

## Cover Crops: What a Difference a Few Weeks Makes!

Cover crops are the workhorses of a vegetable crop rotation. They do the heavy jobs of adding organic matter, supplying nitrogen, and suppressing weeds. However, the biomass these allies produce (and therefore the N fixed or the organic matter added) strongly depends on when the crop is planted and how long it grows. Cover crops may survive when grown outside their ideal window, but they will not do the heavy work they are capable of. All hairy vetch plantings are not the same!

Over the past six years at the Cornell Organic Cropping Systems Trial, we have planted several species of cover crops at many times. In this article I will summarize how they have performed. First, a little background. We have grain and vegetable field experiments. In both of these trials, we compare four treatments—each representing a different approach to organic production or “system”. Please go to <http://www.hort.cornell.edu/extension/organic/ocs/> for more information on the trials.

In this article, I will not distinguish between the systems, because cover crop performance has been more related to planting and tillage dates than system differences. Data from 2005-2011 are all lumped together to better show trends—though there is variability due to weather. When you look at the following charts, focus on the highest values at a given date—this shows the potential of the cover crop at that time under good growing conditions.

The vegetable trial is at Freeville, NY on a mostly very well-drained Howard gravelly loam soil. The last frost in the spring is around May 15 and the first in the fall is typically in late September. The grain trial is about 20 miles north in Aurora, NY, on a marginally-drained, heavier Lima soil. There, the last frost is around May 5 and the first fall frost is around October 10. These sites are similar to much of New York State.

### *Roots*

Before getting into the results, it should be pointed out that we report here only the aboveground biomass (dry plant matter) of these cover crops. A lot is also going on underground. The roots often have about 30% as much additional biomass as the tops, and in legumes roots typically break down more slowly—thus releasing nitrogen more slowly as well. Roots are hard to measure, but they considerably augment the contributions of cover crops.

### *Hairy vetch*

Hairy vetch has performed well at Freeville. It doesn't make too much difference when vetch is planted in the fall, as long as it is before 9/15. After that date, winter survival is unreliable, and the vetch seed may be wasted.

However, the time of termination the next spring is critical. We usually mow, then till this cover crop under after flowering so that it is easy to kill.

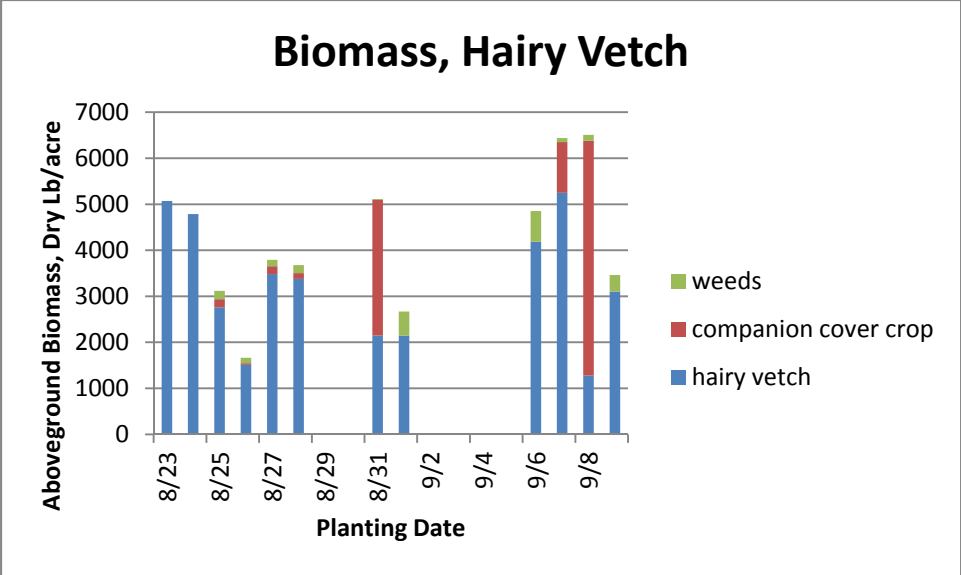


Figure 1. Hairy vetch can produce biomass of up to 5000 lb/acre when it is planted before 9/15. If it is planted with rye or wheat, use a low seeding rate for the companion to maximize vetch growth.

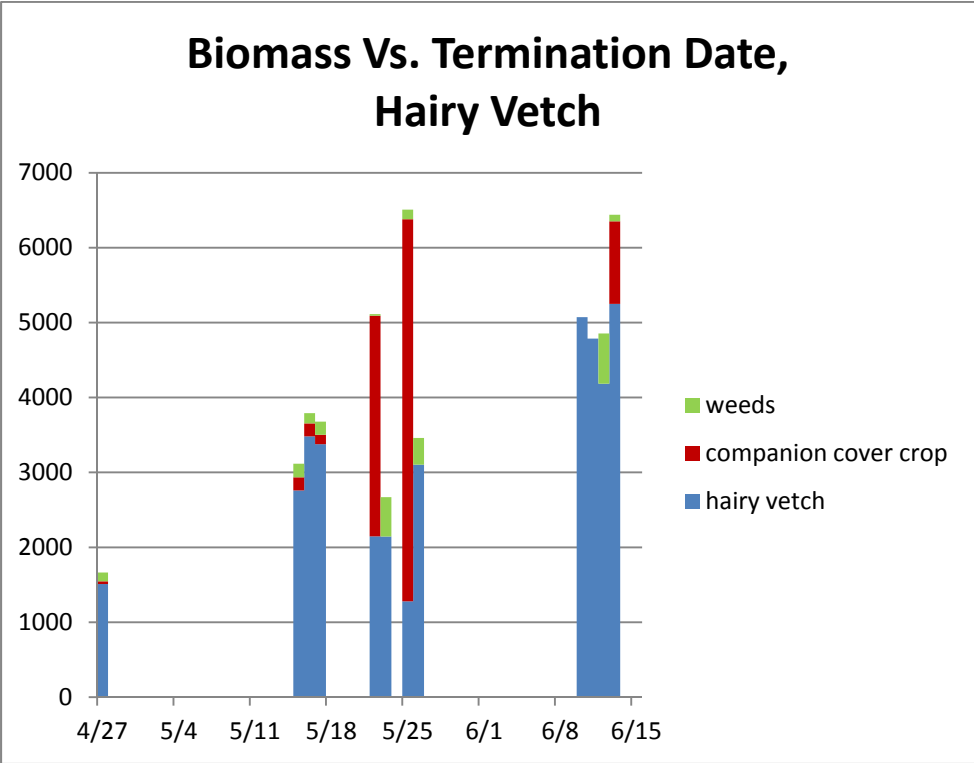


Figure 2. Same data as Figure 1, organized by kill date. The earlier it is mowed, the less growth is attained. Vetch is easily killed when it starts flowering in late May/early June.

When we mowed it one year on April 27, only about 1500 lb/acre of aboveground hairy vetch biomass had accumulated. However, when mowed 20 days later, that figure can be doubled or more. Wait another 25 days, and another 1500-2000 lb per acre is added. Since hairy vetch tissue runs 3-5% nitrogen, the nitrogen contained in the planting terminated in April was a maximum of 75 lb/acre. Waiting until early June, this amount could be 200 lb/acre or more. If seed costs \$100 per acre, that means you're paying \$1.33/lb of N if you cut it off in late April, or a much more attractive \$0.50/lb of N if you let it grow until June. Similarly, if you want to add a lot of organic matter and N with your hairy vetch cover crop, let it grow until after June 1. Hairy vetch has done all this work in 9 months, most of which were cold and snowy! After vetch is mowed and/or tilled in, there is still plenty of time to plant broccoli or other late-planted cash crops.

It is often best to grow a grass-legume cover crop mix. Weed suppression is better with the mix, and N-release can be more gradual. We typically plant hairy vetch with oats, wheat, or rye. When a grass is added, total biomass has approached 6500 lb/acre after late May. The C/N ratio of the cover crop mix is higher than for a straight legume, so that microbial delivery of N to the following crop is more gradual. If the grass dominates the mixture and it is terminated after mid-May, the C/N ratio may be too high and N can be tied up and unavailable to the following crop. To avoid this, be sure to use reduced rates of grass in the mix (half of standard or less). Our favorite vetch mix is vetch @ 40 lb/acre plus rye @ 30 lb/acre.

#### *Field peas and oats*

Another great mix is oats and field peas. We have found that both spring- and late summer-planted oat and field pea crops do well, though aboveground biomass production in the spring is up to 7500 lb/acre—almost twice the highest fall value. To achieve that high biomass, the oats and peas need to be planted in early April and terminated by early July. In the fall, plant in August for best growth before winterkill. We plant these mixes with about 75 lb/acre of oats and 150 lb/acre of field pea seed. This heavy rate allows for excellent weed suppression. Organic field pea seed in bulk may run \$0.60/lb, so this is a bit pricey, but worth it.

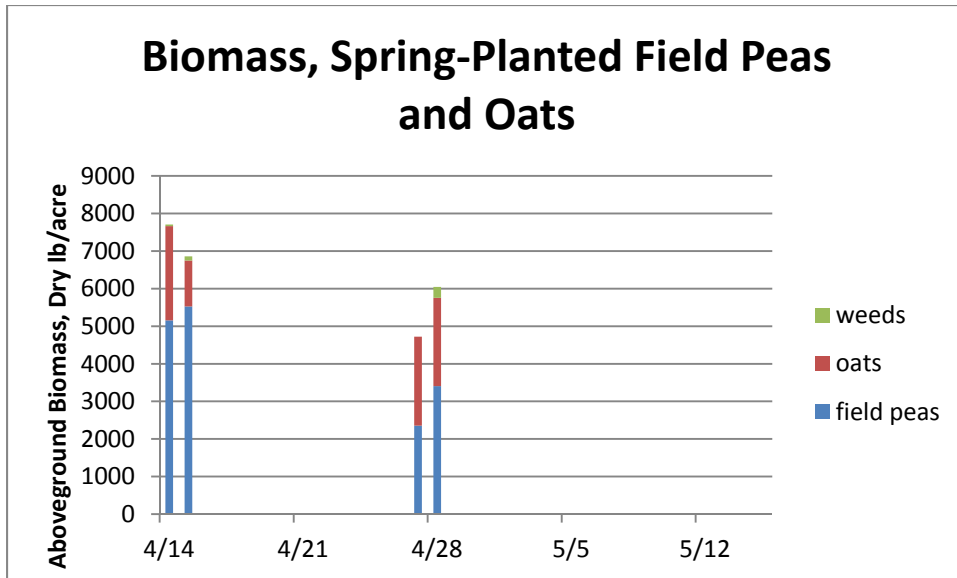


Figure 3. Spring-planted oats and field peas grow strongly and suppress weeds.

In 2007 we planted Esker oats and peas on 8/20 and Esker oats and vetch on 8/31. By late fall, before winterkill, the earlier-planted oats produced 4184 dry lb/acre aboveground biomass, while the oats planted 11 days later only produced 2307. We had a similar situation in 2011. In the pictures below, notice how much heavier oat growth was when planted in early August, compared to a month later.

The take home message from this is that a couple weeks delay in planting oats and field peas in August can cost heavily in production of biomass and N.

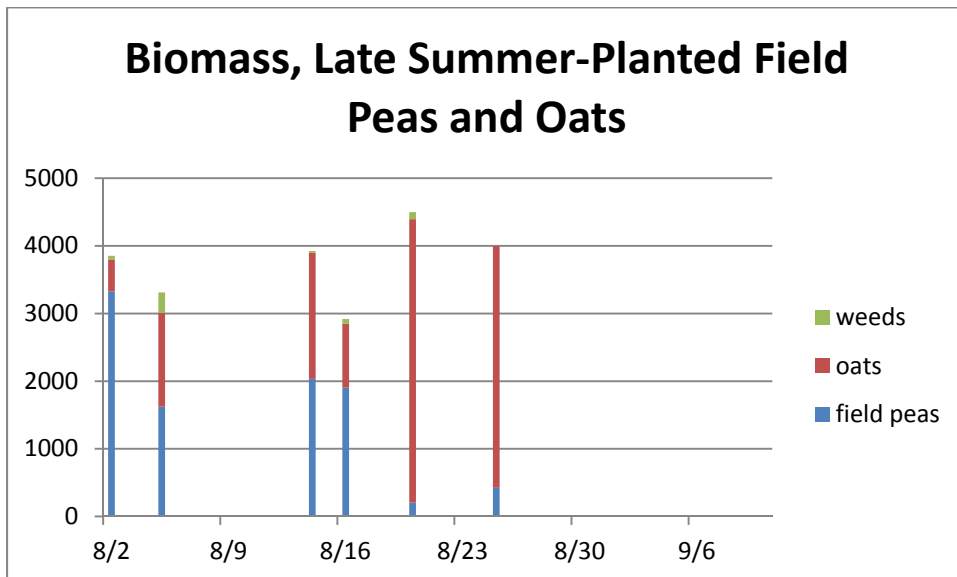


Figure 4. Biomass production of this late summer-planted mix is fair, but much lower than when it is planted in spring.

The pea variety makes a big difference too. In the early years of our trial, we didn't understand that grain-type field peas are often short-statured and don't produce much biomass. Forage types such as "4010" or "Maxum" are rank growers and much better for green manure crops. In the chart above, peas planted on 8/20, 8/25, and 8/31 were grain types and did not perform well.

### *Rye*

We all love rye because it can establish later than just about anything else in the fall. Yet it's good to note that work at Penn State showed that rye there reached a maximum biomass of about 10,000 dry lb/acre when planted from 8/25-9/15 and terminated on May 30 (258+ days of growth). Terminating 10 days earlier reduced biomass by about 2000 lb/acre; as did planting on 10/15 (W. Curran, pers. comm.)

Our results are similar. About 260 days of growth is needed on our sites to maximize rye cover crop production. In practical terms, this means planting by 9/15 and tilling under, rolling, or mowing in late May. Note that the C/N ratio of rye at maximum biomass is high and nitrogen will likely be tied up by the residues if incorporated without extra added N. By mowing the rye in early May, C/N ratio at the end of the month will be lower, but so will the total rye biomass produced. Growing a rye-hairy vetch mix may be a better way of overcoming this problem. Perhaps best is to harvest rye + vetch "hay" in late May, and use it for mulch on a different field. That way, the cover crop root biomass is still in place to build soil, but the carbon-rich topgrowth has been moved and will suppress weeds elsewhere.



*Figure 5. Oats and field peas planted 8/5/11.*



Figure 6. Oats and Hairy Vetch planted 9/1/11. Compare to above. Both photos taken on 10/3/11.

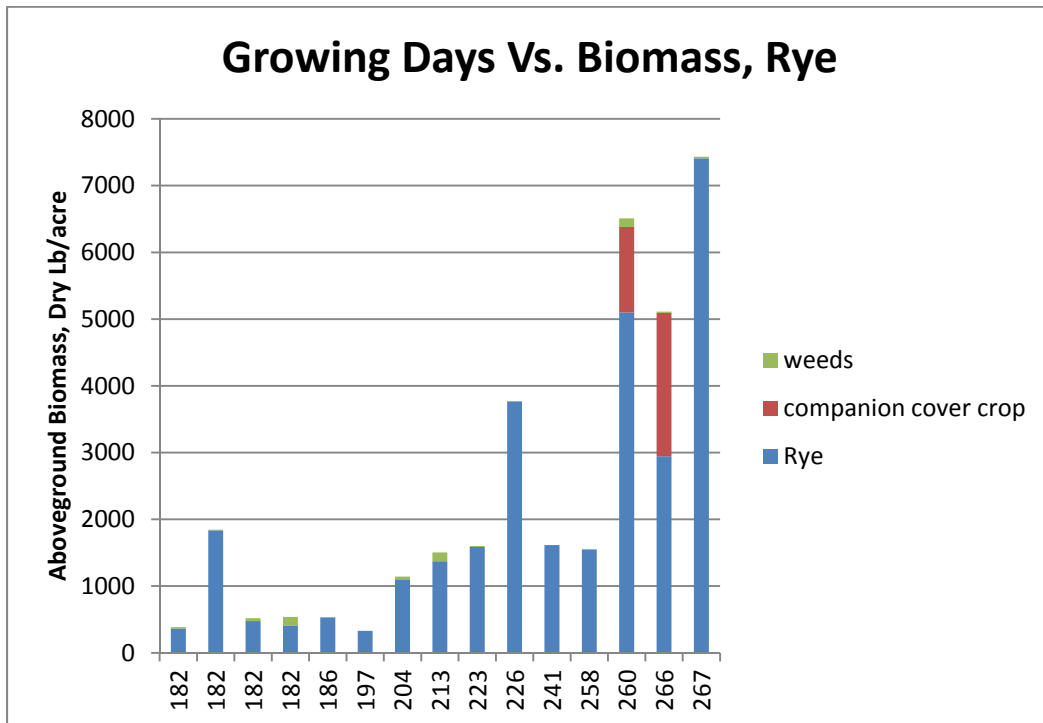


Figure 7. In central NY, rye needs about 260 days for maximum biomass

### *Red clover*

In our grain trial, we frost-seed medium red clover into spelt in March. The red clover grows underneath until spelt harvest in late July; from August until late fall it grows strongly. The topgrowth dies over winter, but the following spring there is another flush of biomass before we plow it under in mid to late May. Thus, the red clover provides inputs of biomass from killed tops in the winter, then again from plowed down tops and roots the next spring. It is in the field for about 14 months, including 4 while it grows beneath the spelt cash crop.

Red clover produced from 2500 to almost 5000 dry lb/acre of aboveground biomass in the spring in our trials. The clover roots were substantial as well, but we lack data for them. Our data seems to show that after May 1, it didn't make too much difference when red clover was plowed in, as far as aboveground biomass was concerned. However, given the fact that clover grows very rapidly in May, this may be due to yearly weather differences. It is probably best to wait as late into May as feasible for clover plowdown, to maximize biomass and N. Medium red clover is an excellent cover crop for production of organic matter and N when handled this way. In our trials, we have consistently grown 150+ bu/acre field corn after red clover green manures, with only starter fertilizer added.

Our limited data suggests that when underseeded into spelt, the red clover also produced about 1500-4000 lb/acre by December, of topgrowth which was winterkilled. Some of the nitrogen from this fall tissue is undoubtedly recaptured by the clover roots and incorporated into spring tissues.

### *Other clovers*

We tried underseeding crimson and berseem clover beneath spelt in the same fashion as the red clover, but they performed poorly.

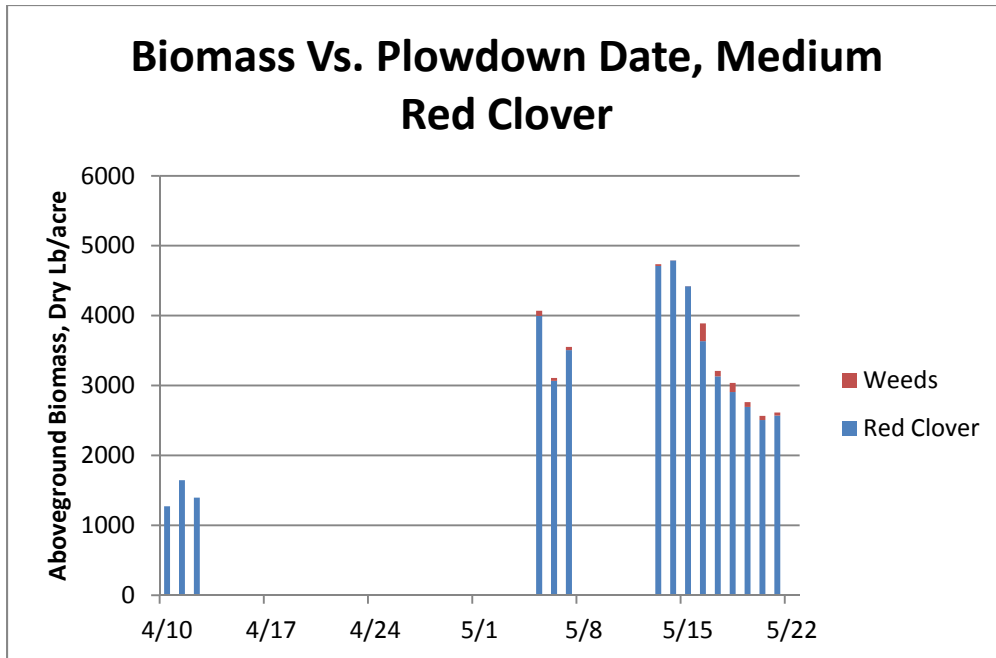


Figure 8. Red clover produces around a ton per acre of dry matter by mid-May in most years.

#### Buckwheat

Buckwheat is unsurpassed in producing biomass in a short period of warm weather. While it doesn't fix nitrogen and does not grow well in the cold, it is great for short windows during summer months. It smothers and suppresses weeds. Buckwheat will produce about 3000 dry lb/acre in 40 days, much more than other common cover crops in the same period. Planting it in the months of June and July is ideal. Our experiences agree with farmer reports that buckwheat biomass production declines if planted later in the season.



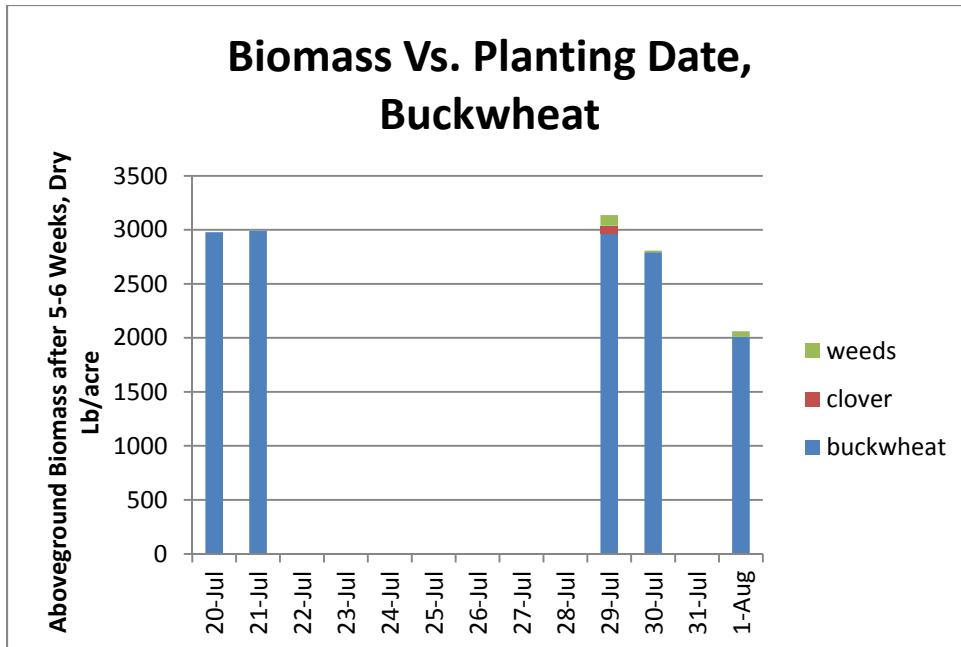


Figure 9. Buckwheat produces about 3000 lb/acre in mid-summer.

### Weeds

A good cover crop stand will out-compete weeds. Plant them at high rates—often double those for grain production—for the best weed suppression. Cover crops planted during the proper windows in our trials have kept weed biomass to below a paltry 150 dry lb/acre in most cases, with few if any weed seeds produced.

### Poor performers

A few other cover crops have not performed well for us. Bell beans seeded in late July were very expensive and produced less than 1000 dry lb/acre of aboveground biomass. Soybeans planted in early August also did not produce even that much. In our vegetable trial, we have tried a novel combination. We have seeded medium red and crimson clovers in mid- to late-July with buckwheat for several years now. The idea was that the buckwheat would shade out weeds, but allow the clover to establish. At first, the clovers produced reasonably well, but in recent seasons, clover stand has been poor and very weedy. We will try this again with an earlier seeding date, but cannot currently recommend this practice.

### In Summary

This table summarizes the best windows for the above cover crops.

Cover crop	Planting window	Termination Window	Comments
Hairy Vetch	Before 9/15	After 5/15	Terminating on 5/30 is much better
Field Peas and Oats --Spring	April	July	They should grow for at least 75 days; use forage varieties
Field Peas and Oats--Fall	Before 8/15	Winterkill	A mild fall can allow for planting a week or two later, but it is a gamble
Rye	Before 9/15	Late May	Best with hairy vetch
Red Clover	Frost seed into winter grain	May of following year	Excellent rotational strategy
Buckwheat	June and July	40 days after planting	Do not wait to terminate; may produce seed

For a great on-line guide to cover crops, please see “Cover Crops for Vegetable Growers” at

<http://www.hort.cornell.edu/bjorkman/lab/covercrops/>

*Many thanks to Molly Shaw for her insightful comments on this article.*