Dry Drop: A Novel Approach to Fertilizing Maize

Crop Physiology

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QUESTION: Is there a more effective timing and placement of dry fertilizer applied to maize?

OBJECTIVE: Assess the effect of precision in-season fertilizer placement and timing on soil nutrient availability and maize grain yield.

INTRODUCTION

Traditionally, the application of dry fertilizer sources occurs as a broadcast application to the soil for maize (*Zea mays* L.) prior to planting, which may lead to losses due to temporally-impaired soil nutrient availability and crop uptake, and spatial constraints on nutrient access and crop root development, especially for soil-immobile nutrients like phosphorus (P) and potassium (K).

Common precision in-season approaches utilize liquid fertilizers concentrated at the base of the plant, known as the Y-Drop application (Figure 1). However, precision placement of in-season dry fertilizers at the base of the plant have not been studied. This novel approach to fertilize maize is called "Dry-Drop" (Figures 2 and 3).

RESEARCH APPROACH

Field design

In the spring of 2023, maize hybrid DKC66-06 was planted at Champaign, IL at a density of 89,000 plants ha^{-1}. Treatments were arranged in a randomized complete block design with 11 replications over two sites.

Fertilizer treatments

All plots received 200 kg N ha^{-1} prior to planting as UAN-32. Additional nutrients supplied at plant growth stage V6 for the treatments were (in kg ha^{-1}) 26 N, 90 P_2O_5, 67 K_2O, 22 S, 2.2 Zn, and 0.6 B. Figures 1 and 2 show the Dry-Drop and Y-Drop applications. The treatments included:

- Untreated Control
- Broadcast application
  - -MicroessentialsSZ(12-40-0-10S-1Zn)
  - -Aspire(0-0-58-0.5 B)
- In-season Banding
  - Y-Drop
    - -Ammonium Polyphosphate (10-34-0)
    - -K-Flex (0-0-19-55 S)
    - -Ultra-Che EDTA 9% Zn
    - -Liquid Boron 10%
  - Dry-Drop
    - -Aspire (0-0-58-0.5 B)
    - -Microessentials SZ (12-40-0-10S-1Zn)

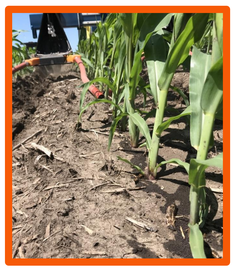


Figure 1. Liquid fertilizer from the Y-Drop application at the base of V6 maize plants.

Figure 2. Fertilizer granules from the Dry-Drop application at the base of V6 maize plants.

Sampling

Soils were sampled at depths of 0-5, 5-10, 10-15, 15-30 cm about 2.5 cm from the crop row at the preplant and VT growth stages to assess per plot change in soil P, K, and S concentrations. Final grain yields were assessed at physiological maturity and yield components were determined using plot subsamples.

RESULTS

- Although there was a **tendency** to achieve greater yield with fertilizer application, none of the fertilizer placements or timings resulted in significant changes in maize grain yield or yield components, indicating that the site was not nutrient-limited. (Table 1).

Table 1. Effect of fertilizer treatments on grain yield and yield components

Treatments†	Yield	Kernel Number	Kernel Weight
	Mg ha^{-1}	kernels m^{-2}	mg $kernel^{-1}$
Untreated Control	13.32	4437	290
Preplant Broadcast	13.80	4742	290
Y-Drop	13.47	4620	292
Dry-drop	13.61	4639	293
LSD(α=0.05)	NS	NS	NS

†Values are averaged across two sites and presented at 0% moisture.

- In-season Dry-Drop and Y-Drop applications **increased** soil-available P, K, and S at the VT growth stage at all soil depths when compared to the untreated control and the preplant broadcast with exception of K at 5-10 cm depth and S at the 15-30 cm depth (Figure 4).

Figure 3. Moist soil from the dew that funneled down the maize plant and dissolved the dry fertilizer.

- Although not soil-mobile, in-season fertilizer application, liquid or dry, increased P concentrations at the 15-30 cm depth by 97%, most likely due to a broader soil diffusion zone after concentrating the fertilizer in a band (Figure 4A). Similarly, greater nutrient levels at lower depths were observed with in-season Dry-Drop or Y-Drop K applications compared to broadcast preplant fertilization (Figure 4B).

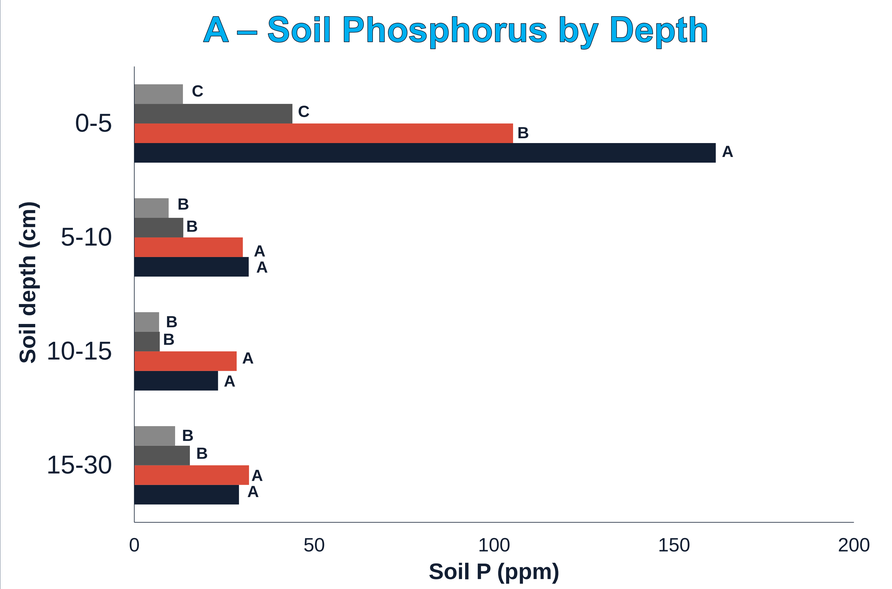
- Liquid application as Y-Drop significantly increased sulfur availability over Dry-Drop at the 0-5 and 5-10 cm depths (Figure 4C), which can be attributed to the need for oxidation of the elemental sulfur present in the MicroEssentials-containing treatments, in contrast to the readily-available sulfate sulfur applied with the liquid treatment.

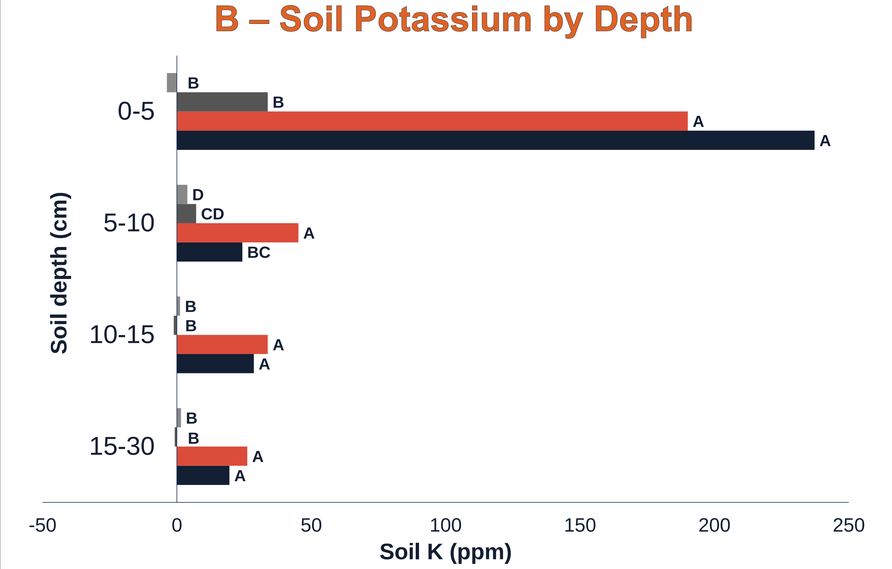
CONCLUSIONS

- **Dry-Drop and Y-Drop methods significantly increased soil P, K, and S availability at the maize VT growth stage at most soil depths compared to traditional preplant-broadcast application.**

- **In-season applications increased soil nutrient availabilities that were not reflected in greater yields, suggesting that, in nutrient-limited conditions, in-season application methods could result in substantial yield increases.**

Special thanks to The Mosaic Company for supporting this research.





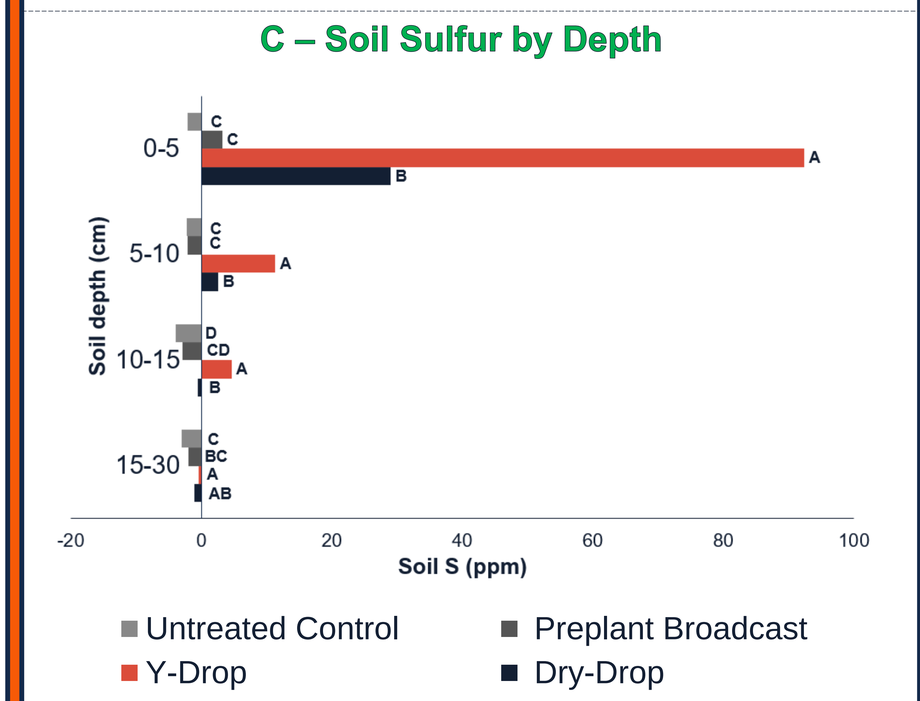


Figure 4. Changes in soil phosphorus (A), potassium (B), and sulfur (C) levels at different soil depths from preplant to the VT growth stage as influenced by the different fertilizer placements and timings.