# Evaluating baseball field surface quality


BY JIM BROSNAN AND DR. ANDY MCNITT

Baseball is our national pastime. From Legion ball to the major leagues, interest in baseball remains strong. It seems that every town in America has a baseball diamond, and these diamonds require maintenance. Someone mows these fields, drags the skinned areas, and puts down chalk lines. In professional baseball, the techniques used by the field manager can impact the game itself.

The industry recognizes that baseball field management (specifically skinned infield management) is more of an art form than a science. Practices have been handed down from one field manager to the next, with what constitutes a quality field in the eye of the beholder.

As scientists, we would like to quantify how various management practices affect playability in the hopes that this knowledge would benefit players, coaches, and field managers. Understanding the effects of things such as (continued on page 16) (continued from page 12) soil conditioners and irrigation regimes would benefit the industry as a whole.

This past summer Jim traveled the country to conduct a survey of baseball field playing surfaces through the Turfgrass Research Project at Penn State. Characteristics of skinned surfaces, as well as natural and infilled synthetic turf surfaces, were catalogued at all levels of play ranging from little league, through the NCAA, and Major League Baseball. While we are still in the early stages of research, we have observed some interesting trends.

First, skinned surfaces are exceptionally hard. Frequently, these surfaces produced Gmax (hardness) values that were so high that resurfacing would be required in sports such as soccer or football. This may contribute to the wear and tear type injuries that are commonly reported by baseball trainers. We need to explore this issue further. Water applications will certainly soften these areas, but little is known about appropriate quantities. For example, do we need 10 gallons of water per 1000 square feet to soften the skinned areas by 10%, or do we need 15 gallons? Of course it will depend on your infield mix. Further research is being conducted at Penn State to try to answer these questions. Stay tuned.

Surprisingly, the moisture content of the infield mixes evaluated had very little effect on ball response after impact. The ball response was measured with a new device affectionately named PennBounce. PennBounce consists of an air cannon that propels baseballs, at various angles, towards the playing surface at speeds up to 150 mph. Infrared speed gates are used to measure ball speed before and after impact with the ground. On skinned infields, observations indicate that the subbase layer (the layer below the soil loosened by grooming equipment) plays an important role in ball reaction. Standard pre-game water applications do very little to soften this compacted base. Increasing the depth of loose material above the base will certainly slow down ball response, but may prohibitively reduce an athlete's traction. Researchers at Penn State are currently measuring changes in ball response, surface hardness, and traction that result from loosening infield mixes to varying depths. In the near future, we hope to equip athletes with devices that measure the amount of force that is exerted on the lower body as they perform on these various surfaces.

Surface characteristics across the diamond varied. Surface hardness was lowest at second base, with hardness increasing at third base and peaking at first base. This is likely due to the nature of the respective positions. First and third basemen tend to be more stationary than middle infielders during play. Also, players reach first base more than any other base on the diamond. This traffic may compact the soil to a greater degree, thus generating higher Gmax (hardness) values.

Baseballs approaching skinned surfaces at a 25-degree angle lost 43% of their initial velocity on the first bounce. For example, a ball leaving the bat at 100 mph will strike the skinned area in front of the shortstop at roughly 88 mph (baseballs lose velocity at a rate of 1 mph for every seven feet of travel), and after the first hop it will approach the shortstop at roughly 50 mph. The skinned areas of the fields observed were quite a bit faster than both the natural and synthetic turf areas. Small differences were found when comparing infill systems to natural turfgrass. Balls striking those surfaces lost 48% and 53% of their speed after the first bounce, respectively. A ball moving 5% slower allows the player to travel approximately a foot further in the approach, which could be the difference between the ball hitting the center of the glove or screaming through the hole into the outfield.

Ball response on infilled synthetic turf surfaces was affected by surface hardness and infill depth, with softer, deeper surfaces having a slower ball speed after impact. Infilled synthetic turf surfaces exhibited a strikingly consistent bounce across the playing surface. Regardless of whether the ball struck in front of home plate, on the third base line, or down the left field power alley, the ball response was the same. This phenomenon was only true of fields greater than one year of age. Infilled synthetic turf fields younger than one year of age showed differences in ball response across the playing surface. Likely, the rubber and sand particles that comprise the infill need time to settle into place and firm up in order to produce this level of consistency. Outfield areas of infilled synthetic turf surfaces had higher Gmax (hardness) values than infields.

There were no surprises with natural turfgrass playing surfaces. As expected, surface hardness, moisture content, and thatch were all key factors in gauging ball speed after impact. Differences in surface hardness and moisture content varied with field positions. Centerfield was slightly softer than left and rightfield. Similar to what was observed with first and second basemen on the skinned areas, centerfielders tend be on the move more during play than left and right fielders. This likely reduces compaction enough to alter surface hardness. Outfields had higher moisture contents than infields. This makes sense, as outfields are left exposed to rain showers while the infield grass is tarped. Further research is being conducted to explore how cultural practices such as mowing height and verticutting, as well as irrigation affect ball response on natural turfgrass.

This survey of playing surfaces at all levels of competition has given us some idea of the range of surface conditions that currently exist. The next step at Penn State is to create field plots that mimic these surface conditions, and determine the degree to which we can manipulate those conditions with management practices. We plan to conduct a series of baseball related research projects at Penn State in the hopes of contributing to the playability and safety of the fields that host our national pastime. ST

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