

# Nutrient and Pesticide Runoff from Golf Course Fairways Caused by Simulated and Natural Rainfall

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## Objectives:

1. The objective of this portion of the project is to investigate the amount of nutrient runoff that occurs from a bermudagrass golf course fairway under normal maintenance conditions.

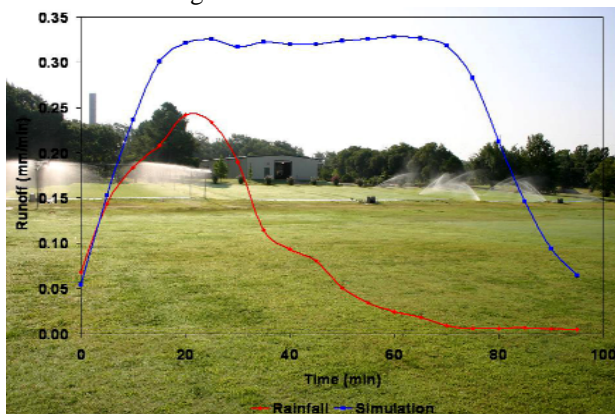
**Start Date:** 2004

**Project Duration:** four years

**Total Funding:** \$90,000

Fairways comprise the largest portion of intensively managed turfgrass on golf courses and often border bodies of water. Fairways are fertilized throughout the growing season and surface runoff of nutrients can occur. Although several studies have measured the amount of nutrient runoff from turf that occurs during simulated storm events, the amount of nutrient runoff that is likely to occur under normal conditions is not known. The objective of this study is to investigate the amount of nutrient runoff that occurs from a bermudagrass golf course fairway under normal maintenance conditions and natural rainfall.

Collection troughs and automated samplers were positioned at the bottom of six 40 by 80 ft. plots (5% slope) for surface runoff collection. Fertilizer (1 lb./1000 sq. ft./month N and 0.5 lb./1000 sq. ft./month P) was applied to two of these plots (6,400 sq. ft.) at the beginning of each month during the growing season on a site specifically constructed and managed to simulate a bermudagrass golf course fairway. A system of time domain reflectometers (18 in all) were used to monitor antecedent soil moisture and irrigation was used to main-



**Figure 1.** Mean runoff rates that occurred from an average of 8 simulated rainfall events compared with mean runoff rates that occurred over 16 natural rainfall events in a 95-minute period.

tain the site at approximate field capacity throughout the study. Runoff samples were collected and tested for  $\text{NO}_3\text{-N}$ ,  $\text{NH}_4\text{-N}$ , and dissolved reactive phosphorus (DRP) during natural rainfall events that produced runoff in 2003 through 2006.

An average of seven rainfall events occur each year that have sufficient intensity and duration to generate runoff from this particular site, but not all of these events occur during the growing season. A total of thirteen runoff events were monitored for nutrient losses during the growing seasons from 2003 through 2006 and flow rates were collected for sixteen events. These events resulted in total losses of less than 1% of the N and P applied as fertilizer during the 4-year period.

The runoff from natural rainfall tends to follow a particular pattern in Oklahoma (Figure 1). Runoff flow rates increase rapidly shortly after initiation, reach a peak, then decline sharply with time. Simulated events do not follow this trend. Consequently, the relationships between nutrient concentrations with time and with flow rates should be investigated to determine if there is a significant difference between nutrient losses during natural rainfall and nutrient losses during simulated events.

Once runoff began, approximately 26% of the rainfall that occurred became runoff. However, the relationship between runoff and rainfall was not linear. After averaging sixteen events by 5-minute time intervals following the initiation of runoff, the cumulative rain-



**Figure 2.** The relationships between mean nitrogen and phosphorus loss rates and natural rainfall runoff flow rates averaged over events after categorizing by time after the initiation of runoff.

fall with cumulative runoff exhibited a nearly perfect quadratic relationship. Using the same preliminary averaging, the relationship between nutrient loss rates and runoff flow rates was also quite strong (Figure 2). However, the N loss rate had a poor relationship ( $r^2=0.07$ ) with N concentrations in runoff and although the P loss rate was much stronger ( $r^2=0.87$ ), the comparisons suggested that runoff volume was the primary factor that influenced nutrient losses.

## Summary Points

- Although both precipitation events provide meaningful data, a typical rainfall event produces a runoff pattern that differs from a simulated rainfall event.
- Although runoff accumulation is directly related to cumulative rainfall, the relationship is not linear
- There is a significant relationship between the amount of nutrients lost in runoff and nutrient concentrations in runoff, but the nutrient losses are primarily driven by the amount of runoff that occurs
- The percentage of applied fertilizer lost to surface water from a bermudagrass fairway site during normal rainfall was very low (~1%).