Reconnaissance Study of Nitrate and Phosphorus Concentrations at Iowa Golf Courses

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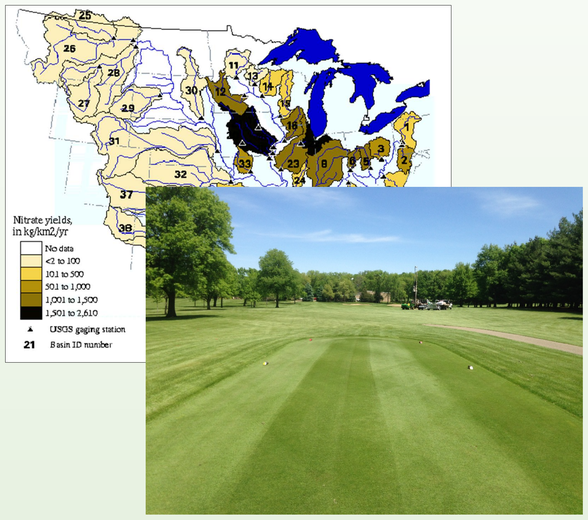
Background

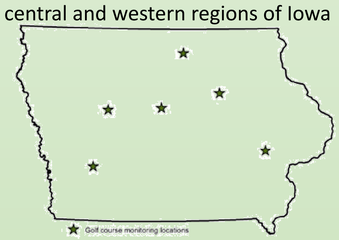
- Nonpoint source pollution from nitrate-nitrogen (N) and phosphorus (P) contributes to nutrient enrichment in local streams and development of hypoxic (dead) zones in regional water bodies, including the Gulf of Mexico
- Iowa Nutrient Reduction Strategy developed to reduce N and P from point and nonpoint sources



- More water quality data is needed that specifically focuses on golf courses
- Objective: measure N and P concentrations in surface and groundwater at a subset of Iowa golf courses to assess the risk posed by these facilities to contribute N and P loads to rivers

Investigation

- Stratified random design used to select six courses for this initial reconnaissance study that includes three 18-hole courses and three 9-hole courses in eastern, central and western regions of Iowa



- Monitoring wells were installed within managed turf grass areas at each course in representative tees, fairway and rough locations

- Soil samples were collected according to the stratigraphy encountered at each site and analyzed for N, P, K, Ca, Mg, Na, pH, CEC, nitrate, and texture
- Quarterly sampling for two years of groundwater from wells and surface water at the golf course

- At one well per course, a water level transducer was installed in the well to measure water table fluctuations

Soil Results

Mean for A horizon	N	P	K	SOM	clay	bottom depth
Course/nutrient	mg kg-1	mg kg-1	mg kg-1	g 100g-1	g 100g-1	cm
Eastern	2.6	21.1	110.2	2.3	31.9	61.1
Eastern	4.1	26.3	73.4	1.6	10.7	37.3
Central	8.0	5.0	142.8	6.2	27.9	30.0
Central	7.2	10.5	113.7	3.5	39.2	37.2
Western	4.5	9.8	251.4	3.2	48.1	60.8
Western	7.6	47.6	295.0	3.2	41.1	28.0

Table 1. Summary of soil sampling results for the soil A horizons.

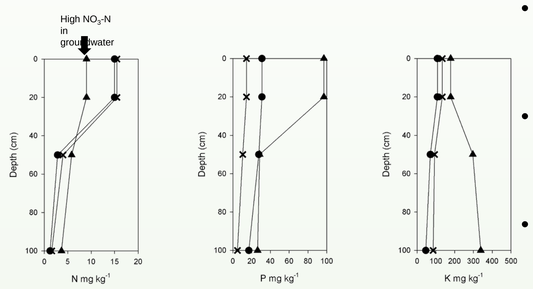


Figure 1. Soil nutrient concentrations with depth at three courses.

- The depth of the soil A horizon varied from 28 to 61 cm across the various sites due to the different landform regions sampled during the investigation
- Highest soil N concentration (8 mg/kg) was found in a soil sample collected from the course located in the recently-glaciated Des Moines Lobe landform region
- Highest P concentration (47.6 mg/kg) was measured in a soil samples from the southwest Iowa loess hills region
- Soil concentrations varied with depth and soil N and P concentrations tended to decline

Water Results

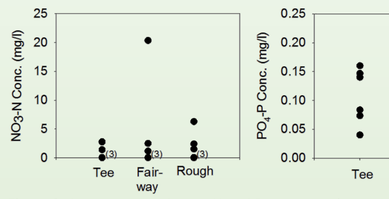


Figure 2. Average groundwater N and P concentrations measured in three different settings.

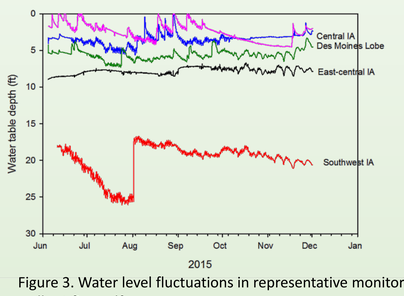


Figure 3. Water level fluctuations in representative monitoring wells at five golf courses.

- Nitrate concentrations above 0.5 mg/l were not detected in three of the six courses
- One course in southwest Iowa continued to show high nitrate concentrations compared to the other courses
- P concentrations were more variable than N and there was not a consistent pattern of detection among the sampled courses
- All concentrations were less than 0.25 mg/l, and most were less than 0.15 mg/l
- Statistical differences were not observed between wells located in tee, fairway or rough locations

Relationship to Management

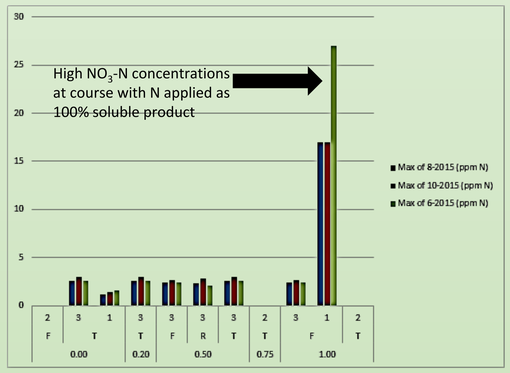
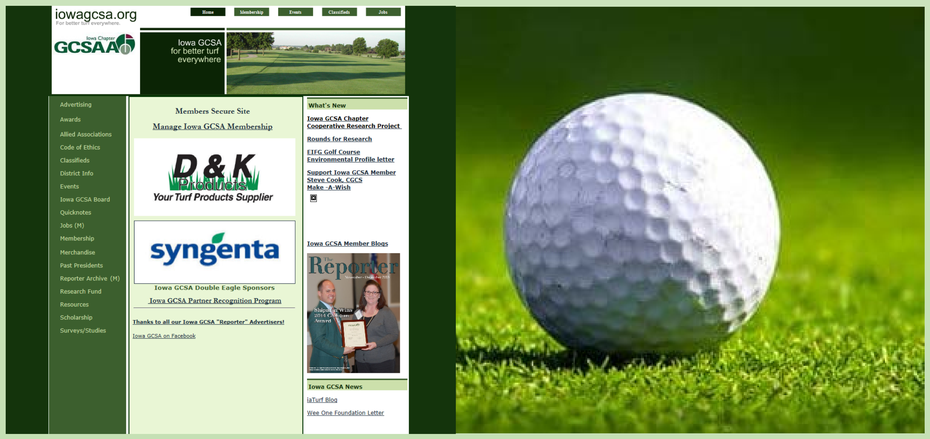


Figure 4. Percent soluble N fertilizer by maximum N concentrations in groundwater.

- Working with the course superintendents to compile land management practices at the six selected courses including the timing, rate and formulation of fertilizer applications
- Correlate management practices with soil and groundwater concentrations
- Goal is to establish best management practices (BMPs) for golf course superintendents to decrease the environmental impact and improve turfgrass fertilization efficiency

Ongoing Activities



- Monitoring - In 2016, we are continuing groundwater and surface water sampling at the six courses
- Evaluations – Throughout this year, golf course superintendents are being surveyed regarding fertility practices
- Presentation – Year 2 findings will be presented at Iowa Turfgrass Conference and Trade Show in Coralville, Iowa
- Final Report – At the conclusion of the two-year project, a report will be prepared that summarize the findings of the project. The report will be made publically available through the Iowa Golf Course Superintendents Association (http://www.iowagcsa.org/)