Legume Inclusion

Rethink Weed Definitions for Greener Turf

By James McCurdy, Scott McElroy and Beth Guertal

Organic, whole, local, eco-friendly, pesticide-free and sustainable. Superintendents can't escape this growing list of adjectives surrounding the green movement. But with a few tweaks, fairways and roughs can become cheaper to maintain and, yes, "greener."

It is impossible to summarize the environmental effects of turfgrass as simply good or bad. Benefits of turfgrass are well documented and include erosion control, increased water infiltration, reduced nutrient leaching, aesthetics and carbon sequestration. Yet the negative impact of turf is rightfully questioned, due in part to the large nutrient and water requirements.

Management of turf is the act of maintaining its value. As turf managers, we have at least a small impact and sometimes a major impact on the environments we are maintaining. Industry outsiders often lead the common public to believe that where there is turf there is environmental decay. However, there is a wide range of turfgrass scenarios, from highway rights-of-way to high-end private golf clubs. When we properly manage individual scenarios, we can make turf more sustainable and we can bolster our industry's public image.

Legume inclusion within turfgrass is a proposed means of increasing the sustainability of certain turf scenarios. Legumes host soil-born bacteria within their roots, most commonly *Rhizobia* spp., which are capable of biologically fixing atmospheric

Hop clover and ball clover.

nitrogen (N_2 and N_2O). Subsequently, fixed nitrogen is shared with the host legume and is incorporated into the plant as important compounds, such as protein. In fact some of our most noxious leguminous weeds, like clover (*Trifolium* spp.) and lespedeza (*Kummerowia* spp.), have long been cultivated as food for grazing animals due to their palatability and protein content. Legumes also transfer nitrogen to associated grasses and improve soil fertility. This occurs indirectly through excreted nitrogen and decomposition of nodules, foliage and roots.

Turf nitrogen requirements vary with species and environmental conditions. Common nitrogen rates range from 0.1 pounds per 1,000 square feet annually for bahia- and centipede- grass to greater than 6 pounds per 1,000 square feet annually for hybrid bermudagrass. That gets expensive. Just as concerning is the environmental cost associated with nitrogen application. With most fast-release fertilizers like urea, a large portion of the applied nitrogen will either volatilize into the atmosphere where it becomes a potent greenhouse gas, or it will be carried away into surface waters.

Including and managing for legume biodiversity within turf offers an alternative means of maintaining adequate soil nitrogen levels for healthy turf, without application of supplemental fertility. It's an approach that works well in low-fertility areas such as roughs and the driving range. In addition, legumes are often more tolerant of temporary drought than turfgrass. Of the legumes capable of turf inclusion, white clover (*Trifolium repens*) is the best reviewed. Estimates of nitrogen fixation for grass-clover systems range from 2 to 5 pounds per 1,000 square feet per year.

Strategies that lead to legume establishment within turf include:

1) Managing an existing stand until it is more vigorous and healthy
2) Seeded establishment

Choosing legumes to sow into turf should be scenario dependent. Surveying your local weed population is the most effective way to identify which legumes to include in your turf. By matching the local flora, it may improve the persistence of your seeded legume stand. Mowing height and legume growth habit are also especially important considerations. Fairways necessitate legumes that are tolerant of low mowing heights like white clover, strawberry clover (*Trifolium fragiferum*) and Japanese lespedeza (*Kummerowia striata*).

Species selection

When selecting a legume, focus on tried and true selections. Do not expect common forage type legumes to produce an aesthetically pleasing turf. For example, white clovers are commonly classified in one of three morphological groups: small, intermediate and large. Large types, which were bred for forage production, would rarely be acceptable in any turf scenario other than tall roughs. Intermediate varieties may be acceptable for roughs, while small varieties lend themselves to fairways. Within the last decade, smaller clover varieties have been developed for the sole purpose of turf inclusion. These clovers are collectively called micro-clovers and are included in several cool-season turf blends available in the United Kingdom and Europe.

Seeding time and rate is important for proper establishment of any clover species. Most published research revolves around the inclusion of white clover in maintained turfgrass. White clover plots in Auburn, Ala., have been successfully established when seeded in late summer to early fall (August through October) and late winter (March). Although fall seeding works well, hard winters and spring frosts decrease seedling survival. Seeding rates vary with species, climate and geography. But common rates range from one-quarter to one-half pound per 1,000 square feet. As with any overseeding, good seed to soil contact is important. Most winters in the Southeast are mild enough and provide adequate soil moisture for establishment of white clover. However, fall seeding may require light supplemental irrigation to ensure seed germination and survival.

Whenever you choose to establish clover, don't be surprised if clover emergence is spotty at first. For this reason, split seeding applications (in fall and spring) may provide the best

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White clover and bermudagrass.

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clover establishment. In addition, monitoring soil nutrient levels is important for all turf management scenarios, even those with legumes included. Adequate soil P and K aid in successful establishment, but ideal soil pH varies with species. So soil tests are recommended.

Seed inoculation prior to planting is common, although it may not be necessary. Natural soil populations are typically able to sustain productive stands, and inoculation has no reported effect upon seed germination. It is important to pick the proper species and strain of bacteria for the legume being seeded. For example, the *Rhizobium* spp. used to inoculate soybeans cannot be used to inoculate clover. Even different clover species are inoculated by different strains, so check several sources and with your seed provider.

Once established, the next challenge is to manage in favor of the desired legumes. Most superintendents associate legumes with clumpy, non-uniform patches. It's true. Legume populations are highly self-regulating. They come and go as soil nitrogen levels fluctuate. However, they become more evenly distributed when mowing and fertilization are reduced. Several steps can help ensure legume health and persistence, such as:

- **Decreasing supplemental nitrogen.** When paired with well-fertilized grass, clover density quickly decreases due to its inability to compete for light. White clover leaves have a higher photosynthetic capacity at low nitrogen levels than do competing perennial ryegrass. Another reason to reduce nitrogen application is its negative effect on biological nitrogen fixation. Fixation is highly dependent on the level of nodulation occurring in root tissues and activity of the bacteria within. High concentrations of soil nitrogen inhibit nodule growth and development.
- **Reducing mowing frequency.** Legumes are much less tolerant of frequent mowing than grasses are. The growing point of grass is well hidden below canopy level. However, most legumes must regenerate foliage lost to mowing by sending up new leaves from the base of the plant, which is energetically unfavorable.
- **Adjusting mowing height and timing.** White clover is especially tolerant of low mowing heights. However, that is not the case for the majority of clover species. Most annuals are less tolerant of close mowing heights, especially during heavy flowering periods. However, if plants can fully mature, seed dispersal may occur naturally or with mowing. Using mowing as a tool to disperse next year's crop is especially important with annuals, while perennials like white clover reestablish mostly through stoloniferous growth.

Deciding to include legumes in your turf is a step toward sustainability. Turf-legume scenarios challenge contemporary turfgrass weed management. However, given the benefits, legume inclusion is a coming-of-age method of going green.

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