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Full Length Research Paper

Monitoring population density and fluctuations of *Anisandrus dispar* and *Xyleborinus saxesenii* (Coleoptera: Scolytinae, Curculionidae) in hazelnut orchards

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Bark (*Anisandrus dispar)* and ambrosia beetles (*Xyleborinus saxesenii)* (Coleoptera: Curculionidae: Scolytinae) include many important pest species of forest and fruit trees. These beetles prefer physiologically stressed trees for colonization but some species also attack healthy trees. Bark and ambrosia beetles consist of two main ecological groups; bark beetles settle in the phloem, whereas ambrosia beetles bore in the xylem (sapwood). The latter are very detrimental in Turkish hazelnut orchards. This study was carried out between 2005 to 2007 to monitor populations of *A. dispar* and *X. saxesenii* (Coleoptera: Scolytinae, Curculionidae), causing considerable damage in hazelnut (*Corylus avellana* L.) orchards in Ordu and Samsun Provinces. Populations of bark beetles were monitored using sticky traps with red wings used to capture these pests. Ethanol (96%) was used as the attractant in the traps. The results of the three-year study indicated that both pest species emerged at different times in Ordu and Samsun. *A. dispar* emerged in large numbers in spring (March - May) as overwintered adults; *X. saxesenii* emerged in large numbers in summer (June - August). Population density of *A. dispar* on the 15th of May, 2007 was 398 adult/trap whereas population density of *X. saxesenii* on the 1st of September, 2005 was 383 adult/trap. The highest catch was recorded in Samsun province.

Key words: Hazelnut, population monitoring, *Anisandrus dispar*, *Xyleborinus saxesenii*, red winged sticky traps.

INTRODUCTION

Hazelnut is one of the most important agricultural products of Turkey; it is cultivated over approximately 550 thousand hectares (84% of global production area), producing 500 thousand tonnes (69% of global production), of which approximately 300 thousand tonnes are exported (Yavuz, 2007).Approximately 150 insect species have been detected in hazelnut orchards. However, only 10-15 of these species result in economic losses, varying between years and region plantations (Işık et al., 1987). According to studies conducted in Turkey, the hazelnut weevil (*Balaninus nucum* L.) is the most significant hazelnut pest (Işık et al., 1987; Ecevit et al., 1995; Tuncer and Ecevit, 1996 a, b; Saruhan and Tuncer, 2001). Bark beetles and ambrosia beetles (*Scolytinae*) are another important pest of hazelnut (Ak et al., 2005 a, b, c). These beetles are a major risk for woody plants world-wide (Hulcr and Dunn, 2011) and have recently been shown to harm hazelnut orchards. Serious damage caused by hazelnut weevil were observed on hazelnut plants in low and middle altitudes of region in recent years (Mani et al., 1990; Raulder, 2003; Kaya, 2004; Ak et al., 2006b, 2010). While other pests directly or indirectly affect the quality and yield in hazelnut orchards, bark and ambrosia beetles (*Scolytinae*) cause product losses by draining young or old hazelnut branches. Additionally, as these pests spend

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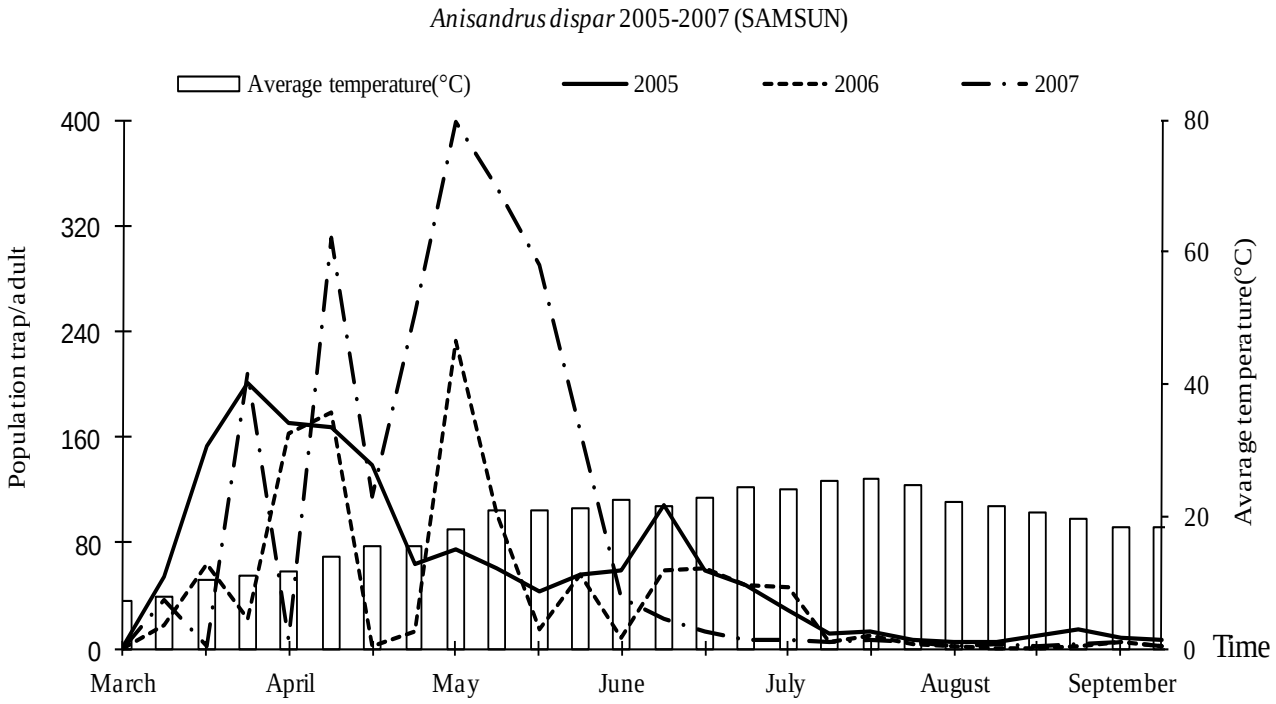

Figure 1. Population density and fluctuation of *A. dispar* in Samsun Province (2005-2007).

most of their lives in the woody tissue of their host, they are very difficult to eradicate. Therefore, a chemical control regime must always be supported by biological control techniques and removal of infested plant material.

For the development of methods to control bark and ambrosia beetles, it is however crucial to know the emergence pattern of adult females. Therefore, in this study we aimed to determine emergence times and population fluctuations of the ambrosia beetles *A. dispar* and X. saxesenii using ethanol-baited Red Winged Sticky Traps.

Due to the high population of pests in hazelnut orchards and the importance of determining the emergence time of adults in controlling them, this study examined the population fluctuation of *A. dispar* and *X. saxesenii*. Both species are important in hazelnut orchards in Turkey. We monitored their populations at different locations in two provinces (Samsun and Ordu) for three years and determined the emergence time of adults.

MATERIALS AND METHODS

Red Winged Sticky Traps used in this study consists of four red-colored sticky plates ("wings") and a 1-liter plastic bottle hunging just below them. Each wing of the sticky trap has an area of 148.9 cm^2 (14.6 cm high and 10.2 cm wide). The total area of the sticky part of the trap is 0.12 m^2. The plastic bottle has four holes to enable the alcohol (96%) to evaporate.

Population monitoring of *A. dispar* and *X. saxesenii* employed red-winged sticky traps for collection of bark beetles, which were located in hazelnut orchards in Samsun (Terme) and Ordu (Central) provinces of Turkey between 2005 and 2007. Three traps were hung at each location used in the study. Traps were placed 1.5 m above the ground and spaced 20 m from each other. Population fluctuations of *A. dispar* and *X. saxesenii* were monitored in sites in Samsun and Ordu province in 2005-2007 (Figures 1, 2, 3 and 4). The numbers of trapped *A. dispar* and *X. saxesenii* were monitored weekly between March and October; traps were cleaned after each count and this process continued throughout the year. In the first year, traps were hung in the Samsun site on the 15th March 2005, and removed on the 25th October, 2005. In the Ordu site, they were hung on the 31th March, 2005 and removed on the 20th October, 2005. In the second year, they were hung in the Samsun site on the 15th March, 2006 and gathered on the 26th October, 2006, and in the Ordu site they were hung on the 16th March, 2006 and gathered on the 27th October, 2006. In the last year of the study, the traps were hung in the Samsun site on the 21th March, 2007 and gathered on the 1st November, 2007. In the Ordu site, they were hung on the 23th March, 2007 and gathered on the 15th October, 2007.

RESULTS

Population density and fluctuation of *A. dispar* in Samsun Province (2005-2007)

The first *A. dispar* individuals were trapped in March in Samsun Province. The highest catch was recorded usually in April. The number of individuals caught in traps decreased from this date, but increased again at the end of June and the beginning of July. The last adults were trapped in October (Figure 1). Data from Samsun Province for the three study years revealed that pests

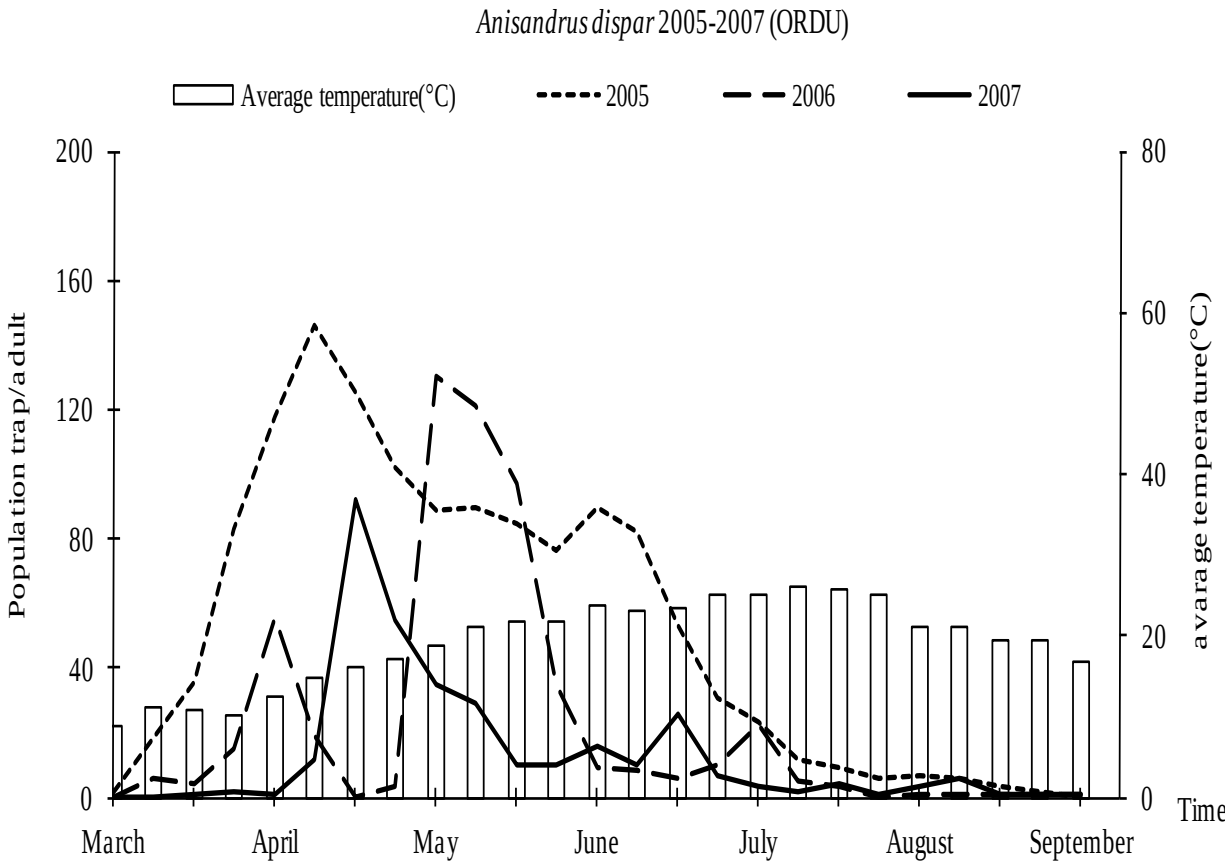

Figure 2. Population density and fluctuation of *A. dispar* in Ordu Province (2005-2007).

generally begin to emerge by the end of March, depending on the season, and reached their highest density emergence in April. Therefore, biological control for the pest should commence at the end of March and chemical control in the first week of April.

Population density and fluctuation of *A. dispar* in Ordu Province (2005-2007)

The pattern for *A. dispar* trapped in Ordu was similar to Samsun Province. The first catch at Ordu occurred in the first week of March and high catches were observed usually in May. The number of individuals trapped decreased from July and ended on September (Figure 2). The data indicate that the emergence of *A. dispar* depends on seasonal factors and that the use of traps should begin one week later than those in Samsun Province while chemical control should be begin by the first week of April, as in Samsun Province Site. Both provinces showed the population decline at the beginning of May and an increase at the beginning of June. Therefore, commencing chemical pest control by the first week of June is of great importance in controlling populations.

Population density and fluctuation of *X. saxesenii* in Samsun Province (2005-2007)

As with *A. dispar*, individuals of *X. saxesenii* were first recorded in traps in the last week of March and continued until the last week of September in Samsun. The highest catches of *X. saxesenii* in Samsun generally occurred in July and August in each of the three study years. Even though the emergence of *X. saxesenii* in the summer season was detected in the first week of May 2007 and the first week of June during 2005 and 2006, the dense emergence of *X. saxesenii* in the summer was determined as being between the end of June and beginning of August. In 2007, adult emergence in May- June might have been as a result of low population levels and high temperatures in the month of May (Figure 3). According to the data, management of *X. saxesenii* should commence at the beginning of July in Samsun Province, unlike *A. dispar.*

Population density and fluctuation of *X. saxesenii* in Ordu Province (2005-2007)

Catch of *X. saxesenii* in Ordu Province were recorded between March and October. The highest catch was

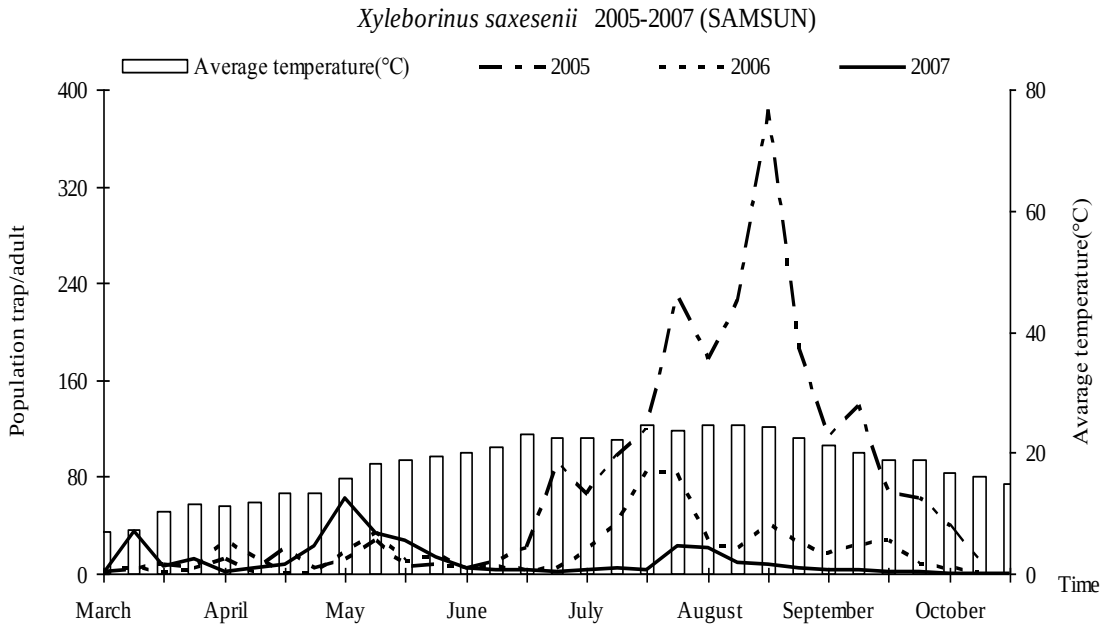

Figure 3. Population density and fluctuation of *X. saxesenii* in Samsun Province (2005-2007).

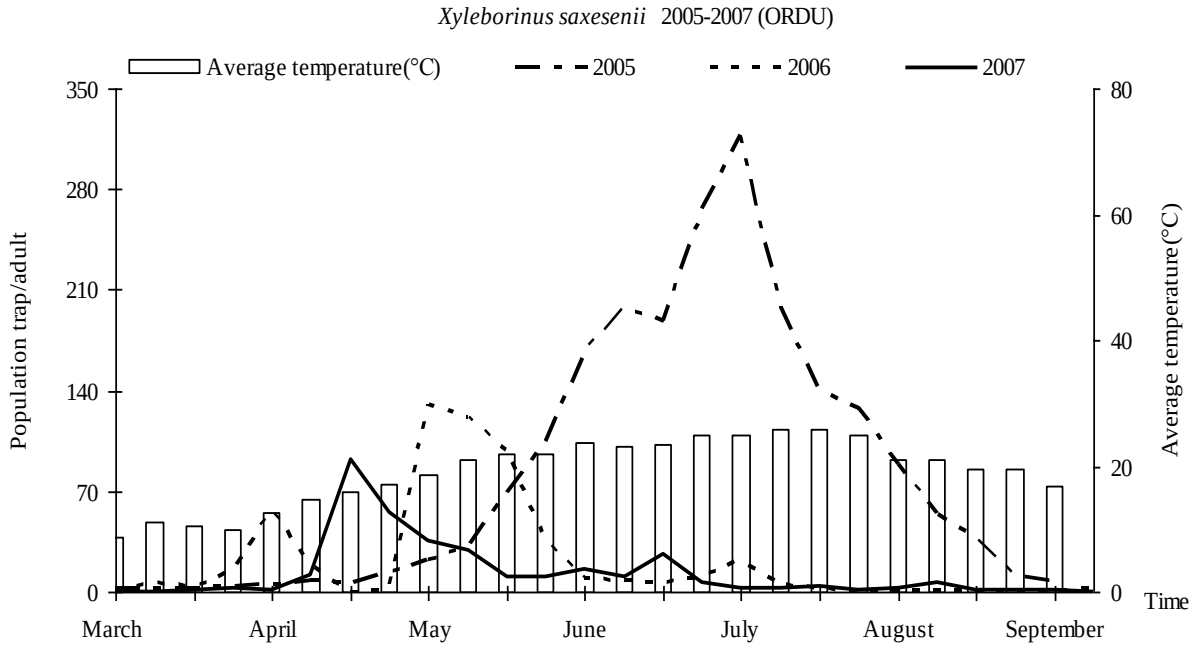

Figure 4. Population density and fluctuation of *X. saxesenii* in Ordu Province (2005-2007).

recorded on July and August. *X. saxesenii* was observed in traps in the last week of September in Ordu Province (Figure 4).

DISCUSSION

In both locations in all three study years, the emergence of adult *A. dispar* was predominantly between March and June, depending on temperature. The emergences during these periods were found to be uneven and occurred as a result of breeding of adults in different periods. Adult *X. saxesenii* preferentially emerged in the summer between the end of June and August at both locations. Additionally, however, some adults individuals dispersed in spring. According to population monitoring

over the three years in Samsun and Ordu Provinces, adults of both pests species emerged at different periods. The phenology of *A. dispar and X. saxesenii* were similar to each other at both locations. These findings support those reported by Ak (2004) and Ak et al. (2005 a, b, c, 2006a).

It was found that *A. dispar* had higher population densities than *X. saxesenii* in both locations during 2006 and 2007, but not 2005.

Population monitoring of *A. dispar* showed that adult emergence increased during the spring season when the temperature was approximately 18-20°C. Similarly, a study by Kaya (2004) in mixed plantations (apple, pear, plum, peach etc.) found that from 1997 to 1999, the first emergence of adult *A. dispar* was on May 8th, April 26th, and May 6th, respectively. Schultz et al. (2002), using ethyl alcohol baited Lindgren and Japanese traps, reported that the first emergence of adult *Xyleborus crassiusculus* was at the end of March and the beginning of April. Mani et al. (1990), using ethanol traps found that *A. dispar* was caught in spring when the temperature was 20°C and that catches lasted for 3-4 weeks. In a study using ethyl alcohol funnel traps in fruit orchards in Canada (Creston), White (1992) reported that *A. dispar* emerged at the end of March and beginning of April and had two peaks in April and June. Ciglar and Boric (1998) stated that 98% ethyl alcohol diluted 1:1 with water could be used as bait in winged traps; *A. dispar* emerged in spring when the temperature was 20°C and the emergence lasted from the last week of April to mid June.

The results of population monitoring of *X. saxesenii* showed emergence of adults in the spring when temperation reached 18-20°C, as is the case with *A. dispar,* and highest emergences were detected in June - August. Similarly, a study by Markalas and Kalapanida (1997) examined flight models of some *Scolytinae* using an ethyl alcohol baited slot tarp in an oak forest in Greece between 1992-1993. The study reported that *A. dispar* emerged in high numbers between March and June, and *X. saxesenii* emerged from the end of April to the end of August. In a study of flight dynamics using alcohol traps, Raulder (2003) found that *X. saxesenii* and *A. dispar* began to fly in spring (at the end of March or the first week of April) when the daily temperature was 18°C and above, and last until autumn; and that the period of highest emergences occurred between the end of April and mid June. In a survey of *Scolytinae* in an Oregon forest Cramer (2005) observed that the first emergences of *X. saxesenii* were in mid February when the temperature reached 18°C and lasted until the end of autumn, with the period of highest emergence being between the beginning and the end of June.

For the development of a pest control regime (mechanical, biotechnical, or chemical), it is very important to know the emergence pattern of bark and ambrosia beetles in a specific region. During the summer period, *A. dispar* showed low levels of emergence from the end of June to mid August. *X. saxesenii* was found to emerge at low levels in spring, depending on tempe-rature, with higher levels observed during the summer season (June - August). Therefore, control of *X. saxesenii* should be conducted during this period.

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