

Soil solution samples are extracted from the soil through instruments called solution samplers or suction lysimeters. These instruments and sampling procedures are described in detail in Taylor et al. (1991).

Rainwater samples

Rainfall contributes significant amounts of nutrients and water to a farm over the course of a year and therefore, must be monitored to prepare farm water and nutrient budgets. It is important that rainfall collectors for nutrient analyses be properly prepared (Taylor et al., 1991). Rainfall samples must not be taken from the raingage for analysis. Generally, the rainwater sample will contain dry fallout (particulate matter) that occurs coincident with the rainfall. Hence, the sample is often referred to as bulk precipitation (wet and dry fallout) that occurred during a rainfall. Bulk precipitation is a better representation of the total atmospheric P input than just rainfall itself. Rainfall should be measured at one or more sites around a farm, depending on the farm size. However, nutrient loading attributed to bulk precipitation can be approached on a regional scale due to the low variability between precipitation nutrient concentrations in similar areas.

Recommended water quality monitoring strategy

A detailed water quality monitoring strategy may be prohibitively expensive with respect to time, instrumentation, and sample analyses. The challenge is, therefore, to develop a strategy that is a compromise between the ideal and the layperson's tendency to simply dip a sample occasionally. It is important to plan a water sampling program carefully, document it rigorously, and conduct it conscientiously. It should be remembered that the monitoring program and resulting data may be important for on-farm management, scientific, and legal reasons.

A reasonable program could begin with locating sampling stations upstream of the main farm pump stations that access area canals. Autosamplers could be used, with suction strainers placed in the middles of the farm canals, 20 to 40 percent of the channel water depth, below the water surface. All farm inflows and outflows should pass by a monitoring station. Water level recorders should be in-

stalled at the water quality sampling sites. These recorders can be used for measuring flow volumes or simply for automatic recording of irrigation and drainage event times. Pump stations should be calibrated such that flow volumes can be calculated. Ideally, inflow structures should also be calibrated to determine the volume of water entering the farm.

In cases where detailed time sequenced water samples are not desired or are unnecessary, flow integrating autosamplers would probably be the most affordable and manageable option.

An intensive water sampling program should begin with a program to assess when peak concentrations occur during drainage and irrigation events. Samplers should be set to collect water every one to two hours, depending on the expected duration of the event. If the event lasts longer than anticipated and the supply of bottles is used up, simply change the autosampler base with a fresh set of bottles. Select a set of 24 samples, equally spaced in time, for analysis. Other samples may be stored or discarded. After following this procedure a few times, the grower will be able to determine the fewest number of samples needed to characterize the water quality at the station during events by examining graphs of water quality versus time. Intensive monitoring should be done for several events during different times of the year in order to characterize small and large rainfall events during the rainy and dry seasons.

When interpreting the water quality data, caution is strongly advised. The correct interpretation of water quality monitoring data can be complex, requiring an expert in statistical analyses to test for significant differences and trends. The proper statistical interpretation of data is important in the assessment of the efficacy of a BMP implementation program.

Irrigation, drainage, and rainfall samples should be analyzed for total phosphorus (TP) and total dissolved phosphorus (TDP) at the very least.

Summary

There are many factors to consider when installing water quality monitoring stations on farms. While there may not be any absolutely "right" way, the grower should consider his farm layout, cropping pattern, and desired information prior to