

## Chromosome Numbers of the Red and the Black Imported Fire Ants, *Solenopsis invicta*<sup>1</sup> and *S. richteri*<sup>1,2,3</sup>

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### ABSTRACT

The chromosome number for the red and black imported fire ants, *Solenopsis invicta* Buren and *S. richteri* Forel, was determined to be  $n = 16$ . A special case of diploidy in *S. invicta* males has been observed; these diploid males are sterile. The occurrence of diploid

males as well as normal haploid males in *S. invicta* is explicable under the hypothesis that sex determination in Hymenoptera is governed by genotypes at one or more sex loci.

Although the chromosome numbers of many myrmicine ant species have been determined (Crozier 1975), such information has not previously been published for 2 important species: the red and black imported fire ants, *Solenopsis invicta* and *S. richteri*.

### MATERIALS AND METHODS

Field-collected colonies from Gulfport and Columbus, MS were handled according to Markin's (1968) technique. Air-dried chromosome preparations (Crozier 1970) were made from prepupal brains, testes, and ovaries.

At least 10 cells were examined from each of 20 ants from 5 ordinary colonies of each species and from one "special" colony of *S. invicta*, according to standard procedures (Crozier 1970).

### OBSERVATIONS

*S. richteri*:  $n = 16$ .—Male pupae, all haploid, from 5 colonies from Oktibbeha and Lowndes Counties, MS (Fig. 1).

*S. invicta*:  $n = 16$ ,  $2n = 32$ .—The material examined includes that from 5 "normal" colonies from Harrison Co., MS, with haploid ♂ and diploid ♀ pupae and prepupae (Fig. 2), and a "special" colony at Hurley, MS, in which 50 ♂ karyotyped were haploid and 25 diploid (Fig. 3). Two hundred females examined were all diploid.

The "special" colony (Glancey et al. 1975) is one of immense size compared with that of normally encountered colonies. The mound measured  $41 \times 1.2$  m horizontally and was 1.5 m deep. More than 20,000 mated queens have been taken from this mound. Examination of 1102 ♂ from this mound showed that 96.2% were sterile, in that little or no testicular tissue was present and there was no sperm in the vas deferens. Prepupal brain preparations from this class of males showed that they were diploid, confirming the result of Hung et al. (1974). In a normal colony, only 0.9% of 1476 ♂ were sterile by the above criteria.

*S. invicta* and *S. richteri* share a haploid number of 16 with 2 native fire ant species, *aurca* and *geminata*, whereas 3 small *Solenopsis* species have  $n = 11$  (Crozier 1970, 1975). The *richteri* karyotype resembles that of *geminata* in having many submetacentric to acrocentric chromosomes, whereas that of *invicta* is similar to the *aurca* karyotype in having predominantly metacentric chromosomes.

### DISCUSSION

The occurrence of both diploid and haploid males in *S. invicta* is explicable under the hypothesis (Crozier 1971, 1975) that sex determination in Hymenoptera is governed by the genotypes at one or more sex loci. In some species (*Apis mellifera* L., *Bracon hebetor* Say, *Neodiprion nigroscutum* Middleton), homozygotes or hemizygotes at a single locus are males; heterozygotes are females. In other species, Crozier (1971, 1975) hypothesized that there is a number of sex determination loci, and that heterozygosity at any one is sufficient to cause development as a female. Also, there is evidence (Garofalo 1973)

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FIG. 1.—Karyotypes of ♂ *Solenopsis richteri*,  $2n = 32$ .

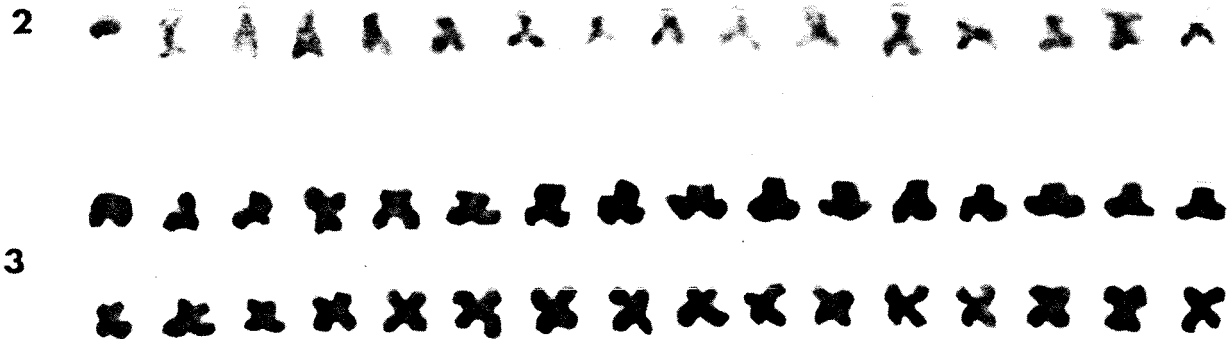


FIG. 2 and 3.—Karyotypes of ♂ *Solenopsis invicta*; (2) normal haploid male; (3) special case of diploid male.

that 2 major loci are involved in sex determination of the bumble bee, *Bombus atratus* Franklin. However, inbreeding has generally failed to lead to the production of diploid males in other than single locus species, possibly because of ♀ inbreeding depression (Crozier 1971, 1975). The 2 *Solenopsis* species are introduced species and have presumably undergone a drastic reduction in genetic variability, which could lead to the production of diploid males in some *invicta* colonies through homozygosity at all major sex-determining loci. The sterility of diploid males could then occur, because of the residual effects of minor sex loci; these males are thus probably slightly intersexual in character. Kerr and Nielsen (1967) found that diploid males of *Apis* are feminized compared with normal haploids in that drones have testes of reduced size (Woyke 1969).

*S. invicta* is the 2nd ant species in which diploid males have been reported. Hung et al. (1972) found some diploid males in a *Pseudolasius* species but did not report the population size, etc.; thus the degree of inbreeding in that ant remains unknown.

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#### REFERENCES CITED

- Crozier, R. H. 1970. Karyotypes of twenty-one ant species (Hymenoptera; Formicidae), with reviews of the known ant karyotypes. *Can. J. Genet. Cytol.* 12: 109–28.
1971. Heterozygosity and sex determination in haplo-diploidy. *Am. Nat.* 105: 399–412.
1975. *Animal Cytogenetics 3: Insecta 7 Hymenoptera*. Gebrüder Borntraeger Verlagsbuchhandlung.
- Garofalo, C. A. 1973. Occurrence of diploid drones in a neotropical bumblebee. *Experientia* 29: 726–7.
- Glancey, B. Michael, C. E. Stringer, C. H. Craig, and P. M. Bishop. 1975. An extraordinary case of polygyny in the red imported fire ant. *Ann. Entomol. Soc. Am.* 68: 922.
- Hung, A. C. F., H. T. Imai, and M. Kubota. 1972. The chromosomes of nine ant species (Hymenoptera: Formicidae) from Taiwan, Republic of China. *Ibid.* 65: 1023–5.
- Hung, A. C. F., Sib. Vinson, and J. W. Summerlin. 1974. Male sterility in the red imported fire ant, *Solenopsis invicta*. *Ibid.* 67: 909–12.
- Kerr, W. E., and R. A. Nielsen. 1967. Sex determination in bees (Apinae). *J. Apicult. Res.* 6: 3–9.
- Markin, G. P. 1968. Handling techniques for large quantities of ants. *J. Econ. Entomol.* 61: 1744–5.
- Woyke, J. 1969. The role of sex alleles in the development of reproductive organs of diploid drones. XXIIInd Beekeep. Congr. Symp.

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