

CONTROL OF POWDERY MILDEW AND



CERCOSPORA LEAF SPOT



ON BIGLEAF HYDRANGEA WITH HERITAGE AND MILSTOP FUNGICIDES



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CONTROL OF POWDERY MILDEW AND CERCOSPORA LEAF SPOT ON BIGLEAF HYDRANGEA WITH HERITAGE AND MILSTOP FUNGICIDES

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INTRODUCTION

Bigleaf hydrangea (*Hydrangea macrophylla* (Thunb. ex J. A. Mirr) Ser., which is best adapted to USDA Hardiness Zones 6 to 9, is not only widely used in landscape plantings across Alabama but also is a staple crop for the florist industry nationwide (3). While the bigleaf hydrangeas typically are not prone to devastating disease outbreaks in landscape, nursery, or greenhouse settings, even under ideal environmental conditions several diseases may have a detrimental impact on plant aesthetics in the landscape or on the salability of container-grown plants (19).

Outbreaks of powdery mildew, which is incited by the fungus *Erysiphe polygoni* DC., commonly occur on container-grown bigleaf hydrangea, particularly in the greenhouse (19). This disease also occurs widely on bigleaf hydrangea in residential and commercial landscape plantings. Symptoms, which are often most severe on tightly packed container stock, include extensive leaf yellowing, premature leaf shed, a reduction in leaf area, and shoot elongation (16).

Cercospora leaf spot, which is caused by the fungus *Cercospora arborescentis* Tehone & E. Y. Daniels, occurs most often in landscape plantings of bigleaf hydrangea and occasionally is found on nursery stock. Typically, this disease is not as serious a threat to the salability of greenhouse-grown bigleaf hydrangea as powdery mildew. Symptoms of Cercospora leaf spot include premature leaf shed as well as a noticeable frog-eye spotting of the leaves beginning on the lower limbs and progressing upward through the canopy and outwards towards the shoot tips (6).

While cultural practices such as surface watering and wide plant spacing may reduce the incidence of powdery mildew and Cercospora leaf spot in landscape plantings, preventative fungicide treatments may be required to consistently produce qual-

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ity bigleaf hydrangea (19). Currently, several fungicides are registered for the control of powdery mildew and *Cercospora* leaf spot on bigleaf hydrangea but limited information is available concerning their efficacy for the control of either disease. Previously, Morrison (9) noted that protective chlorothalonil or mancozeb programs greatly reduced the severity of *Cercospora* leaf spot on 'Nikko Blue' bigleaf hydrangea.

Heritage® (azoxystrobin), which is classified as a strobilurin or QoI fungicide, has activity against a number of plant pathogenic fungi and is currently marketed for use on field, vegetable, and amenity crops (1). Residues of this fungicide not only have protective activity on the leaf surface but also have demonstrated translaminar, or local, systemic movement through adjacent cell layers in a leaf and into new growth(1). In recent Alabama studies, Heritage® has shown activity against *Phytophthora* shoot blight on annual vinca (4), powdery mildew on flowering dogwood (13), *Alternaria* leaf spot on marigold (5), and southern stem rot on aucuba (12) that is equal and often superior to that of other registered fungicides. Recently, Williams-Woodward (17) reported a sizable reduction in the severity of powdery mildew on bigleaf hydrangea with preventative treatments of Heritage® at the 2-ounce-per-100-gallon rate. When applied as a curative treatment, however, this same rate of Heritage® failed to suppress an existing outbreak of powdery mildew on bigleaf hydrangea (18). In addition, Compass™ and Garden Fungicide (0.4 percent sulfur) gave better control of powdery mildew on deciduous azalea than the 1-, 2-, and 8-ounce-per-100-gallon rates of Heritage® (15).

Potassium bicarbonate (baking soda) was recently registered for the control of powdery mildew and other diseases of vegetables, fruit trees, ornamentals, and turf. This chemical is available to commercial growers as Armicarb® 100, MilStop® Broad Spectrum Fungicide, and Kaligreen®, as well as Remedy® for the retail homeowner market. While potassium bicarbonate is a synthetic compound, formulated products are considered a biorational or organic fungicide.

Early development work with potassium bicarbonate focused on the control of powdery mildew and black spot on rose (7). Ziv and Hagiladi (20) got better control of powdery mildew on euonymus with potassium bicarbonate + SunSpray Ultrafine Oil® than with either product alone. Bimonthly applications of Kaligreen® were as effective in controlling powdery mildew on deciduous azalea as Compass™, Banner Maxx®, and Heritage® (15). Perry (14) found that bimonthly applications of Remedy® and SunSpray Ultrafine Oil® gave better control of powdery mildew on bee balm than household baking soda. While Mulrooney and Gregory (10,11) saw a reduction in the incidence of powdery mildew on flowering dogwood with potassium bicarbonate, this fungicide did not control this disease as effectively as Eagle® applied on the same 3-week schedule. When applied weekly, Armicarb® 100 greatly reduced the severity of powdery mildew on flowering dogwood (8). Since the bimonthly Armicarb® 100 program gave less control of powdery mildew than Banner Maxx® applied on the same schedule, Mmbaga and Sauve (8) noted this and other biorational fungicides would not be very competitive against synthetic fungicides in commercial nursery market.

This report summarizes the impact of application rate and treatment interval on control of powdery mildew and *Cercospora* leaf spot on container-grown bigleaf

hydrangea in a simulated nursery setting and compares the performance of Heritage® and MilStop™ with that of other registered fungicides.

MATERIALS AND METHODS

Plant culture. Each year, liners of bigleaf hydrangea (*Hydrangea macrophylla* 'Nikko Blue') were transplanted into #1 (C-650) containers in a pine bark/peat moss medium (3:1 by volume) amended with 14 pounds of Osmocote (17-7-12), 6 pounds of dolomitic limestone, 2 pounds of gypsum, and 1.5 pounds of Micromax per cubic yard of potting mixture. In 1998, plants were maintained outdoors on a clam shell-covered bed under 47 percent shade. Since the Heritage® trials in 1999, 2000, and 2001, as well as the MilStop™ trials were conducted in late fall or early spring, test plants were placed in a heated plastic greenhouse. Regardless of the location, the blocks of hydrangea were watered daily with overhead impact sprinklers. All studies were conducted on the grounds of the Ornamental Horticulture Research Center in Mobile, Alabama.

Fungicide comparison. In all studies, the experimental design was a randomized complete block with six or ten single plant replicates. Fungicide treatments were applied to drip with a CO₂-pressurized sprayer.

In 1998 and 1999, Heritage® 50W was applied at rates of 4 and 8 ounces per 100 gallons of spray volume. For the 2000 and 2001 studies, application rates for azoxystrobin were reduced to the rate range of 1, 2, and 4 ounces per 100 gallons on the Heritage® label. In all of the above studies, applications of Heritage® were made at 1-, 2-, and 3-week intervals. Eagle® 40W at the 8-ounce-per-100-gallon rate was also applied at 2-week intervals. Cleary 3336™ 4.5F at 20 fluid ounces per 100 gallons, which was applied weekly in 1998 and 1999, was replaced in 2000 and 2001 with weekly applications of 1.2 quarts per 100 gallons of SunSpray Ultra-Fine Oil®. Sil-Spread non-ionic surfactant (0.06 percent by volume) was tank-mixed with Heritage® and Eagle®. Fungicides were applied to drip at the above treatment intervals from June 2 to September 24, 1998; October 27 to December 7, 1999; September 22 to November 11, 2000; and from November 1, 2001 to January 3, 2002.

MilStop™ was evaluated for the control of powdery mildew on 'Nikko Blue' bigleaf hydrangea at the 1.25-, 2.5-, 5.0-, and 10.0-pounds-per-100-gallon rates, which were applied at 1- and 2-week schedules. The 1.4-pound-per-100-gallon rate of Daconil Ultrex®, which was also applied at 1- and 2-week intervals, was included as a registered fungicide standard. Fungicides were applied from March 10 to April 22, 2003 and from August 11 to October 20, 2004.

Disease assessment. Incidence of powdery mildew and *Cercospora* leaf spot was assessed using the Horsfall and Barratt rating scale where 1 = 0 percent, 2 = 0-3 percent, 3 = 3-6 percent, 4 = 6-12 percent, 5 = 12 to 25 percent, 6 = 25-50 percent, 7 = 50-75 percent, 8 = 75-87 percent, 9 = 87-94 percent, 10 = 94-97 percent, 11 = 97-100 percent, and 12 = 100 percent of the leaves colonized by the powdery mildew fungus or displaying symptoms of *Cercospora* leaf spot. In 1998, ratings for powdery mildew and *Cercospora* leaf spot were recorded on September 23 and November 12, respectively. For the remaining Heritage® studies, incidence of powdery mildew was

assessed on December 16, 1999; January 5, 2001; and December 18, 2001. In the Mil-Stop™ trials, disease ratings were recorded using the previously described rating scale on April 28, 2003 and October 20, 2004. On April 28, 2003, appearance of the bigleaf hydrangea was rated on a 1 to 5 scale where 1 = low quality plant to 5 = highly attractive plant.

RESULTS

All fungicide treatments significantly reduced the incidence of powdery mildew and *Cercospora* leaf spot in 1998 when compared to the unsprayed control (Table 1). As indicated by a powdery mildew rating of 7.3, approximately 75 to 83 percent of the leaves of the unsprayed control were colonized by the fungus *E. polygoni*. In contrast, no colonies of this fungus were observed on the hydrangea treated at 1-, 2-, or 3-week intervals with the 4- and 8-ounce-per-100-gallon rates of Heritage®. When applied every 2 weeks, Eagle was as effective in protecting hydrangea from powdery mildew as applications of both rates of azoxystrobin. Although Cleary's 3336™ fungicide was less effective in controlling powdery mildew than Heritage, the symptoms and signs on the Cleary's 3336-treated hydrangea, which were restricted to a few leaves, were unobtrusive.

In 1998, the frog eye leaf spot pattern that is characteristic for *Cercospora* leaf spot on hydrangea was observed on 20 percent of the leaves on the unsprayed plants (Table 1). Both rates of Heritage® across all application intervals completely protected hydrangea in 1998 from *Cercospora* leaf spot. Eagle was as effective in controlling *Cercospora* leaf spot as Heritage®. While the incidence of *Cercospora* leaf spot on the Cleary's 3336-treated hydrangea was lower compared to the unsprayed plants, Heritage® and Eagle® gave better disease control than Cleary's 3336™.

In 1999, the effectiveness of Heritage® for the control of powdery mildew was similar to the results observed in the previous year. Few if any colonies of the fungus *E. polygoni* appeared on leaves of hydrangea treated at 1-, 2-, and 3-week intervals at

TABLE 1. EFFECTIVENESS OF TWO RATES OF HERITAGE® APPLIED AT SELECTED TREATMENT INTERVALS FOR THE CONTROL OF POWDERY MILDEW AND CERCOSPORA LEAF SPOT ON BIGLEAF HYDRANGEA 'NIKKO BLUE'

Fungicide	Application		Disease ratings ¹		
	Rate <i>per 100 gal</i>	Interval <i>wk</i>	Powdery mildew 1998	1999	<i>Cercospora</i> leaf spot
Heritage 50W	4 oz	1	1.0	1.2	1.0
Heritage 50W	4 oz	2	1.1	1.0	1.0
Heritage 50W	4 oz	3	1.0	1.2	1.0
Heritage 50W	8 oz	1	1.0	1.2	1.0
Heritage 50W	8 oz	2	1.0	1.0	1.0
Heritage 50W	8 oz	3	1.0	1.3	1.0
Cleary's 3336 4.5F	20 fl oz	1	3.3	1.0	2.8
Eagle 40W	8 oz	2	1.0	1.0	1.0
Unsprayed control	---	---	7.8	6.5	5.7

¹Incidence of powdery mildew and *Cercospora* leaf spot was assessed using the 1 to 12 Horsfall and Barratt rating scale.

the 4- and 8-ounce-per-100-gallon rates of Heritage® (Table 1). Eagle® and Cleary's 3336™ were as effective as Heritage® in controlling powdery mildew on hydrangea. Since the 1999 study was conducted in a heated greenhouse, *Cercospora* leaf spot did not develop.

For the 2000 trial, application rates for Heritage® were reduced to match those on the label of the formulated product (Table 2). As indicated by a powdery mildew rating of 11.5 for the unsprayed control, disease pressure was higher in 2000 than was seen in the previous two years. Although the incidence of powdery mildew on the Heritage-treated hydrangea was lower when compared to the unsprayed plants, considerable differences in the disease ratings were noted across application rates and treatments intervals. As the treatment interval was lengthened from 1 to 3 weeks, the incidence of powdery mildew increased linearly for all rates of Heritage®.

Differences in powdery mildew incidence on hydrangea treated weekly with different rates of Heritage® were small. With disease ratings between 1.0 and 1.6, incidence of this disease on the hydrangea treated weekly with Heritage® was limited to the development of a few small, isolated colonies of the causal fungus on a handful of leaves. A noticeable increase in disease incidence was noted on the plants treated at 1- and 2-week intervals with the 1- and 2-ounce-per-100-gallon rates of Heritage®. On the hydrangea treated with the 4-ounce-per-100-gallon rate of Heritage® at 1- and 2-week intervals, the level of powdery mildew control was similar. Regardless of application rate, Heritage® applied at 3-week intervals failed to effectively protect hydrangea from attack by the fungus *E. polygoni*. As indicated by disease ratings that ranged from 4.9 to 5.5, signs and/or symptoms of powdery were found on at least 10 percent of the leaves on the plants treated with Heritage® on a 3-week schedule. Ultrafine Sunspray Oil®, which was applied weekly, was less effective in controlling powdery mildew than all rates of Heritage® applied at 2-week intervals. As indicated

TABLE 2. IMPACT OF APPLICATION RATE AND TREATMENT INTERVAL ON THE EFFECTIVENESS OF HERITAGE® IN THE CONTROL OF POWDERY MILDEW AND CERCOSPORA LEAF SPOT ON GREENHOUSE-GROWN BIGLEAF HYDRANGEA 'NIKKO BLUE' IN 2000 AND 2001

Fungicide	Application		Powdery mildew ¹ incidence	
	Rate per 100 gal	Interval wk	Jan. 5, 2001	Dec. 18, 2001
Heritage 50W	1 oz	1	1.0	2.8
Heritage 50W	1 oz	2	2.5	2.6
Heritage 50W	1 oz	3	5.5	5.5
Heritage 50W	2 oz	1	1.6	2.0
Heritage 50W	2 oz	2	2.6	1.6
Heritage 50W	2 oz	3	4.9	6.6
Heritage 50W	4 oz	1	1.4	2.0
Heritage 50W	4 oz	2	1.5	2.3
Heritage 50W	4 oz	3	5.1	5.3
SunSpray Ultrafine Oil	1.2 qt	1	3.1	2.4
Eagle 40W	8 oz	2	1.1	1.9
Unsprayed control	---	---	11.5	8.3

¹Incidence of powdery mildew was assessed using the 1 to 12 Horsfall and Barratt rating scale.

by a disease rating of 1.1, very little powdery mildew was seen on the Eagle-treated hydrangea.

When compared to the unsprayed hydrangea, the incidence of powdery mildew was lower on the fungicide-treated plants in December 2001 (Table 2). As was seen in the previous study, powdery mildew intensified as the interval between applications of all rates of Heritage® increased. At all applications rates of Heritage®, the levels of leaf colonization by the fungus *E. polygoni* were unobtrusive on bigleaf hydrangea treated at 1- and 2-week intervals. At the 1-week interval, the 2- and 4-ounce-per-100-gallon rates of Heritage® gave better powdery mildew control than the 1-ounce-per-100-gallon rate of the same fungicide. When applied on a 2-week schedule, Heritage® at the 2-ounce-per-100-gallon rate controlled powdery mildew better than the lower rate but was as equally effective controlling this disease as the higher rate of the same fungicide. In addition, powdery mildew incidence on hydrangea treated at 1- and 2-week intervals with Heritage® at the 1-, 2-, and 4-ounce rates did not noticeably differ. At all rates of Heritage®, disease control declined as treatment intervals lengthened from 2 to 3 weeks. As indicated by powdery mildew ratings between 5.3 and 6.6, a sizable percentage of the leaves on the hydrangea treated at 3-week intervals with Heritage® were colonized by *E. polygoni*.

In the December 2001 study, Eagle® was as effective in controlling powdery mildew as the 2- and 4-ounce-per-100-gallon rates of Heritage® applied at 1- and 2-week intervals (Table 2). When applied at 3-week intervals, both the latter rates of Heritage® failed to control powdery mildew as well as the Eagle® standard. Unlike the previous year, hydrangea treated at the lowest rate of Heritage® at all application intervals had powdery mildew ratings higher than those plants treated with Eagle®. Generally, weekly applications of SunSpray Ultrafine Oil® gave the same level of disease control as the 1-, 2-, and 4-ounce rates of Heritage® applied on a 1- and 2-week treatment schedule.

In 2003, application rate and treatment interval had a sizable impact on the effectiveness of MilStop™ in controlling powdery mildew, as well as on appearance of bigleaf hydrangea treated with this fungicide (Table 3). When applied weekly, the three higher rates of this fungicide limited disease development to scattered colonies on a few leaves and were as effective as Daconil Utrex® in controlling powdery mildew. The 4.0 disease rating for the hydrangea treated weekly with the 1.25-pound-per-100-gallon rate of MilStop™ indicates that between 6 and 12 percent of the leaves were colonized by the fungus *E. polygoni*. In contrast, the percentage of leaves on the unsprayed controls that were colonized by this fungus exceeded 75 percent. At all rates of MilStop™, a noticeable decrease in the level of disease control was seen when the application interval increased from 1 to 2 weeks. This decline in powdery mildew control as the application interval was lengthened was particularly noticeable for the 2.5- and 5.0-pound-per-100-gallon rates of MilStop™.

With the exception of the bimonthly 1.25 pound per 100 gallon program, all MilStop™ treatments noticeably reduced the incidence of powdery mildew in 2004 when compared with the untreated control. However, the activity of MilStop™ against powdery mildew on bigleaf hydrangea was again greatly influenced by application rate and treatment interval (Table 3). The weekly MilStop™ programs gave better disease

TABLE 3. EVALUATION OF MILSTOP™ (POTASSIUM BICARBONATE) FOR THE CONTROL OF POWDERY MILDEW ON GREENHOUSE-GROWN BIGLEAF HYDRANGEA 'NIKKO BLUE'

Fungicide	Application		Plant quality ¹ 2003	Powdery mildew incidence	
	Rate <i>per 100 gal</i>	Interval <i>wk</i>		2003	2003
MilStop	1.25 lb	1	4.1	4.0	4.2
MilStop	1.25 lb	2	3.9	5.5	6.2
MilStop	2.5 lb	1	4.5	2.3	4.8
MilStop	2.5 lb	2	4.1	5.5	5.5
MilStop	5.0 lb	1	3.3	1.5	3.5
MilStop	5.0 lb	2	3.4	4.0	5.2
MilStop	10.0 lb	1	2.1	1.0	1.0
MilStop	10.0 lb	2	2.9	2.4	2.2
Daconil Ultrex	1.4 lb	1	4.3	1.0	1.0
Daconil Ultrex	1.4 lb	2	4.5	1.8	1.0
Unsprayed control	---	---	3.4	7.3	6.7

¹Plant quality was rated on a 1 (poor) to 5 (excellent) scale.

control than the bimonthly programs. Among the weekly MilStop™ treatments, only the 10.0 pound per 100 gallon program completely protected hydrangea from powdery mildew. The percentage of diseased leaves on the plants treated weekly with the 1.25- and 2.5-pound-per-100-gallon rates of MilStop™ ranged between 6 and 12 percent. With disease ratings of 6.2, 5.5, and 5.2, respectively, the bimonthly 1.25-, 2.5-, and 5.0-pound-per-100-gallon MilStop™ programs failed to adequately protect hydrangea from powdery mildew. In contrast, the bimonthly 10.0-pound-per-100-gallon MilStop™ program limited colony development to less than 3 percent of the leaves. When applied at 1- and 2-week intervals, Daconil Ultrex® proved much more effective in controlling powdery mildew than all but the highest rate of MilStop™.

MilStop™ fungicide proved highly phytotoxic to 'Nikko Blue' hydrangea. In 2003, the level of MilStop-induced damage to the leaves worsened and overall plant quality declined as the application rate increased from 2.5- to 10-pound-per-100-gallon rates of this fungicide (Table 3). Hydrangeas treated either weekly or bimonthly with the 10-pound-per-100-gallon rate of this fungicide were in particularly poor condition. In contrast, quality ratings for hydrangea treated weekly or bimonthly with the 1.25- and 2.5-pound-per-100-gallon rates of this fungicide were similar to those for the Daconil Ultrex-treated and the unsprayed hydrangea.

DISCUSSION

When applied at labeled rates, Heritage® often gave excellent control of powdery mildew on bigleaf hydrangea. Some differences in the level of disease control with this fungicide, however, were noted among the four individual studies. Initially, the 4- and 8-ounce-per-100-gallon rates of Heritage® when applied at 1-, 2-, and 3-week intervals were equally and highly effective in preventing the development of powdery mildew on hydrangea. In the latter two studies under heavier disease pressure, noticeable and unacceptable levels of leaf colonization by *E. polygoni* were seen on plants treated at 3- but not at the 1- and 2-week intervals with the 1-, 2-, and 4-ounce rates of this fungicide.

When applied at 3-week intervals in 1998 and 1999, Heritage® at the 4-ounce-per-100-gallon rate was as effective in controlling powdery mildew as bimonthly applications of Eagle® and gave better disease control than Cleary's 3336™. Under heavier disease pressure for the 2000 and 2001 studies, the 4-ounce-per-100-gallon rate applied on a 1- and 2-week schedule consistently gave the same level of disease control as bimonthly applications of Eagle®. While reductions in powdery mildew intensity were seen at the 1- and 2-ounce-per-100-gallon rates of Heritage®, Eagle® gave slightly better disease control when applied on the same schedule. In a recent Georgia study (17), Heritage® gave better control of powdery mildew than several other synthetic and biological fungicides except for Eagle® and Kocide T/O. In contrast, curative treatments of the 2-ounce rate of Heritage® applied bimonthly failed to appreciably slow the spread of powdery mildew (18).

Strobilurin (QoI) fungicides such as Heritage® do not have the plant growth regulator side effects, which include shortened internodes as well as reduced leaf area indices and vegetative dry weight, that can occur after repeated applications of ergosterol biosynthesis inhibitory or sterol (EBI) fungicides such as Eagle® on annuals, perennials, woody ornamentals (1,2). However, repeated applications of a strobilurin fungicide over an extended period of time on greenhouse, vegetable, fruit, amenity, turf, and cereal crops has resulted in catastrophic control failures due to the selection of resistance isolates of plant pathogenic fungi, particularly powdery mildew fungi (1). The superior activity of these fungicides can be safeguarded by limiting the use of a strobilurin to no more than one-third of the total number of fungicide treatments applied to a particular block or crop of ornamentals per production cycle or growing season. In addition, no more than two consecutive applications of one or more strobilurin fungicide(s) should be made. When tank mixed with a fungicide that has a different mode of action, then half of the applications may include a strobilurin fungicide. Daconil Ultrex®, Eagle®, and SunSpray Ultrafine Oil® would be appropriate partners to tank mix or alternate with application of Heritage®.

Cercospora leaf spot appeared on hydrangea only in the 1998 trial, which was conducted outdoors under 47 percent shade. When applied at treatment intervals of 1, 2, and 3 weeks, the labeled 4-ounce-per-100-gallon rate of Heritage®, as well as the Eagle® standard, showed excellent efficacy in controlling Cercospora leaf spot on hydrangea. Although significant reductions in disease severity were also obtained with Cleary's 3336™ when compared to the unsprayed control, this fungicide was less effective in controlling this disease than Heritage® and Eagle®.

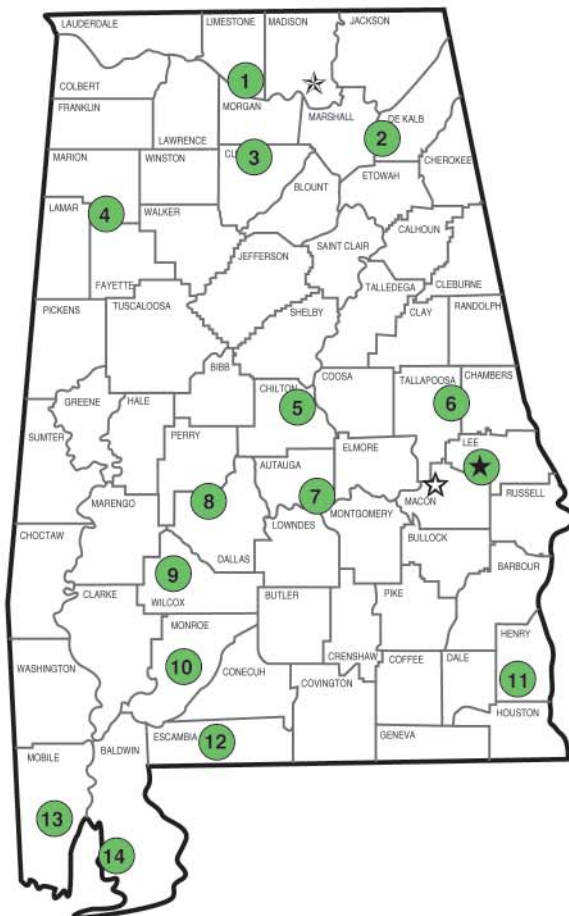
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Alabama's Agricultural Experiment Station AUBURN UNIVERSITY

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.
- ☆ Alabama A&M University.
- ☆ E. V. Smith Research Center, Shorter.

1. Tennessee Valley Research and Extension Center, Belle Mina.
2. Sand Mountain Research and Extension Center, Crossville.
3. North Alabama Horticulture Research Center, Cullman.
4. Upper Coastal Plain Agricultural Research Center, Winfield.
5. Chilton Research and Extension Center, Clanton.
6. Piedmont Substation, Camp Hill.
7. Prattville Agricultural Research Unit, Prattville.
8. Black Belt Research and Extension Center, Marion Junction.
9. Lower Coastal Plain Substation, Camden.
10. Monroeville Agricultural Research Unit, Monroeville.
11. Wiregrass Research and Extension Center, Headland.
12. Brewton Agricultural Research Unit, Brewton.
13. Ornamental Horticulture Research Center, Spring Hill.
14. Gulf Coast Research and Extension Center, Fairhope.