BIOLOGICAL HALF-LIFE OF CESIUM-134 IN
THE RED IMPORTED FIRE ANT,
SOLENOPSIS INVICTA

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ABSTRACT

Three castes of the red imported fire ant, Solenopsis invicta Buren were fed a radioactive (cesium-134) diet to determine biological half-lives. Results from gamma spectrophotometric analyses indicated that the biological half-life of cesium-134 in winged reproductives (females), major workers, and minor workers was 82, 74, and 62 hr respectively.

Radiocesium has been found in fallout from nuclear explosions (Stewart et al. 1967) and low-level nuclear wastes from reactors (Healy et al. 1958, Auerbach and Crossley 1958). The cesium deposition from these sources may then enter into the components of an ecosystem (Davis 1963). This obviously poses both environmental and ecological problems, since radiocesium emits energetic gamma radiations. Milk and other food-stuffs in Florida have also been reported to contain high concentrations of radiocesium (Cromroy et al. 1967).

The aim of this research was to determine the biological half-life (T1/2) of 134Cs in workers (major and minor) and winged females of the red imported fire ant, Solenopsis invicta Buren. Comparison could then be made with the biological half life in individual castes from a fire ant colony.

METHODS AND MATERIALS

An artificial radioactive diet for the red imported fire ant was prepared by adding sufficient quantity of cesium-134 chloride$^2$ to 20% sucrose solution to produce a specific activity of 30 Ci/gm sucrose. Both cesium-134 and cesium-137 have been used for various biological investigations (Crossley and Witkamp 1964, Reichele and Crossley 1967, Crossley 1968). Cesium-134 was chosen for all feeding studies due to its shorter half-life (2.6 yr compared to 30 yr for cesium-137).

Worker ants and winged reproductives (females) were sampled from a large colony collected from Gainesville, Florida. The field-collected colony was maintained in the laboratory for 1 week prior to the experiment.

For biological half-life determination, mixed castes were placed in a plastic flower pot (Lofgren et al. 1967) containing the radioactive food and allowed to feed for 7 days. After this feeding period, ants were then segregated in-

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dividually according to the caste, placed in a plastic test cup (Levy et al. 1973) and supplied with a non-radioactive diet. Total radioactivity of each ant was checked at 12-hr intervals.

Total insect radioactivity of \(^{134}\)Cs was assayed with a single-channel analyzer\(^5\) (NaI crystal 3 X 3 inches diameter). A gelatin capsule\(^4\) was used to hold each ant to establish an appropriate and consistent counting geometry for each replication. Counting efficiency was determined to be 10%. The biological half-life for all castes was determined by a graphic semilogarithmic method. Repeated sampling (i.e. 10 replicates/caste) indicated a \(\pm 10\%\) variability in the average biological half-life for each caste.

RESULT AND DISCUSSION

The biological half-life of \(^{134}\)Cs for the winged reproductives (females), major worker, and minor worker was 82, 74, and 62 hr respectively (Fig. 1). The data indicated that the larger the fire ant caste, the longer the \(T_s\) (Table 1). However, the relationship between body weight and \(T_s\) in the three castes of \(S.\ invicta\) did not follow the pattern of other insects reported by Crossley (1963). This could be due to the social behavior exhibited by the imported fire ant within species rather than the between species comparison that was made by Crossley (1963).

Social characteristics are presumed to be displayed by various ant castes (Metcalf et al. 1962), possibly due to modifications in caste physiology. Therefore, \(^{134}\)Cs retention in ants would probably be more complicated than in non-social insects as was reported by Crossley (1963). In addition, ants used for this research were segregated individually, thus eliminating social or colony interactions between as well as within fire ant castes. Therefore, physiological changes (e.g. metabolic rate) could be expected to occur and influence the resultant biological half-life.

The data in Table 1 also indicated that caste differences can probably be expected in a colony with regard to the cycling of environmental contaminant such as cesium. Since ants undergo trophallaxis, \(^{134}\)Cs cycling would be expected to occur within all members of a colony as well as to the environment and to other biological organisms via excretion.

<table>
<thead>
<tr>
<th>Caste</th>
<th>Body Weight (mg)</th>
<th>(T_s) (hr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Winged reproductive (female)</td>
<td>7.60</td>
<td>82</td>
</tr>
<tr>
<td>Major work</td>
<td>1.80</td>
<td>74</td>
</tr>
<tr>
<td>Minor work</td>
<td>0.78</td>
<td>62</td>
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</tbody>
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![Graph showing biological half-life of Cesium-134 in Solenopsis invicta.](image)

**Fig. 1.** Biological half-life of Cesium-134 in *Solenopsis invicta*.

**Literature Cited**


