

Sweet Corn: No-Till Planting after a Winter Rye Cover Crop

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No-till planting of sweet corn into a killed winter rye cover crop has the potential to provide soil health benefits such as reduced compaction, improved soil water holding capacity, reduced evaporation from soil surface, reduced erosion, and improved weed control, among others. However, challenges with this system also exist, specifically at planting. Over the past three years, trials have been conducted at the Pinney Purdue Ag Center in northwest Indiana to develop a workable system that provides yield and ear quality comparable to conventional tillage. The system is not yet perfected but experiences and results may be useful for growers interested in adopting a similar system.

The research site is on a sandy loam soil with 1.5% organic matter. A three-year rotation of field corn, soybeans, vegetables is followed. For these trials, cereal rye was planted in late September or early October after soybeans. In plots to be managed with conventional tillage (BARE) rye was killed by tillage in early April and plots were subsequently tilled as needed to complete termination of the rye and prepare a seedbed. In other plots rye was terminated with glyphosate in early or mid-May (HERB). In a final set of plots rye was terminated using a roller-crimper either just before (RPRE) or just after seeding (RPOST or ROLL). Where rye was terminated with herbicide or by roller-crimping no tillage was performed before seeding. Sweet corn was seeded with a 4-row John Deere Maxemerge 7000 planter June 9-11. In 2022 only, the trial also included plantings on June 22 and in early July to collect data on emergence and early growth, but these plantings were not harvested. The intended seeding rate was 20,600 / A with rows 30 inches apart. Soil tests did not indicate a need for major nutrients other than nitrogen. Urea was broadcast over the rye in April at a rate of 25 or 50 lb./A of N. Nitrogen was sidedressed at 60 or 90 lb./A. In 2022 only, starter fertilizer 17-15-0-5S was applied at planting at 10 gal./A.

Stand establishment has been the first challenge to overcome in the no-till system. Problems have included the planter unit not maintaining consistent down pressure and getting deep enough into the soil, and the furrow not completely closing over the seed, resulting in poor

seed-to-soil contact. In addition, cereal rye and previous crop residue can interfere with the seed furrow and planting equipment, contributing to poor and non-uniform emergence. These issues were addressed by adding weight to the planter units in the form of sandbags for the no-till treatments beginning in 2021, and, in 2022, evaluating different closing wheels. Furthermore, environmental factors that could be contributing to stand establishment problems include soil moisture and soil temperature. When rye is not terminated until planting, the transpiration of the growing rye removes a lot of moisture from the soil, leaving the soil much drier than in plots where rye is terminated earlier with herbicide or by tillage. If irrigation is available, this can be addressed with timely irrigation. A lower soil temperature is unavoidable when rye residue shades the soil surface. This can delay emergence, thus exposing the corn seedling longer to adverse conditions, pests, and stresses and delaying development.

In order to assess the role of planter equipment for improving sweet corn emergence and stand establishment in no-till and cover crop systems, three closing wheels were compared in the 2022 trials: the standard rubber wheels (STD), the Cruiser Extreme (CE; cast-iron and spiked closing wheel), and the Furrow Cruiser (FC; plastic and spiked closing wheel) (Copperhead Ag, Humboldt, SD). Planter closing wheels are used to cover the seed furrow with soil once the seed has been placed within the soil with the planter. Conventional and factory planter equipment and closing wheels (standard rubber) are often not designed to accommodate high residue systems such as no-till and cover crop use, which can contribute to poor furrow closure, uneven planting depth, and residue interference. Therefore, after-market closing wheels have been developed to improve corn emergence timing and uniformity in heavy residue systems and need to be evaluated in sweet corn systems.

For the discussed research trial, differences in maximum emergence and the uniformity of emergence were observed among the closing wheels. Those effects were similar across the different tillage treatments. Planter settings for seed depth, down pressure on the closing wheel, and weight on the planter unit were set differently for each closing wheel, based on manufacturer specifications, so it isn't clear that the closing wheel was responsible for the observed differences. Across all tillage treatments, emergence was highest with the CE closing wheel (77%) and didn't differ between the STD and FC closing wheels (70% to 71%). Emergence was more uniform over time with the CE and FC than with the STD closing wheel. Uniformity relates to the length of time over which emergence occurs: with more uniform emergence, more seeds emerge over a short period of time, which leads to more uniform crop development. These results suggest that closing wheels can influence success of the system, but based on just this project it is premature to conclude which is best. Therefore, additional research which includes additional locations, environments, and data collection is required.

Yield differences among treatments have been observed all three years. In 2020 and 2021 marketable yield in dozens per acre was higher in conventionally-tilled plots (1303) than no-till plots (964). In the no-till plots, when rye was terminated with herbicide weeks before seeding yield tended to be higher than when rye was killed by roller-crimping at the time of seeding (1028 vs 932), but differences were not consistently significant. In 2022 yield in conventionally-tilled plots (992) and herbicide-killed rye plots (1174) did not differ significantly and yield in

plots where rye was killed by roller-crimping was much lower (234). Plants in the roller-crimped plots showed severe injury; the cause was not definitively determined, and was not observed in previous years or in later plantings of that treatment in 2022.

The different closing wheels did not affect yield in dozens per acre when averaged over all tillage treatments. In the conventional tillage treatment, however, yield with the Cruiser Extreme (920) was significantly lower than with the Furrow Cruiser (1065); with the standard wheel yield was intermediate between these. In the no-till treatments with herbicide killed rye or roller-crimped rye, closing wheel did not significantly affect yield.

Switching from a conventionally tilled system to no-tilling into terminated cover crop necessarily involves numerous changes; it would be surprising if the system worked well right away. However, with careful consideration, attention to detail, and management changes, it can be possible. Several take-home points come out of this work. No-till planting sweet corn after terminating rye with herbicide seems easier to switch to (from conventional tillage) than no-till planting with rye terminated by roller-crimping at planting. The trials suggest that achieving uniform emergence and adequate plant stand can be a problem, especially with the rolled rye. Those interested in making the change should make it a priority to address this. Take time to test, modify, and/or adjust the planter for the conditions in the field. Pay attention to soil moisture—it is likely different than in tilled bare ground and target planting into optimal conditions, rather than chasing the calendar date. If irrigation is available be prepared to use it at planting time if needed. Emergence could be delayed, so be prepared for a longer time to harvest. While focusing on stand establishment, still keep a close eye on the crop and scout regularly for other issues. It is often easier said than done, but take time to step out of the tractor at planting and check seed depth, soil conditions, seed-to-soil contact, and furrow closure, and make adjustments if needed. In addition, different insects, weeds, or disease may show up, or show up at an unexpected time. As the system is perfected it is likely that nutrient applications will change. For example, starter fertilizer applications through the planter can help improve plant access to nutrients when soil temperatures may be low and nutrient immobilization is observed due to the high levels of carbon in cover crop and previous crop residues. Overall, while working through the challenges, keep in mind the motivation for the change: that is what makes the extra effort worthwhile.