Project Title: Determining nutrient release characteristics of various manures

Project Number/Description: (*Designate if this is a new project or continuation of a previously funded project)*

This is a new project.

Project Leader:

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Other Personnel Involved:

Researcher in Wilson lab (to be determined).

Project Location:

University of Minnesota - Saint Paul, MN (this will be a lab study).
439 Borlaug Hall, 1991 Upper Buford Circle
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Justification for Research: *(For new projects only)*

Using manure as a nutrient source can be more complicated than using commercial fertilizers since the nitrogen (N) and phosphorus (P) content can vary depending on species, storage and treatment methods, and application techniques. Farmers, particularly those that grow sugarbeets, are also concerned about when the nutrients are released in the growing season which changes depending on soil types and weather. Despite concerns, there are other benefits of manure beyond being a source of N and P, including improving soil health and providing micronutrients. Plus, the up and down price swings of the commercial fertilizer market make manure more attractive, especially if a farmer has a consistent supply which can offset fertilizer costs.

To help farmers understand nutrient management with manure, the University of Minnesota developed recommendations to help determine N and P credits for a variety of manures. These recommendations were developed several decades ago, however, and since that time the diets of animals, storage of manures, and manure application equipment

have changed. As one example, the recommendations to determine N availability treat all dairy liquid manure the same. However, some dairies have implemented technology to separate the solids from the liquids, thus changing the nutrient dynamics of the manure. Will liquid separated dairy manure have the same N availability as unseparated liquid dairy? For both N and P, are there differences in mineralization across soil types? These questions are particularly important for sugarbeet growers due to the effect late season N availability in the soil has on the sugar content of their crop. Our goal is to better understand N and P release from manure so that farmers are able to make better decisions about when to apply manure in their rotation to maximize benefits while reducing fertilizer costs.

Summary of Literature Review: *(For new projects only)*

Understanding N availability in manure is complicated. The amount that is available will depend on the animal species that made the manure, what kind of bedding (if any) was used, how the manure was treated and/or stored, and how the manure was applied. The University of Minnesota has recommendations for what to expect for N availability (Hernandez and Schmitt 2012), but may need updated since there are new manure handling technologies and feeding and bedding strategies being used today. For example, Russelle et al. (2009) found that nutrient release estimates for stratified bedded pack dairy manure were not consistent with solid dairy manure guidelines in Minnesota. With new state regulations pending regarding how much fertilizer N is applied to fields, farmers that also use manure will need to take great care in determining how much N is supplied from the manure before determining how much fertilizer they can apply.

Understanding P availability in manure is also necessary, and luckily is not quite as complicated as it is with N, although there are still uncertainties. We assume approximately 80% of the total manure P is available the first year, but even this can vary depending on weather conditions. Recent studies have shown, however, that P availability may also depend on soil texture (Pagliari and Laboski 2014). In a recent study done at the University of Wisconsin, Pagliari and Laboski (2013; 2014) found that from 40% to 100% of P from manure became plant available within 50 days and the difference was primarily due to manure chemistry and soil texture.

Literature cited:

- Hernandez JA, Schmitt MA. 2012. Manure management in Minnesota. Saint Paul (MN): University of Minnesota Extension [accessed 24 Nov 2017].
- Pagliari PH, Laboski CAM. 2013. Dairy manure treatment effects on manure phosphorus fractionation and changes in soil test phosphorus. Bio and Fert of Soils 49(8): 987-999.
- Pagliari PH, Laboski CAM. 2014. Effects of manure inorganic and enzymatically hydrolyzable phosphorus on soil test phosphorus. Soil Soc. of Am. J. 78(4): 1301-1309.

- Russelle MP, Blanchet KM, Randall GW, Everett LA. 2009. Characteristics and nitrogen value of stratified bedded pack dairy manure. Crop Management 8(1). https://dl.sciencesocieties.org/ publications/cm/abstracts/8/1/2009-0717-01-RS.

Objectives:

The objective of this study is to evaluate N and P release from a variety of manures and soil types to give farmers a better understanding of how manure will behave.

Materials and Methods: *(Briefly Describe)*

Laboratory incubations will be used to assess N and P release characteristics from a variety of manures in several different soil types. The incubation studies will be a complete factorial with 4 replications and with manure type, soil type, and temperature as the main factors. This means all possible soil and manure combinations will be tested at all chosen temperatures. We will use 4 to 8 manures, including (but not limited to): dairy liquid (separated and non-separated), swine liquid (from a finishing house and a sow barn) and turkey litter. We may also include some composted or anaerobically digested manure. Manure analyses to determine nutrient content will be conducted on all samples prior to incubations. Soils for the incubations will include a coarse, a medium, and a fine textured soil. A small quantity of soil and manure will be mixed to mimic a given amount of nutrient (e.g. 180 lbs of N per acre) and split equally into subsamples. Moisture in the samples will be kept at 60% of field capacity and will be maintained by weighing every 4-6 days and adding deionized water as needed to replace the weight lost. During the incubation study, the temperature inside the incubator will be kept at either 25^{o}C (77^{o}F), 15^{o}C (60^{o}F), or 5^{o}C (40^{o}F). Subsamples will be collected at predetermined sampling intervals to assess the nutrient release rate. Sampling will be done at 0, 7, 14, 28, and 56 days after the experiment has begun. Subsamples will be destructively analyzed for potassium chloride extractable ammonium and nitrate, and Bray-1 or Olsen extractable phosphate. This will allow us to determine how much plant available N and P has been released over time.

Time Line of Anticipated Accomplishments:

2018

- July - December: Collect manures and soils, begin experiment and complete incubations for 1 to 2 temperatures.

2019

- January – June: Finish incubations (remaining 1-2 temperatures). Analyze samples. Prepare final reports.

Progress Toward Objectives of On-going Projects: *(Please List)*

Not applicable since this is a new project and I do not have other ongoing projects.

Prepare a budget for each research project:

Labor:

- Salaries: $19,329 total
    - Justification:
        - Researcher (civil service to be determined) - Will help plan and coordinate incubation experiments and laboratory analyses. Another priority will be maintaining lab safety issues when working with manure. 0.333FTE $15,252
        - Summer salary for PI – 2 weeks, $4,077
- Fringe: $5,515 total
    - Justification:
        - Researcher - $4,149 (27.2%)
        - PI –$1,366 (33.5%)

Equipment (over $250.00)

Supplies

- $8,840 total - Supplies for testing N and P, jars for incubations, etc

Travel

- $602 total
    - Justification:
        - $202 - Saint Paul to Fargo to deliver final report – 482 miles roundtrip
            - Car rental is $48 per day + $0.17 per mile. Gas is estimated to cost $0.15 per mile.
        - $400 - Collect and pickup manure, present results at field days, etc – locations to be determined.
            - Mini-van rental is $54 per day + $0.23 per mile. Gas is estimated to cost $0.15 per mile.

Leases

Other

- $699 total – Initial soil and manure analyses

Total $34,985