Legume Living Mulches in Corn and Soybean

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Living mulches are an extension of cover crops used to decrease soil erosion, suppress weeds, improve soil structure and nutrient cycling, and in the case of legumes, supply nitrogen to a grain crop. Unlike cover crops that are killed before planting the grain crop, living mulches co-exist with the crops during the growing season and continue to grow after the crop is harvested.

The living mulch can be an annual or perennial plant interseeded with a grain crop, or it can be an existing perennial grass or legume stand into which another crop is planted. The latter system usually requires suppression of the existing "living mulch" with herbicides or cultural practices such as tillage or mowing to create what has been referred to as a "sleeping sod." Interest in living mulch systems developed as a tool to mitigate soil erosion on highly erosive land. Perennial legume living mulches can play a significant role in reducing both wind and water erosion in conservation tillage systems during late fall and early spring in addition to providing a high quality forage supply.

Legume living mulches offer advantages over small grain cover crops because they not only provide erosion control but also fix atmospheric nitrogen. Legume living mulches can increase soil organic matter that can improve overall physical condition of soil such as soil aggregation, enhanced structural stability, improved water infiltration and storage, and increased cation exchange capacity and nutrient retention. In certain areas, living mulches can be harvested as a hay crop in the spring before planting the main crop. Additionally, livestock can graze the grain crop stubble and living mulch after harvest and before the following crop is planted.

Generally, living mulch studies that report successful systems controlled the living mulch adequately, did not wait until just before main crop planting to control the living mulch, or used less competitive living mulch species to reduce competition for water and nutrients. A disadvantage of using legume species as living mulches may be the potential to host pathogens and diseases that can be transferred to the grain crop. For example, viruses can be transmitted by soybean aphids and many legumes, including soybean, host these viruses. The extent to which this limits the use of legume living mulches in soybean is unknown. Another disadvantage may be related to weed shifts. Superimposing a perennial cropping system on an annual one may favor greater perennial weed problems, which are already recognized to be the most difficult to control.

SELECTING LEGUME SPECIES

There are many legume species that could be considered for use in living mulch systems. We limited our selection to species that have readily available seed supplies, a perennial life cycle, been successfully grown as a living mulch, and have been reported in the scientific literature. For detailed information on plant adaptability, tolerances, and management information refer to ISU Extension publication *Selecting Forage Species* (PM 1792).

Alfalfa

Mature plants may have from 5 to 25 stems with a height ranging from 24 to 36 inches. Alfalfa varieties differ in their ability to spread by underground stems (rhizomes). Varieties that can form new stems from rhizomes may be superior for living mulch systems because they can spread short distances to cover the soil after the grain crop has been harvested. Alfalfa yield may be higher than other forage legumes if the living mulch is grazed or mechanically harvested in the spring prior to crop planting. On the contrary, alfalfa may compete more for water and light than other less competitive species. Additionally, alfalfa has a relatively short life span, often in the range of 3 to 5 years, so it may require reseeding.

Alfalfa and orchardgrass living mulch after soybean harvest

Kura clover

Kura clover is a long-lived rhizomatous plant, although seedling vigor is poor. Once established, kura clover is persistent and can survive extreme environmental conditions (drought, short-term flooding, cold). Spring and late summer are the best times for kura clover seeding. Kura clover has high protein and low fiber content so bloat is a serious concern when grown in pure stands for grazing. Kura, in association with a specific bacterium (Rhizobium), can fix atmospheric nitrogen into a form available for plant use. Because strains of Rhizobia that work with kura clover are not naturally found in Iowa soils, they must be applied to the seed before seeding. Three commercial varieties of kura seed are currently available.

Kura clover living mulch after soybean harvest

Birdsfoot trefoil

Birdsfoot trefoil can be classified as either Empire or European type. Empire type varieties are finer stemmed, more prostrate in growth habit, flower later, more indeterminate in growth, more winter-hardy, and slower in seedling growth and recovery growth after harvest. Stems may reach 24 to 36 inches under favorable growth conditions. Birdsfoot trefoil has a well-developed taproot with numerous lateral branches in the upper 12 to 24 inches of the soil profile, although the taproot does not grow as deeply as alfalfa. Plants generally live 2 to 4 years, but reseeding is possible in living mulch systems. At least 25 varieties have been developed that are commercially available.

White clover

White clover seedlings form a taproot that generally lives for 1 to 2 years after which plants spread by prostrate aboveground stems (stolons) that form adventitious roots at the nodes. Although variety and management affect root distribution, the majority of white clover roots are located in the upper 8 inches of the soil profile. White clover is usually divided into three types, small, intermediate, and large. The latter two types are usually seeded from improved commercial seed.

Crown vetch

Although crown vetch establishes slowly, it is a long-lived plant that spreads by underground rhizomes. It has a deep taproot with numerous lateral branches. Even with reasonable forage quality, crown vetch has been used mainly for ornamental and soil stabilization purposes. Recently, it has been classified as an invasive species. The three most popular varieties of crown vetch are penngift, emerald, and chemung.

MANAGEMENT OF LIVING MULCHES

Use of living mulches is an innovative management technology that requires diligent attention during critical crop phases. The system is applicable anywhere in Iowa where alfalfa-corn rotations are currently used. Incorporating living mulches into a corn-soybean rotation is also feasible but more challenging, especially with soybean because it is slower growing and more susceptible to competition from the living mulch. Research has shown that with adequate suppression, living mulches can be managed to minimize competition with corn with little or no reduction in yield. Close monitoring and careful control of competition between the living mulch and grain crop is the key to maintaining crop yields in this system.

Competition from the living mulch varies depending on the living mulch species and spring and early summer weather conditions. During a dry spring, living mulches may deplete stored soil water, which may influence early growth of the grain crop. In cool springs, suppression of the living mulch should be applied promptly. There is greater risk of yield loss of the grain crop with early planting dates in Iowa because established living mulches grow rapidly. Seeding rates should be increased by 10 percent because living mulches can interfere with planter operation and seed placement.

Corn should be planted at a depth of 1.5 to 2.0 inches and soybean at 1.0 to 1.5 inches. Because the grain crop will be planted using a no-tillage planter, it is important to have adequate pressure on the closing wheels to close the furrow. It is recommended to wait to plant during the last two weeks of May because soil temperature in a living mulch often is 3 to 5 ºF cooler than in a traditional no-tillage system. After planting, mechanical control (rolling, chopping, flaming) in the interrow is necessary for living mulch systems that kill a band rather than using a sublethal broadcast herbicide. The number of mechanical passes depends on timing and weather conditions, which both influence regrowth of the living mulch. The use of shorter season hybrids and varieties should be considered to allow the living mulch more time to recover in the fall.

Alfalfa living mulch in corn

Suppression of the living mulch is critical and it is recommended to either mow the field or graze it prior to planting. The best results following grazing or mowing have been achieved by sublethal herbicide applications. Herbicides applied to suppress or kill the living mulch before planting usually include nonselective herbicides such as paraquat, glyphosate, or glufosinate. Additional herbicides can be applied to provide residual control. A system that incorporates band-killing of the living mulch over the row where the grain crop will emerge and suppression of the living mulch in the interrow space have consistently provided good performance of corn. The release of herbicide resistant crops has provided additional options to minimize the risk of competition between the living mulch and the row crop and has significantly minimized the risk associated with these systems. Applying herbicides in the fall to kill a band where the row crop will be planted the following season can preserve stored soil water.

Alfalfa living mulch in soybean

Nutrient application should be applied based on soil tests. The late spring nitrogen test (LSNT) can determine how much nitrogen is available from the legume living mulch to corn. For detailed information on using the LSNT, refer to ISU Extension publication *Nitrogen Fertilizer Recommendations for Corn in Iowa* (PM 1714). For nitrogen-fixation to occur in soybean, the nitrogen-fixing bacteria known as Bradyrhizobia japonicum needs to be readily available in the soil or must be applied to the seed in order for the plant to form nodules on its roots. It is recommended to inoculate the seed if nodulated soybean has not been grown in a field in the past 3 to 5 years and if soil pH has not been maintained above 6.0.

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