



FLUID FACTS

NFSA AGRONOMIC NEWSLETTER

CORN NUTRIENT EFFICIENCIES

If nitrogen is being used effectively and efficiently growers should be getting a bushel of corn per pound of applied N. (For \$2.50 corn and \$0.25 per pound of N, that's a return of \$10 per dollar invested.) There are several ways to evaluate nutrient efficiencies. Let's take a look at them.

CROP NUTRIENT REQUIREMENTS

How much N, P₂O₅ and K₂O does a corn crop take up to produce a bushel of grain? (Total uptake of nutrients in the above-ground crop divided by the grain yield.) This is the "internal nutrient efficiency or requirement" to grow a bushel of grain.

According to our database (yield range from 80 to 338 bu./acre) the average internal N, P₂O₅ and K₂O efficiencies are:

Corn nutrient uptake* per bushel of grain produced (lb/bu)

	N	P ₂ O ₅	K ₂ O
Average	1.12	0.47	1.27
Range	1.02-1.20	0.40-0.57	1.04-1.53
Std. dev.	+/- 0.058	+/- 0.073	+/- 0.129

* Above-ground crop uptake

Accordingly, we should achieve the following bushel yield (output) per pound of nutrient uptake

0.89 bu/lb N 2.13 bu/lb P₂O₅ 0.79 bu/lb K₂O

These values are the reciprocals (1/average uptake per bushel) of the above values.

NUTRIENT REMOVAL

How much N, P₂O₅ and K₂O leaves the field with each bushel of corn? This is another way of keeping track of nutrients.

While this may vary with the hybrid, our database indicates the following averages with yields ranging from 80 to 370 bu./acre.

Average nutrient removal per bushel of corn:

	N (LB/BU)	P ₂ O ₅ (LB/BU)	K ₂ O (LB/BU)
Average	0.72	0.36	0.23
Range	-0.68-0.82	0.292-0.433	0.17-0.295
Std. dev.	+/-0.045	+/-0.0429	+/-0.047

Another way of looking at these figures is—what is the N, P₂O₅, and K₂O cost of each bushel that leaves the field? Using current nutrient prices, it comes to about \$0.29 per bushel.

The average nutrient removal figures listed above do not indicate how many bushels of grain can be produced from a given rate of applied N. But, can we get a bushel of corn per pound of applied N?

In studies conducted at several sites in Maryland under no-till culture, Dr. Allan Bandel studied the response of corn to N applied from two sources and with three methods of application of UAN at three sites. A portion of the data from one site is included below:

Table 1.

Effect of method of application and N source on no-till corn yields. Poplar Hill site. Dr. Allan Bandel, Univ. of Maryland.

METHOD OF APPLICATION AND N SOURCE	CORN YIELD—BU/ACRE		
	N RATE—LB/ACRE		
	0	120	160
Control	42.3	-	-
Broadcast—Am. Nit.	-	141.9	163.6
Broadcast—UAN	-	136.3	159.0
Dribble—UAN	-	148.9	176.0
Injected—UAN	-	156.2	178.4

Table 1 shows the best method of application (injected) for the UAN 120 lb N rate produced a yield of 156.2 bushels and 178.4 bushels for the 160 lb rate. That is an increase of 113.9 bu/acre and 136.1 bu/acre for the two rates. (With \$2.50 corn and \$0.25 per pound of N, that's a net return of \$254.75 for the 120 lb rate and \$300.25 for the 160 lb rate.)

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Reading the yield per pound of N applied or gross efficiency (output per unit of input). Table 2 shows method and placement of UAN boosted the gross N efficiency by 14.6 percent for the 120 lb N rate and 13.1 percent for the 160 lb rate. The best gross efficiencies for those treatments are 1.30 and 1.12 bu/lb of applied N, well above the average bushel yield per pound of N uptake, 0.89 bu/lb, shown earlier. Therefore, with those treatments and rates the returns are \$13 and \$11.20 per dollar invested in N, respectively, for the two rates of N.

Table 2.

Gross N efficiencies (total yield/rate of applied N) using data from Table 1.

METHOD OF APPLICATION AND N SOURCE	GROSS N EFFICIENCY N RATE LB/AC	
	120	160
	BU/LB APPLIED N	
Broadcast—Amm. Nitrate	1.18	1.02
Broadcast—UAN	1.14	0.99
Dribble—UAN	1.24	1.10
Injected—UAN	1.30	1.12

YIELD INCREASES

Another way to look at N efficiency, which only can be done in experimental fertility rate studies (unless a farmer maintains a no-nitrogen control area), is to look at the yield increases (output) per unit of nutrient applied (input), or net efficiency. Table 3 shows the yield increases from the treatment comparisons and net N efficiencies.

Table 3.

Corn yield increases and net N efficiencies as affected by method of application, N source and rate on a no-till system.

METHOD OF APPLICATION AND N SOURCE	YIELD INCREASE N RATE(LB/AC)		NET N EFFICIENCY	
	120	160	120	160
	(BU/ACRE)		(BU/LB APPLIED N)	
Broadcast (Amm. Nitrate)	99.6	121.3	0.83	0.76
Broadcast—UAN	94.0	116.7	0.78	0.73
Dribble—UAN	106.6	133.7	0.88	0.84
Injected—UAN	113.9	136.1	0.95	0.85

Note the improvement of the knifed-in treatment over the broadcast UAN treatment. With improved method and placement, the net N efficiencies (net yield increase/lb N applied) reached 0.95 and 0.85 bu/lb of applied N, or 1.05 and 1.17 lb of N per bushel of yield increase. Those efficiencies are yielding a net \$9.50 and \$8.50 per dollar invested in N.

TILLAGE EFFECTS

What is the effect of tillage-system on N response and N efficiencies?

Table 4 compares the effects of N rates with conventional and no-till systems in Dr. Bandel's Maryland research.

Table 4.

Effect of N rates and tillage systems on corn yields. Allen Bandel, Poplar Hill, 1981. Univ. Maryland.

N RATE LB/AC	CORN YIELD TILLAGE		DIFFERENCE (NO-TILL-CONV.) (BU)
	CONVENTIONAL	NO-TILL	
	BU/AC		
0	66.2	24.1	-42.1
80	139.9	125.5	-14.4
120	154.6	168.1	+13.5
160*	162.3	193.0	+30.7
240	158.7	187.2	+28.5
Max. increase	96.1	168.9	

* Optimum N rate.

The higher yield of the conventional tillage without applied N occurs because the tillage helps mineralize soil organic N and, depending upon when the residue was mixed into the soil, usually enhances residue decomposition. Over several years, these differences will decrease as soil organic matter decreases and a new equilibrium is established between the treatments.

There is an interaction between N rate and tillage system. In both the conventional and no-till systems the gross N efficiencies remain above 1 bushel per pound of applied N up to the 160 pound N rate, which is the most profitable incremental rate. (Using Table 4 work out the gross and net N efficiencies on your own.) Based on the gross N efficiency figures at that rate, the gross returns were \$10.10 and \$12.10 per dollar invested in N.

SUMMARY

There are many best management practices to help growers get a bushel of corn per pound of applied N. Remind growers to select high yielding hybrids, plant early, use a plant population based on subsoil moisture and expected seasonal rainfall, have soil pH and P and K soil and fertility levels adequate (be sure on micronutrients too), control weeds and insects, use the pre-sidedressed N test to check on N needs, provide N credits for legumes and/or manure applications, use the best method, time and placement of N for your area (that includes fertigation) and harvest early.