

Managing Double Cropped Winter Annual Small Grains and Corn Silage

There are multiple benefits and some challenges associated with double cropping winter annual small grain silages before or after corn silage in Pennsylvania and regions with similar growing seasons.



Double cropping refers to the practice of producing two crops in succession typically within a season. Winter annual small grains that are often grown for silage include cereal rye, triticale, and wheat. Compared to fallow following corn silage harvest, established winter annuals can prevent soil erosion, scavenge residual nutrients, suppress weeds, and enhance soil structure and biological activity.

In addition, managing small grain winter annuals as a crop, and not just for cover, can increase fall manure nutrient utilization, total harvested forage and reduce on-farm feed production costs. For instance, at the Penn State Agronomy research farm in central Pennsylvania, we applied liquid dairy slurry at 5000 gal/A in fall to cereal rye. Rye grown just 7 to 11 days longer than rye terminated as a cover crop produced 2 to 4-fold more forage (Figure 1) and contained 90% to 3.3-fold more fall-applied manure-Nitrogen than the aboveground rye cover crop.

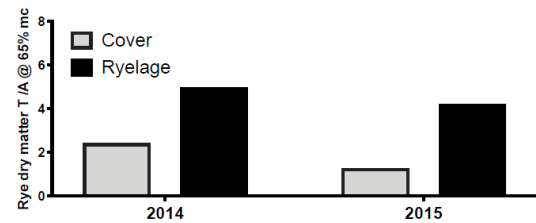


Figure 1. Biomass of Rye grown for cover or harvested 10 days later for Silage (T/A @ 65% MC) Liquid dairy manure was surface broadcast the prior September

When a greater dairy liquid slurry rate of 8000 gal/A was applied, delaying rye harvest one week in two different years increased rye dry matter from 2 to 3.3 fold, and fall-applied manure N by 31% and fall-applied manure phosphorus by 47% in the aboveground rye. By double-cropping ryelage with corn silage, total forage was increased by an average of 28% over two years (Figure 2).

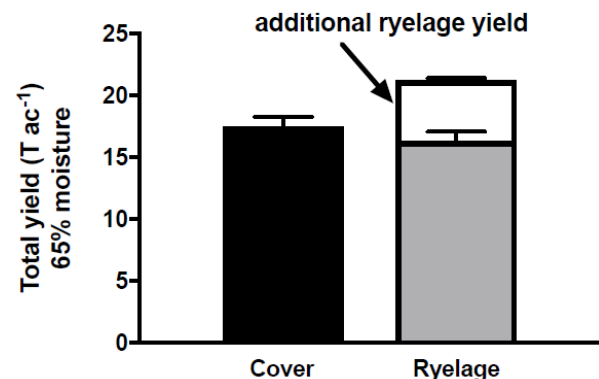


Figure 2. Total Forage from Corn Silage following a Rye Cover Crop and Corn Silage double-cropped with Rye Silage (Ryelage)

Establishing winter annuals

Prioritize small grain planting to increase winter silage yield

Following corn silage harvest, planting the winter cereal as soon as possible has been shown to increase the winter annual silage yield by 21% to 65% depending on the planting date and location, because conditions for crop growth such as daylength and temperature decline in autumn. To optimize winter annual silage yield, have the winter annual crop seed and planting equipment ready to plant immediately after corn



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silage harvest.

Identifying which winter cereal species performs best given a farms' soils, climate and management can make it easier to produce high quality forage. To determine which species work well consider planting and comparing the performance of different small grain species and/or a mixture of a winter cereal and a legume such as crimson clover.

Optimizing fall applied manure-N

The method and timing of fall manure applications can increase crop nutrient availability, reduce fertilizer inputs, and reduce the risk of environmental losses and nutrient pollution.

Delaying manure application until late autumn can increase winter annual crop manure-N utilization

When weather and other field operations interfere with fall field operations, prioritize winter annual planting and delay manure applications until later in autumn when the established winter annual can utilize the nutrients and the cooler air temperatures typically reduce manure $\text{NH}_4\text{-N}$ volatilization losses. When we delayed liquid dairy slurry manure application from prior to rye planting in September until after rye was established in November, the following spring rye contained 44 - 86% more N- manure. Similarly, prioritizing cereal rye planting after corn silage harvest, and delaying liquid slurry dairy manure application until early November increased rye silage yield by 61% and manure-N content by 70% compared to surface applying liquid slurry dairy manure after corn silage harvest and delaying cereal rye planting 3-4 weeks later until mid- October.

Shallow disk manure injection in fall can increase winter annual manure-N content and silage crude protein. If manure is applied prior to winter annual silage planting, manure injection can increase winter annual silage yield.



In two research studies in central PA, we compared fall manure injection to surface broadcast manure application with cereal rye silage prior to corn silage. We compared shallow-disc injected or surface broadcasted liquid dairy slurry manure each at a rate of 5000 gal/A in both: early- fall (September) prior to winter rye planting or 6-8 weeks after rye was planted in late-fall (November). Following an early-fall injected manure application, ryelage yields were 42% greater and manure-N was 57% greater than ryelage that received broadcasted manure (Figure 3). Due to poor rye germination

in the second year, rye was replanted two weeks prior to the late-fall manure injection (November), resulting in 11% loss of rye plants in the following spring and 22% yield reduction. Despite damage and reduced yield, ryelage following late-fall manure applications contained more manure-N whether broadcasted or injected; and the combination of late manure application and injection resulted in the highest ryelage manure-N content: from 60-91% over two years.

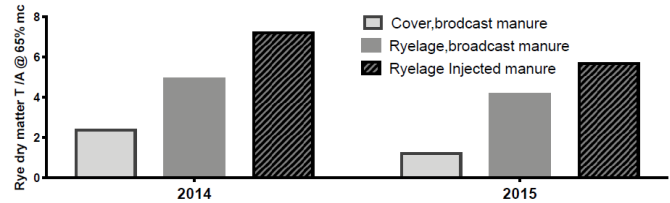


Figure 3. Rye Biomass of Rye Cover crop and Rye Silage (T/A @ 65% mc) with Fall Broadcast manure or Injected manure applied in September

In a second two-year study, we compared the effect of 8,000 gal/A liquid dairy slurry manure injection when either rye planting or manure application was prioritized after corn harvest. When manure application was prioritized after corn harvest in late September and rye was planted three weeks later, fall injected manure increased:

1. rye dry matter over surface broadcast manure by 28%
2. ryelage manure N content by 130%
3. ryelage crude protein was 22% greater.

By contrast, when rye planting was prioritized after corn harvest and the manure application was delayed until early November, injecting manure did not increase rye dry matter compared to surface broadcast manure, but ryelage harvested in spring contained 90% greater manure N, ryelage crude protein was 29% greater, and NDF was 9% smaller and NEL was 10% greater.

Fall manure injection compared to surface broadcast can also increase corn silage yield following rye silage

To assess the impact of fall manure management on corn silage after rye silage harvest, we did not apply additional manure or side-dress N to the subsequent corn silage. Following 5000 gal/A of fall manure and ryelage harvest, manure injection resulted in 30% to 35% more corn silage after late-fall injected (November) than late-broadcasted manure in two years, and in one of two years after early (September) fall manure injection. Corn silage yields were likely greater in part because when manure was late-injected versus late-surface broadcasted, the soil in spring after ryelage harvest and prior to corn planting had a greater percentage of the fall applied manure-N at various depths (1.5 to 5.5-fold greater); and (1.8 to 3.4-fold greater) when late-injected compared to early-injected manure.

Similarly, when rye was planted first and manure was applied in November at 8,000 gal/A, manure injection increased the subsequent corn silage yield by 20% compared to surface broadcasting. If manure was applied after corn harvest and rye

was planted 3 weeks later, despite lower winter silage yields, fall manure injection compared to surface broadcasting also resulted in 10% greater subsequent corn silage yield.

Applying Nitrogen in spring to the winter annual silage may be economical and fall manure injection can reduce N top-dressing rate

Since nutrient management is key for optimal forage production, one should account for nitrogen and potassium removal by both crops and use soil tests to determine if additional potassium is needed. In early spring, top-dressing winter annuals with manure or N fertilizer can boost winter annual silage yield and quality. We also found that reducing N losses with early fall manure injection reduced the need for N top-dress in spring. Over three years we compared no-till rye silage with early fall-applied dairy slurry manure that was surface broadcasted and not incorporated, or injected, both at 4,500 gal/A. To increase rye silage yield and protein, we top-dressed 80 lb. N/A in spring on the surface broadcast manure treatment, and 50 lb. N/A on the manure injection treatment. With 30 lb. N/A less top-dress N, the injected manure treatment produced similar yields to the broadcasted manure. Rye silage yields averaged 8.9 T/A and ranged from 7.2 and 10.8 T/A at 65% moisture content; crude protein ranged from 16.4-19.8% and NDF from 59 % to 62% on a dry matter basis.

Harvesting

To manage for forage quality, plan to harvest winter annual forages at the flag leaf stage. Watch weather forecasts and have equipment and personnel ready to take advantage of dry weather days in spring. Planting more than one winter annual crop species can diversify the optimal days to harvest each species and provide some spring harvest timing flexibility. Consider tedding the forage to dry it quickly for ensiling at the target moisture content for storage conditions (bunker silo, AgBag etc.). Timely spring harvest can be difficult in years with frequent rainfall. Delaying silage harvest can increase yield and produce lower quality forage that matches dry cows, heifers or beef cattle nutritional needs.

Following the winter annual small grain

If planting no-till, be prepared to: i. plant into crop residue with row cleaners, ii. increase the subsequent crop seeding rate, and iii. scout for possible early-season pests such as armyworm and slugs. Plant the subsequent crop soon after harvest, but with caution during rainy weather conditions, as trips across the field to apply nutrients, mow, ted and harvest can compact soil.

In the subsequent crop, assess if and how much side-dress N is needed with nutrient management planning and by monitoring plant or soil N availability. Species selection, nutrient amendments and attention to crop maturity need to be adapted for each farm and weather conditions to produce quality forage and positive economic returns.

Double cropping a winter annual small grain before or after corn silage does have advantages. But to be successful,

management requires fine tuning to meet the needs and limitations of a given operation.

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