Study: Natural turf use levels

INJURIES ARE OF MAJOR CONCERN to parents, coaches and, of course athletes. Few studies have been conducted to relate actual field conditions as well as maintenance practices to reported injuries. We conducted a study in 2007 to determine the level of use that an athletic field will sustain before field conditions begin to affect the playability and safety of the field. Eleven sports turf managers from four New England states volunteered to take part in the study; they represented 12 varsity fields from nine high schools and three universities. Field use included football, soccer or both. Lacrosse was also played on two of the soccer fields.

The turf manager participants were given a form to record the date, event (game or practice) and hours/minutes of use. This provided the number of weeks the fields were in use for which we then calculated the total number of hours of use over the playing season. All participants provided their maintenance program, including nitrogen fertilization treatments, mowing height and frequency, aerification, dethatching, topdressing, overseeding, number of times chemicals were applied to control weeds, insects and/or diseases, and growth enhancement products used. The maintenance practices were quantified for statistical purposes. All the fields in the study were irrigated.

At the conclusion of the study, the participants asked their athletic departments about the number of injuries that could be contributed by players to surface contact; we did not solicit the type of injury. Nine of the 12 schools responded.

FIELD EVALUATIONS

The field surfaces were evaluated at the end of playing seasons for percent grass cover (turf density), percent weeds, surface smoothness, depressions (areas on the fields that can accumulate surface runoff), and stones at the surface. The characteristics evaluated were assigned code numbers (shown in Table 1) for the purpose of statistical analysis. Separate ratings were taken from the heavily trafficked center of the fields from goal to goal and the less trafficked areas along the sidelines. Overall field conditions were determined using the sum of ratings for grass cover and surface smoothness, with ratings for weeds, depressions and stones at the surface subtracted from the sum. The data shown in Tables 2 and 3 are from the heavily trafficked centers of the fields.

Further, we evaluated the quality of the playing surfaces by determining surface hardness, traction, and penetration resistance with separate measurements taken from

Table 1. Rating System with Codes.

Percent grass cover (turf density)			Percent weeds			Depressions		
0	=	10%	1	=	<10%	0	=	none
1	=	11-20%	2	=	10-30%	1	=	few
2	=	21-30%	3	=	31-50%	2	=	moderate
3	=	31-40%	4	=	>50%	3	=	many
4	=	41-50%				4	=	extreme
5	=	51-60%						
6	=	61-70%						
7	=	71-80%						
8	=	81-90%						
9	=	>90%						
Smoothness								
1	=	surface is extremely uneven that will affect play and are hazardous						
2	=	surface is very uneven with irregularities that will greatly affect play						
3	=	surface is uneven with irregularities that will moderately affect play						
4	=	smooth surface with some irregularities						
5	=	smooth surface with no irregularities						

Table 2. Mean and range for characteristics on 12 varsity fields from center of field from goal to goal (2007 playing season).

Variable (code or unit)	mean	minimum	maximum
Usage			
hrs./week	12.1	3.7	21.4
total for year	186.2	39.0	412.0
Field Rating[1]			
overall field condition	7.6	1.0	13.0
surface smoothness (1-5)	3.5	2.0	5.0
turf density (0-9)	6.3	3.0	9.0
weeds (1-4)	1.3	1.0	3.0
Playing Quality			
hardness (g max)	55.8	34.8	103.9
traction (Nm)	38.9	28.8	48.3
penetration resistance (MPa)	1.2	0.5	2.5`
Soil Properties			
gravimetric moisture (%)[2]	25.1	12.0	36.7
soil available K lbs. per acre	177	93	216
soil available P lbs. per acre	24	2	45
bulk density (g per cm^3)	1.46	1.27	1.68
organic matter (%)	5.4	1.0	9.1
pH	5.8	5.5	6.5
sand (%)	74.2	55.7	95.0
Maintenance			
N fertilization lbs. per 1000ft[2]	4.4	2.0	6.0
total maintenance score	16.8	8.8	26.8

1 Density, smoothness, weeds, depression and stones at surface are factored into score for overall field quality condition.
2 Soil samples for soil moisture were collected on day when playing quality measurements were made.

the centers of the fields and along the sidelines. This data also was taken from the heavily trafficked centers (see Tables 2 and 3). Surface hardness was measured using a Clegg Impact soil tester, which is an accelerometer fastened to a 5-pound missile that is dropped from a height of 1 foot with the peak deceleration measured in gravities (Gmax). The higher the Gmax the harder the surface. Traction was measured by a device comprised of a 6-inch steel disc with six soccer studs spaced at intervals around the disc. The disc was weighted with 75 pounds and dropped from a 6-inch height so that the studs fully penetrated the surface. The torque required for the studs to tear the surface was measured in Nm (Newton meters). Penetration resistance was measured using a Penetrometer with a cone point. The cone point was pushed slowly and at a constant rate into the top 2 ½ inches of soil. Twelve readings were taken with each apparatus and then averaged.

SOIL SAMPLES

Soil samples were collected from each field to determine textural class based upon the USDA-NRCS classification system, soil organic matter content, soil available phosphorus (P) and potassium (K). Particle size for determining textural class was analyzed using the hydrometer method by separating the sand, silt and clay fractions. Percent organic matter was determined by weight loss on ignition. Soil available P and K were obtained using the modified Morgan extractant. Two intact core samples, 2 inches in diameter by 2 ½ inches in length, were taken from the center of the heavily trafficked area and two taken along the sidelines with a brass cylinder fitted inside a metal tube for determining bulk density. These results along with bulk density samples taken from the center of the fields are shown in Tables 2 and 3.

Table 3. Significant correlations (r) for data obtained for 12 athletic fields for 2007 playing season.

Co-variables	Correlation coefficient (r)
Field related injuries	
density x field related injuries	-0.62*
Field ratings	
density x weeds	-0.62*
density x smoothness	0.63*
density x overall field condition	0.88***
smoothness x overall field conditions	0.84**
Usage	
hours of use/yr. x density	-0.50†
hours of use/week x g max (hardness)	0.57†
hours of use/week x MPa (penetration resistance)	0.56†
Soil properties and field ratings	
sand x density	0.57†
sand x smoothness	0.88***
sand x overall field condition	0.69*
organic matter x smoothness	-0.68*
bulk density x smoothness	0.81**
bulk density x overall field condition	0.58†
soil moisture x traction	-0.80**
Between soil properties	
sand x organic matter	-0.85***
sand x K	-0.70*
organic matter x K	0.85***
bulk density x sand	0.93***
bulk density x organic matter	-0.89***
Maintenance factors	
N fertilization x overall field condition	0.60*
overall maintenance x density	0.69*
overall maintenance x smoothness	0.74**
overall maintenance x overall field condition	0.86***
Playing quality factors	
g max (hardness) x MPa (penetration resistance)	0.92***

†,*,**,*** Significant at $P \leq 0.10$, 0.05, 0.01, 0.001 levels, respectively.

STATISTICS

Correlation coefficients (r) were computed to identify relationships between ratings, hours of use, playing quality data, soil properties, maintenance practices and incidence of injury. Correlation is a measure of the strength of the association between two co-variables and is shown in Table 3. A perfect relationship or fit between two co-variables is indicated by an r value of "1" with values less than "1" indicating less than a perfect relationship. A negative sign (-) indicates an inverse relationship between any two co-variables. The degree of statistical significance of the correlation from weak to highly significant is indicated in Table 3 by the level of probability (P value) from weak (P£ 0.10) to highly significant (P£ 0.001).

FIELD QUALITY RATINGS AND MAINTENANCE

There was a wide range in field ratings for turf density, weed populations, smoothness and overall field conditions ranging from 3 to 9, 1 to 3, 2 to 5, and 1 to 13 respectively, Table 2. Turf density was positively related to smoothness (r = 0.63) and overall field conditions (r = 0.88), and negatively related to weed populations (r = -0.62) in which weed populations increased with progressively greater turf thinning and loss of density (Table 3). Percent weeds in two of the fields were 30% or greater, which also had the lowest scores for overall field quality conditions. Surface smoothness also had a major influence in improving overall field conditions (r = 0.84) Field maintenance had a considerable role in the condition of the fields. Turf density and surface smoothness increased significantly as maintenance inputs increased (r = 0.69), and (r = 0.74), respectively. Further, as maintenance factors increased, overall field quality increased (r = 0.86) with greater fertilizer nitrogen closely associated with improving overall field condition (r = 0.60).

SOIL PROPERTIES

The textural classes for the studied soils were classified as seven sandy loams with sand contents ranging from 55.7 to 74.3% sand, three loamy sands ranging from 79.2 to 83.2% sand, and two sand rootzones with 92% and 95% sand. Organic matter content in the 12 soils ranged from 1.0 to 9.1% by weight (Table 2). Bulk density values in the heavily trafficked centers ranged from 1.25 to 1.68 g cm-3 with bulk density increasing as the sand content increased (r = 0.93).

Moreover, as the sand content in the soil increased, smoothness of the surface increased (r = 0.88) and the overall field quality increased with greater sand content (r = 0.69). Field turf density also improved commensurate with an increase in sand content (Table 3). The improvement in turf density, smoothness, and overall field conditions are likely the result of better wear tolerance and a firmer surface as shown by our previous studies.

» Figure 1. PANELS TO THE LEFT show high maintenance soccer field while the panels to the right show low soccer maintenance field receiving the same level of use of 146 hours for the season.

Surface smoothness and overall field quality also improved as the bulk density increased (r = 0.81 and r = 0.58, respectively), largely a result of a firmer surface due to greater sand content. We previously had found a highly significant correlation between surface hardness and bulk density.

USE AND INJURIES

The only effect from hours of use was on turf density, hardness and penetration resistance. As the hours of use per year increased, turf density decreased while hardness and penetration resistance increased. A loss in turf density was related to an increase in player to surface injuries. This accounted for 39% of injuries related to the field surface with higher densities associated with fewer injuries. These results underscore the relative importance of sustaining higher turf density for better cushioning and safer playing surfaces. To that end, overall field quality increased with higher N with an average seasonal N rate in this study approaching 4.5 lbs per 1000ft2.

We found no relationship between overall field conditions and hours of use. See Figure 1 in which hours of use were the same for two fields but maintenance input differed. An increase in maintenance input was closely associated with an increase in shoot density, surface smoothness and overall field quality; the likely reason for fewer injuries being reported. Shoot density was the single most important factor accounting for 39% of field related injuries with higher densities associated with fewer injuries. ■

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Managing insect pests

BECOMING AN EXPERT in identifying pests, determining their life cycles, and managing the insect population are valuable skills for turf managers.

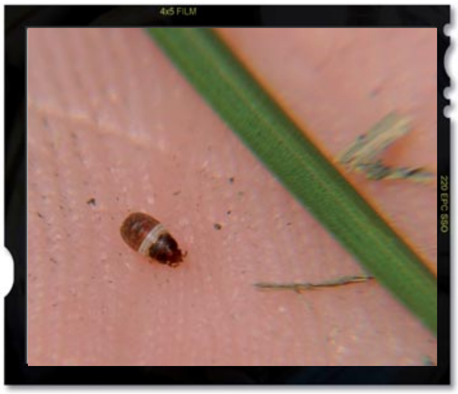
Detecting the presence of an insect is the first step in good pest control. Insect management begins once the early signs of injury or significant numbers of insects are observed. If the turf looks damaged, wilted, and water-starved, then an insect may be involved. Since some insects can only be controlled at certain times during their life cycles, it is essential to identify three key factors: type of insect; the insect's life cycle; and the level of infestation.

TOP PEST OFFENDERS

Various regions of the country experience unique pests. However, there are some fairly widespread turf pests that affect large areas of the United States. Some of the top offenders nationwide include white grub, chinch bugs and leatherjackets.

White grub. These small, plump, white larvae live below the soil and viciously chew on grass roots. Once the grass roots are destroyed, the turf will appear yellow in patches, just as if the lawn is dying out. The damage looks quite similar to symptoms of dryness, and many mistakenly assume that the turf needs only water to restore a lush, green appearance.

Other symptoms to watch for include animals such as skunks and raccoons digging up the turf and birds feeding on grubs, leaving pencil-sized holes. Often, damaged turf will roll back like a carpet. Serious damage can occur in the spring, summer and fall; and if the problem is ignored, the patches will get larger. The damaged areas will then fill in with weeds or crabgrass, so the best time to treat grubs is preventively rather than curatively.



Chinch bugs. These small insects live in and feed on grasses and can destroy turf with little warning. They live above the soil and feed on living grass plants by means of a piercing mouthpart called a stylet—sucking the juices out of the plant. The damage looks quite similar to drought symptoms and, again, many mistakenly assume that turf needs only water to restore its lush green appearance. Look out for suspicious brown patches starting to appear in the turf and, unlike fungal disease, the patches will not be symmetrical. If you determine the brown patches are due to lack of water, you can correct irrigating procedures.

Chinch bugs survive the winter and come out of hiding in the spring. Here they will mate and the females will seek a hot dry location in which to lay their eggs, which will hatch in about 3 weeks. The eggs are laid very close together so that

Mountain Pine Beetle

By Ken Kukorowski

THE MOUNTAIN PINE BEETLE (MPB) is a species of bark beetles native to western North America. The host range for MPB includes ponderosa, lodgepole, scotch and limber pine trees. Female MPB find large diameter, living trees to attack; there they produce pheromones to attract other beetles (especially males), mate, then bore into the host tree where eggs (could be as many as 75 per clutch) are deposited just under the bark.

As an adult, MPB is a small (<½ inch long) black beetle. Adults can appear as early as mid-June and continue to be present even through September, but in most locations adults emerging from lodgepole pines occur in late July and those emerging from ponderosa pines occur in mid-August.

As adults bore into the host trees, healthy trees produce pitch in the bored holes which often traps the adults and prevents successful attack. Within 2 weeks of egg deposit, the eggs hatch and the larvae tunnel through the phloem disrupting nutrient movement down the tree. With severe attacks, the larvae can cut off all nutrient and water flow movement and cause the tree to starve to death. These MPB larvae overwinter in a dormant state in the tree (under the bark) but resume feeding in the spring. They metamorphose into pupae in late spring, early summer (approx. June, depending on host attacked), then emerge as adults, to continue the next generation.

MPB is an effective vector of bluestain fungus, harbored near the mouthparts of MPB; when introduced to healthy pine trees, it blocks the trees defense response to produce pitch to entrap the boring MPB. Bluestain fungus also interferes with water and nutrient movement within the tree; further causing the tree to starve to death.

Since MPB has one generation per year, a spray of Sevin SL at a rate of 5 oz per gallon of water applied before adult emergence in June or July will provide preventative control of adult beetles before they bore into the new host.

This application should be made evenly over the entire circumference of the main trunk from the ground up until the diameter is 5 inches. One (1) gallon of finished spray will treat 50 sq. ft. of bark. ■

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when they hatch the young begin feeding and small patches of small grass begin to appear. If the problem is ignored, the patches get bigger.

Leatherjacket. These flies, which also resemble mosquitoes, are primarily in coastal areas and feed on roots of grass plants resulting in a yellow-colored and wilted turf. If heavy infestations occur, turf can become brown or, even worse, the turf can completely die. Adults emerge mid-July through early October and begin mating immediately. Eggs hatch within a couple of weeks and larvae begin feeding throughout the fall and spend the winter below the surface of the turf. By March and April, heavy feeding occurs as larvae reach maturity. Larvae continue feeding until about mid-July. At this time they begin to pupate, then later transform into adult crane flies. Leatherjacket larvae are more easily controlled in fall or early winter while they are still young. Spring treatments are the best to control this pest.

MANAGEMENT

When it comes to pest management, you must treat the issue immediately in order to restore the turf back to its original, healthy state and to prevent the problem from reoccurring.

Normally, nature creates a balance between insects, natural predators and food supply. But if something such as a change in the weather pattern happens to change that balance, then insect populations increase and may cause extensive damage.

In addition to a solid pest management program that may include preventive and curative strategies, aeration can help to establish a sound root foundation that will be better able to withstand unwanted pests.

Remember, pest management starts with overall plant/turf health. ■

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Annual Bluegrass Weevil

By Laurence Mudge and Rich Hanrahan

WHAT DOES IT LOOK LIKE?

The annual bluegrass weevil (ABW) has a long snout with an antenna that starts at the tip of the snout rather than the base. The blunt snout often causes the ABW to be mistaken for a turf-infesting billbug. ABWs typically measure 3 to 4mm long and their color differs between newly emerged adults and mature adults. Young adults, known as “callows” or “tenerals,” are chestnut to brown in color, while the mature adults are darker ranging from gray to black. The body of an ABW is covered with thin, chestnut-colored hairs that shed with age, thus making the older adults appear shiny and black. These pests have rice-shaped eggs, about 1/32-inch long and gray. The larvae are cream colored with a C-shaped body and a distinct brown head. Young larvae are 1/32 inch and burrow and feed inside grass stems. After the larvae mature, they grow to be about 3/16 inch and feed externally.

ABW adults spend the winter protected near sites such as golf courses and other well manicured turf. In the EARLY spring, adults become active and migrate to shorter-cut turf where females lay eggs inside the leaf sheath of grass plants. By late May or early June, the damage becomes highly visible due to the larvae feeding on and killing stems. A single individual can injure up to 20 stems. The second-generation adults emerge in late June to early July and start the cycle again. This generation will reach the fifth instar by mid-July to early August. Damage from the second brood may become more severe if the first generation is left untreated.

The first recognized ABW to damage turf grass was reported in Connecticut in 1931. Since then, the insect has spread and is found most often in highly maintained turf in the Northeast and Mid-Atlantic. From 2006 to 2007, ABW was identified in Ohio, West Virginia and Virginia. And in 2008, the first-ever report in North Carolina came from a golf course near Asheville. Although ABW has spread throughout many states in the US, it still causes the most damage in the New England.

Prevention tips. Cultural management recommendations include proper nutrition and irrigation, which often help avoid symptoms of ABW damage. Converting from a susceptible turf species to one that is tolerant to ABW is also an effective strategy. Overwintering adults often populate in tree litter. However, tree removal is not recommended as these sites are not actually preferred locations for ABW.

TREATMENT TIPS

Controlling ABW with insecticides is currently the most effective strategy. Applications should be timed to control adult weevils as they depart overwintering sites and move into grass areas. Insecticide with the active ingredient imidacloprid provides optimum control when applications are made before the egg hatch.

The most important strategy to effectively prevent, manage, and treat ABW is to maintain optimum timing and rate of treatment with your applications. Applications should not be made when grass areas are waterlogged or the soil is saturated with water. Due to the level of infestation and the nature of the crop, as well as fluctuating water dilution rates, rainfall, mowing and other factors that can affect control, it is important to follow insecticide label instructions or contact your state cooperative extension service for more detailed information concerning the application timing. ■

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