FROM THE GROUND UP: GROUNDWATER, SURFACE WATER RUNOFF, AND AIR AS PATHOGEN ROUTES FOR FOOD CONTAMINATION

Mark A. Borchardt[1]

Foodborne infectious disease transmission of 31 pathogen types is estimated to account for 9.4 million illnesses, 56,000 hospitalizations, and 1,300 deaths in the United States annually (Scallan et al. 2011). The economic costs from foodborne illness in the United States are more than $50 billion per year (Scharff 2012). The Food Safety Modernization Act of 2011 recognizes agricultural water is a source of pathogen contamination of fresh produce and monitoring strategies are being proposed to assess the sanitary quality of water used for food production and processing. Nonetheless, one lesson learned from foodborne outbreaks the past several years is that the events and pathogen movement routes leading to contamination are often surprising. Food producers need to be constantly vigilant for previously unanticipated contamination routes.

This presentation tells three stories about three studies, highlighting the potential for human pathogens to travel unusual routes and end up in surprising places. Insofar as these routes and places intersect with food, foodborne illness can result.

Attendees are reminded of three summary points:

Groundwater – Contrary to conventional wisdom, municipal drinking water from non-disinfected groundwater sources is not pathogen-free and cannot be assumed to be sufficiently sanitary for food processing.

Surface Runoff – Pathogen types and concentrations are highly variable in runoff from manure-applied fields, and pathogen genomes in these fields can survive for many months.

Air – During spray irrigation of dairy manure, under cool windy conditions, pathogens can be detected at distances greater than 500 feet downwind of the irrigation site. However, under hot, sunny, low-wind conditions, pathogen detections downwind are sporadic.

References

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[1] Research Microbiologist, USDA – Agricultural Research Service, Environmentally Integrated Dairy Management Research Unit, 2615 Yellowstone Dr., Marshfield, WI, 54449.

NITROGEN FERTILIZATION DECISIONS: CAN WE DO BETTER?

James J. Camberato[1/]

Overview of Presentation

Nitrogen (N) fertilization recommendations for corn in several states in the Midwest (including WI and IN) are based on the results of many N response trials conducted over a number of years, locations, soil types, and hybrids. The maximum return to N (MRTN) is calculated based on the yield response to applied N derived from the analysis of these trials and the price of grain and N fertilizer (Sawyer and Nafziger, 2006). The recommended fertilizer rate represents the point at which no further profit is realized by the application of additional N. All states using the MRTN approach consider crop rotation an important factor in determining the N recommendation and several include soil type, soil productivity, or region of the state as well (http://extension.agron.iastate.edu/soilfertility/nrate.aspx).

Although the MRTN recommended N rate is likely to be the most profitable over a similar set of future environmental conditions, soil types, and hybrids, there can be considerable deviation from the recommended N rate in any given situation. For example, the frequency distribution of economic optimum N rate for 41 individual N response trials is shown for the east and central regions of Indiana (Figure 1, left panel) considering a grain cost of $4.50 and a N cost of $0.55 per pound of N ($900 per ton anhydrous ammonia or $310 per ton 28% urea ammonium nitrate solution). The average optimum N rate was 195 pounds per acre under these conditions. The range in optimum N rates for individual locations was about 50 to 250 pounds of N per acre. Only 55% of the trials had optimum N rates between 170 and 225 pounds per acre (20 pounds per acre below, and 30 pounds per acre above, the average economic optimum N rate).

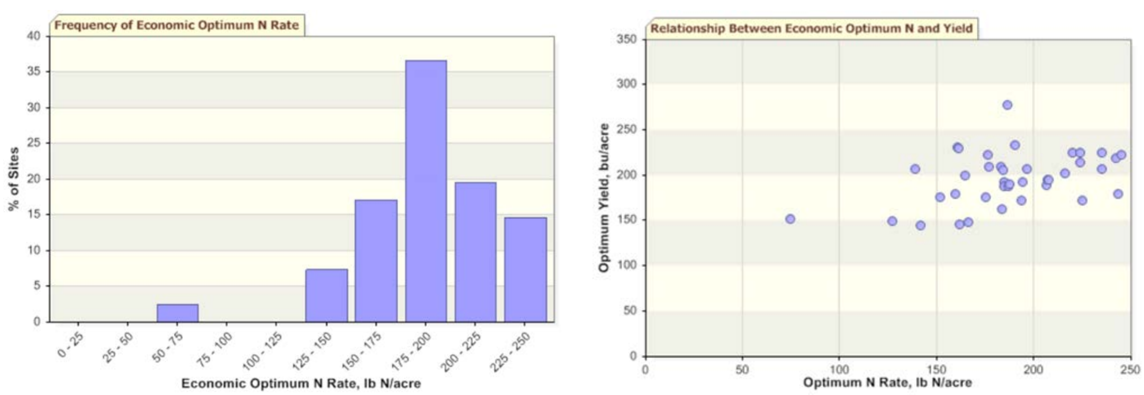

Fig. 1. The frequency distribution of economic optimum nitrogen (N) rate for 41 N response trials conducted in east and central Indiana from 2006 through 2011 [calculated with $4.50 per bushel corn and $0.55 per pound nitrogen ($900 per ton anhydrous ammonia or $310 per ton 28% urea ammonium nitrate solution)] is shown in the left panel. The average economic optimum N rate for the 41 N response trials is 195 pounds of N per acre. The weak relationship between optimum N rate and yield at the optimum N rate is shown in the right panel.

[1/] Professor and Extension Specialist, Dept. of Agronomy, Purdue Univ., 915 W. State Street, West Lafayette, IN, 47907.

There are many factors that may result in the optimum N rate for an individual location varying from the average optimum N rate. Variation in grain yield (perhaps arising from differences in hybrid, plant population, weather patterns, management, etc.) is the most commonly suggested factor altering the crop N requirement and therefore the optimum N rate, even though each of the states using the MRTN approach shows little relationship between optimum N rate and yield attained at the optimum N rate (Fig. 1 right panel, IN for example). Another factor perhaps affecting the optimum N rate at an individual location may be abnormally high or low precipitation causing more or less than average nitrate leaching or denitrification, especially when N fertilizer or manure is applied in the previous fall or winter before corn planting. Soil moisture and temperature conditions can also affect the mineralization of soil and manure organic N altering their contribution to the corn crop, thereby increasing or decreasing the amount of N that must be added to attain the optimum N rate in any given year. In truth there are many other factors and interactions of factors that may affect the optimum N rate in any given situation.

Adaptive management is a recently coined term used to describe an approach for identifying an optimum N rate for a specific soil/management system or in a particular season that is more accurate than an average N rate recommendation such as that obtained from the MRTN approach. Preplant or pre-sidedress soil nitrate, tissue N concentration, sensor-derived crop greenness and biomass, and end-of-season stalk nitrate are measurements that can be used for making season-to-season or in-season adjustments of N rate decisions. Computer modeling that predicts crop development and soil N transformations is another method for addressing soil, management, and weather effects on crop N demand and soil N availability to arrive at a season-specific N rate recommendation. Conducting N response trials is yet another approach to assessing management- and field-specific optimum N rates.

The results of studies evaluating the end-of-season cornstalk nitrate test (Brouder, 2003) and the Cornell developed Adapt-N computer model (Moebius-Clune et al., 2011) as tools for adaptive N management will be discussed in this presentation.

Literature Cited

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