UNIVERSITY OF CALIFORNIA, RIVERSIDE TURFGRASS RESEARCH PROGRAM

Better Turf Thru Agronomics

UCRTRAC Newsletter, December 1999

Contact Transfer of Pesticides from Turf: Refocusing Default Assumptions on Reality

The turf industry will be regulated by unvalidated default assumptions for turf unless the industry provides better data to the USEPA.

If the turf industry is not aggressive in determining the levels of human exposure to pesticides from contact with turf, then regulators, who have little data and are unfamiliar with turf, will decide the industry's risk assessment fate, warns a toxicologist at the University of California, Riverside.

The *potentia*l for human exposure to chemicals from turf occurs when pesticide applicators perform their jobs, when adults and children are recreating in contact with treated turf surfaces, or, to a much lesser extent, when persons breathe the air after treatments (inhalation exposure).

"Without modifying pesticide use practices or using 'safer' pesticides, more accurate human exposure data can result in risk assessments that are less reliant upon default assumptions that inflate exposure assessments and may misguide development of mitigation measures," wrote Bob Krieger, Extension Toxicologist, Personal Chemical Exposure Program, Entomology Department, UC Riverside, in his review article, *"Human Exposure Assessment in Risk Perception and Risk Management,"* published earlier this year by the **American Chemical Society**.

The United States Environmental Protection Agency (USEPA) must make default decisions when they have no data, Krieger said. Turf products are not well-represented in the current database, he said.

Krieger's pilot study has shown that the transfer of pesticide residues from treated turf surfaces results in human exposure well below levels of health significance.

"The default regulatory rate for contact-transfer exposure -- known as the transferable residue -- the amount of pesticide ***assumed*** to be available to a person via clothing or skin in contact with the treated surface is 20% of the applied rate. This 20% default assumption is excessive for turf. In turf, the amount available for exposure by contact-transfer is 1% or less," Krieger said.

"The industry must provide better data to the USEPA on how pesticides are used on turf, when they are used, who uses them, how long they are used, and creditably estimate potential human exposure," Krieger said.

The turf industry will be regulated based on this invalid 20% default assumption unless it takes a proactive role and generates reliable, realistic contact-transfer exposure data for activities associated with turf recreation and management, he said.

The fate of pesticides in the environment after application is illustrated by a curve that shows exponential decay over time (Fig. 1, page 2).

To estimate human exposure from environmental residues, a series of transfer factors have been developed. Human exposure to agricultural chemicals is calculated as residue x transfer factor x time. Similar studies have not been done for persons who contact turf, so the procedures used for agriculture have been adopted.

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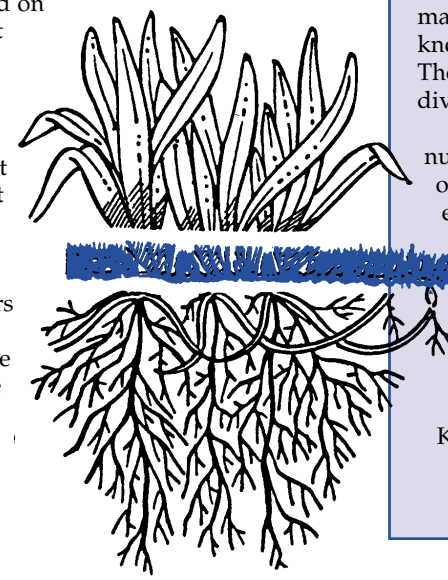


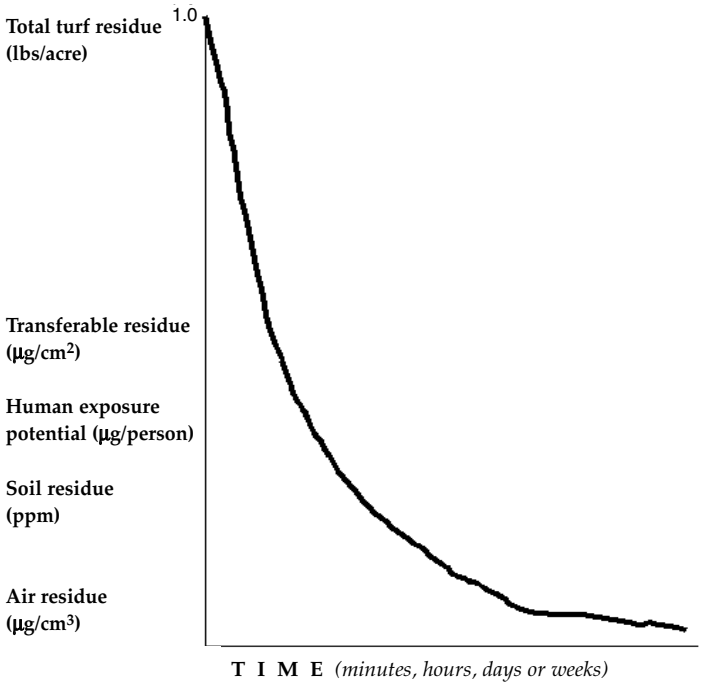
NOEL and Exposure Reduction Measures

"Success or failure of exposure reduction measures are judged by using a toxicological standard -- the no observed effect level (NOEL) -- resulting from hazard identification and dose-response studies in animals. Minimizing risk resulting from absorption of chemicals used as pesticides entails reducing or mitigating exposure relative to the NOEL," Krieger said.

The NOEL is a conservative, regulatory estimate, not a measured level of exposure, he said.

Exposure is a measure of the environment leading to a dose. It is measured as the concentration of a chemical in the matrix in contact with an organism (humans) integrated over the duration of the contact. ***Absorbed dose*** (internal dose) is the amount entering systemic circulation after crossing a specific barrier, such as skin, lung, or digestive tract. The absorbed daily dosage (ADD) is a measure of the absorbed dosage stated in mg/kg/day. The ADD is used to calculate the margin-of-exposure (MOE, also known as margin-of-safety). The MOE is equal to the NOEL divided by the ADD.

"Although both the numerator and the denominator of the margin-of-exposure expression commonly include default assumptions resulting from incomplete knowledge, the accuracy of pesticide exposure assessments can be improved so that apparent risk can be reduced," Krieger said.



Determinants of human exposure shown on the left are not to scale. Time will be determined by the nature of pesticide use on turf and environmental factors, such as moisture and sunlight. Each determinant (not to scale) declines following an exponential function similar to the one shown above. *Source : Dr. Bob Krieger, UC Riverside*

PESTICIDE EXPOSURE, *continued from page 1*

"The concept is very useful, but the exposure estimates are unvalidated in turf," Krieger said.

When golfers kneel on the turf to align a putt, a theoretical potential for exposure to herbicides exists if the turf was treated with herbicides to control weeds. At a specified number of hours after treatment, the pertinent question is, What is the real human exposure risk for contacting herbicide residues on the skin while kneeling (dermal exposure) or for breathing them (inhalation exposure)?

"Only less than 1% of the applied pesticide would be available and only a portion of that amount would penetrate clothing and be absorbed through the skin," Krieger said.

"Since the majority of these chemicals are semi-volatile, very low amounts are present in the air. You cannot breathe fast enough to acquire a toxic dose. That doesn't stop some persons from believing there is a problem. Some regulatory decisions seem to indicate that it is worse for a chemical to smell bad rather than to be bad," he said.

"If an official inventory of the exposure potential of activities associated with turf recreation and management were developed, it could be used to reduce concerns about possible health consequences of human exposure," Krieger said.

Sports Turf Management Overview: I. Primary Maintenance Practices

Editor's Note: Part II. Secondary Maintenance Practices will be printed in the Winter Issue.

Sports turf managers have tough jobs that require fulfilling the performance expectations of athletes, spectators, and owners as well as maintaining playable, safe, durable, aesthetically pleasing, and uniform turf adapted to athletic field sites' intensity of use.

Scientific principles of turf management, budget constraints, marketing strategies, and creative talent for recognizing on-site nuances all play a role in getting the job done successfully.

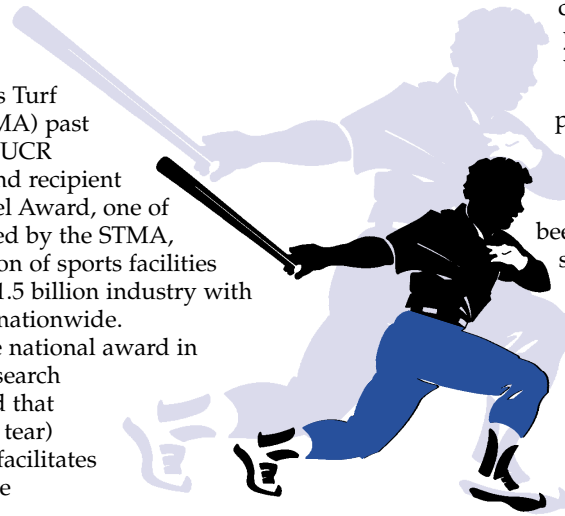
"Field playability is both measurable and perceptual. The speed of the turf surface related to a ball or runner can be measured. The feeling of speed an athlete perceives is related to several controllable factors including firmness, surface uniformity, height of cut, puffiness, and thatch," said Steve Cockerham, UCRTRAC delegate, Sports Turf Managers Association (STMA) past president, superintendent, UCR Agricultural Operations, and recipient of the Dr. William H. Daniel Award, one of the highest honors bestowed by the STMA, the professional organization of sports facilities managers who oversee a $1.5 billion industry with more than 40,000 facilities nationwide.

Cockerham received the national award in recognition of the novel research equipment he has designed that simulates traffic (wear and tear) from cleated shoes, which facilitates fine-tuning cultural practice recommendations. The turf for golf, baseball, and football can improve because Cockerham's simulators yield uniform data for quantifying wear traffic patterns.

The amount of punishment cleats deliver -- the intensity of use -- affects traffic patterns and care requirements, Cockerham said. To ensure a durable, safe, playable, and aesthetically pleasing turf playing surface for sporting events, in which wear tolerance and recuperative ability are nurtured, Cockerham, who consults with professional sports teams, recommends that athletic field managers focus on cultural practices in ten categories.

The first six are called ***primary maintenance practices*** because budgets must be allocated to allow adequate cultural operations in these categories. The final four, called ***secondary maintenance practices***, yield optimum sports turf performance when budgets permit.

But before discussing these cultural practices, three assumptions must be understood. Focusing on maintenance issues assumes that (i) a uniform turfgrass stand has been established, (ii) the turf species selected is adapted to the athletic field site and its intensity of use (traffic conditions), and (iii) the athletic field was constructed to provide adequate drainage.



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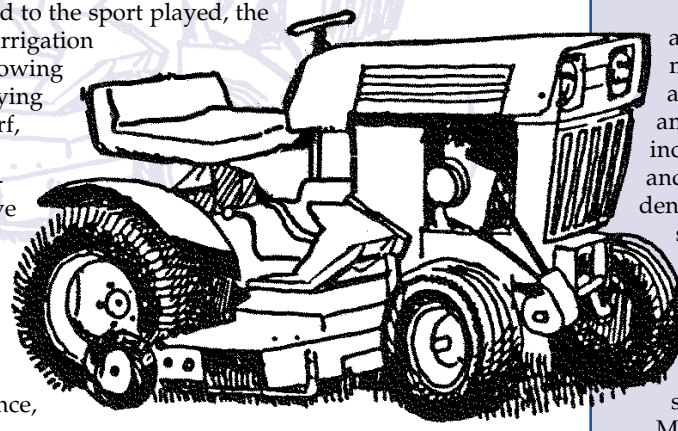
Poor drainage is the single most common cause of field failure, Cockerham said. If a sports field does not drain properly, playability is compromised dramatically. Water not moved off the surface or through the profile in a timely manner will cause extreme play damage and loss of turf. Drainage problems usually result from technical construction errors that occurred long before the turf manager's charge to maintain an existing field in optimum condition.

Primary Maintenance Practices

(1) Mowing

On sports fields, height of cut affects speed of play, impact absorption, traffic tolerance, playability, and appearance. Recommended mowing heights are species specific and related to the sport played, the time of year, and irrigation practices. Low mowing yields a faster playing surface, denser turf, and shorter root system. A rule-of-thumb is to remove less than 1/3 of the leaf blade at one time. Scalping the sports field impairs surface playability, resilience, and appearance.



Mowing patterns can be used to mask many field problems or inconsistencies. Stripes or geometric designs of various widths become the spectator focus.

Vertical mowing can be an important tool to keep thatch and puffiness under control. Although thatch makes mowing more difficult, some thatch is not necessarily a bad thing on certain kinds of sports fields because it increases traffic tolerance, impact absorption, and footing. On the other hand, sports in which playability is influenced by a rolling ball, such as golf and baseball, need turf in which the grain is controlled.

(2) Irrigating

Irrigation events can affect field playability. When determining the amount and timing of irrigation, variables to consider include soil type, turf variety, distribution uniformity, water quality, microclimate, and scheduled sporting events and practices. For example, on sand fields, irrigation prior to use can improve footing; whereas, irrigation of other soil types just before a game could decrease wear tolerance and recuperative ability. Water applied too close to field use can make fields soft and subject to excess damage. Irrigating at night reduces the possibility of playing on a wet field. Irrigation systems must be maintained in good repair with adequate pressure and volume. Efficient systems provide uniform coverage with no dry spots in the field of play.

(3) Fertilizing

Turfgrass nutrition is one of the most critical variables affecting the quality of a sports field. To develop an effective fertilizer program, managers must consider the turf species, types of sport(s) played, events and practice schedules, expectations, and budget.

Nitrogen (N), the fertilizer nutrient required by sports turf in the largest quantity, can be severely deficient if fertilization

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Urban Waste-Based Soil Amendments May Benefit Turf and Landscape Industries

When performance-based technical specifications for organic waste-based soil amendments are developed, suppliers will have the opportunity to respond with high-quality products that have beneficial uses and consistent performance for the turf and landscape industries.

The benefits of organic amendments as soil conditioners, mulch, and planting mix additives are well documented. Organic amendments condition soil by increasing water holding capacity and permeability and reducing bulk density. As mulches, they preserve soil moisture, modulate soil temperature, and improve aesthetics. As planting mix additives, they can be formulated to improve a soil's physical properties or to satisfy special nutritional needs.

More than 4.4 lb/person/day of municipal solid waste is generated nationwide annually. Since the enactment of AB 939 (California Solid Waste Reduction Act), larger quantities of green wastes have been separated from the urban solid waste stream, diverted from landfills, and processed into stable organic matter awaiting beneficial uses, but the resulting organic product is variable in quality, contents, and utility.

"At present, there are no criteria for judging the expected performance of waste-based soil amendments. To be accepted by end users, waste-based products should meet performance-based technical specifications that define their physical and chemical properties," said Andrew Chang, agricultural engineer in the Environmental Sciences Department at UCR.

When waste-based products fit industry specifications, demonstrate consistent performance, and are sold at competitive prices, then suppliers will have a market, end users' needs will be met, and the waste resources will be recycled efficiently, he said.

"If stakeholders -- end users, suppliers, and Cooperative Extension -- will get together, they are in the position to develop industrywide criteria," Chang said.

SPORTS TURF, *continued from page 3*

has been ignored. Recognizing that site-specific issues related to the variables cited above will influence the efficacy of general recommendations, a "generic" N fertilizer program for a hypothetical sports turf located in Southern California is provided as an example: A complete fertilizer, such as 15-15-15, should be applied at a rate of 1 lb N/1000 ft^2 in February. Then in April, June, and September, soluble N products, such as ammonium sulfate (21-0-0) or ammonium nitrate (33.5-0-0) or urea (45-0-0) should be applied at rates of 5.0 lb, 3.0 lb, or 2.2 lb/1000 ft^2, respectively.

To make the value of this "generic" N fertilization program more concrete, it is useful to think in terms of how many hours of adult athletic activity the N fertilizer will support. On Southern California sports turf, these N fertilization rates will support approximately 10 game-time hours of soccer/week (2-3 times for pre-teens) or 6 game-time hours of youth football/week or 20 game-time hours of baseball/week. If the maintenance budget will permit N applications on overseeded bermuda in November and January, then the intensity of use can double for youth football and increase by 50% to 30 game-time hours of baseball/week.

When N is applied before the last mowing of cool-season grasses, it improves spring greenup. When N is applied late in the season on warm-season grasses before they go dormant, fall color retention is improved. The roots of dormant warm-season grasses are still capable of absorbing some N.

Long-term nutritional health must be weighed against short-term turf performance. Managers can push short-term recovery with added N at the expense of long-term turf performance, since high rates of added N favor top growth and lead to decreased root and rhizome growth.

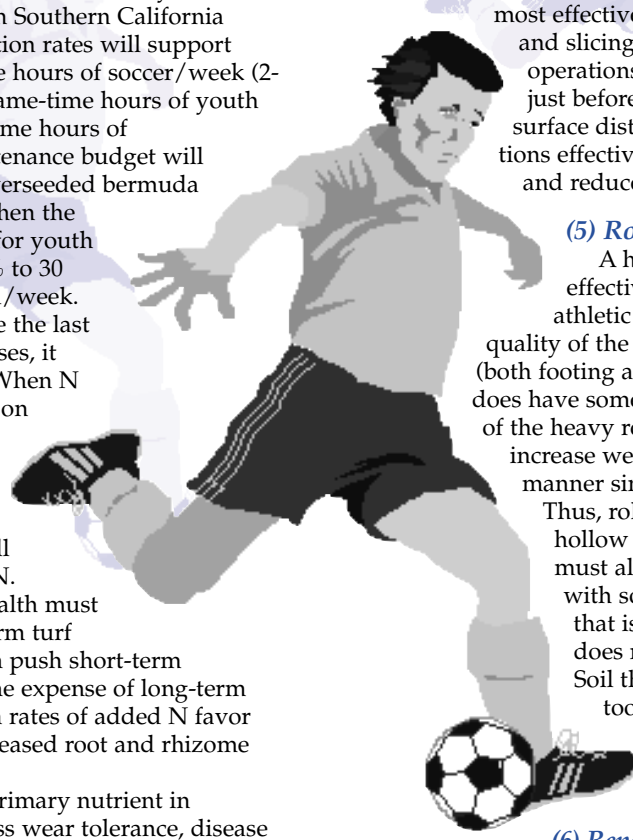
Potassium (K), another primary nutrient in fertilizers, improves turfgrass wear tolerance, disease tolerance, and aesthetic quality. Budgets permitting, a rule-of-thumb is to apply equal amounts of N and K on sand. On loamy soil, K is applied at half the N rate. Regardless of soil type, when budgets permit N and K applications, after using the complete fertilizer in February, then fertilizers such as 12-6-16 or 22-3-10 can be applied monthly in April - July and in September and October.

Iron (Fe) can be applied for color. Even if tests do not show Fe to be deficient, an application of ferrous sulfate will darken the turf, particularly for an event. Care is necessary because excess iron will burn the turf.

(4) Aerating

Aerification is essential on sports fields for compaction relief. Compaction that results from sports traffic does not occur uniformly over the entire field nor throughout the year. Spring sports traffic causes more soil compaction than fall or winter traffic. Compaction occurs primarily in the upper soil inch and manifests as reduced rooting depth in moist soil and reduced total root growth in dry soil.

Sports fields on soil should be core cultivated at least three times per year -- in early spring, summer, and fall -- with 5/8 inch hollow tines to at least 3 inches deep. Dragging the field with a steel mat after aeration to break up the cores and work soil back into the holes will help to reduce thatch. Solid tines, used to shatter the soil below the surface, are most effective on dry soil. Spiking and slicing are quick, temporary operations that can be performed just before a game due to limited surface disturbance. Both operations effectively increase infiltration and reduce surface crusting.



(5) Rolling

A heavy, flat, steel roller is effective for smoothing the athletic field and improving the quality of the turf playing surface (both footing and firmness); however, it does have some drawbacks. The weight of the heavy roller (2.5 tons) can increase wear and compaction in a manner similar to human traffic. Thus, rolling must be followed by hollow tine aeration. Rolling must also be timed to coincide with soil moisture content. Soil that is too dry is hard and does not respond to rolling. Soil that is too wet compacts too readily and is very difficult to manage when a steel roller is used.

(6) Repairing or Replacing Turf

Due to traffic, sports fields will show wear. Worn spots must be reseeded or resodded. Local renovation involves working only the most severely damaged areas, such as the middle of the football field, the goal mouth of soccer fields, or the baseball outfield. Overseeding before games allows the players to work the seed into the surface with their cleats. When the field is too worn for repair, full rehabilitation is recommended. If possible, once per year, the field would benefit from being out-of-play for 30 days.

Better Turf Thru Agronomics is prepared for the delegates and membership of the University of California, Riverside Turfgrass Research Advisory Committee (UCRTRAC). Member organizations are the Southern California Golf Association; California Golf Course Superintendents Association (GCSA); GCSA of Southern California; San Diego GCSA; Hi-Lo Desert GCSA; California Sod Producers Association; Southern California Section, Professional Golfers Association; Southern California Turfgrass Council; Southern California Turfgrass Foundation; United States Golf Association; and UCR. The intent is to present summaries of turfgrass research results and topical information of interest to the Southern California turfgrass industries. The newsletter is written by Deborah Silva and edited by Dr. Vic Gibeault and Dr. Robert Green and designed by Jack Van Hise, UCR Printing and Reprographics.