



IOWA CHAPTER

Analysis of Research on Application of Manure to Soybeans

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Because soybeans are a legume crop, they can biologically fix the nitrogen they need from nitrogen in the atmosphere. Therefore nitrogen fertilizer is traditionally not applied to soybeans. However, with the increasing numbers of Concentrated Animal Feeding Operations (CAFOs) in Iowa, liquid CAFO manure – containing high levels of nitrogen – is now sometimes applied to soybeans for a variety of reasons, including convenience of manure disposal. Published scientific research -- as well as common sense -- indicates that applying manure to soybeans increases the potential for nitrogen to leach into tile drains and contaminate Iowa's water resources.

In consideration of the potential for nitrogen from manure applied to soybeans to contaminate water resources, in November 2006 the Environmental Protection Commission (EPC) initiated rulemaking to limit liquid manure applications to soybeans to 100 pounds of nitrogen per acre and to impose a total ban on applying liquid manure to soybeans five years later, unless further scientific research supports alternative action. As part of the rulemaking, the EPC stipulated that it must review available scientific evidence and affirm or rescind the ban of applying manure to soybeans. The EPC will vote to affirm or rescind the ban at their October 16, 2012 meeting.

Two peer-reviewed research studies that measured the amount of nitrogen leaching when manure was applied to soybeans have been published since the EPC's 2006 rulemaking. Research by Iowa State University scientists (Bakhsh et al., 2009) conducted at Nashua, Iowa compared the amount of nitrate that leached out of field tile drains when manure was applied to both corn and soybeans in a corn-soybean rotation vs. the amount of nitrate that leached when manure was applied to only corn in the rotation. Over the five-year field study they found that when manure was applied to both corn and soybeans, the concentration of nitrate in the tile drainage water increased by an average of 80% in comparison to where manure was applied to only corn in the rotation. The study concluded "that a corn-soybean rotation system receiving manure each year to both corn and soybean is likely to increase NO₃-N (nitrate) leaching to shallow groundwater without resulting in significant yield benefits."

The second study was also conducted in Iowa, at Gilmore City (Lawlor et al., 2011). This five-year study found that nitrate concentrations in tile drainage were 36% higher when manure was applied to both corn and soybeans compared to when manure was applied to only corn in a corn-soybean rotation. A third ISU study has not yet been published, but has been summarized in a project report (Pederson, et al., ISRF08-13). That five-year, replicated study found that when manure was applied at a rate that provided 100 lb/acre of nitrogen to soybeans in a corn-soybean rotation, nitrate concentrations in tile drainage waters were 37% higher than where no manure was applied to the soybeans. This is a very pertinent finding because it tested the currently approved rate of 100 lb/acre of manure nitrogen on

soybeans and found a 37% increase in nitrate leaching as a result. This finding provides strong support for the EPC to affirm the ban on applying manure to soybeans.

Nitrate-laden water from field tile drains flows to nearby streams and ultimately makes its way to the Mississippi River and the Gulf of Mexico. Nitrate is considered to be the limiting nutrient in the growth of the Dead Zone in the Gulf. A study by the U.S. Geological Survey found that “Corn and soybean cultivation is the largest contributor of nitrogen to the Gulf” (Alexander et al., 2008). Therefore, the practice of applying manure to soybeans clearly contributes to the growth of the Dead Zone by increasing nitrogen flows to the Gulf.

The three studies summarized above appear to be the only replicated studies that have measured nitrate leaching to groundwater when manure was applied to soybeans. All three studies found increased leaching of nitrogen, and all were completed since the 2006 EPC rulemaking, which stipulated that in five years “the commission shall review the available scientific evidence and determine whether any further or alternative action is necessary.” Given the results of these studies, the most reasonable and responsible course of action for the EPC is to affirm the ban of applying manure to soybeans. Previous research looked primarily at the agronomic effects of applying manure to soybeans. Some studies found small yield increases when manure was applied to soybeans, primarily in poor soils that were deficient in phosphorus or other nutrients, which is not commonly the case near CAFOs where manure is regularly applied to corn in a corn-soybean rotation. A few studies found yield decreases when manure was applied to soybeans. Schmidt et al. (2001) attributed yield decreases to white mold and soybean lodging. Oelke (1998) found that manure applications to soybeans sometimes resulted in reduced seedling emergence, increases in several fungal diseases and yield decreases. Schmidt et al., (2000) concluded that the application of manure to soybeans is not necessarily meant to increase yield, but mainly to provide a means of manure disposal.

The progression of research findings over the past couple of decades has increased the certitude of the need to ban manure application to soybeans. Early on, researchers – often at the behest and funding of the industry – conducted agronomic research to justify the application of manure to soybeans, with only secondary consideration given to the potential water quality implications of applying that manure. Some of those studies measured residual soil nitrogen levels after applying manure to soybeans and speculated that the residual soil nitrogen would not be enough to cause leaching of nitrogen to water resources – though they did not actually measure nitrogen levels in tile drainage waters. After the recent research of Bakhsh et al. and Lawlor et al. found that applying a full rate of nitrogen from manure to soybeans did indeed cause nitrogen leaching problems, a number of researchers speculated that perhaps a half rate of manure nitrogen (100 to 125 lbs of N/acre) applied to soybeans wouldn’t result in nitrate leaching. That assumption was found to be erroneous by the very recent research of Pederson et al., which found that 100 lb of manure N/acre applied to soybeans raised the nitrate concentration of tile drainage water by 37%. This finding has taken the discussion of applying manure to soybeans to a whole new level and calls into question the older studies that speculated that water quality would not be affected by applying manure to soybeans -- but did not actually measure it.

In my professional opinion, these recent research findings, combined with a body of research that informs us that the agronomic advantages of applying manure to soybeans are minimal to negligible, confirm that the Environmental Protection Commission should vote to affirm the ban on applying manure to soybeans. The convenience of disposing of manure on soybean ground is not worth the risk to water quality degradation it poses.

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References

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