Yield Optimization: A Comparative Study of Traditional vs. Advanced Grain Production

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Abstract

As the world's population increases and the amount of overall arable land decreases, agricultural production will have to intensify every acre in order to continue feeding the world. Intensification of agriculture has contributed substantially to the tremendous increases in food production over the past 50 years (Matson et. al. 1997). This study focused on the potential economic and agronomic benefits of intensification.

Introduction

In this study, two management systems were compared for grain corn yield in north central Wisconsin. This included common management, which represents basic inputs for fertility and pest management, and optimized management, which is more input intensive. A cost/benefit analysis was then done between the two management systems to see if the costs could be made up for in yield.

Study location at Winfield Answer Plot-Stratford, WI.

Figure 1: Cost/benefit Analysis

Per Acre Cost	Common	Optimized
0-0-60 @ 200 lbs/a	$46	$46
18-46-0 @ 150 lb/a	$45	$45
Custom spreading	$5	$5
28% @ 40 GPA	$78	$78
21-0-0-24 @ 20 lb/a	$3.80	$3.80
10-34-0 @ 3 GPA	$9.96	$9.96
Hybrid @ 32,000 plants/acre	$128.80	$128.80
Cornerstone 5 Plus @ 24 oz/a	$4.13	$4.13
Warrant @ 1.5 qt/a	$15.61	$15.61
Class Act NG @ 1% v/v	$3.85	$3.85
Interlock @ 6 oz/a	$3.72	$3.72
Spray application	$8	$8
2 applications of Instinct @ 35 oz/a		$23.80
Zinc 9% @ 1.5 qt/a		$11.80
Ascend @ 5 oz/a		$10.15
28% @ 35 GPA		$68.25
12-0-0-24 @ 20 lb/a		$3.80
Max In ZMB @ 1 qt/a		$6.85
Max In Boron @ 1 qt/a		$7.06
Max In Mn @ 1 qt/a		$6.85
Hybrid with additional 3,000 plants/acre		$23.80
Verdict @ 15 oz/a		$30.45
Priaxor @ 6 oz/a		$32.70
Capture LFR @ 8.5 oz/a		$24.48
Price of corn (October 2014)	$3.15	
Total Input Cost/Acre	$351.87	$601.86
Average Yield (bushels/acre)	164.2	171.45
Profit	517.23	$540.07
Net profit	$165.36	($61.79)

Materials & Methods

This study was conducted in summer 2014 at a Winfield Answer Plot near Stratford, Wisconsin on a Withee silt loam. Two corn hybrids of maturity group 85-89 day were grown in a common management block and an optimized management block. The common block had basic fertilizer and pest management treatments, whereas the optimized block had more inputs for crop protection, fertilization etc. All planting and in furrow chemical applications were done with a 4 row, 30 inch Wintersteiger planter in a non-randomized design. Blanket applications were done with broadcast fertilizer spreaders. Spray applications were done with a 5 foot hand boom at V5 and VT.

Common management treatments included: blanket application of potash at 200 lb/a (pounds/acre) + 18-46-0 at 150 lb/a, preplant fertilization of 28% UAN at 40 gallons/acre (GPA) + 21-0-0-24 at 20 lb/a, starter fertilizer of 10-34-0 at 3 GPA, along with a V5 herbicide treatment of glyphosate (Cornerstone 5 Plus) , acetochlor (Warrant) , a drift reducing agent (Interlock), and a water conditioning adjuvant (Class Act NG). The common block had a plant population of 32,000 plants/acre versus the optimized block with 35,000.

Materials & Methods Continued

The optimized management treatments were identical to the common treatments, plus treatments that included: nitrogen stabilizer (Instinct) with the pre plant fertilizer application, in furrow application of 9% Zinc at 1.5 qt/a + plant growth regulator (Ascend) at 5 oz/a + insecticide (Capture LFR) at 8.5 oz/a, a pre-emergent herbicide (Verdict) application of 15 oz/a, a V5 side dress application of 28% UAN at 35 GPA + nitrogen stabilizer (Instinct) at 35 oz/a + ammonium thiosulfate at 5 GPA, and also adding VT fungicide (Priaxor) at 6 oz/a + foliar micronutrients of zinc, manganese, and boron at 1 qt/a to the post emergent herbicide application. Soil samples, tissue samples, and pictures were taken throughout the growing season to monitor any differences between managements. Yield estimates were taken at the end of the growing season at dent stage.

Results & Discussion

Throughout the growing season there seemed to be differences in weed control, soil fertility, and plant health due to the different management systems, but statistical differences were not analyzed since that was not a main focus of the study. Two way ANOVA was done when comparing final yields, which indicated no statistical yield differences between hybrids (P = 0.5604) and common/optimized treatments (P = 0..2182). Average yield for the common block was 164.2 versus 171.45 bu/a in the optimized block. Even though the two treatments were statistically the same, if we were to look at the cost/benefit analysis (Figure 1), the optimized treatment did not produce enough yield to compensate for the increased input costs, therefore producing a monetary loss. In this study, the common block seemed to be more economically profitable than the optimized block.

Conclusion

- There were no yield differences between the common and optimized management.
- Optimized management seemed to produce too high of costs to be economical.
- Further studies must include more replications and randomized samples.

Further Research

Since this study was only for showcase purposes for Winfield, I would recommend future intensification studies to include multiple replications and randomized samples for better data integrity. Yield Optimization was a statewide study with locations being the replications, but since I had focused on one location, I could see error in the statistical analysis. Further yield intensification studies could also be more economically feasible when commodity prices are higher and/or when input costs are lower.