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The Effect of Hosting Nutritional Resource and Soil Compaction on Lymantri Dispar and Bradyporus Latipes Population (Case Study: Shahid Zare Forest Park in Iran, Mazandaran)

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ABSTRACT
The forests in north of Iran with abundant biodiversity include as one of the rarest stores of biological are Natural ecological and economic perspective. Whereas, pests and plant diseases are serious threat to biodiversity, human health and forest parks, the present study was performed in May and June 2012 in completely randomized design with four replications and three treatments soil compaction consist of no compaction, low and hard compaction. In each of the treatments, additional providing soil samples from a depth of 0-10 centimeters for each treatment in order to measure some physical characteristics of soil with routine laboratory, number of larvae and nymphs for *Lymantridispar* and *Bradyporuslatipes*were counted in three meters height of five tree species such as *Quercuscastaneifolia*, *Zelkovacarpinifolia*, *ParrotiaPersica*, *Cupressussempervirens* and *Pinuseldarica*.The results of comparing three treatments on soil compaction indicated a significant for bulk density, soil PH, percentage of sand and silt particles and non significant for electrical conductivity and percentage of clay particles.Both the number of *Lymantridispar* and *Bradyporuslatipes* pests on host trees became significant in 1 and 5% probability level. Also, *Quercuscastaneifolia* and *ParrotiaPersica* trees specious were identified as the best host for feeding larvae and nymphs.Significant and non-significant in terms of the number of *Lymantridispar* and *Bradyporuslatipes* on soil compaction show the effect of soil compaction on *Bradyporuslatipes* population.Also, was identified that human interventions on the natural ecosystems effect on the pests population.
Keywords: *Lymantridispar*, *BradyporusLatipes*, soil compaction.

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INTRODUCTION

Pest in a broad sense is included the beings that disturbs in the existence, quality or value of some resources such as health, welfare and the peace of mind. Pests and plant diseases controlas human began farming on the planet, has been one of the intellectual concerns [17].Considerable damages are made to crops, forest and pasture that at least part of it depends on the soil environment and human interventions such as mono culturing in order to vast producing of crops [1], eliminating the mixed forests in order to personal welfare such as cut of oak trees and making mono culture of *Albiziajulibrissin* because of appetizing for livestock and or destructing of pastures and altering it to dry farming [25].

Generally pests include some of live factors (e.g.mites, insects, birds, rodents, weeds) and nonlive (environmental factors such as cold, heat, hail and etc) [17]. Since human has been faced during history with the first group, hence the phrase of pest has been used for its more. For example, can be noted to the damage in the United States of America in the decade of 1960 that result from pests and was estimated $7 billion. By adding the cost of management and pest control, the damage was included almost a quarter of the total value of products [1]. Until 1997, the numbers of insect's species that had been named were about one million and the numbers of mites were about 300,000 species.In the one million identified species, 11 thousands of it are herbivores species and less than a thousand species were considered as serious pests [7].

According to estimation of the World Food Organization (FAO) about a third of the world's food crops damage by pests during the growing, harvesting and storing.If the pests are not controlled well, it will be

cause to 25 percent reduction in gardens crops.With regard to the insects with 64.4% have the most abundant living beings on earth [10], they are considered as a pest when intensity of them cause to quantity and quality damages on crops or other different plant organs [16].
However, main part of the damage depends to human activities such as involvements in natural ecosystems. For example of these claims can refer to providing hybrid of *Lymantridispar* and silkworm in 1869 by the Dutch entomologist into Boston's lab and then entering stochastically to the natural environments [24] and transforming as one of the most important pests of forest and ornamental trees in the United States and parts of Europe and Asia [3]. Hence, that forest is a complex and dynamic ecosystem, in the ordinary state; its constituent components are in equilibrium with each other. When it is affected with one or more environment or artificial devastating factors, depending on the severity of its effect, its equilibrium or self-regulation state has been weakened or disappears [4]. Forests dynamics are affected by factors and processes such as habitat conditions, species composition, regeneration and confusion [14]. The forest pests and diseases due to disrupting the natural balance of the ecosystem are included as one of the most important of the inconsistencies.
So, its importance will be more appears with disturbance in forestry programs,and extraction of timber when the pests encompass the wide regions of forests. *Lymantridispar* and *Bradyporuslatipes* are included as a polyphage pests. Thus, they have a wide host range and are capable to feed on various herbs and sometimes different parts of a plant. *Lymantridispar* hasmore than 500 plant speciesand *Bradyporuslatipes* has over 200 species of pasture[8] as the host.
Nowadays, they include in among of the quarantined pests ofIran. *Lymantridispar* is reported at first at 1316 in the forests of Gilan province by Jalal Afshar. And now,it was emitted in overall theHirkani forests andwest and southwest forests of Iran [26] ,[9]. According to the another studies,feeding quality, natural enemies, mating, weather conditions, congestion and spread are some effective factors on survival of *Lymantridispar*.Among of these effective factors, quality and quantity of nutritional resources have the most effect [19].
Saeedi studied the effects of hosting of the five nutritional resources on *Lymantridispar* population. The results represented that number of larvae of the insect on apple host is more than other hosts. Hence, larvae are diedafter a brief feeding of the leaves of white poplar and pear trees. Therefore, this issue can demonstrates the importance of feeding quality and quantity on the survival of larvae and nymphsand population changes of *Lymantridispar*.So, it is important that *Lymantridispar* and *Bradyporuslatipes* are one of the first order pests species types. This implies thatthe pestsnot only attack to trees under stress and prone to disease, but attack to all the trees and provide conditions of infect of trees to other pests.The most damagesof *Lymantridispar* and *Bradyporuslatipes*respectively depend on larval and nymphal stage.
When the trees frequently defoliate, they become more sensitive to others pests and diseases and with expired of trees, conditions will be provided for flaming and erosion.Also, expired of trees leaves in entertain- promenade areas such as forests and parks can be contributed to reduction of tourists and costs of clean-up.However, the point that less attention to, it is that the damages of pests don't limit to the loss of leaves.But sometimes,these lead to drying the trees, costingthe replacing of trees, changing blend of forest types, habitat loss of mammals and birds.Since, irregular interventions in forest ecosystems have provided host conditions for every type of insects.Therefore, recognizing the adverse consequences such as decrease of trees growth, rising soil erosion, falling groundwater resources, rising waste of surface water are necessary in order to informing individual for degradation of the interventions.In this research, additional to investigating the host nutritional resources, the soil compaction effectswas probed as a main human factor on *Lymantridispar* and *Bradyporuslatipes* population.

MATERIALS AND METHODS

The study has carried out in May and June 2012 in the ShahidZare forest park with an area morethan 70 hectares in the south east of Sari city. The Park is located in 53° 07′ 9″ longitude, 36° 32′ 34″ latitude , 36° 32′ 57″ north and 53° 07′ 57″ east (Fig. 1).

Fig (1): Geography location of ShahidZare Forest Park of Sari in Iran.

The minimum temperature in the coldest month (January) is 1.6° C and a maximum in the warmest month (July) is 22.5° C. the annual average temperature of it is 16 degrees Celsius.The forest park has 728 millimeter average precipitation and has precipitation in all month of the year. Hence,its climate is known temperate and humid.Also, according to Embergedmethod, the climate is moisture to semi moisture and moderate (Jalililvand*et al*, 2012). The trees types in the park have been *Quercuscastaneifolia* and *ParrotiaPersica*until at 1344 year was afforested by use of *Pinuseldarica* and *Cupressussempervirens*in order to reclamation of the area and prevention of deforestation.(Fig. 4).

Fig.2. *Lymantridispar*

Fig.3. *Bradyporuslatipes*

As regards of the damages of *Lymantridispar*(Fig. 2) ,and *Bradyporuslatipes*(Fig. 3). peststhe research was carried out in order to consider the effect of host feeding and soil compaction on population of the pests with three treatments no compaction, low and severe compaction(Fig 5).and completely randomized design with four replications.with regard tothe growth form of ShahidZare forest park, five trees species of *Quercuscastaneifolia*, *Zelkovacarpinifolia*, *ParrotiaPersica*, *Cupressussempervirens* and *Pinuseldarica* was selected to investigate the effect of kind of host feeding on the larvae and nymphspopulation of *Lymantridispar* and *Bradyporuslatipes* pest.

Fig.4. Trees cover map of the area
Reference: bureau of natural resource of Mazandaran province.

Fig.5. Soil map of the area
Reference: bureau of natural resource of Mazandaran province.

Then, in each of the treatments, soil samples were provided from a depth of 0-10 centimeters to measure bulk density, soil pH, electrical conductivity and soil texture. The bulk density was measured by using clod method[12], soil PH by using water meter potential method (soil and water, 1:25) [2], soil texture by using hydrometer method (Ghazan Shahi, 2006) and electrical conductivity were measured using EC meter machine. Data analysis was carried out by using the Statistical Analysis System software (SAS) and averages comparisons were done by Duncan test.

RESULTS

The results of decomposition of variance in this study were indicated signifying the number of the pests, the bulk density, the soil PH, the percentage of sand and silt particles and non signifying the clay particles percent and the electrical conductivity between treatments (Table 1)

Table (1): variance decomposition of measured attributes.

Attributes	Variants			
	Fd	MS	CV	P
number of Lymantridispar	4	6.03	13.45	0.032 *
number of Bradyporuslatipes	4	22.6	15.8	0.001 *
bulk density	2	0.001	1.53	0.001 *
Soil PH	2	0.01	1.77	0.013 *
electrical conductivity	2	0.01	15.8	0.89 ns
Sand percent	2	44.27	15.31	0.15 ns
Silt percent	2	27.75	11	0.01 **
Clay percent	2	42.19	8.52	0.04 **

ns, * and ** respectively are non significant and significant in 5 and 1 probability level. and, Fd is degree of freedom, MS is mean of squares, CV is coefficient of variations, P is probability.

In comparison between the numbers of pests based on tree cover, both *Lymantridispar* and *Bradyporuslatipes* pests were significant. Although, the results of comparison between the numbers of pests based on soil compaction indicated only signifying the number of *Bradyporuslatipes* (Table 2).

Table (2): Compare between Lymantridispar and Bradyporuslatipes pests based on soil compaction and tree cover.

pest		Variants		
	comparison	Fd	MS	P
Lymantridispar	trees	4	0.17	0.034
	soil compaction	2	0.022	0.7
Bradyporuslatipes	trees	4	0.63	< 0.0001 **
	soil compaction	2	0.84	< 0.0001 **

ns, * and ** respectively are non significant and significant in 5 and 1 probability level. And, Fd is degree of freedom, MS is mean of squares, CV is coefficient of variations, P is probability.

Also, between non compaction treatments, moderate compaction and severe compaction weren't observed a significant difference with regard to clay particle percent. However, the three treatments were significant difference considering the sand and silt particle percent (Fig. 8).

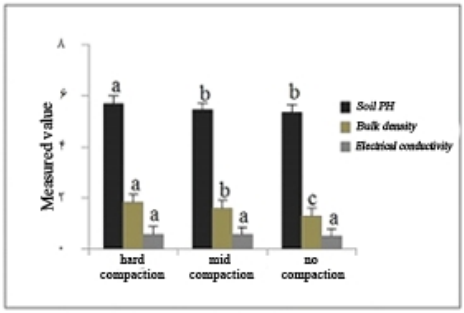

Fig. 7- Comparison of soil compaction based on soil physical characteristics

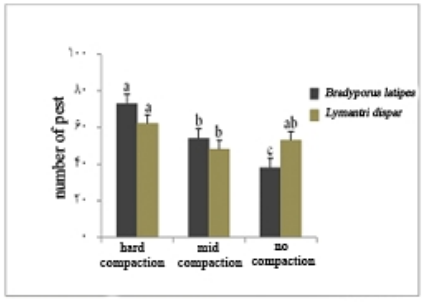

Fig. 6- Comparison of pest number based on soil compaction

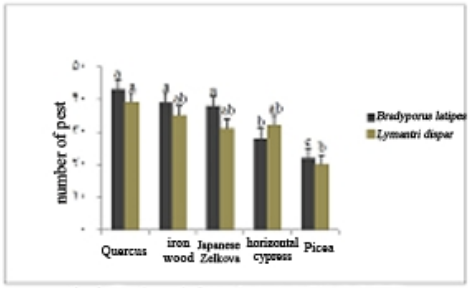

Fig. 9- Effect of food supply on population *Lymantri dispar* and *Bradyporus latipes*

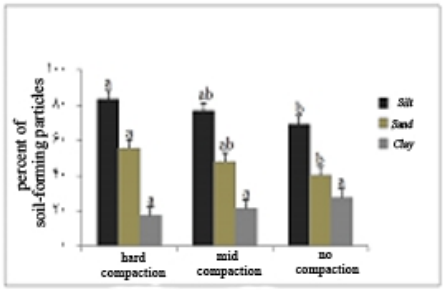

Fig. 8- Comparison of compaction effect on percent of soil-forming particles

The results showed that the number of *Bradyporuslatipes* in the considering treatments have significant difference. In the case of *Lymantridispar*, a significant difference was observed only between the two areas of severe and moderate compaction (Fig. 6).The results of investigating the effects of host nutritional resources on population larvae and nymphs were represented that *Bradyporuslatipes* will prefers respectively *Quercuscastaneifolia*, *ParrotiaPersica*, *Zelkovacarpinifolia*, *Cupressussempervirens*, *Pinus eldarica* and *Lymantridispar*will prefers respectively.*Quercuscastaneifolia*, *ParrotiaPersica*, *Cupressussempervirens*, *Zelkovacarpinifolia*, and *Pinuseldarica*based on feeding resource priority (fig. 9).

DISCUSSION

With regard to that the criterion of measurement soil compaction is bulk density, after that the physical characteristic of the soil was signified (Table 1), the number of pests in the treatmentswithvarious severity soil compaction were considered.So, the results were indicated respectively the significant of number of *Bradyporuslatipes* and non significant of number of *Lymantridispar*.One of the major reasons for this difference refersto the life cycle and spawning locations of these two pests.*Bradyporuslatipes*puts most eggs masses in the deep of soil and *Lymantridispar* is capable to put them in different places such as tree bark, splitting rocks, holes, etc.Since,the soil has lesspollution than air; it has more complications than air in terms of chemical, biological and physical characteristics[23]. Therefore, soil can be considered as a determinantfactor in the pest congestion [16].For this reason, the soil texture effects on *Bradyporuslatipes*population were studied.Although, the percent of clay particles in the three treatments was not significant,but in terms of the percent of sand and silt particlesthe significant differences were observed.The compact area than non-compact area has hadless clay particles but more sand and silt particles (Fig. 8).Thus, according to the research results can be stated that whatever the compaction of soil is more or proportion of clay to sand in the soil is less, then the bulk density increases.

Probability one of the reasons of the issue refers to the lower species diversity and soil leaching.With regard to that clay soils have more cation exchange capacity than sandy soils, thus with increasing the compaction and reducing the diversity of vegetation leaching the soil becomes greater and with increasing rainfall much of exchangeable bases (e.g Na^{+}, Ca^{++}, Mg^{++}, K^{+}) leach to lower horizons or will be out of reach. Accordingly, the soil will be more acidic (Fig. 7).The results of this research are consistent with findings of Endo [6] and kraft and Giels[20]. Also, the results confirm the issue that the damage of pest in light textured with sandy soils is more than heavy textured with clay soils [17]. Whatever, the diversity of plant species is more in the area, thus the natural enemies of pests will be more.

With regard to that the air temperature and the natural enemies are included from effective factors in hatching of grasshoppers, therefore in the soils with severe compaction more eggs become nymph because of suitable environmental conditions.With regard to that nymphs are moving toward host

nutritional resource, so their number is more in these areas (Fig. 6).In this study, the significant difference between the acidity of soil in the both non compaction and severe compaction were observed.
In the area of research, the severe compaction was more that this is consistent with the results in research of Rise *et al* (1982).However, in this factor should not be satisfied (Mohebbi, 1998).Because many factors such as rainfall, temperature, plant species, native stone may effect to soil acidification (Brady, 1974).
In the investigating types of hosting nutrition resource, the results showed the significant difference between numbers of *Bradyporuslatipes* and *Lymantridispar* in 1 and 5 percent levels (Table 2).This subject is signified of the importance of nutritional resource in feeding nymphs and larvae of the pests. Though, in compare of the number of these pests a significant difference wasn't observed in three species of *Quercuscastaneifolia*, *ParrotiaPersica* and *Zelkovacarpinifolia*. But, the results showed that the frequency of these pests on *Quercuscastaneifolia* species is more than other trees. This finding for *Lymantridispar* is consistence with the results of study of Kleiner and Montgomery [18]. *Bradyporuslatipes* pest had least frequency respectively on *Cupressussempervirens* and *Pinus eldarica* in compareof the other three species and the significant difference was observed only between *Quercuscastaneifolia*, *Cupressussempervirens* and *Pinuseldarica*.
Perhaps, one of the reasons that the number of *Lymantridispar* on *Cupressussempervirens* tree species had the most dispersal in compare of*Zelkovacarpinifolia*,refers tothe difference between Asian and European *Lymantridispar* pest because of the more ability of flight in female insect (more than 20 miles) and the ability of the larvae to grow on the trees of conifers.The results showed that the kind ofhost feeding is important in frequency of *Lymantridispar* and *Bradyporuslatipes* pests and this in case of *Lymantridispar* is consistent with research of saeedi [26] but is vary with study of Hajizadeh*et al*[9]. The difference maybe is depended on examined factors in these two studies. Because, in their research were considered the size of egg masses, percent of hatching and etc. But in present study, the number of larvae was counted. Or, it may be due to differences in height of considering the host trees (2 and 3 meters) and impact of height of hatching on trees on the viability of egg masses on trees (Campbell, 1968; [21]. However, both of the researches emphasize the quantity and quality of nutritional resource on survival of larvae and nymphs.In general, however, in this study only one of the human impacts (soil compaction) were examined, but the results indicate that human involvements in ecosystem has been influential in the spread of pests.
In the long term, these may lead to the loss of wide area of trees in these places and may impose economic costs of replacement of trees. Although, some of these costs may offset in practice, but change in forest types, loss of biodiversity, changes in species habitat, loss of natural enemies of pests and plant diseases is irrecoverable. Therefore, it is suggested that human essentially revise in activities such as spraying, over harvesting from forest resources, elimination of native species, farming in forest, mono-culturing crops that unconsciously disrupts the balance of the ecological system. Also, it should be recognized that pests and plant diseases despite very years destroy a significant proportion of crops, grassland and forest, at least part of it due to the soil environments and human involvements. However, these pests are now part of our ecosystem. Despite some studies [8] in identification of the natural enemies of Bradyporus latipes, the need for more researches on the methods of biological control and integrated pests management to be sense.

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