

Nutrient Management Planning for Broiler AFOs

This publication provides information to help the owner/operator of a broiler facility to develop a simple nutrient management plan. This plan should help reduce or eliminate pollutant discharge into surface and ground waters from land application of broiler litter (bedding material and manure) and dead bird compost. Once developed, this plan should be used to guide nutrient applications on all fields and crops. Although not required, the owner/operator may wish to have his or her plan reviewed and approved by a local NRCS district conservationist.

Background

Alabama's National Pollutant Discharge Elimination System (NPDES) rules for Animal Feeding Operations (AFOs) require all AFOs to implement best management practices (BMPs) to protect water quality. While the rules for the larger Concentrated Animal Feeding Operations (CAFOs) require a registration procedure and an NRCS-approved waste management system plan, all sizes of AFOs are affected. Owners/operators of any animal feeding operation in Alabama must "... maintain adequate records to document compliance ... and regularly maintain comprehensive waste management system BMPs to the maximum extent practicable which meet or exceed NRCS technical standards and guidelines to prevent and minimize discharges of pollution during construction and operation." (ADEM AFO/CAFO Rules adopted March 31, 1999 and

reaffirmed February 10, 2006.) A BMP common to all sizes of AFOs, a comprehensive nutrient management plan (CNMP) is one way to help meet this requirement. (Alabama Cooperative Extension System publication ANR-1188, "Best Management Practices for Broiler Operations," briefly explains the most important BMPs for all broiler AFOs.) Nutrients of primary concern are nitrogen (N), which can leach into ground water as nitrate-N, and phosphorus (P), which can run off land and enrich surface waters. Control of these nutrients will also limit bacterial contamination of both surface and ground waters.

Things You Will Need

To proceed through the five steps of this simplified NMP, the owner/operator must have the following:

1. An **aerial photo** or **topographic** map of the farm showing all fields where nutrients (either fertilizer or manure) will be applied and potentially affect streams and water bodies
2. **Soil survey**
3. Current (within last 3 years) **soil test** report from each field where nutrients will be applied
4. **Knowledge of the overall operation** (for example, number of houses, number of birds produced, market weight of birds, dead bird disposal, etc.)

Five Easy Steps

The plan can be developed in five easy steps:

1. Estimate broiler litter and compost production and storage.
2. Estimate nutrient value of broiler litter and compost.
3. Map and calculate land area for spreading, considering required buffers.
4. Determine target crop and nutrient needs and timing for each field.
5. Determine uses for excess litter/compost production and Certified Animal Waste Vendor needs.

Step 1. Estimate Broiler Litter and Compost Production

- First, calculate how many pounds of birds are produced on the farm each year:

$$\text{lb. market wt. birds per year} = \text{no. of houses} \times \text{flock size} \times \text{no. of batches} \times \text{pounds market wt. per bird}$$

CAUTION: Changes in availability of wood shavings and other "new" litter material for replacement litter when houses are cleaned out could make a big difference in the amount of "litter" produced each year by any particular farm. *Use actual figures for litter produced from each farm if at all possible.*

About 0.5 pound of broiler litter will be produced for each pound of market weight bird produced (based on tests by Auburn

University Biosystems Engineering and the Alabama Poultry Industry). Therefore, use the following to estimate pounds of litter produced per year on a farm:

$$\text{lb. manure per year} = \text{lb. market wt. birds per year} \times 0.5$$

Example:

Ima B. Goode has 4 broiler houses that hold 28,000 birds each. She markets 4.5-pound birds and produces 6 flocks a year. How much litter can she expect to produce on this farm each year?

Market wt. birds:

$$4 \text{ houses} \times 28,000 \text{ birds/hse} \times 6 \text{ batches/yr.} \times 4.5 \text{ lb./bird} = 3,024,000 \text{ pounds or } 1,512 \text{ tons market wt. birds}$$

Litter produced:

$$1,512 \text{ tons} \times 0.5 = 756 \text{ tons litter per year (Ms. Goode, like most producers, will probably need to plan to store up to half of this or about 380 tons.)}$$

- Determine dead bird compost produced. (Skip this section if birds are incinerated or taken to a rendering plant.)

Estimate the weight of dead birds that need to be composted each year (Table 1). The amount of litter needed in this composting process is estimated by multiplying the weight of dead birds by 2.5. During the composting process, assume about 20 percent weight loss.

Example:

Ima B. Goode assumes that the average size of her dead birds is 2.1 pounds (Table 1), and she expects about 5 percent mortality.

Dead bird weight:

$$4 \text{ houses} \times 28,000 \text{ birds/hse} \times 6 \text{ batches/yr.} \times 0.05 \text{ mortality} \times 2.1 \text{ lb./bird} = 70,560 \text{ pounds dead birds or } 35.28 \text{ tons}$$

Litter needed to compost dead birds (from Worksheet 1):

$$35.28 \text{ tons} \times 2.5 = 88.2 \text{ tons}$$

(This can be subtracted from the total litter produced.)

Total compost produced:

$$(35.28 \text{ tons dead birds} + 88.2 \text{ tons litter needed}) \times 0.80 \text{ residual} = 99 \text{ tons compost}$$

- Determine litter and compost storage:

Adequate dry stack or temporary storage must be provided to store and/or spread litter according to this plan. State this as part of the nutrient management plan.

Minicomposters (single stage) may have no storage capacity beyond one flock. Determine your compost storage capacity needs to properly time application of generated compost on a growing crop. Dead bird compost should be stored separately from normal broiler litter.

Note: Before spreading any litter, always plan to use the dead bird compost on the farm where it was generated. Dead bird compost cannot be transported without a special permit from the state veterinarian's office of the Alabama Department of Agriculture and Industries. Spreading of the litter at the proper time recommended for the crop to be grown and at the rate recommended is a best management practice.

Example:

Ms. Goode's NRCS-designed two-stage composters will store 3 batches of compost or half of the 99 tons generated in a year.

Step 2. Estimate Nutrient Value of Broiler Litter and Compost

For the purposes of nutrient management planning, average values for litter and composted dead birds can be used from Table 1. These values are estimates of plant available nutrients during the first year under Alabama conditions. As a general rule, poultry broiler litter is a 3-3-2 fertilizer (60-60-40 pounds N-P₂O₅-K₂O per ton), but not all the N in broiler litter is available to crops. Since manure and compost are highly variable, they should be periodically tested to verify the actual nutrient value. Analyzed

values are preferable to values from a table. If actual litter production is used in Step 1 rather than an estimated value, then actual laboratory analyses of the litter should be used in Step 2. Keep laboratory analyses as part of this plan.

Example:

From Table 1, Ima B. Goode estimates that her litter contains 56-58-45 pounds N-P₂O₅-K₂O per ton if incorporated. The dead bird compost contains 50-58-45 pounds N-P₂O₅-K₂O per ton. But since she will surface apply all litter to pastures and hayfields, she can multiply the N value by 0.84 to account for N volatilization.

$$\text{Available nutrients of surface-applied litter} = 47-58-45 \text{ per ton}$$

$$\text{Available nutrients of surface-applied compost} = 42-58-45 \text{ per ton}$$

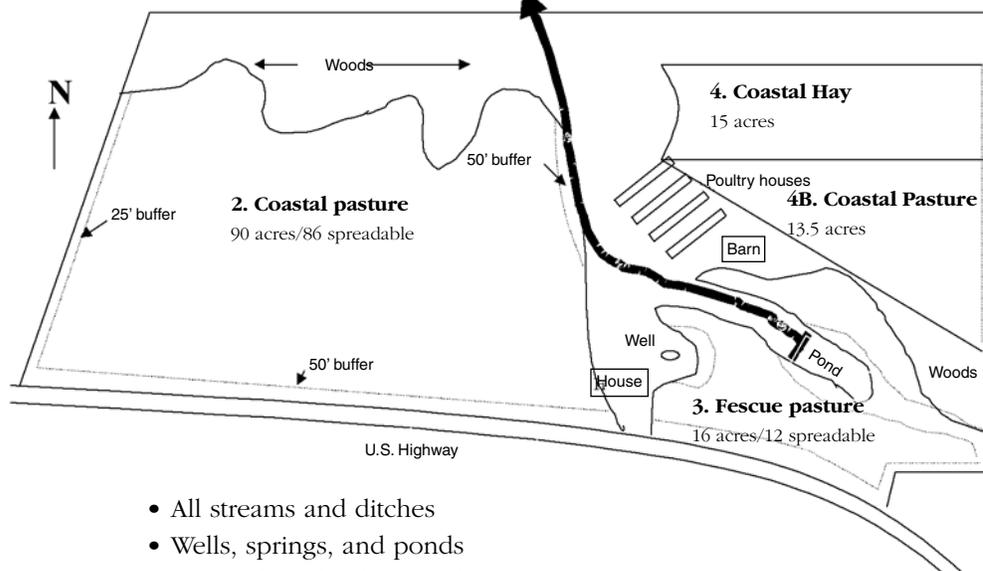
Step 3. Map and Calculate Land Area for Spreading

To identify fields for litter and compost spreading and to calculate spreadable acreage, you will need a detailed farm map to scale. This can be a copy of your conservation plan map or a soil survey map of the farm from NRCS, a Farm Service Agency (FSA) aerial photo of the fields, or a sketch you draw yourself. A topographic map of the farm can help identify steep slopes and waterways. Some maps such as digital ortho quarter quadrangles or DOQQs can be downloaded from Web sites such as the Alabama Extension Water Quality Web site at www.aces.edu/waterquality/gis_data/index.php.

On the field map show the following:

- Field identification (name or number)
- **Spreadable** acreage (total acreage minus buffers, borders, waterways, riparian zones, frequently flooded soils, etc.) (Table 2).

Goode Poultry/Cattle Farm (160 acres total land area)



- All streams and ditches
- Wells, springs, and ponds
- Roads, forestland, and other areas impractical for spreading
- Houses, barns, and other buildings

Spreadable or useable acres in a field can be estimated if you know the scale of the map.

Rectangle or square field: (length in feet x width in feet)/43,560 = acres

Triangle-shaped field: 1/2 (length in feet x width in feet)/43,560 = acres

Round field: (3.14 x radius x radius)/43,560 = acres

Irregular-shaped fields:
estimate area in field

Another way of arriving at spreadable acres is to figure the border/buffer area removed from use and subtract this from the FSA-figured field acres.

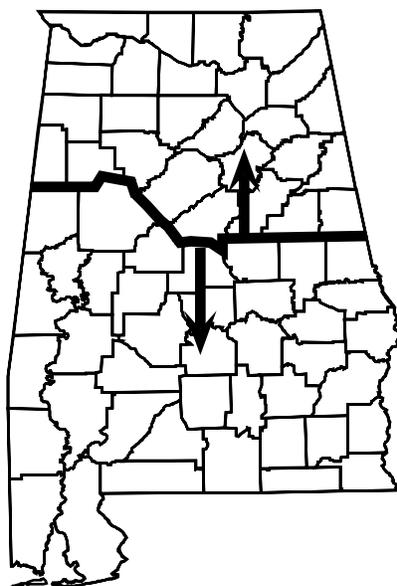
Step 4. Determine Crop and Nutrient Needs for Each Field

Soil samples should be taken from each field (no more than 10 acres per composite sample) at least every 3 years. Samples should be taken from the surface 0 to 3 inches from pastures and hayfields and the plow layer for cultivated cropland. Keep these reports as part of your nutrient management plan. Soil testing is a BMP! Failure to soil test

could justify redesignating an AFO into a CAFO by ADEM.

Apply manures in fall and winter only to actively growing crops. In North Alabama (see Alabama map) from approximately November 15 to February 15, apply no more than 30 pounds of nitrogen per acre to the crops as indicated in Table 3 if the crop meets the minimum grazing height requirements of NRCS conservation practice standard, Prescribed Grazing-528A.

Nutrients (fertilizer or manure) can be applied based on two options and modified based on the phosphorus index (P index), which



can be calculated for each field: (1) nitrogen limit based on soil test recommendations from Auburn University's Soil Testing Laboratory and (2) anticipated crop P removal.

Option 1. Nitrogen Limit.

If phosphorus (P) is needed and recommended, then applying P at the recommended rate is the best option (soil test P rating is "very low," "low," "medium," and sometimes "high"). If allowed by the P index (see below) litter or compost may be applied based on the N recommended for the crop to be grown. In most cases, this will result in more P applied than is needed or recommended, but this will be apparent in the next soil sample taken because soil test P will build rapidly.

Option 2. P Crop Removal.

If soil test P is already rated "high" (H), "very high" (VH), or "extremely high" (EH), then no more P is needed for maximum crop yields. However, since some crops, particularly hay and silage, can remove significant quantities of P, application based on crop removal (Table 3) is allowed. Additional fertilizer N and/or K may be needed for optimum crop production. *Note: Animals grazing pastures remove very few nutrients; this may limit application of litter on pastures.*

P Index

Phosphorus application in excess of P recommended by soil test shall be based on the field vulnerability for offsite P losses to surface waters. This potential is estimated by calculating a P index for every field (see USDA-NRCS publication *Phosphorus Index for Alabama*). The P index is a way of assessing the potential for soil and applied P to run off into surface waters. A low P index is desirable and may allow higher P applications to some soils. Best management practices, such as grassed waterways, setbacks from streams, filter strips, limited animal access to surface waters, and lower P applications can decrease the P index. In some cases

where soil test P is rated “EH,” a low P index may still allow for some litter or compost application. *The planned P rate cannot exceed the P application rate used in calculating the P index.*

P index rating (Field vulnerability)	Basis of P application rate
Very low/low	Nitrogen rate
Medium	3x P removal by crop
High	2x P removal by crop
Very high	1x P removal by crop
Extremely high	No P application

The NPDES AFO rules require the AFO operator to maintain detailed records of all land application of animal/broiler wastes. This includes date of application, weight and/or volume, destination, and acreage spread. These records should easily allow determination of spread rate in each field.

Step 5. Determine Uses for Excess Litter/Compost Production

From these calculations, you will now be able to determine if your present operation can effectively use all the waste nutrients in an environmentally sound manner. Based on step 4, determine how much litter or compost can be reasonably applied to each field and when it should be applied. Animal wastes should only be applied when there is an actively growing crop or when it is less than 1 month before planting a crop.

This is also a BMP. If cleanout of houses does not correspond with the proper time to apply to crops, then storage facilities (e.g., dry stack barns or temporary, covered stacks) may have to be constructed (see Extension publication ANR-839, “Broiler Litter Storage”).

If more litter is produced than can be used on the farm based on step 4, it should be consigned to an Alabama Certified Animal Waste Vendor (CAWV). See Extension publication ANR-1176, “How the Alabama Certified Animal Waste

Vendor Program Works,” for more information. If you use a CAWV, include his or her name in the nutrient/waste management plan if possible. *The owner/operator is responsible, to the extent allowed by law, for the proper use of any excess litter that is not consigned to a CAWV even if it is sold or given to a neighbor or spread on someone else’s land.* Any sale of litter should be accompanied with information on proper use of the litter and be fully documented with a record of the transaction.

Worksheets

The following worksheets may be used in preparing the nutrient/waste management plan, or the owner/operator can develop his or her own worksheet. The important point is to plan the use of all nutrients/waste produced on the farm.

Table 1. Characteristics of Poultry Operations and Waste Generated

Category	Bird weight		No. of flocks per year	Mortality rate (%)	Available nutrients in manure+litter		
	Average (lb.)	Mature (lb.)			N ¹	P ₂ O ₅	K ₂ O
					--Pounds per ton--		
Broiler	2.1	4.5	6	4	56	58	45
Broiler	3.2	6.5	5.5	7.5	56	58	45
Broiler (roaster)	4.2	8.5	4.5	6	56	58	45
Cornish hen	1.0	2.0	9.0	3.5	56	58	45
Pullets breeder replacement	4.0	4.5	2.2	4.0	29	57	35
Pullets layer replacement	2.0	3.0	2.0	2.0	27	57	35
Breeding hens & roosters	6.0	7.5	0.8	11.0	32	53	35
Laying hen	4.0	4.5	0.8	14	31	57	46
Dead bird compost					50	58	45

¹Values for N are for soil-incorporated manure. Multiply N values by 0.84 if surface applied and not incorporated within 3 days to account for N volatilization losses.

NOTE: 1 cubic yard litter = 810 pounds 1 ton = 2.5 cubic yards (Highly moisture dependent. Use actual values for each farm, if available.)

Table 2. Recommended Buffer Widths for Animal Manure and Organic By-Product Application

Object, site	Situation	Buffer width (ft.) from object, site
Well	Located up-gradient of application site	200
Well	Located down-gradient of application site	300
Water body or stream ^{1/}	Waste applied to pasture ^{3/} , hayland, or cultivated land ^{4/}	50 ^{2/}
Public road	Spray irrigated wastewater	100
Public road	Waste applied with spreader truck	50
Public use area ^{5/}	Dry waste	100
	Liquid waste	200
	Spray irrigated wastewater	500
Property line	All	25

^{1/} Water body includes pond, lake, wetland, or sinkhole. Stream includes both perennial and intermittent streams.

^{2/} 200' for Outstanding National Resources Water or Outstanding Alabama Water. On edges of the application field where runoff occurs to environmentally sensitive areas and to nonvegetated concentrated flow areas within the field, buffer widths must include a vegetated filter at least 50 feet wide that is established to permanent grasses (filter strip) with a stem density of at least 1 per square inch. If the filter incorporates a riparian forest buffer, in accordance with NRCS Conservation Practice Standard, Riparian Forest Buffer - Code 391A, the permanent grass filter strip may be 20 feet wide. The vegetated width must be located adjacent to the application field or concentrated flow area and be shaped so that flow from runoff is uniform (sheet flow) and does not concentrate.

^{3/} If good grazing management (i.e., rotational grazing) is not used on pasture land, the vegetative filter must be protected from overgrazing with a fence.

^{4/} Cultivated land for waste application must have adequate erosion control practices in place.

^{5/} Public areas include such occupied locations as a nonowner dwelling, church, hospital, or park.

Table 3. Nutrient Removal by Selected Crops

Crop	Unit yield	Nutrient removal		
		N	P ₂ O ₅	K ₂ O
Alfalfa hay	1 ton	52	12	50
Bahiagrass hay	1 ton	25	7	42
Bermudagrass hay	1 ton	50	12	43
Clover hay	1 ton	40	10	40
Corn grain	1 bushel	1.0	0.4	0.3
Corn silage	1 wet ton	10	4	10
Cotton lint and seed	1 bale	32	12	16
Oats, grain only	1 bushel	0.8	0.3	0.2
Oats, grain, and straw	1 bushel	1.2	0.4	1.4
Pasture: bermuda or bahia	200 lb. beef	6	5	1
Pasture: fescue, ryegrass, or orchardgrass	300 lb. beef	9	7	1
Peanuts, nuts	1 ton	70	11	16
Peanuts, nuts, and vines	1 ton nuts + vines	120	15	93
Peas, vines, and pods	1 ton	48	12	25
Ryegrass hay	1 ton	33	5	28
Sweetpotatoes	100 bushels	13	6	32
White potatoes	100 pounds	0.3	0.2	0.5
Sorghum, grain	1 bushel	0.8	0.4	0.2
Sorghum silage	1 wet ton	11	4	10
Soybean, grain	1 bushel	4	1	1.5
Switchgrass hay	1 ton	23	6	46
Tall fescue hay	1 ton	40	9	48
Tomatoes, fruit	100 pounds	4	1	9
Wheat, grain	1 bushel	1.2	0.6	0.3
Wheat, grain, and straw	1 bushel	1.7	0.7	2.0

Source: Alabama Cooperative Extension publication ANR-449, "Nutrient Removal by Alabama Crops," and USDA-NRCS, AL Nutrient Management Code 590

Nutrient Management Planning Small AFO Summary Worksheet #1

AFO OPERATION NAME _____ ANIMAL TYPE Broiler

TYPE OF WASTE _____ OPERATOR _____ DATE ____/____/____

Step 1. Broiler Litter and Dead Bird Compost Production

Use your complete, verifiable written records of yearly actual litter production from your operation, otherwise estimate litter produced.

Litter produced:

$$\frac{\text{no. of houses}}{\text{no. of houses}} \times \frac{\text{flock size}}{\text{flock size}} \times \frac{\text{no. of batches/yr.}}{\text{no. of batches/yr.}} \times \frac{\text{lb. market wt./bird}}{\text{lb. market wt./bird}} \times 0.5 \div 2000 = \frac{\text{tons litter/yr.}}{\text{tons litter/yr.}} \quad (1.A)$$

Existing dry stack or temporary field storage capacity = _____ (1.B)
tons

Dead Bird Compost: **(Skip this section if birds are incinerated or taken to a rendering plant.)**

Dead birds are incinerated _____ or rendered by _____.

$$\frac{\text{no. of houses}}{\text{no. of houses}} \times \frac{\text{flock size}}{\text{flock size}} \times \frac{\text{no. of batches/yr.}}{\text{no. of batches/yr.}} \times \frac{\text{mortality rate}}{\text{mortality rate}} \times \frac{\text{avg. wt./ dead bird}}{\text{avg. wt./ dead bird}} \div 2000 = \frac{\text{tons of dead birds}}{\text{tons of dead birds}} \quad (1.C)$$

_____ (1.C) x 2.5 = _____ (1.D)
tons of dead birds tons of litter required to compost

(_____ + _____) x 0.80 = _____
tons of dead birds (1.C) - tons of litter required (1.D) tons of compost produced (1.E)

Litter available for on-farm land application:

_____ (1.A) minus _____ (1.D) = _____ (1.F)
tons produced tons for compost tons immediately available

Step 2. Nutrient Value of Broiler Litter and Compost

Litter: Average available N-P₂O₅-K₂O per ton: from table

N _____ lb./ton from laboratory
P₂O₅ _____ lb./ton
K₂O _____ lb./ton

Compost: Average available N-P₂O₅-K₂O per ton: from table

N _____ lb./ton from laboratory
P₂O₅ _____ lb./ton
K₂O _____ lb./ton

Nutrient Management Planning Small AFO Summary Worksheet #2

AFO OPERATION NAME _____ ANIMAL TYPE Broiler

TYPE OF WASTE _____ OPERATOR _____ DATE ____/____/____

Step 3. Area for Land Application. (Attach aerial photo or topographic map and soil survey of farm showing land application areas. Include all buffers and setbacks that apply (Table 2).)

Nutrient Management Planning Small AFO Summary Worksheet #3

AFO OPERATION NAME _____ ANIMAL TYPE: Broiler Page _____ of _____

TYPE OF WASTE _____ OPERATOR _____ DATE ____/____/____

Step 4. Determine Crop and Nutrient Needs for Each Field Planning Sheet Record Sheet

Field & crop information			Soil test		P I N D E X	Basis of P application	Land application		
Field name or no.	Spread- able acres	Crop(s) to be grown	P rating	Recommendation N-P ₂ O ₅ -K ₂ O (lb./acre/yr.)			Total nutrients N-P ₂ O ₅ -K ₂ O (lbs./acre/yr.)	Source of nutrients (litter, compost, fertilizer, etc.)	Month of appli- cation
						<input type="checkbox"/> N limit <input type="checkbox"/> 3x P ₂ O ₅			
						<input type="checkbox"/> 2x P ₂ O ₅ <input type="checkbox"/> 1x P ₂ O ₅			
						<input type="checkbox"/> N limit <input type="checkbox"/> 3x P ₂ O ₅			
						<input type="checkbox"/> 2x P ₂ O ₅ <input type="checkbox"/> 1x P ₂ O ₅			
						<input type="checkbox"/> N limit <input type="checkbox"/> 3x P ₂ O ₅			
						<input type="checkbox"/> 2x P ₂ O ₅ <input type="checkbox"/> 1x P ₂ O ₅			

NOTE: 1 cubic yard litter = 810 pounds (Use actual values, if available.)
1 ton = 2.5 cubic yards (Use actual values, if available.)

Nutrient Management Planning Small AFO Summary Worksheet #4

Planning Sheet or Record Sheet

AFO OPERATION NAME _____ ANIMAL TYPE Broiler

TYPE OF WASTE _____ OPERATOR _____ DATE ____/____/____

Step 5. Determine Uses for Excess Litter and Compost

	Total amount planned or used	
	Litter (total tons)	Compost (total tons)
1. Total on-farm production from Worksheet #1	(Worksheet 1, Item 1.F) _____	(Worksheet 1 Item 1.E) _____
2. Field name or number	Litter (total tons)	Compost (total tons)
2. On-farm land application total (add above lines for fields)		
3. Other on-farm uses (explain)		
4. Total on-farm use (add lines 2 and 3)		
5. Excess to Certified Animal Waste Vendor * (Subtract Line 4 from Line 1) CAWV name _____ CAWV no. _____		

* Keep written records of all CAWV transactions to include tons of litter sold, to whom, and date.



Your Experts for Life

ANR-926

J. Tredaway Ducar, *Extension Waste Management Specialist*, Sand Mountain Research and Education Center, **C.C. Mitchell**, *Extension Agronomist*, Professor, Agronomy and Soils, and **T.W. Tyson**, *Extension Biosystems Engineer*, Professor, Biosystems Engineering, both with Auburn University

For more information, call your county Extension office. Look in your telephone directory under your county's name to find the number.

Issued in furtherance of Cooperative Extension work in agriculture and home economics, Acts of May 8 and June 30, 1914, and other related acts, in cooperation with the U.S. Department of Agriculture. The Alabama Cooperative Extension System (Alabama A&M University and Auburn University) offers educational programs, materials, and equal opportunity employment to all people without regard to race, color, national origin, religion, sex, age, veteran status, or disability.
Web Only, **Revised July 2007**, ANR-926