DISCOVERY OF HYBRID FIRE ANT POPULATIONS IN GEORGIA AND ALABAMA

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ABSTRACT

The recent movement of fire ants into previously non-infested northwest Georgia counties led to an investigation of their identity. Gas chromatograph traces of the cuticular hydrocarbon patterns of these ants showed them to be hybrids of *Solenopsis invicta* Buren and *Solenopsis richteri* Forel. This study extends the known range of the hybrid to ten Georgia counties, twenty-one Alabama counties, and five Mississippi counties.

Key Words: *Solenopsis invicta*, *Solenopsis richteri*, hybrid, distribution, gas chromatograph.

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INTRODUCTION

Two species of fire ants were introduced accidentally into the southern United States from their native homeland of South Africa. *Solenopsis richteri* Forel, the black imported fire ant, was introduced into the Mobile, Alabama, area around 1918. This was followed in the early 1930's by the introduction of a different form designated *Solenopsis invicta* Buren (Buren 1972). The spread of both forms in the United States was generally enhanced by movement of colonies throughout the south via human transportation of nursery stock (Lofgren et al. 1975). *Solenopsis invicta* proved to be either more aggressive or simply better adapted to climatic conditions, since *S. richteri* now occupies only a small enclave in northeastern Mississippi and northwestern Alabama (Vander Meer et al. 1985). The northern limits of climate in which the two species can survive has never been established; however, the northern boundary of the populations was thought to have stabilized due to the inability of either species to cope with prolonged freezing temperatures during winter. The recent finding that certain fire ant free areas of North Georgia have become infested with colonies of large dark colored fire ants, coupled with the recent discovery of hybridization between the two imported fire ants by Vander Meer et al. (1985), has again raised concern about the potential northward spread of the two parental forms and especially the reproductively viable (Ross et al. 1987) hybrid. We report here that these infestations are hybrids of *S. invicta* and *S. richteri*. We further report results of surveys in northern Alabama indicating that the hybrid has a much more extensive range than originally reported.

MATERIALS AND METHODS

Colonies were collected from ten randomly selected areas in Floyd County, Georgia. Each colony was placed in a 10-gallon plastic garbage can and returned to

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the laboratory in Tifton, Georgia. The upper inside edge of each can was coated with talc to prevent the ants from escaping.

Samples of worker ants from these colonies and from field colonies in the counties listed below were taken for chemical analyses as described. In some of the counties, especially the larger Alabama counties, samples were taken from more than one location. This is represented by the number in parentheses following the county's name. Collections were taken from Polk (6), Coweta (1), Morgan (1), Tift (1), Haralson (1), Carroll (1), Heard (1), Troup (1), Paulding (1), Douglas (1), and Chattooga (2) counties in Georgia and Cherokee (1), Dekalb (1), Marshall (1), Etowah (2), Calhoun (4), Talladega (3), Walker (2), Marion (2), Winston (2), Cullman (2), Blount (1), Coosa (1), Shelby (1), Jefferson (1), Cleburne (1), Fayette (2), Lamar (1), St. Clair (2), Randolph (2), and Tallapoosa (2) counties in Alabama.

Live worker ants (3-5 per sample) from each colony were killed by dropping them into a vial which contained enough hexane (Baker, Resi-Analyzed) to cover them. The ants were allowed to soak in hexane for 1 to 24 hours, after which the hexane was transferred to another container and the ant specimens preserved in 75% ethanol. The hexane soak was analysed by gas chromatography (GC) on a Varian 3700 gas chromatograph (Walnut Creek, CA) equipped with a flame ionization detector. A fused silica 30 m × 0.032 mm i.d. DB-1 (J & W Scientific, Inc., Rancho Cordova, CA) capillary column was temperature programmed from 150°C for 1 minute, then to 285°C at 4°C per minute. Using this program both venom alkaloids and the hydrocarbons could be analyzed simultaneously. Samples could be concentrated under a stream of nitrogen or diluted with hexane depending on initial GC results. The data were quantitatively analyzed with a Varian Vista 401 data processor. Alkaloid peak assignments were based on comparison with authentic *S. invicta* poison sac extracts and occasional GC-mass spectroscopy (GC-MS) analysis. Hydrocarbon patterns are distinctly different for *S. invicta* and *S. richteri* and mixtures of the two patterns are readily detected. Gas chromatographic comparison of purified hydrocarbons from *S. invicta* and *S. richteri* hexane soaks and the soaks themselves demonstrated that the species-specific hydrocarbons elute from the GC column without interference from other chemical classes.

RESULTS AND DISCUSSION

The venom alkaloids of *S. invicta* and *S. richteri* are composed of 6-methyl-2-alkyl or alkenyl-piperidines (Vander Meer 1986). Since the structures are identical except for the 2-substituted group they can be readily referred to by specifying the side chain; i.e. $C_{13:0}$ means there is a tridecyl- group at position 2 of the piperidine ring and $C_{15:1}$ indicates that a pentadecenyl- group is attached to the 2 position of the piperdine ring. The two species are readily distinguished by their alkaloid patterns because *S. richteri* is essentially devoid of $C_{15:1}$ and $C_{15:0}$ alkaloids which are dominant in *S. invicta* (Brand et al. 1972). The hydrocarbons of *S. invicta* and *S. richteri* have been identified as series of normal, monomethyl, dimethyl branched hydrocarbons (Lok et al 1972; Nelson et al. 1980) which are species specific and can be used as taxonomic characters (Vander Meer 1986).

Comparison of the alkaloid and hydrocarbon patterns of workers from colonies collected from Floyd County, Georgia with those of the pure species clearly showed them to be hybrids (Fig. 1) based on both biochemical characters.

Vander Meer et al. (1985) recently demonstrated the same phenomenon in a population of fire ants in east central Mississippi. Hybridization of this population has been further confirmed by comparative biochemical (hydrocarbon and venom alkaloid analysis) and genetic (isoenzyme) analyses (Ross et al. 1987).

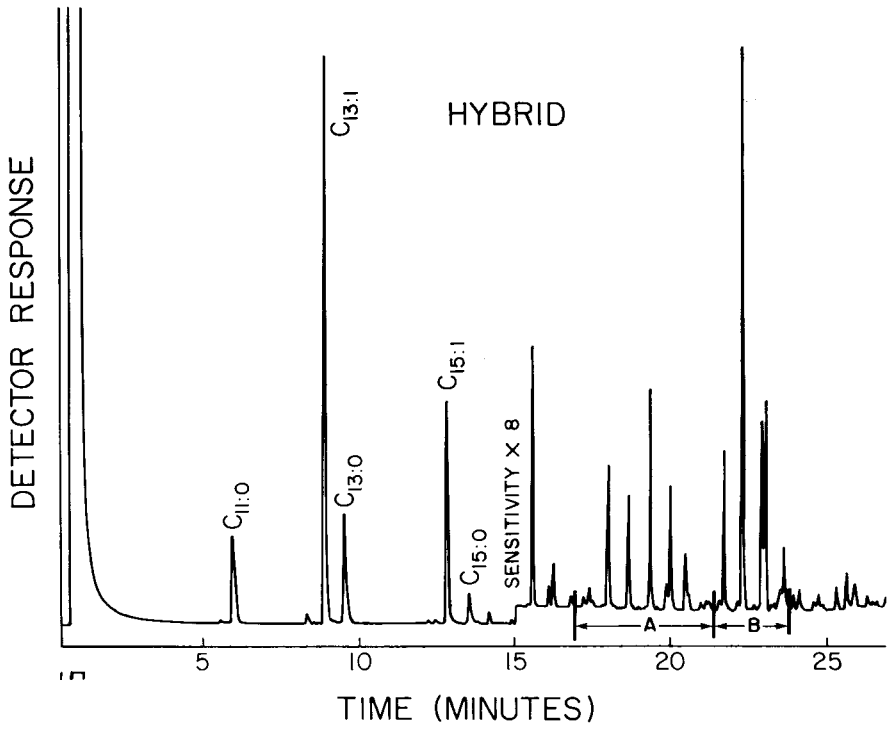

Fig. 1. Representative gas chromatograph trace of venom alkaloids and hydrocarbons from the hybrid of *S. invicta* and *S. richteri*. The 2-alkyl or alkenyl side chains on the piperidine alkaloids are labeled on the chromatogram (retention times to 15 mins). The hydrocarbon sections marked A and B define, respectively, the *S. richteri* and *S. invicta* contribution to the hybrid.

The additional collection and chemical analyses of fire ant workers from Whitfield, Polk, Haralson, Carroll, Heard, Troup, Paulding, Douglas, and Chattooga counties in Georgia and Cherokee, Dekalb, Marshall, Etowah, Calhoun, Talladega, Walker, Marion, Winston, Cullman, Blount, Cleburn, Fayette, Lamar, St. Clair, Clay, Randolph, and Tallapoosa counties in Alabama also demonstrated the presence of the hybrid in these locations. Hybridization between the two species was considered to be a phenomenon localized in an area of east central Mississippi (Vander Meer et al. 1985); however, these data clearly show that the hybrid population is much more extensive and extends across Alabama into Georgia (Fig. 2).

The hybrid is morphologically similar to *S. richteri*, which makes it difficult to detect in the field. Chemical analyses of preserved specimens from as early as

1949 (Vander Meer, Lofgren and Wilson, unpublished results) have demonstrated that hybridization occurred through the history of interaction between the two species in the United States.

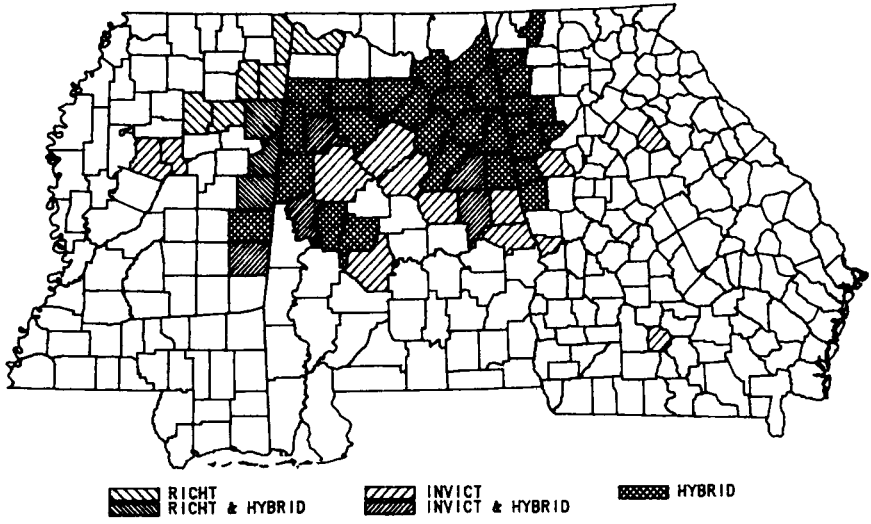

Fig. 2. Shaded counties were surveyed as of November 1986. Species and hybrid are indicated as shown below.

In addition, the extent of the hybrid population, as well as genetic analysis (Ross et al. 1987), indicates that it is reproductively viable and has probably existed in these locations for some time. The discovery of an extensive hybrid population emphasizes the importance of a broad fire ant population survey to delineate the particular form of fire ant in each area of infestation. This is important for several reasons. Though no fault of anyone, the extensive amount of literature that describes the vast range of *S. invicta* is in error. The data shown here raise the question of how much land does each type of ant occupy. In this survey, the hybrid was found in 66% of the counties. This survey may or may not cover the entire area occupied by the hybrid; however, it clearly shows the hybrid infests a sizable amount of land. More survey work is necessary to determine the current (and possibly expanding) range of the hybrid. It will be important to know if the hybrid is out-competing *S. invicta*. Further research will reveal if differences exist between the two in cold tolerance, chemical resistance, etc. In the future we must fully define fire ant collections using both classic morphological and chemical characters.

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