

# WHEEL TRAFFIC IN ALFALFA: HOW MUCH OF THE FIELD IS IMPACTED BY MACHINES AND WHAT DOES THAT MEAN FOR YIELD?

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Alfalfa is unique from other crops as it requires a variety of machines to harvest. Whether it is being harvested for silage or hay, alfalfa harvest can require up to five different pieces of equipment per cutting. With this many machines travelling through a field during a single harvest, a significant portion of production field can be affected by machine traffic. Specific machines involved in alfalfa harvest include a mower, merger or rake, tedder, forage harvester or baler and multiple different types of transport vehicles. In the United States, over 6.7 million hectares of alfalfa were harvested in 2019, worth over \$9 billion (USDA/NASS, 2019) with some of this area seeing multiple passes of machinery traffic. This substantial amount of production in the US shows the impact machine traffic could have.

In 2019 and 2020 all machines involved in alfalfa harvest were monitored using GNSS receivers to determine their paths through the field (Figure 1). The area impacted by the tires was subtracted from the total field area (Figure 2). Results showed that on average, 49% of the field area had tires pass over it (Table 1).

Research plots were assessed at the Arlington Agricultural Research Station with 7 different treatments (Table 2). Figure 3 shows yield results for 2019 and 2020. Wheel traffic applied to the alfalfa plots showed statistically different results for the no-till (P-value = 0.17 and 0.007 respectively) and medium tillage (P-value = 0.01 and 0.11 respectively). Heavy tillage showed no statistically different results due to external factors in the field. Average yield reduction was shown to be 0.68 ton/ac.

Reducing wheel traffic in alfalfa production systems has the potential to increase yield and reduce plant damage and compaction. Future research will investigate ways to reduce wheel traffic and identify methods of reducing the impact of machinery traffic on alfalfa.

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Figure 1. Machine paths during alfalfa haylage harvest including mowing, merging, and harvest operations



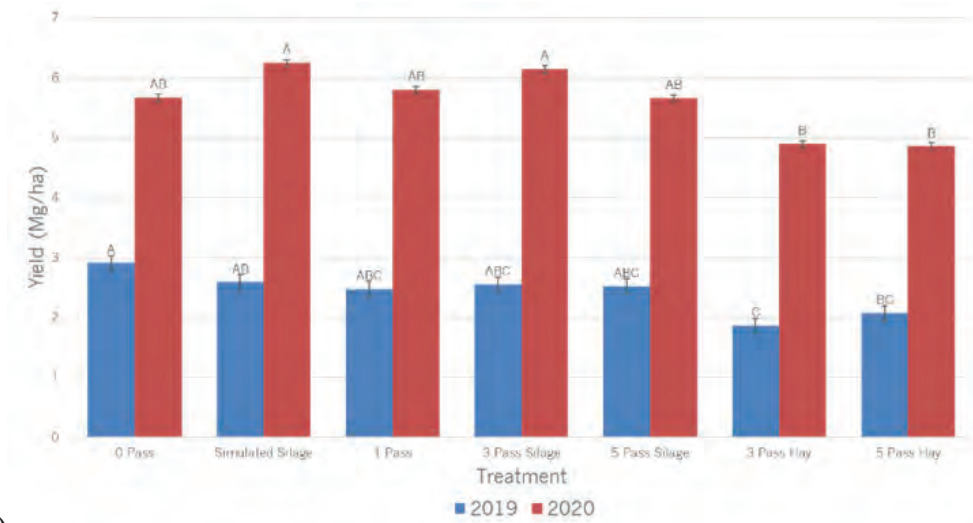
Figure 2. Area of field covered (green) by wheel traffic based on machinery footprints.

Table 1. Percentage of field coverage by wheel traffic during alfalfa haylage harvest in 2019 and 2020.

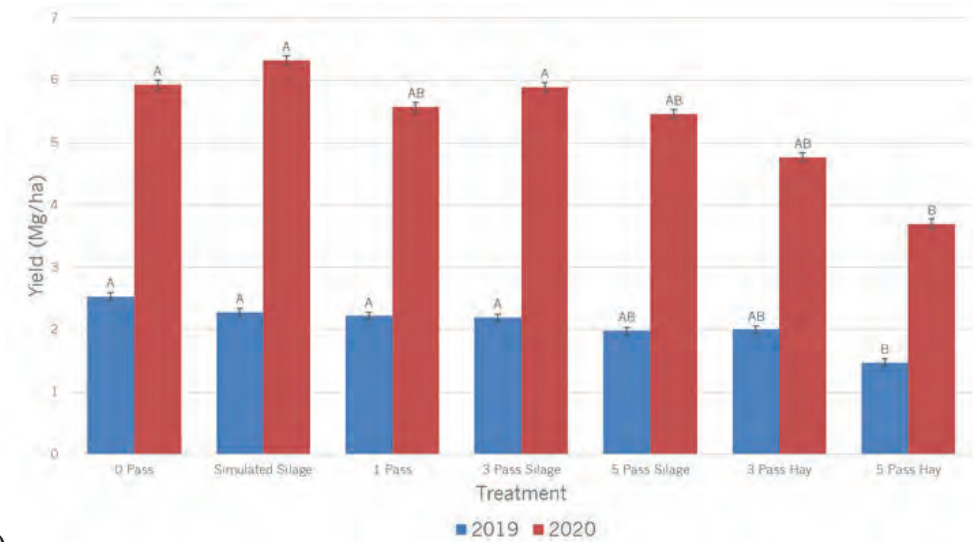
Year	Cutting	Field Size (ha)	Area Covered (ha)	Percent covered
2019	1st	30.90	16.85	55%
2019	2nd	30.90	18.79	61%
2019	3rd	30.90	14.63	47%
2020	1st	30.90	17.59	57%
2020	3rd	30.90	13.35	43%
2020	4th	30.90	10.43	34%
Average				49%
Standard Deviation				9%

Table 2. Wheel traffic treatments applied to the research plots at the Arlington Agricultural Research Station.

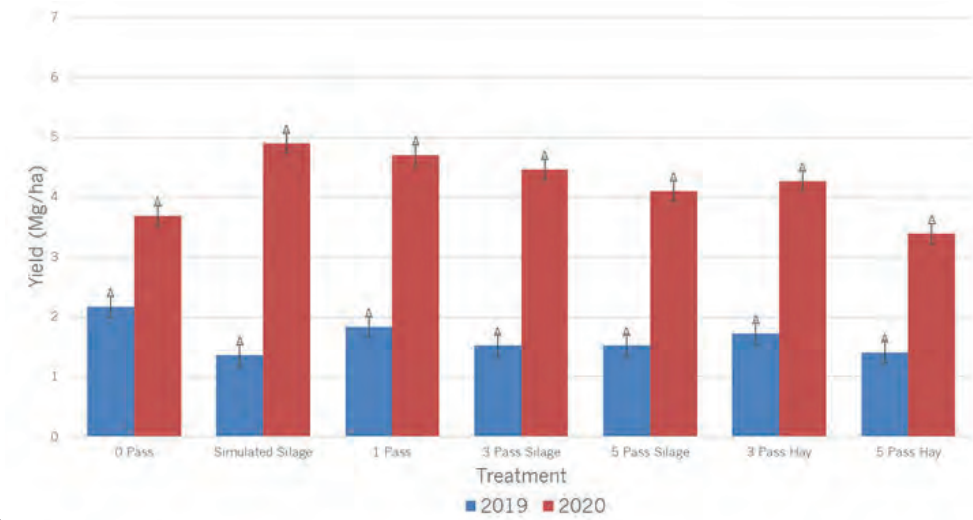
Treatment	Name	Description
1	Single Pass Silage	One application of compaction immediately after harvest covering the entire plot.
2	Three Pass Silage	Three applications of compaction. One immediately after harvest, one 24 hours after harvest and one 26 hours after harvest. Full plot application.
3	Five 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.



A)



B)



C)

Figure 3. Yield results in 2019 and 2020 due to traffic treatments within the various tillage scenarios. No-tillage (A), spring tillage only (B), and fall and spring tillage (C) were considered for this study.