FERTILIZATION OF NO-TILL WINTER WHEAT

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ABSTRACT

There is a growing trend towards the use of minimum and no-till production systems for dryland winter wheat in the Western Great Plains Region. More information is needed regarding management systems to optimize economic return. The proper management of plant nutrients is of main concern to this production system. This research project was initiated in 1983 to provide information concerning N and P fertilizer management. Each year, experiments were conducted at 3 locations over a range of environmental and soil conditions to determine optimum N and P rates, sources, and placements.

The N and P sources increased yield and N and P uptake similarly. Therefore, the non-traditional materials, urea-urea phosphates and liquid suspensions, appear to have an excellent potential as sources of N and P. The effect of placement on yield and N and P uptake was statistically significant. Banding the fertilizer below the seed or dribbling over the seed row after row closure resulted in greater N and P uptake and higher yields than surface broadcast placements. Since these two band placements produced similar grain yields, dribbling over the seed row would have the most potential for application to commercial production conditions since equipment modification would be less expensive than banding below the seed. A maximum rate of 30 lbs N/acre, as UAN, is suggested as a maximum N rate to be placed with the seed to avoid stand damage and reduction in yields.

OBJECTIVES

This research project was initiated in 1983 to provide information concerning N and P fertilizer management of summer fallow no-till dryland winter wheat in the Western Great Plains Region. The primary objectives of this project are threefold: 1) to determine the effect of rate and placement of various N and P fertilizer materials on N and P uptake, grain yield, and fertilizer efficiency, 2) to determine the potential use of urea-urea phosphate materials and UAN and APP 2% clay suspension fertilizer materials, 3) to determine rates of N which can be placed with the seed without stand damage and yield reduction.

MATERIALS AND METHODS

No-till dryland winter wheat sites under summer fallow production were located in Eads, Matheson and Platner, Colorado. Selected chemical characteristics of the soils at each site are shown in Table 1. The fertilizer sources, rates, and placements are shown in Table 2. Since no significant differences between fertilizer sources were observed in 1984, the discussion in this paper will be limited to the effects of rate and placement and rate of N with the seed.

Preplant broadcast applications were made by hand (granular materials) or with a CO_2 pressurized plot sprayer (liquid materials). Banded placements of solution materials were made at planting. Banding below the seed (BBS), approximately one half inch, and placement with the seed were accomplished utilizing the dual placement

Table 1. Soil characteristics for the three locations used for no-till, dryland winter wheat experiments, 1984-85

		Location	
	Eads	Matheson	Platner
Soil Type	Colby silt loam	Weld loam	Platner silt loam
Soil pH	7.8	6.8	7.1
O.M. (%)	1.2	1.4	1.1
AB-DTPA-P	0-1ft. 1.8	4.1	4.1
Nitrate ($ug\ g^{-1}$)	0-1ft. 10	17	13
	1-2ft. 7	5	6
	2-3ft. 5	4	4
	3-4ft. 4	4	2

Table 2. Fertilizer sources, rates, and placements used in no-till, dryland winter wheat field experiments, 1984-85.

Main Treatment Set

Sources
Urea, granular
DAP, granular
UAN, solution
APP, solution
UAN, 2% clay suspension
APP, 2% clay suspension
UUP, granular & solution
N:P ratios of 1:1 and 2:1

Rates
Nitrogen - 0, 30, and 60 lb N/acre
Phosphorus - 0 and 30 lb P_2O_5/acre

Placements
Broadcast (preplant)
Banded below seed (BBS)
Dribbled over seed (DOS)

N With Seed Treatment Set

Sources
UAN, solution
APP, solution

Rates
Nitrogen - 0, 20, 30, 40, 60 lb N/acre
Phosphorus - 30 lb P_2O_5/acre

Placements
Broadcast (preplant)
With seed

planter shoes. Dribbling over the seed (DOS) occurred by banding liquid fertilizer over the seed row after row closure, following the press wheel. Plots were 6' by 56' planted on 12 or 14 inch centers. A randomized complete block experimental design was used with four replications. The semi-dwarf variety Vona was planted at Platner and Matheson and the medium-height variety Sandy was planted at Eads during the last two weeks in September. Nutrient uptake was monitored by collecting tissue samples at the early tillering stage of growth in November and at the boot stage in May. Above ground biomass and total N and P uptake were determined at the boot stage and at harvest with uptake being partitioned between straw and grain at harvest.

There was no statistically significant location by treatment interactions, therefore we have combined treatments across locations in this report.

RESULTS AND DISCUSSION

There was a significant interaction of N rate by N placement on grain yield (Figure 1). At a N rate of 30 lbs N/acre broadcast, a yield of 52.8 bu was obtained, however, when the same N rate was dribbled over the seed or banded below the seed an increase in yield of 5 to 7 bu/acre was obtained. Only at the high N rate (60 lbs N/acre) does the broadcast placement approach the maximum yield obtained by 30 lbs N placed with the seed or dribbled over the seed. This significant N rate by placement interaction demonstrates that increased efficiency of N is obtained with these two band placements, broadcast being less efficient.

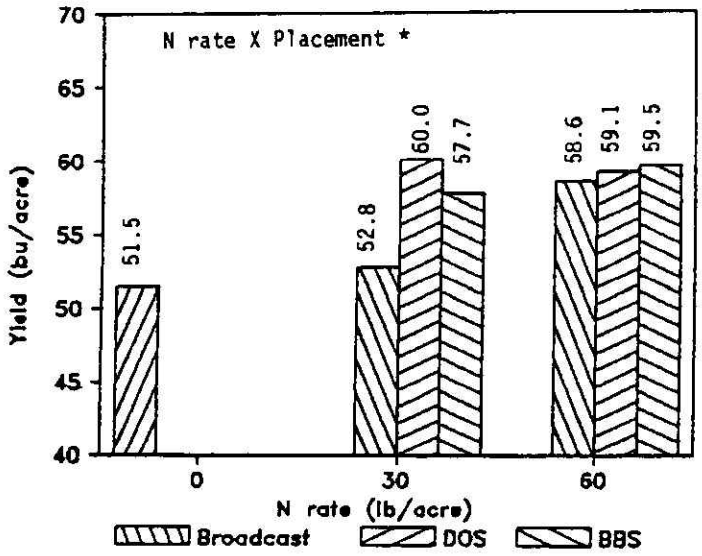

Figure 1. Effect of nitrogen (UAN) rates and placement on winter wheat grain yield, 1984-85. (averaged across phosphorus rates and locations)

Significantly higher P uptake and N uptake (Table 3) resulted from band application of P as contrasted to broadcast P. It is interesting to note the significant effect of P placement on N uptake. There was also a significantly higher yield from the banded P treatment (averaged across N rates) as contrasted to the broadcast P, with the yield advantage being approximately 4 bu/acre, which was significant at the .01 level.

The effect of N rate placed with the seed was not statistically significant for N and P uptake or grain yields (Table 3). However, a definite trend that was consistent at all locations for decreased P uptake, N uptake and grain yield was observed as N rate increased from 30 to 40 lbs N/acre. Our research in 1983-84 showed a substantial increase in stand damage and reduction in yield at the 80 lb N rate BBS, and none to 40 lb/acre. Therefore we conclude that a maximum rate of 30 lb N/A as UAN should be applied with the seed under dryland production systems in eastern Colorado.

Table 3. Effect of N (UAN) and P (APP) placement and rate with the seed on P uptake and yield.

Treatment	Boot Stage P Uptake	Boot Stage N Uptake	Grain Yield
	lb P/A	lb N/A	bu/A
Placement[1/]			
P Broadcast	6.8	63	59
P Banded With Seed	8.4	72	63
Statistical Signif.	**	*	**
N Rate With Seed[2/]			
20 lb/A	7.0	64	62
30 lb/A	7.3	66	61
40 lb/A	6.1	59	56
Statistical Signif.	NS	NS	NS

1/ Averaged across N rates 20, 30 or 40 lb N with the seed, the remaining broadcast. Total fertilizer N = 60 lb/A. P rate = 30 lb P_2O_5/A .

2/ N source = UAN, total fertilizer N = 60 lb/A, remainder applied broadcast. P rate = 30 lb P_2O_5/A broadcast.

Since the effects of banded placement on grain yield are similar, we feel that dribbling the fertilizer over the seed row has greater potential under commercial production systems. Conversion of planting equipment to place liquid fertilizer materials in a band over the seed on the soil surface after row closure is much easier and less expensive than conversion to banding fertilizer with the seed. The problem of potential seedling damage due to close contact between the fertilizer material and the seed would also be eliminated.

ADDITIONAL SOIL FERTILITY RESEARCH PROGRAMS

P Solubility of Fertilizer Reaction Products. Objective: To identify and monitor P reaction product formation in dual N and P injection zones and determine its relationship to P availability to plants. Principal Investigators: D. Westfall and P. Grossl.

S cycling in Great Plains Agroecosystem. Objectives: To identify S cycling in agroecosystem as influenced by long-term tillage systems of dryland winter wheat. Principal Investigators: D. Westfall, P. Tracy, V. Cole, T. Elliott and G. Peterson.

Evaluation of Industrial By-products as Potential Fertilizer Materials: Objective: To evaluate the potential use of industrial by-products as sources of plant nutrients and identify toxic contaminant effects on plant and soil systems. Principal Investigator: D. Westfall.

N and P Requirement and Soil Test Correlation of Dryland Winter Wheat. Obectives: Determine the N and P requirement of wheat and demonstrate to farmers the

benefit of proper fertilization with these nutrients. To develop soil test correlation information. Principal Investigators: D. Westfall, H. Follett, D. Whitney, J. Zupancic.

Spring N Fertilization/Soil Test Calibration of Dryland Winter Wheat. Objective: Develop soil test/plant tissue analysis procedures to guide producers in making spring top-dress applications of N. Principal Investigators: D. Westfall, K. Barbarick, R. Russell, B. Vaughan.

Urease Inhibitors to Increase N Efficiency. Objectives: Evaluate the effect of urease inhibitors on fertilizer N efficiency of corn. Principal Investigators: D. Westfall and W. Wood.

Application of Sewage Sludge to Dryland Winter Wheat. Objectives: Determine the N equivalency of sludge and its effect on production of dryland winter wheat. Principal Investigators: K. Barbarick, R. Lerch, D. Westfall, H. Follett.

Soil and Crop Management Systems. Objectives: Identify the N and P requirements of crop management systems designed to maximize water use efficiency. Principal Investigators: G. Peterson, D. Westfall, W. Willis, W. Wood, D. Smika.

Soil Test Laboratory Recommendation Comparisons. Objective: To evaluate the validity of various soil test laboratory fertilizer recommendations made from soil testing laboratories operating in Colorado. Principal Investigator: H. Follett

N Requirement of Millet. Objective: Determine N and P partitioning and nutrient needs of millet in relation to soil test parameters. Principal Investigators: G. Peterson, R. Rodriquez, D. Westfall.

P Fertilization of Alfalfa. Objectives: Determine the soil fertility requirements of alfalfa and their relationship to soil test levels. Principal Investigators: W. Schmehl and A. Fulton.

Maximum Economic Yield of Corn. Objective: Determine the growth and environmental parameters that control maximum economic yield for corn. Principal Investigator: S. Olsen.

N Fertilization of Potatoes. Objectives: To determine the effect of preplant N rate on tuber growth rate and to evaluate the interaction of plant population and N rate on advanced lines from the potato breeding program. Principal Investigator: M. Thornton