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Investigations on the Biology of Hazelnut Beetle, *Balaninus nucum* L. (Coleoptera: Curculionidae) and its Damage to Hazelnut

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Abstract

The hazelnut beetle (Coleoptera: Curculionidae, *Balaninus nucum* L.) found in many regions of the world. In order to logical control of this pest, it is necessary to determine the biology and form of its damage. In this study, the biology damage caused by *B. nucum* were investigated on larvae and adults collected from the coast of Trabzon province in period of 1996-1998. In the end of the present investigation, the wing (10±0.8 mm for females, 9.3 ± 0.3 mm for males) and rostrum length 0.3 ± 0.4 mm for females. 3.8 ± 0.2 mm for males) of the adults, sex ratio (1/1), the dimensions of eggs (0.795 ± 0.14, 0.525 ± 0.11 mm), and instars of larvae (512.5 ± 15; 800 ± 8; 1005 ± 10; and 1295 ± 6 μm in diameter) were detarmined. Also, the appearance of the damage caused by the insect was observed.

Introduction

Hazelnut beetle is the greatest cause of damage to hazelnut fruits in Turkey, being responsible for a 30-40 percent annual loss of the hazelnut production. The main response of the agricultural studies is to increase the yield of plants per hectare. With the human population of the world rapidly increasing each year, crops must also increase at this demand. Although Turkey occupies the first among all the countries producing and exporting hazelnuts, it is way behind many other countries in terms product harvested. One of the main uses of this situation is that hazelnut has many pests which are not being controlled efficiently. Of these, (*Balaninus nucum* L. is the most significant (Pavlenko and Gorbunov 1985). Generally, it exist in the eastern Black and region of Turkey, in relatively high areas, near forests and especially in places facing north. Its main damage is to hazelnut, a highly important agricultural product for Turkey. Even though the density of the beetle tends to increase each year, it is still the main pest of hazelnut, which it damages by feeding and laying eggs (Sezen and Demirbag 1999; Yemen *et al*., 1999).

The investigation on the biology and damage caused by *Balaninus nucum* in Turkey has been carried out (Ural *et al*., 1973). Gibson (1985) descripted the larvae of *Curculio* sp. and also key characters to separate 15 of 16 species. This weevil genus recorded in eastern parts of USA and mada. Pucci (1992) investigated the population dynamics adults and preimaginal instars in 1987-88 in Caprarala, only. Barrios *et al*. (1987) studied the effects of lecticides against *B. nucum* and a similar study, while Tabamaishvili (1988), in Russia, investigated the chemical control of *B. nucum*. Recently, the resistance of hazelnut trees to *B. nucum* investigated by Piskornik (1992). In order to control pest, it is necessary to know its biology. However, there is no detailed information on this, nor on the form of damage of it causes to the hazelnut. This study, containing detailed information about the biology of and damage caused by the hazelnut beetle was performed on adults and larvae collected from the coast of Trabzon province from 1996 to 1998.

Materials and Methods

Collection of Adults and Larvae: In the present study, adults and larvae of the hazelnut beetle were collected from the coast of the Black Sea near Trabzon in the period of 1996-1998. Starting from March, adults were collected every morning and evening. The insects were collected in a 3 x 4 m cloth, by hitting the trees (Sezen and Demirbag, 1999; Yemen *et al*., 1999), and then taken from the field to the laboratory in appropriate bottles, the cover of which was perforated to permit air flow.

Rearing of Adults and Larvae: One group of adults was fed with food prepared from fresh leaves and fruits of hazelnut, and another group with apple and pear to determine the damage inflicted on other fruits. The food was changed each day to prevent decay.

The insects need to be fed well for mating. The eggs laid in the fruits were followed from the beginning of the incubation period and photographed regularly during the development period. The length of rostrum and wing, and the length and width of eggs were determined. Moreover, the sex of insects was also established.

Results and Discussion

The adult of *B. nucum* was found to be grey in colour and 6-7.5 mm in length. The shape of head was conical, antennae were elbowed and globular, and the body was egg-shaped. The eggs were oval in shape and white in colour, and their lengths were less than 1 mm. The white and curved larva reaches 10-12 mm at the end of the

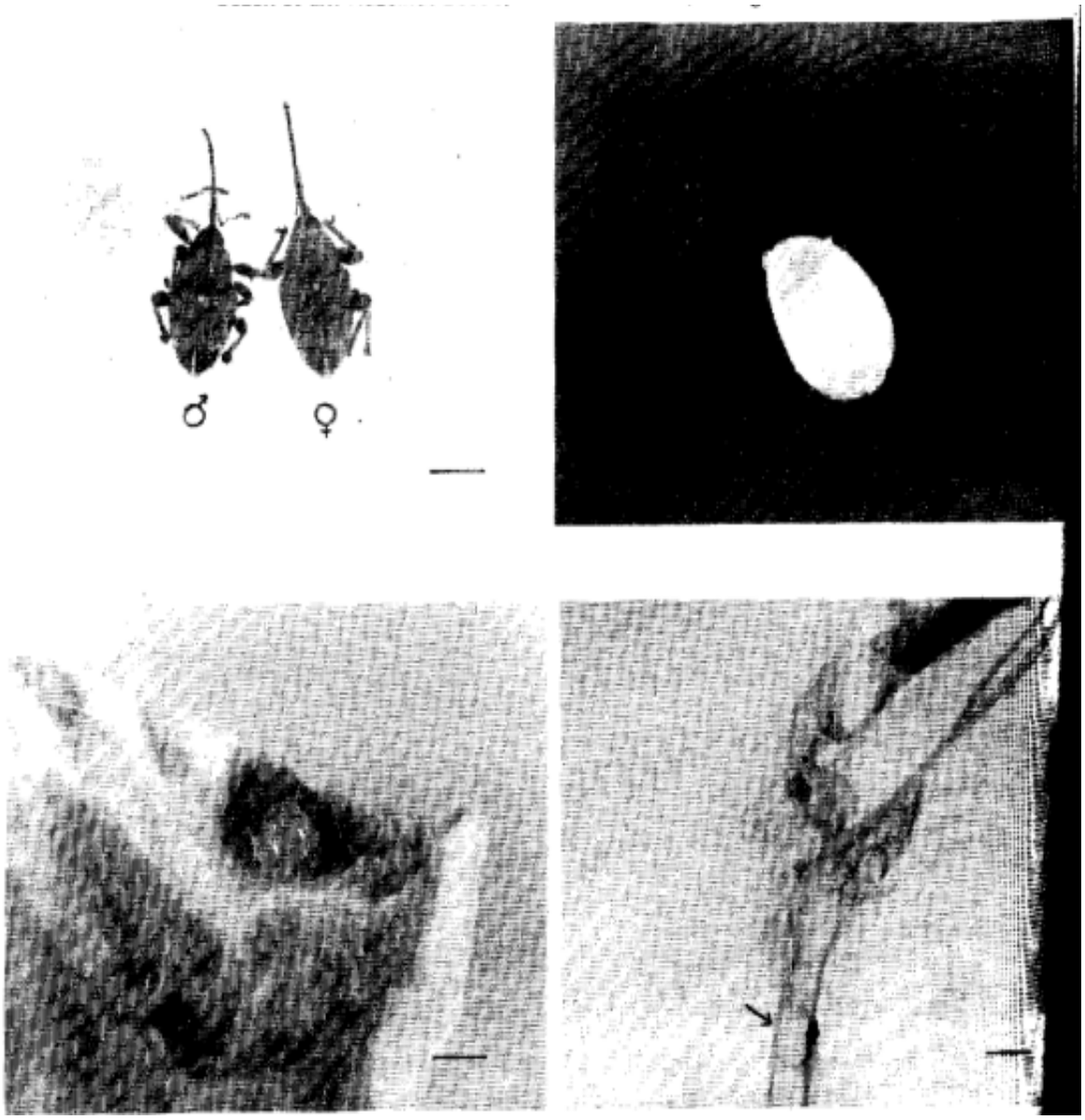

Fig. 1-4: The Life Cycle of *Balaninus nucum*; 1. The view of female and male adults (Bar: 0.26 mm) 2. The view of taken from hazelnut (Bar: 0.265 mm) 3. Original egg (Bar: 053 mm and 4. The eggs in ovipositor (Bar: 0 mm)

fourth-instar. The average body length of the adult female (excluding rostrum) is 7±0.8 mm, and rostrum length is 6 ± 0.4 mm (Table 1). However, we found the body length of the adult male on average (excluding rostrum) to be 6±0.4 mm, and the average length of rostrum to be 3.8±0.2 mm (Fig. 1, Table 1). The average length of the forewing was determined to be 10 ± 0.8 mm for the female, and 9.3±0.3 for the male insects (Table 1), AliNiazee (1998) found that the adults were greyish red in colour, rostrum was slander, strongly curved and longer than body in the female, shorter than body in the male.

The existence of adults starts in mid-March and the maximum density is reached in mid-May, depending temperature. By collecting and counting adults from hectare in various fields, we found that the everage number of males was 263 and of females was 270. On these findings, the sex ratio of hazelnut beet determined as 1 :1. The well-fed insects start mating and lay in June. The adults are not active enough under 16°C, they stay together. However, when the temperature rises the 16°C, they start flying long distances. Adults of has beetle moved towards different plants for feeding later adults which were laying migrated on the

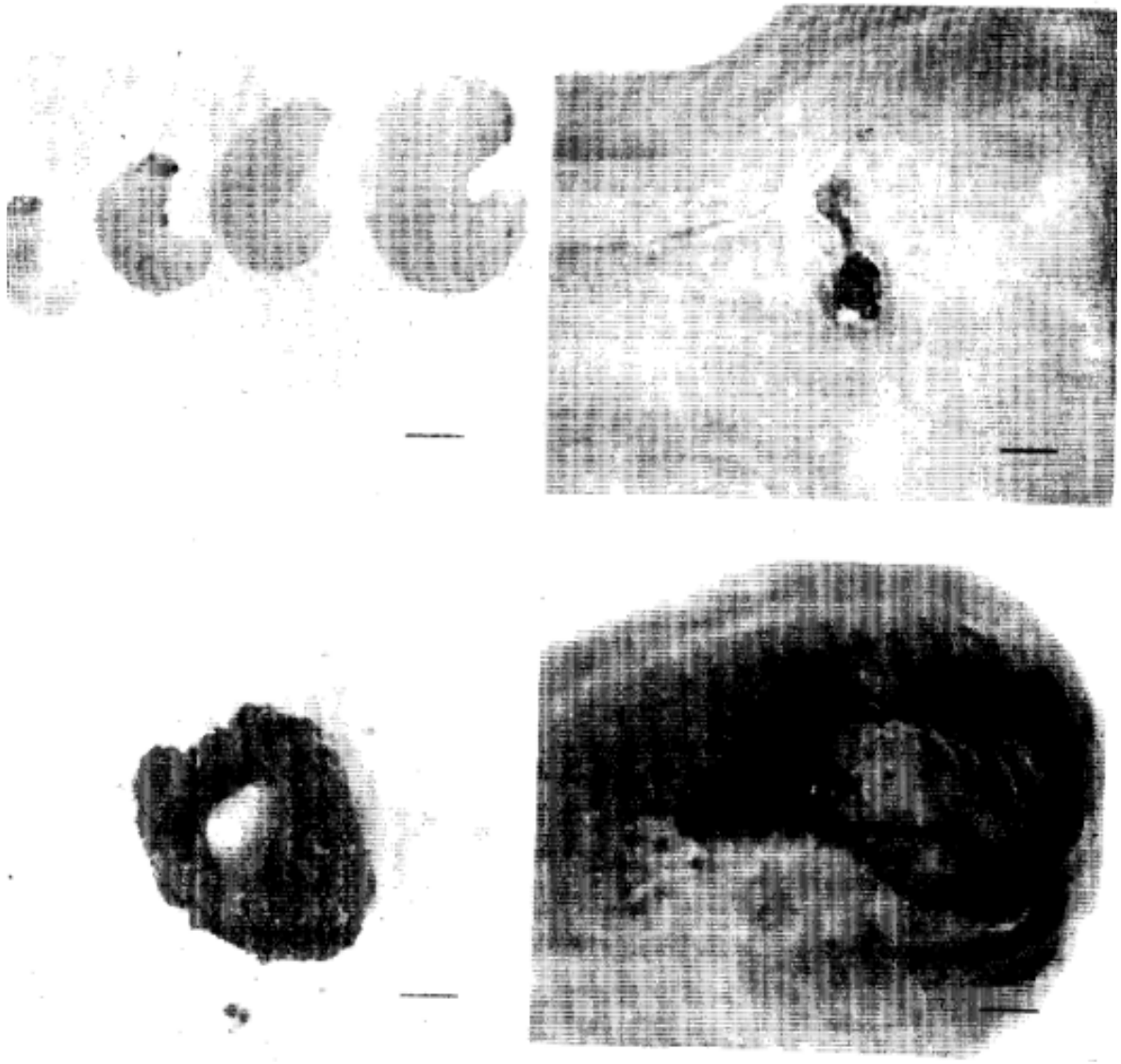

Fig. 5-8: The Life Cycle of *Balaninus nucum*; 5. The general view of four-instar larvae (Bar: 1.295 mm), 6. The hole which was opened by the adult larva to enter to soil (Bar: 1.7 mm), 7. The nest in which the larva spent winter (Bar: 5 mm) and 8. The third-instar larva which fed in hazelnut (Bar: 2.3 mm).

fruits that were not yet mature According to literature knowledge, the adults feed on hazelnut and on the fruits of various trees such as pear, peach, more rarely apple, plum and cherry (Ural *et al*., 1973; Paparatti, 1990; AliNiazee, 1998). Starting from early June, the eggs which were collected, measured, and photographed, They were conical and transparent, and 0.795 ± 0.14 x 0.525 ± 0.11 mm in size and, average (Fig. 2, Table I). During the observations, we detemined that the adult female opens a 4-5 mm cavity in the shell of the hazelnut by drilling with its rostrum without farming the fruit core. Then, it lays only one egg in the activity of each fruit by using the ovipositor. An egg nested in a hazelnut is shown in Figure 3. This process takes approximately 4-5 minutes, and at the end of laying the hole is closed by the insect to protect the egg and not to harm the fruit. After securing the egg, the female goes to another fruit to lay. This will be repeated approximately 40-45 times. Therefore one female insect damages approximately 40-45 hazelnut fruits.

We observed 5-6 eggs in the ovipositor of an insect under the microscope, following dissection (Fig. 4). After laying each egg, a new egg comes into the ovipositor.

Eggs are hatched 8 days after laying and larvae start to go into hazelnut for feeding about 5.7 days. The body of a young larva is transparent, and once outside the egg it is hardly visible macroscopically.

Table 1: Some characters of *Balaninus nucum* Adults, Larvae and Eggs.

Wing length Rostrum length	10.000	±	0.8 mm (female)	9.3 ± 0.3 mm (male)
Body length	6.000	±	0.4 mm (female)	3.8 ± 0.2 mm (male)
Larva head diameters	7.000	±	0.8 mm (female)	6.0 ± 0.4mm (male)
	512.500	±	15 μm (1.instar)	
	800.000	±	8 μm (2.instar)	
	1005.000	±	10 μm (3.instar)	
	1295.000	±	6 μm (4.instar)	
Egg dimensions	0.795	±	0.14 mm x 0.525 ± 0.11 mm	

During the observations, four larval stages were determined, by measuring head diameter: 512.5 ± 15; 800 ± 8; 1005 ± 10; and 1295 ± 6 μm for each instar (Fig. 5, Table I).

Atter feeding approximately for 29-30 days, the larvae open a hole 11.5-2 mm) in the shell of the hazelnut (Fig. 6) and enter the soil to spend the winter (Fig. 7). The over wintered larvae pupate in the soil at the beginning of March. The pupa was found to be white in colour and 8 mm in length. Figure 8 shows a *B. nucum* larva while feeding in a hazelnut fruit.

Knowing that an adult insect damages approximately 80 hazelnut fruits by feeding, and that a female damages approximately 40 fruits by laying, a couple will damage 200 fruits on average, which is approximately 0.5 kg. On average, a hectare has 50 hazelnut tree clusters and about 40-50 insects were collected from 0.5 hectare. Therefore, 22 couples found in 0.5 hectare would damage 2400 nuts, which amounts to about 6 kg, and represents a heavy loss. Tabamaishvili (1990) determined that *Curculio nucum* has 70 percent damage which is a very high ratio on hazelnut in Russian. Paparatti (1990) conducted field studies in Italy to determine the damage of *B. nucum* to hazelnut fruits. As a result, he determined that *B. nucum* causes 21.38 percent of damage every year by feeding.

The hazelnut beetles damage to hazelnut fruits by feeding and egg-laying was established in the current study showed that, the inside of fruits did not attain normal size and the shells did not become hard enough, and assumed a yellowish colour. When the fruits were damaged after attaining normal size, the inside became black. AliNiazee (1998) identified that the attacked hazelnuts were ruined. Also, the feeding punctures of the adult on pears or peaches cause deformations; on young hazelnuts, they cause many of them to drop prematurely.

It was observed that the hazelnut beetle was univoltine and that, of the larvae entering the soil, 18 percent came out in April in the first year, 75 percent of total population in June, and 7 percent in next June; the adults live about three months (Ural *et al*.,1973).

Details of this study on the biology of the hazelnut beetle, which causes serious damage to hazelnut should make an important economic and entomological contribution to the literature, in particular regarding the form of damage.

Acknowledgments

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