

# What Controls Alfalfa Establishment & Silage Corn Yield When Both Crops Are Planted Together?

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Seeding and establishing alfalfa with a silage corn companion crop has the potential to double first-year yields of alfalfa, increase overall forage production, and improve the profitability and environmental sustainability of forage production by farms. However, alfalfa establishment can be challenging, and the yield of silage corn can be negatively affected in this system. The purpose of this two-year study was to use a random forest statistical approach to identify and rank the factors most strongly associated with alfalfa establishment and silage corn yield.

Corn and alfalfa were planted together in May at six experiment stations and thirteen farm locations across Wisconsin, Michigan, and Idaho. Silage corn yield in September was measured and then the number of surviving alfalfa plants was recorded. A wide range of predictors, including management practices, crop pests, soil characteristics, and water availability (rainfall and irrigation) were also recorded during the growing season.

Our results indicate that foliar damage from disease and insects, and competition from annual grass weeds and corn, were the most important factors reducing alfalfa plant density. In contrast, application of agrichemicals such as a plant growth regulator (prohexadione-calcium) and fungicide (fluxapyroxad and pyraclostrobin) plus insecticide (lambda-cyhalothrin), alone or in combination, increased alfalfa plant density, reduced disease and insect pressure. Silage corn yield was primarily enhanced by greater availability of water and inorganic nitrogen in soil, and by higher corn populations, but reduced by high plant density of interseeded alfalfa.

In addition to the key drivers above, several predictors showed moderate to low importance for both alfalfa establishment and corn yield. For alfalfa, environmental conditions, such as growing degree day (GDD) accumulation and rainfall plus irrigation, soil properties (nitrogen, soil clay, organic matter, phosphorus, and potassium), and initial alfalfa plant density in June had smaller effects compared to biotic stress and competition. Similarly, for silage corn yield, variables related to soil properties (except nitrogen), environmental conditions (except water availability), and site-level predictors (weed cover in July, alfalfa planting date, and corn harvest date) contributed less to explaining silage yield variation. While these factors may still influence system performance under specific conditions, their overall impact was limited compared to the primary drivers we identified. These results suggest that managing early-season stress and competition is critical to ensure successful alfalfa establishment without excessively reducing silage corn yield.

Overall, our study highlights the importance of crop competition and pest stress in shaping the performance of this intercropping system. Our results will help to direct additional research to identify optimal management practices for farmers that will ensure the reliable establishment of alfalfa and acceptable yields of silage corn in this intercropping system.