Wind Speed and Vegetation Effects on Drift from A Fan-Cage Highway Sprayer

Circular 219 August 1975

AGRICULTURAL EXPERIMENT STATION / AUBURN UNIVERSITY
R. Dennis Rouse, Director Auburn, Alabama

ACKNOWLEDGMENT

The author wishes to express his gratitude to Span-Spray Division of Ring Around Products, Inc., of Montgomery, Alabama for furnishing the sprayer and other materials used in this study. A special note of thanks is due Michael Patrick of the same firm for operating the sprayer during the tests.

FIRST PRINTING 3M, AUGUST 1975

Wind Speed and Vegetation Effects on Drift from A Fan-Cage Highway Sprayer

RAY DICKENS*

INTRODUCTION

A MAJOR PROBLEM in the use of herbicides for vegetation control on roadsides is the necessity for large quantities of water with conventional spray applications. Volumes of spray solution from 50 to 200 gallons per acre are not unusual.

A recently developed herbicide application system promises to reduce the volume of liquid needed to less than 6 gallons per acre. The fan-cage highway sprayer[1] utilizes a combination of rotating cage and fan to break up and distribute the spray. The basic system has been used for general crop spraying for several years.

The sprayer designed for highway use differs from the crop sprayers in two important ways: (1) the fans are mounted on the end of a highly maneuverable boom and (2) the fans direct the spray downward instead of discharging it horizontally.

Drift of herbicides onto non-target areas is another major concern to highway vegetation management personnel. Many of the materials used for roadside vegetation control can cause serious injury to sensitive crops or ornamental plants. Chemicals which drift off target are wasted. Physical drift is usually due to wind movement; but temperature inversions or convection currents can prevent very small droplets from falling to the target surface. These microscopic droplets may be carried away from the application site even during relatively calm wind conditions.

---

* Associate Professor, Department of Agronomy and Soils.

[1] The sprayer used in these tests was a Span-Spray® model 145 Highway unit manufactured by Span-Spray Division of Ring Around Products, Inc., Montgomery, Alabama.

Drift of sprayed materials is influenced by factors such as particle size, wind conditions, height of nozzles, and nozzle design. High pressures usually cause a decrease in particle size and a consequent increase in the amount of drift.

No information on the drift characteristics of this machine was available. Therefore, work was initiated by Auburn University to determine the drift potential for the machine as affected by wind speeds, vegetation heights, and drift control agents.

GENERAL TEST PROCEDURE

Three pounds of Auragreen®[2] a water soluble turf dye (malachite green 60.2 percent; auramin 36.1 percent; crystal violet 3.7 percent) were mixed in 20 gallons of water and placed in the spray tank. A household detergent containing a combination of anionic and nonionic surfactants was added in the amount required for 0.2 percent solution by volume. The terminal fan unit was positioned approximately 4½ feet above the ground and turned downward at about 45° from vertical to provide a spray swath of approximately 8 feet in width. The rate of fluid delivery was determined and this information was used to calculate the rate of application for each test run. The application rate was approximately 6.2 gallons per acre in all runs. A reference sample for determining dye concentration was taken prior to each spray operation. Aluminum foil discs, 6.5 inches in diameter were anchored horizontally to small strips of wood and placed 10, 15, 20, 30, 40, and 60 feet down wind from the spray path (Figure 1). The spray path was perpendicular to the wind direction. Four discs were placed at each sampling distance. One to three passes were required to ensure enough dye for measurement, and to average out slight variations in wind speed during individual runs.

After the sprayer passes were completed the discs were collected and placed in 9-inch aluminum pie pans containing 25 milliliters of 0.2 percent detergent-water solution. The pans were swirled by hand to elute the dye and the resulting dye solution was placed in polyethelene bags and transported to the laboratory for analysis. The concentration of dye in the 25 milliliter samples and in the samples taken from the tank at the time of spraying was determined colorimetrically. Preliminary work showed that recovery of dye from the plates was in excess of 95 percent 24 hours after application. Concentration data were

[2] Mallinckrodt Chemical Works, St. Louis, Missouri.

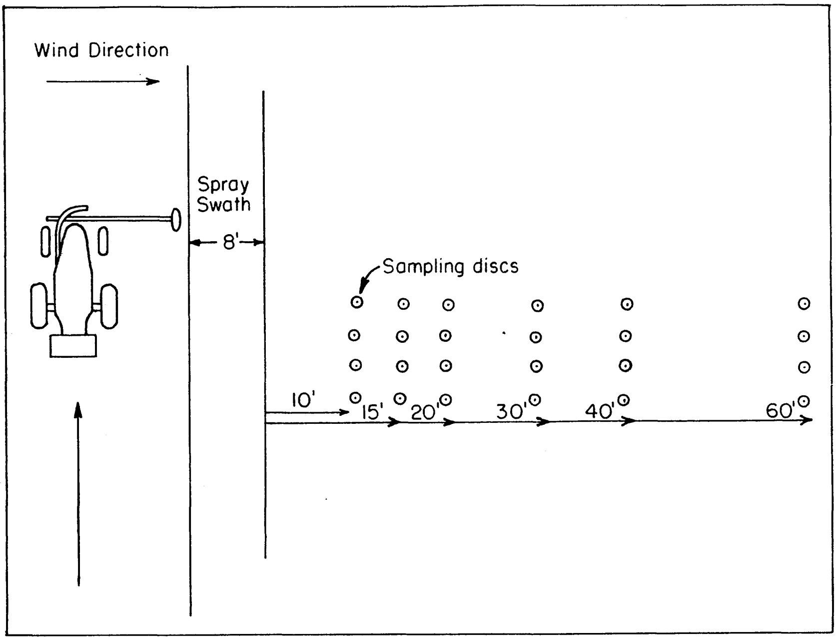


FIG. 1. Layout for drift sample collection.

used to calculate the amount of drift deposited at various distances from the spray swath. Test runs were made at low (0 to 2 miles per hour), medium (4 to 6 miles per hour), and high (12 to 14 miles per hour) wind speeds over low (¼-inch golf green); medium (4-inch dormant bermuda turf); and high (30-inch dormant sericea lespedeza stems) vegetation. Wind speeds were monitored throughout each run with a hand-held aneometer having ± 3 percent accuracy. The discs were placed at the level of the existing vegetation except in the case of the high vegetation where they were placed at ground level. The width of the strip of high vegetation was 16 feet. Two test runs were made under each combination of wind and vegetation conditions.

An additional test was conducted to evaluate the effect of Nalco-Trol (polyvinyl polymer) drift control agent on the drift obtained from the machine. The tests were conducted over low vegetation and at 9 to 10 miles per hour wind speeds. Two separate evaluations were made with the standard mix and two more with Nalco-Trol (polyvinyl polymer) added at ½ ounce per 100 gallons of spray solution.

All data were converted to percent of the application rate applied to the 8-foot swath if no drift had occurred. All data were analyzed and only statistically significant differences will be discussed.

RESULTS AND DISCUSSION

In general, the amounts of drift deposited decreased rapidly as the distance from the spray swath increased. The amounts of drift measured ranged from a high of 8 percent at 10 feet from the spray swath under high wind and low vegetation to less than 0.1 percent at 60 feet under low winds. Higher wind speeds caused increased drift deposition only at 10 and 15 feet from the spray swath over low vegetation (Figure 2). But, when spray was applied to medium and high vegetation there were differences due to wind speeds at all points up to 60 feet from the spray path (figures 3 and 4). One possible reason for less effects of wind speed over the lower vegetation is lesser effect of lower vegetation on the air movement created by the fan. The air movement created by the fan was sufficient to move the spray particles 60 feet under these conditions, whereas the higher vegetation dampened the effects of the fan sufficiently to cause less drift under low wind conditions. The position of the fan was

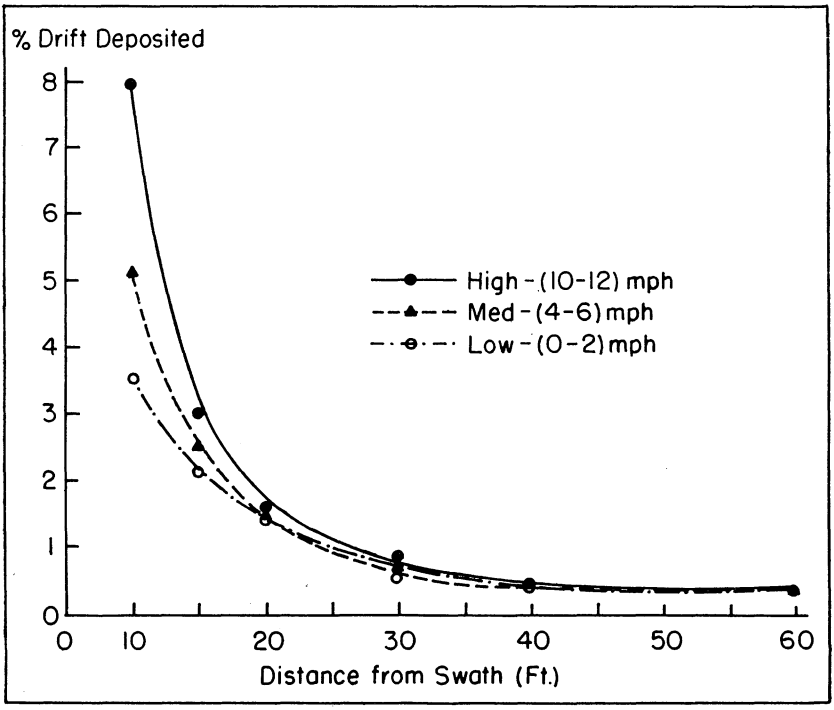


FIG. 2. Effects of windspeed on drift in low (1/4") vegetation.

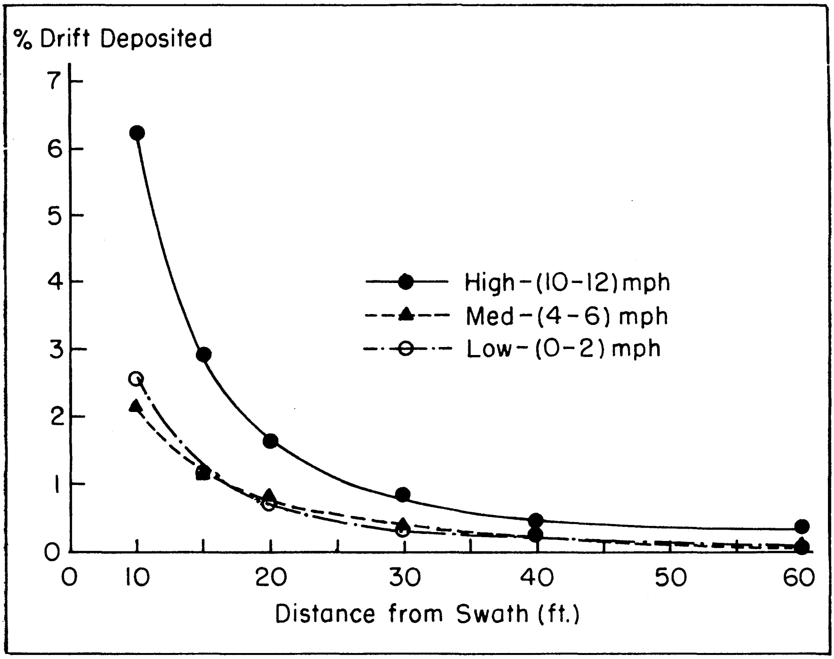


FIG. 3. Effects of wind speed on drift in medium (4") vegetation.

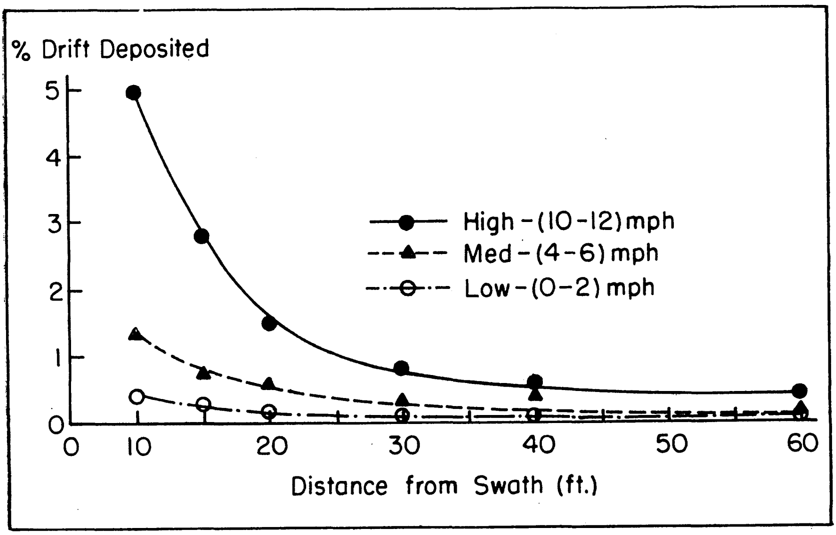


FIG 4. Effects of wind speed on drift in high (30") vegetation.

such that the particles of spray were driven into the vegetation under rapid air movement. Then the vegetation reduced air movement to the point that most of the particles were deposited very near the spray swath. There was less difference between the amounts of drift deposited at low and medium wind speed than between medium and high wind speeds. Again, the lower wind speeds may not have been sufficient to override the effects of the air blast created by the fan.

Vegetation heights caused differences in the amount of drifts deposited at all points under low and medium wind conditions (figures 5 and 6), whereas, under high wind conditions the height of vegetation was important only at 10 feet from the swath (Figure 7).

Results of the tests involving Nalco-Trol indicate that the product is of doubtful value in controlling drift from a fan-cage application (Figure 8). The addition of Nalco-Trol to the spray solution caused a greater amount of drift to be deposited 10 feet from the swath, but had no effect on drift at distances greater than 10 feet. This added deposition of dye solution toward the outer edge of the spray swath was observable during spraying. When spraying the conventional dye solution an uneven application of spray is obtained across the swath. Most of the spray is

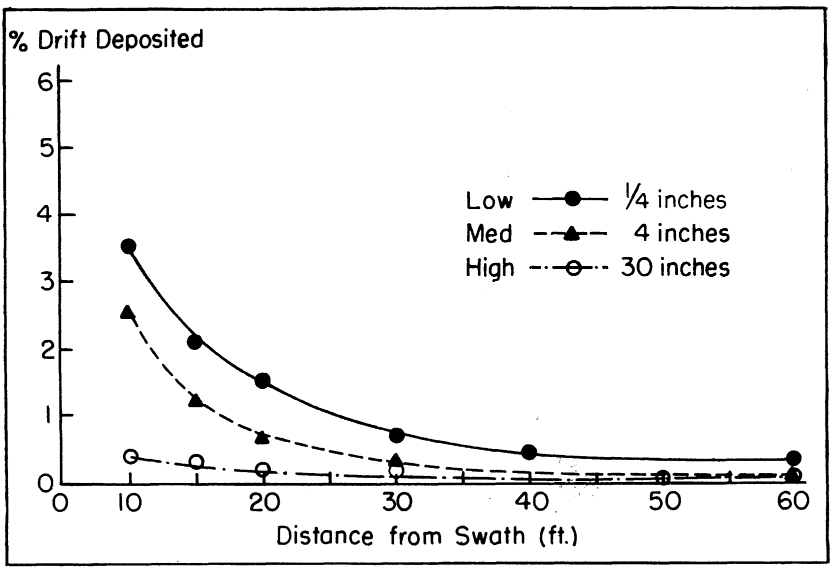


FIG. 5. Effects of vegetation height on drift under low (0-2 mph) wind conditions.

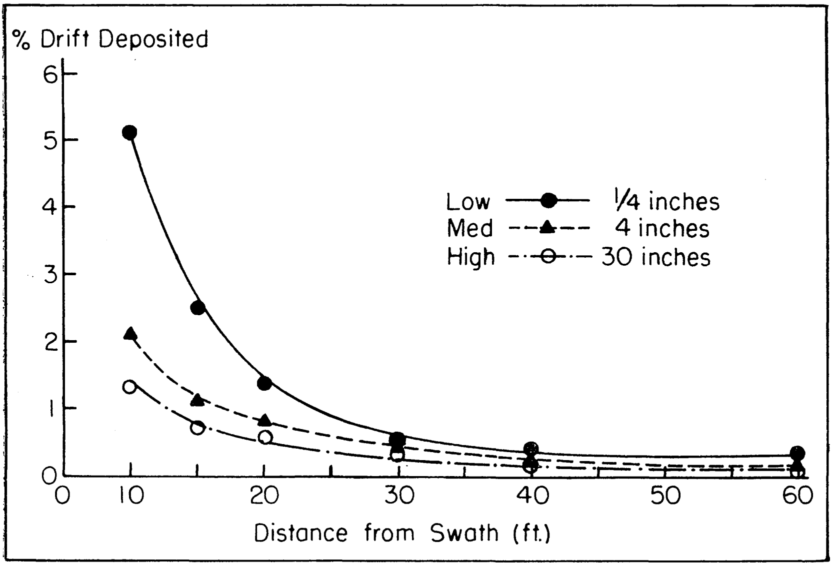


FIG. 6. Effects of vegetation height on drift under medium (4-6 mph) wind conditions.

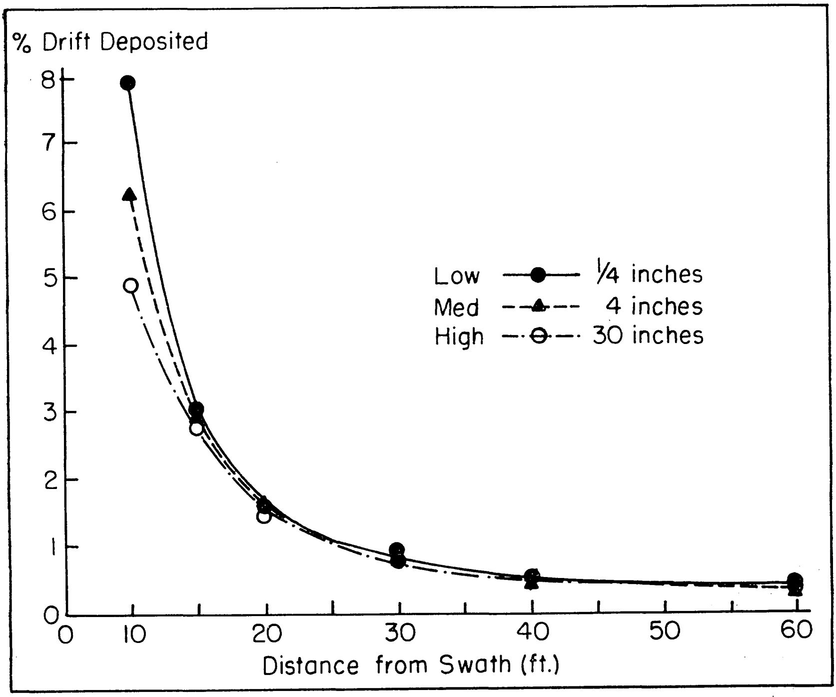


FIG. 7. Effects of vegetation height on drift under high (10-12 mph) wind conditions.

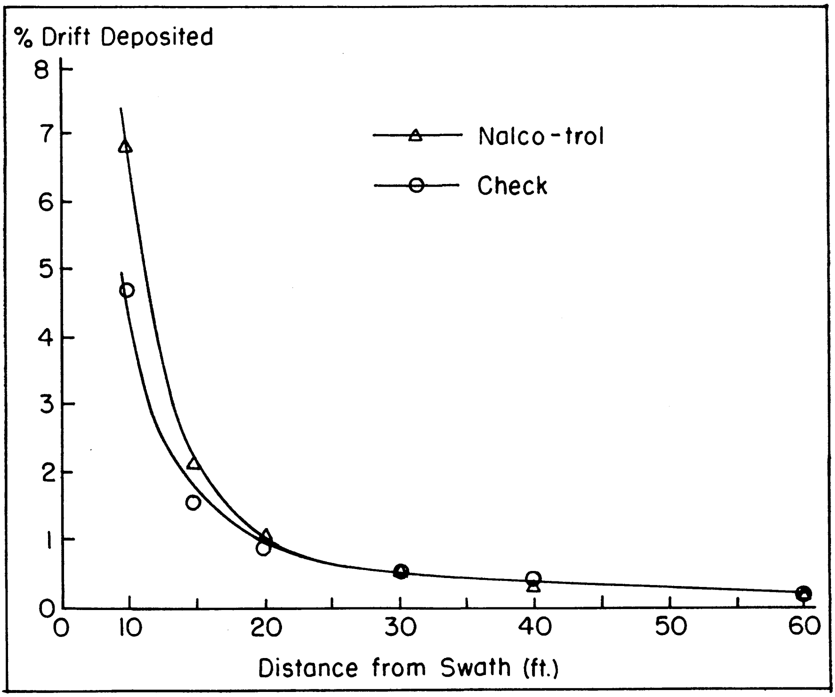


FIG. 8. Effects of Nalco-Trol spray additive on drift.

concentrated in the area nearest the fan with a rapid decrease in the amount applied as distance from the fan increases. The addition of Nalco-Trol caused a noticeably more even application of dye across the 8-foot spray swath. Perhaps the addition of this or other drift control materials might be advisable in situations where more uniformity of application is desired across the entire spray swath.

CONCLUSIONS

Results of this study indicate that drift from the fan-cage highway sprayer will be influenced by both wind conditions during spraying and the amount of vegetation present on the sprayed area. When the fans are directed downward 45° from horizontal; wind speeds less than 6 miles per hour and the presence of vegetation will substantially reduce drift.

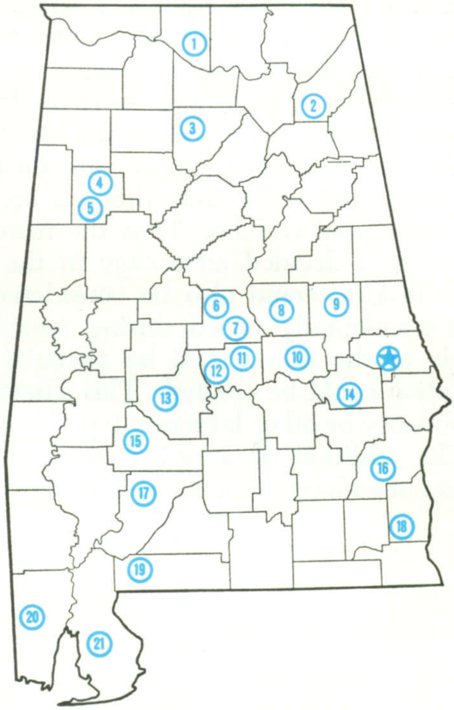
The amount of drift encountered under the above conditions appears to be of negligible concern in the application of many vegetation control chemicals. For instance, if one applied 2 pounds of MSMA plus 5 pounds of diuron per acre as a guard rail treatment in a 4 mph wind he could expect deposits of less than .03 pounds per acre of MSMA and .02 pounds per acre of diuron 20 feet from the edge of the spray swath. The effects of these amounts of the chemicals would not be detectable on most plants. On the other hand, if 2,4-D or other phenoxy herbicides were being applied then some injury to certain susceptible crops, such as tomatoes or cotton could conceivably occur.

Although no comparisons were made it is reasonable to assume that, if the fans were directed upward or horizontally, drift would be increased. Likewise, it is common knowledge that the higher above ground level spray droplets are released, the greater the drift potential will be. Thus the maneuverability of the boom, although a decided advantage in the application of herbicides to roadsides, could also be considered a hazard. If the boom was accidentally raised during spraying both the height and angle of the fans would be changed and a very serious drift situation could be created. This situation would be most serious if phenoxy or other hormone type herbicides were being applied.

The addition of a drift control agent (polyvinyl polymer) does not reduce the amount drift from the fan-cage sprayer.

Alabama's Agricultural Experiment Station System
AUBURN UNIVERSITY

With an agricultural research unit in every major soil area, Auburn University serves the needs of field crop, livestock, forestry, and horticultural producers in each region in Alabama. Every citizen of the State has a stake in this research program, since any advantage from new and more economical ways of producing and handling farm products directly benefits the consuming public.



Research Unit Identification

★ Main Agricultural Experiment Station, Auburn.

1. Tennessee Valley Substation, Belle Mina.
2. Sand Mountain Substation, Crossville.
3. North Alabama Horticulture Substation, Cullman.
4. Upper Coastal Plain Substation, Winfield.
5. Forestry Unit, Fayette County.
6. Thorsby Foundation Seed Stocks Farm, Thorsby.
7. Chilton Area Horticulture Substation, Clanton.
8. Forestry Unit, Coosa County.
9. Piedmont Substation, Camp Hill.
10. Plant Breeding Unit, Tallassee.
11. Forestry Unit, Autauga County.
12. Prattville Experiment Field, Prattville.
13. Black Belt Substation, Marion Junction.
14. Tuskegee Experiment Field, Tuskegee.
15. Lower Coastal Plain Substation, Camden.
16. Forestry Unit, Barbour County.
17. Monroeville Experiment Field, Monroeville.
18. Wiregrass Substation, Headland.
19. Brewton Experiment Field, Brewton.
20. Ornamental Horticulture Field Station, Spring Hill.
21. Gulf Coast Substation, Fairhope.