

## Red Imported Fire Ants:<sup>1</sup> Capability of Queens from Established Colonies and of Newly-mated Queens to Establish Colonies in the Laboratory<sup>2</sup>

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### ABSTRACT

Fifty-nine physogastric queens of the red imported fire ant, *Solenopsis invicta* Buren, taken from established mounds in the field, and 50 de-alated females taken from a multiple queen colony, did not successfully found colonies in the laboratory when they were held without worker ants. All the physogastric queens were dead

by 8 wk, and all the de-alated females were dead by 12 wk after initiation of the tests. When such queens were held with 25 or more worker ants, survival of the queens was enhanced and colonies were established. In contrast, 74% of 150 newly-mated queens did successfully found colonies within 8 wk in the laboratory.

If an area is treated with a single application of mirex bait for control of the red imported fire ant, *Solenopsis invicta* Buren, it usually becomes reinfested within 3–12 mo with many small incipient colonies (Lofgren et al. 1964, Banks et al. 1970, 1973). These colonies have been thought to develop from newly-mated queens that fly into the area just before or shortly after the bait treatment. However, Tschinkel<sup>6</sup> suggested that queens in some colonies might survive treatment even though all their worker ants were eliminated. These queens resume egg laying at some time after treatment and thus produce "new" colonies.

No data were available to support or refute the theory of Tschinkel since all published studies of colony development by the red imported fire ant have been on colonies initiated by newly-mated queens (Khan et al. 1967, Fincher and Lund 1967, Markin et al. 1972, 1973). Even though Wilson (1971) reported that queens of *Solenopsis saevissima*<sup>7</sup> resumed brood care in young colonies from which the worker ants were suddenly removed; he did not comment on the further development or ultimate fate of these colonies.

We therefore investigated at Gulfport, MS and Gainesville, FL, the establishment of colonies in the laboratory by queens taken from well established field mounds and by newly-mated queens.

### MATERIALS AND METHODS

Tests were conducted at both locations with newly-mated queens and with physogastric queens taken from established field colonies. The Gulfport tests also included fertile de-alate females from the multiple queen colony of imported fire ants found at Hurley, MS (Glancey et al. 1975). (These de-alated females will hereinafter be referred to as Hurley queens.)

The newly-mated queens were collected from the soil surface after nuptial flights; whereas, the physogastric and Hurley queens were collected by excavating field nests and recovering the queen along with worker ants.

In the laboratory, all the queens in the Gulfport study and the newly-mated queens in the Gainesville study were confined individually in 6-in. plastic flower pots or 50-ml shell vials. The holes in the bottom of the pots and holes drilled in the bottom of the shell vials were covered with a ¼-in. layer of plaster of paris-builder's cement (9:1 ratio). Thus, when the containers were set on damp peat moss, absorption of moisture through the plaster-cement mixture maintained high humidity in the containers.

In the Gainesville study with physogastric queens, the queens and workers from 30 mature field colonies were each established in the laboratory in plexiglass ant nests (Wilson 1962) in plastic trays (ca. 400×520×75 cm). After an acclimation period of 10 days, all worker ants and immature forms were removed from 10 nests so as to leave only the queen. In 10 other nests the populations were reduced to 25 workers, 25 larvae and pupae, and the queen. The remaining 10 colonies were left intact with the queen and 6–8,000 workers and larvae and pupae.

Food was provided ad lib. for all the queens and colonies. Temperature was maintained in the laboratories at 27.5±2°C.

Observations of colony status were made once every 2 wk (data was recorded every 4 wk) through 8 wk at Gulfport and 16 wk at Gainesville. Also, a final observation at 7 mo was made on the colonies founded by the newly-mated queens at Gainesville.

### RESULTS

None of the 59 physogastric queens confined without worker ants established a colony in the laboratory (Table 1). Indeed, only one queen produced any eggs or larvae, and none of the larvae survived to produce worker ants. All but 5 of the queens were dead by 4 wk and all were dead by 8 wk. Queens with 25 workers and 25 immature forms survived better, 7 of 10 queens survived long enough to produce eggs and larvae, and these colonies showed an increase in the number of workers by 4 wk. At 8 wk, 6 of the queens had died, and the number of workers in these 6 colonies had begun to decrease. By 16 wk,

<sup>1</sup> Hymenoptera: Formicidae.

<sup>2</sup> This paper reflects the results of research only. Mention of a pesticide or a commercial or proprietary product does not constitute a recommendation or an endorsement of this product by the USDA. Paper received for publication March 19, 1976.

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<sup>6</sup> W. R. Tschinkel. 1974. FIFRA Doc. 293. Statement submitted as testimony in EPA public hearing on mirex.

<sup>7</sup> The ants studied by Wilson were probably *Solenopsis invicta*.

Table 1.—Queen survival and colony establishment in the laboratory by queens of the red imported fire ant from established colonies alone and with workers and by newly mated queens.

Type of queen or colony	No. of queens	No. of colonies with following castes after indicated weeks											
		Live queen				Immatures <sup>a</sup>				Worker ants			
		4	8	12	16	4	8	12	16	4	8	12	16
Physogastric	59	5	0	0	0	1	0	0	0	0	0	0	0
Physogastric + 25 workers + 25 immatures	10	6	4	3	2	7	6	4	2	7 <sup>b</sup>	5	3	2
Physogastric + 6-8,000 workers	10	9	8	8	5	10	9	9	7	10 <sup>b</sup>	9	8	6
Hurley	50	8	3	0	0	5	0	0	0	0	1	1	0
Newly-mated	150	135	116	69 <sup>c</sup>	49 <sup>c</sup>	129	120	78 <sup>c</sup>	57 <sup>c</sup>	16	111	78 <sup>c</sup>	58 <sup>c</sup>

<sup>a</sup> Immatures include eggs, larvae, and pupae.

<sup>b</sup> Only colonies in which worker population was static or increasing are included.

<sup>c</sup> One test at Gulfport discontinued after 8 wk and one after 12 wk, thus numbers at 12 wk are based on 120 and at 16 wk are based on 100 of the original 150 queens.

8 of the 10 queens had died, and the workers were dying off in all colonies except the 2 with surviving queens. The situation was reversed in the normal colonies: all 10 queens survived long enough to effect an increase in the number of workers by 4 wk. One queen was dead at 3 wk, a 2nd queen was dead by 8 wk, and 5 of the 10 queens were dead at 16 wk. At this time, the number of worker ants had begun to decrease in all the queenless colonies.

Results were similar with the 50 Hurley queens: 8 queens produced eggs or larvae by 4 wk, but only one queen ultimately produced worker ants and this queen died shortly after the workers eclosed. Fourteen of the queens survived for 4 wk but only 5 for as long as 8 wk and all were dead by 12 wk.

In contrast, 111 of the 150 newly-mated queens successfully established incipient colonies in the laboratory. Eggs or larvae were produced by 129 queens by 4 wk, but only 111 of the queens had produced minim workers by 8 wk. The queens in 34 nests died after producing minim workers and before any minor workers were produced. In the Gainesville test where regular observations were made through 16 wk, 49 colonies contained live queens and several hundred worker ants and immature forms at that time. Thus, they appeared to be healthy, flourishing colonies. Observations made at 7 mo showed that 37 of the original 100 colonies in the Gainesville test were still growing and doing well.

#### DISCUSSION

The results of the studies at Gulfport and Gainesville indicate that the queen of an established fire ant colony could not re-establish a colony if she loses all her workers because of pesticide poisoning or some other factor. The explanation may lie with certain aspects of the biology of the ants. The dissolution of the wing muscles in newly-mated queens apparently provides a substantial food source for rearing the 1st workers (Green 1967). Queens from established colonies would have utilized these reserves in the initial colony-founding and would not have sufficient food

reserves in the body to found another colony. Further, we have observed that the queens from old established nests do not cluster the eggs and tend them as do newly-mated queens, instead, they leave them scattered about the bottom of the nest. Thus the behavioral pattern of egg-tending may be lost as the queen ages and the function is assumed by the worker ants. In the absence of almost continuous care, the eggs are highly subject to decimation by fungus (Khan et al. 1967, O'Neal and Markin 1973). Furthermore, Glancey et al. (1973) found that in the laboratory all of 7 newly-mated queens laid trophic eggs in the 1st clutch but only 2 of 19 queens taken from established nests laid trophic eggs. The lack of production of trophic eggs by the majority of the queens from the established nests suggests that the mother queen of a large nest does not produce trophic eggs and that the 2 queens that did so were probably newly-mated queens recently adopted by the colonies. Trophic eggs have been shown by Glancey et al. (1973), O'Neal and Markin (1973) and Bass<sup>8</sup> to serve as food for the developing larvae. Thus trophic eggs are important and, in the absence of worker ants, may be vital to the development of the queen's 1st brood. If trophic eggs are indeed vital to the survival of larva, the fact that queens from established colonies apparently do not lay trophic eggs (Glancey et al. 1973) may make it impossible for these queens to re-establish in the absence of worker ants. Indeed, the fact that in the present tests only one of the queens from established field colonies laid eggs of any type suggests that worker ants must be present (probably to provide an adequate supply of food) in order for the queen to produce eggs. The fact that the colonies in this study in which worker ants were present produced eggs, larvae, and worker ants supports this conclusion. We have likewise observed in other studies (unpubl.) that physogastric queens taken from field nests invariably

<sup>8</sup> Bass, J. A. 1974. Selected aspects of the biology of the imported fire ant and the geographical location and identification of the fire ant species in South Carolina. MS Thesis, Clemson University, Clemson, SC 29631. 40 p.

were fertile and laid eggs in the laboratory when worker ants were present.

The failure of the Hurley queens to produce colonies indicates that even though large numbers of fertile queens may be present in a single colony, they cannot successfully found a new colony without assistance from worker ants. These Hurley queens were not physogastric but they could be distinguished as fertile by the care given them by the worker ants. Our unpublished data show that fertile queens are tended much more closely by the workers than are nonfertile de-alate females.

The newly mated queens were fairly successful in founding new colonies. In these tests, 111 (74%) of 150 queens had produced worker ants by 8 wk. We do not know how this compared with the percentage of queens that successfully found colonies in the field, but it is presumably higher because of the freedom from predation and other adverse factors present in the field.

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