

## A Strategy to Improve Soil Health in a Southern Minnesota Corn-Soybean System

Farmers adapting management to improve soil health find that **by integrating several cropping practices into a system, where each practice complements the other with benefits exceeding the sum of the parts.** Managing for Soil Health is recognized as a regenerative approach for farmers to achieve greater resilience to the effects of extreme weather conditions and attain higher yield capacity on any soil.

The following is an approach for a **Corn-Soybean (C-SB) farmer interested in a no-till cropping system that is low in risk, and will jump start nearly any soil type toward higher production capacity and function:**

**Step 1: Harvest corn as early as practical. Scout and treat problem perennial weeds like dandelion and thistle if present.** No-Till (NT) a Cereal Rye Cover Crop (CC) into corn stalks right after harvest - It's easy to establish and easy to kill. Cereal Rye is one of the most versatile cover crops because it is very cold tolerant, one of the most tolerant species to residual corn herbicides, and can be seeded aerial, incorporated with a vertical tillage tool or drilled with a high rate of success. It can be mixed with other species such as daikon radish or rapeseed depending on the seeding date, resource concerns, and fall conditions. This is your first No-till operation.

**Step 2: NT soybeans into living cereal rye at the normal planting dates.** The rye will likely be 10-14" tall. The rye should be sprayed three days before or after the planting date. Terminating the rye at this stage is much easier than at the jointing stage. The Carbon to Nitrogen ratio (C:N) ratio is much lower at this time and the rye will decompose relatively quickly. Remember to check the RMA zones when terminating.

**Optional:** NT a relatively early group soybean into the living cereal rye and try to plant these beans late May to the first week of June. Early group soybeans are more determinant which gives you a wider window to seed a cover crop mix next fall and still allows you to benefit from the extra rye growth. Terminate the rye within three days before or after planting. If the rye is terminated before, it should not be rolled and spraying too early will make the rye ropery and increase hairpinning. This option provides greater benefits but does require a higher level of management.



Cereal rye and Austrian winter pea drilled



Cereal rye in the spring



Soybeans planted into 14" tall cereal rye

This becomes your second No-till operation. Adjusting termination dates can help with managing both wet and dry soil conditions. Soybeans respond well to the cereal rye environment, even when planted into tall cereal rye. Soybeans are not adversely affected by immobilized Nitrogen (N) which can be associated with a high C:N ratio cereal grain like rye. Soybeans respond favorably to a high C:N ratio which has great benefits for weed control, reducing disease, keeping soils cooler in summer, and late season water conservation. During most Midwest summers an extra ½" to 1" of water in August can have a major benefit to soybean yield.



Soybean no-tilled after cereal rye

**Step 3: Plant a low C:N ratio CC mix after SB.** Cover crops prior to corn should trap or produce N in the fall and early spring, but release N at the optimum time in the spring/summer. Planting corn into a mix that may include: Oat, Barley, Daikon Radish, Austrian Winter Pea, Turnip, Rapeseed will capture or produce organic N and release the N at time of greatest need. This becomes your third No-Till operation.



Soil structure after cereal rye

If winter cereal grain cover crops are the only available option due to other resource concerns (such as erosion control), plan to terminate them before the jointing stage and consider adding species with lower C:N like brassicas. Winter cereal grain cover crops ahead of corn may have high N immobilization if allowed to mature, previously incorrectly identified as allelopathy. This can limit plant available nitrogen for the corn crop. Remember that C:N ratio is closely related to CC maturity. Also consider timing a portion (20-50 #/ac) of N application at planting or in starter fertilizer.



Corn Planted Into a Low C:N ratio Cover

**Step 4: NT corn into the low C:N mix the following spring.** This makes the NT corn the 4<sup>th</sup> NT operation that has jump started the soil with many of the soil health qualities from a more mature system. By planting a cover crop mix with a low C:N ratio, N is released more timely and the corn crop also benefits from the timed release of the organic N.

By now, soil biological populations and processes are well on their way which reduce the chances of failure typically seen in transitions to no-till. Soil aggregates are stabilizing and pores are opening. Water infiltration and holding capacity are on the rise. Nutrients are cycling and accessible from alternate pathways.

**Result... great production potential! Soil health-** "The capacity of a soil to function as a vital, living ecosystem that sustains plants, animals, and humans"

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