Evidence of a Replete Caste in the Fire Ant *Solenopsis invicta*[1, 2]

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About 3 years ago, we collected some workers and alates from a field colony of the fire ant *Solenopsis invicta* Buren that had been fed soybean oil containing blue dye one year earlier, and gave a portion of the collection to Virgil Owens, Animal and Plant Health Inspection Service, USDA, at Gulfport, Miss. Mr. Owens subsequently called to our attention that large amounts of a blue substance were visible in the crops of the largest major workers, in the crops and wing veins of alate females, and in the crops of a few minor workers. Indeed, the abdomens of these major workers were so distended that they could be easily picked out with the naked eye. Subsequent chemical tests showed that the substance was an oil-dye mixture, which was puzzling because the oil and dye would not have been present if normal food exchange, metabolism, and excretion had occurred after the initial feeding of the ants. The present paper reports the results of the studies we made of this phenomenon.

In our 1st tests, we fed 4 field colonies with soybean oil containing 0.5% Calco N-1700 red dye for one week. Then 6 months later, samples of ants were taken from 2 colonies and returned to the laboratory for examination. (The other colonies had moved and could not be located.) Dye was found in all alate females (23), all dealated females (7), in all large workers (200), and in 6.75% of 622 minor workers. Dye was also found in sex larvae but not in worker larvae, and none of 42 ♂ examined contained dye. We therefore made 3 similar tests and found that the results (see Table 1) all verified our initial findings, i.e., dyed oil was found in ants from 6 to 18 months after it was fed to them.

In another test, a portion of a colony that had been fed dye 6 months previously and of a colony not fed dye were brought into the laboratory and held without food or water. Then 100 minor workers from each colony were examined at intervals after collection. No dye was seen in any ants in the colony that received no dye (control), but 45, 71, and 93% of the ants from the test colony contained dye the 3rd, 4th, and 7th days after collection, respectively. By the 9th day, all control ants were dead; the ants in the test colony were still healthy.

Table 1.—Results of tests (in which colonies of ants were fed oil and dye) to test theory of oil storage in *S. invicta*.

Test	Time elapsed after feeding (months)	No. colonies tested	% of indicated ant form that contained dye: Minor workers	Major workers	Alate females
1	6	4	28	39	38
2	6	3	29	30	0
	18	2	0	29	29
3	9	4	1	29	35

Finally, 4 field colonies that had been fed dyed oil were placed in soil nests in the laboratory without additional food or dyed oil. Then minor workers from these colonies (100/sample) were examined for dye at intervals over a period of 18 days. The results were as follows.

Day	% of minor workers containing dye in indicated colony: 1	2	3	4
1	22	79	1	10
3	24	80	0	5
7	27	71	4	58
14	86	96	Died	78
18	75	100		86

Obviously, under the stress of starvation, major workers distributed dyed oil to minor workers. Moreover, all except Colony 3 lived for 3 weeks without food. (The test was terminated at that time.)

Only 2 logical explanations are apparent; either the ants are capable of storing oil in their crops for long

[1] Hymenoptera: Formicidae.

[2] Mention of a commercial or proprietary product does not constitute endorsement by the USDA.. Received for publication July 10, 1972.

periods, or they maintain food in storage receptacles within the mound. The latter explanation does not appear likely because researchers of *S. invicta* have never located any liquid food storage areas within the mounds of this ant. Thus, the large major workers must be storing oil in their crops and functioning as a replete caste.

The concept of a replete caste in ants is usually associated with the storage of nectar or honeydew by ants of the genus *Myrmecocystus*. The gaster of a replete worker of this genus may become so swollen that the insect cannot walk and is compelled to lead a quiescent life, hanging by its claws from the roofs of the nest chamber. The food stored by these repletes can be passed to the rest of the colony.

Wheeler (1910) stated that true repletes are developed only within the nest where they remain and store the sweets brought in by the forager ants. Sudd (1967) described repletes as "anatomically simply ordinary workers, often of the larger sort, whose gaster is enlarged by the stretching of the membrane between the plates." In his book, *The Insect Societies*, Wilson (1971) reported that repletism occurs in a wide range of ant genera belonging to several subfamilies, including the Myrmicinae (*Oligomyrmex*, which is related to *Solenopsis*). Repletism is usually limited to the major caste in these various genera.

Our observations, too, indicate that the large major fire ant workers are similar to other workers in the colony, but they function as repletes by storing liquid food in their crop. Also, they provide food for the female sex brood or for workers during stress periods when natural food supplies are limited. The general absence of the dye in the minor forms in normal colonies indicates to us that repletes normally feed the sex forms directly rather than through the minor workers. Stored oil would be a highly beneficial food source for the ants because nutritionally, 1 g of fat yields 2 cal compared with a yield of 1 cal from 1 g of carbohydrate.

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