FERTILIZING TO PROTECT WATER QUALITY - A CASE STUDY

P. E. Rieke
Crop and Soil Sciences
Michigan State University
East Lansing, Michigan

In recent years turf managers, agronomists and other specialists have placed less emphasis on fertilizing to provide dark green turf and much greater emphasis on improving the stress tolerance of turf and protecting the environment. Many golf courses, parks and other turfs are maintained adjacent to ponds, lakes and streams where pollution of surface waters is possible. Turfs along hard surfaces, such as streets and parking lots (particularly if storm sewers are present) should be fertilized so no fertilizer is thrown directly onto those surfaces that could ultimately end up in surface or ground waters. The potential for leaching of fertilizer nutrients should be an important factor when planning a fertilization program. If poor fertilization and irrigation practices are followed, leaching could cause pollution of either surface or ground waters. So it is essential that turf managers plan fertilization programs carefully to provide the quality and stress tolerance of turf desired as well as protecting water quality.

Many environmental groups have targeted golf courses and home lawns as significant polluters of surface and ground waters. As the turf industry responds to these claims it is essential that we consider all the scientific evidence available so we can give reasonable, articulate and confident answers. Because one can prove almost anything if data are manipulated appropriately, it is important that we carefully weigh all the data so we are not guilty of misrepresenting the results as is being done by some environmental groups. If the data prove there is degradation of water quality because of fertilization programs on a given turf site, we must change management practices to correct the situation. Unfortunately, it is necessary that continuing evidence is needed to persuade certain groups that proper turf management can provide a reasonable quality turf and protect water quality at the same time.

With this in mind, the Drain Commissioners office in Grand Traverse County in Traverse City contacted the Cooperative Extension Service to determine how to best evaluate the effects of turf sites on the water quality of Mitchell Creek, a small stream which drains into the east bay of Grand Traverse Bay. We were contacted about how to proceed with specific interest in testing the water in Mitchell Creek. A study was developed to test nutrient levels in soil and water at four turf sites in the Mitchell Creek watershed. Recommendations on all aspects of turf maintenance was to be provided by M.S.U. specialists, including integrated pest and turf management with emphasis on protecting the quality of the Mitchell Creek.

The four turf sites to be studied were Mitchell Creek Golf Course, Elmbrook Golf Course, Traverse City East Junior High School grounds and the Ball World softball fields. At each golf course several sampling sites were established. Three fairways were selected at each course for sampling for nitrate nitrogen analysis at depths of 0-6, 6-12 and 12-18 inches. The same fairways were sampled for available soil phosphorus levels at depths of 0-3, 3-6 and 6-9 inches. Adjacent to each of the 3 fairways at each course beside the 150 yard marker, a suction lysimeter was installed to measure phosphorus and nitrate nitrogen in the soil water. These suction lysimeters were installed with the porous ceramic tip placed at a depth of 3 feet so water samples extracted for the soil represented the nutrient content of soil water at a depth of 3 feet. Water samples were also obtained from Mitchell Creek on each course at the point of entry and as it left the course. Three greens were selected for nitrate nitrogen and phosphorus testing as well. The nitrate testing for the greens was a total of 90 samples tested for nitrate nitrogen. Results indicated 33% were less than 1 ppm, 49% were between 1 and 5 ppm, 11% between 5 and 10 ppm and 7% between 10 and 22 ppm. Those above 10 ppm were all in the 0-6 and 6-12 inch depths with none in the 12-18 inch depth.

Testing done on the level of nitrates in the suction lysimeters indicated that of the 18 samples tested, 14 were less than 1 ppm and 4 tested between 1 and 3 ppm nitrate nitrogen. Ten of those lysimeter samples were analyzed for phosphorus, all of which were less than 0.05 ppm phosphorus which is very low.

The tests on the water samples taken from Mitchell Creek indicated that of the 39 tested for nitrate nitrogen, 24 were less than 1 ppm and 15 were between 1 and 1.4 ppm. Fourteen were tested for phosphorus and all were less than 0.05 ppm. In every case the nutrient content of the water leaving the course was no different than that entering the course. These samples were taken monthly so there is the possibility that some nutrients could have reached the water during the intervening period, but the nutrient level in the creek is very low and certainly was not affected by fertilizers at the time these samples were taken. The major concern would appear to be that during application no fertilizer is thrown directly into the creek.

The phosphorus soil tests indicated all fairway samples were low in available phosphorus at the deeper depths even where the surface layer tested adequate. One of the courses had fairway surface soil tests which were considered marginally adequate. The greens tested high in medium to high in phosphorus. It was recommended that no phosphorus be applied on greens on either course and that no phosphorus be applied to the fairway on one course. The other course could apply some phosphorus if needed to prevent deficiencies and encourage growth.

The phosphorus tests at both Ball World and the Junior High School were high so it was recommended that no additional phosphorus be applied it either site.

Considering the data obtained to date, the conclusion is that the fertilizer management on these turf sites is not causing a degradation of the quality of water in Mitchell Creek. Careful management of future fertilization programming should continue to protect this stream.

GENERAL RECOMMENDATIONS TO PROTECT WATER QUALITY

There are several practical recommendations which can be made to protect against fertilizer pollution of surface and ground waters. One must adapt fertilizer programs and practices which are needed for specific turf and soil conditions.

1. Never permit fertilizer to be thrown directly into any water body. Use a drop spreader if fertilization next to the water is necessary. This allows absolute control of where the fertilizer is placed. Centrifugal spreaders should not be operated close to water bodies.
2. Follow fertilization techniques which prevent throwing fertilizer on hard surfaces from which runoff could ultimately reach surface or ground waters.
3. Calibrate and fill spreaders on hard surfaces from which any spills can be collected.
4. Irrigate after fertilizer application to move the nutrients down into the thatch and soil. If a heavy rain follows there will be little potential for runoff to occur. This is especially important for organic fertilizers which are usually lighter in density. In the past a common recommendation was to fertilize just before a rain. When there is potential for intense rainfall, irrigating immediately after application is a safer approach from an environmental perspective.
5. Never apply fertilizer on frozen ground.
6. If possible divert runoff water into an area where it can gradually drain through the soil rather than run directly into a water body.
7. Utilize a buffer strip along water bodies. This may mean planting an alternative species other than turf or planting a low nitrogen requiring grass in that area. Mowing the grass at a higher height can slow runoff water movement into the water body. Use lower nitrogen application rates on turfs adjacent to the water. The width of the buffer strip may vary with the site, anywhere from 5 to 15 feet.
8. In sensitive areas near surface waters use light, frequent fertilizer applications. A combination of soluble and slow release sources may be appropriate. On turf areas established on sands it is especially important to follow a fertilizer program which provides a modest amount of nitrate nitrogen throughout the season to prevent leaching of nitrates.
9. Irrigate so the applied water does not exceed the water holding capacity of the rootzone and cause leaching. It is especially important to irrigate at modest levels when there is probability of heavy rainfall. Knowledge of the water holding capacity of the soil, rooting depth, probable levels of evapotranspiration and rainfall and drainage conditions should all be considered.
10. Keep organic matter from reaching the water. Grass clippings from mowers and tree leaves in the fall should be handled to prevent them falling into the water as much as possible. Any organic matter will add nitrogen and phosphorus to the water, degrading the quality of the water.
11. Use soil tests to determine the need for phosphorus. If no additional phosphorus is recommended, a fertilizer program with zero phosphorus should be followed. If there is suspicion of a problem with phosphorus, take soil samples representing 0-3 and 3-6 inch depths. If the deeper soil level tests high

in phosphorus, take another sample from the next layer down. Deeper in the soil we always find the soil phosphorus levels low.

12. On very sensitive sites it may some times be possible to divert tile drainage away from the water body into an area where the water will gradually dissipate. This would prevent ready movement into the water body. This is a very conservative approach and would not normally be needed.
13. Set up a testing program of your own. Be sure to include testing protocol which will provide the information needed. Check with someone who has experience with such a testing program so you can be sure the data are collected in a scientifically sound manner. One practical point that should be mentioned is that if sampling water from a stream which passes through the turf area, be sure there is no nutrient contribution from a landowner on the opposite side of the stream. It is best if you control the management of the property on both sides of the stream. Also, be sure there is no drain coming from other locations which could contribute a nutrient load. For example, a common source of nutrients is a septic drain field from a residence which runs into the water body.