N O T E

Distribution of the Fire Ant (Hymenoptera: Formicidae) Hybrid in Georgia[1]

Wayne A. Gardner[2], Stan Diffie[3], Robert K. Vander Meer[4] and Mark A. Brinkman[5]

Department of Entomology, University of Georgia, College of Agricultural and Environmental Sciences, Griffin Campus, Griffin, Georgia 30223-1797 USA

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The red imported fire ant, *Solenopsis invicta* Buren, and the black imported fire ant, *S. richteri* Forel, are reproductively isolated in their native South America even where their ranges overlap (Ross and Shoemaker 2005, Mol. Ecol. 14: 3,419-38). Yet, these invasive ant species readily hybridize in their expanded ranges in North America. Vander Meer and Lofgren (1988, Florida Entomol. 71: 232-32) determined that hybridization occurred in south Alabama soon after the invasion of these ant species. Hybrid ants are morphologically similar to *S. richteri* and *S. invicta*, and chemical analysis of ant venom and cuticular hydrocarbons or genetic characterization are required to distinguish hybrid ants from the parent species (Vander Meer et al. 1985, Florida Entomol. 68: 501-06; Ross et al. 1987, Evol. 41: 280-93).

Drees et al. (2006, Texas Coop. Ext. B-6043) recently showed *S. richteri* distributed in only 8 counties in northern Mississippi and 10 counties in west central Tennessee. The *S. richteri* x *S. invicta* hybrid, however, is more widely distributed in southern Tennessee, the western tip of North Carolina, and northern areas of Mississippi, Alabama, and Georgia. Although hybridization occurred upon arrival of these two species in North America, *S. invicta* now occupies the remaining quarantined areas in North America (see *http://aphis.usda.gov*) owing to its apparent displacement of *S. richteri* and the hybrid in this expanded range.

Diffie et al. (1988, J. Entomol. Sci. 23: 187-91) initially reported the discovery of the hybrid ant in Alabama and Georgia and mapped its known distribution in Georgia, Alabama and Mississippi. Their survey included ants collected from 20 counties in Alabama and 11 counties in Georgia. The survey reported herein expands those

[1]Received 02 July 2007; accepted for publication 24 July 2007.
[2]Address inquiries (email: wgardner@uga.edu)
[3]Department of Entomology, UGA Tifton Campus, Tifton, GA.
[4]USDA-ARS-CMAVE, Gainesville, FL.
[5]Gordon College, Barnesville, GA.

samples to establish an eastern and southern boundary to the range of the *S. richteri* x *S. invicta* hybrid in Georgia.

To establish sampling sites for the survey, a grid of 125 blocks (27 × 27 km per block) was superimposed to scale on a Georgia highway map. The grid extended west to the Alabama border, north to the Tennessee border, east to the South Carolina border and from near Elberton, GA (Elbert Co.) southward to Wrightsville, GA (Johnson Co.), and south along a line from Wrightsville westward through Harris Co. on the Alabama border. This encompassed an area of approx. 9,112,500 ha covering 77 of Georgia's 159 counties.

Fire ants were collected from mounds at 3 locations in proximity to each grid intersection on the map. One sample was taken as closely to the grid intersection as road access allowed. The other 2 samples were taken 1.6 km on either side of that site, with the cardinal directions of those samples being predetermined by route of travel. Sampling began in January 1999 and continued through March 2000.

Ants were collected by placing a disposable culture tube (16 × 100 mm) into the

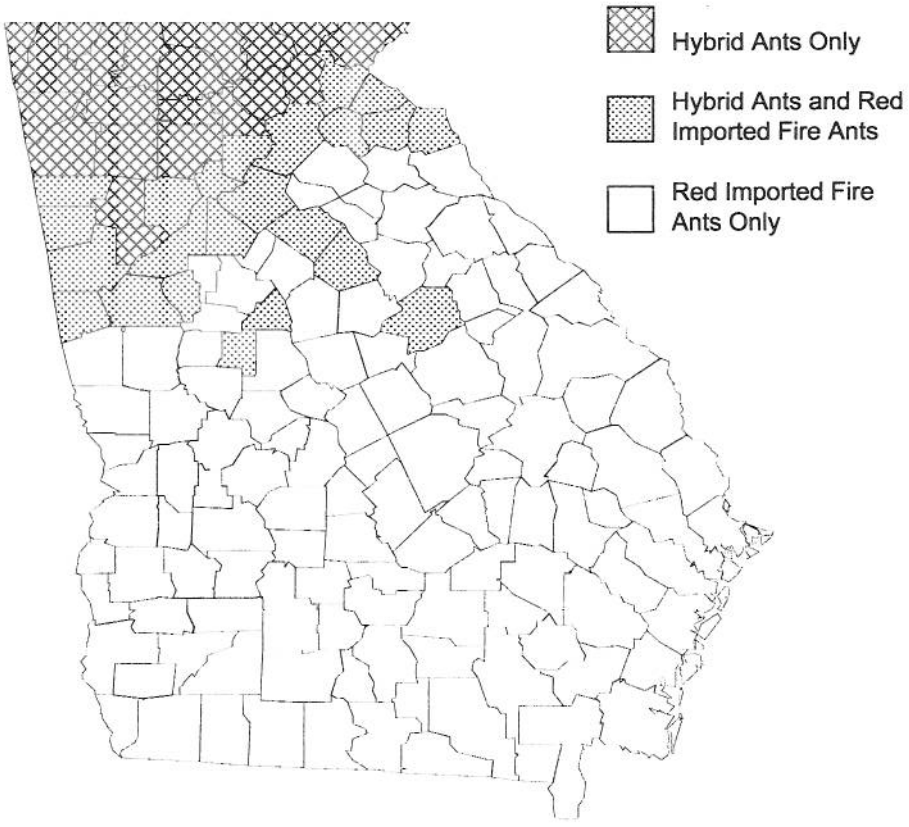
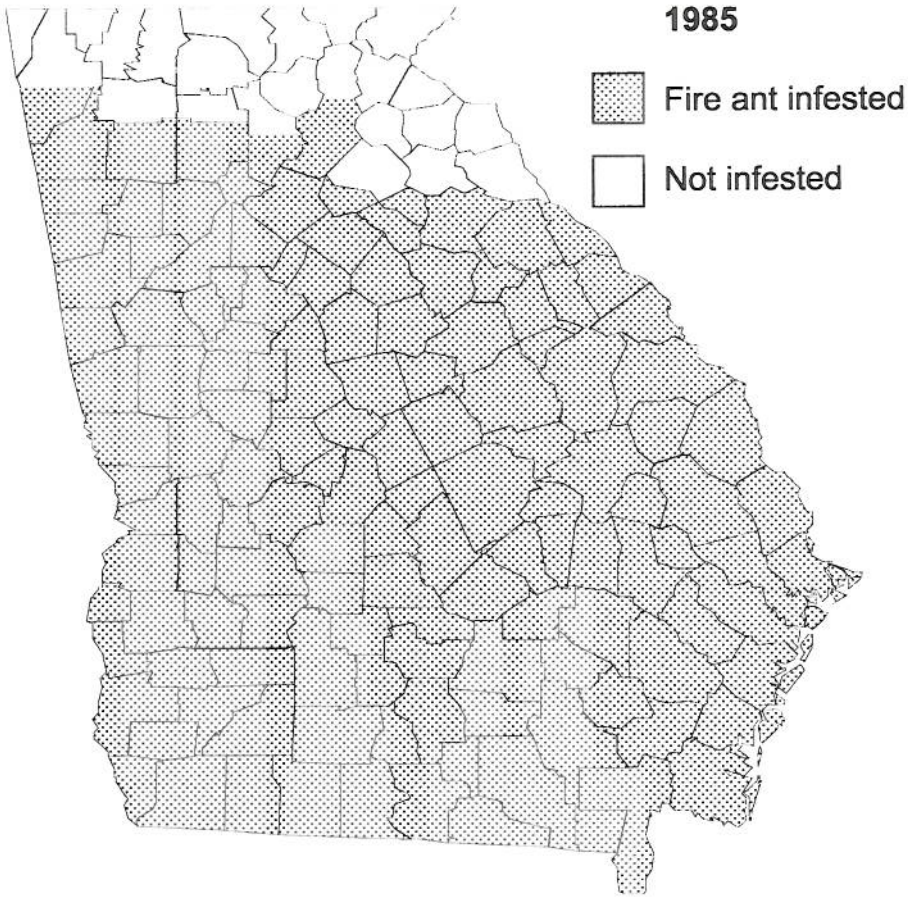


Fig. 1. Distribution of *S. richteri* x *S. invicta* hybrid and *S. invicta* in Georgia counties

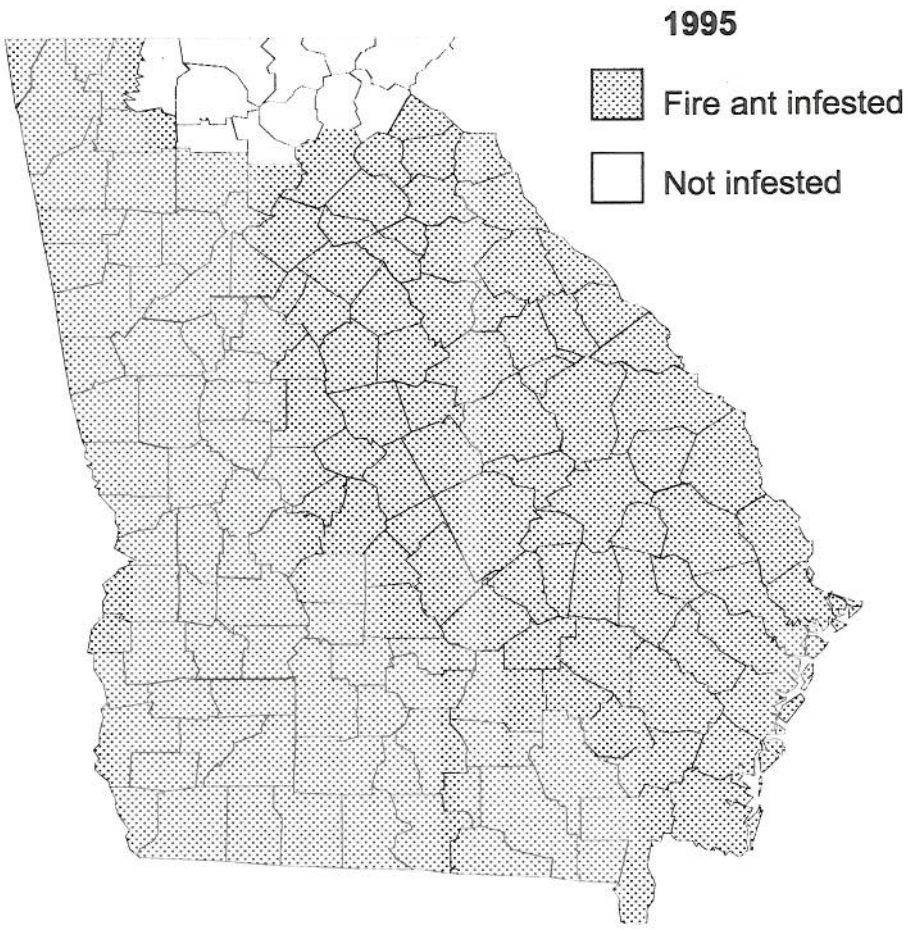
mound and allowing defensive workers to crawl into the tube. The upper inner surfaces of the tubes were coated with Fluon™ (Northern Products, Woonsocket, RI) to prevent worker ants from escaping. When a minimum of 30 ants was captured, the tube was capped and returned to the laboratory. In the laboratory, ants were cooled for 30 min to slow their activity and then transferred to scintillation vials containing hexane. After 48 h, the hexane in each vial was transferred to 20-mL vials and allowed to evaporate at ambient room conditions. Ethyl alcohol (70%, v/v) was added to the scintillation vials to preserve the ants.

The hexane residues were reconstituted with hexane and analyzed by gas chromatography using a Varian 3,700 GC (Walnut Creek, CA) equipped with a flame ionization detector. The fused silica (30 m × 0.032 mm i.d., DB-1) capillary column (J&W Scientific, Inc., Rancho Cordova, CA) was temperature programmed from 150°C for 1 min, then to 285°C at increments of 4°C per min. Venom alkaloids and cuticular hydrocarbons could be analyzed simultaneously with this program. Samples



could be concentrated under a stream of nitrogen or diluted with hexane depending upon initial chromatographic results. Data were quantitatively analyzed with a Varian Vista 401 or Turbochrom data processor. Alkaloid peak assignments were based on comparisons with extracts from *S. invicta* poison sacs and GC-mass spectroscopy analysis. Cuticular hydrocarbons were compared with purified hydrocarbons extracted from *S. invicta* and *S. richteri*. Hydrocarbon patterns from *S. invicta* and *S. richteri* are distinctly different, with *S. richteri* x *S. invicta* hybrids producing intermediate mixtures of the two (Vander Meer et al. 1985).

Chemical analysis of the ants collected in this survey demonstrated that *S. richteri* x *S. invicta* hybrids occurred at 73 of the 144 sample areas. These areas were located within 43 of the 77 counties included in this survey (Fig. 1). Only hybrids were collected in 21 of those counties (48 sample areas), whereas hybrids and *S. invicta* were collected in 22 counties. The remaining 34 counties (71 sample areas) yielded samples of only *S. invicta*.



This further delineates the southern and eastern boundary of the hybrid zone in Georgia. The earlier survey by Diffie et al. (1988) served to identify the potential extent of this hybrid zone – a zone which the reproductively viable hybrid (Ross et al. 1987) has invaded primarily through human transport and mating flight behavior (Vander Meer et al. 1985). In fact, the infestation of all 159 Georgia counties by imported fire ants can be visually correlated with this apparent spread of the hybrid. In 1985, 23 counties across northern Georgia were not infested with imported fire ants (Fig. 2), whereas only 11 counties were not infested in 1995 (Fig. 3) (B. Sparks, S. Diffie & M. Bass, unpubl. data). All counties were infested by 1999/2000 when this survey was conducted. The invasion of these northern, more mountainous counties was apparently by hybrid ant populations, as evidenced in the survey results reported herein (Fig. 1). This is further supported by the postulation that *S. richteri*, whose native range is temperate areas of Argentina, and the *S. richteri* x *S. invicta* hybrid are better adapted to cooler more northern latitudes than *S. invicta* in their expanded North American ranges (Vander Meer and Lofgren 1988).

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