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Nitrification Inhibitor Boosts Corn Yields

Colorado researchers combine UAN with nitrapyrin to increase amount of N available to plant in the NH_4^+ and NO_3- forms.

Summary: *Corn yield increases of from 9 to 30 bu/A were obtained from treatments that increased the amount of available N in the NH_4^+ form to approximately 50 percent by applying a nitrification inhibitor (nitrapyrin or N-Serve) with ammonium forms of N fertilizer. These irrigated field experiments were conducted from 1983-86 in a calcareous soil low in organic matter (1.6%).*

The effectiveness with which N is used by corn is important because of the increasing costs of manufacture and distribution of N fertilizer. In the past 30 years the increase in corn yield has not been proportional in increased N use.

A real need exists, therefore, to increase N fertilizer use efficiency by crops and to determine what soil and plant factors related to available N can limit crop productivity in given environments. Two forms of available N (ammonium, NH_4^+ and nitrate, NO_3-) can be supplied to a crop by choosing N fertilizer forms and nitrification inhibitors.

When used with ammonium sources of N, nitrification inhibitors result in NH_4^+ availability for an extended period of time, making it possible for corn to increase NH_4^+ uptake and possibly realize benefits of an enhanced NH_4^+ supply.

In a normal sequence of events, N fertilizer is applied to the soil and NH_4-N forms are rapidly nitrified to NO_3-N, which is then the form of N mainly used by plants. This NO_3- form also leaches readily and may be displaced from the root zone. Studies with nitrification inhibitors have been mainly designed to keep more N fertilizer in the slowly leachable NH_4^+ form, and thus conserve N for the crop. Corn and other crops can use both NH_4-N and NO_3-N. Studies have indicated that corn can grow better when supplied a mixture of NO_3- and NH_4^+ than with NO_3- alone. The result is more kernels per corn plant.

Our objective in this study was to measure whether the supply of available N in various combinations of NH_4^+ and NO_3- forms can affect corn yields. Our hypothesis was that a combined N supply of NH_4^+ and NO_3- forms for corn would increase N use efficiency by the plant and increase corn yield compared with equal amounts of available N in either form alone.

Response favorable

As shown in Figure 1, irrigated corn yields increased when *N-Serve* was added to UAN. As can be seen, split applications of UAN were made in April, July, and August. Prior to this, preplant applications of P (100 lbs/A P_2O_5) and K (200 lbs/A K_2O) had been broadcast and disked in.

Methodology

Site. Field experiments were conducted in 1983, 1984, and 1986 in Fruita, Colorado.

Soil. Soil at this site is a calcareous Youngston (formerly Ravola) fine sandy loam low in organic matter, and is a Typic Torrifluvents. Soil properties are shown in Table 1.

Irrigation. At one site, level basins were established and irrigations produced no runoff. One experiment was conducted in 1986 outside the level basins. Usual farmer practices were followed with furrow irrigations. Runoff occurred. Water was applied as needed by ET measurements. Total water applied was 24 to 26 inches during the growing season in the level basins.

Fertilizer. As already noted, P and K were broadcast preplant and incorporated by disking. Subsequent split applications of N were applied in the irrigation water in the level basins and within the furrows for a given treatment. The nitrification inhibitor, nitrapyrin or *N-Serve*, was

applied with the fertilizer in the irrigation water at recommended rates. Treatments were randomized within the level basins and there were five replications. On the 1986 plot outside the level basins, split applications were made between the rows, with the N and inhibitor mixed before application. The plots were cultivated and furrowed following this application.

Planting. The level basin plots were planted in 24-inch rows with Funks G4507 in 1983 and 1984, and with DeKalb 656 in 1986. The furrowed plots were planted in 30-inch rows with DeKalb 656, and with five replications.

N as catalyst

Nitrogen has two major roles:

1. Establishment of yield capacity
2. Establishment and maintenance of photosynthetic capacity.

Researchers have noted that in cereals an adequate N supply during early growth stages is important in determining the number of ears per unit area. Researchers have further suggested that sink (kernels) sizes may frequently limit crop yields. The supply of reduced N to the ear during reproductive growth is important in the establishment of a viable sink. However, a balance between N in the vegetative plant parts and the N supply to the developing sink must be achieved to allow maximum productivity.

It has been suggested that continued input of N into the plant is responsible for the maintenance of leaf duration and continued photosynthetic activity. The availability of current photosynthate and reduced N ensures the longer duration of grain fill. The end result is a higher yield per plant.

Another conclusion drawn from research is that the loss of N from corn leaves to the stalk and ear is a major cause of senescence. A long period of grain-fill could be facilitated by a large N supply in leaves at the start of rapid grain filling. A large N supply in leaves should allow a more appropriate redistribution of N to support ear development and leave more N in the leaves to maintain the photosynthetic apparatus.

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Table 1. Chemical properties of Youngston Ravola fine sandy loam used in corn fertility experiments.

pH	7.8
Organic matter (%)	1.6
$NaHCO_3$- extractable P (ppm)	14
K, exchangeable (ppm)	110
NO_3-N, soluble in 2N KCL (ppm)	27
DTPA extractable nutrients (ppm):	
Fe	23
Mn	8
Zn	7

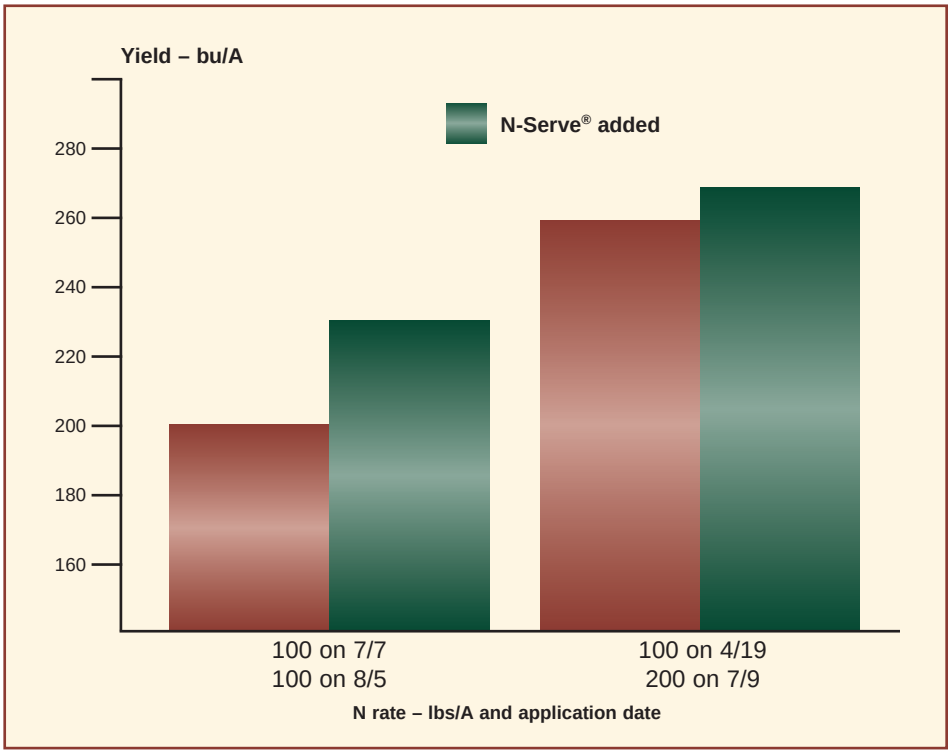

Figure 1. Corn yields as affected by split UAN applications with and without nitrapyrin (N- Serve), Olsen, et al., USDA/ARS, Fruita, CO, 1986.