MORE REGARDING THE FERTILIZER VALUE OF LIQUID SWINE MANURE

This email newsletter further addresses how we can arrive at a justifiable value for liquid swine manure in comparison to wholesale/retail costs for traditional inorganic fertilizers.

Inorganic fertilizer prices are at record or near record highs. Current prices for anhydrous ammonia (AA), Potash (POT) and diammonium phosphate (DAP) are $1155:ton (5.8¢:lb.), $920:ton (46¢:lb.) and $1131:ton (56.6¢:lb.), respectively. Typical application costs for AA, POT and DAP are $7.00:acre, $3.25:ac and $3.25:ac. As a result, many grain producers are looking for alternative soil amendments as sources for N, P and K. One of these alternative soil amendments is liquid swine manure or slurry. Slurry has some obvious advantages including lower cost, a good source of N, P and K, local availability, high organic matter content and the ability to enhance soil characteristics. However, just because swine slurry may be lower priced (cheaper) than inorganic fertilizer does not necessarily imply slurry is a more economical soil amendment for the environment. Historically manure has been land applied as a sole source soil amendment (fertilizer) for N, P and K. Applying manure to meet the crops N requirement and thereby over applying P can result in soil P buildup. Whether or not this increase in localized soil P has contributed to surface water hypoxia may be debated. Certainly more research clarifying this issue is required. Regardless, management of liquid swine manure has become an important issue in American agriculture. The potentially negative environmental consequences for handling and land application of swine slurry must be addressed in relationship to the same consequences for using inorganic fertilizer sources. These consequences, including the runoff to surface water and leaching to ground water of nutrients (especially N, P and K) must be assessed from a scientific perspective based on actual data collection and not on theoretical projections. The LUW Team is currently conducting or has planned several studies designed to evaluate these issues. In order to correctly design studies to evaluate the energetic, environmental and economic impacts of utilizing slurry, we must first recognize what we already know.

What do we know? Assume the following scenario, a farmer has four grow-finish buildings, each with a one-time capacity of 1100 hogs and a turn-over rate of 2.25 times:year producing 9,900 finishers and generating 2,409,000 gallons of slurry:year. The gallons of slurry generated:year is based on an average pig in the buildings weighing 200 pounds producing 1.5 gallons of slurry:day containing 0.06 lbs. N, 0.02 lbs. P and 0.04 lbs. K: gallon. Total N, P, K production for the operation in one year is 144, 540 lbs N, 48, 180 lbs. P and 96,360 lbs. K. We know that one bushel of shelled corn production requires 1.33 lbs. N, .22 lbs. P and 1.10 lbs. K. In this scenario, 180 bushels of shelled corn:acre requires 239 lbs. N, 39.6 lbs. (40 lbs.) P and 198 lbs. K.

For this scenario, the inorganic fertilizer choices are Potash (60% K_2O, 50% K), A.A. (82% N) and DAP (18% N, 19% P). Accordingly, 246 lbs. A.A., 208 lbs. DAP and 396 lbs. POT costing \$142.68, \$118.56 and \$182.16, respectively are required. Total inorganic fertilizer cost:acre including application (\$13.50:ac) is \$456.90 if land applied today (November, 2008).
If the 2,409,000 gallons of slurry are land applied to satisfy the 180 bushel:acre corn yield based on total N requirement (144,540 lb. N ÷ 239 lb. N:ac) each acre requires 3,982 gallons of slurry applied over 605 acres; based on total P requirement (48,180 lb. P ÷ 40 lb. P:ac) each acre requires 1980 gallons of slurry applied over 1217 acres; and, based on total K requirement (96,360 lb. K ÷ 198 lb. K:ac), each acre requires 4947 gallons of slurry applied over 487 acres. Based on a survey of manure applicators in Illinois conducted during the fall of 2007 (www.sweeta.Illinois.edu), the average cost to land apply slurry via injection is 2.01¢:gallon for less than one million gallons, 1.67¢:gallon for 1 – 4 million gallons and 0.9¢:gallon for more than 4 million gallons. Therefore, for this scenario the cost to land apply slurry is 1.67¢:gallon.

If the slurry is applied to meet the N requirement, N is met at exactly 239 lbs. N:ac, P is over applied by 40 lbs:ac or 2 times the required amount and 159 lbs. of K are applied which is 39 lbs. short of the required amount. Therefore, 78 lbs. of POT is needed costing \$39.13 (including application cost). Subtracting the cost:acre to land apply slurry (3,982 gallons x 1.67¢ = \$66.50:acre) and the cost of POT (\$39.13) from the total cost to apply inorganic fertilizer (\$456.90), slurry has a fertilizer value of \$351.27:acre or 8.82¢: gallon returning \$212,473 to the swine operator (2,409,000 gallons x 8.82¢:gallon). But, the operator over applied P.

If the slurry is applied to meet the P requirement, P is met at exactly 40 lbs. P:acre, N is deficient 120 lbs. and K is deficient 119 lbs. Therefore, 146 lbs. of A.A. costing \$94.68 (including application cost) and 238 lbs. of POT costing \$112.73 (including application cost) is needed. Subtracting the cost:acre to land apply slurry (1980 x 1.67¢ = \$33.07:acre), slurry has a fertilizer value of \$219.42:acre or 11.08¢:gallon (\$456.90 - \$94.68 - \$112.73 - \$33.07 = \$219.42) returning \$266,917 to the swine operator (2,409,000 gallons x 11.08¢:gallon). Applying slurry to meet P requirements and supplementing slurry to meet N and K requirements provides a nutrient balanced fertilizer program and returns the most potential income to the swine operator.

If the slurry is applied to meet the K requirement, K is met at exactly 198 lbs:K acre, and N and P are applied in excess (+ 58 lbs. N:acre; + 59 lbs. P:acre). In other words, slurry is applied as a sole source of fertilizer to guarantee the minimum amount of N, P, K required to grow 180 bu:acre of shelled corn. Applying 4947 gallons of slurry to meet the K requirement costs \$82.62:acre (4947 x 1.67¢) and the fertilizer value for slurry (not counting the excess N and P applied) is \$374.28:acre or 7.57¢:gallon of slurry (\$456.90 minus \$82.62). This rate of application returns \$182,361 to the swine operator (2,409,000 gallons x 7.57¢). However, regulations for nutrient management plans (NMP) in most states limit manure application:acre to the amount of N required to grow the specific crop and many NMP's are beginning to prohibit applying excess P:acre above what the crop requires. In several states the soil P rating (low, medium or high) provides a recommendation(s) to not limit P application (lb:acre) if the P soil test is low (in Illinois ≤ 50 lb:acre), to limit P application to the amount required for crop production if the P soil test is medium (in Illinois between 50 and 70), and to not apply any P if the P soil test is high (in Illinois above 70 lbs:acre).

From a fertilizer perspective, slurry has greatest economic value per gallon if it is applied to satisfy the crops P fertilizer requirement. Applying less slurry per acre provides more value per gallon but requires more acres to apply a given amount of slurry. If costs for transporting slurry to the field are included, more acres translates to less total return to the swine operator. Applying slurry to meet N or K requirements may not be allowed under NMP guidelines and may not be environmentally sustainable.

<u>What do we not know?</u>

We do not know the effect of

1) utilizing slurry as the sole source of fertilizer or
2) utilizing slurry in combination with inorganic fertilizer compared to using inorganic fertilizer as the sole source of soil amendment on the following: crop growth and yield, soil structure, soil cation exchange capacity, soil organic matter, nutrient overload in ground water, net dollar return per acre and net dollar return for slurry generation. Hopefully the LUW Team studies will help provide answers to what we do not know.

<u>Suggestions for land applying slurry.</u>

1) Obtain pit specific slurry samples for chemical analyses prior to land application. Slurry composition varies by storage method. Slurry stored in lagoons is more dilute than slurry stored in deep pits. Fresh slurry (less than 2 weeks old) is more dilute than slurry stored for prolonged periods. Slurry from shallow pits where pit flushing and/or pit recharging with water is used is more dilute than slurry stored in deep pits for prolonged periods. The liquid manure generated by sows, nursery pigs and grow-finish hogs varies in nutrient composition and N, P, K concentration. The concentration of solids and N, P, K will vary substantially from pit to pit. Separate samples from each pit are required.

2) How samples are obtained affects N, P, K concentration analyses. The solids are concentrated on the bottom of a pit or lagoon. The effluent containing little biosolids is on top. Therefore, constant and complete agitation of the slurry is important to obtain a representative sample. Even with agitation a slurry probe should be used to collect truly representative slurry samples. Be sure the probe can reach to the bottom of the pit.

3) Obtain multiple samples from each pit/lagoon. Collect probe samples from multiple locations within the pit/lagoon. Obtain a minimum of one sample for every 50,000 gallons if multiple pits are sampled. If one large slurry storage facility (one million gallons or more) is sampled, obtain one sample for every 200,000 gallons.

4) Be sure to use the slurry analyses when calculating how much slurry to apply:acre. Do not average all samples to determine how much slurry to add per acre. Only average the sample values for each storage facility. When the source of the slurry is changed, use the analyzed values from that specific storage facility and re-calculated gallons of slurry required per acre.