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Full Length Research Paper

Effects of diameter at breast height (dbh), oviposition place and orient on number of egg masses gypsy moth, *Lymantria dispar* (L.)

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The gypsy moth, *Lymantria dispar* (L.) (Lepidoptera: Lymantriidae) is one of the most important pests in Hyrcanian forests, north of Iran. The objective of this research was to determine the effects of diameter at breast height (dbh), oviposition place and oviposition orient on number of egg masses gypsy moth. Sampling was carried out in Golestan State region, during 2008. Data and means were compared using Duncan's multiple range tests. By global position system (GPS) device with using polygons with width of 20 m and determined azimuth, defoliated trees were recorded. Results showed that the diameter at breast height was not significantly affected by the number of egg masses. Maximum of egg masses were observed at 110-120 cm dbh (2.37 egg masses/tree). The effect of oviposition place on number of egg masses gypsy moth were significant (*P<0.01*). The highest number of egg masses (2.148 egg masses/tree) was observed at trunk of defoliated trees, also, minimum (1.65 egg masses/tree) occurred in branches of defoliated trees. The effects of oviposition orient were significant (*P<0.05*). The comparison of means showed that the maximum rates of egg masses was occurred in south (2.04 egg masses/tree), the least of defoliation was related to north (1.57 egg masses/tree).

Key words: Defoliation, egg masses, gypsy moth, *Lymantria dispar,* oviposition.

INTRODUCTION

The gypsy moth is one of the most important forest pests in the eastern United States (Doane and McManus, 1981; USDA, 1995). Defoliation stresses and kills trees, and indirect effects of defoliation can reverberate throughout forested ecosystems. Social impacts are also substantial. Recreational use of parks and camp grounds is sharply curtailed during outbreaks, and the substantial nuisance created by large numbers of wandering larvae and frass raining from trees exacerbates its pest status in urban areas (Herms, 2003). In the northeastern United States, moths emerge from late July to early August. Female moths emit a chemical (a pheromone) from glands to attract male moths for mating, and then oviposition eggs. The female does not fly, even though she has large wings. Egg masses or clumps are usually found near empty pupal cases of females. Eggs are placed in dark sheltered areas, bark crevices, under loose bark, and the undersides of limbs, rocks, stumps, leaf litter, vehicles, and outdoor household equipment. Each egg mass may contain from 100-1,000 eggs. Larvae form in eggs within one month, but activity ceases during overwintering diapause. Increasing heat in the spring, plus other stimuli, prompts larvae hatch. Newly emerged 1st instar larvae disperse by climbing to the top of vegetation or structures and then ballooning away on a long spun strand of silk. Young larvae prefer to eat newly flushed foliage or the leaves of trees under stress. Most feeding occurs during daylight hours; at night the young larvae lie in silk mats spun on leaf undersides. By the 3rd instar, larvae feed at night and take cover under loose bark or in leaf litter during daylight hours. Generally, male larvae have 6 instars, females 6, but more may occur. The larval stage

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may last from 20-60 days. Pupation occurs in secluded sites and lasts 14-17 days. Adult moths emerge and renew the cycle. There is only one generation per year (Leonard, 1981). In the Northeast, the most susceptible forests occur on dry ridges and steep upper slopes with shallow soils and on deep excessively drained sands where growth is slowed or stopped (Houston, 1979). Leaves from weakened or stressed trees have higher concentrations of nutrients, and larval mortality is lower on drought-stricken trees (Leonard, 1974). Gypsy moth is one of the most important pests in Hyrcanian forests, North of Iran. It was observed for the first time in 1937 in Guilan State region in Hyrcanian zone. The largest outbreaks of gypsy moth occurred in Talesh forest in Guilan State region in 1975 (Kavosi, 2008). It is speared in Hyrcanian, Arasbaran and Zagros forests (oak forests) during this time. It was recognized that gypsy moth is distributing in thorough Hyrcanian forests and the most importantly, its focus are, Daland park (Golestan State), Zare and Noor parks (Mazandaran State) and Rezvanshahr and Masal forests (Guilan State) (Hajizadeh et al., 2012). The activity of this pest in central parts and south western forests of Iran has been admitted outside these regions (Hajizadeh and Kavosi, 2011). The defoliated rate in Hyrcanian zone is further more than the other zones and thousands of hectares of forests in this zone are getting extinct (rate of defoliated in Guilan State region has reached to the fields and houses) (Hajizadeh, 2010). Hajizadeh and Kavosi (2011) found that the primary host tree species of gypsy moth in Iran was Persian ironweed, *Parrotia persica*. Hajizadeh et al. (2012) studied the effects of oviposition height and host tree species on some biological parameters of gypsy moth, *L. dispar*, in Hyrcanian forests. Samples were taken on five oviposition heights (0.5, 1, 1.5, 2, 2.5 m) on trunk of four common host tree species including, *Zelkova carpinifolia*, *P. persica*, *Q. castanifolia* and *Carpinus carpinifolia*. Results showed that the oviposition heights significantly affected pest biological parameters (egg clutch size, egg hatching percent, larval body length and mortality percent of first instars), but the effects of host tree species and interacting effects were not significant. The highest survival percent, egg clutch size and body length was observed at oviposition height of 0.5 m on the *P. persica* species, and the most egg mortality of first instars was recorded at oviposition height of 2.5 m on the *Quecrus castanifolia* species. Lechowicz and Jobin (1983) studied the effects of estimating the susceptibility of tree species to attack by the gypsy moth. Numbers of gypsy moth larvae feeding on each of 922 randomly sampled trees in a *Quercus- Acer- Fraxinus* forest in southwestern Quebec, Canada were counted in 1979 and in 1980 to quantify the larval feeding preferences as observed in the field for eighteen deciduous and one coniferous tree species at the northern range limit of the gypsy moth. Both the diameter height (dbh) and the estimated foliage biomass of the sampled trees were used to calculate the relative proportions of foliage represented by each of the nineteen tree species in the forest canopy. The objective of this research was to determinate the effects of diameter at breast height (dbh), oviposition place and orient on number of egg masses gypsy moth, *L. dispar* (L.) in Hyrcanian forests, North of Iran.

MATERIALS AND METHODS

The experiment was conducted in Daland park, which is part of the larger Golestan forest in Hyrcanian zone, Iran (latitude 36°2′S-36°4′S, longitude 36°3′E-41°5′E) (Figure 1). This area is approximately, 3750 m long and 2900 m wide and has a total area of 608 ha. The study region has an average temperature of 16.5°C, a total annual rainfall of 660 mm and an altitudinal range of 75-119 m above sea level. The park consists almost entirely of *P. persica*, *Q. castanifolia*, *Zelkova carpinifolia* and *Carpinus betulus* with a few small areas of other species (*Populus alba*, *Ficus carica*, *Morus alba*, *Cupressus* S.V. *horizentalis*, *Pinus eladerica*, *Thuja orientalis* and *Acer insigne*). The study site was recently infested by the gypsy moth. It was considered to be part of the eastern leading edge of the generally infested area (Anonymous, 2005). To coordinate the egg masses gypsy moth, to zigzag between the trees were moving. By global position system (GPS) device with a width of 20 m and azimuth polygon specific coordination of defoliated trees was recorded. Sampling was carried out in Golestan State region, during 2008. Data and means were compared using Duncan's multiple range tests.

RESULTS

Results showed that the diameter at breast height (dbh) of host tree species has no significant effect on the number of egg masses gypsy moth. The relationship between of diameter at breast height (dbh) and number of egg masses had high positive correlation. The compare of means showed that maximum rate of defoliation in diameter at breast height occurred in 110-120 cm (2.37 egg masses) and the least of defoliation was related to 0-10 cm (1.11 egg masses) (Figure 2). In geographical direction of the trunk of host tree species, there was no significant difference ($P<0.01$) (Table 1). The compare of means showed that the maximum rates of egg masses in defoliated trees occurred in south (2.04 egg masses/tree), the least of defoliation was related to north (1.57 egg masses/tree) (Figure 3). The effects of oviposition place were significant ($P<0.01$). The highest number of egg masses (2.148 egg masses/tree) was observed at trunk of defoliated trees.

DISCUSSION

The gypsy moth, *L. dispar* (L.), is one of the most important pests of forest trees throughout the world, including Hyrcanian forests of northern Iran. Larval herbivory can result in leaf area reductions, leaves abscission, and eventually, yield quality and quantity

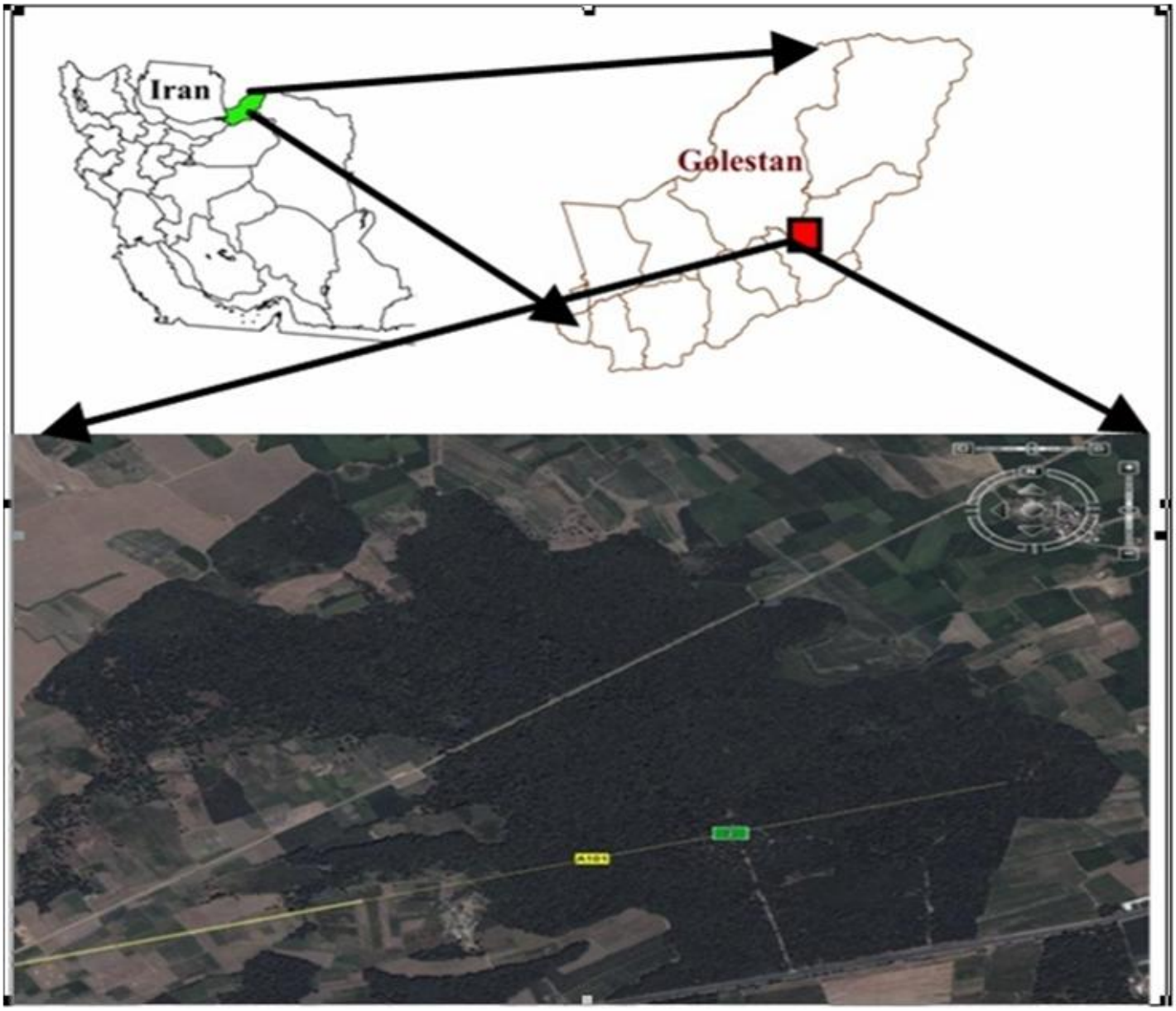

Figure 1. Location of the study site inside the Golestan State region, Hyrcanian forests, north of Iran.

losses. The average of egg masses gypsy moth, as an index, which indicates the status invasion. Recognition of oviposition place and diameter at breast height (dbh) of host trees is a way to study the population dynamic and sampling programs to monitoring gypsy moth. Criteria such as the defoliation, reducing the diameter of the trunk and killing the host tree species to determine the economic damage of gypsy moth, are used (Barbosa, 1978). The relationship between infestation and diameter at breast height of host tree species varies depending on the forest types. However, the infestation rate in the mixed forest types of trees with a low canopy is less (Smitley et al., 1993). In this study, the highest infestation rate was observed in the diameter of 110-120 cm, this result was in consistent with other researchers (Roden et al., 1992; Smitley et al., 1993; Nesslage et al., 2007). Kurt et al. (1999) studied the effect of silviculture treatments in the management of gypsy moth, they concluded destruction and persistency of forest trees areas of activity provide the pest. Construction of facilities in fringes of forest areas and degraded forests into agricultural lands and orchards in the areas of the forest canopy is open. Opening the forest canopy, high temperatures, low humidity and light on the forest environment are followed. The better conditions for growth and development of gypsy moth in forest areas

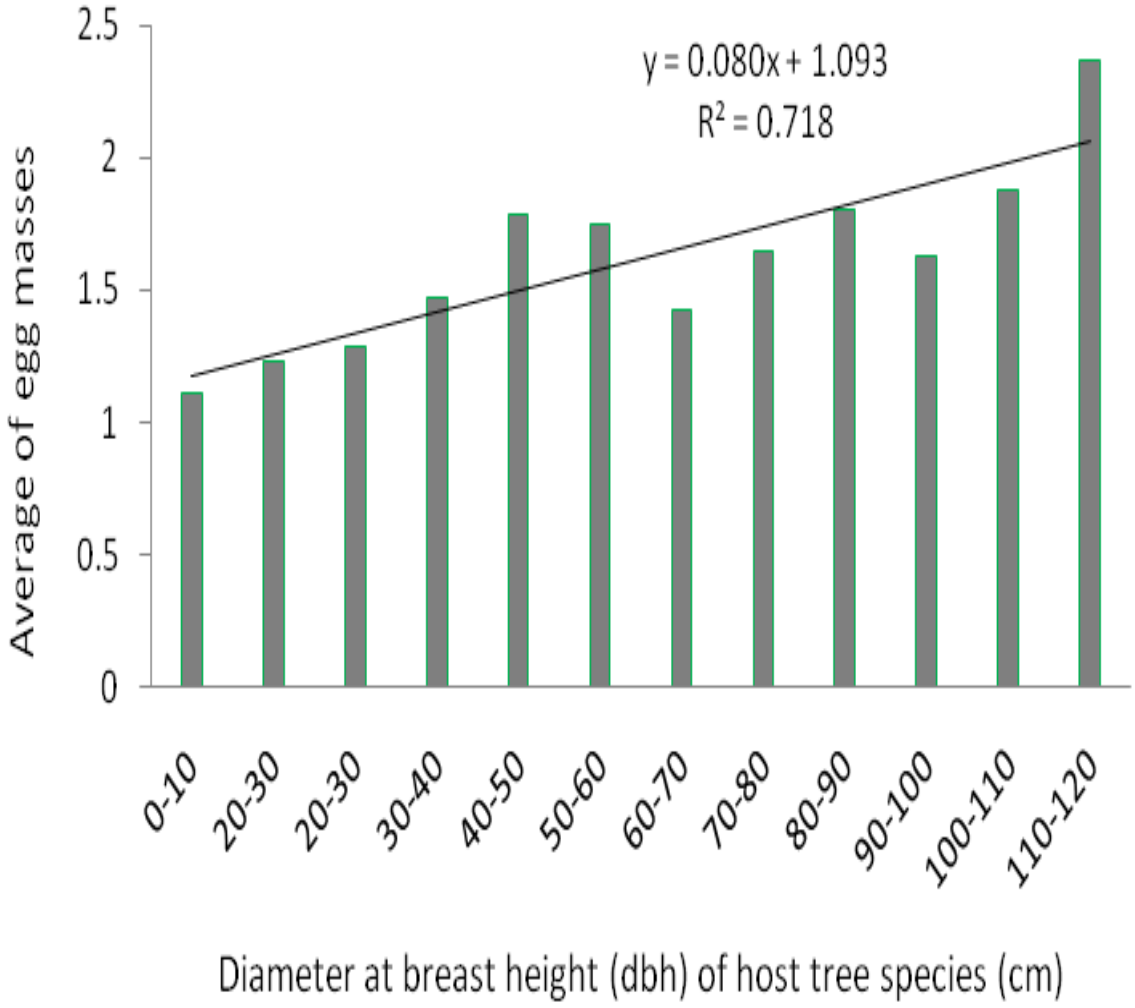

Figure 2. Average of egg masses gypsy moth in classified diameter at breast height (dbh) of host tree species in Daland Park, Golestan State region in 2008.

Table 1. Analysis of variance of gypsy moth egg masses, as influenced by oviposition orients.

Source	df	MS	F	Sig
Between groups	3	6.757	2.684	0.046*
Within groups	589	2.517		
Total	592			

Asterisks *(*P<0.05*) indicate significant differences between the treatments.

make available (Ghent and Onken, 2004). The highest infestation rate in south direction of the trunk defoliated trees was observed, which was consistent with findings of other researchers. Gypsy moth, in Hyrcanian forests, north of Iran, the second half of June to August according to altitude and weather conditions, at night on leaves, the skin split tree trunks, rocks and even man-made forest in the oval-shaped mass oviposition on them with a bunch of hair and fluff coats. So after leaving the pupal skin, usually in the same location will start oviposition. Then, all part of the summer and autumn and winter as eggs in diapauses State spends the life cycle gypsy moth, eggs categories that are easy to biopsy.

High population densities in the gypsy moth, the eggs on the trunks of host trees are found in most categories. However, at low population densities, a large percentage of egg categories, under the rocks and trees along streams are observed. Categories of eggs of this pest, the outbreak had a small organ, each are containing 75 to 100 eggs. But the growing population and a static number of eggs in very few categories of rebellion, but their larger size, each containing 700 to 1000 eggs. In this study, the highest rate of egg masses gypsy moth on the trunks of host trees was the lowest of the branches of trees, which is consistent with findings of other researchers (Barbosa and Capinera, 1974; Elkinton and Liebhold, 1990).

Figure 3. Average of egg masses gypsy moth in geographical direction of trunk in defoliated trees.

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