KEYS TO ALFALFA ESTABLISHMENT IN HIGH-YIELDING SILAGE CORN

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Alfalfa has often been replaced in rotations by corn silage, in part because corn produces greater forage dry matter yield than alfalfa. First year yields of spring-seeded alfalfa are particularly low, often being one-half that of subsequent full production years. Planting small grain, grass, or legume companion crops with alfalfa can modestly improve forage yields in the establishment year, but seeding companion crops with alfalfa often reduces forage quality. Thus, new approaches are needed to increase the yield of alfalfa, especially during its first year of production.

One way to bypass the low yielding establishment year would be to interseed alfalfa into corn to jumpstart full production of alfalfa the following year. When successfully established, first year dry matter yields of interseeded alfalfa are 1.6- to 2.25-fold greater than conventionally spring-seeded alfalfa. During and after establishment, interseeded alfalfa also serves as a cover crop to reduce soil and nutrient loss from cropland. Unfortunately, this system has been unworkable because traditional intercropping methods require producers to plant corn at low density (sacrificing high silage yields) to allow reliable establishment of alfalfa.

Therefore, scientists at the USDA-Agricultural Research Service, the University of Wisconsin and other institutions are working to develop reliable methods for establishing alfalfa in high yielding silage corn. During the course of this work in Wisconsin, it has become apparent that successful establishment of alfalfa in corn can be greatly improved by applying growth altering and protective agrichemicals on alfalfa seedlings. Good alfalfa establishment and high yields of corn silage can also be ensured by proper field selection and preparation and by using good weed control, adequate nitrogen fertilization, adapted alfalfa varieties, suitable seeding rates, and appropriate planting and harvest dates. In ongoing work, we will identify corn hybrids that are best suited for interseeding and will further refine management practices to ensure interseeded alfalfa production systems will be reliable, high yielding, and profitable for farmers.

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ALFALFA COMPACTION FROM WHEEL TRAFFIC: HOW DOES MACHINERY TRAFFIC EFFECT YIELD AND SOIL COMPACTION

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Alfalfa harvest requires multiple machinery passes over the field to complete. Harvesting alfalfa for hay production requires mowing, raking, and baling; while silage harvest requires mowing, merging, and chopping passes. Each harvest practice impacts the plants on re-growth as well as the soil due to ground pressure applied by the tires of harvest machines. A research project at the Univ. of Wisconsin-Madison is aiming to simulate these traffic patterns to assess the impact of wheel traffic on alfalfa yield and quality while monitoring impacts on the compaction incurred by the soil. This project is also assessing the machinery used during alfalfa silage harvest at a commercial dairy to quantify the area of the field impacted by wheel traffic and using remote sensing technology to help model and predict alfalfa yield impacts due to wheel traffic.

To assess the impact of wheel traffic, plots were established at the Univ. of Wisconsin Arlington Agricultural Research Station. These plots were blocked into four different tillage treatments: 1) fall and spring tilled, 2) spring tilled, 3) no-till, and 4) established alfalfa (2nd year of production). Replicated treatments were randomized within each of these blocks to test different harvest methodologies and the wheel traffic each of these apply. These treatments are listed below.

1. Single Pass Silage: One application of compaction immediately after harvest covering the entire plot.
2. Three Pass Silage: Three applications of compaction. One immediately after harvest, one 24 hours after harvest and one 26 hours after harvest. Full plot application.
3. Five Pass Silage: Five applications of compaction. One immediately after harvest, two passes 24 hours after harvest, and two passes 26 hours after harvest. Full plot application.
4. Simulated Silage: Two wheel tracks applied within the plot. One pass immediately after harvest, one pass 24 hours after harvest, and two passes 26 hour after harvest.
5. Three Pass Hay: Three applications of compaction. One immediately after harvest, one 48 hours after harvest and one 72 hours after harvest. Full plot application.
6. Five Pass Hay: Five applications of compaction. One immediately after harvest, two passes 48 hours after harvest, and two passes 72 hours after harvest. Full plot application.
7. Zero Compaction (control): No machine traffic applied.

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The newly seeded alfalfa plots were harvested three times in 2019 and the standing alfalfa plots were harvested four times over the growing season. A small walk-behind plot harvester was used to harvest the plots and any compaction applied by this machine was considered negligible. Four ~400g samples were taken from each plot and dried to determine moisture content of the harvested material and yield results were corrected to dry matter weights based on these values. Statistical analysis shows that the compaction treatments (P-value < 0.0001), tillage treatments (P-value = 0.0005), harvest date (P-value < 0.0001) were all significant. Interactions between harvest date and compaction treatment (P-value = 0.0262), harvest date and tillage treatment (P-value < 0.0001), and harvest date, tillage treatment, and compaction treatment (P-value = 0.0002) were all significant as well. Table 1 shows the effect of compaction treatments on alfalfa yield over all harvest dates and tillage treatments. The no-compaction control was the only statistically different treatment (Table 1).

Table 1: Dry matter yield results (ton/ac) for seven different compaction treatments applied to the alfalfa plots in 2019.

Treatment	Dry matter yield (ton/ac)	Standard error (ton/ac)
Zero Compaction (control)	1.89[a]	0.09
Three Pass Silage	1.44[b]	0.09
Three Pass Hay	1.41[b]	0.09
Five Pass Silage	1.38[b]	0.09
Five Pass Hay	1.34[b]	0.09
Single Pass Silage	1.33[b]	0.09
Simulated Silage	1.33[b]	0.09

*Letter differences indicate statistical differences at alpha = 0.05.

The tillage treatment results showed that the standing alfalfa (1.87 ton/ac) and the no-till alfalfa (1.71 ton/ac) had higher yields over the growing season than the tilled new seeding. The spring tillage treatment yielded 1.26 ton/ac and the fall and spring tilled treatment yielded 0.94 ton/ac over all harvests. Interaction between harvest date and compaction treatment showed, not unexpectedly, that first harvest yielded higher than second, third, and fourth harvest. Within each of these harvests the no compaction treatment yielded numerically higher than the other compaction treatments, but the difference was not always statistically significant.

In summary, wheel traffic influences alfalfa dry matter yield. One single pass over the plant at harvest can show a dry matter yield reduction between 0.45 and 0.56 ton/ac. This work is continuing to look at alfalfa quality and quantify the area of the field impacted by wheel traffic in an alfalfa silage harvest system.