## ALFALFA RESPONSE TO POTASSIUM ($K_2O$) TREATMENTS AFFECTED BY PREVIOUS LIMESTONE QUALITY AND APPLICATION METHODS

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**Background.** Beef cattle producers rarely are concerned about limestone methods of application on their forage fields. In a perennial forage production system, limestone normally is spread on the soil surface and not tilled into the soil. We initiated a study of alfalfa response to fertilizer potassium (K) on a relimed site where limestone had previously been evaluated according to the method of application. Unanticipated results from the study are reported.

In late spring 1997, we applied ECCE 72% limestone (1440 lb effective limestone/ton) at a rate equivalent to 5.6 tons/acre in a randomized complete-block design. Treatments included (1) lime applied and the whole site was roto-tilled 6-inches deep; (2) limestone roto-tilled 2-in deep; (3) limestone left on the soil surface; and (4) a no-lime check. Immediately before planting, limestone from the same lot was applied at the same rate to one set of replicated plots and ECCE 100% limestone was applied to other plots and left on the soil surface. All limestone treatments in the four replications were duplicated with 80 g of molybdenum added to determine its effect on yield. Alfalfa was grown on these plots for four years, and was eliminated. Limestone (ECCE 100%) was uniformly applied at about 3.5 tons/acre to the whole site followed by disk incorporation and packing with a weighted roller. A blended fertilizer was prepared and spread on Nov. 19, 2002 to apply 35 lb N, 120 lb $P_2O_5$, 40 lb sulfur, and 4 lb boron/acre and the site was seeded to 'Tahoe' alfalfa, a multi-leaf variety, Dec. 2, 2002 to evaluate response to rates of potassium split applied beginning in April 2003. Rainfall was insufficient to allow earlier planting. The nitrogen was added to help the alfalfa seedlings become established because the seeding date was so late that we feared the rhizobia inoculated onto the seed might not be sufficiently active to fix needed amounts of nitrogen for the new plants during the coming winter months. We maintained the integrity of the plots used in the previous limestone incorporation study. One-half of each potassium rate was applied Apr. 10, the other Sept. 4. The total rates were 0, 80, 160, 240, 320, and 400 lb $K_2O$/acre.

**Research Findings.** In order to cut the alfalfa as it reached about 10% bloom, five low-yielding alfalfa harvests were made in 2003 (Table 1). The first four cuttings had been fertilized with only the first half of the total potassium rate. Alfalfa dry matter yield was statistically similar in any cutting and in the total for all cuttings due to increasing potassium rates. The residual potassium applied for the previous alfalfa study remained adequate and the alfalfa growth was insufficient to stress the ability of the soil to supply potassium.

Table 1. Alfalfa response to muriate of potash rates applied to a Darco loamy fine sand in 2003.

| *Potash rate ($K_2O$)* | *Dry matter yield by harvest date* | | | | | *Total Yield* |
|---|---|---|---|---|---|---|
| | 5/16 | 6/25 | 7/24 | 8/26 | 10/10 | |
| lb/ac | lb/ac | | | | | |
| 0 | 166 ns[†] | 1713 ns | 405 ns | 202 ns | 319 ns | 2805 ns |
| 80 | 204 | 1803 | 640 | 313 | 315 | 3301 |
| 160 | 212 | 1967 | 766 | 205 | 317 | 3467 |
| 240 | 322 | 1961 | 824 | 222 | 348 | 3677 |
| 320 | 60 | 1758 | 423 | 153 | 291 | 2685 |
| 400 | 177 | 1763 | 504 | 309 | 268 | 3021 |
| $R^2$ | 0.48 | 0.51 | 0.50 | 0.20 | 0.47 | 0.53 |
| C.V. | 98.5 | 10.0 | 46.6 | 72.2 | 17.5 | 19.9 |

[†] ns indicates no statistically significant differences in response data.

Yield data were evaluated based on the limestone surface or incorporated applications made in 1997 (Table 2). Alfalfa yield patterns were similar to responses that occurred in alfalfa grown in the four years after those lime treatments. Yield was the same for limestone incorporated either to the 6- or 2-in depths. Response to surface applied limestone, whether applied early or immediately before seeding, was similar. Limestone apparently had insufficient time to react after the 3.5 ton/acre re-application was disked into the soil in early August, 2002.

Table 2. Alfalfa response to method of limestone incorporation from treatments applied in 1997.

| *Limestone treatment* | *Dry matter yield by harvest date* | | | | | *Total Yield* |
|---|---|---|---|---|---|---|
| | 5/16 | 6/25 | 7/24 | 8/26 | 10/10 | |
| How incorporated | lbs/acre | | | | | |
| 6-inches | 232 ns | 1926 a[†] | 754 a | 226 ns | 333 ns | 3472 a |
| 2-inches | 259 | 1808 ab | 705 a | 297 | 315 | 3385 a |
| Surface | 78 | 1762 ab | 321 b | 179 | 280 | 2620 b |
| No lime | 51 | 1293 c | 55 b | 68 | 139 | 1605 c |
| 62% ECCE Surface | 166 | 1532 bc | 287 b | 207 | 243 | 2435 b |
| 100% ECCE Surface | 167 | 1755 ab | 325 b | 91 | 196 | 2534 b |
| $R^2$ | 0.67 | 0.83 | 0.89 | 0.65 | 0.76 | 0.85 |
| C.V. | 101.7 | 12.3 | 42.0 | 77.5 | 29.5 | 20.6 |

[†] Yields followed by a different letter within a column are statistically different at p = 0.05.

**Application.** Data indicated that incorporation of lime is critical for crops that are sensitive to soil acidity. Even in a low-production year, alfalfa grown in plots where limestone was incorporated yielded one-half ton/acre more dry matter compared to yield in plots with limestone left on the soil surface. This effect was still evident five or more years after the initial limestone treatment occurred.