## Crop Nutrition

By Karl Czymmek, Quirine Ketterings and Jerry Cherney

Potassium ranks second only to nitrogen in corn's and alfalfa's total nutrient requirements

# Potassium management makes good crop sense

**There are important reasons** why good crop managers pay attention to potassium (K) fertility, especially at today's high prices. It's second only to nitrogen in total crop requirement for both corn silage and alfalfa. Potassium plays a key role in regulating water and nutrient flows at the cellular level. And it helps with corn standability and winter survival in alfalfa.

Soil, manure and fertilizer are the major K sources. If soil doesn't release enough K, you need manure and/or fertilizer for optimal production.

Over the past eight years, the Nutrient Management Spear Program, Cornell Cooperative Extension, PRO-DAIRY and Jerry Cherney, professor in the Cornell Department of Crop and Soil Sciences, have conducted manure- and compost-based large-scale corn silage/alfalfa-grass rotation at the Musgrave Research Farm near Aurora, N.Y.

The N-based manure system had 20,000 gallons per acre of liquid manure surface applied annually compared to the P-based system with about 8,000 gallons per acre of manure incorporated shortly after application in the spring. For comparison, inorganic fertilizer plots were included in the trial. Alfalfa-grass was seeded in 2006.

**Table 1. Alfalfa yields in tons of dry matter per acre**

| | Fertility management in previous five corn silage years | | | | |
|---|---|---|---|---|---|
| | Compost ~34 T/acre | Compost ~20 T/acre | Manure ~20,000 gallon/acre | Manure 8,000 gallon/acre | Fertilizer N |
| | Alfalfa yields (dry matter in tons per acre) | | | | |
| 2006 | 3.26 a | 3.10 a | 3.20 a | 2.94 ab | 2.67 b |
| 2007 | 2.88 a | 3.07 a | 2.99 a | 2.69 a | 2.68 a |
| 2008 | 7.41 a | 7.02 ab | 7.36 a | 7.21 a | 6.51 b |

*The fertility treatments were manure, compost or inorganic fertilizer applications made annually to each of the five corn silage years preceding the alfalfa. No fertilizer, compost or manure was added to the alfalfa beyond a small P and K application in the establishment year. Where yields are followed by the same letter (a, b) within a year (so comparing the manure, compost and fertilizer N treatments within a year), we are 95% certain that any slight yield differences are not caused by the treatment.*

### Research results

The trial shows potential for K fertilizer savings. Soil test K levels in the plots that received manure and compost increased steadily during the five years of corn under both N-based and P-based systems.

Alfalfa yields on plots that didn't receive any manure or compost during the corn portion of the rotation yielded significantly less than the plots with manure or compost histories in two of the three years. **(Table 1)**

### Trial changes

Soil test data from 2006 when the seeding was established show potash levels to be significantly higher in the plots that received manure or compost during the corn portion of the rotation compared to the plots with inorganic fertilizer only.

Because phosphorus levels were high, we wondered if the higher yields in the manure and compost plots were related to potash fertility. Will the lower K, non-manured plots respond to extra K as Cornell guidelines suggest?

To answer that we added potash treatments in 2007 and 2008 to the plots that had no manure or compost history to see if there was a crop response to added K. We had five rates: 0, 140, 280, 420 and 560 pounds of 0-0-60 per acre per year for the

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## FYI

■ Karl Czymmek is a PRO-DAIRY specialist in agronomy and environmental areas. Reach him at 607-255-4890. Email: kjc12@cornell.edu.

■ Quirine Ketterings is associate professor of nutrient management and leads the Cornell Nutrient Management Spear Program in the Department of Animal Science. Tel: 607-255-3061. Email:qmk2@cornell.edu.

■ Jerry Cherney is EV Baker Professor of Agriculture and a forage management specialist in the Cornell University Department of Crop and Soil Sciences. Tel: 607-255-0945. Email: jhc5@cornell.edu.

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past two years. The 420 pounds of potash equated to expected crop removal. **(Table 2)**

When we add the yields of the past two years, we see no significant response to this extra potash. Though there is a trend to slightly higher yield in the highly fertilized plots, it's nowhere near enough to pay for the potash at current prices. The overall yields in the K fertilized plots may start to pull away from the others in 2009, but the yield differences seen in 2008 don't yet justify the extra K.

How can the lack of an economic response to K on non-manured fields be explained? Where is this potassium coming from? We believe the key is in New York soils – most of them have a fairly high potassium-supplying capacity because of the type and amount of clay present.

**Looking ahead**

Based on our results, we want to test the current Cornell K guidance on more dairy farms. While we seek funding for this research, we'll conduct limited studies in New York this year.

One thing we know for sure: Dairy farm fields where manure is the main N source during the corn portion of a rotation should be in very good shape for potash going into hay.

Here's our recommended strategy:

- Use the Cornell soil test to determine K requirements before establishing new seedings.
- If you plan to apply extra potash to hayfields with a manure history, consider leaving untreated check strips to begin building some observations on your dairy.

If you're a New York producer and would like to work with us as we expand testing on potassium, let us know. Watch future issues of *Eastern DairyBusiness* for updates on this project. ❒

**Table 2. Alfalfa/grass yields in tons dry matter per acre**

| | | K applied in spring (lbs. 0-0-60 per acre) | | | | |
|---|---|---|---|---|---|---|
| Year | Cut | 0 | 140 | 280 | 420 | 560 |
| 2007 | Total | 2.84 a | 2.63 a | 2.62 a | 2.56 a | 2.61 a |
| 2008 | Total | 6.28 a | 5.86 b | 6.46 ab | 6.74 ab | 6.95 a |
| 07+08 | Total | 9.12 a | 8.49 a | 9.12 a | 9.31 a | 9.60 a |

*Where yields are followed by the same letter (a, b) within a year (so comparing the manure, compost and fertilizer N treatments within a year), we are 95% certain that any slight yield differences are not caused by the treatment.*

### Getting a good read on P *continued from page 21*

stances, reliability dropped off quickly when fewer than three soil cores per acre were collected. In two scenarios – sampling too close to manure application and sampling in July instead of after harvest – collecting one soil core per acre gave a 40 to 50% chance that the field average soil test result was more than plus or minus 10 to 15 pounds per acre (plus or minus 20% for these fields). On the other hand, when soil is tested in the fall before manure application, one or two samples per acre were reasonably reliable (plus or minus 15%).

Based on Grandt's study and results from other research work, follow these guidelines where you need or expect higher accuracy on phosphorus soil tests:

| Conditions | Number of soil cores/acre |
|---|---|
| Spring/summer sampling | 3 |
| Fall/winter sampling before manure application | 1-2 |
| Planning to convert Mehlich-3 to Morgan soil test P | 3 |
| Fall sampling after manure application | 2-3 |
| Annual sampling* | 1-2 |

** Mehlich-3 to Morgan conversion may provide unsatisfactory results across years. When using a conversion, one sample per acre annually is only a substitute if the accuracy of the conversion equation has been checked (i.e. sample is split, sent in for both Morgan and Mehlich-3 analysis, and both the true Morgan and the estimated Morgan compare well).*

### 10 tips to manage manure on alfalfa-grass fields *continued from page 20*

seedings with companion crops work better on some dairies and in some locations than others, so test it out on a few acres first if you're not sure.

**6.** For established hay stands, the risks of smothering and/or salt injury increase with manure application rates exceeding 4,000 gallons per cut, especially when applications are delayed beyond three to four days after cutting.

**7.** Where you want to maintain – not increase – P levels, limit manure application rates to 4,000 gallons per acre for the year across all years of the stand. If fertility levels are very high, it's unnecessary to apply manure in the seeding and early production years.

Here's a practical approach to maintaining P levels: Apply 4,000 gallons of manure per acre after cuttings – where field conditions allow – in the final years of the stand to rebuild P and K levels after drawdown. Always check manured fields for forage K content if you plan to feed the crop to dry cows.

**8.** If you apply manure in the last production year to address P and K levels, apply it while the crop is actively growing to enhance N uptake during summer or early fall. Then kill the alfalfa-grass the following spring rather than the previous fall to reduce the potential for large N losses prior to planting corn.

**9.** Follow these practices to minimize wheel traffic damage:

- Plant traffic-tolerant varieties.
- Use small tractors if possible.
- Avoid unnecessary trips across a field.
- Use larger harvesting equipment and drive on fields as soon after cutting as possible.

**10.** Field applying manure from animals infected with pathogens, particularly Johne's disease, may spread these infections. In the case of Johne's, don't expose animals younger than a year to contaminated pastures or to feed coming from these fields. ❒