Black plastic alternatives: Fertility, variety, seasonality

Changes in year two and mid-season observations.

By Eric Winter, Rodale Institute Seasonal Research Technician

From left to right: Black plastic, rolled cover crop, mowed cover crop.

This is year two of the three-year Sustainable Agriculture Research and Education (SARE) grant that is investigating alternatives to black plastic. Since the end of year one (see the article **Black Plastic Alternatives: Year 1**) we have moved to a different field at the Institute and have set up field trials with three collaborating farmers in Pennsylvania and one in Northern New Jersey.

Instead of working with three different varieties of tomatoes (Glacier, Bellstar, Black Prince) and green beans, as we did last year, we decided to grow only Glacier tomatoes, a larger salad tomato that takes 55 days to produce fruit. The decision to plant an early variety was especially advantageous this year. With our extremely wet spring, we had a later-than-desirable transplanting date of June 22.

There is a total of nine treatments; each of which is replicated four times, resulting in 36, 50-foot rows with 24 tomatoes per row. The nine treatments are comprised of the following cover crop/termination combinations:

- Aroostook rye (seeded at 3 bushels/acre)
- Hairy vetch (seeded at 28 lbs/acre)
- Rye/vetch mix (25 lbs/acre vetch and 70 lbs/acre rye)

Each of these cover crops were planted in the fall and then terminated in late May/early June by one of following methods:

- Roller-crimper (mounted on the front of our John Deere 6430 tractor)
- Flail mower (a rear mounted John Deere 390 flail mower pulled by John Deere 2040)
- Moldboard plow (an International 145 pulled by our Ford 8240 tractor) followed by a black plastic layer

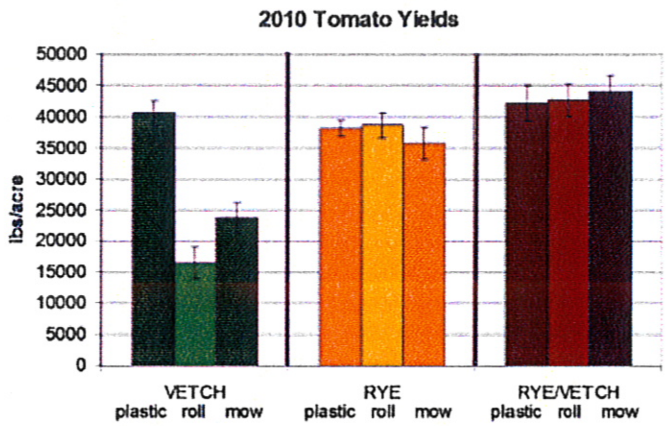
Meanwhile, the collaborating farmer trials have a more straight-forward design of two treatments on their sites:

1. Their standard practice (anything from plowing the cover crop and laying black plastic, to killing cover crops with herbicide and no-till planting)
2. Roller-crimping the cover crop, generally working with the mixed rye/vetch cover crop (though at one site, a farmer planted a rye/clover mix in their treatment)

Data Collected

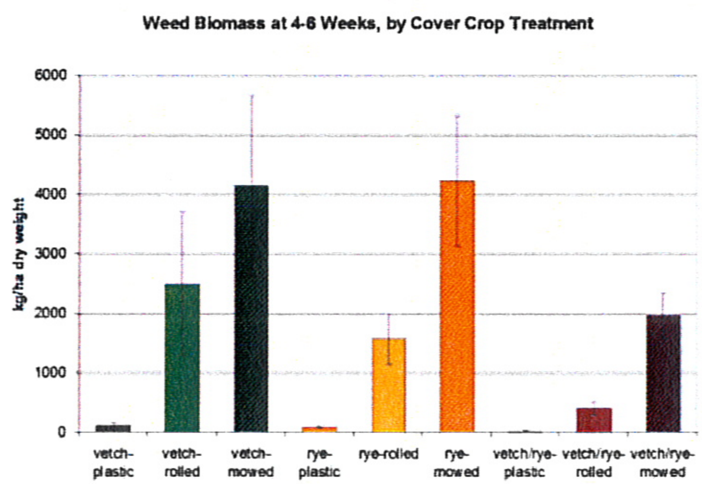
At each site, spring cover crop biomass cuts were taken from each treatment right before the cover crops were terminated to assess potential nitrogen added to the soil. Weed biomass cuts were taken twice, once at four to six weeks and again at eight to ten weeks after planting the main crop, to help quantify weed competition. Soil temperatures are recorded automatically via soil sensors every four hours throughout the growing season at each of the five sites. Only at the end of the season will we take the soil temperature sensors out of the ground, upload them and compare the temperatures. Lastly, soil moisture is sampled gravimetrically (measuring soil weight when wet and again after oven-drying) monthly at Rodale Institute throughout the growing season.

We expect that the black plastic will be the hottest and driest treatment much like last year, but we won't know for sure until all the data are in. (Just to recap, after the 2010 growing season, we found that the mowed rye/vetch treatments were the most effective in producing comparable or better yields than black plastic and were the best at suppressing weeds.)

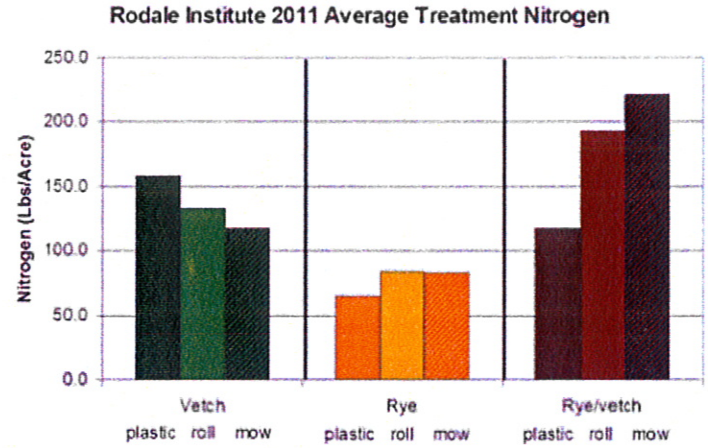


Preliminary results and observations

This year, so far, we are seeing that the rolled rye/vetch is the most effective cover crop combination at suppressing weeds and just behind mowed rye/vetch for supplying nitrogen.



Although the average nitrogen content of the rye/vetch mixture was almost half of the average nitrogen content of vetch alone, the sheer volume of biomass produced by the rye/vetch cover crop was almost two to three times that of the vetch biomass. The rye/vetch mix produced 6,200 to 11,500 lbs/acre and the vetch alone produced only 3,700 to 4,000 lbs/acre.



Weeds that are getting through the mat are not right next to the tomatoes; rather, they are mostly in between the rows. The picture below illustrates how effective the rolled rye/vetch is at suppressing weeds and that the weeds are predominately in the aisles. This looks like a lot of weeds but it's important to keep in mind that these weeds were not managed at all. As such, the weed biomass looks abundant, but it's comprised primarily of a few large weed plants which would have been easy to pull, had our experimental design allowed for it this year. (We are considering managing the weeds in portions of the plots next year to assess the time and labor required, and the impact on yields.)

Left: Rolled rye/vetch weed supression. Right: Author, Eric Winter, cutting spring biomass for carbon and nitrogen analysis.

Additionally, our field-scale equipment forces us to create wider rows than a grower would realistically set for a single tomato row (see photo at top of article). Where weeds are heavy on the left and right side of the figure, a typical grower would have another row of tomatoes. Therefore weed pressure on the tomatoes is minimal. Growers can easily manage weeds between rows by hoeing, weed whacking, flaming or any other practice. This year, we also found that the foot traffic from twining tomatoes was an effective passive weed suppressor. Just keeping up with twining kept most weeds away from the tomatoes. A weed whacker was used to control weeds in black plastic rows and their walkways both years.

The importance of nitrogen

We suspect a lack of available nitrogen may be affecting tomato rows planted into the rye cover crop. Tomatoes need approximately 100 lbs of nitrogen per acre. Our cover crop data (see average treatment nitrogen figure above) shows that both the vetch and the rye/vetch treatments supplied more than 100 lbs of nitrogen per acre but the rye alone did not. Visibly, the tomatoes planted into the rye alone are yellowing and smaller than tomatoes in the other cover crops.

Last year, tomatoes were fed a dosing of OMRI-approved Fertrell 411 fish emulsion liquid fertilizer at the time of transplanting. However, this year, the tomatoes were not provided with supplemental nitrogen until two weeks after planting, which might have further affected growth. Dosing was different for each cover crop, based on the anticipated amount of nitrogen provided by the vetch component of the cover crop. This year each cover crop received the following mix:

- Tomatoes in the rye-alone cover crop plots received 1.83 gallons of Fertrell 411 per 100 tomato plants, resulting in application of 52 lbs of nitrogen per acre.
- Tomatoes in the rye/vetch cover crop plots received 0.94 gallons of Fertrell 411 per 100 tomato plants, resulting in application of 26 lbs of nitrogen per acre.
- Tomatoes in the vetch-alone cover crop plots did not receive any additional fertilizer since the vetch fixes its own nitrogen. The vetch plot tomatoes did, however, receive the equivalent quantity of water as was required to apply the fertilizer to the other treatments (approximately a half gallon per plant), to equalize any potential benefit derived from the water alone.

Weather patterns between this year and last year could have also caused differences. This year, the cold and wet spring season rapidly transformed into a very warm and dry early summer which then changed into a wet and hot mid-to-late summer. The farm went five weeks without rain in June and July, and then received 2.5 inches of rain at once at the end of July, followed by almost 12 inches of rain in August. Last year the weather pattern was more conducive to growing tomatoes: It was consistently hot and dry with moderate rain events throughout the season.

As such, the 2010 tomatoes received enough rain (about an inch of rain per week) to keep tomatoes growing happy and strong all season, with irrigation required only a few times during the season. This year, by comparison, we irrigated through the drought period and occasionally even two times a week. Similar weather changes were seen at our collaborating farms, supporting more abundant weeds and weakening some vegetable treatments. It will be interesting to compare yields between the five farm sites.

As any farmer will tell you, seasonal weather patterns can make all the difference. That is just one of the many reasons long-term agricultural research is so important. Managing research trials over multiple years, each with its unique weather anomalies, allows us to develop more accurate answers to our research questions regarding the impact of treatments on yields (as opposed to impacts of the weather alone).

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