Site-Specific and Weather-Adjusted Nitrogen Management in Maize

Adapt-N Increased Grower Profits and Decreased Nitrogen Inputs in Two Seasons of On-Farm Strip Trials

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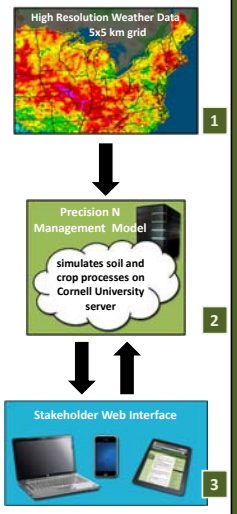
Concerns with Nitrogen in Corn

- Corn is the largest consumer of N in US (~ $5 Billion/yr)
- Current predictions of annual corn N fertilizer needs are generalized and imprecise (+ or - 40%) due to dynamic, complex and locally-specific weather, soil and management variables
- N use efficiency is often less than 50%
- Large NO_3^- leaching losses contribute to hypoxia in estuaries
- N_2O from denitrification makes up largest fraction of greenhouse gas emissions associated with U.S. agriculture
- Losses occur in wet spring/early summer or following the cropping season if excessive N was applied, or drought limits crop N uptake

Adapt-N: a tool for precision N management

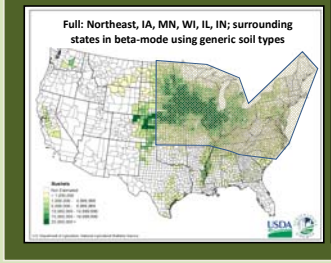
A computational tool for farmers, crop consultants, and planners to develop precise in-season N recommendations for fields adjusted for local weather, soil characteristics, and management practices.

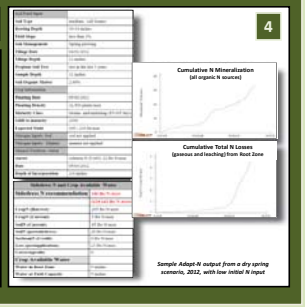
Adapt-N Infrastructure



1) Uses high resolution climate data (daily precipitation and temperature, 5x5 km)
2) Well-validated Precision Nitrogen Management (PNM) dynamic simulation model simulates daily soil C and N transformations, water transport and corn N uptake. Calculates in-season N fertilizer needs.
3) Server-based web-interface at adapt-n.cals.cornell.edu allows users to define field-specific management and soil test info to run simulations from any internet-capable device.
4) Sidedress recommendation and information provided, such as N mineralization, losses, growth stage, weather impacts, current soil N content. Retrospective evaluations also available.

Adapt-N 2013 Coverage





2011 & 2012 On-Farm Beta-Testing Results

Sample Strip Trial Layout

Treatments imposed at sidedress time:
- A = Adapt-N recommended N rate
- G = N rate according to current grower practice
- Zero, high, or low rates in some trials
- Usually 4 reps (2-8 in some trials)

G1
A1
A2
G2
A3
G3
G4
A4

Spatially Balanced Complete Block Design (after van Es 1993).

Yield assessed via calibrated yield monitor, weigh wagon, or representative sampling. Partial profits calculated using prices of 5.50 and 6.00 $/bu (grain) for 2011 and 2012, respectively; 50 $/ton (silage) in both years; 0.60 $/lb of N and $8/ac for sidedressing operation used for all trials.

Adapt-N On-Farm Trial Locations, 2011 & 2012

Treatment comparison (Adapt-N) – (Grower-N)	Iowa	New York	Grand Mean
	(n=28)	(n=56)	(n=84)
N fertilizer input; lb ac^{-1} (kg ha^{-1})	-32 (-36)	-66 (-74)	-54 (-61)
N leaching loss; lb ac^{-1} (kg ha^{-1})	-1 (-1)	-10 (-11)	-8 (-9)
Total N loss; lb ac^{-1}, (kg ha^{-1})	-2 (-2)	-52 (-58)	-39 (-43)
Yield; bu ac^{-1} (Mg ha^{-1})	0 (0.00)	-3 (-0.20)	-1 (-0.07)
Profit; $ ac^{-1} ($ ha^{-1})	$20 ($49)	$31 ($77)	$27 ($67)
Trials with greater profit	75%	80%	79%*

* Overall, 88% of trials would have resulted in greater profit with updated tool and optimal user inputs.

2013 On-Farm Trials

- >100 trials in NY, IA, MN, IN, IL, VT, PA, MD underway
- Excessive May and June rainfall in much of user region generated higher-than-average sidedress recommendations
- Field reports are positive. Strip trial data will be used to calibrate model for extreme-wet conditions.

Preliminary Results from 5 Trials in NY

Treatment comparison (Adapt-N) – (Grower-N)			
Trial	N input lb ac^{-1} (kg ha^{-1})	Yield bu ac^{-1} (Mg ha^{-1})	Profit Gain* $ ac^{-1} ($ ha^{-1})
NY 1	40 (45)	30 (1.88)	$127 ($314)
NY 2	20 (22)	23 (1.44)	$102 ($252)
NY 3	30 (34)	26 (1.63)	$85 ($210)
NY 4	60 (67)	42 (2.64)	$174 ($430)
NY 5**	-50 (-56)	-8 (-0.50)	-$11 (-$27)

* Using $5/bu, $0.6/lb N
** Variable field due to manure N contribution

Adapt-N Benefits

1) Economic and Environmental Benefits
2) Reduced N inputs after dry or average springs (2011-2012) with profit gains of $27/ac from N savings
3) 900 acre NY farm saved >65,000 lb of N and > $30,000 with Adapt-N in 2012
4) Moderately increased N applications led to yield and profit increases after wet spring (2013)
5) Adapt-N improves on grower practice in 88% of cases with appropriate use of current version of tool
6) Adapt-N provides incentive for sidedressing. Reducing preplant/starter applications enables increased profit and decreased N loss from more accurate N recommendations at sidedress time.

More info at http://adapt-n.cals.cornell.edu
Adapt-N accounts available: adapt-n@cornell.edu