REPRINTED FROM:

Applied Myrmecology

A World Perspective

EDITED BY

Robert K. Vander Meer,
Klaus Jaffe, and Aragua Cedeno

Westview Press
BOULDER, SAN FRANCISCO, & OXFORD

27

The Little Fire Ant *Wasmannia auropunctata* (R.) (Hymenoptera: Formicidae)

P. Ulloa-Chacon and D. Cherix

INTRODUCTION

The little fire ant, *Wasmannia auropunctata*, is a typical tramp species which has yet to be studied intensively. This paper summarizes the few research contributions to the biology, ecology and economic importance of this tiny ant, and some preliminary results obtained in our research program concerning reproductive biology of this polygyne species.

HISTORY

The little fire ant, which belongs to the subfamily Myrmicinae, is native to the American tropics and was described for the first time by Roger (1863) who, based on samples from the island of Cuba, named it *Tetramorium auropunctatum*. Forel (1884) found that the females exhibited certain morphological characters different from the genus *Tetramorium*. This led him to suggest that this species should be classified within the genus *Ochetomyrmex* (Mayr) (Forel 1886). Nevertheless, Forel (1887), placed it in the new subgenus *Xiphomyrmex (Tetramorium)*. Finally, Forel (1893), established the new genus, *Wasmannia*, comprised of *W. auropunctata* (Roger) and *W. sigmoidea* (Mayr).

Since Forel's time, *W. auropunctata* has been reported in Latin America and in the Caribbean Islands. According to Kempf (1972) six varieties have been described: *rugosa, australis, laevifrons, nigricans, obscura and brevispinosa.*

MORPHOLOGY

Within the genus *Wasmannia*, workers are monomorphic. They have an 11-segmented antenna with a 3-segmented club; the last segment is very large and longer than the two preceding segments combined. The clypeus is arched both longitudinally and transversely.

W. auropunctata has a long antennal scape reaching the occiput; it also has an antennal scrobe. The mandibles have 5 teeth, its maxillary palp are 3-segmented and the labial palp is 2-segmented. The large head is much broader than the thorax. The prothorax has angular humeri; and it lacks a promesonotal suture. The petiolar node in profile is subrectangular and higher than the postpetiole; the epinotal spines are prominent. The head and thorax are sculptured with large longitudinal and transversal rugules, interspersed with fine reticulations. Body hairs are long, erect and sparse. The ant is golden brown to brown, and reaches 1.2-1.5 mm in size. The sting is well developed.

The queen is very large (length 4.5-5.0 mm) compared to workers. The antenna, are like the worker's and the antennal scrobe, is well marked. The postpetiole node is much shorter than in the worker. The gaster is smooth and shiny. The first gastric tergite nearly covers the whole gaster in dorsal view; sculpture, pilosity and pubescence are as in the worker. The forewing has no closed discoidal cell. The queen is dark brown in color.

The male is about as long (4.2-4.5 mm) as the female, but with a more slender body. The antenna is 13-segmented. The gaster is elongate, with very conspicuous genitalia in which the external valves are curved and long, nearly two-fifths the length of the abdomen. Sculpture, pilosity and pubescence differ from those of the worker and queen. Color is more like that of the queen, except that the antenna, legs and external genitalia are yellowish. Forewing venation is as found in the queen.

ECONOMIC IMPORTANCE AND ECOLOGICAL IMPACT

W. auropunctata was accidentally introduced by man into several warm regions of the world. Additionally, in 1907 it was found in nursery plants at Kew Gardens (London) (Donistorphe 1915). Today, the ant is well-established in the United States, particularly in southern Florida (Smith 1929; Wheeler 1929; Spencer 1941), and in California (Nickerson 1983). Large numbers of the ants are also found in the Galapagos Islands (Silberglied 1972) and in New Caledonia (Fabres and Brown 1978). The species can be considered a pest in three different ways.

The Invasion of Cultivated Fields

This first point includes the symbiotic relationship with other pest species, such as Homoptera (aphids, white flies, scales), which excrete honeydew and in turn serve as an essential food source for the ants. At the same time, the ants protect these insects from their natural enemies (parasites and predators). This ant causes an ecological imbalance in phytophagous insect communities in Florida citrus crops (Spencer 1941); Puerto Rican coffee (Smith 1937); Cameroon cocoa (Bruneau de Miré 1969); Columbian coffee and cocoa (Posada et al. 1976); New Caledonian coffee, citric and ornamentals (Fabres and Brown 1978); and Brazilian cocoa (Delabie 1988).

Some emphasis should be placed on the stinging habits of the workers (Spencer 1941). In addition to its powerful sting, the mandibular secretion contains alkylpyrazines, compounds which may have both alarm and defensive functions (Howard et al. 1982).

Infestation of Human Houses

W. auropunctata as a house pest contaminates food; it is attracted to dirty and sweaty clothing and can infest bedrooms (Spencer 1941; Fernald 1947; Smith 1965).

Interspecific Competition with Local Fauna

Interspecific competition gradually eliminates native ant species and terrestrial invertebrates in the newly-colonized areas. In the Galapagos Islands, Clark et al. (1982) and Lubin (1984, 1985), found that the greatest density of other ant species occurred in dry areas which have the lowest density of the little fire ant. They suggest that the little fire ant's success as a colonizer can be attributed to its ability to nest in diverse habitats, its mass recruitment to food and its uninterrupted circadian activity.

Due to its importance as a destructive insect, some methods of crop control--such as destruction of nests, use of sticky strips (Spencer 1941) and chemical control with poisoned baits containing highly toxic products (Fernald 1947; Osburn 1948)--have been tested and implemented.

BIOLOGY AND ECOLOGY

Life History

Little is known about the life history of *W. auropunctata.* The morphology of immature stages and worker brood development was studied by Ulloa-Chacon and Cherix (1988). The egg is elliptical and whitish. It has an average size of 0.22 mm by 0.15 mm. The first instar larva measures 0.27-0.30 mm, and last instar 1.20 mm. The pupa is about 1.04 mm. In laboratory conditions (26°C and 60% relative humidity), the incubation period lasts from 8 to 10 days, the larval stage 16 to 18 days and the pupal stage 11 to 12 days. The entire development from egg to adult worker takes 37 days (min. 35 days, max. 40 days).

Wheeler and Wheeler (1954) described the worker and queen larvae.

Nest and Social Structure

W. auropunctata nest in a wide variety of substrata and in semi-arid to humid habitats (Spencer 1941; Kusnezov 1951). Nevertheless, it prefers high heat-humidity conditions for its foraging activity (Lubin 1985).

The nests, diffuse and inconspicuous, are composed of an aggregate of individuals (workers, queens and brood) (Clark et al. 1982). Several such nests are interconnected by worker trails forming a colony without boundaries. This type of social structure, called "unicolonial," is also common in other ant tramp species like *Monomorium pharaonis*, *Pheidole megacephala* and *Iridomyrmex humilis* (Hölldobler and Wilson 1977).

In *W. auropunctata*, nests are usually established at ground level, close to the surface. They are located around plant roots, under the rough bark of growing trees, in hollow branches or decaying logs, beneath dead leaves or stones, in preformed cavities (from borers), and under leaf bases of palms

(Spencer 1941; Kusnezov 1951; Fabres and Brown 1978; Torres 1984; Ulloa-Chacon and Cherix 1988).

In a Panamanian tropical forest composed of deciduous trees, Levings and Franks (1982) reported a density of 0.05 to 0.13 nests per m^2. Infested areas of the Galapagos Islands showed an increase of density of 0.75 to 1.75 aggregations per m^2 (Lubin, 1985). The highest density occurred in man-made habitats, like cultivated fields and pastures and ornamental plants (Torres 1984). In fruit crops we observed an average of 2.7±1.2 aggregations per m^2 (N=31 plots each 1 m^2).

The social structure of *W. auropunctata* was studied during the dry season at the Universidad del Valle experiment station in Cali, Colombia (altitude 970 m, average annual temperature: 24°C and 65-70% relative humidity). From 138 samples, we found three major kinds of aggregates within the unicolonial system.

- Queenright aggregates (54.4%), were composed of single or multiple queens with workers and brood (eggs, larvae and pupae).
- Worker-brood aggregates (40.0%), formed by workers and one or more immature stages (eggs only; eggs, larvae and pupae; pupae only), representing 40.0%.
- Worker aggregates (6%), formed by workers only (mainly young workers).

The number of queens per aggregate ranged from 1 to 16 with an average of 1.7±3.3 (N=44). The mean number of workers per queen ranged between 548.8±384.7 (N=48) in aggregates with a single queen to 259.3±192.3 (N=96) in aggregates with multiple queens. The mean number of workers per larva decreased significantly from 7.9±6.4 in aggregates with one or more queens to 3.9±3.6 in worker-brood aggregates ($t=3.06$, $p<0.01$, df59). Seasonal changes in composition and density of nests are under study.

Apparently new nests are formed by budding, since nuptial flights have never been observed (Spencer 1941; Lubin 1984).

Feeding Habits

The little fire ant is a polyphagous and opportunistic species. It feeds preferably on honeydew from sucking insects (Spencer 1941; Smith 1937; Clark et al. 1982), a great variety of prey (Arthropods, Gasteropods and Annelides), and vegetable material (seeds, flowers and leaves)(Clark et al. 1982; Torres 1984). They also eat dead insects (Spencer 1941; Kusnezov 1951; Torres 1984). In houses, the ants are attracted to fatty or oily material (Fernald 1947).

Workers are highly predaceous, and have been used as a predator of cocoa bugs (Bruneau de Miré 1969). They have also been observed taking floral and extra-floral nectar from plants (Lubin 1984; Meier 1985). Its importance as a factor in the evolution of plant-insect relationships has been studied by Schemske (1980) and Horvitz and Schemske (1984).

Reproductive Biology of Queens

Only *W. auropunctata* queens lay eggs; as workers are sterile (Ulloa-Chacon and Cherix 1988). There are, however, considerable differences in the oviposition rate of queens. These differences occur both

TABLE 1. Estimation of the influence of queen age on egg production in laboratory polygynous colonies (N=12). Total life span: 13.0 ± 1.8 months.

Age of queens (months)	Number of eggs/queen/day Mean	±	S. D.	t-test DF: 11 P< 0.001
2	6.0	±	1.1	
				8.2
5	12.0	±	2.5	
				10.5
10	4.7	±	1.4	

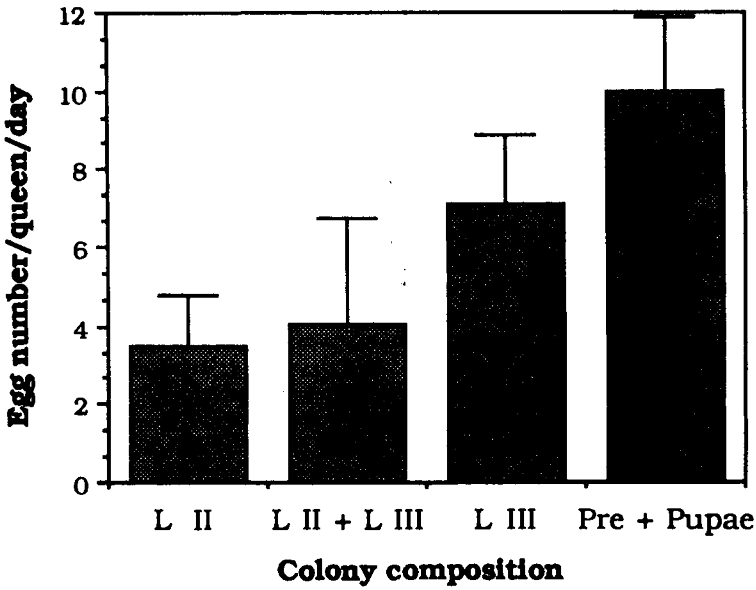

FIGURE 1. Influence of brood composition on egg production by *W. auropunctata* queens (L II = 2nd larval instar; L III = 3rd larval instar; Pre = prepupae).

among queens from the same population, and queens reared under identical laboratory conditions. Thus the total number of eggs laid per queen in twelve weeks ranged from 305 to 942 with an average of 599±193 (Ulloa-Chacon and Cherix 1988). This variability in queen fecundity may be due to genetic, individual and/or social factors. We found that queen age was an important influence on queen fecundity (Ulloa-Chacon and Cherix In Press). In polygyne laboratory colonies, egg production changes significantly during the queens' life-time (Table 1).

Queen fecundity is also influenced by colony composition (worker brood) (Ulloa-Chacon and Cherix In Press). Comparison between experimental monogyne colonies with worker brood (larvae only and pupae

TABLE 2. Brood production in monogynous and polygynous laboratory colonies containing queens of different fecundity rates. Colonies M= 1 queen; colonies T= 3 queens; colonies S= 6 queens and colonies N= 9 queens.

Colony No.	Average oviposition rate eggs/queen	eggs/colony (range)	Brood production during 90 days workers	sexuals
M-1	5.0	(1-5)	+	++
M-2	7.0	(6-10)	+	+
M-3	9.0	(6-10)	+	++
M-4	12.0	(11-15)	++	+[a]
M-5	14.0	(11-15)	+	+[a]
M-6	23.0	(16-25)	++	-
M-7	41.0	(> 25)	+++	-
T-1	2.3	(1-5)	+	++
T-2	7.7	(6-10)	+	+
T-3	13.7	(11-15)	++	+[a]
T-4	13.3	(11-15)	++	-
T-5	14.3	(11-15)	+	+[a]
T-6	16.0	(16-25)	++	-
T-7	21.3	(16-25)	++	-
S-1	3.2	(1-5)	+	++
S-2	11.7	(11-15)	++	-
S-3	14.3	(11-15)	++	-
S-4	22.0	(16-25)	+++	-
N-1	2.6	(1-5)	+	++
N-2	3.1	(1-5)	-	++

[a] Sexual larvae but no pupae were produced.

only) and broodless colonies revealed the following differences: the oviposition rate of queens was similar in broodless colonies and in colonies containing pupae only, whereas the oviposition rate was significantly lower in colonies with a majority of second instar larvae (Fig.1). This difference could result from food competition between queens and larvae, larval inhibition and/or oophagy.

Production of Sexuals

Under natural conditions, sexual forms are frequently reared in large worker-brood aggregates with a high worker/larva ratio (Ulloa-Chacon unpublished). Nevertheless, under certain laboratory conditions it was observed that sexual brood is produced both in queenless and queenright colonies. In experimental nests containing a single or several queens of different fecundity levels (established by counting the number of eggs per queen produced in 24 hours), gynes are reared only in colonies with a reduced average queen fecundity (Table 2). So, all colonies in which the average oviposition rate ranged between 1 and 10 eggs produced sexual brood. By contrast, all colonies in which the average oviposition rate was higher, 11-15;

16-25 or more than 25 eggs per colony, only workers are produced. In several colonies with an oviposition rate of 11-15 eggs, the sexual larvae produced did not survive to the pupal stage.

These preliminary observations suggest that the inhibition of alate production by "little fire ant" queens, as for the Pharaoh's ant (Edwards 1987), is dependent on queen fecundity. Extensive laboratory and field studies are required to determine what factors affect the production of sexuals in this species.

ACKNOWLEDGMENTS

We thank Dr. C. Baroni Urbani (Institute of Zoology, Basel), L. Keller (Museum of Zoology, Lausanne) and Dr. E. Vargo, University of Texas, for their critical comments on the manuscript, as well as, M. L. Baena and Hugo Ortiz, students of the Universidad del Valle (Cali, Colombia), for their valuable assistance in the field. P. Ulloa-Chacón is supported by a grant from the Universidad del Valle.

REFERENCES CITED

BRUNEAU de MIRÉ, P. 1969. Une fourmi utilisée au Cameroun dans la lutte contre les mirides du cacaoyer *Wasmannia auropunctata* (Roger). Café, Cacao, Thé 13: 209-212.

CLARK, D. B., C. GUAYASAMÍN, O. PAZMIÑO, C. DONOSO, and Y. PÁEZ DE VILLACÍS. 1982. The tramp ant *Wasmannia auropunctata* Autecology and effects on ant diversity and distribution on Santa Cruz Island, Galapagos. Biotropica 14: 196-207.

DELABIE, J. H. C. 1988. Ocorrência de *Wasmannia auropunctata* (Roger, 1863) (Hymenoptera, Formicidae, Myrmicinae) em cacauais na Bahia, Brasil. Rev. Theobroma 18: 29-37.

DONISTORPHE, J. K. 1915. British Ants Their life-history and classification. Plymouth William Brendon and Son. Limited. 379 pp.

EDWARDS, J. P. 1987. Caste regulation in the pharaoh's ant *Monomorium pharaonis* the influence of queens on the production of new sexual forms. Physiol. Entomol. 12: 31-39.

FABRES, G., and Jr. W. L. BROWN. 1978. The recent introduction of the pest ant *Wasmannia auropunctata* into New Caledonia. J. Aust. Entomol. Soc. 17: 139-142.

FERNALD, H. T. 1947. The little fire ant as a house pest. J. Econ. Entomol. 40: 428.

FOREL, A. 1884. Etudes Myrmécologiques en 1884, avec une description des organes sensoriels des antennes. Bull. Soc. Vaud. Sc. Nat. 20: 316-380.

FOREL, A. 1886. Espèces nouvelles de fourmis américaines. Ann. Soc. Ent. Belgique. 30: 38-49.

FOREL, A. 1887. Fourmis recoltées à Madagascar par le Dr. Conrad Keller. Mitt. Schweiz. Ent. Ges. 7: 381-389.

FOREL, A. 1893. Formicides de l'Antille St. Vincent, récoltées par M. H. H. Smith. Trans. Ent. Soc. London. 4: 333-418.

HÖLLDOBLER, B., and E. O. WILSON. 1977. The number of queens An important trait in ant evolution. Naturwissenschaften 64: 8-15.

HORVITZ, C. C., and D. W. SCHEMSKE. 1984. Effects of ants and an ant-tended herbivore on seed production of a neotropical herb. Ecology 65: 1369-1378.

HOWARD, D. F., M. S. BLUM, T. H. JONES and M. D. TOMALSKI. 1982. Behavioral responses to an alkylpyrazine from the mandibular gland of the ant *Wasmannia auropunctata*. Insectes Soc. 29: 369-374.

KEMPF, W. W. 1972. Catálogo abreviado das formigas da Regiïo Neotropical (Hymenoptera Formicidae). Studia Entomol. 15: 3-344.

KUSNEZOV, N. 1951. El género *Wasmannia* en la Argentina. Acta Zool. Lilloana 10: 173-182.

LEVINGS, S. C., and N. R. FRANKS. 1982. Patterns of nest dispersion in a tropical ground ant community. Ecology 63: 338-344.

LUBIN, Y. D. 1984. Changes in the native fauna of the Galapagos Islands following invasion by the little red fire ant *Wasmannia auropunctata*. Biol. J. Linn. Soc. 21: 229-242.

LUBIN, Y. D. 1985. Studies of the little fire ant, Wasmannia auropunctata, in a niño year, pp. 473-493. In El niño en las Islas Galápagos El evento de 1982-1983. Fundación Charles Darwin para las Islas Galápagos, Quito, Ecuador.

MEIER, R. E. 1985. Coexisting patterns and foraging behavior of ants on giant cacti of three Galapagos Islands, Ecuador. Experientia 41: 1228.

NICKERSON, J. C. 1983. The little fire ant, *Ochetomyrmex auropunctata* (Roger) (Hymenoptera Formicidae). Fla. Dep. Agric. Consumer Serv. Entomol. Circ. 248.

OSBURN, M. R. 1948. Comparison of DDT, chlordane and chlorinated camphene for control of the little fire ant. Fla. Entomol. 31: 11-15.

POSADA, L., I. Z. DE POLANÍA, I. S. DE ARÉVALO, A. SALDARRIAGA, F. GARCÍA, and R. CÁRDENAS. 1976. Lista de insectos dañinos y otras plagas en Colombia. Inst. Col. Agrop. Bol. Tec. 43 97 pp.

ROGER, J. 1863. Die neu aufgeführten Gattungen und Arten meines Formiciden-Verzeichnisses, nebst Ergänzungen einiger früher gegebenen Beschreibungen. Berl. Ent. Zeitschr. 7: 131-214.

SCHEMSKE, D. W. 1980. The evolutionary significance of extrafloral nectar production by *Costus woodsonii* (Zingiberaceae) An experimental analysis of ant protection. J. Ecology 68: 959-967.

SILBERGLIED, R. 1972. The little fire ant, *Wasmannia auropunctata*, a serious pest in the Galapagos Islands. Noticias de Galapagos 19/20: 13-15.

SMITH, M. R. 1929. Two introduced ants not previously known to occur in the United States. J. Econ. Entomol. 22: 241-243.

SMITH, M. R. 1937. The ants of Puerto Rico. J. Agric. Univ. Puerto Rico 20: 819-875.

SMITH, M. R. 1965. House-infesting ants of the eastern United States. USDA-ARS. Tech. Bull. 1326 105 pp.

SPENCER, H. 1941. The small fire ant *Wasmannia* in citrus groves-a preliminary report. Fla. Entomol. 24: 6-14.

TORRES, J.A. 1984. Niches and coexistance of ant communities in Puerto Rico repeated patterns. Biotropica 16: 284-295.

ULLOA-CHACÓN, P., and D. CHERIX. 1988. Quelques aspects de la biologie de *Wasmannia auropunctata* (Roger) (Hymenoptera Formicidae). Actes Coll. Insectes Soc. 4: 177-184.

ULLOA-CHACÓN, P., and D. CHERIX. 1989. Etude de quelques facteurs influençant la fécondité des reines de *Wasmannia auropunctata* (R.) (Hymenoptera, Formicidae). Actes Coll. Insectes Soc. In Press.

WHEELER, G. C. and J. WHEELER. 1954. The ant larvae of the Myrmicinae tribes Meranoplini, Ochetomyrmicini and Tetramoriini. Amer. Midland Nat. 52: 443-452.

WHEELER, W. M. 1929. Two neotropical ants established in the United States. Psyche 36: 89-90.