonstration. Unfortunately, heavy rains in late May and early June washed out the seedlings and led us to replant all three cover crops on June 6th.

Our target date for mow-killing the summer cover crops and planting pumpkins was July 1st. This is usually late enough for most spring-planted cover crops to mature sufficiently to be killed by short mowing. This also allows plenty of time for pumpkin fruits to mature in time for fall sales. Finally, there is also an advantage to pest management. We (and others) have observed that, if we have not grown spring cucurbits nearby, overwintering populations of squash bugs will have starved out when planting is delayed past July 1st, giving fall-planted pumpkins a bit of a break.

Unfortunately, because of the need to replant, mowing and planting activities were delayed until July 20th. This delayed harvest as well, and reduced marketable yields.

We used the BCS tractor with sicklebar attachment for mowing. Immediately following the mowing operation, mulch from the edges of the plot was raked to the center for deeper cover. This left approximately one-fourth of the field area bare.
We seeded six pumpkin varieties using a European Push or “jab” planter, which easily penetrated the mulch and set the seeds at a uniform depth. Drip tape was then laid over the mulch and irrigation started immediately.

Harvest began on October 20th, following a killing frost the previous evening. The delayed planting led to a somewhat higher percentage of fruit being too immature to harvest following frost-kill.

Cover Crop Observations

We elected to plant crotalaria, sesbania, and pearl millet as the three test cover crops in our demonstration.

Crotalaria. Crotalaria, also known as *sunn hemp* is a tall-growing, summer annual legume. Commercially, it is grown as a green manure, as livestock fodder, and as a source of lignified fiber. It also has potential as a biofuel crop. It is subtropical and grows vigorously in the South.

Crotalaria uses standard cowpea *Rhizobium* inoculants, and is valued for nitrogen fixation. It is also known to suppress several nematode species and is valued in rotations for this reason. Crotalaria varieties contain variable levels of natural toxins, especially in the seed, which is considered hazardous to birds. It is a short-day plant, however, and may not even be able to set mature seed as far north as Oklahoma or Arkansas. Assuming this to be true, it also presents little hazard of becoming a weed problem.

Crotalaria seed is not easy to find through local sources. We obtained ours from Peaceful Valley Farm Supply, in Grass Valley, California.

Sesbania. Like crotalaria, sesbania is another, somewhat obscure, subtropical legume. It is very tall growing, with thin cane-like stems which can be hard to incorporate into the soil. Sesbania has no difficulty setting seed in our climate. These can be long-lived in the soil; thus, it does have potential to become a weed. It certainly is recognized as such in parts of the Southeast where it can be a problem in cotton and other row crops! Its seed is also hard to find. Again, we obtained ours from Peaceful Valley Farm Supply. Sesbania
requires a special class of legume inoculants, which are also available from Peaceful Valley.

**Pearl Millet.** Millets are commonly-grown for grain, especially in areas where drought, high temperatures, and low soil fertility limit growing corn and other grains. Pearl millet is the most widely-grown of all the millet types. It is a shallow-rooted, summer annual grass. While not as tall as crotalaria or sesbania, it produces a dense canopy of leaves. Its seed is much easier to obtain from local sources.

We chose to grow these three species based on previous experience growing and mechanically killing these cover crops. All three have been easy to kill at midsummer using a sicklebar mower. We demonstrated this again in 2011; none of the three showed any regrowth.

Pearl millet produced the greatest amount of biomass and effective mulch, followed by crotalaria. Though it was the tallest of the cover crops, sesbania produced the least amount of mulch cover. Despite these differences, there was virtually no weed emergence through any of the mulches. In zones where the soil remained bare, a few amaranth and solanaceous weeds emerged, but they were spotty and easily controlled with light hoeing. More common were prostrate species resembling carpet weed or purslane. They were not competitive with the crop, and we chose not to hoe them since they provided useful ground cover.

We credit the lack of weed competition to a number of factors. First, our bioextensive rotation and sanitation efforts have reduced weed populations in all crops on the Cannon site. Second, the in-situ mulch strategy provided good suppression. Third, vigorous growth of pumpkin plants covered much of the ground with a dense canopy. Fourth, low precipitation reduced the number and range of weed species that might have become problematic.

In this trial, targeted drip irrigation not only supplied the pumpkins’ needs, but avoided stimulating weeds.
Pumpkin Variety Observations

We planted six different pumpkin varieties in each of the three mulched zones. Because of the delayed planting and the earliness of the frost, a larger percentage of the fruit was immature at harvest than desired, but we were still pleased with the outcome. And while there was insufficient replication in this demonstration to draw fine differences among varieties, we feel comfortable with the generalizations that follow: [1]

Cinderella. (C. maxima) Also known as Rouge Vif D’Etampes, Cinderella was our most successful variety, producing a good number of beautiful pumpkins. The reddish-orange fruits are medium-sized, flattened, and ribbed. The flesh is good in pies or when baked. Sources say that immature fruit can be picked small and fried much like summer squash. It is an heirloom type that was popular in France at least as far back as the 1880s.

Howden. (C. pepo) Our second best pumpkin in 2011, Howden is a classic jack-o-lantern type. The fruit is quite uniform in shape, deep orange in color, ribbed, with sturdy handles. The largest fruits commonly weigh around 25 lbs. Howden was developed in Massachusetts in the 1960s, and might be considered an heirloom by some, though it is still popular commercially.

Jack Straw. (C. pepo) Jack Straw also performed fairly well, though not as well as Howden. Jack Straw is a smooth-faced jack-o-lantern type. It features dark orange skin and a stout handle. The fruits are quite uniform in shape, and stand from 8” to 14” tall. It is an exclusive variety developed in recent years by the High Mowing Seed Company.

Big Max. (C. maxima) Big Max produces large fruit (up to 200 lbs). Our plants did not produce too many, but we suspect there is a trade-off between number of fruit and size. The round, bright-orange fruit are good for pies and canning, as well as for decoration. This variety is commonly found on lists of heirloom varieties.

New England Pie. (C. pepo) This popular pie pumpkin did not yield that well for us, though the fruit produced was excellent. The dark orange fruit has flesh considered ideal for cooking and pie filling as it is high in dry matter and is stringless. This variety has been available at least since the 1860s.

Old Fashioned Tennessee Vining. (C. moschata) We chose to try this heirloom because it was reputedly resistant to squash vine borer—a common pest problem in our area. Unfortunately, it had poor emergence and poor fruit set. Without further evaluation, we don’t feel comfortable evaluating its performance, which may have been due to poor seed.
Results and Conclusions

We were quite pleased with the outcome of our killed-mulch pumpkin trial. Weed control was exceptionally good. This was due in part to the dry weather, but organic management also played a big role. Insect and disease pressure was low. We credit this to the fact that no spring cucurbits were grown nearby, thus starving out much of the pest population early on.

While all three cover crop species worked well, we felt that pearl millet provided the most thorough mulch cover. We were unable to detect any clear interactions between the specific cover crops and the pumpkin varieties. We expect to explore killed-summer cover crops as a crop management scheme much more in coming years.

Resources

The varieties described in this publication are available from the following seed companies:

HIGH MOWING ORGANIC SEEDS
76 Quarry Road
Wolcott, VT 05680
802-472-6174
www.highmowingseeds.com
New England Pie, Jack Straw, Howden, Cinderella.

BAKER CREEK HEIRLOOM SEEDS
2278 Baker Creek Road
Mansfield, MO 65704
417-924-8917
www.rareseeds.com
Big Max, Howden, New England Pie, Cinderella.

SOUTHERN EXPOSURE SEED EXCHANGE
P.O. Box 460, Mineral, VA 23117
540-894-9480
www.SouthernExposure.com
Big Max, Old Fashioned Tennessee Vining, Cinderella, New England Pie.

End Notes

1. Note that the descriptions provided for these varieties have been adapted from the Baker Creek, Southern Exposure, and High Mowing seed catalogs. See resource list for contact information.

Pumpkins are members of the large *Cucurbitaceae* or “Gourd” family, which also includes melons, watermelons, cucumbers, gherkins, and squash. They share the genus *Cucurbita* with summer and winter squash, plus a few edible gourds and the small, hard-shell gourds. The most common pumpkin varieties—the jack-o-lantern types—belong to the species *pepo*. These are considered the “true pumpkins.”

Surprisingly, what most Americans are accustomed to eating in their holiday pumpkin pie is technically squash of the *moschata* species. Varieties include Kentucky Field Pumpkin and the famous Dickinson Pumpkin—an heirloom variety from the 1800s—which continues to fill most cans on the supermarket shelf. There are also several (mis-named?) pumpkins of the *maxima* (E.g. Big Max) and *mixta* (Green-Striped Cushaw) species. [2]