Natural Grass Playing Fields: Denison University, Granville, OH

Introduction

Institutions and communities often have questions about whether natural grass can meet their athletic and recreational needs, and how best to manage a natural grass field to achieve optimum performance. The Toxics Use Reduction Institute (TURI) has compiled this case study to help institutions learn from one another's experiences.

Denison University, located in Granville, OH, is a small liberal arts college with a robust environmental sustainability program on campus. The campus includes 30 acres of athletic fields.[1] All but one of the athletic fields are natural grass; there is also one artificial turf field. The grass fields are managed using Integrated Pest Management (IPM) techniques.

This case study includes information about:

- *Rebuilding a natural grass field for varsity soccer games on a college campus*
- *Improving and maintaining a natural grass field with sustainable methods*

This case study provides information about natural grass management of Denison's athletic fields. It provides an example of a college campus with a well-established natural grass program for its athletic fields, as well as an Integrated Pest Management plan for grounds. This information is intended to be useful for colleges and universities that are making decisions about whether to invest in natural grass fields or in artificial turf. Denison University's experiences help to demonstrate the viability of creating high-quality natural grass fields that meet the athletic needs of the campus. Information is also provided on the costs of maintaining the artificial turf field.

This case study is one in a series of TURI case studies of institutions and communities that have invested in building and maintaining high-quality natural grass fields. TURI's other case studies focus on organically managed natural grass fields. Denison's athletic fields are not managed organically, but their management includes key elements of organic management, including the use of compost tea and organic fertilizer, and frequent aeration of the soil.

Photo: Denison University, Facilities website

Barclay-Thomsen Field. Before reconstruction of the Barclay-Thomsen varsity soccer game field, weather-related cancellations were routine. Since the field was rebuilt and a new drainage system created, athletes can play on the field even after heavy rain. After a rainfall of an inch in a single hour, the field was playable after one hour.

December 2021

Overview

Denison University's athletic fields include varsity fields used for games, as well as practice fields. A wide range of sports, including soccer, baseball, softball and track and field, take place on these grass fields. Non-sports campus events also take place on the fields.

This case study focuses on two of Denison's grass fields: the Barclay-Thomsen Field, a varsity field used for soccer games, as well as summer soccer camps; and a practice soccer field. Details about these two fields provide an illustration of how Denison University manages its natural grass sports fields.

Table 1: Two types of field at Denison University: Overview

Field	Area	Soil base	Grass type	Activities	Field design
Soccer varsity game field (Barclay-Thomsen)	Approximately 2 acres	6" sand cap	Bermudagrass and ryegrass	Varsity soccer games and soccer summer camps	Sand capped field with slit drainage. Rebuilt in 2017.
Soccer practice field	Two fields: one is 3.5 acres, and one is 5 acres	Native soil/ high silt	Perennial ryegrass and custom blend rhizomatic fescue	Soccer practice	Native soil field.

Program design, startup and maintenance

Kevin Mercer, Grounds and Landscape Manager, initiated the natural landscape management program, bringing insights he had developed in prior work at other campuses. This initiative fit well within Denison University's broader commitment to sustainability on campus.

A major motivation for Denison University's approach is the desire to protect the natural environment. For example, the well-designed natural grass fields support stormwater management, helping to reduce flooding.

Maintenance activities are developed for each field based on its specific needs.

Choice of grass types. Denison University made use of the National Turfgrass Evaluation Program, which provides information about the best turfgrass for a particular site. For most fields, they chose a mix of fescues, a cool-climate lawn grass. One field is planted with Bermudagrass and overseeded with rye. Bermudagrass forms a deep root system, improving stability. The two types of grass thrive in different temperature conditions, extending the seasons during which the grass is growing. Planting both grasses also helps with recovery; when the Bermudagrass goes dormant in late fall, the rye grass covers all stress areas of the field, and it provides a spring "green up" for any early spring scrimmages.

Mowing. Mowing length depends on the field. For non-athletic grass areas, the grounds staff cut the grass to 4 inches, which shades out weeds. However, grass on athletic fields is kept shorter.

Soil testing. Soil testing is carried out every year or two. For example, Mr. Mercer described the initial soil testing for the soccer game field (Barclay-Thomsen) in an article in *SportsField Management*.[2] The soil was composed of 60% silt, 20% sand, 10% clay and 10% organic matter. The soil overall was high in calcium and magnesium and low in sulfur and the pH of the soil was too high. This baseline information helped to inform the process of rebuilding the field.

Aerating. Aeration is done several times per soccer season. It is described in greater detail below.

Fertilizer and soil amendments. Denison grounds staff apply an organic fertilizer.[3] In addition, Denison staff make their own compost and compost tea. They use red wiggler worms to process the compost. In addition to fruits, banana peels, coffee grounds, and other compost ingredients, they add bone meal, which provides potassium, and blood meal, for nitrogen. The compost is processed once a year in a rented composting machine.

They add beneficial mycorrhyzal fungi to the compost. This helps to build the health of the soil ecosystem and enables the grass to take up greater amounts of nutrients and water.

Compost is applied to the fields once a year in October, at a thickness of ¼ to ½ inch. The compost warms the soil and promotes germination of new grass seed. Among other advantages, this approach saves money on buying expensive topsoil.

On the athletic fields, because the grass is cut shorter and use is higher, Denison staff also use a bi-weekly nutrient program, as well as top dressing with compost.

Irrigation. The grounds staff use an automatic irrigation system on the field and target irrigation heads for the higher use areas. They monitor the moisture of the field weekly and make adjustments as needed.

Weed control. Mostly organic weed control products are used as needed. Corn gluten meal is applied to suppress crabgrass; it also serves as a fertilizer. An iron-based product is applied to suppress broadleaf weeds. Other organic weed control products used at Denison are a non-selective herbicide for grasses and broadleaf weeds, made from animal fat; an insecticide for grubs and pests; and a biofungicide. Some lower-toxicity synthetic herbicides are also used; these products adhere to the university's Integrated Pest Management plan.

Barclay-Thomsen Field (Soccer varsity game field): Field reconstruction

Barclay-Thomsen Field receives intense use during the university's men's and women's soccer games. It also hosts summer soccer camps. This field is an example of the performance that can be achieved through completely rebuilding a field to optimize drainage.

Before field reconstruction and the start of the improved management system, the Barclay-Thomsen Field was the lowest-performing field. The Bermudagrass system had shallow roots and drainage was poor. There was frequently standing water on the field after rain.

Field reconstruction. Denison staff used a topographical evaluation using GIS satellite data to better view the grades of the field. In Figure 1, the deeper red is the lowest elevation and the blue area is the highest elevation. At baseline, there was too much drainage to the edges of the field. To improve the field, the existing turfgrass was removed and a new drainage system was created. Staff installed a slit/engineered drainage system in the field, crowned the field and capped it with several inches of sand, and increased aeration.

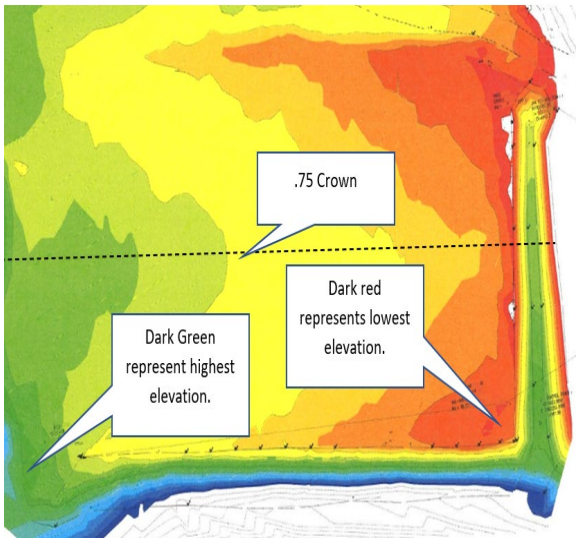

Figure 1: Topographical analysis of Barclay-Thomsen Field.

Weather-related cancellations of field use were routine before these upgrades. Since the upgrades, there have been no cancellations for weather-related field conditions. Water drains readily from the field and there are no difficulties with standing water. As a result of the field reconstruction, athletes are able to play on the field even after heavy rain. For example, after a rainfall of an inch in a single hour, the field was playable after one hour. The field was transformed from the worst field on the campus to the best; teams from other colleges specifically request to play on the field.

Field maintenance. While the soccer game field is not managed organically, several elements of organic or sustainable management are used; these include frequent aeration, use of compost, and moving the play area and goals periodically. All of these measures help to ensure a high-quality natural grass playing surface.

A variety of formulations of fertilizer are used, depending on the time of year and specific needs. For example, a fertilizer is used to build up the carbohydrates for play and for winter dormancy. Another fertilizer is applied for stress recovery from summer camps and to add organic material to the sand cap profile. In August, fertilizer is added to the field to encourage the ryegrass to germinate.

Each June, they aerate 6 inches deep with ¾ inch hollow tines, and apply top dressing and fertilizer. In August, they aerate using ¾ solid tines and then verticut (remove thatch from) the field. Verticutting helps to germinate the perennial ryegrass. It also helps to thicken the Bermuda grass. They top dress again and apply perennial ryegrass and starter fertilizer to encourage the ryegrass to germinate. They also apply fertilizing sprays to the grass.

Photo: Kevin Mercer, Denison University

Verticutting of field.

Before games in September, staff inspect the field for safety and perform a GMAX test for player safety. Fertilizer is applied after each game to build up carbohydrates for play and for winter dormancy, and this is also the rationale for October applications.

Soccer practice field: Effective management of an existing grass field

The soccer practice field is used for men's and women's soccer practice. The field dimensions for the two soccer practice fields are 3.5 acres and 5 acres. As with the game field, several elements of organic or sustainable management are used; they help to ensure a high-quality natural grass playing surface. This field provides an example of effective management of a grass field without reconstruction. The field manager has also focused on improving soil quality gradually over time.

The practice field is aerated at a depth of 6 inches in March, with slit seeding and application of a starter fertilizer. (Slit seeding is accomplished using a tool that creates holes in the soil for seeding.) After aerating, they remove the soil plugs and top-dress with compost at 1/8 inch. The reason they remove the soil plugs is to help gradually change the soil profile, due to poor original soil quality. Aeration at a depth of 6 inches is repeated in June.

Mowing of the practice field begins in April, three times per week with height at .75 inches for spring practice. Mowing is reduced in November and the turfgrass is allowed to grow in order to build a deeper root system by spring. In addition to fertilizer, compost tea is applied twice a month from May through July and in September. Herbicides and fungicides are also used.

To help maintain grass quality, the field managers periodically move the play area by three to four feet, in addition to moving the goals. This helps to ensure that wear and tear is not focused in one part of the field.

Costs

Costs for natural grass field maintenance for 21 acres total just under $37,000 per year, or just under $1,800 per acre, not including costs of pesticides. The grounds manager notes that the cost of sustainable products is falling and quality is improving as interest and demand in this area grow.

The grounds manager has found that the grass fields are far more cost effective than the artificial turf once the full costs are factored in. Denison resurfaces its artificial turf field every seven to eight years, at a cost of about $800,000. It also spends about $115,000 annually for maintenance of the artificial turf field.

Photo: Kevin Mercer, Denison University

Barclay-Thomsen field.

Table 2: Selected costs: Seed, fertilizer, composting machine rental, and labor costs associated with management of 21 acres of athletic fields at Denison University*	
Products	***Cost***
Seed x4 applications ($1,350)	$ 5,400
Fertilizer (5-4-5)**	$ 1,000
Fertilizer (46-0-0)	$ 100
Fertilizer (8-2-2)	$ 700
Fertilizer (0-0-50)	$ 200
Top dressing (compost application)	$ 2,900
Rentals	
Composting machine	$ 2,500
Labor	
Annual labor	$ 24,000
Total costs	$ 36,800
Annual cost per acre	**$ 1,752**

* Costs shown here do not include synthetic pesticides.
** The three numbers for fertilizer refer to the ratio of nitrogen, phosphorous and potassium.

Soccer play time on the soccer game field is approximately 370 hours over the course of 10 weeks, and soccer practice is approximately 500 hours over the course of 12 weeks.

Table 3: Two Fields at Denison University: Hours of soccer practice and play, 2020				
Field	**Activity**	**Hours per week**	**Weeks per season**	**Total: Hours per season**
Soccer game field (Barclay-Thomsen)	Soccer	36	8	288
	Soccer camps	40	2	80
	Total			**368**
Soccer practice field		42	12	504

Integration with campus sustainability activities

Denison grounds experts emphasize the importance of outreach and education about the benefits of sustainable grass management. Sustainable grounds plans are integrated into the overall campus sustainability plan, and an Integrated Pest Management plan provides consistent guidance. It is also helpful to involve students. The campus also contains rain gardens and designated ecological areas planted with wildflowers and sunflowers, and students help to catalogue pollinators. Pines are used around dormitories to control weed growth. Thus, the campus' investment in maintaining high-quality natural grass playing fields forms part of a larger sustainability effort.

Conclusions

Denison University's experience demonstrates the viability of creating high-quality natural grass fields that fully meet the athletic needs of the campus. Takeaways from Denison's experience include the following:

- Drainage issues can be remedied. Since the Barclay-Thomsen field was rebuilt in 2017, it has had no cancellations due to rain. It went from being the lowest-performing field, which had poor drainage and frequent standing water, to one that teams from other colleges ask to play on. Athletes are able to play on the field even after heavy rain.
- Selection of grass is important. Denison's use of the National Turfgrass Evaluation Program, which provides information about the best turfgrass for a particular site, helped them select grasses that would work well for the climate in which they are located.
- Denison finds that grass fields are far more cost effective than artificial turf once the full costs, including maintenance and resurfacing/replacement of the artificial turf, are factored in.
- Incorporation with the campus sustainability and Integrated Pest Management plans, and student participation in campus ecological management, help to support the choice of natural grass for athletic fields.

To learn more about sustainable land care, see TURI's information sheet on organic management of natural grass athletic fields, as well as TURI's case studies of communities in Southwest Pennsylvania and the Massachusetts communities of Springfield, Marblehead, and Martha's Vineyard.

[1] "My Landscape: Grand Award for University Grounds." *Turf Magazine* April 8, 2020. Viewed at https://www.turfmagazine.com/turfmagazine/my-landscape/my-landscape-grand-award-for-university-grounds/, March 11, 2021.

[2] Kevin Mercer, "Growing Bermudagrass in the North," SportsField Management, Feb 18, 2020, https://sportsfieldmanagementonline.com/2020/02/18/growing-bermudagrass-in-the-north/11132/

[3] Denison purchases organic fertilizer from Earthworks.

Acknowledgements

This case study was prepared by Susan Kaplan (consultant), Rachel Massey and Lindsey Pollard (Toxics Use Reduction Institute). Information for this case study was provided by Kevin Mercer, Grounds and Landscape Manager, Denison University. Funding for the preparation of this case study was provided by the Heinz Endowments.

Toxics Use Reduction Institute, University of Massachusetts Lowell • The Offices at Boott Mills West • 126 John Street, Suite 14 • Lowell, MA 01852-1152 • (978) 934-3275 • www.turi.org