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Assessing the Prevalence of Wood-Boring Insects in Green Spaces of Herat City, Afghanistan

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ABSTRACT

Elevated temperatures, changes in precipitation, and extreme weather events associated with climate change can subject trees to increased stress. Stressed trees are more susceptible to pest infestations, as their weakened state makes them less able to defend against attacks. Pests of green areas are one of the most important challenges for maintaining and developing urban green areas. Among these pests, wood-boring insects, the most important pests of trees in green spaces, play an important role in causing damage and destroying green spaces. Many insects feed on different parts of the tree, such as roots and stems, causing damage and even death. This study aims to determine the prevalence of wood-boring insects in four important green areas of Herat City. In this research, trees, and shrubs in the green spaces of Bagh-e-Mellat, Takht-e-Saffar, Malekyar, and Farhang parks have been investigated and studied based on their visible signs and symptoms. The two extensive areas of Takht-e-Saffar and Bagh-e-Mellat were subdivided into 10 plots, and 5 plots were randomly selected. The trees and shrubs in the other two areas, Farhang and Malekyaar Parks underwent a comprehensive examination. Subsequently, the collected data were analyzed using the Excel program. The lowest occurrence of wood-boring insects was noted in the Farhang Park area, with 6 infested trees out of 268, while the highest prevalence was observed in Takht-e-Saffar, where 45 trees out of 400 were infested.

Keywords: Climate change, Green spaces, Herat city, Wood-boring insects

INTRODUCTION

Urban areas face formidable challenges due to the rapid pace of urbanization and the effects of climate change. The current environment is transforming partially natural or artificial land surfaces, thereby impacting energy flow, solar radiation, and atmospheric parameters (Voogt, 2003). Urban trees play a crucial role as a significant component of the green infrastructure in numerous towns and cities worldwide (Pearlmutter et al., 2017), mitigate the impact of urban flooding (Berland et al., 2017), offer recreational opportunities (Jennings et al., 2016), and are esteemed as valuable landscape features (Price, 2003). Pest organisms respond to environmental changes both directly and indirectly, through changes in forest structure and the decreased resistance of trees. Climate changes can also result in pests that currently have minor significance becoming key species, thereby causing significant damage (Lange et al., 2006). Insects and pathogens can further impact trees' ability to contribute to climate mitigation and adaptation, particularly in terms of their capacity to cool urban temperatures and assist in mitigating air pollution, preventing landslides, and mitigating flooding (Anderegg et al., 2020). The risks associated with tree insects and pathogens are expected to escalate due to international trade, human mobility, and climate change (Potter and Urquhart, 2017; Tubby and Webber, 2010). Urban areas, with transport hubs and a diverse array of potential host trees in streets, gardens, and parks, are particularly susceptible to the introduction of non-native tree insects and pathogens (Branco et al., 2019). The biosecurity threat posed by introduced tree insects and pathogens, particularly in conjunction with rising heat and drought conditions, presents an escalating challenge to modern urban tree management, especially in terms of human and financial resources (Tomlinson et al., 2015). Some of these insects cause heavy damage to urban plants. The damages caused by the activity of these insects include discoloration and deformity of leaves and stems, defoliation of part or the whole plant, severe weakening, or even death of infected plants. (Konijnendijk, 2005). In the case of large numbers of bark beetles, they can destroy large trees within a month to a year. As seen, the damage caused by these pests is significant in most parts of Afghanistan and has destroyed deciduous and evergreen trees (Habibi, 2009). The objectives of this study are to investigate the prevalence of wood-boring

insects in the green areas of Herat province and to identify the factors contributing to the prevalence of these insects in the mentioned areas.

MATERIALS AND METHODS

Study area: Herat city is situated at 34° 20' 31" N north latitude and 62° 13' 11" east longitude. Herat city with an area of 182 square kilometers is located in the west of Afghanistan, at an altitude of 964 meters above sea level. The average annual temperature is 16.2 degrees Celsius, and the average annual relative humidity is 52%. The average annual rainfall is 214 mm, which reached 267 mm, in 2009 (Omid, 2010).

At first, four green areas of Herat city including Takht-e-Saffar with an area of 840222 square meters, Bagh-e-Mellat with an area of 296,447 square meters, Malekyar Park with an area of 239,731 square meters and Farhang Parks with an area of 11,268 square meters, were selected as research areas. In this research, the prevalence of wood-boring insects has been determined based on the major signs they create (including excavating tunnels in various forms, as well as the presence of shot hole borer in tree stem). Due to the large area of Takht-e-Saffar and Bagh-e-Mellat, each area is divided into 10 plots. Out of 10 plots, five were randomly selected for study, (the number of trees per plot is 80). In two other areas (Malekyar and Farhang Parks), all the existing trees were selected. Collected data were analyzed and prepared using MS Excel v. 2016.

RESULTS

Green space of Takht-e-Saffar: To investigate the prevalence of wood-boring insects in this area, the trees were divided into 10 plots, and five plots were selected for investigation. The number of trees infected with wood-boring insects in each plot was determined, in out of 400 trees, 45 infected trees were observed (**Fig 1**).

Green space of Bagh-e-Mellat: To assess the prevalence of wood-boring insects in this area, the study site was divided into 10 plots. Out of these 10 plots, 5 plots were randomly selected. The number of trees infected with wood-boring insects in each plot was determined, in which out of 400 trees, 40 infected trees were observed (**Fig 1**).

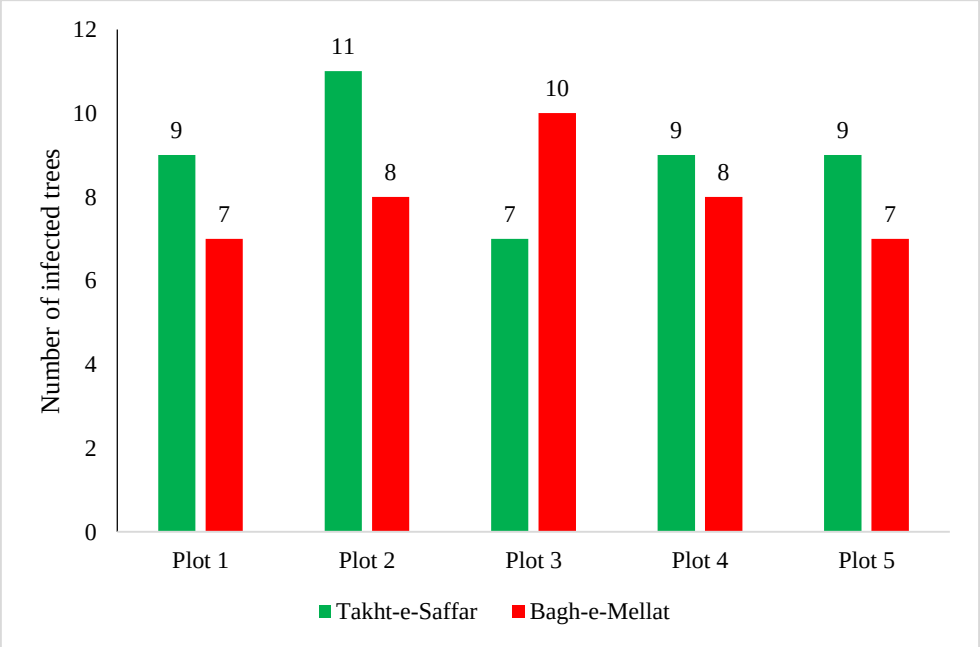

Figure 1: Number of trees infested with wood-boring insects in green space of Takht-e-Saffar and Bagh-e-Mellat.

Green space of Malekyar Park There are 961 trees and shrubs in this area. Out of these 961 trees and shrubs, 26 trees were observed infested with wood-boring insects **(Fig 2)**.

Green space of Farhang Park: Due to the small size of this area, all the trees in this space were investigated. There are 268 trees and shrubs in total. out of 268 trees and shrubs, 6 trees were observed to be infested with wood-boring insects (**Fig 3**).

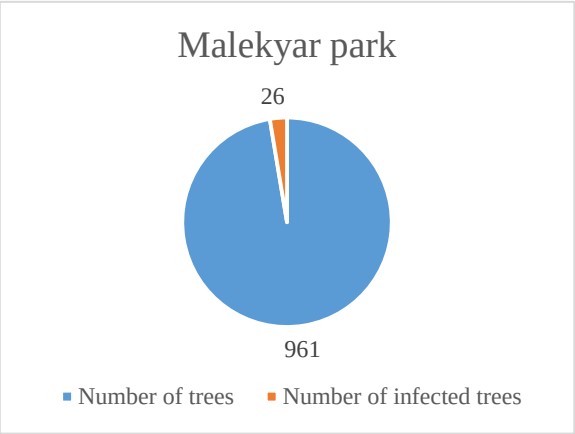

Figure 2: Number of trees infested with wood boring insects in green space of Malekyar park.

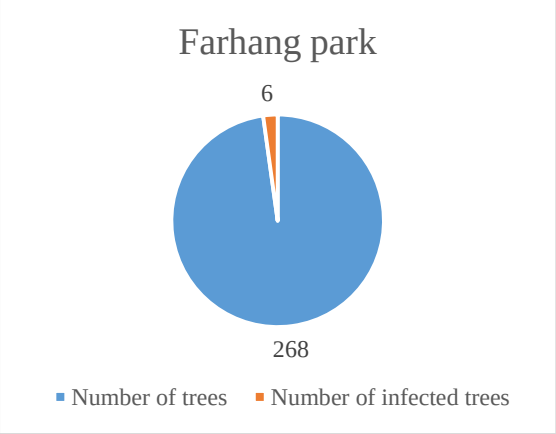

Figure 3: Number of trees infested with wood boring insects in green space of Farhang park.

Table 1: Comparison of four investigated green areas based on infected level with wood-boring insects.

Number	Green space name	Number of trees investigated	Number of infected trees	Percentage of infected trees (%)
1	Takht-e-Saffar	400	45	11.25
2	Bagh-e-Mellat	400	40	10
3	Malekyar park	961	26	2.7
4	Farhang park	268	6	2.2

It is worth mentioning that a prevalence of infestation by bark beetles belonging to the Scolytidae family has been noted in most green spaces, especially in Malekyar Park.

DISCUSSION

One of the factors contributing to the phenomenon of tree mortality is the infestation of wood-boring beetles. These living agents have been recognized as secondary factors in tree mortality in some parts of the world by invading the trees under the environmental stress conditions, such as drought (Mattson & Haack, 1978). Fan et al. (2008) stated that tree density, crown width, tree species, and the percentage of crown dryness are significantly correlated with tree mortality and infestation intensity by wood-boring beetles. In 2008, two researchers named Greenwood and Weisberg expressed in their research findings that tree density has a positive relationship with the occurrence of pests. Hosseini (2011) stated in conducted research that when trees are under stress and weakness, the prevalence of wood-boring beetles accelerates their mortality. Similar to what was mentioned, Habibi (2009) stated that wood-boring insects attack weakened trees and that the damage caused by these pests is considered significant in most parts of Afghanistan, leading to the loss of deciduous and evergreen trees.

As mentioned, investigation results indicate that most areas with infected trees to the wood-boring insects observed were due to the carelessness plan such as (inadequate nutrition, unscheduled irrigation, and un-removable severely infested trees).

CONCLUSION

In this study, the prevalence of wood-boring insects in green spaces of Herat city has been investigated based on major signs and symptoms. In Takht-e-Saffar area, a total of 400 trees were studied, among which 45 trees were found to be infected with wood-boring insects. In Bagh-e-Mellat, out of the total number of trees examined, 40 trees were observed to be infected with wood-boring pests. In the Malakyar park area, out of a

total of 961 trees, 26 trees were observed and recorded as infected, while in Farhang park, out of a total of 268 trees, 6 trees were observed as infected. Trees in Farhang park have least percentage of infection with wood-boring insects. Serious attention to timely nutrition and irrigation of trees, along with timely pruning operations, can be among the major reasons for the lowest infection of wood-boring insects in this area. On the other hand, Takht-e-Saffar Park area, due to the negligence in timely nutrition and irrigation of trees, as well as the removal of severely infested trees, has the highest percentage of infestation with wood-boring pests, considering the number of planted trees.

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