Keys to alfalfa establishment under densely planted 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 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 two-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 alfalfa. Therefore 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 using growth altering and protective agrichemicals, adapted alfalfa varieties, adequate alfalfa seeding rates, and proper timing of alfalfa interseeding after corn planting. Initial studies from 2008 to 2014 demonstrated that foliar applications of a growth retardant known as prohexadione (PHD) on interseeded alfalfa in June increased seedling survival by 40 to 300% under high yielding corn grown at >75,000 plants ha^{-1}. Several of these studies indicated shifting the seeding rate of alfalfa from 9 to 18 kg ha^{-1} increased alfalfa plant density by 32 to 50% following corn harvest. Preliminary work in 2016 with two alfalfa varieties grown with and without PHD indicated late-season survival of seedlings heavily shaded by corn was enhanced by early-season carbohydrate accumulation in alfalfa roots. Because of its effectiveness and low toxicity, efforts are now moving forward to register PHD for use on alfalfa interseeded into corn. Work initiated in 2017 found that fungicide and insecticide applied after PHD further doubled survival of interseeded alfalfa to give excellent stand establishment even when corn was planted at populations of up to 108,000 plants ha^{-1}. Other Wisconsin interseeding studies in 2015 and 2016 with 38 alfalfa varieties found substantial and repeatable differences in plant survival between conventional, glyphosate-resistant, and leafhopper-resistant varieties. Without PHD treatment, plant density of alfalfa varieties following corn harvest ranged from 18 to 90 plants m^{-2} in 2015 and from 0 to 10.4 plants m^{-2} in 2016. Alfalfa varieties also exhibited a 0 to 5-fold increase in fall plant density in response to PHD treatment. Lastly, studies in 2016 and 2017 suggested survival of PHD treated alfalfa under corn was up to 50% greater if interseeding was carried out at corn planting rather than at corn emergence or the two-leaf stage of corn. Ongoing studies will evaluate the use of plant breeding to develop improved alfalfa varieties for interseeding and aim to optimize agrichemical applications and other management practices to ensure successful and cost-effective establishment of well-adapted alfalfa varieties in corn. The overall goal of this work is to develop reliable and profitable corn-interseeded alfalfa production systems for use on farms in northern states where alfalfa cannot be successfully established in the fall after corn silage harvest.