Recently Gained Insight on Potato Phosphorus Use and Management Strategies

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Introduction: Phosphorus (P) is one of the three essential macro nutrients required for plant growth and development. Specifically, phosphorus is key in the production of a healthy potato crop where as much as 1 lb P/ac per day is taken up by the plant. Within the plant, phosphorus is used for many basic plant functions such as protein synthesis, adenosine diphosphate (ADP) phosphorylation to adenosine triphosphate (ATP), and as a key component of cell structure. Due to its relative immobility in the soil and potential to bind with free cations, deficiency can be a common occurrence.

Key legislation has been passed that prohibits the sale of fertilizers that contain phosphorus for homeowner use in Washington. Concerns of future legislation that may impact agriculture has spurred the potato industry to be proactive in seeking out options to better manage phosphorus. These options consist of products and sources that claim to increase phosphorus use efficiency (PUE) by delaying phosphorus release (slow release), binding to free cations to improve phosphorus availability, and using phosphorus mining bacteria that release existing soil phosphorus that is bound up.

Materials and Methods: Trials conducted on Umatilla Russet during the summers of 2014 and 2015 investigated the use of alternative products and sources to improve PUE in potato production in the Columbia Basin of Washington. The products used were Avail, Accomplish, and Micro Essentials Sulfur and Zinc (MESZ). Ammonium poly phosphate (10-34-0) was also used as an industry standard to compare to the alternative products along with an untreated control which did not receive any phosphorus input.

Avail and Accomplish were mixed at the prescribed rates with 10-34-0 and banded shortly after planting as was the standard 10-34-0. The band consisted of two lines of fertilizer applied via CO_2 injection 2inches to either sides of the seed piece and 2 inches above it. MESZ was broadcast applied and rototill incorporated into the top 6 inches of soil prior to planting. All products, including the standard, were applied at rates of 50 and 100 lbs of actual phosphorus per acre with exception of the standard, which also included a 200 lbs of actual phosphorus per acre. Nitrogen was added to balance all treatments to account for amounts added from the various products. All other management practices were conducted consistent with industry standards to ensure no limiting factor was introduced.

During the growing season, petiole and soil samples were collected to assess plant phosphorus status. Along with these samples, emergence counts, stems count, and vine senescence was evaluated during the growing season. Each treatment consisted of 4 reps arranged as a randomized complete block design (RCBD). Three row plots were used consisting of a border, petiole, and a final harvest row. Plots were 16.67ft long with 34 inch row spacing and 10 inch seed spacing with a planting depth of 8 inches.

Plots were harvested 150 days after planting (DAP) and assessed for total yield, marketable yield, #1 and #2 yield, and culls. Samples were also taken to assess specific gravity and screen for internal defects. Economic return was then determined based on the yield assessment while also incorporating the cost of the individual products.

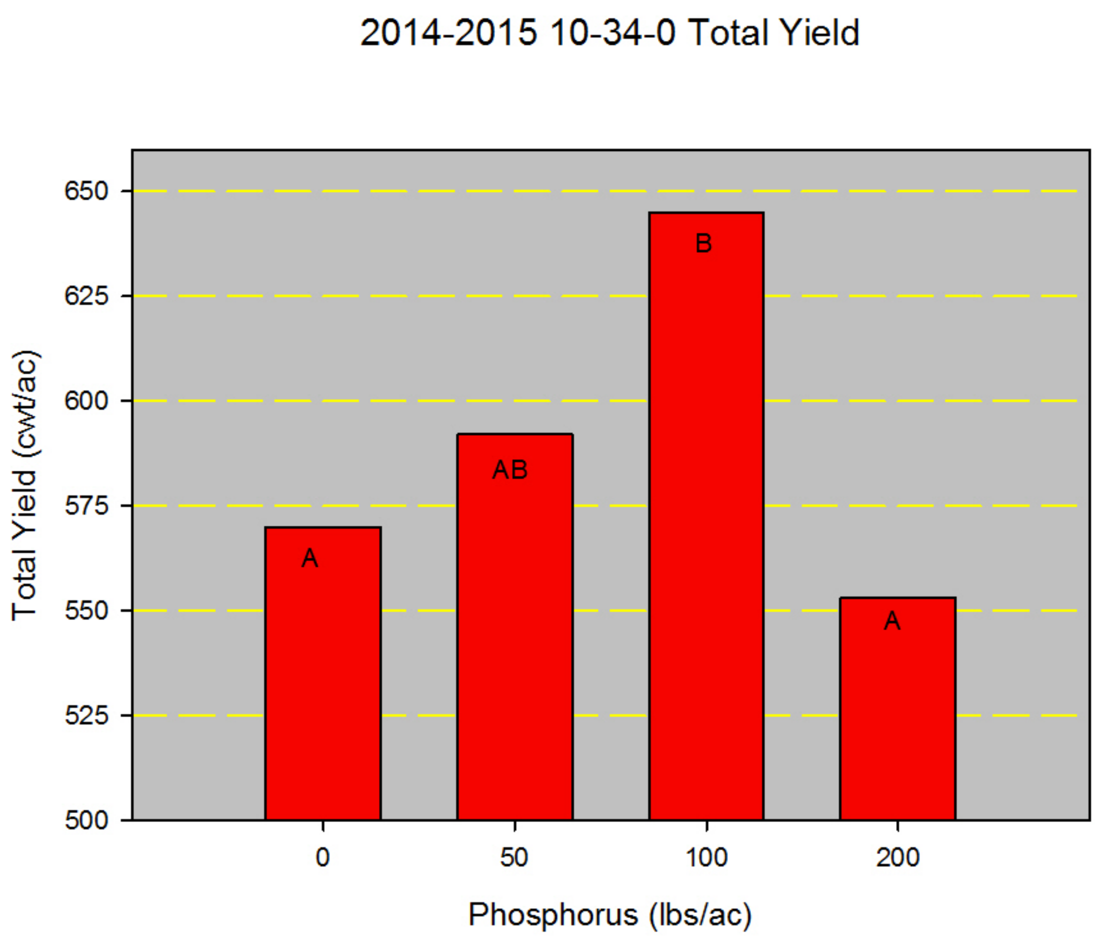
Results: Data collected from the 2015-16 growing seasons did not demonstrate any significant difference between the products Avail, Accomplish, and MESZ from the industry standard 10-34-0 or the untreated control at either the 50 or 100 lbs P/ac rate. There was a general trend for those treatments receiving phosphorus to demonstrate an increased yield, though not significant.

The industry standard treatment of 10-34-0 at a rate of 100 lbs P/ac did provide a significantly greater yield and return than the untreated control and the 10-34-0 200 lbs P/ac rate, though not a significantly greater yield than the 10-34-0 50 lbs P/ac rate (Figures 1 and 2). MESZ did not significantly increase total yield compared to the industry standards at either rate or the untreated control (Figure 3). At both the 50 and 100 lbs P/ac rates, MESZ reduced returns 3 and 6% respectively when compared to the industry standard rates, though not significantly (Figure 4).

Accomplish at either rate did not significantly increase yield when compared to the industry standard or untreated control (Figure 5). Neither rate of Accomplish (50- & 100-lbs P/ac) significantly increased economic return when compared to the industry standard treatment. (Figure 6).

Avail at either the 50 or 100 lbs P/ac rate did not significantly increase yields compared to the industry standard rates of 10-34-0 or the untreated control (Figure 7). Neither rate of Avail (50- or 100-lbs P/ac) significantly increased grower return when compared to the industry standard. (Figure 8).

Conclusions: Yield data suggest that there is no advantage to be gained my implementing the use of Avail, Accomplish or MESZ. These products provided similar yields to the industry standard 10-34-0, but failed to pay for themselves when economic return was assessed. It appears that the added cost of using alternative P products does not provide the return needed to offset their cost at either the 50- or 100 lbs P/ac. Alternatively, the industry standard 10-34-0 appears to provide the greatest rate of return without the addition of any enhancement products. Data also demonstrated that a rate of 100 lbs P/ac provided the greatest return versus the 50- or 200 lbs P/ac. This would imply that applying rates greater than 100 lbs P/ac would result in a loss of return to the grower and an over-application of phosphorus from a sustainability standpoint. This research will continue one more year.


2014-2015 10-34-0 Total Yield
Total Yield (cwt/ac)
650
625
600
575
550
525
500
B
AB
A
A
0
50
100
200
Phosphorus (lbs/ac)
Figure 1

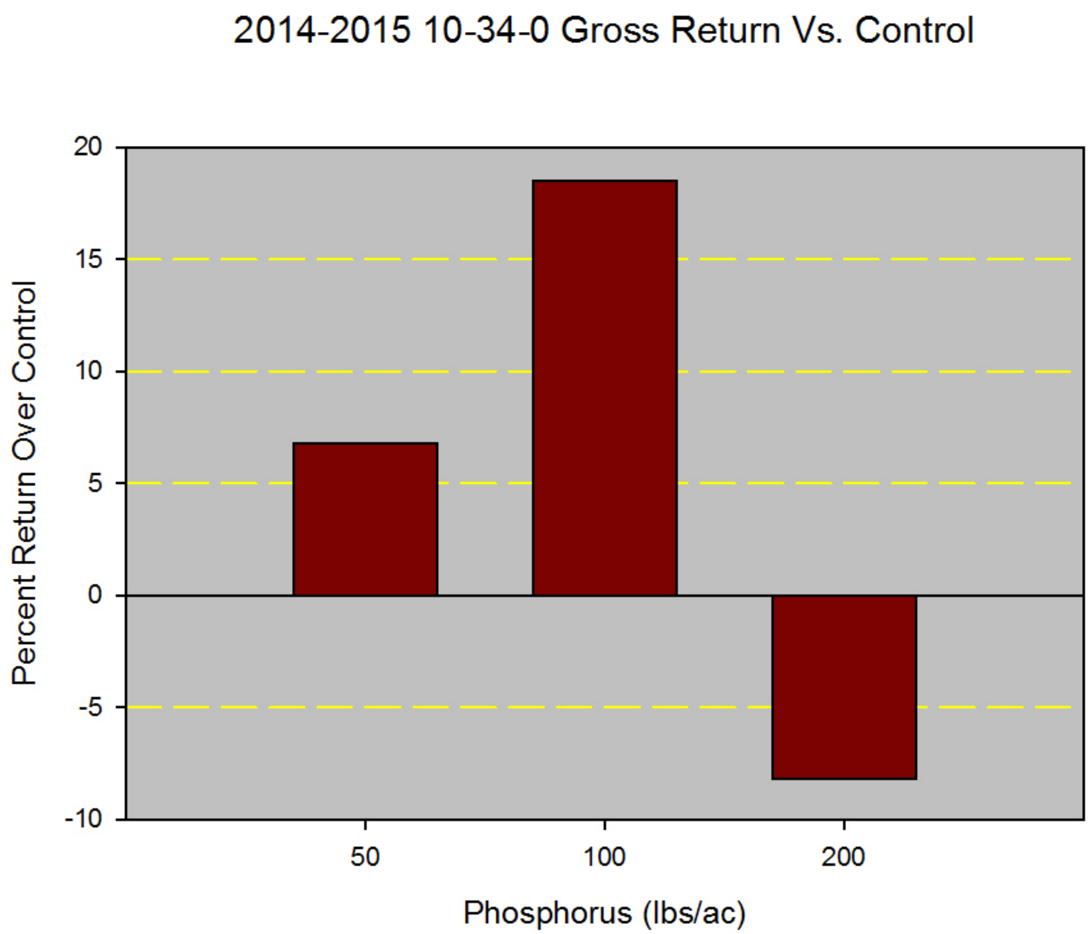

2014-2015 10-34-0 Gross Return Vs. Control
20
15
10
5
0
-5
-10
Percent Return Over Control
50
100
200
Phosphorus (lbs/ac)

Figure 2

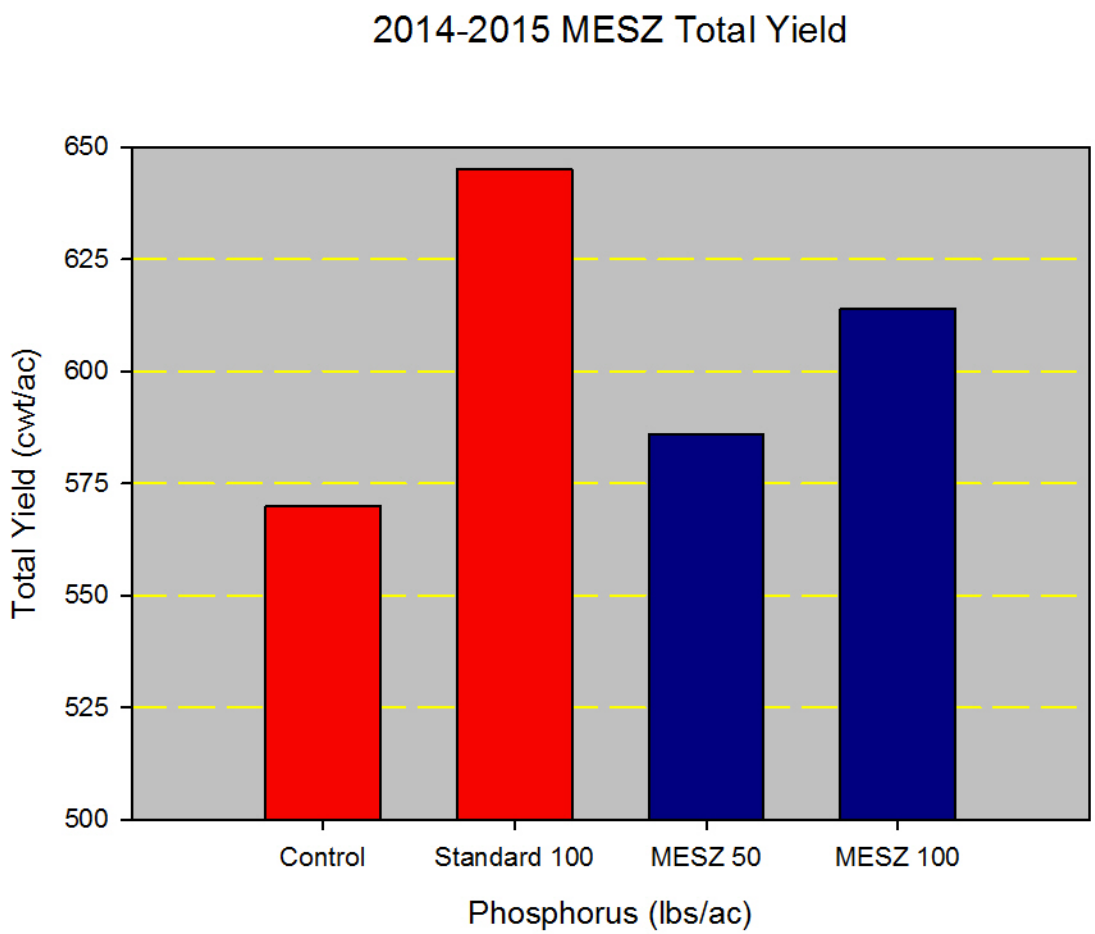

2014-2015 MESZ Total Yield
650
625
600
575
550
525
500
Total Yield (cwt/ac)
Control
Standard 100
MESZ 50
MESZ 100
Phosphorus (lbs/ac)

Figure 3

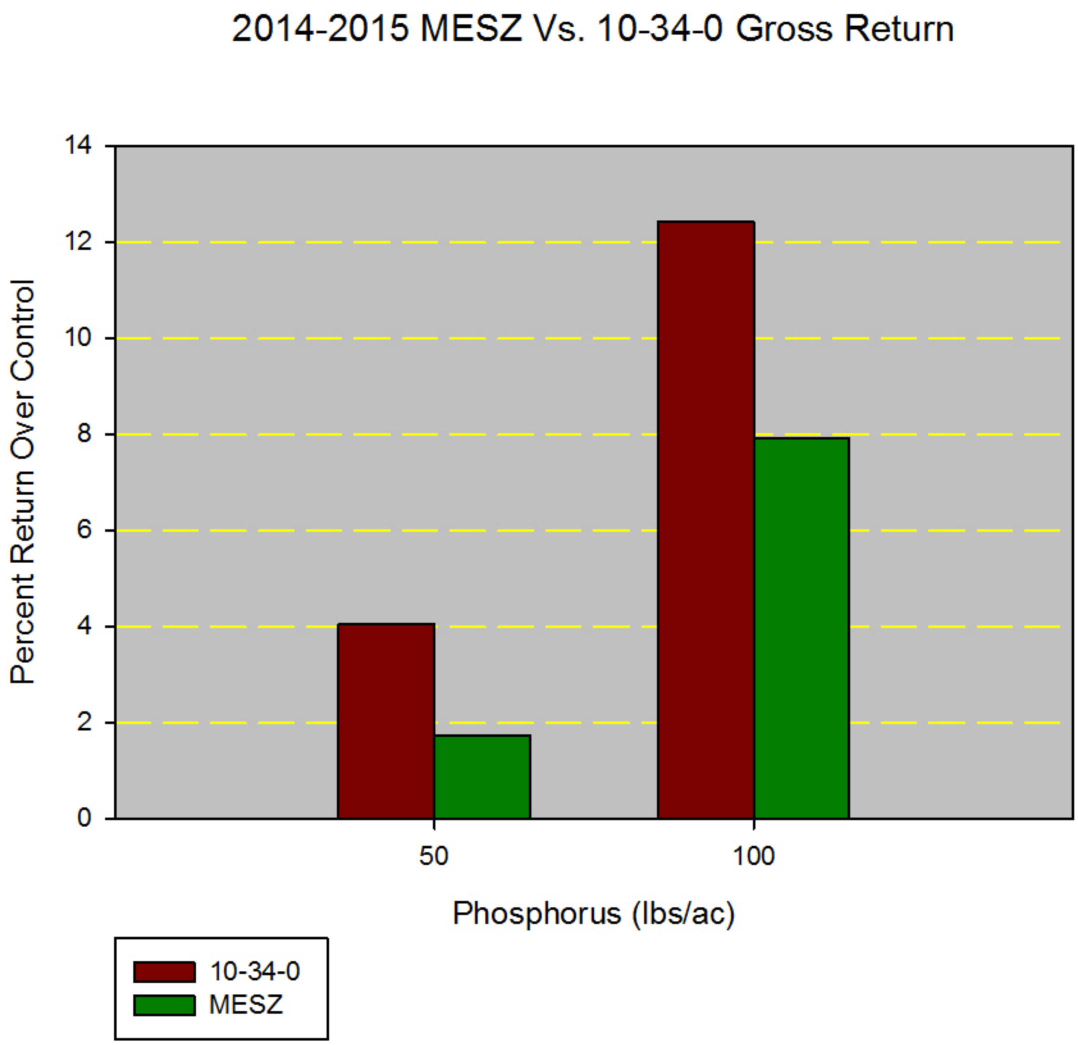

2014-2015 MESZ Vs. 10-34-0 Gross Return
Percent Return Over Control
0
2
4
6
8
10
12
14
50
100
Phosphorus (lbs/ac)
10-34-0
MESZ

Figure 4

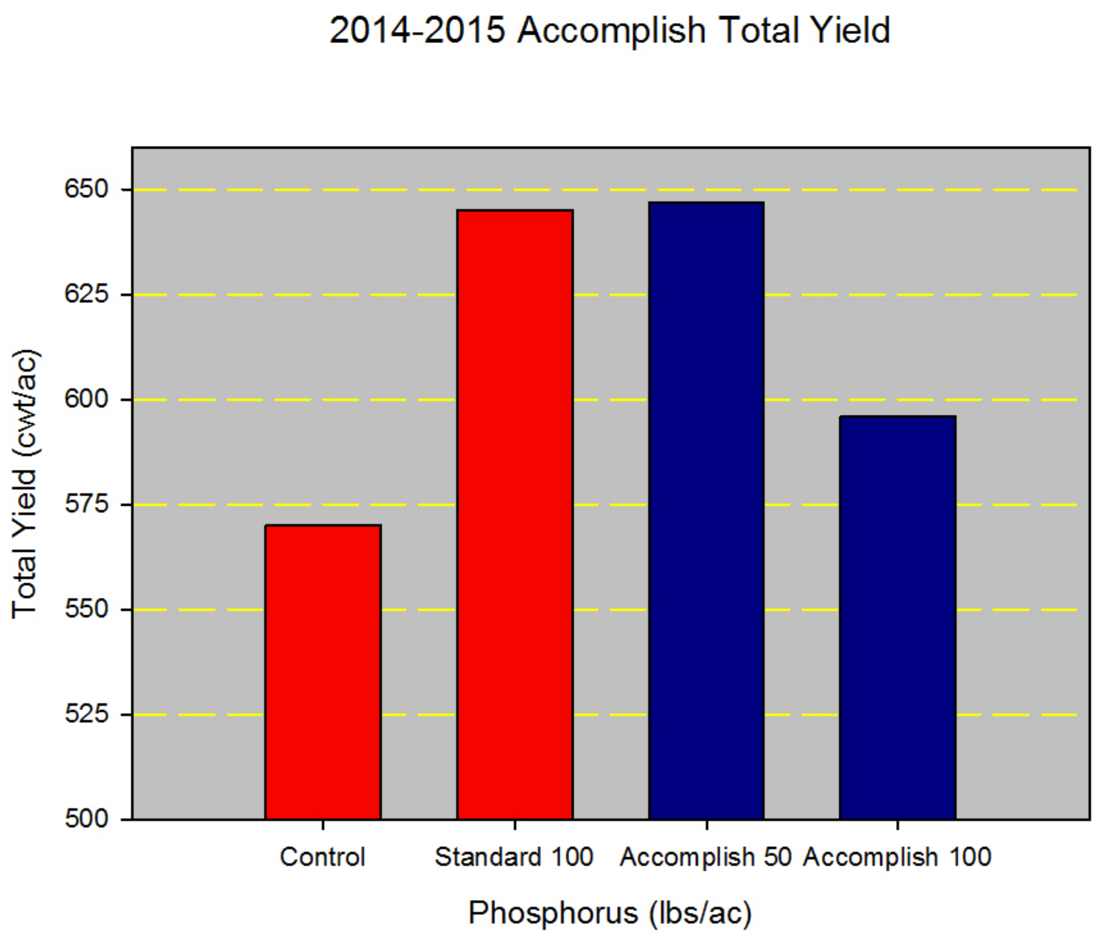

2014-2015 Accomplish Total Yield
650
625
600
575
550
525
500
Total Yield (cwt/ac)
Control
Standard 100
Accomplish 50
Accomplish 100
Phosphorus (lbs/ac)

Figure 5

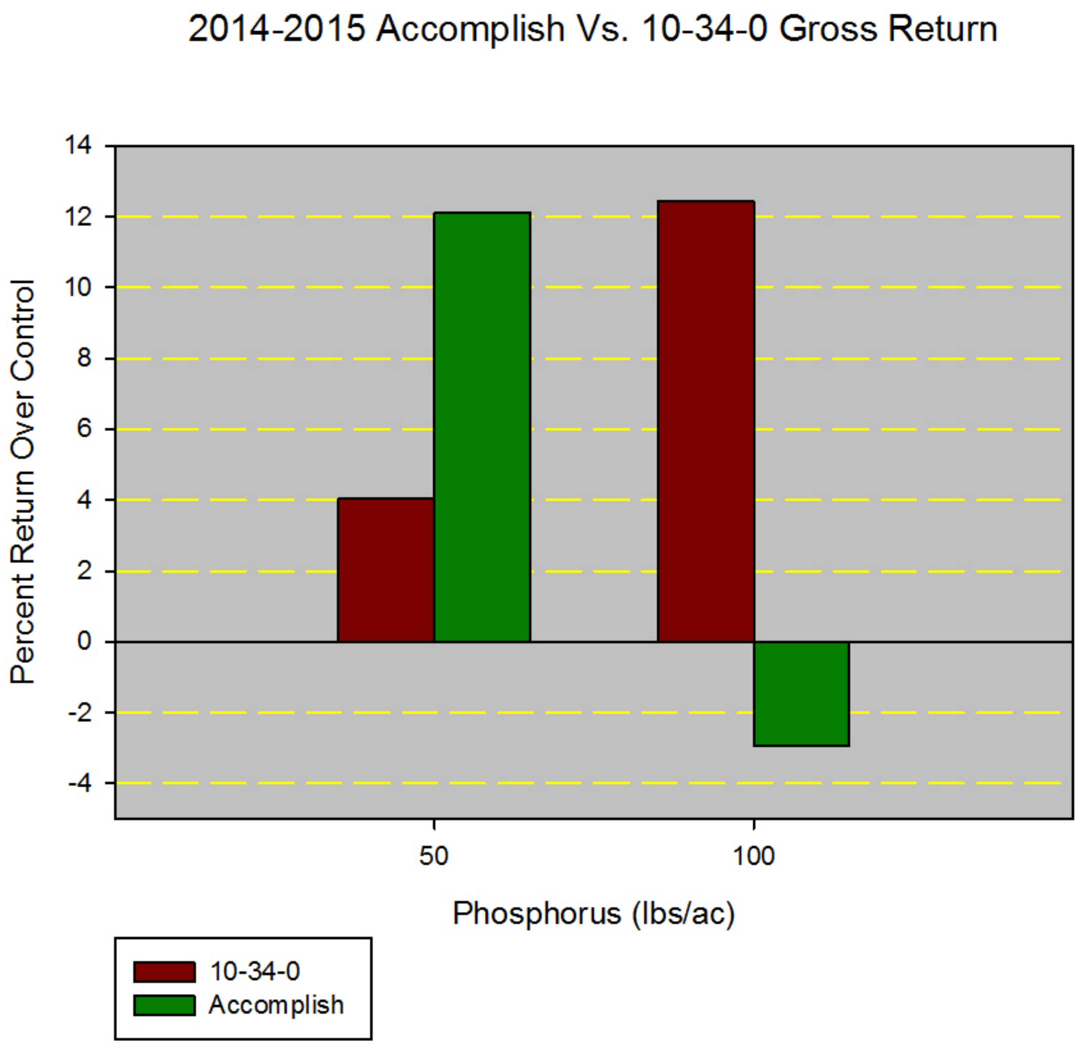

2014-2015 Accomplish Vs. 10-34-0 Gross Return
Percent Return Over Control
14
12
10
8
6
4
2
0
-2
-4
50
100
Phosphorus (lbs/ac)
10-34-0
Accomplish

Figure 6

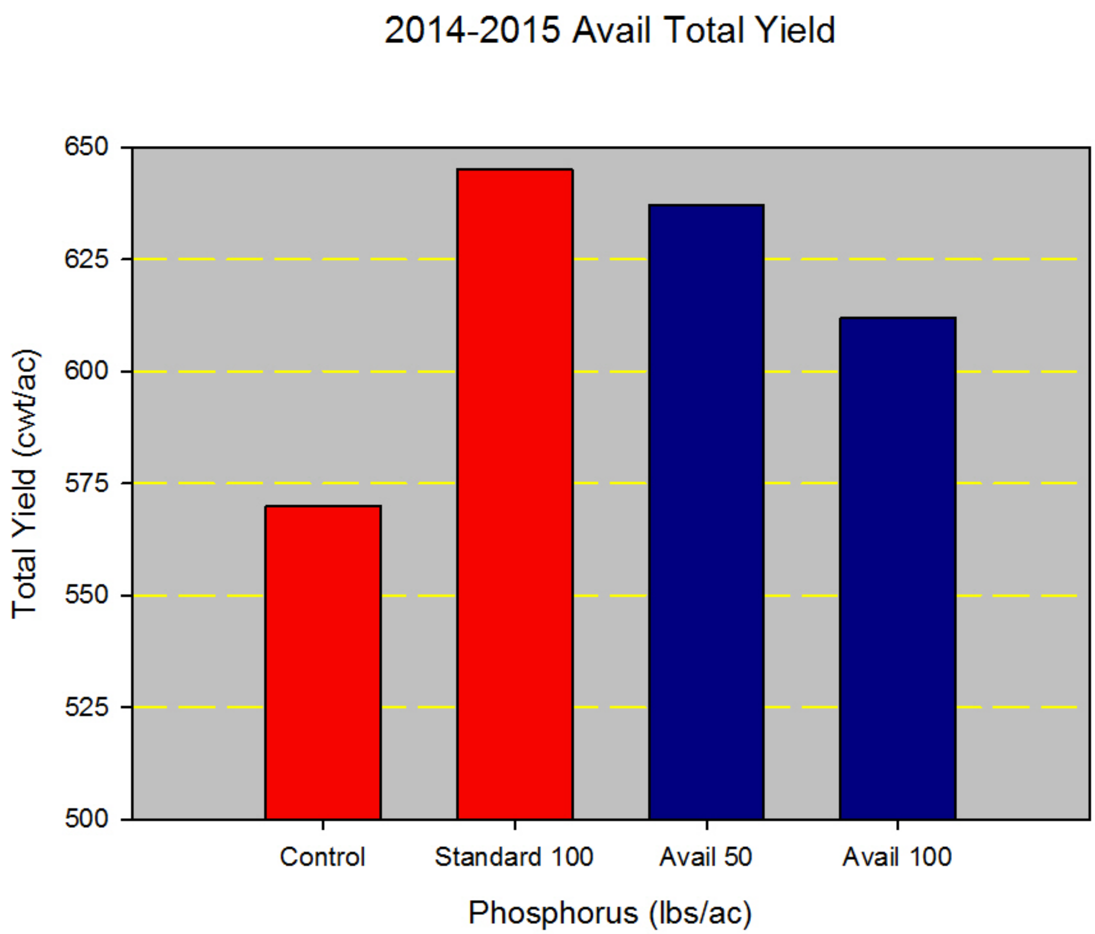
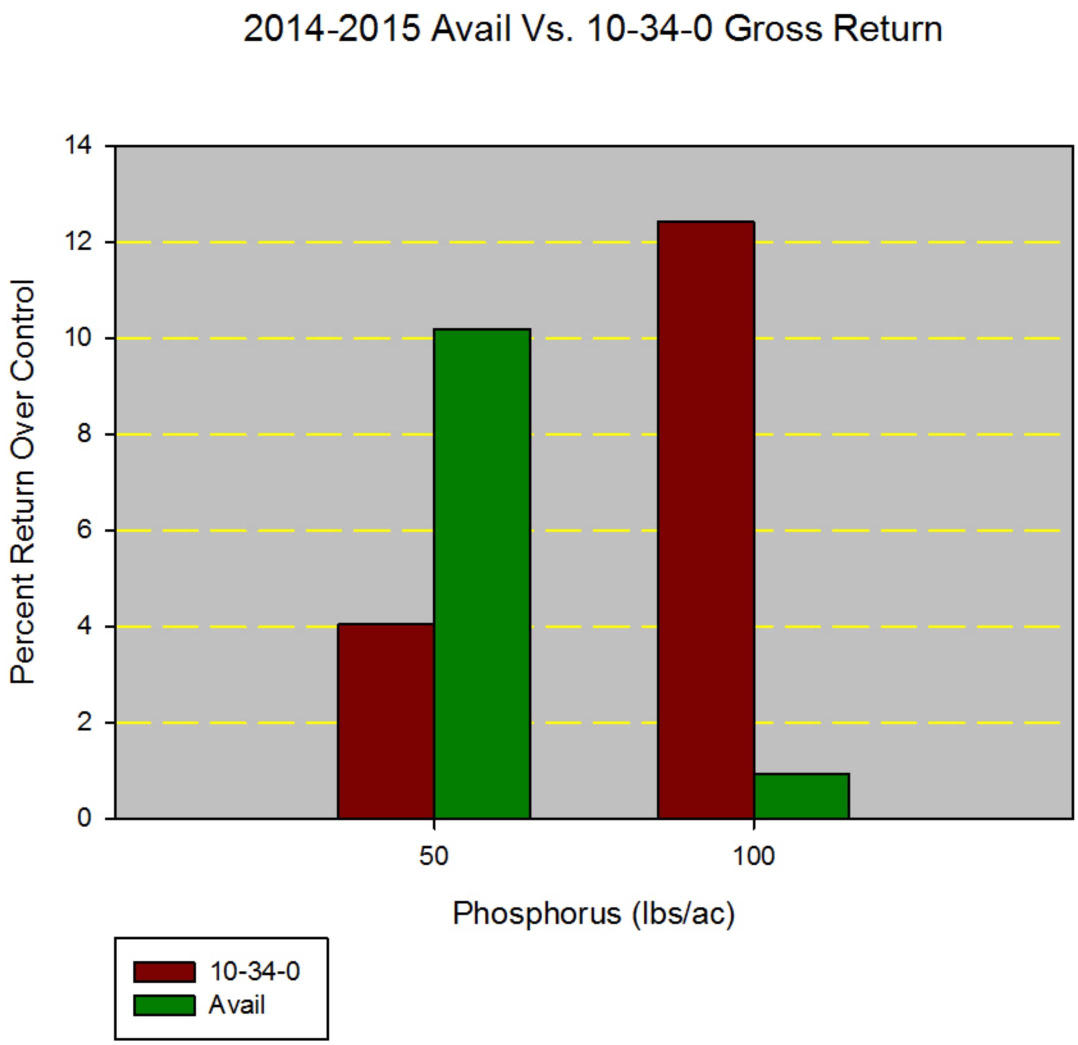

2014-2015 Avail Total Yield
650
625
600
575
550
525
500
Total Yield (cwt/ac)
Control
Standard 100
Avail 50
Avail 100
Phosphorus (lbs/ac)

Figure 7



2014-2015 Avail Vs. 10-34-0 Gross Return
Percent Return Over Control
0
2
4
6
8
10
12
14
50
100
Phosphorus (lbs/ac)
10-34-0
Avail

Figure 8