EFFECT OF METHODS OF APPLICATION AND SOIL SAMPLING ON RECOVERY OF FERTILIZER N

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INTRODUCTION

In fertility studies carried out in the field at Swift Current we have often been unable to recover even 50% of the applied N as early as 24 hr after application. To determine whether this apparent loss of fertilizer N was real or due to sampling variability we set up a semicontrolled experiment with Wood Mountain loam in the field.

MATERIALS AND METHODS

Flats (2'x2'x6") were made up and partitioned in such a manner that soil units could be sampled by coring and also by bulk sampling (Fig. 1). In order to facilitate bulk sampling, polyethylene liners were placed in the four small compartments before they were filled with soil. On each sampling date, duplicate cores were taken from the unsegmented half of each box and these were combined to give a single sample. Simultaneously, all the soil from one of the small compartments was removed, mixed, and subsampled (bulk sample).

There were three N treatments: (1) No N added (control), (2) 50 ppm N added as $Ca(NO_3)_2$, and (3) 50 ppm N added as $(NH_4)_2SO_4$. Each N treatment was applied in the field by three different methods: (1) by placing soil in the box and then spraying the N solution (in a minimum of water - 200 cc) onto the soil surface as uniformly as possible, (2) by mixing the solution (200 cc) with approximately the same amount of soil used in (1) on a plastic sheet then placing

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the treated soil in the box, and (3) by uniformly mixing the appropriate amount of N in powder form with the soil on plastic and placing the treated soil in the box. In the case of the control, water was substituted for N solutions.

Initial samples were taken from soil at the same site. Samples were then taken at 3 hr and at 1, 3, 7, 14, 28 and 56 days after application. Since each box allowed only four samplings it was necessary to use two boxes per treatment. We therefore sampled both boxes of each treatment on day 7 to obtain an estimate of variability between boxes. The boxes were placed in the holes from which the soil was taken so that they were level with the surrounding soil in the field. Samples were analyzed for NO_3-N exchangeable NH_4-N, and moisture.

RESULTS AND DISCUSSION

NO_3-N added (Fig. 2)

Theoretically, the concentration of NO_3-N found immediately after application should equal that present in the control soil (5 - 10 ppm) plus that added (50 ppm), which totals 55 to 65 ppm.

It can be seen that when $Ca(NO_3)_2$ was sprayed directly on the soil surface, the initial recovery of NO_3-N by core sampling was 2 to 3 times greater than expected, while that recovered by bulk sampling was within 10 ppm of the theoretically expected value. However, when NO_3-N in solution or powder form was mixed with the soil there was little difference in recovery between core and bulk sampling up to 7 days after application, even though in most cases the bulk method seemed to give a slightly higher recovery than core. The largest difference between core and bulk sampling when NO_3-N was applied as powder was 15 ppm, but when it was applied as a solution (sprayed or mixed) differences as high as 60 ppm were found.

The recovery of NO_3-N when applied as a powder or as a solution mixed with soil was only slightly higher than theoretically expected and it did not decrease as rapidly as was the case when the solution was sprayed onto the soil surface.

A comparison of supposedly duplicate samples which were taken from two different boxes on day 7 provided an indication of the type of variability one might expect as a result of chance alone. It can be seen that the differences were greatest where NO_3-N was applied as a solution and smallest where it was applied as a powder. The most uniform recovery and the best agreement between methods of sampling throughout the entire 56-day period was obtained when N was applied in solid form (like the farmer does).

NH_4-N added (Fig. 3)

When NH_4-N was added to soil the results were similar in most respects to those obtained when NO_3-N was added. For example, the concentration of NH_4-N recovered by core sampling immediately after application was considerably more than expected theoretically when N was sprayed onto the soil surface. However, bulk sampling yielded concentrations very close to expectations.

In contrast to the results obtained when NO_3-N was added, and as had been observed in our past experiments, there were sudden decreases in NH_4-N immediately after application and these were not accompanied by any concomitant increases in NO_3-N. It can be seen that the initial departure from the theoretically expected recovery value was greatest when mixing was least, i.e., core sample of N applied by spraying. The latter was true whether NO_3- or NH_4-N was applied. It would appear, therefore, that these initial sudden decreases in NH_4-N are the result of sampling a nonuniform N medium. Note that as time progressed there was the expected gradual decrease in NH_4-N and corresponding increase in NO_3-N signifying the occurrence of nitrification.

As with NO_3-N ammendments the powder method of NH_4-N application seemed to be the most precise and the most accurate - while the surface spraying method was the least desirable. Bulk sampling did not appear to be any better or worse than core sampling; the overriding factor being the method of N application.

Finally, it is worth emphasizing the size of the differences which one can obtain between samples treated in exactly the same manner under semicontrolled conditions. For example, when NH_4-N was sprayed on there was a difference of about 40 ppm between box 1 and box 2 bulk samples on day 7. This fact should be borne in mind since we often attempt to place too much emphasis on relatively small differences found when monitoring N in field fertility experiments.

SUMMARY

(1) The variability in N recovery after application of fertilizer can be quite large even in semicontrolled experiments.

(2) The size of the variability is primarily dependent on the method of application. The precision and accuracy of recovery increased with the degree of mixing and was greater for solid than for dissolved N.

(3) There was no consistent difference in recovery between core and bulk methods of sampling.

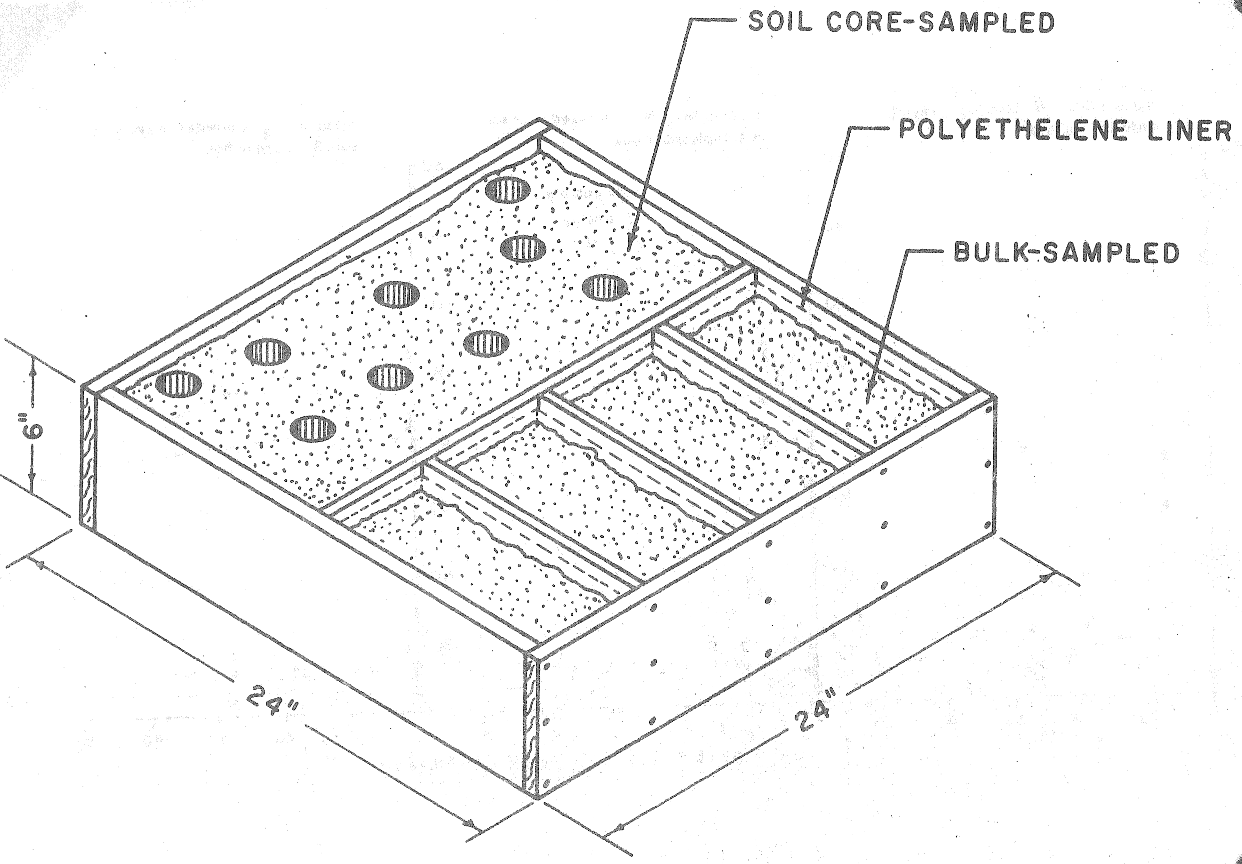


Fig. 1. Partitioned soil flats.

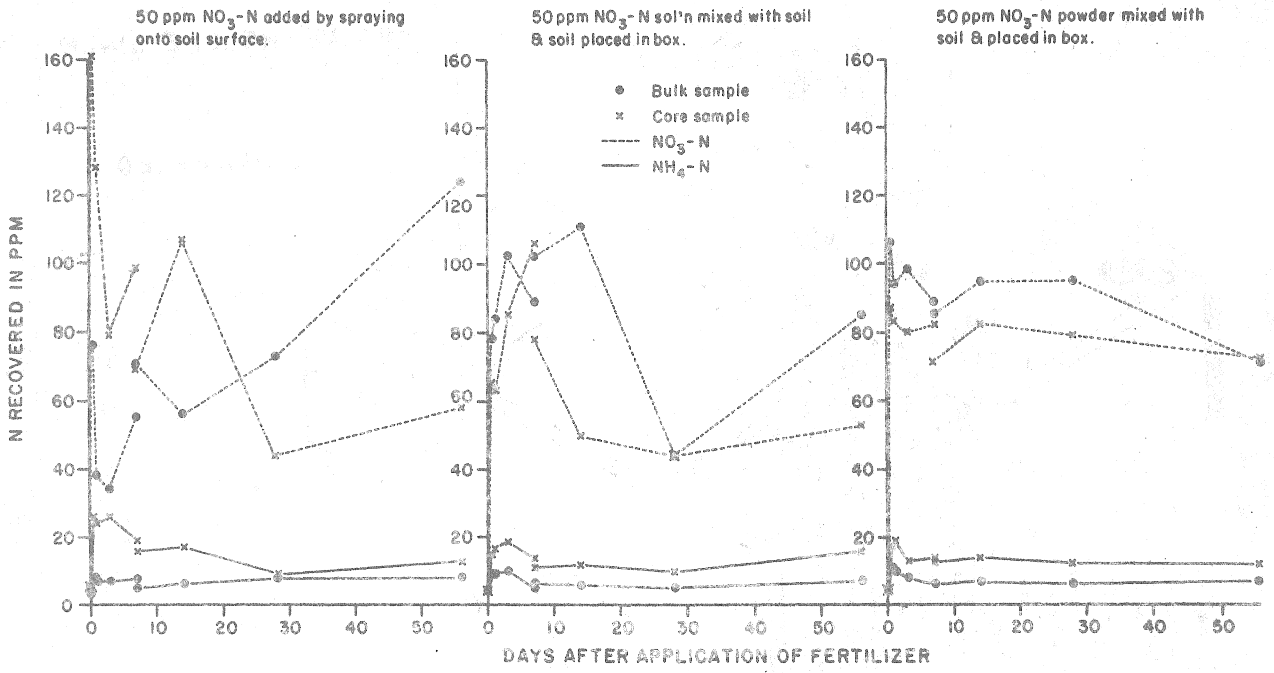
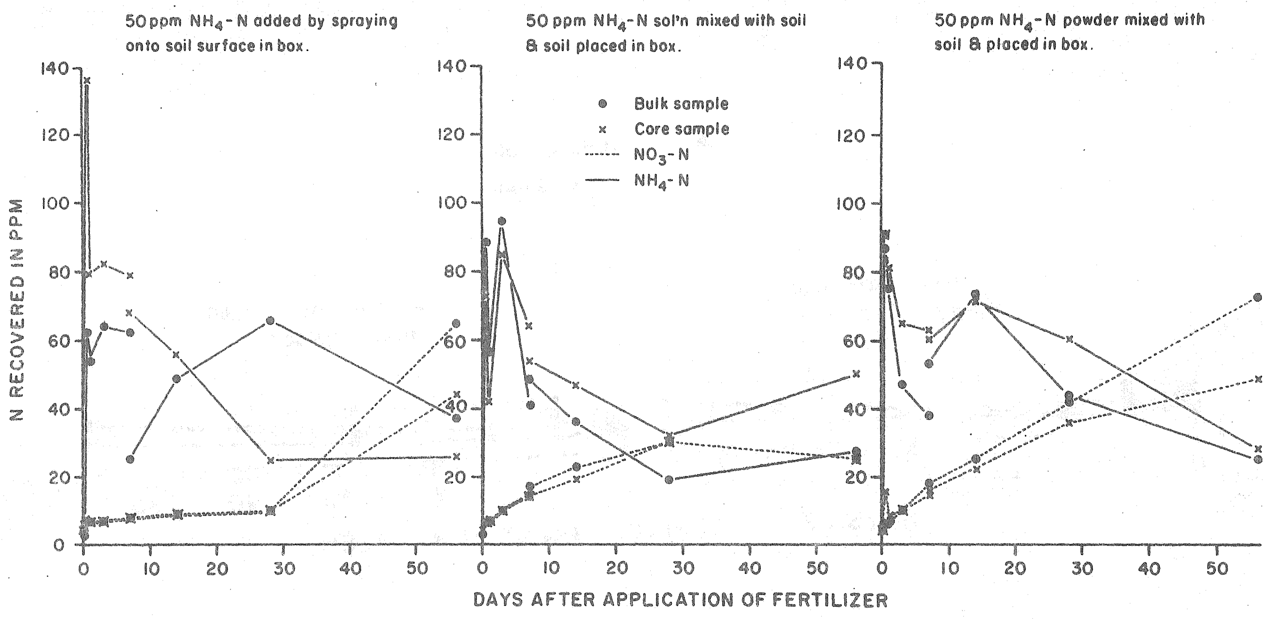


Fig. 2. Effect of methods of application and sampling on recovery of fertilizer N - NO_3-N applied.



50 ppm NH_4-N added by spraying onto soil surface in box.

50 ppm NH_4-N sol'n mixed with soil & soil placed in box.

50 ppm NH_4-N powder mixed with soil & placed in box.

Fig. 3. **Effect of methods of application and sampling on recovery of fertilizer N - NH_4-N applied.**

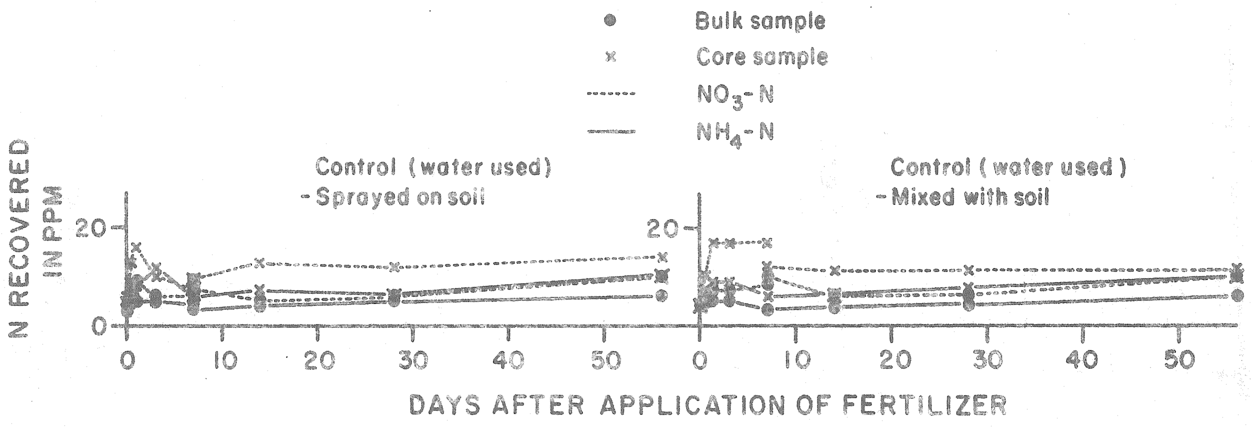


Fig. 4. Effect of methods of application and sampling on recovery of fertilizer N - water applied (controls).