Reducing Pesticide and Nutrient Runoff from Fairways Using Management Practices

Scientists at the University of Minnesota investigate how superintendents play a key role.

BY PAMELA RICE AND BRIAN HORGAN

OBJECTIVES

- To quantify pesticide transport with rainfall runoff and evaluate the ability of management practices to mitigate pesticide and nutrient loss with runoff.
- To evaluate the mobility of snow mold fungicides and late-fall fertilizer with rainfall and snow-melt runoff.
- To determine the impact of location of chemical application to their transport with surface runoff.

Start Date: 2005
Project Duration: Three years
Total Funding: $90,000

We designed experiments to measure the quantity of fertilizers and pesticides transported with runoff from golf course fairway turf, and to evaluate the ability of management practices to reduce the transport of applied chemicals with runoff. During the 2005 season, half of the plots were aerified with solid tines, while the remaining plots were aerified using hollow tines. Cores removed with the hollow tines were allowed to dry, broken into smaller pieces, and worked back into the turf.

Fertilizer (18-3-18; N, P_2O_5, K_2O), a conservative tracer (potassium bromide), and a commonly utilized herbicide (2, 4-D), insecticide (chlorpyrifos), and fungicide (flutolanil) were applied to all plots 12-36 hours prior to the initiation of the simulated precipitation. Rainfall simulations and collection of resulting runoff were completed 2 days and 63 days following aeration (2d, 63d).

Runoff volume was reduced in fairway turf plots aerated with hollow tines relative to solid tines. When plots were aerated 2 days prior to initiation of the rainfall simulations, the plots aerated with hollow tines demonstrated a 55% reduction in total runoff volume compared to plots aerated with solid tines. Similar trends were observed when plots were aerated 63 days prior to simulated rainfall and runoff. However, the difference in measured runoff volume was reduced to 10%.

Chemical analysis of the runoff water revealed a greater than 30% reduction in quantities of phosphorus (soluble-P), ammonium nitrogen (NH_4-N), and nitrate nitrogen (NO_3-N) measured in the runoff from turf plots aerated with hollow tines 2 days prior to initiation of the rainfall simulations compared to plots aerated

Nutrient and pesticide runoff from fairways can be mitigated using hollow-tine aeration when compared to management with solid-tine aeration.

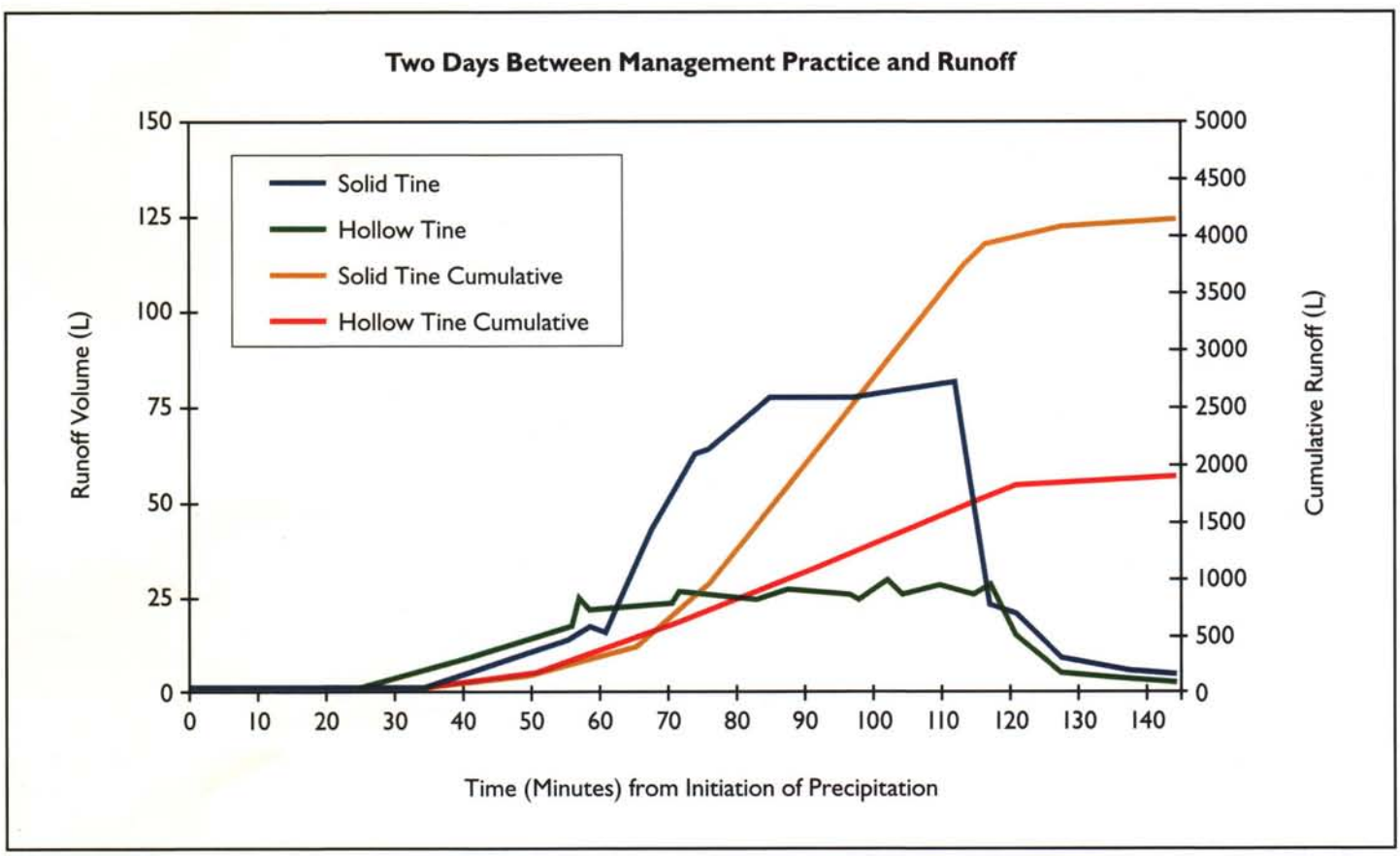
Rain simulators were used to produce runoff 2 and 63 days after aeration treatments. Runoff was then analyzed for 2,4-D, chloropyrifos, flutolanil, and a potassium bromide tracer.

with solid tines. A 5% to 27% reduction in nutrient loss with runoff from the hollow-tine plots remained even when the time between aeration and runoff increased to 63 days. Results of the pesticide analysis show a 15% to 56% reduction in quantity of pesticides measured in runoff from plots aerated with hollow tines compared to solid tines.

An additional management practice, vertical mowing, was evaluated during the 2006 season. Prior to the first rainfall simulation and collection of runoff, all plots were treated identically with weekly sand topdressing and aerified with hollow tines 11 days before the chemical application. Cores removed with the hollow tines were allowed to dry, broken into smaller pieces, and worked back into the turf. Volumes of runoff collected from the plots were similar.

Five weeks following the first rainfall simulation, all plots were aerified a

Research at the University of Minnesota determined that solid-tine coring was less effective than hollow-tine coring in reducing runoff losses from fairway turf.



Preliminary results of fertilizer transport show reduced runoff volume, nitrogen loss, and phosphorus loss with hollow-tine aeration compared to solid-tine aeration.

CONNECTING THE DOTS

An interview with Dr. Brian Horgan *regarding the runoff mitigation work at the University of Minnesota.*

Q: *The preliminary results of your study are very promising and seem to offer superintendents a real tool to help mitigate fairway runoff losses. Please explain how the potassium bromide tracer is used in this study.*

A: As a salt, potassium bromide, KBr, is water soluble. When the salt dissociates, the bromide acts similarly to nitrate, NO_3^-, and water-soluble pesticides like 2,4-D. The use of KBr in these studies allows us to validate results for water-soluble nutrients and pesticides we identify in runoff.

Q: *How widely is solid-tine coring done in Minnesota, and do you think your data will influence superintendents to choose hollow-tine coring as a stronger management plan to mitigate runoff?*

A: On fairways, both hollow- and solid-tine coring are common practices, depending on the overall objective of the aerification practice. For those superintendents not managing a thatch problem, convincing them to use a more labor-intensive hollow-tine coring technique to reduce pesticide movement may be a challenge.

Q: *Please describe the timing and application rates of late-fall fertilization. Is late-fall fertilization commonly practiced on Minnesota golf courses? Do you have sufficient data to determine how different fairway aeration methods affect nutrient runoff? If so, how much difference did the treatments make?*

A: The "art" of late-fall fertilization is not a perfected science. Golf courses that apply a late-fall fertilizer wait until just after a mowed turfgrass no longer produces clippings. At this time, roots are still actively growing and producing and storing sugars for winter survival and spring green-up. Data are still being analyzed to determine the impact of fairway aeration methods on nutrient runoff from late-fall applied fertilizers.

Q: *What is the public's perception of the effect of Minnesota golf courses on water quality? What state and/or local regulatory restrictions are in place regarding nutrient and pesticide applications to Minnesota golf courses?*

A: Minnesota is the first state in the country to restrict the use of fertilizers containing phosphorus applied to turfgrass. Throughout the debate, the positive attributes associated with proper applications of fertilizer applied by educated turfgrass managers were defended. Golf courses received an exemption to the law following training. Over 500 golf course personnel have received this ongoing training.

Q: *Do you feel you have enough definitive results from this study to include hollow-tine coring and vertical mowing in a best management plan (BMP) to mitigate pesticide and nutrient runoff from Minnesota fairways?*

A: Yes, a greater than 27% reduction in nutrient runoff and up to 56% reduction in pesticide runoff is possible when using hollow-tine coring and vertical mowing as a BMP.

Q: *How are golf course superintendents reacting to this information when it is presented at conferences and field days?*

A: Very positively. Golf course superintendents are looking for ways to enhance their environmental stewardship. This research provides tangible options and opportunities.

Q: *Have you gotten reaction to this work from scientists in other states that may be interested in extrapolating your work into their own BMPs?*

A: Data have been presented at scientific conferences around the world and the reaction by our peers has been positive. Three manuscripts have been submitted to various journals for peer review.

Jeff Nus, Ph.D., *manager, USGA Green Section Research.*

second time. Seven days later, half of the plots received vertical mowing to increase water infiltration and further manage thatch. The fertilizer, pesticides, and conservative tracer were applied 8 days following the vertical mowing and within 24 hours of the second rainfall simulation. Chemical application, rainfall simulation, and sample collection followed the protocol initiated in 2005.

Infiltration measurements, quantification of runoff volumes, and examination of hydrographs revealed the addition of vertical mowing increased water infiltration and further reduced quantities of water leaving the turf plots as runoff. Measured nutrient and pesticide loads transported with the runoff showed the addition of vertical mowing reduced soluble-P and nitrate nitrogen (NO_3-N) losses by 27% and 39% and fungicide (flutolanil) and insecticide (chlorpyrifos) losses by 11% to 29%.

Additional cultural practices were implemented, followed by chemical application, rainfall simulation, and sample collection. Results of this research will provide information that will allow for informed decisions on best management practices that are both environmentally responsible and provide quality turf.

SUMMARY POINTS

- Aeration of fairway turf with hollow tines reduced runoff volumes, nutrient loss with runoff, and pesticide loss with runoff compared to management with solid-tine aeration.
- Addition of vertical mowing to hollow-tine aeration increased water infiltration and further reduced quantities of water leaving the turf plots as runoff.
- Addition of vertical mowing to hollow-tine aeration reduced the off-site transport of nutrients (soluble-P, NO_3-N) and pesticides (flutolanil, chlorpyrifos) with runoff.

RELATED INFORMATION

http://turf.lib.msu.edu/ressum/2007/53.pdf
http://turf.lib.msu.edu/ressum/2006/49.pdf
http://turf.lib.msu.edu/ressum/2005/44.pdf

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