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COLLEGE OF AGRICULTURE

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Subject: **Environmental Protection Commission Considerations Regarding Manure Application to Soybean**

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As in all crops, nitrogen (N) is important for successful soybean production. It is well-known that soybean plants symbiotically fix N. The assumption may be that all the soybean plant's N needs are met through fixation. That is not the case. The source of half, or more than half, of the N taken up by the plant is the soil system. Depending on soil conditions, the plant preferentially takes up inorganic N from the soil and obtains any remaining need through symbiotic fixation. Inorganic N in soil or mineralized from soil organic materials results in reduced N fixation. In relation to other sources and application rate, manure reduces fixation, but does not necessarily stop it. As with corn, the soybean plant's efficiency in the uptake of applied N will not be 100 percent. The majority of total plant N winds up in the seed —approximately 70 percent of the N is harvested in the grain. Given a 50 bushel per acre soybean yield, the plants will take up approximately 240 to 250 lb N/acre — half or more from soil sources and the remainder from fixation.

Therefore, the issue of applying manure to grow a soybean crop should include careful consideration of the amount of N the plant is fixing and the amount acquired from soil sources. In other words, what is the amount of N compensation that could be substituted with manure N application.

Considering the above information, a manure application rate should not greatly exceed the potential amount of N that would not be fixed due to applying manure to soils. Currently, Iowa Department of Natural Resources manure plans allow a manure N rate based on 3.8 lbs N/bu that is removed when soybean grain is harvested. With a reasonable soybean crop yield, this application would approach 200 lbs N/acre, an amount that is more than the N typically fixed by soybean. Basing the 200 lbs N/acre rate on total N in grain assumes that all N is fixed and ignores the N derived from manure or other soil sources. It assumes that farmers should apply N based on what's removed in the harvested grain.

The Environmental Protection Commission should consider two key issues:

1. Is 3.8 lbs N/bu from harvested soybean grain the most appropriate value? Recent Iowa State University research data indicate 3.1 to 3.4 lbs N/bu in soybean grain.

2. Does the currently allowed manure N application rate based on grain N removal, which can be upwards of 200 lbs N/acre, represent an over-application? Preliminary results from Iowa State's Nashua water quality research site show the effect — more nitrate measured in the tile flow — from using current swine manure application rates for corn (150 lbs N/acre, which is at the top end of suggested rates) and for soybean in a corn-soybean rotation (the DNR allowable rate of 200 lbs N/acre). Unfortunately, no comparative research data — from Nashua or any other site — are available on tile-flow nitrate that results from using more moderate manure application rates in similar cropping systems.

Considering these issues, a more reasonable manure N application rate to soybean would better relate to compensating for the amount of N that would not be fixed when manure is applied. Depending upon yield level, this amount could be more in the 100 to 125 lbs N/acre range. Soybean plants will compensate for any shortage of N supply from the soil, or applied manure, by fixing N. So, using a more moderate manure N rate — one that is less than the total amount of N typically fixed — should not negatively influence soybean production. Recent field trial research with liquid swine manure has documented that a manure N rate of 100 to 125 lbs N/acre will limit residual nitrate in the soil profile after harvest.

A reasonable approach would be to consider this moderate “allowable” rate for manure planning, rather than eliminating the option to apply manure. This would allow soybean growers to continue to use valuable manure applications, minimize the potential for nitrate reaching surface water systems, and gain the desired benefits (increased yield, supply of nutrients other than N such as phosphorus and potassium, less impact on soil erosion when injected into cornstalks, etc.).

Another point to consider is that if manure is not applied to soybean, and by default is restricted to corn, then the environmental effect — nitrate in water systems — may not change because the same amount of manure will be applied. That application may go on second-year corn or continuous corn, which at the rates applied for those rotations, could have the same effect on nitrate in surface water systems.

In summary, a suggestion to the EPC is to consider a moderation of manure rates applied to soybean for manure plans. Also, further research should be undertaken to better document soybean production enhancement from manure application (and from manure sources other than swine) and the subsequent impact on soil profile nitrate and nitrate in water leaving soybean fields.