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A new technique for phosphorus fertilization of winter wheat

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Quick Facts

Proper placement of P fertilizer is essential for maximum yield response.

Broadcast P fertilizer that is not incorporated thoroughly into the soil will not result in maximum P fertilizer efficiency and yields.

Dribbling P fertilizer on the soil surface after row closure is an effective method of applying fertilizer to dryland winter wheat when hoe drills are used.

The modification of equipment to dribble fertilizer over the seed row after row closure is simple and inexpensive.

The use of "hoe" drills in the planting of dryland winter wheat offers special opportunities for the use of a unique technique for placing P and N fertilizers. Hoe drills are designed to place the seed in the moist soil by pushing aside the dry surface soil and placing the seed below the bottom of the furrow, followed by a press wheel to insure firm seed-moist soil contact.

Studies conducted by the agronomy department at Colorado State University identified a technique for surface application of P that results in efficient P uptake and maximum grain yield as compared to other application/methods. The methods of application evaluated were: a) preplant broadcast without incorporation; b) dribbling the fertilizer over the seed row on top of the soil after row closure; and c) banding the fertilizer directly below the seed at planting.

The differential response of crops to various P fertilizer placements has been well documented. Phosphorus is relatively immobile in soils and will remain near the point of application. Therefore, placement in the vicinity of active root growth is essential if maximum P fertilizer use efficiency and yield response is to be achieved. This is especially true for dryland winter wheat production in Colorado where soil moisture is low in the soil surface for much of the growing season.

This information provided by:

1. D. G. Westfall, Colorado State University Cooperative Extension professor; R. Hunter Follett, Cooperative Extension agronomist and professor; agronomy. 10/92. ©Colorado State University Cooperative Extension. 1994. For more information, contact your county Cooperative Extension office. Some recommendations change regularly. Please contact your Colorado State University Cooperative Extension county office for current recommendations.

N and P Uptake

Banding fertilizer below the seed resulted in a 36 percent increase in N uptake and a 31 percent increase in P uptake at the boot stage as compared to unincorporated broadcast applications. The dribble over the seed placement resulted in a 29 percent increase in N uptake and a 26 percent increase in P uptake at the boot stage of development. Both methods increased P uptake by wheat, as compared to the broadcast unincorporated treatment, and were essentially equal in effectiveness.

Grain Yield

The average yield and protein responses to the various placements are shown in Table 1. Fertilizer placement did not significantly affect protein. However, the banded below the seed and dribble over the seed placements yielded 4 to 6 bu/A more than broadcast. The difference between the banded below the seed and dribbled over the seed placements was not statistically significant, therefore we would not expect either fertilizer placement to be consistently advantageous over the other.

Why Does Dribbling P Over Seed Work?

Why does application of an immobile nutrient like P on the soil surface produce P uptake and yields equal to banding the P below the seed? The reason is quite simple. Hoe drills are designed to move the dry soil to the middle of the row so the seed can be placed in moist soil. The general soil surface configuration "at planting" is shown in Figure 1. The seed is planted approximately 0.75 to 1.5 inches below the bottom of this furrow made by the hoe on the drill. The fertilizer is dribbled on the soil surface in a band directly over the seed. Wind and water action and natural soil sloughing move the soil from the ridge to the deep furrow; in a short time the original fertilizer band becomes buried under the soil ("with time," Figure 1).

How does this help the plant get the P? Crown roots are initiated at approximately the 3.5 leaf stage of growth, 0.5 to 0.75 inches below the soil surface. They intercept the fertilizer band that was originally placed over the seed row on the soil surface at planting (but that now has become covered by soil due to sloughing into the furrow). This close root-fertilizer placement results in

efficient N and P uptake and allows the dribble over the seed treatment to be as effective as banding P fertilizer with the seed or banding P fertilizer under the seed at planting.

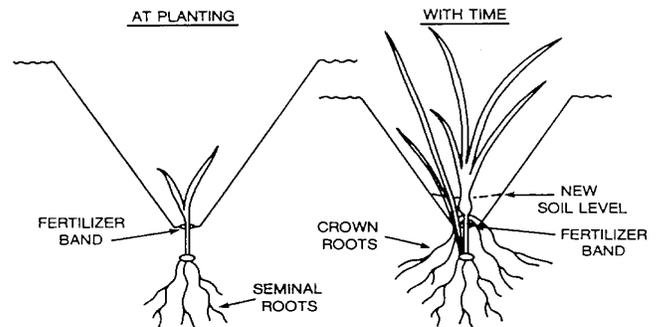


Figure 1: The shape of the soil surface at planting and with time. (Surface banded fertilizer becomes subsurface band with time as soil sloughs into drill row.)

Dribbling the fertilizer over the seed row before row closure by the press wheel would undoubtedly be an equally efficient placement method, however we have not evaluated this technique. Some physical problems may be encountered such as caking of the soil to the press wheel due to the wetting by the fluid fertilizer, or if a high N rate is used, some fertilizer may come in contact with the seed and create a salt effect. Germination may be retarded.

Equipment Requirements

How is this method an advantage? The conversion of existing planting equipment to dribble fertilizer over the seed row after row closure is inexpensive and easy to accomplish, compared to modifying existing planting shoes or purchasing new shoes to place P fertilizer below the seed. Equipment required is a fertilizer-dispensing device, such as a squeeze pump if fluid fertilizers are used, and a simple attachment of a tube to direct fertilizer behind the press wheel after row closure. The modification of one type of hoe drill is shown in Plates 1 and 2. New planting shoes, disc openers, etc. are not required. The fertilizer is dribbled directly over the seed after row closure.

The configuration of the press wheel in the soil surface after planting is very important if the dribble over the seed application method is to be effective. If planting occurs on a flat surface, it will probably not be as effective as banding the fertilizer below the seed because

no soil will cover the fertilizer and there will be no root activity in the vicinity of the fertilized soil. However, with hoe drills and others that produce a soil configuration as shown in Figure 1, dribbling fertilizer over the seed row after row closure is an effective fertilizer placement technique that results in maximum P fertilizer efficiency and yield response.

Table 1: The effect of fertilizer placement on grain yield and protein content.

Fertilizer placement	Protein (%)	Grain yield (bu/A)
Broadcast	10.5	55
Banded below seed (BBS)	10.8	59
Dribbled over seed (DOS)	10.8	61
LSD (.10)	NS	3