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## THE ARMORED SCALE INSECTS (HEMIPTERA DIASPIDIDAE) OF ALABAMA, USA (1)

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Waltman K.G., Ray C.H. Jr., Williams M.L. – The armored scale insects (Hemiptera Diaspididae) of Alabama, USA.

A continuing survey of the armored scale insects of Alabama has resulted in recording 113 species in 47 genera, among the tribes Aspidiotini, Diaspidini, and Odonaspidini. Alabama now ranks second among states in the southeastern United States in number of species of armored scales, trailing only Florida with its 150+ species. Comments on some of the more notable diaspidids, not previously collected in Alabama, are made along with notes on their hosts and distribution in the State.

KEY WORDS: biodiversity, Aspidiotini, Diaspidini, Odonaspidini

### INTRODUCTION

The family Diaspididae (armored scale insects), is a large and diverse family, which is widely distributed across the state of Alabama. Yet, there is no published literature available cataloging the occurrence of armored scale insects in Alabama. OWEN (1925), BOYD (1932), TIPPINS (1953), and WALTMAN (2008) all did Master's theses pertaining to scale insects in general, or select scale insects that included Diaspididae in Alabama. WALTMAN (2008) was the most inclusive of the four and she listed 107 species in 42 genera as occurring in Alabama. Two studies on the biology of tea scale and obscure scale were completed by CHIU (1974) and HENDRICKS & WILLIAMS (1992) respectively.

Although there is a lack of published information for Alabama distributions and records, work with this family in several other sister-states has been published. Comprehensive coverage of host plant relationships, distribution, and morphology was recorded for the armored scales of Florida by DEKLE (1965). In Georgia, Beshear, Tippins, and Howell published a short listing in 1973, in which they cited 100 species in 46 genera (BESHEAR *et al.*, 1973). There are also publications available for Mississippi & Louisiana including HERRICK (1911) listing certain scale insects in the Mississippi region and HOWARD & OLIVER (1985) listing the armored scales of Louisiana.

The purpose of this paper is to document the current results of a continuing survey on the scale insects of Alabama, begun in 1973, by publishing a listing of the species of armored scale insects recorded in Alabama to date.

### MATERIALS AND METHODS

Upon joining the faculty at Auburn University in March of 1973, the third author began a research project to survey the scale insects of Alabama.

All the known literature pertaining to the family Diaspididae and its occurrence in Alabama was reviewed and any pertinent information was integrated into a research database. Literature on Diaspididae from surrounding states was also reviewed for comparison purposes. All generic and species names recorded from Alabama during this survey were compared to the diaspidid information listed on the scale insect database ScaleNet (<http://scalenet.info>) (GARCIA *et. al.* 2015) to insure that all of the records being generated used the most current terminology.

The slide collection and records of the U. S. National Museum and the U. S. Department of Agriculture in Beltsville, Maryland were examined for Alabama records and all information pertaining to Alabama records were incorporated in our survey database

Dried pre-collected material was gathered from around the state from different institutions and individuals to identify any species not already recorded in the state. They were then slide mounted, examined, identified, and pertinent collection information was recorded in the Auburn University scale card catalogue.

Throughout the survey fresh material was collected from different regions of Alabama. Special attempts were made to collect armored scales that had been recorded from neighboring states but had not yet been collected in Alabama. Samples of all collected material were slide mounted, assigned a slide number, identified, and the slide number and collection information including host, locality, date of collection and collector were recorded in both a slide mounting record book and a survey database. All slide-mounted specimens collected during the survey are deposited in the Auburn University Coccoidea Collection (AUCC).

Additional information was recorded for each identified species that included: biology, distribution across Alabama, a listing of host plant species, a photograph of the specimens (before slide mounting), and a short description of morphological characters of the cover, for aid in simplification of field identification. This information will be used to publish a manual of the Diaspididae of Alabama for use by extension personnel, regulatory officials, and the general public at a later date.

<sup>1</sup> Original scientific contribution presented and discussed at XIV International Symposium on Scale Insect Studies, Catania-Italy, 13-16 June 2016.

## RESULTS AND DISCUSSION

Prior to this survey, begun in 1973, only 48 species belonging to 17 genera of Diaspididae were recorded in Alabama. As a result of this survey, Alabama now has recorded 113 species in 47 genera. A breakdown of the armored scale insects of Alabama listed by tribe, genus, and number of species (in parentheses) is presented in Table 1, and an alphabetical listing of the 113 species currently recorded in Alabama is presented in Table 2. This study has added 65 previously unrecorded species of Diaspididae in Alabama. Not included in the list of species recorded in Alabama are an undescribed species of *Clavaspis* and an undescribed species of *Lindingaspis* which were collected in Alabama and are currently being described.

Table 1 – Alabama armored scale insects.  
(Reported by tribe, genera, and number of species in parentheses)

Odonaspidini - 2 genera	Diaspidini - 24 genera
<i>Odonaspis</i> (3)	<i>Aonidomytilus</i> (4)
<i>Froggattiella</i> (1)	<i>Aulacaspis</i> (2)
	<i>Carulaspis</i> (2)
<b>Aspidiotini - 21 genera</b>	<i>Chionaspis</i> (13)
<i>Abgrallaspis</i> (3)	<i>Diaspis</i> (4)
<i>Acutaspis</i> (2)	<i>Duplacionaspis</i> (1)
<i>Aonidia</i> (1)	<i>Fiorinia</i> (2)
<i>Aonidiella</i> (2)	<i>Fissuraspis</i> (1)
<i>Aspidiella</i> (1)	<i>Gymnaspis</i> (1)
<i>Aspidiotus</i> (3)	<i>Haliaspis</i> (1)
<i>Chortinaspis</i> (1)	<i>Kuwanaspis</i> (3)
<i>Chrysomphalus</i> (4)	<i>Lepidosaphes</i> (7)
<i>Clavaspis</i> (2 + 1 undescribed)	<i>Lopholeucaspis</i> (1)
<i>Comstockaspis</i> (1)	<i>Neopinnaspis</i> (1)
<i>Comstockiella</i> (1)	<i>Niveaspis</i> (1)
<i>Diaspidiotus</i> (11)	<i>Parlatoria</i> (3)
<i>Dynaspidiotus</i> (1)	<i>Pinnaspis</i> (2)
<i>Hemiberlesia</i> (5)	<i>Pseudaulacaspis</i> (3)
<i>Lindingaspis</i> (1 undescribed)	<i>Pseudoparlatoria</i> (1)
<i>Melanaspis</i> (7)	<i>Quernaspis</i> (1)
<i>Morganella</i> (1)	<i>Thysanoflorinia</i> (1)
<i>Oceanaspidiotus</i> (1)	<i>Unachionaspis</i> (1)
<i>Pseudaonidia</i> (2)	<i>Unaspis</i> (1)
<i>Rhizaspidiotus</i> (1)	<i>Velataspis</i> (1)
<i>Selenaspis</i> (1)	

The following two species, previously recorded in Alabama, could not be verified by us as actually occurring in the State as they were not recollected by us and there were no slide-mounted specimens from Alabama in any of the collections we examined: *Chrysomphalus diversicolor* (Green) – A single USDA record listed this species as being collected from Jefferson County, Alabama on palms. The Birmingham Botanical Gardens is in Jefferson County and they have a palm collection so this is possibly a valid record; and *Lepidosaphes lasianthi* (Green) – Another USDA record listed this species as occurring in Alabama, but according to TAKAGI (1970) all records of *Lepidosaphes lasianthi* in Hawaii, the Philippines and North America are all misidentifications of *Lepidosaphes tokionis* (Kuwana). We have not collected *L. tokionis* in Alabama and the listing of this species in Table 2 is based on the reference by TAKAGI (1970).

Alabama now ranks number two in terms of number of species of diaspidids in the southeastern United States. Alabama is second only to Florida with 150+ species. The only other state in our region that has recorded anywhere near as many species as Alabama is our neighboring state of Georgia with 105 diaspidids recorded. Although our other

neighbors like Mississippi, Tennessee, Louisiana and Kentucky have recorded much lower numbers of species (all below 70), we have no doubt that this is largely due to a lack of collecting with this particular group of insects in those states.

Some of the more notable diaspidids that were not previously collected in Alabama include *Melanaspis arundinariae* Deitz & Davidson, which had previously only been collected in South Carolina as far as U.S. records are concerned. They also include *Quernaspis quercicola* Tippins & Beshear, which worldwide had only been collected in Georgia and is quite a rare find. Lastly, *Diaspidiotus crystallinus* Ferris has also been found in Alabama in multiple locations and had only been recorded worldwide from Texas.

The discovery of these and several other newly recorded diaspidids have great implications for Alabama and the surrounding states. Species that were previously thought to be primarily of western distribution, like *D. crystallinus* and *Clavaspis texana* Ferris, may actually be distributed across the nation. Species that are considered serious pests in other states, like the newly recorded *Aspidiella sacchari* (Cockerell), may be newly introduced or may simply be inhibited by some unseen factor keeping it from reaching pest status in Alabama. More research and additional surveys in other states would greatly contribute to helping answer these questions and many more for the better of state-wide integrated pest management programs.

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Table 2 – Alphabetical listing of the Diaspididae recorded in Alabama.

1. <i>Abgrallaspis cyanophylli</i> (Signoret)	58. <i>Duplacionaspis divergens</i> (Green)
2. <i>Abgrallaspis ithacae</i> (Ferris)	59. <i>Dynaspidiotus californicus</i> (Coleman)
3. <i>Abgrallaspis liriiodendri</i> Miller and Howard	60. <i>Fiorinia fioriniae</i> (Targioni-Tozzetti)
4. <i>Acutaspis morrisonorum</i> Kosztarab	61. <i>Fiorinia theae</i> Green
5. <i>Acutaspis perseae</i> (Comstock)	62. <i>Fissuraspis ulmi</i> (Hoke)
6. <i>Aonidia atlantica</i> Ferris	63. <i>Froggattiella penicillata</i> (Green)
7. <i>Aonidiella aurantii</i> (Maskell)	64. <i>Gymnaspis aechmeae</i> Newstead
8. <i>Aonidiella taxus</i> Leonardi	65. <i>Haliaspis spartinae</i> (Comstock)
9. <i>Aonidomytilus crookiae</i> (Ferris)	66. <i>Hemiberlesia diffinis</i> (Newstead)
10. <i>Aonidomytilus hyperici</i> Ferris	67. <i>Hemiberlesia lataniae</i> (Signoret)
11. <i>Aonidomytilus sabatius</i> Tippins	68. <i>Hemiberlesia neodiffinis</i> Miller & Davidson
12. <i>Aonidomytilus solidaginis</i> (Hoke)	69. <i>Hemiberlesia palmarum</i> (Cockerell)
13. <i>Aspidiella sacchari</i> (Cockerell)	70. <i>Hemiberlesia rapax</i> (Comstock)
14. <i>Aspidiotus cryptomeriae</i> Kuwana	71. <i>Kuwanaspis hikosani</i> (Kuwana)
15. <i>Aspidiotus marisci</i> Tippins & Beshear	72. <i>Kuwanaspis howardi</i> (Cooley)
16. <i>Aspidiotus nerii</i> Bouché	73. <i>Kuwanaspis pseudoleucaspis</i> (Kuwana)
17. <i>Aulacaspis rosae</i> (Bouché)	74. <i>Lepidosaphes beckii</i> (Newman)
18. <i>Aulacaspis yasumatsui</i> Takagi	75. <i>Lepidosaphes camelliae</i> Hoke
19. <i>Carulaspis juniperi</i> (Bouché)	76. <i>Lepidosaphes gloverii</i> (Packard)
20. <i>Carulaspis minima</i> (Signoret)	77. <i>Lepidosaphes lasianthi</i> (Green)
21. <i>Chionaspis americana</i> Johnson	78. <i>Lepidosaphes newsteadi</i> (Sulc)
22. <i>Chionaspis caryae</i> (Cooley)	79. <i>Lepidosaphes pallida</i> (Maskell)
23. <i>Chionaspis furfura</i> (Fitch)	80. <i>Lepidosaphes ulmi</i> (Linnaeus)
24. <i>Chionaspis gleditsiae</i> Sanders	81. <i>Lopholeucaspis japonica</i> (Cockerell)
25. <i>Chionaspis heterophyllae</i> Cooley	82. <i>Melanaspis arundinariae</i> Deitz & Davidson
26. <i>Chionaspis kosztarabi</i> Takagi & Kuwana	83. <i>Melanaspis bromeliae</i> (Leonardi)
27. <i>Chionaspis longiloba</i> Cooley	84. <i>Melanaspis deklei</i> Dietz & Davidson
28. <i>Chionaspis nyssae</i> Comstock	85. <i>Melanaspis nigropunctata</i> (Cockerell)
29. <i>Chionaspis pinifoliae</i> (Fitch)	86. <i>Melanaspis obscura</i> (Comstock)
30. <i>Chionaspis platani</i> (Cooley)	87. <i>Melanaspis smilacis</i> (Comstock)
31. <i>Chionaspis salicis</i> (Linnaeus)	88. <i>Melanaspis tenebricosa</i> (Comstock)
32. <i>Chionaspis styracis</i> Liu & Kosztarab	89. <i>Morganella cueroensis</i> (Cockerell)
33. <i>Chionaspis triformis</i> Tippins & Beshear	90. <i>Neopinaspis harperi</i> McKenzie
34. <i>Chortinaspis subchortina</i> (Laing)	91. <i>Niveaspis ilicis</i> (Hoke)
35. <i>Chrysomphalus aonidum</i> (Linnaeus)	92. <i>Oceanaspidiotus spinosus</i> (Comstock)
36. <i>Chrysomphalus bifasciculatus</i> Ferris	93. <i>Odonaspis benardi</i> Balachowsky
37. <i>Chrysomphalus dictyospermi</i> (Morgan)	94. <i>Odonaspis ruthae</i> Kotinsky
38. <i>Chrysomphalus diversicolor</i> (Green)	95. <i>Odonaspis saccharicaulis</i> (Zehntner)
39. <i>Clavaspis crypta</i> Howell & Tippins	96. <i>Parlatoria camelliae</i> Comstock
40. <i>Clavaspis texana</i> Ferris	97. <i>Parlatoria pergandii</i> Comstock
41. <i>Comstockaspis perniciosis</i> (Comstock)	98. <i>Parlatoria theae</i> (Cockerell)
42. <i>Comstockiella sabalis</i> (Comstock)	99. <i>Pinaspis aspidistrae</i> (Signoret)
43. <i>Diaspidiotus ancylus</i> (Putnam)	100. <i>Pinaspis strachani</i> (Cooley)
44. <i>Diaspidiotus bumeliae</i> Ferris	101. <i>Pseudaonidia duplex</i> (Cockerell)
45. <i>Diaspidiotus confiferarum</i> (Cockerell)	102. <i>Pseudaonidia paeoniae</i> (Cockerell)
46. <i>Diaspidiotus crystallinus</i> Ferris	103. <i>Pseudaulacaspis cockerelli</i> (Cooley)
47. <i>Diaspidiotus forbesi</i> (Johnson)	104. <i>Pseudaulacaspis pentagona</i> (Targioni-Tozzetti)
48. <i>Diaspidiotus juglansregiae</i> (Comstock)	105. <i>Pseudaulacaspis prunicola</i> (Maskell)
49. <i>Diaspidiotus liquidambaris</i> (Kotinsky)	106. <i>Pseudoparlatoria parlatorioides</i> (Comstock)
50. <i>Diaspidiotus mcmcombi</i> McKenzie	107. <i>Quernaspis quercicola</i> Tippins & Beshear
51. <i>Diaspidiotus osborni</i> (Newell & Cockerell)	108. <i>Rhizaspidiotus dearnessi</i> (Cockerell)
52. <i>Diaspidiotus taxodii</i> (Ferris)	109. <i>Selenaspis articulatus</i> (Morgan)
53. <i>Diaspidiotus uvae</i> (Comstock)	110. <i>Thysanoflorinia nephelii</i> (Maskell)
54. <i>Diaspis boisduvallii</i> Signoret	111. <i>Unachionaspis tenuis</i> (Maskell)
55. <i>Diaspis bromeliae</i> (Kerner)	112. <i>Unaspis euonymi</i> (Comstock)
56. <i>Diaspis echinocacti</i> (Bouché)	113. <i>Veletaspis dentata</i> (Hoke)
57. <i>Diaspis townsendi</i> Cockerell	

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