

**POPULATIONS OF *RHIZOECUS* SP. (PSEUDOCOCCIDAE)
IN POST-FIRE SOIL OF PINE FOREST AT MOUNT CARMEL, ISRAEL**

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ABSTRACT

A huge forest fire consumed on September 1989 a large portion of natural Aleppo pine forest at Mount Carmel, Israel. Since 1991 soil arthropods in both burnt and unburnt plots were studied. Acari and Collembola comprised about 80% of the total number of arthropods found in standard soil samples, while the rest belonged to another 18 orders or classes of the Arthropoda. In November 1991, 2 years post-fire, a remarkable increase in the number of *Rhizoecus* sp. mealybugs (Coccoidea: Pseudococcidae) was recorded in the soil of the burnt area only; 286 mealybugs were collected from 12 soil cores (diameter 5 cm), which constituted 70% of all the arthropods sampled, excluding Acari and Collembola, or 16% of the total number of arthropods collected. In the unburnt area, only 23 mealybugs were collected from similar cores. A sharp decline in mealybug numbers was recorded in February 1992, probably due to a one-week snowfall, which is extremely rare in this Mediterranean region. The relatively high number of mealybugs in the burnt area was recorded for about 3 years.

KEYWORDS: Pseudococcidae, *Rhizoecus*, arthropods, fire ecology, Israel.

INTRODUCTION

Fires in the Eastern Mediterranean zone have always been man-made and accompanied the history of this region. The huge man-made fire in the area of Nahal Kelach (Mt. Carmel) in autumn 1989 consumed a large portion of the natural Aleppo pine stand of Mt. Carmel. The first observations on soil insect fauna in the burnt area revealed a significant decrease in the different faunal elements compared to unburnt plots (Broza et al., 1993).

With the first rains of the first post-fire winter, a massive outgrowth of vegetation, by germination of seeds as well as by sprouting of bushes and trees, occurred in the burnt area. These processes continued during the second rainy post-fire winter. Toward the end of the second rainy post-fire year or soon thereafter, an outbreak of a few species of insects living in different habitats occurred in the burnt area. It included the endemic and monophagous aphid, *Ctenocalis israelica* (Broza et al., 1992). These insects fit the category "colonizers" or "pioneers" as defined by Dindal and Metz (1977).

In the present paper we describe the infestation by another second-year post-fire pioneer, *Rhizoecus* sp., a mealybug insect (Pseudococcidae, Homoptera) that inhabits the soil and feeds by sucking plant roots.

MATERIALS AND METHODS

The sampled area is located on Mount Carmel, Israel (34°46'N, 35°00'E), 400 m above sea level. It is a natural *Pinus halepensis* forest, on the slope of Nahal Galim. A large portion of the forest had been burnt in autumn 1989. The pine forest soil was sampled for soil arthropods with a standard corer, 5 cm in diameter, to a depth of 15 cm. Twelve random samples were taken in both the burnt and the unburnt area on each visit. The arthropods were extracted from the soil by a Berlese funnel directly into glass tubes filled with the fixative containing 750 ml ethyl alcohol (95%), 250 ml ether, 30 ml glacial acetic acid and 3 ml formaldehyde (40%).

RESULTS

The 20 groups of soil arthropods that constitute the soil fauna of the Aleppo pine forest in the Carmel Nature Reserve are shown in Fig. 1. It includes the five arthropod groups: Acari, Palpigradi, Pauropoda, Collembola and Protura. Out of them only 11 were recorded in the burnt area, 2 years post-fire. Homopteran insects were seldom found in soil samples from both the burnt and the unburnt area up to the November 1991 collection. In November 1991 a pioneer

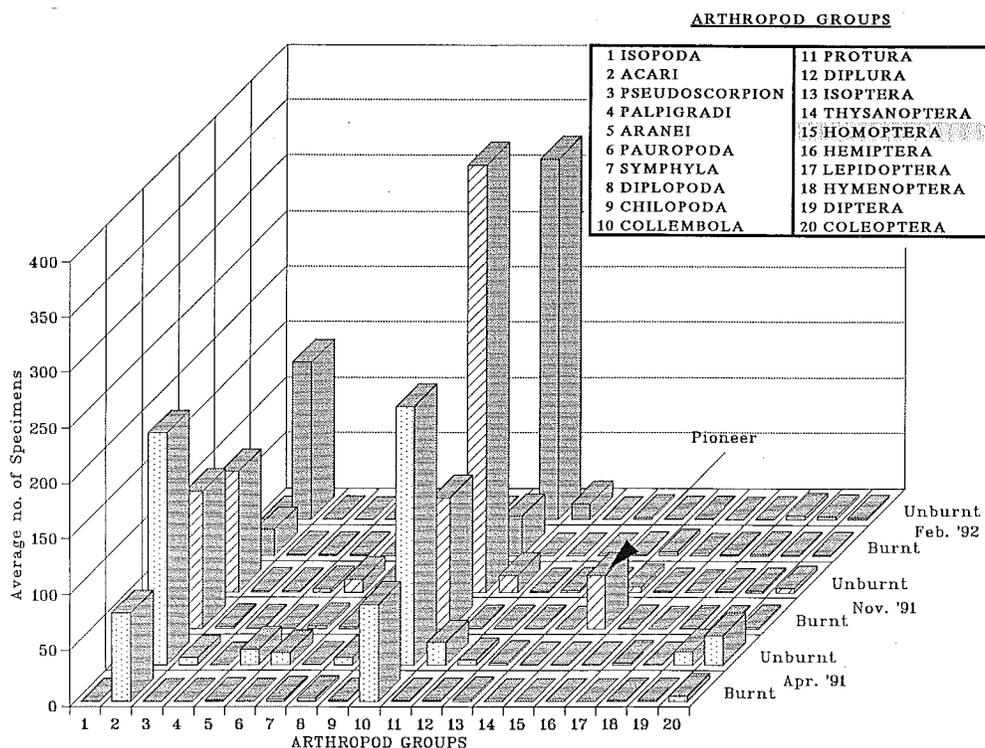


Fig. 1. Seasonal changes in the occurrence of 20 arthropod groups in the burnt and unburnt area. The population includes the orders Acari (column no. 2) and Collembola (column no. 10). No Homoptera specimens were seen in the burnt area up to November 1991, when an outbreak of an insect of this order occurred (column no. 15).

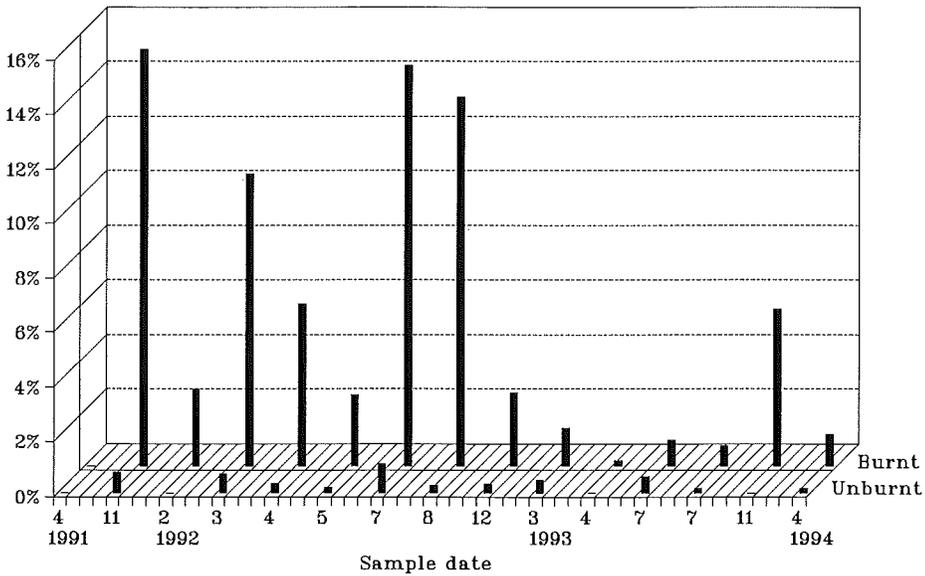


Fig. 2. In November 1991, 2 years post-fire, a remarkable number of mealybugs (*Rhizoecus* sp.) was found in the soil of the burnt area only. 286 mealybugs, which constituted 16% of the total arthropods, were sampled in the burnt area. In spite of the seasonal changes, relatively high numbers of mealybugs were recorded in the burnt area even in the fifth post-fire year.

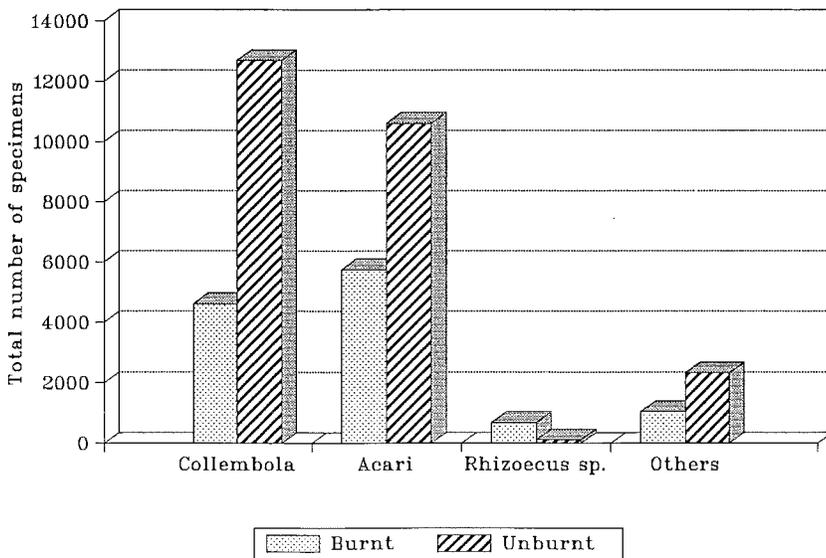


Fig. 3. Total numbers of *Rhizoecus* sp. collected from the soil during the research in the burnt and in the unburnt area as compared to the total numbers of the main two orders (Acari and Collembola) and all other 17 minor groups together.

species of Homoptera occurred in large numbers only in the burnt area (Fig. 1) and was identified as *Rhizoecus* sp. (Pseudococcidae).

The seasonal occurrence of *Rhizoecus* sp. since its first discovery is shown in Fig. 2. It seems that the population level of this species reached its highest density during the end of the summer in 1991, 1992 and 1993. However, the main outbreak occurred during the 12 months following its appearance. A sharp decline in mealybug numbers was recorded in February 1992, probably due to a one-week snowfall, which is extremely rare in this Mediterranean region. We identified the same species also in samples taken from the unburnt forest, but in very low numbers; this emphasizes its pioneering nature in the burnt area. Its relative abundance in comparison to all soil arthropod specimens collected is further stressed in Fig. 3.

DISCUSSION

The huge and intensive fire that occurred on Mount Carmel in 1989 reduced the numbers of many soil arthropods. Among them are some groups which were found to be very sensitive to the fire itself or to its indirect influences. In contrast, an uncommon pseudococcid species (*Rhizoecus* sp.) was highly reproductive and suddenly invaded the area towards the end of the second post-fire year. The pioneer insects could not be detected during the first post-fire year. We assume that during this year the build-up of the population had just started. The same pattern of a pioneer outbreak occurring only by the second year had been documented for the endemic aphid *Ctenocalis israelica* (Broza et al., 1992) as well as for some isotomiid species of the order Collembola (Poliakov et al., 1994).

We assume that the pioneering species responded to some ecological changes triggered by the availability of nutrients as well as by the intensive vegetational growth starting soon after the fire. We do not know yet whether *Rhizoecus* sp. is feeding on the root of a specific plant that flourished after fire or on several plant species.

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