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Texas Agricultural Experiment Station - Edward A. Hiler, Director
Texas A&M University System - College Station, Texas

EFFECT OF CROPPING SYSTEM ON NO_3-N CONCENTRATION OF SURFACE RUN-OFF WATER AND LEACHATE FROM POULTRY LITTER APPLICATION

D. R. Earhart, V. A. Haby, M. L. Baker, and J. T. Baker

Background. Broiler production is increasing in the South. Expanded production increases the amount of poultry litter requiring disposal in a timely and environmentally sound manner. Manure supplied nutrients can accumulate, thus increasing the risk of pollution and movement of nutrients, especially NO_3-N, into surface water and soil water percolate.

A study was initiated in fall 1992 to investigate nutrient loss due to run-off and leaching in a vegetable, forage, litter management system. The cropping systems were spring vegetable-fall forage, spring cover-fall vegetable, and spring vegetable-fall fallow. The spring crops were sweet corn and sorghum-sudan, and the fall crops were broccoli and rye.

Graded troughs lined with 6-mil black plastic were established at the ends of the experimental plots and connected to Parshall flumes. Containers were installed at the end of each flume to intercept a portion of the run-off to determine nutrient loss. For determining loss in the soil solution, vacuum extraction tubes equipped with porous ceramic tips, were placed in each plot to a depth of 4 ft. Samples were obtained after each major rainfall event.

Research Findings. Negligible amounts of NO_3-N in run-off water were observed from any cropping system (Fig 1). This could be explained by the fact that all litter treatments were incorporated by power tilling prior to planting. This greatly reduced the amount of exposed litter that could be moved in surface run-off water. Cropping system had a significant effect on leachate concentration. A two-fold decrease in NO_3-N concentration was found when a system of spring vegetables followed by fall cover is compared to the other two systems.

Application. A systems approach has been beneficial in reducing N concentration in the soil solution. Utilizing cover crops in a spring vegetable production system greatly reduces the concentration of NO_3-N in soil water leachate. Soil incorporation of litter will greatly reduce incidents of non-point source pollution of surface water. The information gained from this study will be beneficial to producers by helping them develop management plans that will qualify for Best Management Practices (BMP's).

Acknowledgement. This study was supported in part by a grant from the Southern Region Sustainable Research and Education Program.

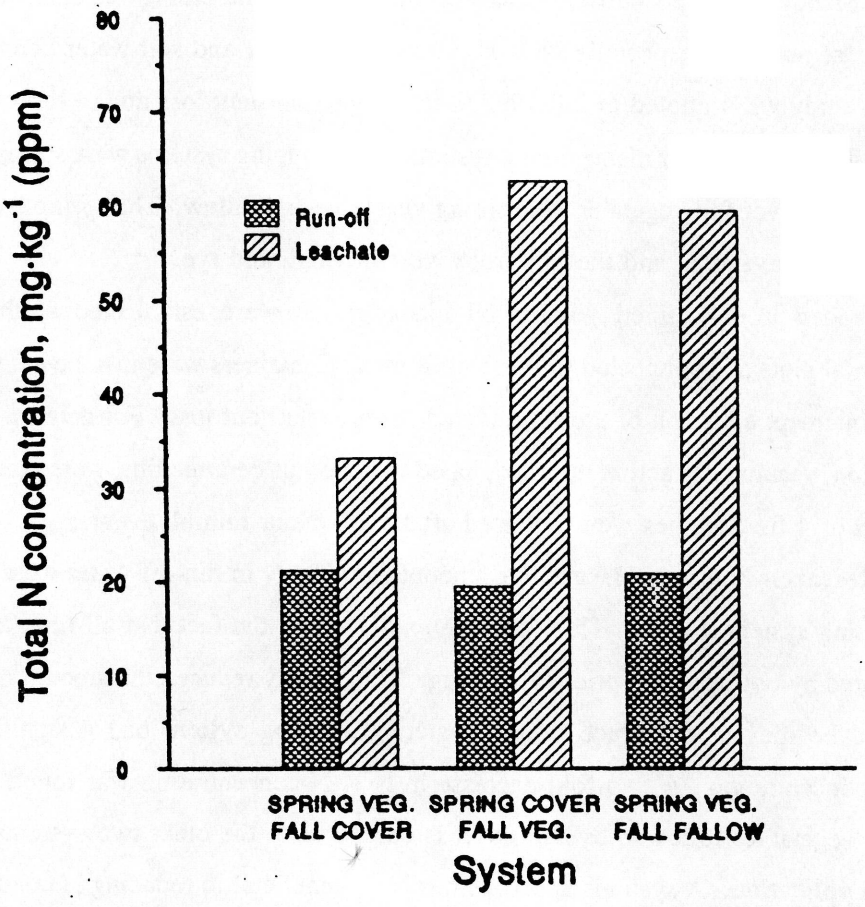

Fig. 1. NO_3-N concentration of surface run-off water and leachate samples obtained at 122 cm (4 ft) depth from 3 cropping systems in spring 1993.

CROPPING SYSTEM AND SEASON OF APPLICATION OF POULTRY LITTER AFFECTED RESIDUAL SOIL P CONCENTRATION

D. R. Earhart, V. A. Haby, M. L. Baker, and J. T. Baker

Background. Broiler enterprises produce excess manure for environmentally safe recycling in cropping systems. Application frequencies and rates are often excessive and lead to nutrient accumulation. The recommended practice is to apply litter according to the N needs of the crop. When litter is applied in this manner, P can accumulate, resulting in levels that are detrimental to plant growth and increase the risk of non-point source pollution of surface water. Phosphorus addition to surface waters from non-point agricultural sources is an increasing resource management concern. Phosphorus has been regarded as the primary nutrient controlling biological activity in surface waters.

A study was initiated in spring 1992 to investigate the effect of different vegetable cropping systems and season of application on P accumulation from poultry litter. The spring crops were tomatoes and sorghum-sudan, and the fall crops were turnips and rye. The cropping systems studied were spring cover followed by fall vegetable (SC-FV), spring vegetable followed by fall cover (SV-FC), and spring vegetable followed by fall vegetable (SV-FV). Litter was applied in either the spring, fall, or both spring and fall. The information presented covers a period of fall 1992 through fall 1993. Spring of 1992 data are not reported since there was no system until the beginning of fall 1992.

Research Findings. The initial P concentration of the surface 6 in. of soil in the experimental area was approximately 17 ppm. All treatments increased P accumulation over time when compared to the control (Fig. 1). A cropping system of SV-FC greatly reduced P accumulation regardless of season of application. A significant reduction was also noted when this system was compared with the other two cropping systems (SC-FV, SV-FV). In all systems, the greatest accumulation was when litter was applied in both spring and fall with the least from a spring-only application.

Application. Results to date indicate that a management practice of applying litter only to a spring vegetable crop and planting a fall cover crop would greatly reduce P accumulation. If there is excess litter that cannot be disposed of from a once-per-year application, then a twice-per-year application could be made under this cropping system. The information indicates that the potential for excess P accumulation would be greatly reduced.

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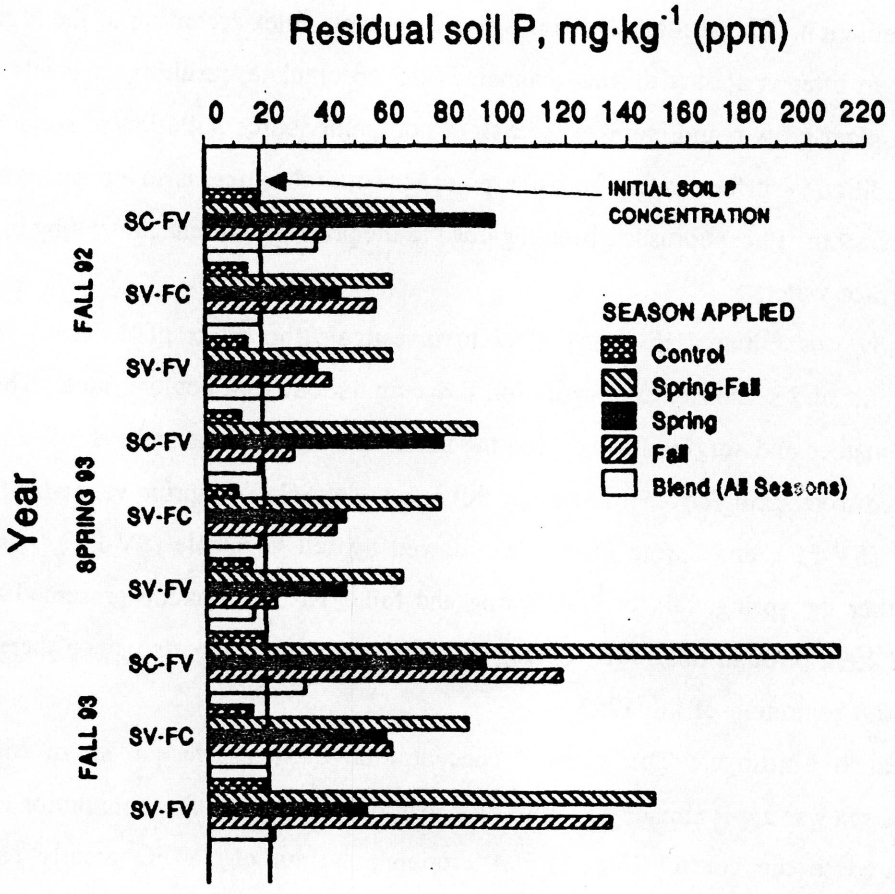

Fig. 1. Residual soil P from poultry litter as influenced by cropping system and season of application over 3 growing seasons. SC-FV = spring cover-fall veg.; SV-FC = spring veg.-fall cover; SV-FV = spring veg.-fall veg.

EFFECT OF CROPPING SYSTEM ON RESIDUAL SOIL P FROM POULTRY LITTER APPLICATION

D. R. Earhart, V. A. Haby, M. L. Baker, and J. T. Baker

Background. Poultry litter rates are generally based on crop N requirements. When litter is applied to meet the N needed, P can accumulate. Excess accumulation of P can be detrimental to plant growth and increases the risk of non-point source pollution of surface water. Little information is available concerning the fate and management of litter supplied P in soil. Cover crops can be used to recycle nutrients or remove excess nutrients through grazing, hay or silage. A three-year study was initiated in spring 1992 at the Texas A&M University Agricultural Research and Extension Center at Overton. The purpose was to investigate the feasibility of growing warm- and cool-season annual forage crops to remove excess nutrients supplied by litter in rotational cropping, vegetable systems.

Research Findings. Experimental treatments were applied each spring and fall through spring 1994. Spring crops were tomatoes and sorghum-sudan. The fall crops were turnips and rye. Fertility treatments were a control, recommended litter to furnish the N need of the individual crop (1X), twice the recommended rate (2X), and a commercial blend fertilizer. Systems were spring vegetable-fall forage, spring forage-fall vegetable, and spring vegetable-fall vegetable. Information presented covers spring 1992 through fall 1993.

Cropping system and rate of litter application increased residual P in the surface 6 in. of soil (Fig. 1). The initial soil P was 17 ppm. In spring 1992, only vegetables and cover crop are shown. The highest increase in P over time was due to 2X rate applied in a cropping system of spring cover-fall vegetable. This increase was also demonstrated by 1X rate applied in the same system. A system of spring vegetables followed by fall cover lowered accumulation from 1X and 2X rates. Only a slight accumulation of P above the initial concentration was observed when fertilizer blend was applied regardless of season of application.

Application. A cropping system of spring vegetables-fall cover would be best for reducing P accumulation. Using this system, litter rates could be doubled without drastically increasing P accumulation.

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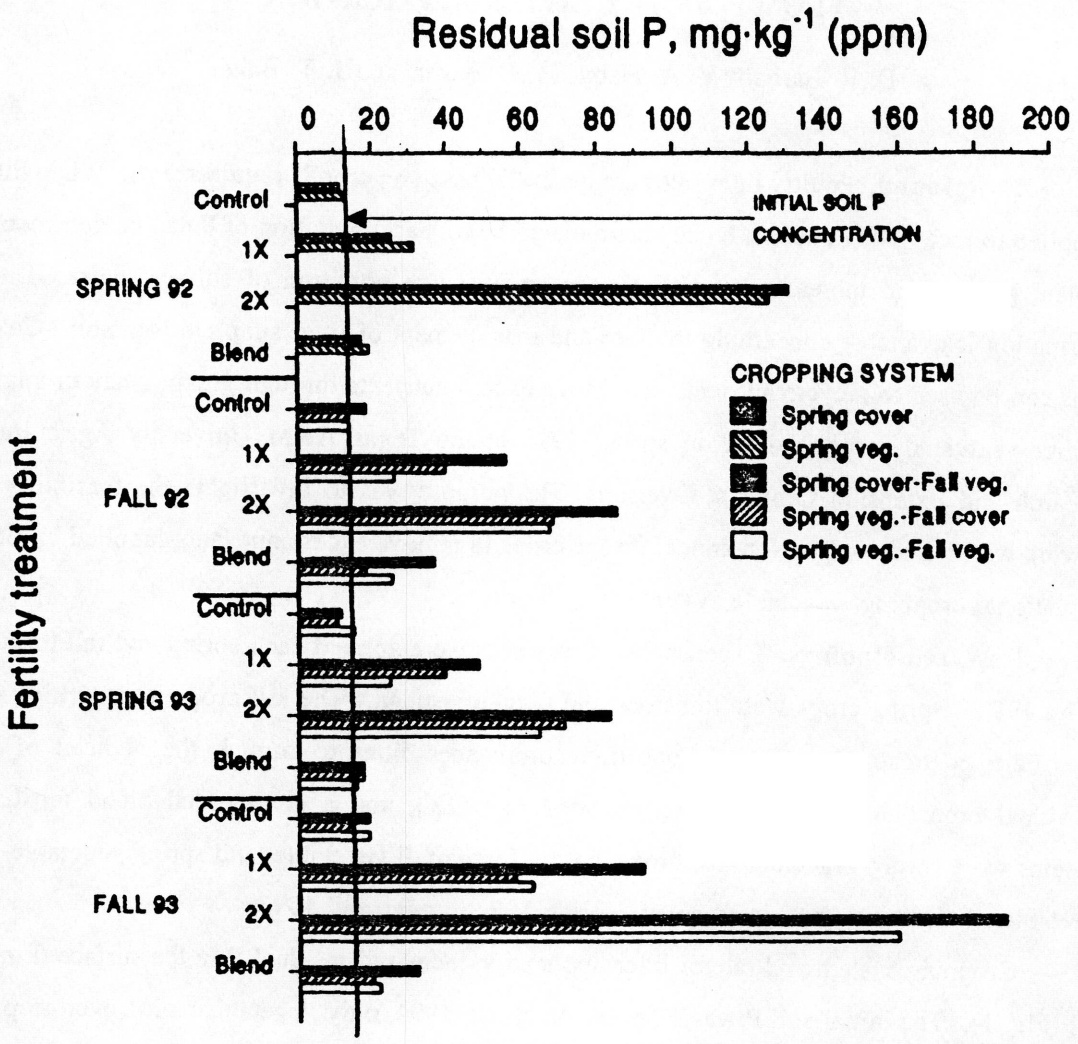

Fig. 1. Residual soil P as influenced by cropping system and fertility treatment over 4 growing seasons.

EFFECT OF POULTRY LITTER RATE OF APPLICATION ON RESIDUAL SOIL NO_3-N

D. R. Earhart, V. A. Haby, M. L. Baker, and J. T. Baker

Background. Application rates of poultry litter that contains approximately 4% N on a dry weight basis is often excessive. This N is the major component for determining application rates. Excessive rates cause accumulation of nutrients in soil. This increases the potential for movement of nutrients into surface and ground water.

To develop management plans, rates of application were evaluated beginning in spring 1992 and ending in fall 1993. Soil samples were obtained at the beginning of each planting season to determine the recommended litter rate based on N needs of the individual crop. Sweet corn ('Merit') was used as the spring crop and broccoli ('Green Valiant') was the fall crop.

The 1X litter rates used in 1992 were: spring, 4.8 tons/ac and fall, 3.9 tons/ac. In 1993, the rates were: spring, 2.3 tons/ac and fall, 4.1 tons/ac. The fertilizer blends used in 1992 were: spring, 23.8N-4.3P-4.1K and fall, 68.0N-26.0P-24.9K. In 1993, the blends were: spring, 33.6N-12.5P-46.6K and fall, 28.0N-7.3P-51.1K.

The results reported are from soil samples obtained at the end of the fall 1993 study. This reflects the accumulation and leaching of litter and fertilizer supplied NO_3-N over time.

Research Findings. Little difference in accumulation in the surface 1 ft. of soil from any of the treatments was noted (Fig. 1). Accumulation was greatest at lower depths from the two highest rates and blend. There was almost a two-fold increase in concentration at 4 ft. as rate increased from 1X to 4X.

Application. This study indicates that poultry litter can be applied seasonally without causing environmental problems when rates are applied according to soil test results. Also litter applied at recommended rates results in less leaching and accumulation of NO_3-N than from fertilizer blend.

Acknowledgement. This study was supported in part by the Southern Region Sustainable Research and Education Program.

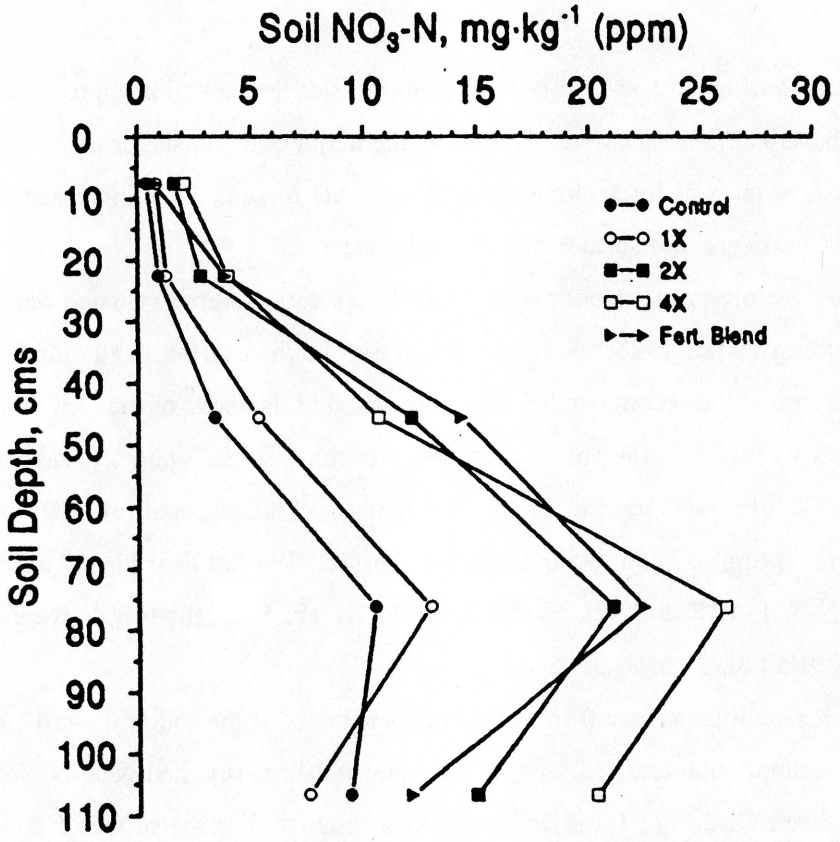

Fig. 1. Soil concentration of residual N from poultry litter and blended fertilizer applied each spring and fall over a 2 year period (1992-93). 1X=15.1 tons/ac; 2X=30.2 tons/ac; 4X=60.4 tons/ac; fert. blend=153.4N.