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EFFECTS OF LAND-APPLIED POULTRY LAGOON EFFLUENT ON THE ENVIRONMENT. 4. NUTRIENT CONCENTRATIONS IN RUNOFF WATER

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Background. When manure effluent from poultry operations is applied on the land at rates that provide nutrients in excess of vegetation needs, concerns about nutrient losses in runoff increase. In surface water, the presence of small quantities of N and P can lead to algal blooms that deplete dissolved oxygen levels. Phosphorus concentrations are usually greater than 5 to 20 parts per billion (ppb) in surface water and seldom exceed 100 ppb (0.01 ppm) even in highly eutrophic waters. However, as little as 5 ppb of inorganic P per liter is needed for eutrophication under summer conditions. Phosphorus levels have been found to exceed 1000 ppm in soils that have received repeated effluent applications over many years and have the potential to contaminate surface waters. Concentrations of P in surface runoff waters have been directly related to soil P levels. We established 4- x 8-ft plots on Ships clay and Bowie fine sandy loam to determine the effect of poultry lagoon effluent on nutrient concentrations in surface runoff. Plots were contained within metal borders on the sides and up-slope end. A runoff catch basin was cemented into the soil at the lower edge of each plot. The lip of this basin at the plot edge was set flush with the soil surface to allow direct entry of runoff water from the plots. Poultry lagoon effluent was applied to plots of Coastal bermudagrass/TAM 90 annual ryegrass (CR) and Coastal bermudagrass (C) with no cool-season annual forage. Total annual effluent rates applied were none (0X), 480 lb of N/acre (1X), and 960 lb of N/acre (2X) split into seven applications over one-year. Runoff water was collected after each significant rainfall event. Volume of runoff was determined and a sample was collected for chemical analysis. This sample was stabilized by freezing until it was analyzed. Analyses were done using standard analytical methods for water and wastewater.

Research Findings. The Ships clay had a slope of 0.5 % and had a runoff of 98 mm from 601 mm of rainfall in 16 events. The Bowie soil had a slope of 5.0% and had a runoff of 213 mm from 595 mm of rain in 19 events. The larger runoff volumes resulted in larger nutrient losses from the Bowie soil (Table 1). The mass of nitrogen in runoff from effluent-treated plots on the Ships and Bowie soils was not significantly affected by increasing application rates with each cropping system. Similarly, P and K in runoff from the Ships clay were not affected by increasing application rates. Runoff P and K were significantly increased by increasing rates of poultry lagoon effluent on the Bowie soil. This increase was not significant at the 1X rate compared to 0X, but was significant at the 2X rate.

Application. Poultry lagoon effluent applied at 480 lb of N/acre appears to be an environmentally safe rate when applied to Coastal bermudagrass or to a combination of ryegrass/Coastal bermudagrass. Effluent applied at rates that apply greater amounts of N become environmentally unsafe relative to surface water quality. The more sandy, sloping Bowie soil contributed larger quantities of N, P, and K to runoff water than did the level Ships clay.

Table 1. Average concentrations of nitrogen, phosphorus, and potassium, and totals in surface runoff from the Ships and Bowie soils over 10 months at College Station and 14 months at Overton, respectively.

Vegetation application rate	Nutrient rate applied	College Station, Ships		Nutrient rate applied	Overton, Bowie	
		Avg.‡ conc.	Nutrient mass		Avg.§ conc.	Nutrient mass
	lb/ac	ppm	lb/ac	lb/ac	ppm	lb/ac
	Nitrogen					
C†-0X	0	10.8	51 a§	0	24.5	65 c
C-1X	480	22.9	41 a	480	29.4	208 bc
C-24	960	26.1	52 a	960	32.0	146 bc
CR-0X	0	20.2	56 a	0	14.9	309 ab
CR-1X	480	16.2	46 a	480	18.1	336 ab
CR-2X	960	30.1	58 a	960	27.0	453 a
	Phosphorus					
C-0X	0	5.1	12.6 a	0	3.3	6.7 d
C-1X	63	7.5	10.8 a	52	3.2	16.6 cd
C-2X	127	7.4	12.0 a	101	10.3	31.6 bc
CR-0X	0	7.0	10.0 a	0	1.8	31.7 bc
CR-1X	63	7.0	5.6 a	52	3.0	45.9 ab
CR-2X	127	8.3	10.7 a	101	3.3	57.2 a
	Potassium					
C-0X	0	27.2	106 a	0	30.1	69 c
C-1X	928	62.6	108 a	1047	113.2	199 bc
C-2X	1853	83.9	192 a	2088	429.6	467 a
CR-0X	0	36.5	109 a	0	9.4	77 c
CR-1X	928	50.4	119 a	1047	19.7	265 bc
CR-2X	1853	98.3	186 a	2088	26.4	324 ab

†C = Coastal bermudagrass; CR = Coastal bermudagrass/ryegrass.
‡Average of 14 surface runoff events.
§Average of 19 (CR plots) and 10 (C plots) surface runoff events. Means in the same column, followed by the same letter, are not statistically different using the Student-Newman-Keuls test at an alpha of 0.10.