

## LATE SUMMER-FALL N RELEASE AFTER WHEAT AS AFFECTED BY PREVIOUS CROP

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### Abstract

Fertilizer N is applied and incorporated with wheat residues to hasten decomposition based on the assumption that available N would otherwise be limiting. Sixty soil samples from the 0-12" depth were collected after the harvest of wheat, and prior to re-wetting, during August 2002 and 2003 from wheat fields previously in different crops, with emphasis on fields previously in alfalfa hay and alfalfa seed. The post-harvest residual N was measured and the samples were incubated using a buried bag technique to measure the N mineralized in disturbed samples during the late summer-late fall period. Both post-harvest and mineralized N were higher in 2002 than 2003. The mean mineralized N across years (73 lb/A) exceeded mean post-harvest residual N (51 lb/A) and the combination averaged 124 lb/A. The survey results suggest adequate N is available from either post-harvest residual N, mineralized N, and certainly from the combined total to support wheat residue decomposition without fertilizer N.

### Introduction

Wheat residues associated with irrigated production are relatively high. Producers spend considerable time and effort contending with these residues, if they don't burn them, because the residues can interfere with subsequent seedings. Many producers apply and incorporate fertilizer N with wheat residues in part based on the assumption that N is otherwise limiting to residue decomposition. Previous ARS research in southern Idaho (Smith, 1971, Smith et al. 1973) suggested that there is sufficient residual and mineralized N in soil to support wheat residue decomposition without adding fertilizer N. Nevertheless, the practice of adding N to wheat residues before incorporation to speed decomposition has persisted for over thirty years since their information was published, possibly because of a lack of information on the N mineralized in soils once they are rewetted.

Residual N after wheat harvest can vary from extremely low values to amounts that would support a second wheat crop without adding more N. The post-harvest residual N depends largely on the amounts of N applied to the previous crop and to the wheat. In addition to the post-harvest residual N, there is continued N mineralization and release of N from the organic N pool until late fall soil temperatures preclude further biological activity. This N release is governed by the size of the active organic N pool and the soil conditions conducive for decomposition following harvest. There are few reports of the late summer-late fall N mineralization following wheat and there are currently no N recommendation differences for straw residue management based on the crop previous to wheat. However, all UI fertilizer guides

for row and field crops include N recommendations based in part on whether small grain residues are returned to the soil.

Late summer-late fall N mineralization after wheat could be appreciable following alfalfa. Wheat vegetative growth and most active N uptake occurs during the coolest time of the season when temperatures are least conducive for N mineralization. Wheat matures relatively early in the season and does not benefit from a full season's N mineralization as does full season crops such as corn. In addition the soil dries considerably in the first foot depth as the grain matures prior to harvest and following harvest until the residues are worked and water applied. Until the field is re-wetted, N mineralization at least nearer the soil surface is likely limited due to low moisture, despite highly favorable temperatures. Delayed N mineralization of previous crop alfalfa residues would conceivably increase subsequent N mineralization and increase N available for wheat residue decomposition.

Whereas the residual N following a wheat harvest is readily measured, estimates of the mineralizable N are more problematic as there is no commonly used laboratory test for mineralizable N, especially calibrated for fall N release. A better appreciation for the amounts of soil N mineralized and available for residue decomposition would be useful for determining if N was limiting for residue decomposition, and whether added N was needed for that purpose. Avoided N applications could (1) significantly reduce N fertilizer costs associated with straw management, (2) reduce late fall soil nitrate concentrations resulting from excessive N applied for residue decomposition, and (3) reduce nitrates leaching to groundwaters. The objective of this survey was to measure the post-harvest residual N and late summer-fall N mineralization and N release available for small grain residue decomposition as affected by previous alfalfa and other crops.

## Methods

Western Idaho (Canyon, Washington, Elmore, Owyhee, and Malheur Co) soil samples to a depth of 12 inches were collected post harvest in August 2002 (27 samples) and 2003 (37 samples), without the surface residue, and prior to re-wetting, from wheat fields taken out of alfalfa hay, alfalfa seed, or other crops the previous year. Samples were collected from August 5 to August 29 in 2002 and from August 1 to August 21 in 2003. Post harvest samples were air-dried at the Parma Research and Extension Center, homogenized, re-wetted and incubated in buried moisture proof polyethylene bags placed in the ground at the 0-12 inch depth (September 6, 2002 and September 12, 2003) at the Parma Station according to the published buried bag procedure (Westermann and Crothers, 1980). The bags were removed from the soil on November 22, 2002 and December 2, 2003. Buried bag soil samples were analyzed for nitrate-N at the beginning and end of the incubation by the UI Analytical Services Lab. Mineralization of N was taken as the difference between the initial and final nitrate concentrations. The primary interest was in fields taken out of alfalfa (seed or hay) but fewer previous crop hay fields were located in the 2002 season as good alfalfa hay prices resulted in fewer fields being taken out the previous year.

## Results and Discussion

There were 27 samples collected from wheat or barley fields in 2002, and 37 in 2003. The number of post-harvest samples from wheat fields collected with the same previous crop included 22 fields in alfalfa seed, 11 in alfalfa hay, 6 in beans, 6 in beets, 4 in potatoes, 3 in peas, 3 in corn, 3 in onions, 1 in wheat, and 1 in alfalfa/triticale mixed .

Soil moisture of the collected soils was not measured but they appeared to vary considerably. Soil moisture was affected primarily by the timing of the last wheat irrigation as rainfall during grain maturation and post harvest was insignificant. Whereas most all samples were very dry in the first 4-6", some samples were surprisingly moist at the 6 to 12" depth, and moisture contents may have been adequate to support continued N mineralization until samples were collected in August. Continued N mineralization then may be one factor influencing the post-harvest residual N values of some samples; the earliest collected samples would conceivably reflect less mineralized N. Another factor influencing post-harvest residual N, and perhaps the most critical, is the amount of N provided in excess of wheat's capacity to use it. There is little soil testing done for irrigated wheat and ignoring pre-plant residual N can lead to applied N that far exceeds its requirement, and in turn, appreciable post-harvest residual N.

Post harvest residual N in the first foot averaged 59 lb/A in 2002 and ranged from 12 to 128 lb/A. Residual N averaged 44 lb/A in 2003, less than in 2002, and ranged from 16 to 140 lb/A. Post-harvest residual N ranged widely for most previous crops as shown in Figure 1a for both years. Previous crop effects on residual N were not very clear. Post-harvest N was lowest for corn (22 lb/A), potatoes (19 lb/A), and wheat (15 lb/A) and averaged higher for alfalfa seed (59 lb/A), alfalfa hay (51 lb/A), beets (55 lb/A), onions (52 lb/A), peas (72 lb/A), and beans (42 lb/A). The results suggest that it would be worthwhile to soil test for residual N before buying and applying N in the fall to enhance residue decomposition.

The N mineralized in buried bags averaged 86 lb/A in 2002, ranging from 36 to 128 lb/A. In 2003 mineralized N averaged less at 63 lb/A, and ranged from 37 to 88 lb/A. It is not clear why mineralized N was lower in 2003. There were no fewer heat units (base 50) in 2003 than 2002 during the incubation periods (data not shown). The samples were not handled any differently in the two years.

Mineralized N for each previous crop did not range as widely as post-harvest N, except for corn and potatoes, as shown in Figure 1b. There was a weak effect of previous crop on mineralizable N. Mineralized N averaged 22 lb/A higher for alfalfa seed as a previous crop than for alfalfa hay as a previous crop (83 vs 61), but was essentially the same as the mean for previous crop onion (83 vs 81). Mineralized N averages for other previous crops in lb/A included 77 for peas, 76 for beets, 68 for potatoes, 59 for beans, and 58 for corn.

The total N available (residual plus mineralizable) following wheat ranged from 56 to 232 lb/A and is shown in Figure 1c. Total post-harvest N was higher in 2003 than 2004 (146 vs 107 lb/A). The previous crop effect was more obvious for total N than for either the post-harvest residual N or mineralizable N. The least total N available (80-87 lb/A) following the wheat harvest occurred when wheat was preceded by wheat, corn or potatoes. The most total N

available was from previous crops of peas (149), alfalfa seed (143), onions (133), and beets (131). Alfalfa hay (113) and beans (106) were intermediate in total N available.

This limited survey is not extensive enough to provide highly accurate estimates of post-harvest N, mineralizable N, or total available N for each previous crop. For example, the number of samples collected for each previous crop ranged from only 1 for wheat to 22 for alfalfa seed. The augered soil used for the buried bag incubation for mineralized N was highly disturbed as compared to non-disturbed soils in the field. Even plowed soils would likely not have been as disturbed as the augered soils. The disruption of soil may have increased N mineralization. On the other hand, augered soils were air-dried soon after sampling and the collected samples were out of the ground for 8 to 32 days in 2002 and 22 to 42 days in 2003. For the earliest collected soil samples, there was a considerable period after drying during which little if any mineralization occurred. Thus, total N available may be underestimated for those soils with moisture contents below 6" that could have sustained continued N mineralization.

Still, even with all the confounding factors, there are some general inferences to draw from this limited survey. Late summer/fall mineralizable N contributed significantly to the total N available for residue decomposition. Average mineralizable N actually exceeded the post-harvest residual N average (73 vs 51 lb/A). The results suggest there is sufficient post-harvest residual N in many fields cropped to wheat to support active microbial decomposition of wheat residues. Furthermore, when post-harvest residual N is taken together with mineralized N, there is ample N to support residue decomposition in practically all fields, though the total may be affected somewhat by previous crop.

Slow residue decomposition, if a concern, is more likely limited by delayed incorporation (minimal residue contact with soil) and inadequate moisture than readily available N. There is little evidence from this survey to support the practice of applying fertilizer N expressly for increasing available N to promote residue decomposition.

## References

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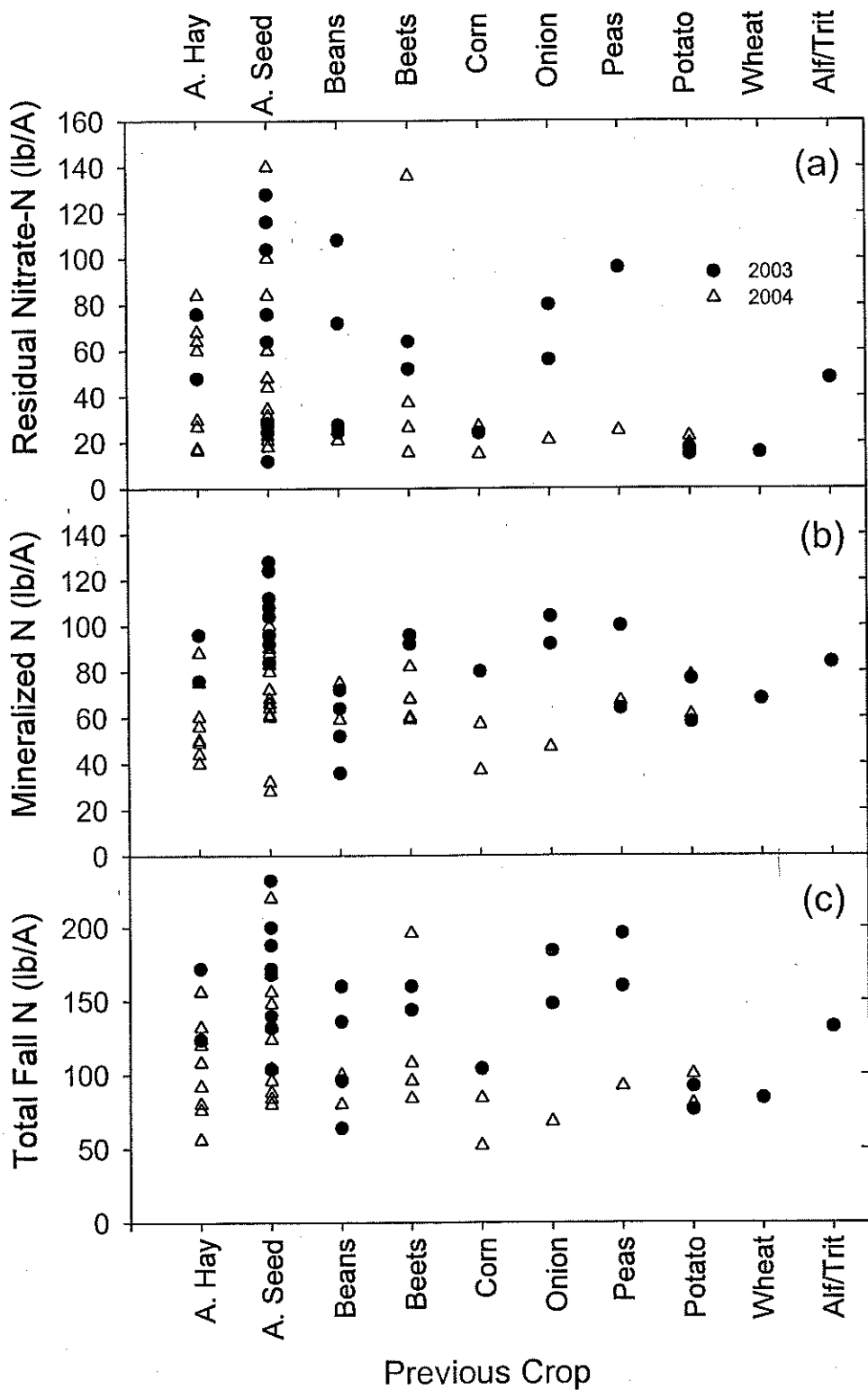


Figure 1a-c. Post-harvest residual N (a), late summer-late fall mineralized N (b), and total available N in southwestern Idaho wheat fields as affected by year (2002 closed circles; 2003 open triangles) and previous crop.