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# Simulated Rain Experiments Measure Runoff of N and P

Tests by Georgia scientists indicate UAN may not be as susceptible to runoff losses as granular fertilizers.

***Summary:*** *Runoff was equal for two scales of plots. There were greater losses of soluble-P from the larger (6,692 sq. ft.) plots (1.25 lbs/A) than from the smaller (60 sq. ft.) plots (0.9 lbs/A). Nitrate-N losses averaged 2.4 lbs/A and bioavailable-P losses were 2.05 lbs/A. Greatest $NO_3$-N and soluble -P losses occurred the day after application of granular fertilizer whereas bioavailable-P loss was greatest at days 14 and 29. No increase in $NO_3$-N losses was found one day after application of UAN, possibly indicating that liquid fertilizers are not as susceptible to runoff losses as granular fertilizers. Results of this study should encourage the use of small plots, thereby saving research time and expense, plus provide useful data for estimating losses at similar sites.*

Runoff from agricultural fields is a nonpoint source of N and P pollution. Such nutrient losses from runoff can accelerate eutrophication of streams and lakes and enhance hypoxia. Attempts have been made to experimentally determine conditions that contribute to runoff losses. Parameters include:

• Soil characteristics, ground cover, residual fertility, slope

• tillage, timing, quantity, and method of fertilizer application

• intensity, quantity, and timing of rainfall.

In spite of these attempts, no widely accepted procedure has emerged for the evaluation of runoff losses. Variable study conditions have been used and there has been no standardization of plot size and other variables. The minimum plot size needed to make a reasonable prediction of runoff from a field is not known.

Runoff experiments often have used whole watershed or field approaches by instrumenting, applying fertilizer, and depending on natural rainfall. In such experiments, there are no controls of intensity, quantity, or timing of rainfall. If rainfall does not come in sufficient intensities and quantities within a few days after application of fertilizer, little information will be obtained concerning losses under conditions conducive to runoff.

**Simulation as an answer**

Parameters that are uncontrollable at watershed or field scales under natural rainfall may be more controllable when simulated rainfall is applied at lesser scales. Therefore, there has been interest in the use of rainfall simulation experiments to generate information for cases when rainfall occurs shortly after application of agricultural chemicals.

The objective of a study we conducted in 1992 and 1993 was to observe the runoff losses of $NO_3$-N, soluble-P, and bioavailable-P under conditions of simulated extreme rainfall. We simulated rainfall at the rate of one inch/hr for two hours, eight days prior and one, 14, 29, 49, and 108 days after fertilization and planting of corn. Experimental sites received (April 13 and 15 in 1992 and April 12 and 14 in 1993) 45 lbs/A of N, 40 lbs/A of $P_2O_5$, and 112 lbs/A of $K_2O$ as granulated fertilizer, broadcast and incorporated to a depth of six inches. An additional 105 lbs/A of N was surface banded (sidedressed) as UAN at day 28, which was one day prior to simulated rain.

A rainfall simulator system applied water with irrigation sprinklers spaced 10 feet apart. The sprinklers were positioned atop 10-foot risers on two irrigation laterals arranged 44 feet apart along the length of the plot. The variable drop size simulator (median drop diameter of .06 inch) provided constant rainfall intensity of one inch/hour for two hours. Such an event occurs on the average of 0.95 days/year in the Southeast. Thus, the expected return frequency of such an event is one in each 1.05 years. Six such events were conducted within 117 days to create worst-case runoff conditions, especially considering that rainfall immediately followed fertilizer application for two of the six events.

**Plot size important**

We used and compared conven-tionally-tilled corn plots near Tifton, Georgia, sized on two scales. The meso-plots measured 6,692 sq. ft. and the micro-plots 60 sq. ft. They were smaller than agricultural fields but had flow lengths sufficiently long to produce rill erosion as in fields, and, therefore, were large enough to investigate both tillage and crop effects. Smaller plot experi-ments have the potential to estimate greater losses than those measured in the whole watershed experiments, because they are generally simulating conditions that are severe and, therefore, rarely encountered in field studies. The micro-plots were adjacent to but separated hydrologically from the meso-plots. Micro-plots were treated simultaneously and identically with meso-plots.

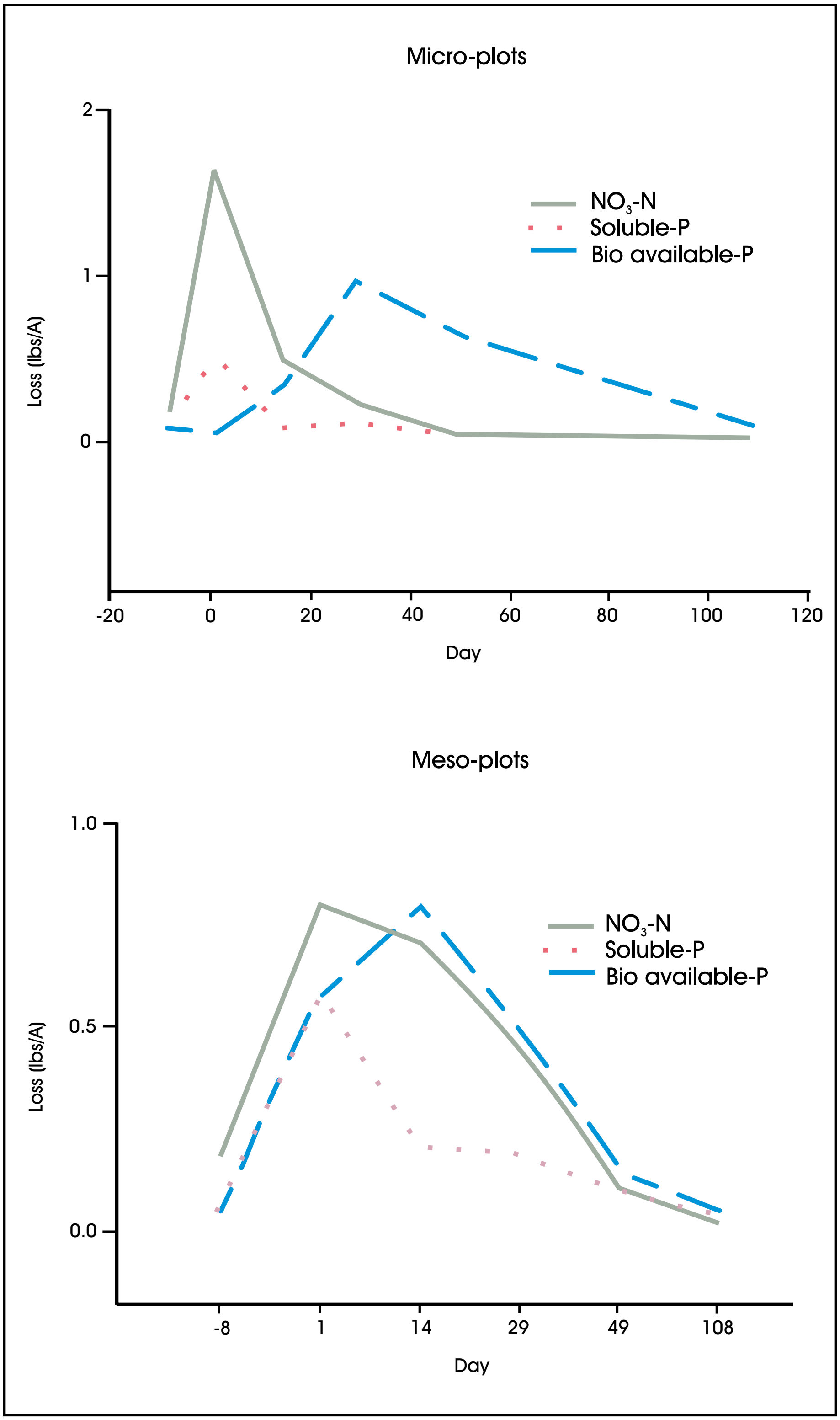


Figure 1. Losses of NO3-N, soluble-P, and bioavailable-P in lbs/A of applied N and P, data means of two replications and two years, Gascho, st al., University of Georgia, 1992-93.

**Losses come early**

Losses of $NO_3$-N and soluble-P were massive one day after fertilizer application and then decreased markedly (note the spikes in Figures 1 and 2). Much of the day one loss was likely direct movement and dissolution of granular fertilizer with runoff.

One of the most interesting aspects of the data is that there was no increase in $NO_3$-N loss after application of 105 lbs/A of N as UAN at day 28. These data suggest that granules at or near the soil surface are more susceptible to movement in extreme runoff than liquids, which are quickly absorbed by the soil.

Losses of bioavailable-P were greatest at day 14 in the meso-plots and day 29 in the micro-plots. These losses were largely sediment bound.

Following five 1.97-inch incremental applications of irrigation water applied after fertilization, total loss in meso-plot runoff amounted to 1.4 percent of the applied N as $NO_3$-N, 3 percent of the applied P as soluble-P, and 5.1 percent of the applied P as bioavailable-P. Losses for meso- and micro-plots were equal for $NO_3$-N and bioavailable-P. Greater losses for soluble-P were found in the meso-plots.

It is difficult to compare results of our experiments with those previously reported without many qualifying comments. Losses of $NO_3$-N under the relatively extreme conditions imposed in this study were generally greater than under field conditions of other studies. Timing of greatest losses relative to rainfall, however, was similar. Greatest losses followed closely behind application when there was rainfall after application. In other studies, subsurface flow accounted for most of the losses. Only surface flow was analyzed in our study.

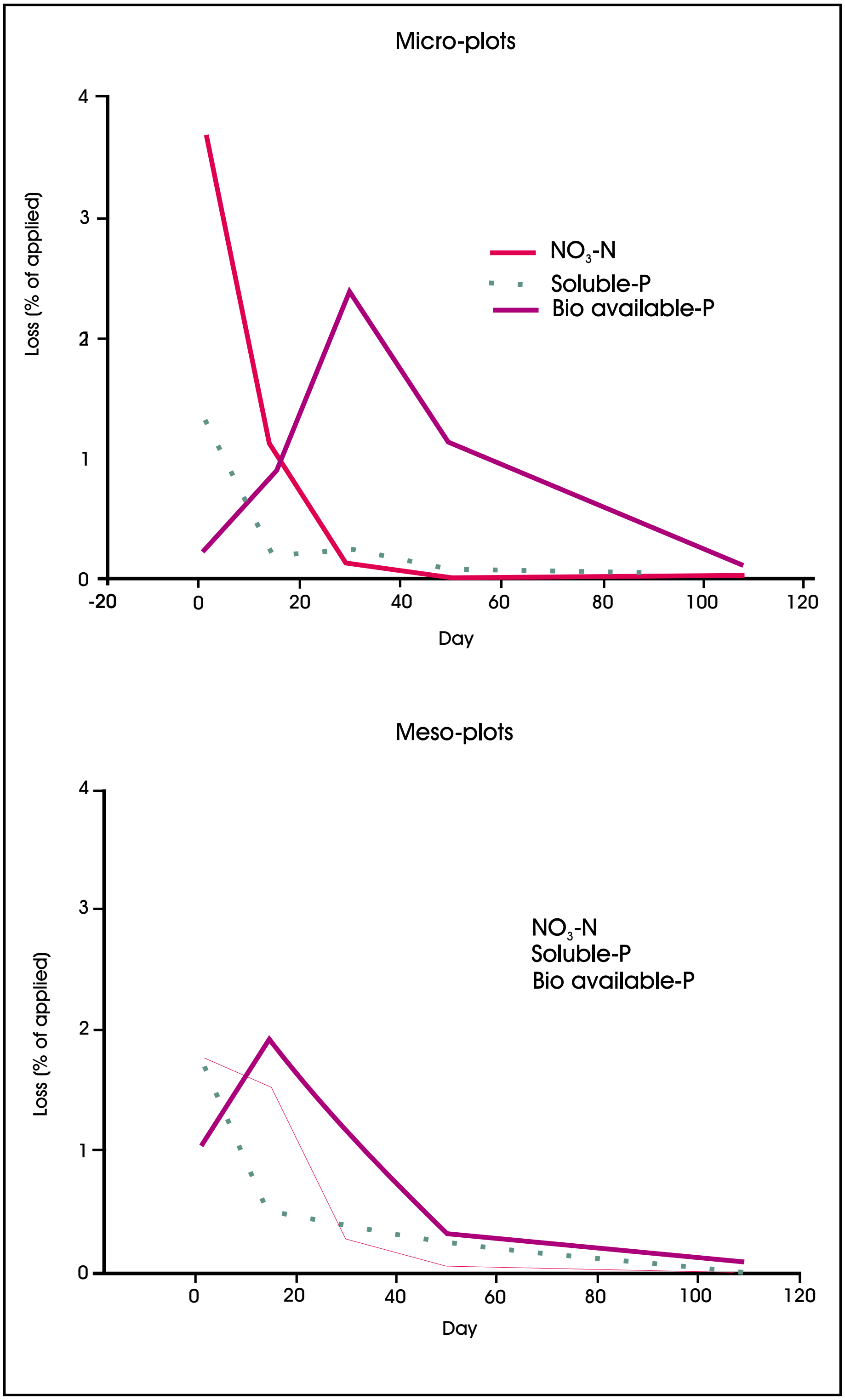


Figure 2. Losses of NO3-N, soluble-P, and bioavailable-P as percent of applies N and P, data means of two replications and two years, Gascho, et al., University of Georgia, 1992-93.

**Looking ahead**

Data collected in this study may be useful as estimates of maximum losses from runoff under similar farming practices. Such estimates are desirable in efforts to determine the loss potential of fertilizers under varying conditions.

The data in this study suggest that experiments can be accomplished in micro-plots much more economically than is possible in meso-plots of the size used in this experiment or even larger plots that attempt to approximate a watershed.


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