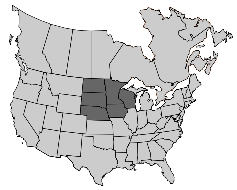
NEWS & VIEWS

A regional newsletter published by the
Potash & Phosphate Institute (PPI) and the
Potash & Phosphate Institute of Canada (PPIC)



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March 2001

Evaluating the Profitability of Starter Fertilization for Various Nitrogen and Propane Costs: A Wisconsin Corn Grain Example

IS STARTER FERTILIZATION a good idea this year? Low crop prices, higher nitrogen (N) prices, and potentially higher propane and grain drying costs next fall are causing many to question whether or not a starter fertilization program will pay for itself. Given the tight margins in today's agriculture, it is important that this decision be made carefully. Not applying starter fertilizer when the chances of economic benefits are good can lead to missed revenue. Applying starter fertilizer when it is not needed results in losses and missed opportunities to put money in other areas of the operation. This publication outlines a way of evaluating the economics of a starter fertilization program.

Potential Benefits of Starter Fertilization

Research over the years has shown that starter fertilizer is capable of producing the following benefits:

- enhanced root and above-ground development, resulting in earlier cultivation, increased competition with weeds, reduced heat stress during pollination, and earlier harvest
- quicker soil cover, decreasing runoff and erosion potential
- reduced grain moisture content at harvest, cutting production costs
- improved N use efficiency, increasing production efficiency and reducing the potential for water pollution
- increased yield, enhanced crop quality, and greater farmer profit potential.

While such benefits are possible, they are not always probable. One of the most important steps in evaluating a starter fertilization program is to understand what conditions lead to greater chances of economically important responses. Generally speaking, starter fertilizer has increased chances of producing economic benefits whenever the plant's demand for nutrients becomes greater than the root system's ability to supply them. Placing nutrients close to the seed makes them readily available early in the season. Circumstances where starter fertilization can provide benefits are:

- cold, wet soils early in the season
- ideal growing conditions for the first couple weeks of the season (increases shoot/root biomass) followed by a cold period
- reduced tillage systems
- compacted soils
- soils low in nutrients
- areas with detrimental herbicide carryover
- high soil salinity
- high soil acidity
- for corn, longer season hybrids planted late.

These are general guidelines. To better understand when starter fertilization is needed, one should be familiar with the scientific research information pertinent to an individual situation.

Economic Analysis of Starter Fertilization

Properly evaluating the economics of starter fertilization means attempting to account for all associated expenditures and sources of revenue (partial budgeting). **Table 1** lists the added costs and the added returns and reduced costs considered here. Added costs include

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nutrients, their application, and additional drying, hauling, and handling associated with increased yield. Additional returns are generated from any increase in yield or quality. Starter fertilization can also result in lower grain moisture at harvest, so savings on drying costs should also be considered. Earlier maturity, possible with starter fertilization, may also carry value (considering opportunity costs) by increasing the timeliness of operations performed after harvest.

Table 1. Added costs and added returns and reduced costs associated with starter fertilization.

Added costs	Added returns and reduced costs
Nutrients	Increased yield
Application	Savings on drying costs
Drying costs of additional grain from yield response	Enhanced quality
Additional hauling and handling from yield response	More timely operations

To demonstrate how to perform economic calculations, let's consider an example. We will use the results of a three-year study conducted by the University of Wisconsin (Bundy and Widen, 1991). The study examined no-till and conventional tillage systems. Other factors were planting date and relative maturity of the corn hybrid. Across all years, tillage systems, and planting dates, the average responses to 10-25-25 (pounds N-P_2O_5-K_2O per acre) applied as starter fertilizer placed 2 in. to the side and 2 in. below the seed were a 9.9 bu/A increase in yield and a 1.0 percent reduction in grain moisture (**Table 2**). In this study, all plots were harvested at the same time each year. In production practices, differences in grain moisture will diminish the longer the crop is allowed to dry in the field after maturity.

Table 2. Corn grain yield and grain moisture response to 10-25-25 starter fertilizer applied 2 in. below and 2 in. to the side of corn seed (Bundy and Widen, 1991).

Treatment	Yield	Yield response	Grain moisture	Grain moisture response
	- - - - - bu/A - - - - -		- - - - - - - % - - - - - - -	
No starter	148.1	- -	24.5	- -
Starter	158.0	9.9	23.5	-1.0

The calculations to be performed are listed in **Table 3**. Details and explanations of specific calculations are given below (all line numbers refer to **Table 3**).

Line 1: Nutrient costs

Nutrient costs were calculated by assuming $0.25/lb P_2O_5, $0.14/lb K_2O, and $0.30/lb N. Total nutrient costs for starter are shown in **Table 4**.

Table 3. Partial budget for 10-25-25 starter applied to corn, Wisconsin example.

Line no.	Description	Value, $/A
Added costs		
1.	Nutrients	12.75
2.	Application	1.71
3.	Drying additional grain from yield response	3.17
4.	Additional hauling and handling from yield response	1.49
5.	Total costs (sum of lines 1 through 4)	19.12
Added returns and reduced costs		
6.	Revenue from yield response	19.80
7.	Savings on drying costs	5.92
8.	Improved quality	0.00
9.	Total (sum of lines 6 through 8)	25.72
Economic analysis		
10.	Net return (line 9 – line 5)	6.60
11.	Rate of return (line 10 ÷ line 5) x 100	34.5 %

Table 4. Nutrient costs for starter applied to corn at rates of 10-25-25, Wisconsin example.

Compound	Calculation	Amount
N	$0.30/lb N x 10 lb N/A	$3.00/A
P_2O_5	$0.25/lb P_2O_5 x 25 lb P_2O_5/A	$6.25/A
K_2O	$0.14/lb K_2O x 25 lb K_2O/A	$3.50/A
Total		**$12.75/A**

Line 2: Application costs

Application costs were set at **$1.71/A** (Lazarus, 1999). These were average additional planting costs associated with planters with fertilizer and insecticide attachments. No attempt was made to separate costs of insecticide and fertilizer applications, possibly inflating the cost estimate of fertilizer application at planting.

Heated-air drying

Heated-air drying costs include propane, labor, equipment, repairs, maintenance, taxes, and insurance. The average total cost of a continuous flow dryer with fuel in 1996 was reported to be $0.02/percent/bu from a Minnesota survey conducted late in the year (Lazarus, 1997). However, we desired some estimate of how much of this cost could be attributed to propane costs alone. The 1996 propane price in the fall and winter of that year went through large price fluctuations, starting at approximately $0.50/gal at the start of October and peaking to $1.075/gal on December 16, according to historical records of the Conway, Kansas, terminal, where prices are strongly influenced by the agriculture sector's use of propane for grain drying (Energy Information Administration, 1997). An average propane requirement to dry grain is 0.02 gal/percent/bu (Wilcke, 2000; Wilcke and Morey, 1995). If a cost of $0.50/gal is used, the cost of the propane used to dry grain in 1996 is estimated to be 0.02 gal/percent/bu x $0.50/gal = $0.01/percent/bu. Therefore, of the total $0.02/percent/bu cost reported to dry grain, approximately half could reasonably be attributed to propane costs, with the other half ($0.01/percent/bu) attributed to other, less market dependent costs, such as labor, equipment, etc. These latter costs are hereafter referred to as base costs and are held constant at $0.01/percent/bu.

With some estimate of the base costs, the influence of varying propane price could be examined. Since 1995, propane costs have been above $0.25/gal at the Conway, Kansas terminal. This price was considered the lower limit. An appropriate upper limit should encompass the highest price paid by consumers. A cursory survey of prices available on the internet indicated prices exceeding $2.00/gal. Therefore, the upper price of propane was set at $3.00/gal. **Table 5** shows the conversions of propane price to grain drying costs.

Table 5. Conversion of propane price to grain drying costs, assuming base price of $0.01/percent/bu and propane usage rate of 0.02 gal/percent/bu.

Propane price, $/gal	Grain drying cost, $/percent/bu
0.25	0.015
0.50	0.020
0.75	0.025
1.00	0.030
1.50	0.040
2.00	0.050
3.00	0.070

Line 3: Costs of drying additional grain from yield response

Added yield results in higher drying costs for a corn crop. The average moisture content of the grain where starter was applied was 23.5 percent. Assuming that grain is dried to 15.5 percent moisture, drying would remove 23.5 percent to 15.5 percent, or 8 percent moisture. A propane cost of $1.50/gal was used, which translated to drying costs of $0.04/percent/bu. The cost of drying the additional grain would then be 8 percent x $0.04/percent/bu x 9.9 bu/A = **$3.17/A**.

Line 4: Costs of additional hauling and handling from yield response

Greater grain hauling and handling costs come with higher yields. The sum of these costs was assumed to be $0.15/bu (Lazarus, 1997). The total additional grain hauling and handling costs for the average yield increase from starter was $0.15/bu x 9.9 bu/A = **$1.49/A**.

Line 5: Total cost

The total cost was the sum of nutrient, application, additional drying, and additional hauling costs: $12.75/A + $1.71/A + $3.17/A + $1.49/A = **$19.12/A**.

Line 6: Revenue from yield response

Corn price was set at $2.00/bu. Yield response from starter fertilizer was 9.9 bu. Added revenue from starter was then $2.00/bu x 9.9 bu/A = **$19.80/A**.

Line 7: Savings on drying costs

When crop maturity is hastened, grain moisture at harvest can be reduced. In this example, grain moisture for the entire crop was reduced by an average of 1.0 percent. To determine the impact of this lower moisture on savings in drying costs, the yield without starter fertilizer was multiplied by the cost required to dry an additional 1.0 percent moisture. The yield without starter fertilizer was used because it was the yield associated with the higher moisture content. The savings was therefore 148.1 bu/A x 1.0% x $0.04/percent/bu = **$5.92/A**.

Line 8: Added returns from improved quality and timeliness of operations

Although not considered in this example, starter fertilization can result in increased quality that adds value. Earlier maturity and earlier harvest can expand the period needed to perform fall operations, resulting in better timeliness in performing needed operations.

Line 9: Total

The total added returns and reduced cost were the sum of the revenue from yield response and grain drying savings: $19.80/A + $5.92/A = **$25.72/A**.

Line 10: Net return

Net return is calculated by subtracting line 5 from line 9, or $25.72/A - $19.12/A = **$6.60/A**.

Line 11: Rate of return

Rate of return is the ratio of net return to total cost, or $6.60/A ÷ $19.12/A = 0.345. To express this as a percentage, multiply by 100: 100 x 0.345 = **34.5 percent**.

Market Analysis of Starter Response

The calculations performed above were repeated for various combinations of N and propane costs. They were performed in a spreadsheet and carried a higher precision throughout the calculations. For this reason, the numbers in the tables below may be slightly different than those used in the calculation above.

Table 6 shows that as propane costs increase, net returns increase for any given N price. Net returns ranged from $4.40 for the lowest propane cost and highest N price to $11.19 for the highest propane cost and lowest N price. Rates of return (**Table 7**) ranged from 24.9 to 58.9 percent for the same propane and N cost combinations. This trend shows that the propane cost savings from the 1.0 percent average grain moisture reduction in this example has a greater positive impact as propane price increases.

Table 6. Net return to starter fertilization (Wisconsin example for 10-25-25 starter) for various combinations of N and propane costs.

Nitrogen cost, $/lb N	Propane costs, $/gal 0.25	0.50	0.75	1.00	1.50	2.00	3.00
	- - - - - -	- - - - - -	- - - - - -	$/A	- - - - - -	- - - - - -	- - - - - -
0.05	7.40	7.74	8.09	8.43	9.12	9.81	11.19
0.10	6.90	7.24	7.59	7.93	8.62	9.31	10.69
0.15	6.40	6.74	7.09	7.43	8.12	8.81	10.19
0.20	5.90	6.24	6.59	6.93	7.62	8.31	9.69
0.25	5.40	5.74	6.09	6.43	7.12	7.81	9.19
0.30	4.90	5.24	5.59	5.93	6.62	7.31	8.69
0.35	4.40	4.74	5.09	5.43	6.12	6.81	8.19

Table 7. Rate of return to starter fertilization (Wisconsin example for 10-25-25 starter) for various combinations of N and propane costs.

Nitrogen cost, $/lb N	Propane costs, $/gal 0.25	0.50	0.75	1.00	1.50	2.00	3.00
	- - - - - -	- - - - - -	- - - - - -	%	- - - - - -	- - - - - -	- - - - - -
0.05	50.5	51.5	52.4	53.3	54.9	56.3	58.9
0.10	45.6	46.6	47.6	48.6	50.4	52.0	54.8
0.15	40.9	42.1	43.1	44.2	46.1	47.9	51.0
0.20	36.5	37.8	38.9	40.0	42.1	43.9	47.3
0.25	32.4	33.7	34.9	36.1	38.2	40.2	43.8
0.30	28.6	29.9	31.2	32.4	34.6	36.7	40.4
0.35	24.9	26.3	27.6	28.8	31.2	33.4	37.2

Summary

Methods for evaluating the economics of starter fertilization were provided and an example worked. In the example provided, starter fertilization increased grain yield by 9.9 bu/A and reduced grain moisture by 1.0 percent, on average. Positive economic impacts occurred regardless of fluctuations in N price or grain drying costs. Higher N prices decreased net returns as well as rates of return. Higher propane costs increased both net return and rates of return because of the 1.0 percent reduction in grain moisture from starter fertilization observed in the example study. This analysis shows that, when they occur, reductions in moisture are an economically important outcome of starter fertilization, and have increasing importance as drying costs increase. It is important for the reader to become familiar with the research results in his/her particular area to determine the frequency and degree to which such impacts may reasonably be expected. ■

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RN 01057

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March 2001

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