Mulching with straw immediately after transplanting from greenhouse to field is extremely important. We were able to do that this past growing season with sweet potatoes, for instance (a longer-term crop), and we had to weed only once by hand between transplanting and harvest. We also mulched 1,000 cabbages immediately after transplanting, which greatly improved cabbage performance this season.

Dense straw around early transplanted vegetables can help protect the tender young starts from sudden plunging temperatures and frost. With floating row cover, such as Agri-Bon, this can be effective protection against mild frost occurrence, but not a hard freeze.

Too dense of straw mulch around plants, in varieties ranging from sweet potatoes to beans, has given cover to chipmunks, moles and field mice, which then robbed us of vegetables and cut our yields.

Neighboring cats and Jack Russell terriers can help remediate this problem, but only when mulch is not too dense. Too little mulch allows weeds to quickly overcome any type of straw.

We've experienced some volunteering of small grains and prairie grass in the straw – both during vegetable production and after we harvest, retire the beds and incorporate plant matter into the soil.

This seems to happen most with the oats and least with the switch grass, as shown in the field trial. Soil tilth and fertility, however, seem to greatly improve from the volunteer plants, especially with oats. The volunteer plants do not get very high, certainly not as high as many varieties of weeds, nor are their root systems as troublesome as many types of established weeds and grasses. They do not advance with great density in their own straw mulch and are not difficult to remove.

Weed growth in straw mulched beds is most vigorous immediately around vegetable starts, much more so as weeks advance than we've seen in most black plastic mulch use. This vegetation is easily removed by hand at harvest, and isn't usually very time-consuming.

Application of straw mulch, even by hand, is generally much less time-consuming than even a single weeding of most varieties of vegetables. In periods of ample rain, we had to weed beds of vegetables 4 and 5 times over a growing season before we began using any type of mulch. As our scale increased, we would lose some beds to weeds because we had not enough help to keep up with cultivation, harvests, replanting, sales and livestock responsibilities simultaneously mid-season.

Prairie grass straw seems to hold up better under high foot traffic in vegetable beds. We've also used this straw effectively to mulch paths between beds of black plastic mulch, saving us push mower time and expense. We mow driving paths fairly quickly with a tractor and large rotary mower.

Straw for mulching vegetable crops usually ranges from 7 to 10 tons per acre, but is under 5 tons per acre at Scotch Hill Farm, which employs and mows grass paths between mulched beds. That is at a rate of 250 to 300 bales per acre of straw mulch, depending on the size of the bales. We plant a wide variety of vegetables in beds on 8 or 9 acres each season, not including another 4 or 5 acres of sweet corn each year, which we have never mulched.

Straw in bulk sells in our area for about $3 per 40-lb. bale. Garden supply houses locally get $5 to $7 per bale for small quantities of wheat straw bales that home gardeners purchase. Scotch Hill straw production expenses run under $1 per bale, depending on highly variable prices of gasoline, locations of rented fields in given years and whether we pay for field help or can rely on volunteers and farm interns.

By comparison, the most recent FarmTek Growers Supply catalog at the time of this writing lists black plastic mulch at about $146 for a 48-inch roll, 4,000 feet long. That would accommodate 20 double rows, 200 feet long. Even with increasing straw mulch use, we are still using several rolls of black plastic mulch this size each season, especially to provide extra warmth to help some long-term transplants through a cool, early spring, and to outlast weeds throughout a growing season for long-term plant varieties.

Prairie grass and small grains establishment

Timing for switch grass seed harvesting (September in southern Wisconsin) and the prairie grass straw harvesting (early November here), can help spread labor for a vegetable crop farm.

When we plant small grains, winter wheat (late September, early October) or oats as a nurse crop to hay (late March, early April) we are typically pressed with regular season vegetable crop production.

Small grains and straw harvests (July) also prove challenging for us, during mid-season vegetable harvests and delivery. Cultivation of sweet corn and baling of hay also come at this time.

Both planting and harvesting of the fine switch grass seed must be done with specialized equipment. The Wisconsin Department of Natural Resources provided their native species seed planting drill for our establishment of a little less than 4 acres of prairie grass. They regularly provide this service

free to landowners, who usually partner with groups such as Pheasants Forever to cover seed costs of restoring wildlife habitat and conservation plantings.

Preparing a field for planting switch grass is not much different than for small grains in an organic system. The notable differences are that the oats and wheat are annuals, the switch grass a perennial, and that the prairie grass can be managed for 10 years or more once established (a process that takes 2 to 3 years of multiple mowing and a controlled burn). Challenges of weather (wet fields from snowmelt or rain in spring, delaying planting time, for instance), can be similar, too.

Fields we rented 4.5 miles from our farmstead to plant oats and prairie grass were wet, very late into spring; the landowner also did not finish harvesting his corn from the previous year, well into March 2009. We chopped up the corn stalks, grass and weeds on March 30 with a 6-foot rotary mower (4 hours). We disked and planted one field to hay and oats as a nurse crop on April 12 (7 hours' labor). I disked the field with a 9-foot implement and a JD 3020 tractor. My son Micah followed me, seeding the oats with a 9-foot drill and a small Massey Harris tractor.

Using the same equipment and manner of ground preparation, I established a winter wheat stand in a second field the following October. Oats and wheat grain harvested from both fields were mixed with purchased organic feeds for our own livestock to cut down on feeding expenses. We have seen 300 and 400 percent increases in purchased certified organic feeds for poultry, sheep and goats over the past 10 years.

Switch grass can be successfully planted into late spring. With the same equipment again, we mowed corn stalks and weeds in the second rented field, where we planted the switch grass, on June 5, 2009, (3.5 hours labor) and disked the field twice on the same day with the JD 3020 and hydraulic disk (2.5 hours). The specialized drill, a Truax 812 circa 1978, from the DNR quickly planted the field on June 12. Cooperating with a public program requires advance planning and scheduling around state-owned seed drill use over broad areas by multiple landowners.

I mowed the switch grass/prairie grass field with the 6-foot JD rotary and tractor on Aug. 24 to help the grasses get established over competitive weeds and to keep weeds from going to seed. Conservationists recommend two cuttings the first season, but our farm was short-handed and time did not permit a second cutting in 2009.

Two conservationists recommended controlled burning of the stand the following spring to enhance robust, heavy cellulose qualities in stems and to strengthen competition with weeds and other grasses. Burning is especially effective in controlling broad leaf weeds. We were not able to do this. Area prairie grass establishment enthusiasts who have the equipment and capability of conducting controlled burns were already committed. We did mow the field in 2010.

Applied Ecological Services of Brodhead, Wis., which provided the 20 lbs. of native species switch grass seed (*Panicum virgatum)* for our study, was not able to harvest seed from our study's planting before the grass went to seed in 2011. Recommended seeding rate was 5 lbs. per acre (per AES and the DNR). A good seed harvest rate is about 300 lbs. per acre.

We went ahead Oct. 22 with our first harvest of the straw after the seed had fallen. We harvested about 240 bales from a little more than 3.5 acres, which compares well to the modest yields of straw we've been harvesting from our small-field oat and wheat plantings for several years.

I cut the switch grass the day before harvest, on a warm, windy, sunny day. I raked the grass the next morning as soon as the autumn dew subsided and baled it very late afternoon, just before dark. Temperatures both days were well into the 60s F, and skies were clear. Rain was threatening in the Sunday forecast; we would surely have left the grass dry a second day had we been able to do so.

Wild switch grass seems to dry under the conditions we experienced more quickly than hay would have**. "**Switchgrass is a diverse species, with striking differences between plants. This diversity, which probably reflects evolution and adaptation to new environments as the species spread across the continent, provides a range of valuable traits for breeding programs. Switchgrass has two distinct forms, or "cytotypes": the lowland cultivars, which tend to produce more biomass, and the upland cultivars, which are generally of more northern origin, more cold-tolerant, and therefore usually preferred in northern areas."
(http://en.wikipedia.org/wiki/Panicum_virgatum)

The native species switch grass seed, which we obtained from AES and used to establish our own switch grass field, seems to be finer, thinner than the prairie grass straw we obtained in 2008 in partnership with a neighboring fruit and vegetable crop grower. That grower established his switch grass field ahead of our SARE study.

For the 2009 growing season in our comparison, we had about 25 bales of stored oat straw and about the same amount of stored wheat straw on hand from previous harvests. We also had nearly 300 bales of prairie grass straw in our haymow from helping this neighboring asparagus and fruit producer harvest his own straw on his property in November 2008.

We took several loads of the prairie grass straw as compensation for helping this neighbor harvest his straw when his machinery broke down. The 2009 growing season was our first to employ prairie grass straw as a mulch for our own vegetable crops.

Seed prices for wild-type Switch Grass (as of October 2011, per AES) range from $7 to $20 per lb., depending upon origin. It is very important to obtain seed from the same source as one expects to work with at harvest later on. That source must be in the market for the seed, of course, and have the capability of harvesting, cleaning and processing the seed for sale to a wider market. Other more common selections of switch grass seed generally fetch much less in return, $3 to $7 per lb. Cave-in-the-Rock and Blackwell are common selections.

Applied Ecological Services and Taylor Creek Nursery and Restorations, in rural Brodhead, Wis., about 6 miles from our farmstead, has strong capability to harvest, clean, process and sell native species grass and flower seeds. Prairie grasses reseed themselves several times through a growing

season. They also provide cover for pheasants and other game birds in spring and fall. They are attractive hunting grounds along tree lines and hedgerows for hunters, providing alternative and additional sources of income from a planting primarily intended for harvesting straw mulch.

Switch grass has been researched as a bioenergy crop since the mid-1980s, and is still being considered for use in several bioenergy conversion processes, including cellulosic ethanol production, biogas, and direct combustion in pelletized form to produce thermal energy. Studies have shown that it can take less than a third as much fossil fuel to produce than equivalent yields of corn. Because it requires far few inputs and chemicals to produce, its output to input ratio as a biofuel has been put at 20 to 1. These potential uses for switch grass promise additional revenue streams in the future from mastering its production for straw mulch use today.

Sharing Straw Mulch Comparisons

We sent out the attached press release on the field day held at our farm to state-line and local, general circulation newspapers. We also notified growers through our state-line Collaborative Regional Alliance for Farmer Training and the Madison Area CSA Coalition. About 30 growers or organic and sustainable farm interns on mostly Community Supported Agriculture farms in southern Wisconsin and northern Illinois attended the field day.

Our comparative use of straw mulch was shared with an annual May Tour the Farm Day (of more than 100 state-line visitors) and a workshop we hosted here on high tunnel greenhouse construction and use for the Madison Area CSA Coalition this past winter (about 20 people attended). Both UW Extension and DNR participants in our study made presentations on the straw mulch study at our field day.

A PowerPoint on using prairie grass and small grains straw mulch to bed vegetable crops is being made from this report for a Farmers Forum presentation at the National Small Farm Trade Show & Conference in November 2011. Wisconsin State Farmer's editor has agreed to publish an article written from results of this SARE project. The article or similar news features will be sent to a number of other general circulation and farm publications in the region.

List of Photos

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Public invited to Aug. 30 straw mulch field day

Crop growers and gardeners are welcome to view prairie grass and small grains straw mulch at Scotch Hill Farm, 1 to 4 p.m., Monday, Aug. 30.

An optional potluck meal at noon will precede the field day at the small crop and livestock farm on the Green-Rock county line north of Brodhead. Meal participants should bring a warm or cold dish to pass.

Certified organic vegetable crop farmers Dela and Tony Ends have been comparing switch grass, wheat and oat straw mulches for two seasons. They are trying to cut reliance on rolled black plastic mulch, which they use to control weeds in thousands of transplanted bedding plants.

UW Extension Rock County and Wisconsin Department of Natural Resources staff have been taking part in the USDA Sustainable Agriculture Research and Education farmer-rancher study. Dr. Jim Stute, an Agriculture Extension Service crops and soils educator, and Brian Benzow, DNR conservation field service staff member, will take part in the field day.

Switch grass, oat and wheat straw are mulching several types of beans, cabbage, Brussels sprouts, sweet potato and other vegetable crop varieties at Scotch Hill Farm. The 16-year-old farm grows more than 100 vegetable varieties for several hundred families who subscribe for weekly fresh produce delivery.

Black plastic mulch has increasingly helped vegetable crop farmers control weeds since the 1950s. By 1999, the practice had spread globally to more than 30 million acres.

Mulches conserve soil moisture, prevent erosion, cut soil compaction and eliminate root damage deep cultivation or hoeing may cause. Their weed suppression cuts labor expenses, too.

Extracting and disposing of plastic mulch after the growing season pose challenges for most growers, though photodegradable and biodegradable plastic mulches are being developed.

Organic mulches contribute plant matter back to the soil, increasing soil fertility and mineral production for subsequent crops. The Scotch Hill study is comparing how readily different kinds of straw mulch break down and make nutrients available to the soil.

Applied Ecological Services of Brodhead, which restores native species plantings, provided switch grass seed for this study. Switch grass is also drawing interest in the Upper Midwest as a bio-fuel alternative to gasoline.

A map and driving directions to the farm and field day are available at www.scotchhillfarm.com
Contact the Ends at 608 897-4288 or tony@scotchhillfarm.com

Scotch Hill is a Madison Area Community Supported Agriculture Coalition grower and steering committee participant n the state-line Collaborative Regional Alliance for Farmer Training (CRAFT). The Aug. 30 field day is a CRAFT farm tour for interns and Farm Beginnings participants.