Terminating Cover Crops With a Roller Crimper in Organic Grain Rotations

Optimizing timing of hairy vetch and cereal rye rolling can prevent incomplete cover crop termination.

Background

Cover crops are an integral part of organic systems, where they can provide multiple benefits, such as nitrogen management or weed suppression. There is also growing interest in using cover crops to reduce tillage in organic grain rotations by using rolled cover crop residues as a mulch to suppress weeds during the summer cash crop growing season. A mix of hairy vetch and a winter grain is often used before corn and cereal rye is predominantly used before soybean. For this strategy to work, timely termination of the cover crop is critical to prevent it from producing viable seed and possibly becoming a volunteer later in the rotation. In this article, we present strategies to optimize hairy vetch and cereal rye rolling and review problems that can result from incomplete cover crop termination.

Optimal timing for roll-crimping hairy vetch before corn

Hairy vetch is usually sown alone or with a grass such as triticale or cereal rye, and it is rolled before planting corn. Triticale can be a better companion crop for a rolled hairy vetch than cereal rye because triticale matures at the same time as hairy vetch. Cereal rye will mature earlier than hairy vetch making optimum rolling timing more complicated. Hairy vetch is a legume capable of producing 3 tons of dry matter biomass and providing 180 lb/ac of nitrogen to the following cash crop. We recommend roll-crimping when hairy vetch is at full bloom to early pod set (stages 6 - 7, Figure 2). Hairy vetch biomass does not increase much after full bloom (stages 5-6, Figure 2), and as it starts to fill pods, so there may be a slight decrease in biomass as lower leaves start to senesce. However, hairy vetch biomass is still sufficient to form the mulch needed to suppress weeds in the early stages of corn development and before the hairy vetch biomass decomposes.

Research was conducted for three years at Penn State to determine the best timing for effective hairy vetch termination with the roller crimper. Results indicate that waiting until full bloom is critical to control hairy vetch and limit seed production and minimize volunteer problems in other phases of the rotation. Hairy vetch biomass does not increase much after 80% bloom (Figure 3, bars) but the percent of hairy vetch that is controlled by the roller crimper increases from 80 to 98% as rolling is delayed from 40% bloom to full bloom (dotted line).
If termination of hairy vetch seems incomplete after one pass, a second pass can improve the effectiveness of the roller crimper. Hairy vetch can be rolled just before corn planting and again approximately 7 days after planting. The weight of the tractor and planter can greatly help to effectively kill hairy vetch.

### Impacts and consequences of volunteer hairy vetch later in the rotation

Termination of hairy vetch with the roller crimper before growth stage 6 – 7 (Figure 2) is likely to be incomplete. Rolling at early growth stages allows hairy vetch to continue its growth, resulting in seed production that can affect other phases of the rotation. Research on impacts of volunteer cover crops has focused on a three-year rotation of corn, soybean and a winter grain, with hairy vetch before corn and cereal rye before soybean. In this rotation, incomplete termination of hairy vetch by the roller-crimper resulted in hairy vetch germination in the cereal rye cover crop in the following year (Figure 4). Volunteer hairy vetch in the cereal rye was not controlled by rolling because cereal rye was still vegetative when it was rolled, and it continued to grow in the soybean and eventually produced seeds that germinated in the following winter grain (Figure 5).

Winter grain contamination with hairy vetch seeds may be an issue when selling the crop as food-grade. The USDA-Grain Inspection Service allows only 5% of "foreign material" in food-grade wheat, so limiting volunteer cover crop seed production in the rotation should be a priority. Contamination with cover crop seed can cause similar problems if winter grain is produced for seed. Finally, if volunteer cover crop biomass is large enough, it may compete with the winter grain crop and reduce yields.
Optimal rolling times for cereal rye before soybean

When growing cereal rye to roll and use as a mulch in soybean, later termination results in greater biomass (Figure 6, bars). Also, late termination can improve control of cereal rye (Figure 6, dotted line). However, control of the standing cereal rye does not eliminate the potential for regrowth or seed production. If cereal rye is rolled too early (before 50% anthesis, stage 65 or 10 in the Zadoks' and Feekes' scales, respectively, Figure 7), it can produce new tillers that flower and produce seeds. If it is rolled too late (after the medium milk stage, Zadoks' stage 75 or Feekes' stage 11, Figure 7), kernels will continue to develop on dying plants and mature on the soil surface. Therefore, termination of cereal rye with a roller-crimper should target the period between 50% anthesis and early milk stages (stages 65-73, or 10.1-10.3, Figure 7).

Figure 6. Cereal rye biomass (bars, left axis) and percent cover crop control after rolling depending on termination dates. Percent control was measured as the percentage of the plots without new tillers or erect stems. Even if percent control is higher, late rolled cereal rye can still produce viable seeds that can germinate later in the rotation. Adapted from Keene et al. (2017)
To improve the control of the cover crop, we recommend rolling cereal rye twice, once approximately one week before soybean planting and again on the day of soybean planting. Unlike in corn, rolling should not occur after soybean planting to avoid injuring the soybean. The weight of the tractor and planter can complement the rolling by further crimping the cereal rye.

**Impacts and consequences of volunteer cereal rye later in the rotation**

If cereal rye is allowed to produce seed (late termination, Figure 6), volunteer plants are likely to occur in other phases of the rotation and are especially harmful if other winter grains such as wheat are grown (Figures 8, 9).

Research on volunteer cover crops was done in a three-year rotation of corn, soybean and winter grain, with hairy vetch before corn and cereal rye before soybean. Late termination of cereal rye (after the early milk stage) resulted in cereal rye growing in soybean and later in wheat (Figure 10, bars), which resulted in a 9-10% contamination of wheat grain at harvest (Figure 10, dotted line). The USDA-Grain Inspection Service allows only 5% of "foreign material" in food-grade grain. Foreign material includes other grains for which there are no standards, including cereal rye. In addition to affecting grain marketability, volunteer cereal rye can also decrease wheat yields, especially if there is a large infestation of cereal rye in the wheat.
Cover crops that are managed to produce heavy biomass can provide an adequate barrier to germinating weeds in a succeeding cash crop when rolled and crimped prior to planting the cash crop. In contrast to production systems where the cover crop is terminated and incorporated into the soil with tillage, cover crops destined for rolling and crimping must be managed more carefully and intensively. Management considerations that ensure heavy biomass include use of high quality cover crop seed, adequate seeding rates, timely establishment, and sufficient fertility to support the growth required prior to spring termination. Producers who are new to these practices are encouraged to begin on limited acreages and gain experience prior to expanding the practice.

**Literature Cited**


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