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Infestation hits first-year multi-variant tomato trial

Heirloom variety outlasts hybrids in test of cover crops, beneficial soil fungi, organic fertility and weed suppression.

By Miriam Gieske
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By good fortune, the Striped German heirloom tomato plants used in the 2009 Rodale Institute tomato trial showed high tolerance to the late blight, surviving in a productive mode much longer than two hybrid varieties in the same plots. Another heirloom variety in a field trial on the farm did not show this resistance.

The results from this year's Rodale Institute tomato trial don't look pretty. Like many farmers this year along the entire East Coast, particularly the Northeast, we struggled with weather too wet and cold for a subtropical fruit and, subsequently, disease that thrived in those tomato-negative conditions.

Nonetheless, we got some tasty tomatoes—and some information to share about using rolled cover crops for vegetable production.

Research set-up

In the fall of 2008, we planted plots of three cover crops: hairy vetch alone, rye alone, and a

mixture of vetch and rye. We allowed them to over-winter and grow in the spring, then rolled them with our **roller-crimper** when they reached the flowering stage. The resulting mat became mulch for our 1,440 tomato plants as we examined the effects of the respective cover crops as well as mycorrhizal (beneficial soil fungi) inoculation on yields, weed pressure, and cost of providing nitrogen for the plants relative to yield obtained.

We planted three varieties of tomatoes: two hybrids, **Juliet** and **Pink Beauty**, and one large-fruited heirloom, **Striped German**. We spaced the plants 18 inches apart within the rows, with 40 inches between rows, for a total of 120 plants per 20- x 30-foot plot or about 8,700 plants per acre. Half the plants in the test plots were inoculated with mycorrhizal fungi, which have been found to increase plants' phosphorus, zinc, and copper uptake and improve soil structure. (Planting story [here](#).)

Small crop-free areas within the plots allowed us to separate the mulch's contribution to weed suppression from that of the tomatoes. Over the summer, we measured weed biomass and tomato yields. This year's late blight epidemic also allowed us to gather some information on disease resistance. Now that the growing season is over, our tomato patch has been plowed and is planted to rye, ready to wait for another year.



A few Striped German tomatoes were nearly lesion free, but many had minor to significant lesion damage from the late blight.

2009 research results

Big differences in cover crop mulches

Rye at both seeding rates (3 bu/acre and 1.5 bu/acre) grew very well, producing similar amounts of mulch – about 10,000 lbs/ acre and 7,500 lbs/acre, respectively. The vetch performed poorly, both when planted alone at 30 lbs/acre and when planted with rye at 15 lbs/acre. Alone it produced only about 3,000 lbs/acre of mulch, and with rye it produced negligible biomass. However, despite relatively poor performance (probably due to a too late planting date), the vetch still provided 100 lbs of nitrogen per acre, more than meeting tomatoes' 50 lbs/acre requirement. This year we're expecting even better mulch production by all cover crops, since they were established in August instead of October.

No difference in yield between plants inoculated with mycorrhizal fungi and those not inoculated. This is really not too surprising. From a plant's point of view, the main reason for associating and cooperating with these fungi is that they help the plant explore all the nooks and crannies of the soil in search of phosphorus. In return for that help, the plant gives the fungus food in the form of sugars. But tomatoes have a lot of fuzzy little feeder roots, so they're really good at exploring those nooks and crannies themselves. Besides that, our soil is very high in phosphorus as a result of centuries of being amended with manure—especially this field, which is just behind the barn! Our tomatoes simply didn't need the help of the fungi.



Cover crop treatment affected weed pressure, but did not affect yields. Four weeks after we rolled our cover crops and planted our tomatoes, the amount of weed biomass was about the same no matter what cover crop was used. By 10 weeks after

Weed pressure varied significantly between rye and no-rye plots, but yield did not.

rolling, however, the vetch plots had become significantly weedier than the rye or rye-vetch mix plots. In spite of that, the vetch plots yielded just as much as the others, perhaps because the rolled-down vetch gave the tomatoes an early nitrogen boost and a head start on the weeds.

Vetch a much more economical nitrogen source than fish emulsion. We side-dressed the rye and vetch-rye mix plots with liquid kelp/fish emulsion at a rate of 20 pounds nitrogen per acre in the rye plots and 10 pounds nitrogen per acre in the vetch-rye mix plots. We did not side-dress the vetch plots. The fertility cost (cover crop seeds and/or side-dress fertilizer) worked out to:

- \$58.80/acre or 0.9 cents per pound of tomatoes for the vetch
- \$445.83/acre or 8.1 cents/lb tomatoes for the vetch-rye mix
- \$825.95/acre or 13.8 cents/lb tomatoes for the rye.

Of course, using manure or compost as a supplemental nitrogen source instead of fish emulsion would bring the cost of fertilizing the rye and vetch-rye mix plots down considerably. We needed to avoid using manure because of our high soil phosphorus levels, but where this imbalance is not a consideration, manure or compost could be a good option.

Tomato plants suppress weed growth. There was about half as much weed biomass in the alleys between the tomato rows as in the “crop-free zones” where we didn’t plant anything into the mulch, which means the tomatoes themselves helped keep the weeds in check. Go tomatoes!



This Pink Beauty plant shows the advanced lesions and black, desiccated leaves typical of the 2009 late blight.

Late blight survival varied by variety. The pathogen appeared on our plants in early August. We considered spraying with copper (a synthetic fungicide that is **allowed but restricted** within the National Organic Program), but decided against it because copper is expensive, doesn’t work very well, and can poison the soil if it’s used too much. We pulled out two of our varieties, Juliet and Pink Beauty, in hopes of slowing the spread of the disease. We were pleasantly surprised to discover that our sole heirloom variety, Striped German, was partially resistant to the blight. While some of the fruits developed the tell-tale late-blight lesions, the leaves were unscathed by the usual browning and withering of the disease. We left Striped German plants in the ground and they kept trooping along through early September, putting out big and tasty—if at times rather ugly—tomatoes.

Tomato yield was much lower than Pennsylvania’s commercial field average for the last 10 years—around 6,000 pounds per acre versus a range of 10,500 to 22,000 pounds per acre. This was largely due to the weather and the blight, although it must be admitted that our management played a role as well. We started

our tomatoes too early and didn't feed them enough before transplanting, so when we put them out in the field they were pretty leggy and pitiful-looking. The ones transplanted into the vetch mulch greened up quickly, but the ones transplanted into the other mulches took several weeks to catch up.

Building on what we've learned from this year, we plan to do a similar tomato trial in another field in 2010. We will have the same three cover crops (rye alone, vetch alone, and vetch plus rye) and test three different ways of terminating them: plowing, rolling, and undercutting. We will also have plots mulched with black plastic for comparison. Many organic farmers use plastic mulch to suppress weeds and warm the soil, but the use of plastic mulch has negative environmental consequences since it increases runoff from the fields, reduces soil organic matter by speeding up decomposition and often cannot be recycled after it is used.

We hope to show that rolled cover crop mulches are a feasible alternative to plastic mulch for organic growers. We also plan to do a trial of rolled rye mulch for green bean production.

We'll keep you posted about these trials on our website, so stay tuned!

Miriam Gieske was a 2009 research intern at the Rodale Institute.

Rodale Institute photos by Miriam Gieske and Greg Bowman