Review “Active-Optical Reflectance Sensing Corn Algorithms Evaluated for Nitrogen Fertilizer Rate Recommendations”

This work challenges algorithms from Nebraska, Missouri and Oklahoma, where added scrutiny can only help. Having not previously reviewed this material that spends a lot of time on the ‘Oklahoma’ approach, my focus is on getting some of this either corrected, or deleted. My views are nonetheless jaded coming from a document that failed to engage those scientists (1 of 3 algorithms) that have worked in this arena.

* 49 trials, 8 states, over three years
* Eight land-grant Universities (Iowa, Illinois, Indiana, Minnesota, Missouri, North Dakota, Nebraska, Wisconsin)
* Furthest south site (trials in this paper), 38.8 N Latitude, (near, Columbia, MO) to Fargo, North Dakota (46.8N)
* Stillwater Oklahoma, 36.1N.

Page 2, 4th paragraph: “*Also the time and effort required to establish N reference areas or strips may be cumbersome (Franzen et al., 2016)*.

There are just as many references that delineate the value of N Rich Strips and that have been conveniently omitted. The literature review should communicate our present science

Page 3, first paragraph: *Three published corn algorithms are the University of Missouri algorithm (ALGMU; Scharf et al., 2011), the Holland-Schepers algorithm (ALGHS; Holland and Schepers, 2010), and the Oklahoma State University algorithm (ALGOSU; Oklahoma State University, 2016).*

There are over fifty different Yield Potential (YP0) equations for an array of crops listed on the NUE site (<http://www.nue.okstate.edu/Yield_Potential.htm>). The equation that you chose to use, came from 2007, and was generated using data in Oklahoma (rainfed and irrigated). Oklahoma is included in the Great Plains region, but where corn production and yields are much lower (extreme heat, lower rainfall, etc.). Noteworthy on our web site, are the many different equations that have been generated and studied, whereby the recognition of differing “models” was paramount to the success of the YP0-RI approach. However, it has always been emphasized that yield potential prediction equations needed to be tailored to the specific regions where sensor based technologies were to be applied. This is communicated in several manuscripts (several included here).

Work from Nebraska (NE sites included in this work) has also delineated the need for region/site specific algorithms as well (Soil Sci. Soc. Am. J. 66:544–553 (2002). “*We conclude that the spatial application of the existing recommendation algorithm developed for uniform application may be inappropriate, at least for these sites, and that unique recommendation equations for major soils and climatic regions may be necessary to achieve substantial increases in N-use efficiency*.”

Since you have noted that this web site with 50+ different algorithms was “published” then you would have to embrace the specificity of needing region-specific-data, for generating yield potential equations (<http://www.nue.okstate.edu/Algorithm/Algorithm_Outline.htm>), further highlighted on this same site. We were not offered the opportunity to provide the best algorithm for your study.

Within the United States we have generated limited **corn**-specific YP0 equations other than Oklahoma. As winter wheat best characterizes our region, added wheat algorithms from various countries have been a focus. Other crops, including sorghum, canola, and rice have also been investigated, and YP0 equations accordingly developed. Only limited USA corn work outside Oklahoma has been conducted and certainly not further north where photoperiods, planting date, growth rates, and soil profile moisture are drastically different. We have indeed successfully tested the OSU approach in Nebraska and where harvest results were collected by the USDA-ARS, UNL group.

<http://nue.okstate.edu/Index_NFOA.htm>

<http://www.nue.okstate.edu/Nebraska_USDA_ARS.htm>

Nonetheless, putting together a YP0 equation for the southern boundaries evaluated in your study could be easily accommodated, but we were never consulted to as much. Understanding the need for region specific yield-potential-prediction-equations, why would you expect a 2007, YP0 equation (mined from the NUE web site) and developed in ‘Oklahoma’ to work in these high yielding/production corn states? States north of Oklahoma would also need a specific YP0 equation that encumbered later planting dates, different growth rates, and shorter maturity hybrids.

Because of this, your OSU evaluation was doomed to fail, and the equation that was chosen was inappropriate. Again, no one from OSU was consulted. And for this region, and the sites that were evaluated in more northern states, why wasn’t an algorithm from Ohio, or Kansas, or Iowa chosen, instead of Oklahoma where heat and drought predominate? The casual treatment of our science, and the scientists that have contributed to this specific area is disconcerting.

Why also would the authors of this paper pick Oklahoma work to compare, when we fully embraced being a part of this entire project from the very beginning? And then only to have a totally inappropriate model used (from Oklahoma), without ever consulting our scientists who have been immersed in this science from the onset?

With the amount of attention focused on Oklahoma ‘in your paper’, the literature review fails to include key documents.

The importance of the independence of YP0 and RI, and the need to have independent estimates of both, remains incredibly important if viable algorithms for N, are to be developed. Both papers that document this theory and that encumbered 216 and 90 years of data follow.

<http://nue.okstate.edu/Index_Publications/New1335.pdf> (2013, Arnall) 261 site years

<http://nue.okstate.edu/Index_Publications/PRAG_Ind_YP0.pdf> (2010, Raun) 90 site years

Also included is a paper that Dr. Schepers and Dr. Holland published two years after the 2010 manuscript. Please discern as you see fit. If nothing else, mention of all three papers is warranted and that should reference that some debate still exists. The robust treatment (years and locations from published work) of this concept will stand the test of time, because data from Iowa, Nebraska, Wisconsin, and Oklahoma, all showed the exact same thing. Colleagues of Dr. Schepers in Nebraska willingly shared their data and that further delineated the independence of yield potential and N response, and that were referenced accordingly. This fundamental theory is precisely why the OSU algorithm works because it recognizes the need for both estimates. Granted you have to use the right yield potential prediction equation, which for this paper, was not the case.

Evidence of dependence between crop vigor and yield, James S. Schepers, Kyle H. Holland 2012

<https://link.springer.com/article/10.1007/s11119-012-9258-5>

The manuscript below documented the benefits of a YP0-RI algorithm and that included Dr. Schepers as a co-author (Optical Sensor-Based Algorithm for Crop Nitrogen Response. 2007. Comm. Soil Sci. Plant Anal. 36: 2759-2781). Inconsistent?

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<http://nue.okstate.edu/Index_Publications/NDemand108-6-2165.pdf> (2016, Dhital)

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<http://nue.okstate.edu/Yield_Potential.htm>

YP0=2592(INSEYx1775.6)

YP0=2592\*(Exp(NDVI/ sum of GDD\*1775.6)