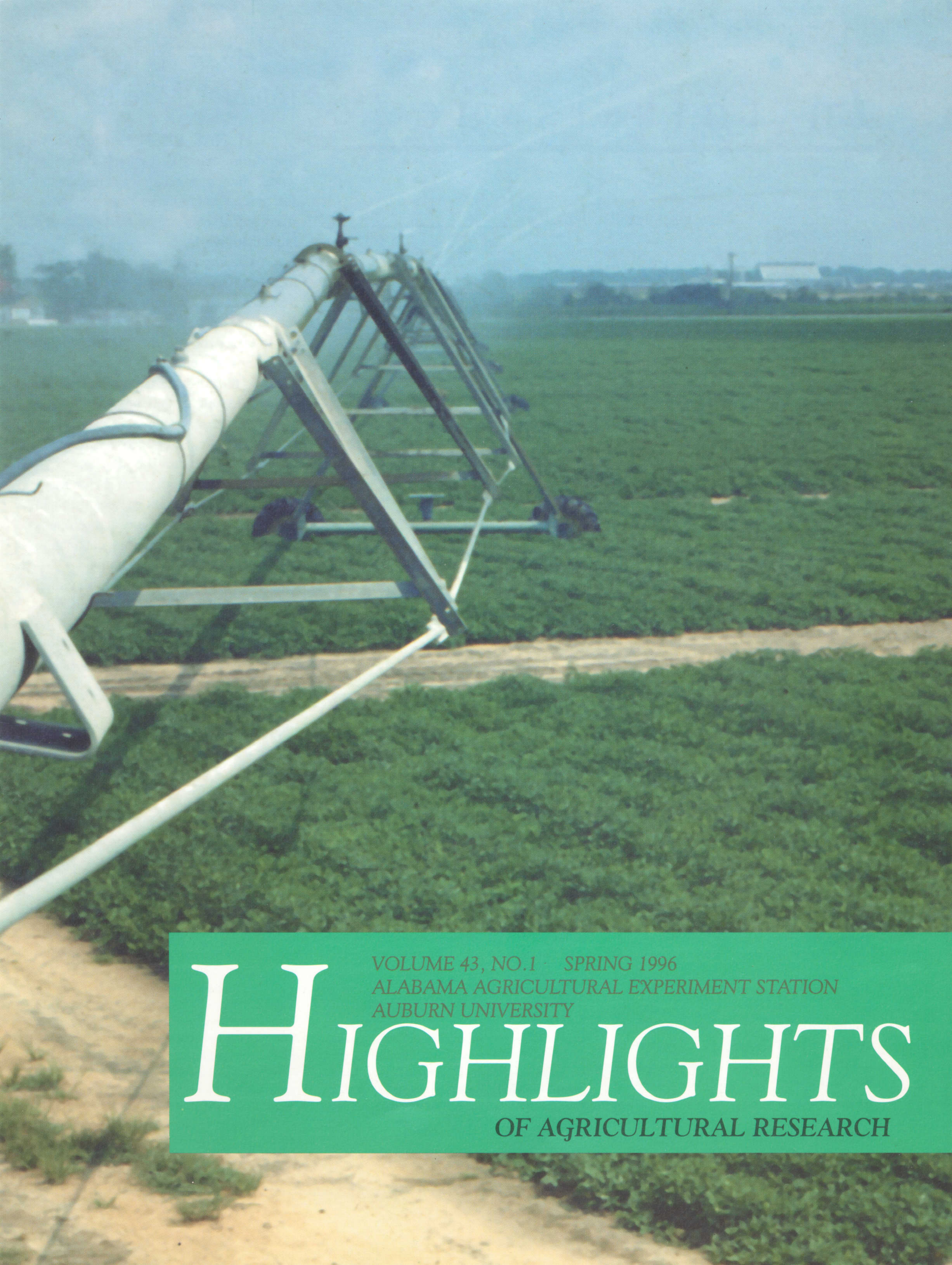

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HIGHLIGHTS OF AGRICULTURAL RESEARCH

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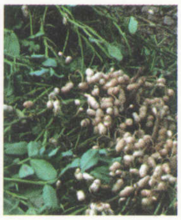

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ON THE COVER: Irrigation is just one management tool available to peanut growers. See related articles on pages 4 and 12.

from the Director

IT HAS BEEN ESTIMATED that, during the 20th Century alone, the world's human population and its demand for space, commodities, and amenities from global ecosystems have increased more than five-fold.

Clearly, state Agricultural Experiment Stations and Cooperative Extension Services must critically re-examine and modernize their land grant vision if they are to effectively deal with a broadening science and education agenda that includes relationships among agriculture, natural resources, and the environment, including the broader global ecosystems and human communities to which agroecosystems are inextricably linked.

To begin with, greater communication is necessary among scientists and specialists with disciplinary backgrounds in ecology and those currently conducting research and extension programs

Next, moving from individual fields to whole farms to basins and landscapes creates a need to employ new methodologies for acquiring and analyzing data at these higher levels of organization, including measurements and analytical techniques for determining the impact of agricultural practices at the agroecosystem level. Also, cooperative efforts are needed to develop contemporary extension and academic program educational materials to more effectively communicate concepts and issues dealing with agriculture in an ecological framework.

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Inset, cabbage plants being grown in composted poultry litter.

New Uses for Broiler Litter

Research Shows Broiler Litter Enhances Potting Soil Media

Elizabeth A. Guertal, Bridget K. Behe, Joe M. Kemble, and David G. Himelrick

As Alabama's poultry industry grows and expands, so does the industry's need for environmentally sound ways to dispose of its by-products. AAES research is exploring new uses for broiler litter, and results of a recent study suggest that broiler litter can be successfully added to potting soil media used for growing vegetable transplants.

Broiler litter is a mixture of manure and bedding material (sawdust, peanut hulls, etc.) that is removed from poultry houses after the birds have been raised. While this by-product can be applied to agricultural fields and pastures as a source of nutrients and organic matter, continued long-term application or applying too much litter to land may result in an overload of nutrients that can contaminate surface and ground water. Additional options for broiler litter use can provide new markets for this agricultural by-product and help avoid contamination problems.

Research conducted by the AAES, the Tennessee Valley Authority (TVA), and Bonnie Plant Farm explored the possibilities of using composted poultry litter as a vegetable transplant potting material. The objective of this study was to utilize composted, ground poultry litter material (supplied by TVA) in a large-scale transplant production system, and to determine if the addition of broiler litter to these media would alter plant growth or final crop yields.

The study was conducted in one cropping year with three fall crops (collards, broccoli, and cabbage) and

Broiler Litter, continued on page 4

Broiler Litter, continued from page 3

three varieties of one spring crop (tomato). All transplants were produced by Bonnie Plant Farm, a vegetable and bedding plant production facility located in Union Springs.

All transplants were grown in "six-pack" plastic trays, the type commonly used for selling vegetable transplants to home gardeners. Selected crop varieties were Packman broccoli; Vates collards; Bonnie cabbage; and Rutgers, Bonnie, and Big Boy tomatoes. Plastic trays were filled with either a standard peat-based Fafard potting media or a 50/50 mixture of Fafard and composted poultry litter. All flats were maintained under standard growing conditions used by Bonnie Plant Farm.

Each week after planting, nine six-packs of each crop in each potting mix were randomly selected from the greenhouse, and the above-ground portion of each seedling was clipped, weighed, and analyzed for total nitrogen (N) content. Sampling of fall crops continued for five weeks and spring tomatoes were sampled once. When the plants were of appropriate size, they were moved from the greenhouse to the field and planted.

Fall cool season brassica (collards, cabbage, and broccoli) crop production was located at the E.V. Smith Horticultural Research Unit in Shorter, and spring tomato production was located at the Chilton Area Horticulture Substation in Clanton. All crops were grown on raised planting beds covered with black plastic (fall) or white plastic (spring), with drip irrigation installed under the plastic. Fall crops were harvested once and spring tomatoes were harvested eight times throughout the growing season.

When the fall crops were sampled in the greenhouse there were size differences due to potting mix during the first weeks of sampling. Cabbage, collards, and broccoli grown in 50/50 mix were often smaller than those grown in 100% Fafard. However, such differences disappeared by the fourth week of sampling. By the time a homeowner would have purchased these transplants (five weeks after planting) there were no size differences due to type of potting mix. For tomatoes, the single greenhouse sampling date showed no differences in wet or dry weight due to type of potting mix.

Final yields of harvested cabbage, collards, and broccoli were not affected by type of potting mix. Total yields of harvested tomatoes were usually not affected by type of potting mix, except that there were more tomatoes classed as "nonmarketable" harvested from the 50/50 poultry litter/Fafard potting mix. Fruit classified as nonmarketable may be insect or disease damaged or too small for fresh-market sale by a commercial tomato grower.

These results suggest that composted poultry litter is a suitable amendment for greenhouse potting mixes used for vegetable transplant production. If the cost of processing and shipping the composted poultry litter is less than the cost of using 100% peat mixes, such as Fafard, amended potting mixes may become a production benefit for greenhouse transplant growers and the state's poultry producers.

Guertal is an Assistant Professor of Agronomy and Soils; Behe is an Associate Professor, Kemble is an Assistant Professor, and Himelrick is a Professor of Horticulture.

ECONOMIC

Alabama, Georgia, and Florida produce about 65% of the nation's peanuts. Uncertainty about government price support and increasingly stringent environmental regulations place many of these growers in double jeopardy. Recent AAES research indicates three-year rotations that include switchgrass in the rotation may provide more environmental benefits, while cotton-peanut rotations provide greater economic gains.

Environmental Evaluations of Peanut Rotations with Switchgrass and Cotton

Krishna P. Paudel, Neil R. Martin, Jr., Nancy Kokalis-Burelle, and Rodrigo Rodriguez-Kabana

Pesticide expenditures in peanuts are more than $100 per acre. The major traditional crops rotated with peanuts to reduce certain chemical applications, such as nematicides, are cotton and corn. However, these alternative crops do not alleviate the environmental concerns because they are heavily dependent on other chemicals. Search for an alternate crop that would require less chemical input has been intense by agriculturalists with the prompting of environmentalists.

Advocates of sustainable agriculture propose the incorporation of forage grasses in cropping patterns since this often results in reduced chemical use and soil erosion, which help reduce water quality degradation. Switchgrass, a native warm season forage grass, can be found from the U.S.-Canadian border to South Florida and Texas. This grass has low fertilizer requirements, is widely adapted to different soil types, has soil conservation properties, a deep root system, and provides an excellent wildlife habitat. Switchgrass may be a good rotation crop in peanut fields to reduce the infestation of nematodes and diseases, such as southern stem rot and cercospora leaf spot. If switchgrass is adopted in a peanut rotation system it may create a cropping system that reduces a farmer's dependence on chemicals.

To learn more about the environmental and economic benefits of using switchgrass, information obtained from cropping experiments conducted at the Wiregrass Substation in Headland, for three years and enterprise budgets from the Alabama Cooperative Extension Service were linked.[1] Florunner peanut, Alamo switchgrass, and Deltapine 90 cotton varieties were incorporated in different experimental rotation systems.

Eight cropping patterns were compared over a three-year period. The cropping systems included in this analysis were:

Peanut plus Peanut plus Peanut with Temik (PNTPNTPNT);

Peanut plus Peanut plus Peanut without Temik (PNTPNTPNT);

Switchgrass plus Peanut with Temik plus Switchgrass (SGPNTSG);

Switchgrass plus Peanut without Temik plus Switchgrass (SGPNTSG);

Switchgrass plus Switchgrass plus Peanut with Temik (SGSGPNT);

Switchgrass plus Switchgrass plus Peanut without Temik (SGSGPNT);

Cotton plus Peanut without Temik plus Cotton (CTPNTCT); and

Cotton plus Cotton plus Peanut without Temik (CTCTPNT).

Peanut Rotations, continued on page 6

[1]Budgets for major row crops in Alabama. 1994. Alabama Coperative Extension Service, Department of Economics and Rural Sociology, Auburn University.

The amount of money spent for chemicals was measured as a proxy for determining the effect of a cropping pattern on groundwater pollution, assuming that the amount of money spent on chemicals correlates with the amount of chemicals used. It should be noted that with some of today's low-input chemicals this cost-use comparison would not be feasible because these low-input chemicals are more expensive even though less chemicals are used. However, in this study costs of traditional chemicals were used.

The study assumed that an ideal rotation pattern was one that maximized profits while minimizing risk and chemical use. All three factors should be considered when selecting an environmentally and financially beneficial crop rotation system. Multi-objective solutions were compared for minimum level of chemical use at given levels of income and risk.

The eight different combinations of enterprise rotations were analyzed for their profit potential and the extent of environmental degradation each rotation caused. The analyses were done for a peanut-based cropping system. Since Congress is currently considering substantial modification or even the elimination of the peanut quota system, the analyses were conducted based on three scenarios: (1) the existing situation (peanuts priced at $700 a ton), (2) possible future peanut quota price assumptions (peanuts priced at $625 a ton), and (3) a situation in which no peanut program exists (peanuts priced at $500 a ton).

The results of these analyses are shown in Table 1. The first analysis is the present situation where farmers can sell quota peanuts at prices that are fixed by the U.S. Department of Agriculture. In this situation, half of a farmer's land was planted in peanuts for three consecutive years and the remainder in cotton for two years followed by one year of nonquota supported peanuts. Maximum profit was $351,143 with a deviation $23,373. Chemical use was calculated to be almost $212,000.

To compare this with switchgrass-based rotations, the model required that rotation patterns include at least one year of switchgrass. This resulted in a reduction of profit to 28% of the former level. On the other hand, in this situation the farmer used a much lower volume of chemicals ($92,381). Risk was measured to be $13,354 deviation in this maximum profit level.

Assuming that Congress will continue a peanut program similar to the past program with quota price reduced to $625 per ton, maximum profit for the analytical farm would decline to $286,724 but enterprise selection and chemical application remained the same. Risk was reduced only slightly to $22,047.

A requirement that cropping patterns include at least one year of switchgrass with a peanut price of $625 per ton resulted in 78% less profit compared to the unrestricted solution. Risk also was reduced, but the cropping pattern and chemical use did not change from the forced switchgrass solution at a $700 per ton price.

Analyses of cropping pattern selection, income and risk, and chemical use in the absence of the peanut program also were conducted for a peanut market price of $500 per ton. Cropping pattern and chemical use were identical to the results for the past peanut program and the modified program with a price of $625 per ton. Income with the $500 per ton price was approximately the same as for the $625 price because there was no price reduction for additional peanuts in the $500 per ton analysis. However, deviation in income increased to $38,378 in the

Table 1. Profit, Risk, Chemical Use, and Cropping Pattern with Various Peanut Policy Provisions for a Typical Peanut Farm in Southeast Alabama

Policy provision	Selection options	Profit	Risk	Chemical use	Cropping pattern[1]	No. acres
Past peanut program:	Normal	$351,143	$23,373	$211,988	CTCTAP[3]	200
Quota price ($700/ton)					PNTPNTPNT*[4]	200
Add. price ($350/ton)	Forcing SG[2]				SGPNTSG*[5]	200
	pattern	97,457	13,354	92,384	SGSGPNT*[6]	200
Modified peanut program	Normal	286,724	22,047	211,988	CTCTAP	200
Quota price ($625/ton)					PNTPNTPNT*	200
Add. price ($310/ton)	Forcing SG				SGPNTSG*	200
	pattern	64,009	11,658	92,384	SGSGPNT*	200
Complete elimination	Normal	285,289	38,378	211,988	CTCTAP	200
of peanut program:					PNTPNTPNT*	200
Peanuts priced at	Forcing SG					
$500/ton	pattern	66,940	18,101	92,384	SGPNTSG*	400

[1] An * denotes peanuts with Temik.
[2] Switchgrass.
[3] Cotton followed by cotton, followed by additional peanuts.
[4] Peanuts planted for three consecutive years.
[5] Switchgrass followed by peanuts followed by switchgrass.
[6] Switchgrass followed by switchgrass followed by peanuts.

Peanut Rotations, continued from page 6

absence of the stability provided by the past peanut program.

A requirement that cropping patterns include at least one year of switchgrass with a peanut price of $500 per ton resulted in the selection of switchgrass followed by peanuts followed by switchgrass. Income was slightly higher and deviation slightly lower than the parallel solution with quota peanuts priced at $625 per ton. Chemical use was $92,384, the same as the other solution restricted to include at least one year of switchgrass.

Table 2 contains additional analyses in which cropping patterns were selected to maximize profit subject to farm resource limitations plus a requirement that chemical use not exceed the level associated with Table 1 solution, which includes at least one year of switchgrass. All cropping patterns were candidates for selection with the requirement that chemical use not exceed $92,384. The highest income (lowest deviation), $179,244 ($15,036), was found under the conditions of the past peanut program. The cropping pattern for this solution was continuous peanuts on 149 acres. This, the maximum profit solution, left 251 acres idle in order to hold chemical application to $92,384. Obviously, the ratio of idle acreage to peanut acreage would facilitate a rotation of peanuts and idle land. Perhaps a peanut-idle rotation pattern would allow use of less chemicals per acre, and thus greater possible income, but this was not reflected in the experimental data and not included in this analysis.

The cropping pattern in Table 2 (chemical expenses limited to $92,384) for the $625 per ton peanut price situation was a small amount of cotton followed by peanuts followed by cotton (eight acres) and 193 acres of cotton followed by cotton followed by peanuts. Profit is less than the parallel result for the current program, but income deviation is increased.

Maximum profit results, assuming elimination of the peanut program, a market price for peanuts of $500 per ton, and a maximum limit on chemical expenses of $92,384, provided $149,103 in income with a deviation of $18,967. Interestingly, this is more than twice the income and only five percent more risk with the same level of chemical expense as the parallel solution in Table 1, where cropping systems were required to contain at least one year of switchgrass. This is because PNTPNTPNT and CTCTPNT rotations in Table 2 replaced the SGPNTSG rotation in Table 1. Thus, from a standpoint of maximum profit with an analytically derived limit on chemical application, peanut rotation systems with switchgrass are not economically competitive with continuous peanuts and the peanut rotation system with cotton.

From this analysis, we can conclude that peanut-switchgrass rotation has some benefit based on environmental aspects but not based on profit alone. If we do not consider the externality created by the application of chemicals on groundwater and the environment, then we have to say that switchgrass is not beneficial in a peanut rotation system. However, its almost stable yield and low-risk income is attractive to peanut growers who must struggle to maintain income with minimum risk in an increasingly regulatory environment. Also, switchgrass has multipurpose benefits that other forage grasses do not possess.

Continuation of the experimental test used in this study will allow for further analysis of switchgrass as a relatively new rotation alternative. The model and approach contained in this paper will be useful in conducting such analysis.

Table 2. Profit, Risk, and Cropping Pattern Subject to a Maximum Chemical Use of $92,384

Policy provision	Profit	Risk	Cropping pattern[1]	No. acres
Past peanut program: Quota price ($700/ton) Add. price ($350/ton)	$179,244	$15,036	PNTPNTPNT*[2]	200.00
Modified peanut pgm: Quota price ($625/ton) Add. price ($310/ton)	157,118	20,200	PNTPNTPNT*	7.55
			CTPNTCT[3]	7.55
			CTCTPNT[4]	192.45
Complete elimination of peanut program: Peanuts priced at $500/ton	149,103	18,967	PNTPNTPNT*	7.55
			CTCTPNT	200.00

[1] An * denotes peanuts with Temik.
[2] Peanuts planted for three consecutive years.
[3] Cotton followed by peanuts followed by cotton.
[4] Cotton followed by cotton followed by peanuts.

Paudel is a Graduate Research Assistant, Martin is a Professor of Agricultural Economics and Rural Sociology; Kokalis-Burelle is a Post-Doctoral Fellow and Rodriguez-Kabana is a Professor of Plant Pathology.

Municipal Waste Becomes Asset to Farm Land:

Proper Carbon:Nitrogen Ratio is Key to Success

Jim A. Entry,
Brenda H. Wood,
James H. Edwards, and
C. Wesley Wood

Municipal solid waste as collected by municipalities is composed of tree limbs, chopped whole trees, stumps, leaves, and lawn clippings. The debris is ground in a tub grinder (left) to reduce the volume of yard waste so that it can be placed in rows for composting (above.) Composting the yard waste reduces the volume 30 to 40% to form an organic by-product that is environmentally safe for land application.

Safe disposal of large amounts of municipal solid wastes (MSW) is a major problem for cities and large industries in the United States, but properly applying MSW to agricultural lands may provide a safe and beneficial way to dispose of these by-products. It may also help reduce the risk of negative environmental impacts from the application of animal waste products.

An average of 67% of municipal solid waste in the U.S. goes to landfills, 23% is recycled, and 10% is incinerated. Landfill disposal of MSW is expensive — ranging from $8 per ton in New Mexico to $75 per ton in New Jersey (1994 figures). Disposal of MSW also is under scrutiny by the U.S. Environmental Protection Agency, which has mandated a reduction in the nation's dependence on landfill disposal. The expense and problems associated with MSW disposal has caused many municipalities to look for alternative disposal methods for MSW. One potential method is applying organic MSW to agricultural lands.

Continual agricultural production can gradually decrease the organic matter content of soils, which can decrease soil fertility and crop yields. Applying animal wastes to farm land has been one effective way to improve the physical, chemical, and microbiological properties of soils, which ultimately results in increased crop yields. But animal wastes also run the risk of nitrate contamination to surface and groundwater. An AAES study was conducted to determine if organic MSW could provide benefits similar to animal wastes for soils and also mitigate nitrate problems associated with

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Herbicide, continued from page 12

tion scale level using enterprise budgets developed by the Alabama Cooperative Extension Service for nonirrigated peanut production (See tables 1 and 2). Peanut net return calculations were based upon the assumption that the crop would be marketed at a 3:1 ratio of quota and additional peanuts and have a normal grade. Value was $700 and $350 per ton, respectively.

Starfire applied EPOST was an essential component in obtaining acceptable sicklepod and Florida beggarweed control. Control with Starfire-containing programs provided 76% to 90% control. Pursuit did not effectively control sicklepod. Additionally, combinations with Butyrac 200 did not control sicklepod due to the size of the sicklepod when POST applications were made.

Pursuit EPOST at either rate, applied either alone or followed by any POST herbicides, provided at least 74% control of yellow nutsedge. When Pursuit was not applied, Basagran was essential in obtaining adequate yellow nutsedge control. Only the Basagran-containing POST-applied treatments provided adequate control when used alone.

Starfire plus Pursuit at either two or four ounces per acre applied EPOST, followed by either of the herbicide-containing POST treatments provided at least 75% bristly starbur control. The standard treatments of Starfire plus Basagran EPOST, followed by either Starfire plus Butyrac 200 or Starfire, Butyrac 200, and Basagran gave 70% and 83% control of bristly starbur, respectively.

An EPOST treatment of Starfire plus Pursuit followed by either of the two herbicide-containing POST treatments generally had greater yields. However, the standard treatment used by many growers (Starfire plus Basagran EPOST, followed with Starfire plus Butyrac 200 plus Basagran POST) provided yields equivalent to systems with Pursuit as a component. Systems with only EPOST- or POST-applied treatments resulted in lower yields. Yield with Pursuit alone was the lowest, reflecting late season competition from broadleaf weeds.

Peanut injury from Pursuit alone or with Starfire was intermediate between that observed with Starfire alone and Starfire plus Basagran. Injury from EPOST herbicide was transient and the peanuts had recovered by the time POST herbicides were applied. Injury from any of the POST treatments was no greater than 8%.

Systems that included both an EPOST and POST treatment provided superior net returns. While this is in general agreement with yield, net returns did not necessarily parallel yield. Starfire alone EPOST, followed by Starfire plus Butyrac 200 plus Basagran POST provided the highest net return at $933 per acre. The cost of this entire system was $66 per acre. This included $17.59 per acre application cost (Table 1) and $48.41 per acre for the herbicides; PPI plus EPOST plus POST (Table 2). This was not the most expensive treatment. Systems with Starfire plus Pursuit EPOST followed by either of the two herbicide-containing POST treatments ranked among the top four in net returns. Programs with Pursuit alone EPOST generally provided lower net returns than the Starfire plus Pursuit systems.

These data show the utility of incorporating Pursuit into Starfire-based weed control programs. However, in this study Pursuit was not always needed for adequate weed control, maximum yield, or highest net return. Pursuit was essential only for the control of yellow nutsedge. Pursuit provided little control of sicklepod or Florida beggarweed compared with systems containing only Starfire, Butyrac 200, and Basagran. Systems with Pursuit provided bristly starbur control comparable to that obtained with those containing Basagran. Net returns analyses showed that EPOST and POST herbicide treatments can be combined to increase profits in peanut production. Selection of herbicide materials and timing of applications can have a much larger impact on the dollar value of net returns than on treatment cost. Thus, treatment cost should not be a sole factor in deciding which system of EPOST should be applied for weed control in Alabama peanut production.

Grey is a Graduate Research Assistant, Wehtje is an Associate Professor, and Walker is a Professor of Agronomy and Soils; Martin is a Professor of Agricultural Economics and Rural Sociology.

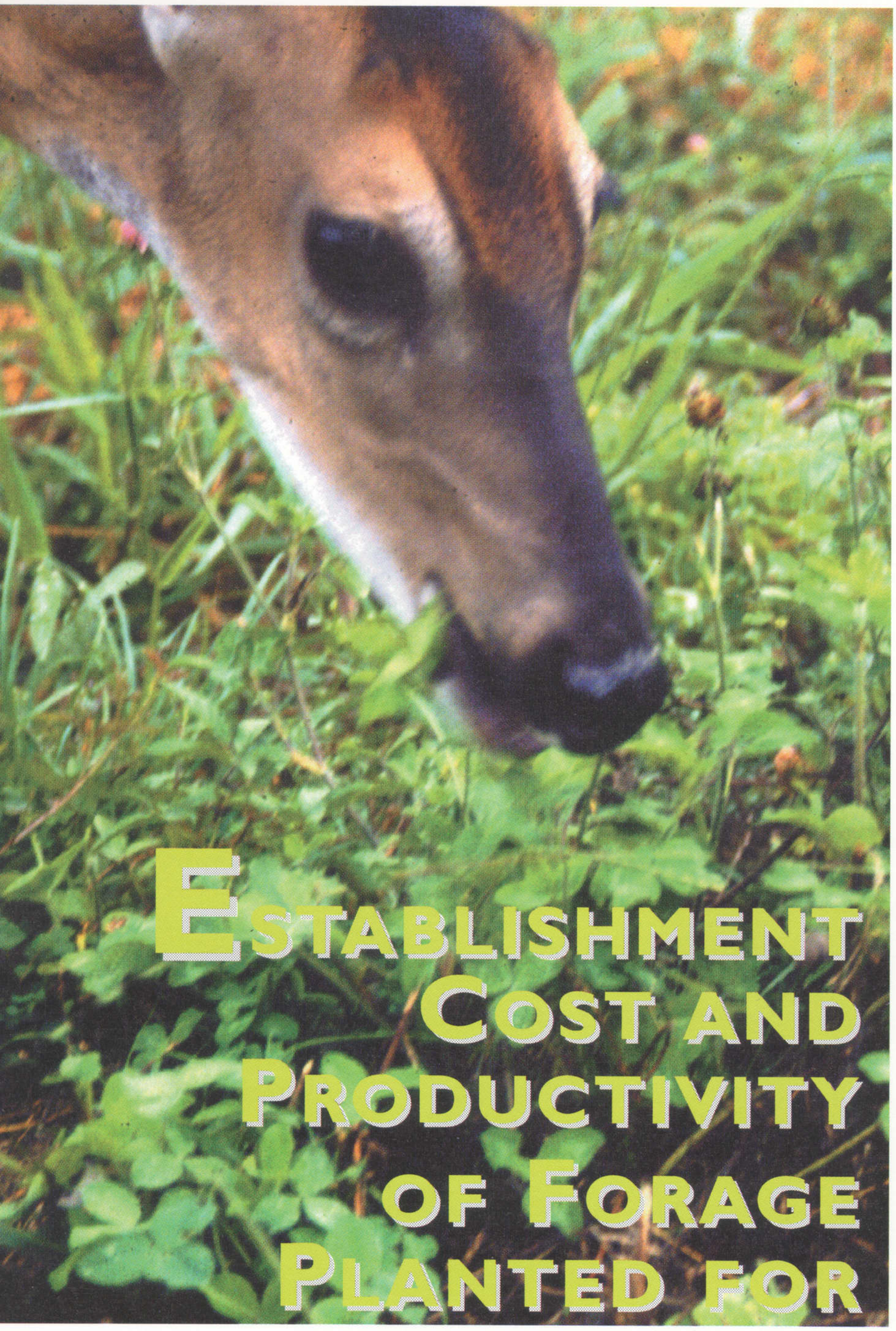
Table 1. Specific Cost Related to Herbicide Application for All Years, Wiregrass Substation, Headland

Herbicide group	Machinery cost: Labor	Variable	Fixed	Total application cost
	Dol./acre			
PPI	$1.84	$1.32	$2.53	$5.70
EPOST	1.63	1.74	2.57	5.94
POST	1.63	1.74	2.59	5.95

Table 2. Herbicide Treatment Cost for All Years, Wiregrass Substation, Headland

EPOST	POST treatments: Starfire plus Butyrac 200	Starfire plus Butyrac 200 plus Basagran	Post only
		Dol./per acre	
Pursuit 0.5 X[1]	$45.31	$62.63	$33.02
Pursuit 1X	65.22	82.55	52.95
Starfire	31.08	48.41	21.00
Starfire+Pursuit 0.5X	51.02	68.34	38.71
Starfire+Pursuit 1X	70.93	88.26	58.65
Starfire+Basagran	39.74	57.07	27.41
No EPOST	25.41	42.69	13.08 [2]

1 Pursuit 0.5X and 1X = Pursuit applied at two and four ounces per acre, respectively. Basagran was applied eight ounces per acre EPOST and 16 ounces per acre POST. Starfire and Butyrac 200 both were applied at 16 ounces per acre.
2 Includes application of Prowl PPI.



Establishment Cost and Productivity of Forage Planted for White-tailed Deer

Neil A. Waer, H. Lee Stribling, and M. Keith Causey

ALABAMA OUTDOOR AND HUNTING ENTHUSIASTS commonly use planted forage crops for white-tailed deer management in areas known as green fields. When doing so, the type of forage planted should be chosen carefully based upon the goal of the planting because expenses associated with this practice vary widely. A recent AAES study determined the most cost-effective of nine warm-season and 39 cool-season forage varieties.

Wheat, oats, and rye are the most cost effective for attracting deer during hunting season.

Planting typically is done for two reasons—to facilitate deer harvest during hunting season or to provide year-round supplemental feed to wildlife. If the planting goal is to facilitate harvest, then forages should be used that are highly palatable to (preferred by) deer and also that produce well and are cost effective from early autumn through winter. If year-round supplemental feeding is the objective of a planting, then preferred forages that provide an adequate quantity of cost-effective, high-protein forage during specific time periods should be used.

The study was conducted at the Piedmont Substation in Camp Hill from 1989 to 1993. Researchers measured forage production over time and calculated establishment costs by adding cost estimates (1994 dollars) of seed, fertilizer, lime, and use of equipment (tractor and implements to prepare soil, spread, and cover seed). Labor costs were not included because plot managers usually donate their own time for establishing and maintaining forage plantings.

Establishment costs (dollars per acre) for cool-season forages ranged from $44.08 for white dutch clover to $107.20 for alfalfa (see table). Clovers were less expensive (range $44.08 to $65) to plant than small grains (range $87.75 to $102.06) or ryegrass (range $86.76 to $88.51). Establishment costs for warm-season forages ranged from $59.50 for cowpea to $108.10 for sericea lespedeza. Soybeans and peas had the lowest establishment costs (range $59.50 to $68.20). Seed cost varied by season and generally was higher for warm-season forages. Fertilizer was the most expensive component associated with establishing forages.

Cost of establishing legumes generally was less expensive than

White-tailed Deer, continued on page 16

Cost Per Ton of Forage Based on Cost of Establishment Per Acre and Production, Camp Hill, 1989-1990

Forage	Total cost per acre	Total production[1,2]	Cost per ton of forage	Total production September-March[1]	Cost per ton of forage September-March	Total production April-September[1]	Cost per ton of forage April-September
		Kg/ha		*Kg/ha*		*Kg/ha*	
Cool Season							
Regal ladino clover	$46.90	2,797	$37.60	394	$266.87	2,402	$43.76
Imperial Whitetail ladino clover	49.10	3,070	35.86	389	282.98	2,681	41.06
Osceola ladino clover	46.90	3,061	34.35	424	247.99	2,636	39.89
California ladino clover	46.15	2,653	39.00	420	246.35	2,233	46.34
Tibbee crimson clover	53.00	1,905	62.38	599	198.37	1,306	90.98
Mt. Barker subterranean clover	65.00	1,400	104.09	256	569.25	1,144	127.38
Bigbee berseem clover	63.80	1,183	120.91	319	448.40	864	165.55
Yuchi arrowleaf clover	45.76	1,934	53.05	496	206.84	1,438	71.34
Redland II red clover	55.60	4,453	27.99	243	512.98	4,210	29.61
Redired red clover	55.60	1,0481	18.94	240	519.39	809	154.08
White dutch clover	44.08	531	186.11	40	2,470.66	491	201.28
Coker 820 oats	90.56	3,117	65.14	2,024	100.31	1,093	185.76
Buck Magnet 833 oats	93.76	2,790	75.34	950	221.27	1,840	114.24
Delhi Bob oats	89.76	2,471	81.44	1,1021	82.61	1,369	147.00
Florida 501 oats	88.96	2,138	93.29	963	207.11	1,175	169.74
Wren's Abruzzi rye	92.04	3,938	52.40	2,416	85.41	1,522	135.58
Gainey AFC 20-10 rye	93.72	3,124	67.26	1,401	149.98	1,723	121.95
Maton rye	93.72	3,3106	3.48	1,222	171.95	2,088	100.63
Pioneer 2551 wheat	102.06	2,445	93.59	1,416	161.59	1,029	222.37
Pioneer 2548 wheat	102.06	2,940	77.83	1,281	178.62	1,659	137.92
Saluda wheat	89.46	4,474	44.83	2,727	73.55	1,747	114.81
Bogard's Caldwell wheat	89.46	2,325	86.27	509	394.04	1,817	110.38
Fuller Florida 302 wheat	89.46	2,434	82.40	1,269	158.05	1,165	172.16
Dovebuster feed wheat	87.75	2,207	89.14	1,1861	65.88	1,023	192.31
Marshall ryegrass	88.51	2,782	71.33	1,158	171.36	1,624	122.19
Smith Surrey ryegrass	88.51	3,091	64.20	1,173	169.17	1,919	103.41
Rustmaster ryegrass	88.51	2,948	67.31	1,268	156.50	1,680	118.11
Gulf ryegrass	86.76	3,084	63.07	1,187	163.70	1,897	102.54
AU Triumph tall fescue	95.16	1,406	151.74	648	329.24	757	281.83
Kentucky 31 tall fescue	91.56	1,673	122.70	812	252.80	861	238.41
Cahaba white common vetch	56.80	1,376	92.55	869	146.54	507	251.17
Cimarron alfalfa	107.20	3,394	70.81	427	562.86	2,967	81.00
Maku big trefoil	68.70	893	172.48	218	706.53	674	228.52
Austrian winter pea	52.30	1,076	108.97	601	194.96	475	246.85
Purple top turnips	87.56	535	366.93	535	366.93		
Civastro (forage) turnips	95.26	85	2,512.59	85	2,512.59		
Emerald rape	95.26	236	904.96	236	904.96		
Triticale	99.76	2,182	102.50	1,463	152.88	719	311.07
Phalaris	98.76	1,6241	36.34	721	307.10	903	245.20
Warm Season							
Davis soybean	61.20	3,664	37.45				
Quail Haven soybean	68.20	2,601	58.79				
Combine cowpea	59.50	2,695	49.50				
Catjang pea	65.70	2,940	50.10				
Velvetbean	73.20	3,345	49.06				
American jointvetch	103.20	946	244.11				
Sericea lespedeza	108.10	1,8731	29.40				
AU Lotan lespedeza	104.20	1,3811	69.16				
Kobe lespedeza	76.30	2,149	79.60				

[1] Totaled over months forage was available and averaged over all seasons planted; does not include production of perennial forages after first year's growth.
[2] Represents peak production of warm-season forages averaged over all seasons planted.

Red clover is considered a preferred and productive forage from late spring to late summer.

establishing other forages because of lower fertilizer costs ($19 per acre for legumes versus $58.56 per acre for nonlegumes). Legumes typically require less fertilizer (200 pounds per acre of 0-20-20 often is recommended) than nonlegumes (600 pounds per acre of 13-13-13 often is recommended to maximize forage production).

Cost estimates for establishing forages were based on replanting each year and did not account for reseeding ability of some forages (ryegrass, crimson clover, and subterranean clover) and the perennial growth of others (ladino clovers, fescue, trefoil, alfalfa, and red clover).

Researchers found wheat, oats, and rye to be the most cost effective for attracting deer during hunting season. Some popular varieties of these forages cost less than $100 per ton of forage from September through March (see table). As a group, small grains are considered the most productive and preferred of cool-season forages during this time. Crimson clover and ryegrass are cost effective from winter through early spring, costing less than $200 per ton of forage from September through March. Ryegrass and crimson clover are considered preferred, productive forages from early winter to early spring. Combining these forages with small grains satisfies both the objectives of attracting deer during hunting season and supplying abundant, high-quality forage during the late autumn-winter stress period.

Ryegrass, crimson clover, and possibly some ladino clovers would be very cost effective for supplying forage during hunting season and winter stress if they are planted on good soils that support reseeding and perennial growth. From spring through summer, ladino and red clovers are very cost effective, especially when planted on high-quality sites that facilitate perennial growth. These forages cost less than $50 per ton of forage from April through September. Ladino clovers generally are considered the most productive and preferred of the cool-season forages from spring to early summer. However, peak production and use of ladino clovers occurs during spring green-up when native browse is plentiful and succulent. Red clover is considered a preferred and productive forage from late spring to late summer. Red clover and perhaps ladino clover (if planted on high quality sites) continue to produce well from early to late summer. During this time native vegetation is scarce and of low quality, to that deer will use planted forages heavily.

Soybeans, velvetbeans, and peas are cost-effective, warm-season forages. They produce abundant, desirable, low-cost forage of high quality throughout the summer. Cost per ton of forage of these plantings ranged from $37.45 to $58.79 (see table). Soybeans generally are considered the most productive and preferred warm-season forage, velvetbeans are intermediate in production and deer preference, and peas are productive but rate lower in deer preference than soybean or velvetbeans.

Because there is little difference in production, nutritional quality, and deer preference among different varieties of most forages, seed availability and cost should determine choice of a forage variety. For year-round forage supplies, the less expensive small-grain, ryegrass, crimson clover, red clover, ladino clover, and soybean varieties adapted to the area are the most cost-effective forage mixtures.

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On-Farm Composting Feasible for Disposal of Swine Carcasses

Tom A. McCaskey, Joe A. Little, Rachel M. Krotz, Sarah P. Lino, and Todd C. Hannah

IN ALL COMMERCIAL SWINE OPERATIONS, it is common for a small percentage of animals to die during production. The disposal of dead pigs is a vexing task for swine producers, but AAES research has shown that swine carcasses can be composted on farms to produce a valuable fertilizer without generating offensive on-farm odors.

Composting has become common on poultry farms and is widely accepted by environmental agencies as a feasible, environmentally acceptable method for disposal of chicken carcasses. However, making this technology work with swine carcasses, which are larger than poultry carcasses, and controlling any odor problems during the composting process are legitimate concerns. An AAES study was conducted to determine the best composting techniques and to learn more about the problems or benefits associated with composting dead pigs.

Composting is a process through which microorganisms break down organic materials into a safe, stable humus. For composting to take place, several components are required. These include:

(1) The material being used for composting must be organic in nature (such as farm animal mortalities, animal manures, food wastes, etc.);

(2) The materials must be blended with carbon sources to achieve at least a 15:1 carbon-to-nitrogen (C:N) ratio of the compost mixture so that microorganisms can work;

(3) Moisture levels of the compost mixture should be adjusted to about 40%, which is favorable for microorganisms to degrade the organic material (carcasses);

(4) A bulking agent, such as poultry litter or recycled compost, is recommended to be added to the mixture to make the compost degrade more quickly and also generate heat that kills pathogenic bacteria, such as *Samonella* and *E. coli*, which might be in the compost.

The composting trials were

conducted at the Lower Coastal Plain Substation in Camden. The composting ingredients consisted of: (1) recycled compost generated from previous composting studies, which was used as a bulking agent; (2) dead pigs weighing less than 15 pounds each; (3) chopped hay as a carbon source; and (4) water.

These ingredients were added in the wet weight ratio of 3:1:0.3:0.5, respectively (see Table 1). Based on this ingredient ratio, swine carcasses comprised 20.8% of the compost weight, and the compost mixture had a C:N ratio of 15:1.

Composting was conducted in wooden bins four feet square at the base and five feet high. A six-inch layer of recycled compost was placed in the bottom of the bin, followed by a layer of swine carcasses (mortalities), a layer of chopped hay, and water was added to the top of the layers. Each time swine mortalities were added to the bin, the layers were repeated until the bin was filled, resulting in about half a ton of ingredients. Finally, a six-inch cap of recycled compost was added to the top of the bin to control odors and vermin.

Temperature probes were placed in the bins to monitor the heat generated in the compost. For optimum composting, the compost temperature should reach at least 122°F and hold that temperature for five days to eliminate any enteric pathogenic bacteria.

After 30 days, the compost was removed from the bins, mixed for aeration, and returned to the bins to undergo a second 30-day composting process. After the com-

Table 1. Compost Ingredients and Quantities

	Ratio	Lb.	Pct.
Recycled compost	3.0	625	62.5
Swine mortalities	1.0	208	20.8
Chopped hay	0.3	63	6.3
Water	0.5	104	10.4
Total	4.8	1,000	100

Table 2. Performance of Swine Mortality Composting Process

Composting trials	1st stage		1st and 2nd stages		Temperature (°F) of compost	
	Mass	Volume	Mass	Volume		
	Pct. decrease		*Pct. decrease*		*Max.*	*Days>122*
1	14.9	9.3	23.9	14.7	128	9
2	11.4	19.3	23.0	24.9	133	9
3	13.7	21.4	19.8	29.8	130	19
4	14.0	17.6	21.7	17.7	13	16
Average	13.5	16.9	22.1	21.8	131	13

Table 3. Fertilizer Value[1] of Second Stage Swine Mortality Compost

Composting trials	Lb./wet ton			Value/wet ton
	N	P_2O_5	K_2O	
1	52.1	91.8	58.3	$45.10
2	46.2	89.7	54.0	42.10
3	50.7	110.7	66.2	50.07
4	49.1	108.8	65.7	49.11
Average	49.5	100.3	61.1	46.60

*Fertilizer value calculated on pound basis as N = $0.29, P_2O_5 = $0.23 and K_2O = $0.15.

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Swine Carcasses, continued from page 19

posting process, samples were collected for N-P-K analyses. All analyses were conducted on a dry weight basis and performed in triplicate.

Four composting trials were conducted, and all compost mixtures had the same ingredients in the same ratio. After first-stage composting, the weight of the compost mixture decreased an average of 13.5% and the volume decreased 16.9% (Table 2). After combined first- and second-stage composting, the weight and volume decreased a total of 22.1% and 21.8%, respectively. Most of the decrease occurred during first-stage composting, amounting to 61% for mass and 78% for volume. Weight and volume decreases are due in part to moisture loss and to volatilization of gases produced during degradation of the organic matter. When the composting process is complete, weight and volume will stabilize.

Based on the compost ingredient ratio of 3:1:0.3:0.5 (recycled compost:mortalities:chopped hay:water), the recycled compost (bulking agent) made up 62.5% of the compost mixture. During two-stage, static pile composting, the compost weight decreased 22%. If the finished compost is recycled as a bulking agent, 80% of the compost weight generated in one compost bin can be used as an ingredient to compost another bin of mortalities. This leaves 20% excess compost generated during each composting cycle.

The finished compost contains about 35% moisture, has no noxious odors, and contains (on a wet ton basis) about 50 of pounds N, 100 pounds of super-phosphate, and 61 pounds potash (Table 3). Based on commercial fertilizer costs, the fertilizer value of a wet ton of the swine mortality compost was determined to be $47.

These results suggest that swine carcasses can be composted on farms without creating offensive odors and yields a valuable fertilizer, thus giving swine producers another way to turn a waste product into a valuable resource.

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