Agricultural Machinery Traffic Significantly Reduces Alfalfa Production & Persistence

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Alfalfa harvesting, which occurs 4 to 5 times per growing season in the Upper Midwest, requires various mechanized operations. This results in agricultural machinery traffic (AMT) occurring at least once on ~50% of the alfalfa field during one growing season, with ~14% of it receiving 2 or more AMT passes. Machinery weight and tire type vary significantly across the various types of equipment, causing distinct damages to the alfalfa stand. Recently, a novel production system – the silage corn – alfalfa interseeded system - has been developed as a potential strategy to increase alfalfa acreage in the United States. In this system, alfalfa is established on corn inter-rows ~7 days after corn is planted, which is harvested for silage in the first growing season. Early corn biomass removal allows alfalfa to recover growth without competition during the fall, resulting in a fully established and productive alfalfa field in the following growing season. Early adopters of this novel system indicated concern with traffic damage to alfalfa stands during silage corn harvest, which could exacerbate traffic stress already present in subsequent alfalfa harvest operations. The objective of this study was to evaluate how AMT associated with silage corn and alfalfa harvest operations affect alfalfa forage accumulation and persistence. We evaluated 6 AMT treatments from silage corn harvest (No Traffic, Chopper, Truck, Tractor, Chopper + Truck, and Chopper + Tractor; imposed on Year 1) followed by 2 AMT treatments from alfalfa harvest (No Traffic and Truck; imposed on Year 2) in a full factorial, randomized complete block design with four replicates at Arlington, WI. Trucks were equipped with road tires, while other equipment had agricultural tires. Silage corn AMT was imposed one day after the silage was harvested with small plot equipment. Alfalfa AMT was imposed 3 days after alfalfa harvest to simulate hay production. In the spring following silage corn AMT, the Chopper + Truck had 25% less stem/m^2 than the No Traffic treatment (544 vs 734 stems/m^2, respectively; p-value=0.05), but silage corn AMT had no effect on alfalfa forage accumulation at first cut (4.0 Mg DM/ha; p-value=0.68). Interactions between silage corn AMT and alfalfa AMT were not significant, but alfalfa AMT had a negative cumulative effect on alfalfa production and persistence responses. Third and fourth alfalfa harvests were 2.5 and 1.6 Mg DM/ha under Traffic compared with 3.3 and 1.9 Mg DM/ha under No Traffic, resulting in AMT-related reduction of 9% in alfalfa season forage accumulation (11.0 compared with 12.1 Mg DM/ha under No Traffic; p-value=0.002). Forage accumulation reductions were strongly associated with increase in soil compaction measures, with values above the threshold for root development and growth impediment at third and fourth harvests. End-of-season alfalfa root biomass to 15 cm depth was also reduced by ~10% under Traffic compared with No Traffic (3.0 vs 3.3 Mg DM/ha, respectively; p-value=0.049). We conclude that alfalfa forage accumulation might not be negatively affected by one-time AMT imposed with agricultural tires during silage corn harvest in interseeded systems. However, AMT during alfalfa harvest has a cumulative and negative effect on alfalfa production and persistence responses, particularly when imposed with trucks equipped with road tires. More studies are needed to quantify multi-year effects of AMT on alfalfa production and persistence, and to establish management strategies that reduce AMT in alfalfa fields.