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QUANTIFICATION OF THE EFFECTS OF CULTURAL PRACTICES ON TURFGRASS WEAR TOLERANCE ON SAND BASED AND NATIVE SOIL ATHLETIC FIELDS

By

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ABSTRACT

Quantification of the Effects of Cultural Practices on Turfgrass Wear Tolerance on Sand Based and Native Soil Athletic Fields

By

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Methods of quantifying the effect of cultural practices on turfgrass wear tolerance on an athletic field were investigated on both a sand based field and a loam soil field. The variables manipulated in the research included fertilizing, mowing, and cultivation. Mowing rates consisted of mowing once or twice per week. Fertilization rates consisted of 25 g N at 5 g N m^{-2}/app., 25 g N at 2.5 g N m^{-2} / app., or 35 g N at 5 g N m^{-2}/app. Cultivation rates consisted of no cultivation or cultivating twice per year. Each treatment was evaluated for color, quality, quantitative and qualitative density, shear strength, and surface hardness.

Results for the sand soil study showed mowing twice per week increases turfgrass cover, quality, color, shear strength and decreases surface hardness. Fertilizing at the 25 g N m^{-2} $year^{-1}$ rate is good on a sand based root zone (at least 8 applications per year). Also, if less frequent fertilizer applications are used, a greater amount of annual nitrogen should be applied. Cultivation increased turfgrass cover and lowered surface hardness and shear strength. Results for the native soil study showed little variability. Due to drought, the turf was in summer dormancy throughout much of the experiment, thus potentially inhibiting the effect of the treatments.

Dedicated to John C. Sorochan,
my parents, David and Lynn Lundberg and
my sister, Andrea Scott
Thank you

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INTRODUCTION

An athletic field is made up of many components and the interaction between these components determines the playability of the field. These components can be divided into two levels; components that have a direct effect on game play (level one) and components that have an indirect effect on game play (level two). Level one factors include field stability, ball roll, rebound resilience, and traction (Canaway *et al.,* 1990). Level two factors include turfgrass cover, surface hardness and uniformity, and drainage (Adams, 1981; Canaway, 1984; Holmes and Bell, 1986; Rogers *et al.,* 1988; McClements and Baker, 1994). The two attributes most frequently cited in relation to field playability, and subsequently field safety, are turfgrass cover and surface hardness (Harper *et al.,* 1984, Rogers *et al.,* 1988). Although these two attributes, and to a lesser extent traction and player performance (Waddington and McNitt, 1995), are the most commonly sited in relation to player injury, all of the aforementioned factors affect the safety and the longevity of the field.

If one or all of these factors are not at an adequate level, then player injury can potentially result. In 1965 athletic injuries were correlated with poor field conditions (Wilcox *et al.,* 1965). Sanderson (1979) suggested that soil compaction is the major cause of these injuries. Orchard et al. (1999) suggested that water, or the lack of water on the field's surface has a specific effect on knee injury occurrence. These findings support the idea that poor surface conditions lead to increased athletic injury. This idea was quantified in 1981 when a study was done at twelve different Pennsylvania high schools (24 fields). This study found an accumulative average of 210 football injures occurred during the football season. Of these injuries, 21% were rated as definitely or possibly related to field conditions (Harper *et al.,* 1984). This study also highlighted the fact that generally, the better maintained a field, (adequate nitrogen supply, frequency of cultivation, and frequency of mowing), the better the playing conditions (increased field uniformity, greater cover, and fewer weeds).

With the increase of participation in sports in Michigan, athletic field managers are being pressured to maintain fields adequately so the potential of field related injuries can be reduced. Unfortunately, many of the field managers do not have adequate knowledge of field maintenance. To measure the extent of this knowledge, a survey was sent through the Michigan High School Athletic Association to high schools in December 1999 and 2000. The results of this survey are displayed in Appendix A. Generally, the survey revealed there is a need for general guidelines for athletic field maintenance as well as a need for the quantification of the effect of the maintenance practices on athletic fields.

In response to these concerns, a study was initiated at Michigan State University to evaluate a range of management programs considered typical for Michigan athletic fields. Each of these programs was evaluated with respect to its effects on field longevity. The hypothesis was if the maintenance practices were implemented at the proper rate and frequency, increased turfgrass density and field stability, and decreased surface hardness would result. An additional goal of this study was to analyze the cost benefit of each regime. This analysis will help athletic directors who often have difficulty developing, justifying, and attaining an annual maintenance budget.

The 12 treatments of this study consisted of three levels of fertilization, low infrequent (25 g N at 5 g N m^{-2}/app.), low frequent (25 g N at 2.5 g N m^{-2}/app.) and high (35 g N at 5 g N m^{-2}/app.), two frequencies of cultivation (zero (low) and twice (high) per year), and two frequencies of mowing (once (low) or twice (high) per week). These three variables represent the major cultural practices over which athletic field managers have control. The study was conducted on two different root zones, one was a sand soil base, and the other was a Capac loam soil (Fine-loamy, mixed, mesic Aeric Ochradqualfs). The study was conducted on these two root zones because both have benefits for athletic field traffic and may respond differently to treatments.

With this study, we intend to learn what the incremental returns of field quality are as compared to the inputs of maintenance practices. Previous research has found that mowing, fertilizing, and cultivating, done at the proper rates and frequencies, can increase turfgrass cover, decrease surface hardness, and improve surface conditions that affect player injury (Adams, 1981; Canaway, 1984; Harper *et al.,* 1984; Holmes and Bell, 1986; Rogers *et al.,*1988; McClements and Baker, 1994; Waddington and McNitt, 1995). However, research has yet to answer how this information relates to a game field. Thus, it needs to be determined how long the effects of these practices will last under athletic traffic. There is an abundance of research supporting the guiding principals set forth in this thesis; however, none of the research thus far can answer the question of how many more games an athletic field can hold by following these principals. This research is the pioneer for what should be continued research in the quantification of the effects of management practices on athletic field life expectancy.

Specific Objectives

1. Quantify the relationship between 12 turfgrass management programs and turfgrass longevity under trafficked conditions on a sand based root zone athletic field.
2. Quantify the relationship between 12 turfgrass management programs and turfgrass longevity under trafficked conditions on a native soil athletic field soil.