

# One-Shot Phosphorus Gives Years of High Returns

One phosphorus application on winter wheat boosts yields, encourages nitrogen uptake.

By Ardell Halvorson

**T**oday's gloomy wheat prices have everyone squeezing down costs, and rightfully. But, USDA research conducted at Akron shows that one application of phosphorus fertilizer for winter wheat can pay off for several years in both improved crop yields and enhanced nitrogen uptake. That makes that shot of phosphorus a good long-term investment.

Soil phosphorus deficiency for winter

wheat is common in the Central Great Plains. Research in eastern Colorado in the mid-80s has shown that a single application of phosphorus, incorporated into the top three inches of soil, has increased winter wheat grain yields for three years. Moreover, soil tests showed that even after the first three crops were harvested, there was enough residual phosphorus for an additional 2-3 crop years. Putting on phosphorus was like putting money in the bank and drawing several years of interest on it.

In addition, using adequate phospho-

rus for optimum growth increased the plants' ability to utilize soil nitrate-nitrogen. The improved uptake of nitrogen fertilizer not only improved yield but also reduced the amount of potentially leachable nitrate in the soil profile, an important environmental consideration. That advantage is illustrated in the charts at right.

The phosphorus research reported in this article from the Central Great Plains Research Station at Akron was conducted in the mid-'80s on irrigated, continuous winter wheat. Similar dryland, wheat-fallow research is in progress now at the Akron Station. Begun in 1985, the final results of the dryland experiments will be released at the conclusion of the test in 1994.

Unlike many previous phosphorus fertilizer tests which have measured only the crop's yield response the first year after application, these studies measure multiple year responses of wheat to a single application of  $P_2O_5$  fertilizer. Additionally, the irrigated wheat study combined several rates of nitrogen fertilizer combined with the one-time phosphorus application.

That study was conducted using a no-till, annual winter wheat cropping system. Phosphorus, as concentrated superphosphate (0-45-0), was applied only once, in September, 1983 just before planting. Three levels of  $P_2O_5$ , 0, 69 pounds and 138 pounds of per acre were tested. Nitrogen was applied annually as ammonium nitrate (34-0-0) to each phosphorus treatment. The five nitrogen application rates used in each of the three years are shown on the accompanying table at right.

Winter wheat was grown on the plots three consecutive years (1984, 1985, 1986) under limited irrigation.

**A phosphorus and nitrogen fertility program boost irrigated wheat yields. A similar program for dryland is also being researched at the USDA Akron station.**



The Weld silt loam had an initial Olsen soil test phosphorus level of 5.7 parts per million, which is a low rating, and a soil pH of 7.1. The phosphorus application in 1983 (both the 69 lb./acre rate and the 138 lb./acre) increased soil test levels in the 1984, 1985 and 1986 crop years compared to the check site where no P<sub>2</sub>O<sub>5</sub> had been applied.

While the cropping caused the phosphorus level to decline each year, after three years the soil test level was still higher than where no phosphorus had been applied. The residual amount appeared to be sufficient to safely anticipate a crop response for at least another 2-3 years.

Application of phosphorus at both rates increased winter wheat grain yields each crop year. In 1984, grain yields increased as the nitrogen fertilization rate increased. The highest grain yield, 64 bushels, was obtained with the application of 300 lb. of N/a to the 69 lb. P<sub>2</sub>O<sub>5</sub>/a treatment. The higher rate of phosphorus treatment (138 lb./a) yielded slightly less than the lower rate because of a possible phosphorus induced zinc deficiency at the higher rate.

The highest yields in 1985 occurred with the application of 60 pounds of

nitrogen on the 138 lb./a phosphorus treatment. In 1986, the highest yield was with the application of 120 lb./a of nitrogen to the 138 pound phosphorus plot. Over the three-year period, the yields increased almost 40% with the highest rate of phosphorus.

Results of the Akron study show that it is reasonable to amortize the cost of phosphorus over several years so that you can justify using sufficient phos-

phorus in a single application to optimize your winter wheat yield.

—Ardell D. Halvorson is the research leader / soil scientist with the USDA Agricultural Research Service at the Central Great Plains Research Station at Akron, CO. His address is USDA-ARS, P.O. Box 400, Akron, CO, 80720, (303) 345-2259.

## Phosphorus + N = Plant Vigor

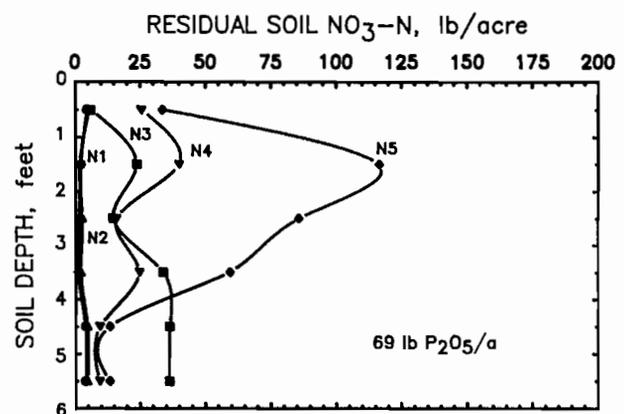
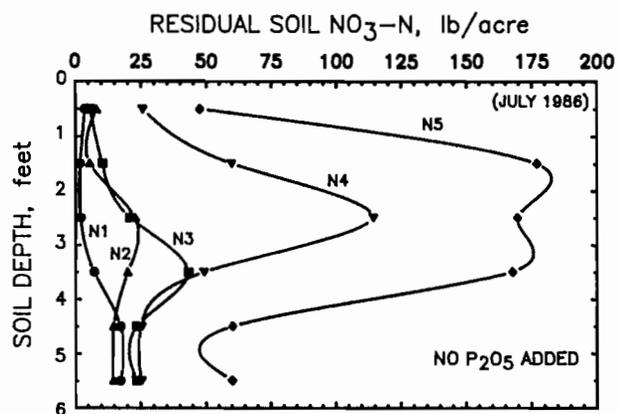
N Rate	1984	Crop Year	
		1985	1986
		lb. N/a Added	
N1	0	0	0
N2	50	30	30
N3	100	60	60
N4	200	120	120
N5	300	240	240

These five nitrogen fertilizer rates were applied annually during the one-shot phosphorus fertilizer trial. Phosphorus was applied only in 1983 at three rates—0 lb./a (the check), 69 lbs./a and 138 lbs./a.

# Where Does Your Nitrate Go with

## No Phosphorus?

## 69 lbs./a Phosphorus?



The addition of phosphorus to the winter wheat fertility program resulted in significant reductions of nitrate-nitrogen in the soil profile—by improving utilization by the wheat plants. Reductions of nitrate levels are shown at right as a result of phosphorus being applied at a rate of 69 lbs./a. Similar reductions occurred when phosphorus was applied at 138 lbs./a although at that phosphorus rate more nitrate at the N<sub>3</sub> level was removed from the soil profile.