Managing the weed seedbank with cover crops and tillage
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Weed control is a principal concern for vegetable growers. The adoption of sustainable agricultural techniques can reduce land managers' dependency on expensive or harmful chemicals, but may also result in increased weed presence. Weed control is not just a matter of preventing weed emergence or killing weeds that arise during the growing season. A good management strategy should include reducing the size of the existing weed seedbank. Adopting techniques that reduce the weed seedbank is a necessary step toward long term weed management solutions.

Weed seedbank

Every plot of land has a seedbank which is made up of seeds that are lying in the soil awaiting acceptable conditions to germinate. Seeds may require specific levels of moisture, temperature, light, disturbance, or sometimes special conditions such as fire to germinate, and seeds of some plant species may lie dormant for years before germinating. Several techniques have been tested for reducing the weed seedbank. One way is to disturb the soil prior to planting crops, allowing weed seeds to germinate. Weed seedlings can then be killed either by mechanical or chemical means. This reduces the weed seedbank and prevents weeds from emerging later in the season and competing with the crop. This is called the “stale seedbed” technique. The stale seedbed takes advantage of another strategy to reduce the weed seedbank, which centers on preventing seeds from entering into the soil. This can be accomplished by killing weeds before they release seeds or using cover crops to suppress weed emergence. Both methods if used appropriately will prevent weeds from replenishing the seedbank.

In two separate field experiments at the University of Maryland Upper Marlboro Research and Education Facility we tested the effects of cover crops (Cover Crop Experiment) and tillage techniques (Tillage Experiment) on the weed seedbank. To accomplish this, we took soil cores (depth = 15 cm) from treatment plots in both experiments prior to mowing cover crops. The soil was evenly spread in plastic flats and placed in favorable greenhouse conditions
for six weeks. This allowed the weed seeds present in the seedbank to germinate, after which they were counted and identified. We have three and two years of seedbank data from the Cover Crop and Tillage Experiment, respectively, giving us some early clues as to whether cover crops and tillage can influence the weed seedbank.

Cover Crop Experiment

The Cover Crop Experiment consisted of field plots grown with one of three cover crop treatments and a no cover crop check treatment. The three cover crops treatments were (1) barley, seeded at 100lb/A, (2) crimson clover, seeded at 20 lb/A, and (3) a mixture of barley and crimson clover, seeded at 60 and 40 lb/A respectively. Cover crops were planted in the fall of 2011 and 2012, and flail mowed and strip tilled each spring. A vegetable crop was then planted into the tilled strips, leaving cover crop residue between planted rows. We collected seedbank soil cores in 2011 (for a pre-treatment baseline), 2012, and 2013, prior to planting the vegetable crop in early spring or summer.

Tillage Experiment

The Tillage Experiment consisted of field plots planted with a forage radish, rye, and crimson clover cover crop mixture. In the spring, cover crops were flail-mowed and the plots tilled using one of four techniques: (1) no till, where crops were seeded directly into the cover crop
residue, (2) strip till, where narrow strips (~12 inches) were tilled for planting the crop, leaving most of the plot covered by cover crop residue, (3) black plastic, where transplants or seed were planted on black plastic mulch after the plots were chiseled plowed and disked, and (4) bare ground, where the plots were plowed and disked after the cover crops were flail-mowed. (For additional details on this experiment, see the article by G. Chen et al. in this issue).

Results

Two years of data from the cover crop study showed that plots grown with crimson clover germinated fewer seeds compared to the other treatments (Figure 2, left panel). Two years of data from the tillage study showed that plots containing black plastic have the greatest reduction in the weed seedbank compared to the other treatments (Figure 2, right panel). These two experiments had very different numbers of germinating seeds, despite being less than 1 km (~0.6 miles) apart. The two experimental field sites were grown under very different conditions prior to these experiments, highlighting the importance of historical land use for the current weed seedbank.

Figure 2. Number of seedlings emerging from soil cores taken from the Cover Crop Experiment (left panel) and Tillage Experiment (right panel), after six weeks of greenhouse conditions. Error bars are ± 1 SE.

Conclusions

Managing the weed seedbank is a long-term endeavor, but can provide long-term benefits. While these two to three years of data can only serve as an early indication as to how different cover crops and tillage methods might influence the weed seedbank, we do see that
techniques offering greater soil coverage might be most effective at managing the weed seedbank. Soil coverage can suppress weed emergence and growth, preventing weeds from releasing seeds back into the soil. Over time, this can reduce the size of the weed seedbank and help provide long term weed management.

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