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Bionomy and ecology of *Cinara cupressi* (BUCKTON, 1881) (Hemiptera, Aphidoidea)

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ABSTRACT. The bionomy and ecology of *Cinara cupressi* on *Thuja occidentalis* was studied under insectary and controlled conditions. The number of generations per year was determined, as well as the lifespan of a generation, fecundity of the females and demographic characteristics of the population.

KEY WORDS: Hemiptera, Aphidoidea, *Cinara sp*., ornamental shrubs.

INTRODUCTION

Cinara cupressi (BUCKTON, 1881) is a holocyclic species of aphids, feeding on plants from Cupressaceae family, mainly *Cupressus lusitanica, Cupressus macrocarpa, C. sempervirens, Chamaecyparis lawsoniana, Thuja occidentalis and Juniperus* sp. It has also been encountered on *Thuja orientalis* (BLACKMAN & EASTOP 1988). The geographical range of this species covers North America (from where it is believed to have originated) (WATSON et al. 1999), Southwest Asia, India and Europe. Also, it has been introduced to Africa (BLACKMAN & EASTOP 1988, CIESLA 1991).

Until the 70s, this species was considered rare in Poland and was only observed on Western Arborvitae and Eastern Juniper (SZELEGIEWICZ 1978). SOIKA and ŁABANOWSKI (2001) also claim *Juniperus scopulorum* and *Thuja Smaragd* to be host plants. Biology of this species is poorly known and it usually concerns areas with climate different than in Poland (MUSTAFA 1987, CIESLA 1991, WATSON et al. 1999).

The aim of this paper was to study the bionomy of *Cinara cupressi* and determine the hatching time in spring, as well as the number of generations per season and aphid fecundity within particular generations. The field research was carried out to determine the rate of aphid infestation on the host plant. In aim to determine the demographic characteristics of the population, aphids were observed under controlled conditions.

Material and Methods

Bionomy of the species was observed from the beginning of March until the end of October in 2005 and 2006. For this purposes aphids were bred on isolated *Thuja occidentalis* twigs. One apterous virginoparae was placed under each insulator. The first larvae they gave birth to would mark the beginning of a new generation. They were then placed under another insulator where their fecundity and the length of particular developmental periods were observed and examined. In each generation the development of five females was observed and the observations were carried out five times a week.

The research was conducted from 2004 to 2006 under insectary conditions in three places located in Rzeszów parks and at an arboretum in Bolestraszyce. Aphids on *Thuja occidentalis* were observed in two-week intervals.

In 2006 the research was carried out under controlled conditions. Aphids were bred at a constant temperature of 20°C, relative air humidity of 70% and photoperiod of 16:8. To determine the demographic characteristics of the populations, 100 larvae were observed. Mortality rate of larvae and adults was determined, as well as total life expectancy. Birch (1948) method was used to calculate demographic characteristics.

RESULTS

C. cupressi feeding on *T. occidentalis* has a brownish body of an average length of 3.1 mm with a slight waxy coating. They were usually observed in large concentrations of up to 60 insects. This species is often visited by ants. In the larval development there were three ecdysis among apterous specimens and four among alate females. Fundatrices hatched in the first half of April. The hatching percentage was 45%. There were nine *C. cupressi* generations (Table 1). First alate females were observed in May, i.e. in the second generation of fundatrigeniae. The length of development of a generation of *C. cupressi* aphids was determined.

The first period, i.e. the prereproductive period lasted the longest among females from the second fundatrigeniae generation (Fig. 1). For the virginoparae from subsequent generations the prereproductive period was slightly shorter. There was no prolongation of this period among last generations in a season.

The reproductive period lasted the longest among fundatrices, while for the virginoparae from subsequent generations this period was of approximately the same length. The length of the reproductive period was shortened in the ninth generation (Fig. 2).

The postreproductive period usually lasted from 0 to 4 days (Fig. 3). It was prolonged in the sixth and seventh generation; in the latter one it even lasted for as long as 13 days.

Table 1. Time of subsequent generations of *C.cupressi* in insectarium conditions.

Year	Generation								
	I	II	III	IV	V	VI	VII	VIII	IX
wingless virginoparae aphids									
2005	14.04	26.04	19.05	10.06	5.07	26.07	19.08	4.09	18.09
2006	10.04	24.04	18.05	8.06	7.07	27.07	17.08	7.09	21.09
winged virginoparae aphids									
2006			21.05					12.09	5.10

The highest fecundity was found among the fundatrices (average of 43.8 larvae per female) with a maximum of 57 larvae per female (Fig. 4). Fecundity decreased in subsequent generations, especially in the summer. There was a raise in fecundity only in the autumn generation. Alate males were observed in the middle of October. Amphigonic females laid from two to six eggs, beginning in the middle of October.

Size dynamics of the species in question showed two peaks, first in the middle of May and the second one at the end of September and in the middle of October (Fig. 5).

In order to calculate the demographic characteristics of the population, the development of aphids under controlled conditions was monitored. Survival rate, length of particular developmental periods and fecundity were determined. As many as 76% of larvae reached maturity in the thirteenth day of their lives (Fig. 6). It took a generation 25 days to develop. The highest 24-hour fecundity was 2,4 larvae per female in the twenty-second day of life (Fig. 7). The postreproductive period lasted one day.

The calculated demographic characteristics of the population for the females from the autumn generations indicates growth of population at a rate of 1.08 times per 24 hours. The development period of one generation lasts 20.09 days during which the population grows 5.09 times (Table 2).

Table 2. Demographic parameters of *C.cupressi* population.

Species	r_m	Ro	T	λ
Cinara cupressi	0.0963	5.09	20.09	1.08

rm - intrinsic rate of population increase
Ro - net rate of reproduction
T - mean generation time
λ - finite rate of population increment

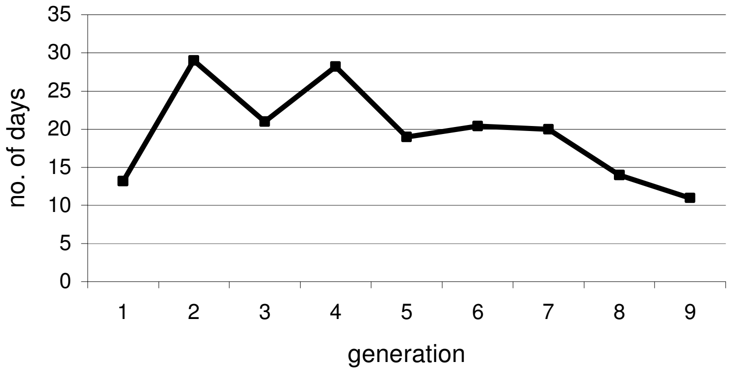

Fig. 1. Average length of prereproduction period of virginoparae from generations of *C.cupressi*.

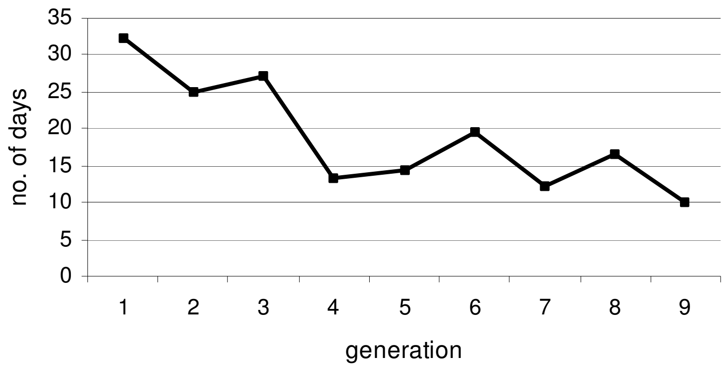

Fig. 2. Average length of reproduction period of virginoparae from generations of *C.cupressi*.

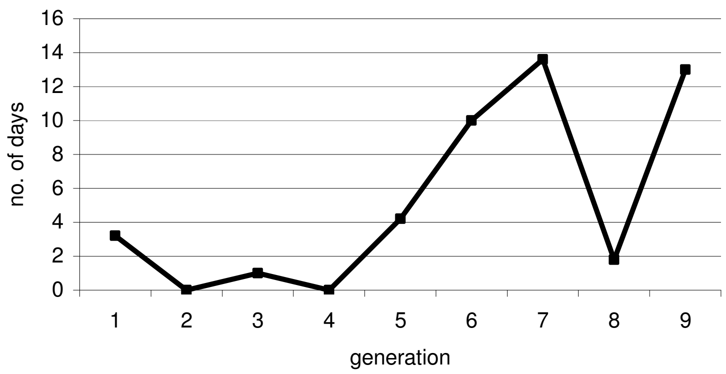

Fig. 3. Average length of postreproduction period of virginoparae from generations of *C.cupressi*.

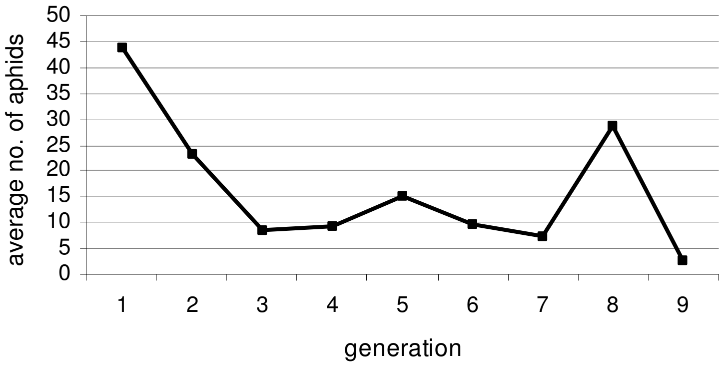

Fig. 4. Average fecundity of wingless virginoparae from subsequent generations of *C.cupressi.*

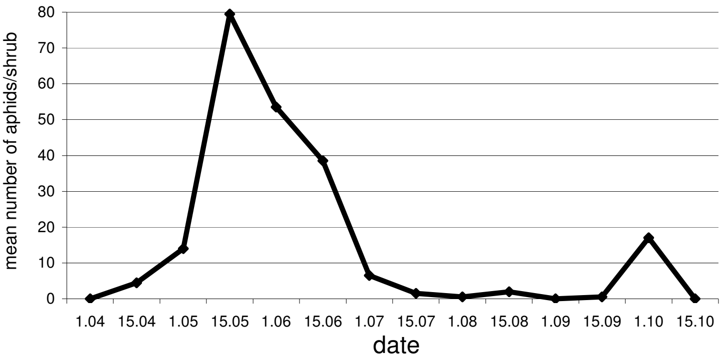

Fig. 5. Dynamics of the *Cinara cupressi* population in 2004-2006 in Poland.

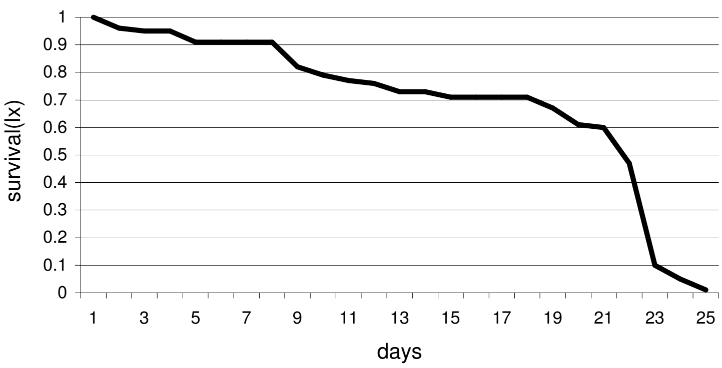

Fig.6. Curvae of *Cinara cupressi* survival in reared under control.

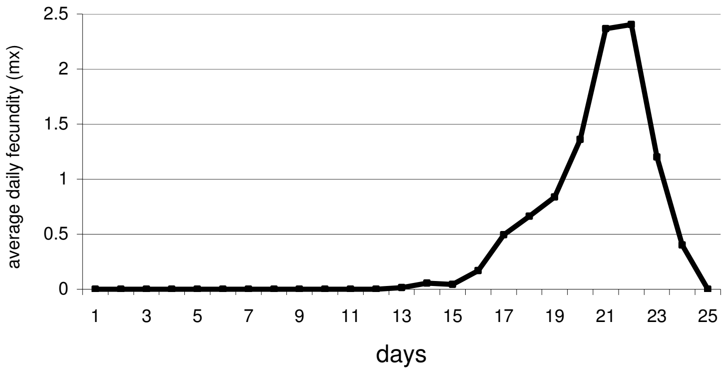

Fig.7. Fecundity of *Cinara cupressi* wingless virginoparae reared under control.

DISCUSSION

The hatching time of *C. cupressi* fundatrices, in Poland falling on Aprils corresponds with the observations carried out in Colorado, USA (MUSTAFA 1987).

The number of generations observed within a year amounted to nine, which confirms studies carried out in Jordan, where eight to nine generations were observed (MUSTAFA 1987).

Acquired data concerning development of *C. cupressi* is comparable to studies carried out on *Cinara cupressi*. The length of development of a single generation in Poland was 25 days, in Jordan 21.9 days (MUSTAFA 1987) and in Africa 24.82 days (KAIRO & MURPHY 1999).

The reproductive period lasted the longest among fundatrices; they also showed the highest fecundity. Similar dependencies were observed among other species of aphids (CICHOCKA, GOSZCZYŃSKI 1996, BOROWIAK-SOBKOWIAK 2005, 2006). High mortality and a decrease in fecundity observed in summer generations of the species in question are related to the influence of high temperature on aphids. Such an occurrence was also observed in *Cinara juniperi* (JAŚKIEWICZ 2000, 2003) when temperature of about 30°C caused a decrease in the size of the population on *Juniperus communis*. There were, however, no forms of females which, having reached maturity, would not propagate for one or two days, as observed by KAIRO and MURPHY (1999).

Both the time of appearance of androgynous specimens (amphigonic females and males), which in Poland was in October, as well as the time of laying eggs by females correspond with data from the USA (GILLETTE, PALMER 1924)

The demographic characteristics of the population under study are comparable to the population developed in Africa, which during development of one generation grew 7.05 times (KAIRO & MURPHY 1999). It shows that development of this species is comparable in our country, as well as proves adaptation to the host plant (*T. occidentalis*) introduced to Poland. The species also shows a relatively slow reproduction rate as compared to other species of aphids, e.g. *Macrosiphum rosae*, where it amounts to 40.007 (CICHOCKA 2003), or *Amphorophora idaei* with 80.67 (BOROWIAK-SOBKOWIAK 2006). Despite that, *C. cupressi* is considered a serious forest pest in Africa, feeding mainly on *C. lusitanica* (CIESLA 1991). It seems this species may become a serious pest for decorative plants, more and more often planted in our climate, especially during springtime.

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