Title of the Project: **Fixation of Excess Soil Phosphorus to Decrease Phosphorus in Runoff Water**

Principal Investigator: Vincent Haby, Regents Fellow and Professor
Texas Agricultural Experiment Station
Texas A&M University Agricultural Research and Extension Center
P. O. Box 200, Overton, TX 75684-0200
Telephone 903-834-6191; Fax 903-834-7140; Email v-haby@tamu.edu

Amount of Funding Requested: $8,000

Duration of Project: 1.0 year

Project Need, Description, and Expected Outcomes:

The USDA Economic Research Service recently estimated poultry farms produce 483,646 tons of nitrogen (N) and 252,493 tons of phosphorus (P) in excess of the amount that is environmentally safe to apply on these farms. Northeast Texas growers account for an estimated 400,000 tons of litter. The average P content of this litter approximates 2.1%, or 42 lb per ton. Applications of broiler litter with this P content need not exceed 2 tons/acre on moderate or higher P soils. Excessive levels of P occur in soils treated for several years with N-based rates of broiler litter and increase the risk of non-point source pollution from poultry farms. Hay removed from most meadows each year contains from 20 to 40 lb of P/acre. When grazed, more than 90% of the P in forages is recycled to the soil as excrement. Runoff water from high P soils contains dissolved P and particulate clays and organic matter with adsorbed P that enriches the P content of fresh-water streams and lakes. Dissolved P is the larger portion of the total P in non-point source runoff and is 100% bio-available to phytoplankton and other water plants.

Soil test P (STP) is included in the phosphorus index (PI). The PI has been developed to evaluate the potential for P losses in runoff water when determining rates of animal manure that safely can be applied to agricultural soils. Increasing soil acidity from pH 6.5 to 5.0 decreased the level of STP 30% in the surface 6-in depth of Darco loamy fine sand at TAES-Overton (Figure 1). We propose to determine the effect of soil acidity levels and the resulting P fixation on decreasing P in runoff from the surface of Darco loamy fine sand to the point where maximum forage production is maintained.

Objectives include (i) Evaluate the effect of P fixation on decreasing P in runoff water; (ii) Quantify the effect of soil acidity on P fixation and reduction of the PI in field soils; (iii) Determine the effect of broiler litter on a TAM 90 ryegrass - Tifton-85 bermudagrass forage system at varying soil pH.

Broiler litter rates of 0, 2, 4, and 8 tons/acre will be applied in early spring to 10 x 20-ft plots with surface 6-in depth pH ranging from below 5 to about 7. These rates will be applied to three sets of three different plots varying in pH with a common check in each of three replications in a randomized complete block design. Established Tifton-85 bermudagrass will be harvested in the warm production season. Annual ryegrass will be over seeded in October to approximate a year-round forage system. These

grasses will be fertilized for each regrowth with additional N and possibly K at rates required for optimum production. Forage samples collected at harvest and semi-annually collected soil samples will be analyzed to determine the effects of soil acidity on P availability. Excess simulated rainfall will be applied to selected plots and runoff water and soil samples from the rainfall simulation plots will be collected to determine the effect of soil acidity and concomitant P fixation on levels of P in runoff.

The potential for managing soil acidity to lower the soil P level from very high to high or to medium will decrease the PI by 4 or 6 points, respectively. According to the design of the PI, this should have the impact of lessening the P content in runoff water from poultry litter-treated soils and from any other soils treated with manure P sources such as dairy effluent or sludge, poultry manure and effluent from layer houses, municipal sewage sludge, and commercial fertilizer. If other PI factors are relatively low or moderate, this could allow additional broiler litter to be applied without adverse environmental effects on water quality. Use of additional broiler litter on site permits producers to continue benefiting from production of this nutrient-rich resource on their own farms.

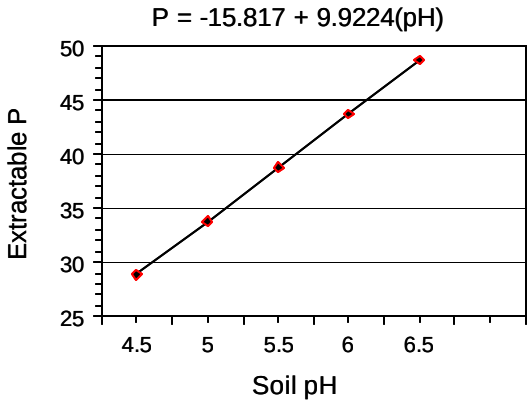

Fig. 1. Extractable P response to acid soil pH

Cooperators in this research include Dr. Gerald Evers and Dr. Sam Feagley. Dr. Evers, Regents Fellow and Professor- Forage Physiology and Agronomy, Texas Agricultural Experiment Station-Overton has conducted numerous studies on the effects of broiler litter on soil P content, forage production, and removal of excess soil P by cropping. He will analyze plant samples for N, P, and K content. Dr. Feagley, State Soil Environmental Specialist- Texas Cooperative Extension and Professor- Soil and Crop Sciences Department, College Station, recently purchased a Tlaloc 3000 rainfall simulator and will conduct the rainfall simulations and runoff sample collection and analysis. He is conducting three research projects evaluating the PI across Texas, has co-authored nutrient management handbooks for poultry, feed yard, and dairy wastes, and is the coordinator for the Texas Certified Nutrient Management Specialist Short course and co-author of the course handbook. Dr. Haby, who is also published in evaluation and analysis of manure waste application to agricultural lands and the resulting forage production, will coordinate the field research, collect and analyze soil samples, and report results.

Successfully lowering soluble P in runoff from high P soils could affect water sources draining from broiler production farms that potentially account for more than 100,000 acres in northeast Texas. Acid soil acreage affected by broiler production and litter application in other areas of Texas also could be affected. Results could be used to adjust PI calculations based on levels of soil acidity.

TAES/TWRI
Water Resources Research
Project Budget Form

Expenditure Description	Amount Requested	Other Sources	Total
Staffing Requirements:			
1) Research assistant, 5% time		$1,400	$ 1,400
2) Research associate, 5% time		$1,750	$ 1,750
3) Student labor, 10 hr/week		$2,880	$ 2,880
Fringe Benefits		$1,185	$ 1,185
Total Staff Costs		$7,215	$ 7,215
Travel:	$1,000		$ 1,000
Supplies and Materials:			
Poultry litter, fertilizer, sample bags	$ 900		$ 900
Chemicals, pesticides, other materials	$ 900		$ 900
Rainfall simulator filters	$1,500		$ 1,500
Capital Equipment (purchases over $5,000)			
Printing and Publications			
Other Direct Costs:			
Sample analyses: Soils	$1,000		$ 1,000
Plants	$1,200		$ 1,200
Water	$1,500		$ 1,500
Total Project Costs	$8,000	$7,215	$15,215

Potential funding sources:

Funding requested from the Texas Water Resources Institute is proposed for use as start-up money to initiate a three-year evaluation of the described research. Other potential funding sources include, but are not limited to, (i) US Geological Survey National Competitive Grants Program; (ii) Tyson Foods, Inc.; (iii) Pilgrim's Pride Corporation.; (iv) Texas Department of Agriculture; and (v) Texas State Soil and Water Conservation Board. Based on a successful pre-proposal, we have been requested to submit and recently have submitted a full proposal to US Poultry and Egg Association for this research.