GTI HILTES

Non-Chemical Control of Weeds in Turf

Prof. J.C. Hall, Prof J.L. Eggens, K.L. Sagan, & Dr. K. Carey

Prevention of initial weed infestation in newly seeded sports fields may be enhanced by the choice of grass species, cultivar or establishment procedures. The objective of these management procedures is to rapidly establish a competitive cover to prevent the encroachment of weed species.

The above GTI researchers compared eight seed sources, in addition to commercial sod, to establish turf on a bare soil at the former GTI research field at Cambridge. Seeding was done on July 31, 1991 and the turf was maintained under standard management procedures.

Observations at establishment indicated significant differences between seed sources in the rate of attainment of a dense turf cover (data not provided). In 1993 the plots were rated on three occasions between July 15 and Sept. 13 for broadleaf weed and annual bluegrass content. The visual rating was done on a scale of 1 to 5, with 5 being a heavy infestation of more than 50% of the plot area.

The data show significant differences between seed sources (Table 1). The most efficient weed suppression procedure was sodding which provided a near weed-free environment for two years. While the cost of sodding a sports field may be excessive for some situations, the reduced weed control required in the initial years of use should be factored into that cost. The weed suppression by the sod is an excellent example of the competitive ability of a dense turf. Of course it is imperative that the sod be weed free at the beginning.

The use of a named cultivar of Kentucky bluegrass also had a significant effect on weed suppression, reducing the broadleaf weeds by 68% and annual bluegrass by 44% of the weed content where commercial seed was used. Levels of weed infestation, similar to commercial seed, were observed where several different of-the-shelf lawn mixes were used.

The comparison of a named cultivar of perennial ryegrass with common seed, however, did not show any advantage for the named cultivar in suppressing broad leaf weeds . Annual bluegrass infestation, on the other hand, was reduced by 36%.

Annual bluegrass appeared to be the most prominent weed at this site. No herbicide is available for the removal of annual bluegrass from a Kentucky bluegrass sports field. Furthermore, annual bluegrass is an inferior species with regard to wear tolerance. The use of nursery sod, therefore, becomes a more viable cost alternative to seeding where annual bluegrass is known to be prevalent at the field. Again it must be emphasized - ***the sod must be weed free.***

Table 1: The effect of seed source and method of establishment on broadleaf and annual bluegrass content two years following establishment.

Seed Source	Broadleaf Weeds	Annual Bluegrass
	(Rating of 1 to 5 ; 5 = 50%+ ground cover)	
Sod	.07	.05
Bare Soil	1.77	2.35
Kentucky bluegrass (Princeton)	.40	1.40
Kentucky bluegrass (Commercial)	1.25	2.50
Perennial ryegrass (Repel)	0.95	1.50
Perennial ryegrass (Common)	0.55	2.35
Lawn Mix #1	0.85	2.20
Lawn Mix #2	1.10	2.20
Lawn Mix #3	1.70	2.80
Lawn Mix #4	1.25	2.65

GRASS CLIPPINGS

Poa annua (annual bluegrass) is a weed grass that grows in every state in the United States, in Canada, and throughout the entire world. It seeds profusely and can germinate without a period of dormancy. It is called "annual" because after germinating it can produce seed within two months. However, it is actually a perennial because under favourable conditions it produces shoots from nodes on each stem until the plant is killed by some environmental factor such as cold temperatures or drought.

POTASSIUM for HIGH SAND ROOT ZONES

With the recent trend to the use of a high sand content rooting zone for sports field turf more attention must be paid to the potassium nutrition of the turf. The high maintenance level of the turf and frequent traffic make the grass prone to environmental and wear stress.

Potassium may be more readily leached from the root zone due to the low cation exchange capacity of the sands and to the heavy application of irrigation water. Soil testing, unless it is done frequently, may not reflect the potassium available to the grass during peak periods of stress.

Fortunately potassium is not considered a ground water contaminant, thus there is no environmental risk to having some potassium loss from the rooting zone. The only negative factor is the cost of the fertilizer.

Prof. Robert N. Carrow of the University of Georgia reported on some interesting data on nitrogen - potassium interactions on turf in the Summer, 1994, issue of the Better Crops Magazine. The study was conducted on a green containing 96.7% sand.

Four rates of potassium, as potassium sulphate, were applied to 'Penncross' creeping bentgrass on a golf green as a split application of 1/3 in March, 1/6 in June, 1/6 in late July and 1/3 in September. The rates of potassium were 0, 3.0, 6.0 and 9.0 lb. K_2O/1000 ft.^{2} to plots receiving either an average (6.0 lb. N/1000 ft.^{2}) or high (9.0 lb. N/1000 ft.^{2}) rate of nitrogen. The rates were repeated each year for a two year study.

The second summer was dry and water stress was often evident. At low N increasing the rate of potassium improved the quality of the turf (Fig. 1) The visual quality of the turf was rated inferior at high rates of N, however, the application of high rates of potassium in conjunction with the high N overcame much of the adverse effects of high N.

Potassium increased the clipping yield of the turf in August of the dry season at the low N rate (Fig. 2). At high N the lack of potassium depressed clipping yields below that of the low N treatment. At higher rates of K, however, the yield surpassed that obtained at a low level of N fertilization.

The improved quality and growth may be a reflection of the ability of potassium rich turf to withstand moisture stress. It is known that without sufficient potassium plants are unable to maintain adequate turgor pressure in the leaves and wilt will be observed.

Prof. Carrow recorded an assessment of the percent of a plot showing wilt in August (Fig. 3). While wilt symptoms were reduced by potassium at low N, at high N fertilization wilt was worse without potassium, yet was reduced to the same level as observed a low N when adequate potassium was provided.

As mentioned previously high sand content rooting zones will seldom show adequate potassium on a soil test. The turf manager, therefore requires a 'rule-of-thumb' which he may use to estimate the potassium requirements of the turf. From Carrow's study it would appear that a 2:1 ratio of nitrogen (N) to potassium (K_2O) would be satisfactory.

The frequency of application would be dictated by the nitrogen required to maintain the colour and density of turf that the manager desires.

For sports fields growing on normal loam or finer textured soils the turf manager should still rely on the soil test analysis to predict his potassium requirements.

[Editors Note: This study was conducted in Georgia with at least a two month longer growing season than most of Canada, hence the nitrogen rates used in this study may be 1/3 higher than would be suggested for Canadian conditions].

Figure 1

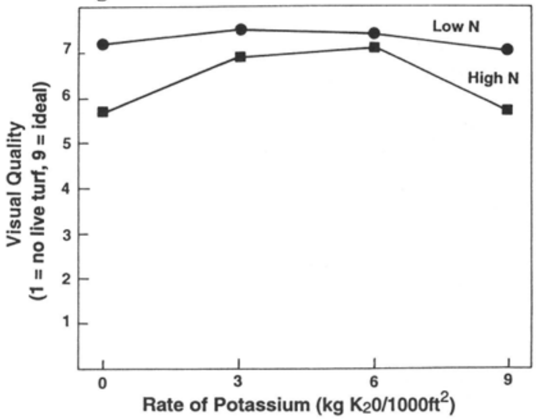


Figure 2

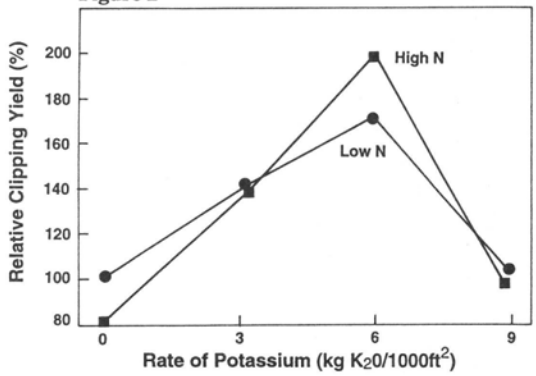
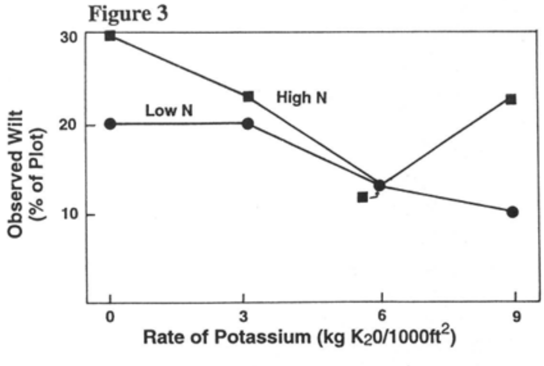


Figure 3



NEW MEMBERS

Gordon van Dyk, Scarborough College, U. of T.
Rob Sarson, Scarborough College, U. of T.
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Lindsay Herbert, North York Parks & Recreation
Chris Sheldon, North York Parks & Recreation
Gordon Andrews, North York Parks & Recreation

UNDERSTANDING TURF MANAGEMENT
The fourteenth in a series
by R.W. Sheard, P.Ag.

TOPDRESSING

It has been suggested that the concept of topdressing originated when someone recognized that creeping bentgrass growing on coastal sand dune areas spread faster and provided a more dense stand where the stolons were covered by drifting sand. This observation was applied to the maintenance of golf and bowling greens where it had the added benefit of levelling the surface and providing a smoother ball roll.

Since that discovery several reasons have emerged for topdressing. They are: thatch control, soil modification, smoothing and levelling, covering of bentgrass stolons, covering of seed during overseeding, recycling organic wastes through composting and winter protection. Two of these reasons, thatch control and soil modification will be covered in some detail.

Although thatch does not present a problem in most sports field management programs, lightly used areas on a field, such as corners may have a significant build up of thatch. Thatch can also become a problem on the grounds surrounding a sports field. Thatch is defined as the accumulation of living and dead leaves, roots and stems and other organic debris between the soil surface and the base of the green vegetation.

Why worry about thatch on a sports field? It should only make the surface more resilient. Thatch influences the quality of the turf, however, by creating localized dry spots, causes scalping during mowing, and increases the potential for disease, insect and winter injury.

Studies by Prof. Eggens of the GTI have demonstrated that topdressing is one of the most efficient procedures available for thatch control (Table 1). In this experiment topdressing was done monthly with the soil indigenous to the site at a rate of 0.1 m^3/100 m^2. The data was recorded after 10 topdressing operations over two years. Although cultivation reduced the depth of thatch, Eggens found topdressing alone was more efficient for the control of thatch than any of the cultivation procedures which are more costly and time consuming.

Substitution of topdressing for turf-damaging verticutting or coreing has the additional advantage of not opening up the turf sward to allow the germination of weeds. Eggens studies tended to show that annual bluegrass was not as prevalent in topdress-only plots as in plots where some form of cultivation was used.

Topdressing is often recommended for the modification of the root zone as well as levelling and smoothing the surface. The latter is accomplished by matting the surface after the topdressing operation.

A cardinal rule in topdressing is to topdress with the same material as was used in the construction of the existing root zone. If this rule is not followed it is impossible to predict what water transmission and retention values may develop with time as diverse layers of sand:soil mixes build up. Coring to relieve compaction, followed by topdressing with a non compatible mix may, over a period of time, result in a clay:silt:sand ratio which will compact to a greater degree than the original material.

A noted Canadian golf superintendent once remark "You can tell the number and duration-of-tenure of superintendents at any golf course by the number and depth of the sand layers in the surface of the green." The same may be said for some sports fields. Each resulting layer will have different water characteristics.

If the original rooting zone was a clay, a saturated zone may occur in the topdressing layer following a heavy rain or irrigation. Similarly a saturated zone may eventually develop due to a perched water table if the original root zone was constructed from a sand having a significantly different size distribution than the topdressing sand. The worse scenario is to topdress a sand rooting zone with a silty clay soil which will eventually plug the pores in the sand and ruin the advantages of a sand rooting zone.

Because of the time required to modify a rooting zone, the danger of incompatibility of particle size of the original material with the topdressing material and the restriction of the new root zone to the depth of coring, it is not recommended that topdressing be used as a procedure for field renovation. It is better to 'bite the bullet' and carry out a complete field renovation at which time corrections of any drainage problems can also be achieved.

The rate and frequency of topdressing is generally dictated by the amount of thatch accumulation. The rate may vary between 1/8 and 1/4 inch per application. Table 2 converts the depth of application to vol-

Table 1: The influence of topdressing and cultivation on the control of thatch in bentgrass maintained as a putting surface.

		Without Topdressing	With Topdressing
		mm	
Control	11.5		
Topdressing Only	4.2		
Vertical Mowing		9.4	4.0
Core Cultivation		8.1	4.9

Table 2: The volume of material required to topdress 1000 ft.^{2} area to various depths.

Depth of Topdressing	Volume ofSoil
(inches)	(cubic yards)
1/8	0.40
1/4	0.77
3/8	1.14
1/2	1.54
5/8	1.91
3/4	2.31

ume of material required per 1000 ft^2. Light topdressing at a rate of 1/8 inch every two weeks may be necessary if a new bowling green is being levelled. Most sports fields, however, may only require a topdressing at 1/4 inch twice each season to control thatch. The operation should be coordinated with periods of rapid tiller development and with the time of overseeding.

Topdressing may be used as a means of disposal of composted organic wastes from other parts of a grounds maintenance program (see Bladon, Sports Turf Newsletter Vol. 6, No. 1, pp 4). Bladon has found his program of topdressing with a soil:compost mix has reduced his thatch problems to near zero. He no longer uses any form of verticutting or coring for thatch. High capacity topdressing equipment has made the procedure rapid and economical. Furthermore his tipping costs at the local landfill site have been greatly reduced.

A factor which should be considered in the selection of topdressing materials is freedom from weeds. Obvious contaminants such as quack grass rhizomes should be ample reason to reject a supplier. Freedom from other weeds may be checked by a simple germination test. Freedom from herbicides used on the field where the topsoil was obtained should also be considered.

A final consideration should be freedom of the material from stones and other debris, such as broken glass, which might cause injury to the athlete.

Environmental Persistence of 2,4,-D and Other Pesticides used in Turfgrass

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GTI, University of Guelph

Pesticide use can be an important component in well designed programs to maintain turfgrass in high use areas. However, it is important to examine the persistence of any pesticides used if we are to understand and to minimize the chance for human exposure to these pesticides, particularly in public areas such as parks, school yards or sports turf situations.

Despite all the facts to the contrary, the general public continues to be fearful of 2.4-D. The logical and correct reaction is that most people prefer to avoid exposure to 2,4-D, or to any pesticide. Some municipal and school jurisdictions have banned the use of 2,4-D in public areas. The Ontario government has developed regulations that some areas must be posted with signs when treated with pesticides so that people can choose to avoid the area and minimize any chance for exposure. These concerns and questions led to a series of studies at the Univ. of Guelph on the environmental persistence of 2,4-D and other pesticides used on turfgrass.

The following is a summary of the main results of these studies.

When turfgrass is treated with pesticides for weed or insect control, only very low percentages (1 - 6%) can be physically dislodged by vigorous scuffling with cloth-covered boots immediately after treatment. Dislodgeable residues decline rapidly to well below 1% of applied material within one day for the insecticides diazinon, chloropyrifos or isofenphos and within four to five days for 2,4-D or related herbicides.

Mowing the turfgrass does not markedly influence the disappearance of dislodgeable residues.

At equivalent rates of active ingredient, granular herbicides or insecticides are less dislodgeable than liquid formulations of the same chemicals applied as sprays. However, at the high rates usually recommended for 2,4-D applied as a fertilizer formulation, the dislodgeable residues were not lower.

Irrigation or rainfall immediately after application reduced dislodgeable pesticide residues to negligible levels (less than 0.01%) even on the day of application. A light irrigation may even enhance the effectiveness of insecticides, particularly when they are applied as granular formulations.

[Editor's Note: A summary of an address presented by Prof. Stephenson at the First Annual Ontario Turfgrass Symposium, Guelph, Jan. 7 -9, 1992]

Turf Management, Athletic-field Conditions, and Injuries in High School Football

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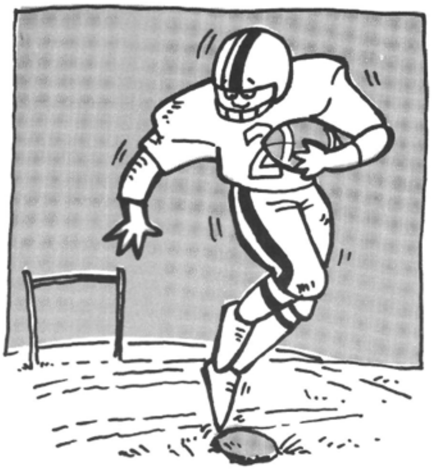
The wide range of turfgrass conditions existing on high school athletic fields in Pennsylvania may reflect: i) procedures used during construction, ii) past and current maintenance practices, iii) intensity of use, or iv) a combination of these factors. The conditions of a playing field is not only of aesthetic importance, but it also may affect play and player safety.

The prevention of athletic injuries, particularly in a violent contact sport such as football, is of major concern to most educational institutions. At college level, comparison of natural turf and artificial surfaces in regard to football injuries has received attention in recent years, but differences in quality of the turf on grassed fields has been a topic that has received only minor attention.

Wilcox, Fox, and Beyer [Athl. J. 45(10):34, 1965] reported a pronounced reduction in practice field injuries at one high school when practice sessions were moved from a dry and heavily compacted area to a field where the turf had been adequately maintained. Of course, the reduction in injuries may have been influenced by factors not under consideration. Also, conclusions based on data from a single high school may not be valid for other schools. Sanderson [Athl. Purch. and Facil. 4 (5) 54, 1979] stated that soil compaction of athletic fields is a leading cause of football players' knee injuries. He advocated a full maintenance program of aerification, overseeding, fertilization, and weed control to provide a playing surface that would tend to reduce the incidence and severity of injuries.

Well controlled studies of the effects of turf management practices on the incidence of injuries in football are needed. The purposes of this study were i) to evaluate conditions of high school game and



practice fields and determine the relationship of field conditions to maintenance programs; ii) to determine if a relationship existed between field conditions and the incidence of field related injuries in high school football, and iii) to provide professional advice concerning turf management programs in an effort to improve the quality of high school football fields.

Experimental Procedure

Selection of Participants:

In May, 1981, all high school athletic trainers who were active members of the Pennsylvania Athletic Trainers' Association were mailed a brief description of the proposed project. Trainers used the enclosed response card to indicate whether their school agreed to participate in the study and whether they were willing to provide the required reports of injury throughout the 1981 football season.

While most trainers expressed interest in the study, only 12 schools were willing to participate. This sample came from various locations across the state and provided 24 fields (12 game fields and 12 practice fields) for evaluation. Two of the schools did not provide a complete record of injuries, so injury results and correlations involving injuries are based on the data from 10 schools. Field condition and maintenance comparisons reflect evaluations of all 12 schools, however.

Injury Reporting:

All injuries to football players in the sample schools were reported through the National Athletic Injury/Illness Reporting System (NAIRS), established by The Pennsylvania State University in 1974. NAIRS receives weekly reports, submitted by team trainers or physicians, of injuries and illnesses sustained by members of an athletic team during practice and during competition. In this study injuries and illnesses were classified by NAIRS into four categories, as follows:

1. *Minor* - any reportable injury/illness (other than dental or head injuries) that did not prevent an athlete from returning to practice or competition for longer than seven days following the injury or illness.
2. *Significant* - all head and dental injuries (regardless of time lost from play or practice), and any injury/illness that kept an a thelete from returning to play or practice for longer than seven days.
3. *Major* - any significant injury/illness that prevented a player's return to practice or competition for 21 days or longer.
4. *Severe* - any permanently disabling injury, such as paraplegia.

Injuries/illnesses were reported on standard forms to NAIRS and coded into the system's data bank. Trainers of the cooperating schools included in their reports the location of the activity at the time of injury (playing field, practice field, or elsewhere) and their options about the likelihood of a casual relationship of playing surface to injury (definitely related, perhaps/possibly related, or definitely not related).

At the end of the season, data collected during the football season of the 12 schools - nature and category of injuries, condition of the field (wet, frozen, etc.) when the injury occurred, and the opinion of the trainer as to the relationship of the playing surface condition to occurrence or severity of the injury were compiled for study and analysis by the authors of this study.

Injury reports from two of the schools were not compete, and these schools were not included in the comparisons of injuries to conditions of playing surfaces.

Field Assessment:

School representatives provided information about maintenance practices and uses over the previous year. Maintenance practices included fertilization, liming, aeration (core cultivation), mowing, irrigation, overseeding, and control of weeds, insects and diseases. Uses included football games and practices, other varsity and intramural sports, physical education classes, band practices, community activities, and other activities. Estimated numbers of occurrences for each use were obtained.

Game and practice fields were evaluated twice - first in August, prior to or during preseason football practice, and again in early November as the season was ending. Inspections and evaluations were made by two turfgrass specialists from the College of Agriculture. Data were collected on kinds and amount of turfgrass, kinds and amount of weeds, total vegetative cover, turfgrass density, total weed coverage, smoothness of the surface, vegetative clumps, and stones on the surface. The recorded ratings represented a consensus. Data for subjective evaluations were assigned code numbers for use in statistical analysis. Evaluators inspected game fields at nine areas (between inbound hash marks and near each sideline at midfield and near each goal line). Areas inspected on the practice fields were selected to represent obvious differences in the playing surfaces. As part of the final field inspection, each field was also characterized according to undulations (free draining swales), depressions (which could hold water), crown or slope, and internal drainage. In contrast to ratings for natural undulations or depressions, the field roughness rating was an indication of holes and other irregularities caused by play. Also during the initial visit, soil samples were taken for determination of soil textural class, bulk density, pH, and available phosphorus (P) and potassium (K). Samples for bulk density represented the more intensively used portions of the fields. The percentages of sand, silt, and clay and the textural class of the surface soil were obtained by particle size analysis using a hydrometer method. Bulk density, the mass of soil per unit bulk volume, was determined from 10 soil cores, each an inch in diameter and 2.5 inches long. Samples from the surface 2.5 inches were used for pH determination using a 1:1 soil-to-water paste, and for phosphorus (P) and potassium (K) using Bray No. 1 and neutral, normal ammonium acetate extractants, respectively.

Upon completion of the second evaluation, Penn State specialists prepared a letter that described field conditions and suggested maintenance and/or renovation programs for fields at each school.

"As many as 20% of field injuries could have been prevented... by more favourable field maintenance."

Characterization of Data:

The number of injuries occurring during games (expressed as injuries per 1000 exposures) was compiled for the total sample of 10 schools and for each individual school. Data were summarized to indicate the number of reported injuries on each field, the relation of injuries to field conditions, and the number of injuries within various body-part categories.

Statistical procedures involving Spearman rank-order correlations for non-parametric data were determined to ascertain the possible relationships among the incidences of injury, field characteristics, and maintenance practices. The variables used in correlations were as follows:

Soil Properties: Sand (%), Silt (%), Clay (%), Bulk Density (g/cc), pH, Available P (lb/A) and Available K (lb/A).

Field Surface Rating Codes For Undulations, Depressions and Roughness: 0 = none, 1 = few, 2 = moderate, 3 = many, 4 = extreme.

Field Rating Codes for Stones (1 cm diam.): 0 = none, 1 = few, 2 = many.

Field Rating Codes for Vegetative Clumps: 0 = none, 1 = few, 2 = many.

Vegetative Characteristics Rating Codes:

Aug. & Nov. Cover: 0 to 9 where 0 = none, 9 = 100%

Aug. & Nov. Weeds: 0 = 2%, 1= 2 to 25%, 2 = 26 to 50%, 3 = 51 to 75%, 4 = 75 to 100%.

Aug. & Nov. Density: 0 = bare, 1 = thin, 2 = moderate, 3 = dense.

Maintenance Factors:

Nitrogen fertilization (lb/1000 sq. ft./year)

Aeration or core cultivation (no. of passes/year)

Mowing height (inches)

Use Rating: 0 = light, 1 = moderate, 2 = heavy, 3 = severe

Overall Field Rating: 0 = poor, 1 = fair, 2 = good, 3 = excellent.

Injuries - possibly or definitely field related (number).

When field conditions varied across a field, ratings used for correlations were representative of the area between the inbound hash marks.

Discussion of Results

Reported Injuries

A total of 210 injuries were reported by the 10 participating schools. Of these injuries, 96 occurred in varsity or junior varsity games, 4 in practice games, and 110 during scheduled practices. Of these injuries, 152 were classified as minor and 58 were significant. Of the significant injuries reported, 23 were major. No severe injuries were reported. The 10 schools had a total of 35,155 exposures during the football season (31,816 and 3,339 in practice and games, respectively). Rates of injuries per 1000 exposures were 4.21 for minor injuries, 1.59 for significant injuries, and 0.65 for major injuries.

Although the number of injuries sustained in practices was about the same as that in games, the number of exposures during practices, based on the average size of squads (practice or game), and the number of sessions (practice or game) was nearly 10 times as great as the number of game exposures. However, the severity of contact and intensity of play during the games probably were considerably greater than for the practice sessions.

Of the 210 injuries reported, 12 (5.7 percent) were definitely field related, 15.2% were considered possibly field related, and 76.7 percent were definitely not field related. In the judgement of the trainers responsible for recording the data on location at the time of injury, a total of 44 injuries (20.9 percent) may have been caused by poor field conditions. On the basis of these data, it can be estimated that as many as 20 percent of the reported injuries could have been prevented or perhaps rendered less severe by more favourable field conditions. Safety conditions should thus be an incentive for the construction and maintenance of high-quality playing surface, for practice as well as games.

Within each body-part category, injuries are further classified according to their relation to field conditions. As would be expected, most of the injuries judged to be related to field conditions involved the lower extremities (i.e., hip/leg, knee, and ankle/foot). Also, it should be noted that the majority of injuries to lower extremities were classified as definitely not field related or, in other words, they were considered by the athletic trainers in attendance at the time of occurrence to be injuries likely to have been sustained regardless of field conditions.

Field Characteristics

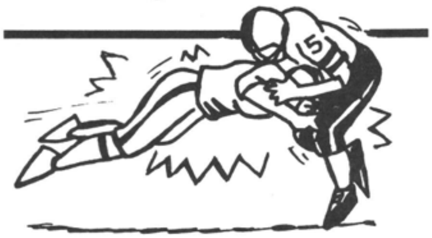
Field Maintenance: Data collected on maintenance of game and practice fields indicated considerable variation between fields at a particular school as well as among fields of different schools. Although practice fields were much more intensively used than were the game fields, they received less care.

Mowing heights were similar on game and practice fields, but game fields received more nitrogen fertilization and more aeration than practice fields. Game fields averaged 2.0 lb. N/1000 sq. ft. compared to 0.2 lb. N/1000 sq. ft. for practice areas.

Herbicides were used for weed control on 25 percent of the game fields: not one school reported use of weed killers on practice fields. All fields receiving weed control chemicals were treated with a preemergence crabgrass herbicide and a combination herbicide for broadleaf weed control.

Eighty-three percent of the 24 fields involved in this study were overseeded in the spring. Only 75 percent of the 12 playing fields and 25 percent of the 12 practice

Practice fields were used more, yet received less care than game fields.



fields were aerated. Not one of the schools had access to a disk seeder, and only a few schools had access to aerators. Some of the fields were thus overseeded without adequate seedbed preparation. Without the seed-to-soil contact provided by proper preparation of the seedbed, success of the seeding is highly unlikely.

Field Conditions: Game fields were in better condition than practice fields. In general, game fields had smoother surfaces, lower bulk densities (less compact soil), fewer weeds, more vegetative cover, and more dense turf. The better conditions on the game fields are no doubt a reflection of better construction and maintenance practices. Soils on all fields were medium or fine textured and were distributed among the following textural classes: loam, silt loam, clay loam, silty clay loam, and silty clay. Kentucky bluegrass was the predominant turfgrass species on most fields. Perennial ryegrass had been used to overseed fields; in some instances, the ryegrass population approached or exceeded that of Kentucky bluegrass.

Weed cover decreased during the season, primarily because of the poor wearing qualities of species such as clover and knotweed, and loss of summer annuals such as crabgrass, goose grass, and knotweed. Lower ratings for vegetative cover during the second of the two evaluations were associated with reductions in weed populations. Turf density likewise decreased during the season: most practice and some game fields were nearly or entirely without vegetative cover between the inbound hatchmarks at the second of the two field evaluations.

Additional or more effective maintenance practices (i.e., aeration, fertilization, overseeding, and weed control) were needed on most of the game fields and on all practice fields surveyed in this study. Practice fields were used more than game fields, but received lower levels of maintenance. All practice fields in this study were considered to be in poor condition, thus presenting surfaces potentially more conductive to player injury.

Relationship Between Various Field Variables: Correlations were used to indicate a relationship between two variables. Two variables may be correlated because one directly affects the other, or because both are influenced by an external factor. A negative correlation coefficient indicates that one variable decreased as the other increased.

Statistically significant correlations based on data from all fields were listed. In general, correlations indicated that the field with better maintenance practices also had better field conditions. good maintenance practices seemed to be a carryover of good construction methods. For instance, factors associated with higher rates of nitrogen fertilization were fewer undulations and depressions, more aeration, lower bulk density, fewer weeds, and greater cover. Factors associated with increased aeration were higher nitrogen fertilization, fewer weeds, and greater cover early in the season. Fields with the most depressions also had more undulations, a rougher surface, more stones, less dense turf, less cover, less nitrogen fertilization, and severer use.

Good cover prior to the season was associated with higher N fertilization, more aeration, greater density, less roughness, fewer depressions and stones, and less use. At the conclusion of the season, better cover was associated with good cover in August, greater density in August and November, smoothness, fewer depressions and undulations, lack of stones, less use, and fewer weeds in August.

The highest correlations with use ratings were the negative correlations with density in August and with cover in August and November. Cover in November gave the best correlation with overall field rating.

Correlations were also determined for game fields only and practice fields only. Fewer significant correlations occurred when the sample was limited to either game or practice fields; however, the results tended to support the relationship found when all fields were considered. The complexity of interpreting correlations can be illustrated by the negative correlation between aeration and November density for game fields. One might question the result because it seems that a better aerated field should better support a turfgrass stand. On the other hand, fields that have a less dense cover are in greater need of aeration, and the data suggest that they are getting more.

Recommendations for Field Improvement: Good fields were associated with good management programs. Some fields, however, were poor because of construction methods and needed renovation beyond that provide by normal maintenance practices. Suggestions for maintenance and renovation programs were sent to each school following the second field evaluation. Subsequent visits have indicated that those schools that followed these suggestions have substantially improved their fields.

Methods for getting information about construction, maintenance, and renovation of fields to those in charge of field management must be implemented and improved. Valuable information is published in various forms, but it may not be reaching those having the greatest need. Chalmers (Tech. Turf Topics 7: 1982) reported that a survey of football field managers in Virginia indicated that 78 percent were not happy with the turf quality of their fields and 94 percent wanted to improve the quality of the fields. County extension personnel, extension specialists, turf consultants, representatives of turf equipment and supply companies, and others involved in turfgrass management can and usually are quite pleased to provide guidance and information about athletic field maintenance.

The quality of construction and maintenance use for school fields may be related to socioeconomic factors within the community. Our results indicted a trend for better maintenance practices on better constructed fields. Such a trend may have been coincidental, but it should be an incentive to construct and maintain high quality playing surfaces.

In general, better field conditions were associated with better maintenance. Schools with well- constructed fields often had better turf management programs. Practice fields were used more than game fields, but received lower levels of maintenance and were in poorer condition. Additional or more effective maintenance practices (i.e., aeration, fertilization, overseeding, and weed control) were needed on all practice fields and most game fields evaluated in this study.

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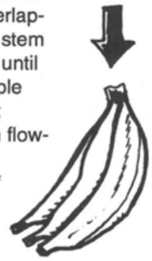
GRASS CLIPPINGS

In a monocot the leaf sheath is often a structural or support element. The overlapping sheaths form a tube through which the new leaf or stem grows. An extreme example is the banana "tree." A fifteen-foot 'trunk' is formed by overlapping leaf sheaths. The stem remains below ground until flowering, when a flexible stem snakes up an out through the top to form flowers and fruit.

[Madison - Principles of Turf Culture]



FLEET SAFETY PROGRAMS

They Can Make A Difference

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It seems that two items which are continuously stressed in the workplace these days are increasing health and safety and the seemingly never ending budget constraints. All of us from front line staff to managers to department heads are trying to create a safer workplace, while at the same time reduce our costs, without lowering service levels. Needless to say, a constant challenge.

However, there is a one way to achieve these goals - development of a Fleet Safety Program. This will increase employee safety through accident awareness and prevention training, while at the same time reduce your costs. If you can demonstrate to your insurance carrier that you have an ongoing fleet safety program, and that you have a commitment to safe driving, your premiums will be lower. Less accidents means fewer repair costs and reduces the potential for employee injury and lost time from work and hardship for families.

Whether you have a small fleet of equipment consisting of a few trucks, riding mowers, tractors, or a large fleet such as a municipality, school board, or post secondary educational institution with many pieces of equipment; your operation will benefit by having a fleet safety policy and program.

Fleet safety programs can have a number of objectives, but primarily they should be designed to reduce and eliminate accidents, thereby increasing safety and reducing fleet operating costs through repairs and insurance. From personal experience in sitting on a committee to develop a fleet safety program, it can be seen that by instituting a safety program accidents have been reduced, which translates into lower insurance premiums and lower repair costs for vehicles and equipment. Depending on the size of the operation, these savings can be sizable.

First and foremost a fleet safety program must stress Defensive Driving. Simply defined, defensive driving emphasizes that a defensive driver is one who is always aware that others can and will make driving errors. Therefore, a defensive driver operates his/her piece of equipment or vehicle in a manner which avoids accident - producing situations for potential accidents, given the traffic and road conditions.

Some objectives of a fleet safety program can be the following;

- develop an attitude of defensive driving in the operators of your vehicles and equipment,
- reduce and eliminate vehicle and equipment accidents thereby reducing fleet operating costs by means of accident prevention techniques and employee training,
- promote accident prevention through investigation and review of all accidents which will assist in ensuring the accountability of drivers for their actions,
- provide the safest possible environment for employees and other community members through operating vehicles and equipment in a professional and courteous manner,
- ensure that all operators of your fleet of equipment know and obey the regulations of the Highway Traffic Act and appropriate municipal By-Laws, and
- provide for continuous education and training for employees to attain and maintain the driving skills necessary to avoid accidents.

An effective fleet safety program will clearly spell out guidelines for the hiring staff who will be driving vehicles and/or equipment as part of their duties. This should begin with the job posting or job description. The portion of the job posting related to driving should identify the following;

- note which class of licence is required for the position ie. G, D, A, DZ, AZ, F