Purdue University Department of Agronomy

Soil Fertility Update

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Adjust Nitrogen Rate to Maximize Profit in Corn

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Corn yield response to increasing nitrogen (N) rate follows the Law of Diminishing Returns – as higher and higher increments of N are applied, the increase in grain yield becomes smaller and smaller (**Figure 1**). Eventually, maximum yield occurs and applying more N does not increase yield any further.

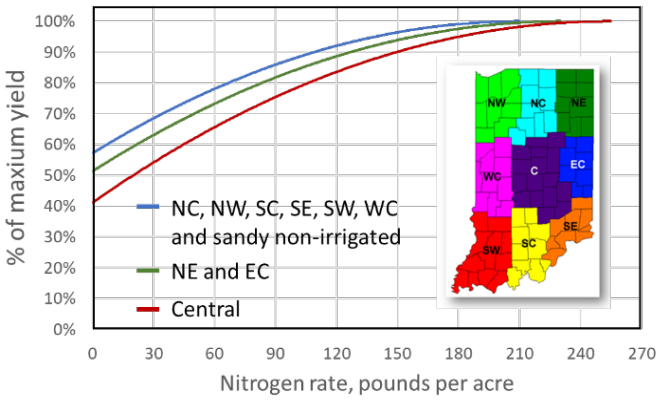

***Figure 1**. Percent of maximum corn grain yield produced with different nitrogen rates for three groupings of regions in Indiana; northcentral (NC), northwest (NW), southcentral (SC), southeast (SE), southwest (SW), westcentral (WC), and sandy non-irrigated soils, northeast (NE) and eastcentral (EC), and central (C).*

Interestingly, maximum yield regarding N fertilization does not produce the maximum profit. Profit from N application is maximized when the value of additional grain produced is just greater than the cost of additional N. Beyond that rate of N, profit declines because the cost of N is more than the value of additional grain produced.

We recommend that farmers select the rate of N to be applied based on the cost of N and the expected value of grain. Currently, the cost of N is historically high, nearly $1 per pound of N from anhydrous ammonia to more than $1 per pound for liquid N. Use Table 1 to find your cost of N per pound from the per ton cost. Grain prices are also relatively high and some expect them to increase in the future.

To obtain the profit-optimizing N rate recommendation for your N cost and expected grain price use the Table for the appropriate regional grouping. For example, assuming N at 1$ per pound and corn at $6.50 per bushel, the optimum profitable N rate for corn after soybeans for the three IN regional groupings would be 191, 209, and 171 pounds of N per acre for fine-textured soils in central (Table 2), northeast and eastcentral (Table 3), and the remainder of Indiana including sandy non-irrigated soils (Table 4). At these profit-optimizing rates the reduction in yield would only be 1-2%, compared to fertilizing for maximum yield.

For more information about how these recommendations were developed and other N management practices that can increase profit, download this online summary:

Jim Camberato, RL (Bob) Nielsen, and Dan Quinn. 2022. Nitrogen Management Guidelines for Corn in Indiana. Purdue University, Agronomy Dept., Applied Crop Research Update. https://www.agry.purdue.edu/ext/corn/news/timeless/NitrogenMgmt.pdf [URL accessed Mar 2022]

Table 1. Comparative costs per lb. of actual N for a range of costs per ton of product for four fertilizer sources of N commonly used in Indiana.

Anhydrous	N cost/lb	28% UAN	N cost/lb	32% UAN	N cost/lb	Urea	N cost/lb
$1,200	$0.73	$500	$0.89	$725	$1.13	$825	$0.90
$1,250	$0.76	$525	$0.94	$750	$1.17	$850	$0.92
$1,300	$0.79	$550	$0.98	$775	$1.21	$875	$0.95
$1,350	$0.82	$575	$1.03	$800	$1.25	$900	$0.98
$1,400	$0.85	$600	$1.07	$825	$1.29	$925	$1.01
$1,450	$0.88	$625	$1.12	$850	$1.33	$950	$1.03
$1,500	$0.91	$650	$1.16	$875	$1.37	$975	$1.06
$1,550	$0.95	$675	$1.21	$900	$1.41	$1,000	$1.09
$1,600	$0.98	$700	$1.25	$925	$1.45	$1,025	$1.11
$1,650	$1.01	$725	$1.29	$950	$1.48	$1,050	$1.14
$1,700	$1.04	$750	$1.34	$975	$1.52	$1,075	$1.17
$1,750	$1.07	$775	$1.38	$1,000	$1.56	$1,100	$1.20

Table 2. Range of economic optimum N rate (EONR) values (lbs applied N / ac) for **corn following soybean** in **central Indiana on medium- and fine-textured soils** as influenced by nitrogen cost per lb N (Table 1) and grain price per bushel. The underlying yield response data are from 23 field scale trials conducted from 2006 to date. The average agronomic optimum N rate for this region of Indiana is approximately 232 lbs N / ac. These rates assume N management practices that minimize the risk of N loss prior to plant uptake.

Central Indiana

	Grain price						
N cost	**$4.50**	**$5.00**	**$5.50**	**$6.00**	**$6.50**	**$7.00**	**$7.50**
$0.60	196	200	203	205	207	209	211
$0.75	187	192	195	198	201	203	205
$0.90	178	184	188	192	195	197	200
$1.05	169	175	181	185	189	192	194
$1.20	160	167	173	178	182	186	189
$1.35	151	159	166	171	176	180	184
$1.50	142	151	158	165	170	174	178
$1.65	133	143	151	158	164	168	173

Table 3. Range of economic optimum N rate (EONR) values (lbs applied N / ac) for **corn following soybean** in **northeast and eastcentral Indiana on medium- and fine-textured soils** as influenced by nitrogen cost per lb N (Table 1) and grain price per bushel. The underlying yield response data are from 37 field scale trials conducted from 2006 to date. The average agronomic optimum N rate for these regions of Indiana is approximately 254 lbs N / ac. These rates assume N management practices that minimize the risk of N loss prior to plant uptake.

Northeast & Eastcentral Indiana

	Grain price						
N cost	**$4.50**	**$5.00**	**$5.50**	**$6.00**	**$6.50**	**$7.00**	**$7.50**
$0.60	215	219	222	225	227	229	231
$0.75	205	210	214	217	220	223	225
$0.90	195	201	206	210	213	216	219
$1.05	185	192	198	203	207	210	213
$1.20	176	184	190	195	200	204	207
$1.35	166	175	182	188	193	197	201
$1.50	156	166	174	181	186	191	195
$1.65	146	157	166	173	179	185	189

Table 4. Range of economic optimum N rate (EONR) values (lbs applied N / ac) for **corn following soybean** in **northcentral, northwest, southcentral, southeast, southwest, and westcentral Indiana primarily on medium- and fine-textured soils, plus sandy non-irrigated areas throughout the state** as influenced by nitrogen cost per lb N (Table 1) and grain price per bushel. The underlying yield response data are from 106 field scale trials conducted from 2006 to date. The average agronomic optimum N rate for these regions of Indiana is approximately 211 lbs N / ac. These rates assume N management practices that minimize the risk of N loss prior to plant uptake.

Northcentral, Northwest, Southcentral, Southeast, Southwest, Westcentral + Sandy Non-irrigated areas of Indiana

	Grain price						
N cost	**$4.50**	**$5.00**	**$5.50**	**$6.00**	**$6.50**	**$7.00**	**$7.50**
$0.60	176	180	182	185	187	188	190
$0.75	167	172	175	178	181	183	185
$0.90	159	164	168	172	175	177	180
$1.05	150	156	161	165	169	172	174
$1.20	141	148	154	159	163	166	169
$1.35	132	140	147	152	157	160	164
$1.50	124	132	139	145	150	155	159
$1.65	115	124	132	139	144	149	153