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EFFECT OF POULTRY LITTER RATE ON RESIDUAL SOIL P OVER A FIVE SEASON STUDY PERIOD

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Background. A rapid growth in the poultry industry is being experienced by several southern states. This expanded production increases the amount of poultry litter requiring disposal in a timely, profitable, and environmentally sound manner. Nitrogen (N) - phosphorus (P) - potassium (K) ratio in poultry litter does not match the ratio of nutrients required by vegetable crops. As a result, complete nutrient utilization is rarely accomplished. The amount of litter to apply is based on N content of the litter and N recommendation for specific crop production. When litter is applied in this manner, P can accumulate and result in conditions that increase the risk of non-point source pollution of surface water. A three-year study was initiated in the spring 1995 at the Texas A&M University Agricultural Research and Extension Center, Overton. The purpose was to investigate the feasibility of growing warm- and cool-season legume crops to remove excess P supplied by poultry litter and commercial blend fertilizer.

Research Findings. Litter rates were applied according to soil test recommendation for N for the specific vegetable crop being grown. Rates were 0 (control), 1X (recommended rate), 2 times or 4 times the recommended rate. A commercial blend fertilizer was applied for comparison. The vegetable crop, percent N, dry matter, tons per acre litter, and pounds per acre commercial blend for each season were: spring 1995 - watermelon, 3.4% N, 57% DM, 1.0 tons/A, 40N-10.9P-25K lbs/A; fall 1995 - broccoli, 3.4% N, 51% DM, 3.7 tons/A, 130N-21.8P-25K lbs/A; spring 1996 - tomato, 3.3% N,60% DM, 3.0 tons/A, 90N-15.3P-70K lbs/A; fall 1996 - collards, 3.3% N, 60% DM, 4.0 tons/A, (summer veg.-fall veg), 4.0 tons/A (summer legume-fall veg.), 165N-17.4P-83K lbs/A and 170N-21.8P-99.6K lbs/A to the respective systems; spring 1997 - squash, 3.4% N, 61% DM, 1.7 tons/A, 80N-19.6P-45.6K and 150 $KMgSO_4$, 15 S lbs/A (summer veg.-fall legume), 80N-13P-33.2K and 150$KMgSO_4$, 15 S lbs/A (summer veg.-fall veg.).

Application rates of poultry litter affected soil P over time (Fig. 1). Applying litter at the recommended rate from soil testing (1X), maintained P levels in the surface 0-6 inch soil depth at approximately 60 ppm (160 lbs/A) during the study period of 5 seasons. This is below the maximum rate set by Soil Conservation Standards for the typical soil types of East Texas (600 lbs/A). Leaching of P through the soil profile was also reduced. Increasing litter application rate from 2 times (2X) to 4 times (4X) the recommended rate increased concentration. The least amount of P accumulation was from commercial blend fertilizer. This treatment maintained P levels approximately equal to the control plot.

Application. Management is the key to efficient utilization of litter nutrients by a crop. Proper management will increase economic returns, sustain soil productivity, and reduce environmental concerns. This study has shown that by utilizing soil test results for litter application, P concentrations in the soil can be held in check, thus reducing the chance for non-source pollution of surface water.

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

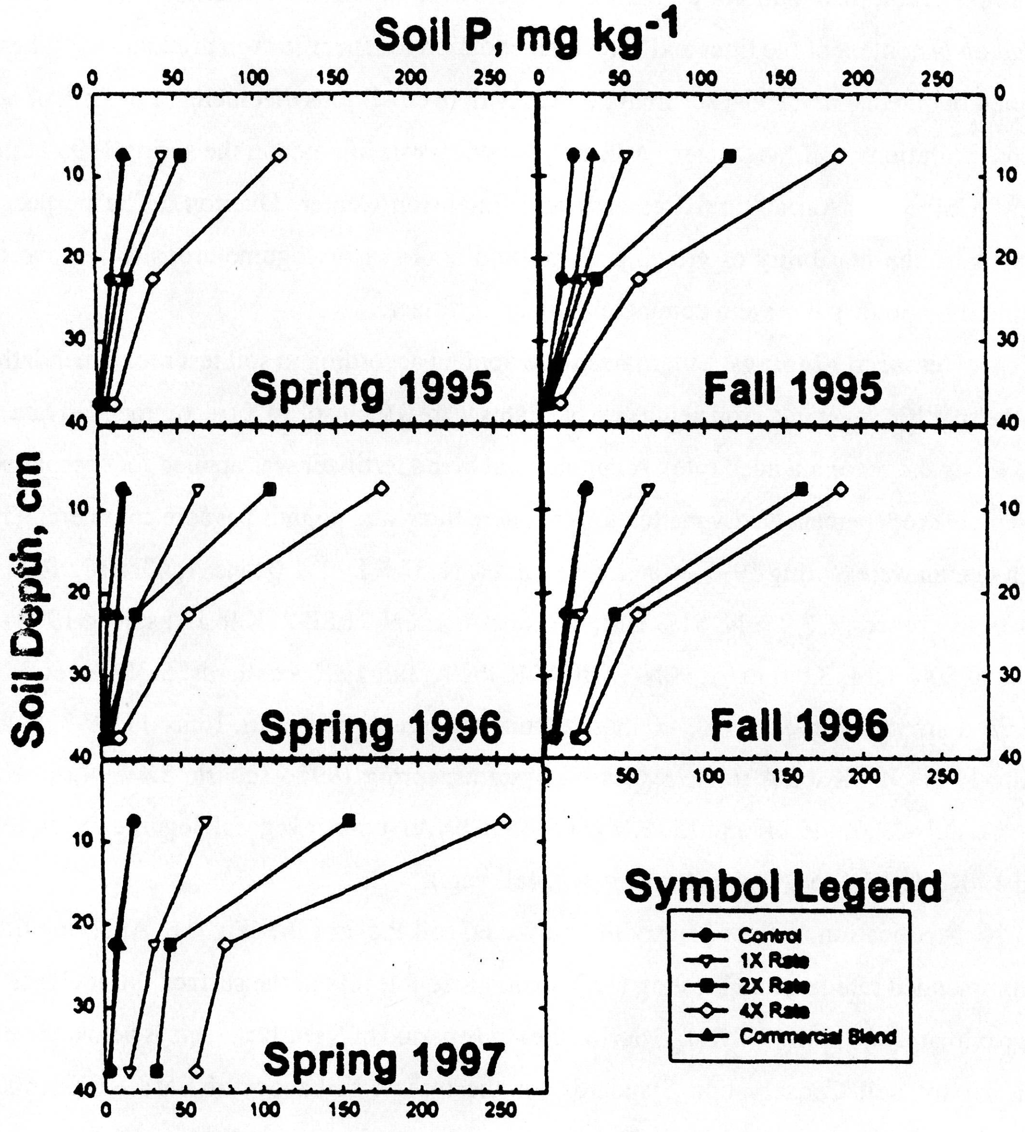

Fig. 1. Residual soil P vs. soil depth following poultry litter fertilizer application rates and blended commercial fertilizer treatments. Fertilizer treatments were applied to watermelon (Spring 1995), broccoli (Fall 1995), tomatoes (Spring 1996), and collard greens (Spring 1997).

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

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Background. Applying poultry litter at rates sufficient to meet crop needs for nitrogen (N) results in phosphorus (P) accumulation that can lead to non-point source pollution of surface waters. Legumes are able to use significant amounts of P. An advantage of using legumes for removing excess P is that no additional N fertilizer has to be applied since legumes can obtain N from the atmosphere through N_2 fixation. Including warm- and cool-season legumes for hay or silage may be one way to reduce excess soil P. A three-year study was initiated in spring 1995 at the Texas A&M University Agricultural Research and Extension Center at Overton. The purpose was to investigate the use of warm- and cool-season legumes in rotational cropping systems to remove excess P supplied by poultry litter.

Research Findings. The cropping systems studied were: summer legume-fall vegetable, summer vegetable-fall legume, and summer vegetable-fall vegetable. The litter rates applied were based on soil test nitrogen requirement of the vegetable crop and percent N and moisture content of the litter. Litter was applied at the recommended rate and 2 or 4 times this rate. The summer legume crop was 'Iron and Clay' cowpea and the fall crop was crimson clover. The vegetable crops were: watermelon - spring 1995; broccoli - fall 1995; tomato - spring 1996; collards - fall 1996; squash - spring 1997. The percent N, dry matter, and tons per acre of litter applied to each vegetable crop for each season were: spring 1995 - 3.4% N, 57% DM, 1.0 tons/A; fall 1995 - 3.4% N, 51% DM, 3.7 tons/A; spring 1996 - 3.3% N, 60% DM, 3.0 tons/A; fall 1996 - 3.3% N, 60% DM, 4.0 tons/A; spring 1997 - 3.4% N, 61% DM, 1.7 tons/A.

Utilizing a cropping system approach to reducing soil P accumulation proved to be very effective (Fig. 1). In comparing 5 seasons of data, it was found that a system of planting a summer vegetable and following with a fall cover of crimson clover reduced soil P in the surface 0-15 cm (0-6 in.) dramatically. A system of planting a fall vegetable followed by a cover crop of Iron and Clay cowpea also reduced P accumulation over time but not as great as the above mentioned system. The greatest accumulation was when litter was applied to a vegetable crop continuously for both seasons.

Application. This study helped to identify a vegetable cropping system that reduces P accumulation, thus reducing the chance for non-point source pollution of surface waters. Utilizing a system of applying litter to a summer vegetable crop and cover cropping with a winter legume effectively reduces P accumulation.

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

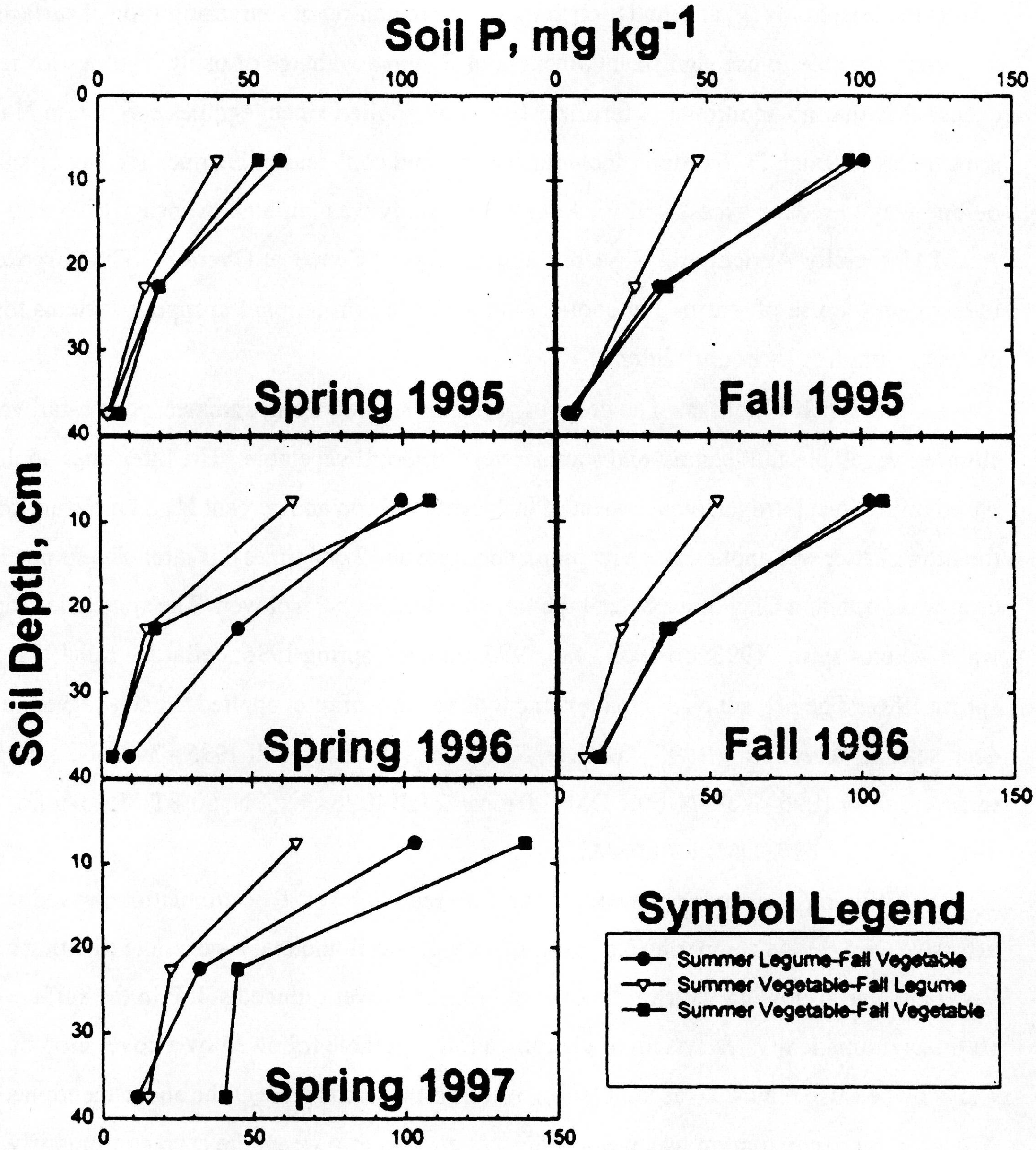

Fig. 1. Residual soil P vs. soil depth following poultry litter fertilizer application rates for three cropping systems for three years.

INTERACTIONS OF POULTRY LITTER, POLYETHYLENE MULCH AND FLOATING ROW COVERS ON TRIPLOID WATERMELON PRODUCTION

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Background. The poultry (*Gallus domesticus)* industry in the United States is projected to grow by 5% per year into the foreseeable future. The litter from these operations is often eliminated by applying it as a fertilizer to nearby pastures and crops, as it contains most mineral elements essential for plant growth. However, the litter can degrade water quality through the leaching of nitrates into ground water and surface runoff of N and P into rivers and lakes. Over the past 25 years, plasticulture, or the use of polyethylene mulch to cover the soil, and use of drip or trickle irrigation have increased substantially in commercial vegetable production systems. However, no information is available on the use of poultry litter in intensive crop management systems utilizing polyethylene mulch and row covers for the production of triploid watermelon. Triploid watermelons have become increasingly popular among consumers in recent years and projections indicate that this trend will continue. The objectives of this study were to compare yields, yield components, and leaf and soil nutrient contents of triploid watermelons cv. 'Tiffany' fertilized with either poultry litter or commercial fertilizer and grown with or without polyethylene mulch and floating row covers.

Research Findings. Triploid watermelon was grown on the same plots in 1990 and 1991 at the George Millard Farm near Nacogdoches, Texas, and fertilized with either poultry litter or commercial fertilizer. Additional treatments included bare soil or plots mulched with black polyethylene and plots with or without spunbonded fabric row covers over both bare soil and mulch. Watermelon yields were unaffected by fertilizer source in 1990 (Table 1) but were significantly higher for poultry litter than for commercial fertilizer treatment in 1991 (Table 2). Polyethylene mulch significantly increased post-harvest soil NO_3 and leaf N concentrations in 1990 and increased yield and yield components in both years. There were no beneficial effects of row covers on yield in either year, presumably because no early season freezes occurred.

Application. We conclude that composted poultry litter is a viable alternative to commercial fertilizers for production of triploid watermelon. Inclusion of an unfertilized overwintering cover crop appears to be one way of reducing the accumulation of soil P for cropping systems utilizing poultry litter as a fertilizer source. Our results indicate polyethylene mulch increases triploid watermelon production in part by improving N availability and uptake.

Table 1. Interaction of mulch (M) and row cover (RC) treatments on yield and yield components of triploid watermelon grown in 1990. Pretransplant fertilizer source (FS) treatments were poultry litter and chemical fertilizer. Main effect means for FS omitted (NS).

Mulch	Row cover	Yield (t/acre)	Melon no. (1000/acre)	Melon fresh weight (lbs/melon)
Yes	Yes	36.4	11.3	6.6
	No	36.3	9.7	7.5
	Mean	---	---	7.1
No	Yes	29.4	14.0	4.2
	No	27.1	9.5	5.7
	Mean	---	---	5.1
Significance of F				
FS		NS	NS	NS
M		0.004	NS	0.010
FS*M		NS	NS	NS
RC		0.016	NS	NS
FS*RC		NS	NS	NS
M*RC		0.015	NS	NS
FS*M*RC		NS	NS	NS

NS Nonsignificant at $P \leq 0.05$.

Table 2. Main effect of fertilizer source (FS), mulch (M), row cover (RC), and preplant fertilizer rate (R) on yield and yield components of triploid watermelon grown in 1991. Main effect for RC omitted (NS).

Treatment	Yield (t/acre)	Melon no. (1000/acre)	Melon fresh weight (lbs/melon)
FS			
Poultry	41.2	9.1	9.0
Commercial	30.6	7.6	7.5
M			
With	47.3	10.1	9.3
Without	24.5	6.5	7.3
R			
1X[z]	32.3	7.8	7.7
2X	39.5	8.8	8.8
Significance of F			
FS	0.029	0.002	NS
M	0.003	0.011	0.007
FS*M	NS	NS	NS
RC	NS	NS	NS
FS*RC	NS	0.032	NS
M*RC	NS	0.047	NS
FS*M*RC	NS	NS	NS
R	NS	NS	0.019
FS*R	NS	NS	NS
M*SR	NS	NS	NS
RC*R	NS	NS	NS
FS*M*R	NS	NS	NS
FS*RC*R	NS	NS	NS
M*RC*R	NS	NS	NS
FS*M*RC*R	NS	NS	NS

[z] 1X and 2X refer to single and double preplant fertilizer application rates, respectively.
NS Nonsignificant at $P \leq 0.05$.