To investigate the evolution and adaptation of invasive ant species in various foreign environments, we conducted cytogenetic, karyological, and molecular analyses of the fire ant (*Solenopsis invicta*) in invasive areas, including the southern United States (Florida) and Taiwan (Taoyuan), and compared the results to those obtained from a native (northern Argentina) population. The main results were as follows: (1) the fire ant *Solenopsis invicta* in invasive ranges had different chromosomal morphologies, indicating that invasive populations are intermediate between *S. invicta* and other *Solenopsis* species; (2) the fire ant populations in Florida and Taiwan indicated a high variation in the number of chromosomes, mainly differing in ploidy; (3) fire ant populations in Taiwan exhibited the highest variations in the number of chromosomes; (4) there was a significantly large number of Ag-NOR signals on the chromosomes of the Taiwanese population, indicating a positive regression between the number of Ag-NOR signals and transfer physical distance from the native population; (5) the 18S rDNA and telomere FISH signals differed among each population, and the telomeric signals were only detected on a pair of chromosomes in the Taiwanese population; and (6) the molecular phylogeny of the fire ant revealed a high frequency of introgression and hybridization, even in native populations. These data suggest that high frequencies of cytogenetic and molecular variations in invasive populations might invoke rapid evolution and adaptability. Possible factors influencing cytogenetic diversity include hybridization among different *Solenopsis* species and/or the use of insecticides in invasive areas.