Uttar Pradesh Journal of Zoology

Volume 44, Issue 19, Page 92-97, 2023; Article no.UPJOZ.2778
ISSN: 0256-971X (P)

Studies on New Emerging Insect-Pest, Burr – Knot Borer of Apple (*Malus domestica* Borkh) Under High Density Apple Plantation

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

Article Information

DOI: 10.56557/UPJOZ/2023/v44i193622

Editor(s):
(1) Prof. Juan Carlos Troiano, University of Buenos Aires, Argentina.
Reviewers:
(1) Kauresh D. Vachhrajani, The Maharaja Sayajirao University of Baroda, India.
(2) R. Valliappan, Annamalai University, India.

Original Research Article

Received: 14/06/2023
Accepted: 20/08/2023
Published: 02/09/2023

ABSTRACT

Shimla district of Himachal Pradesh is an apple growing regions that always experiences attack of many insect pests which alter the quality and production of apples. The attack of these insect-pests generally recorded maximum in the apples grown under high density plantation in district Shimla. This study mainly reports on the relative abundance of burr knot borers under high density apple growing regions for two consecutive years (2021-2022). This survey was conducted from March to December during 2021-2022. During the study period emergence of burr-knot borers started in March coexisting with the pink bud stage of the apple. The mean per cent density i.e., 60.0% and relative density i.e., 10.5% in burr-knot borers were recorded maximum during the year 2021. Highest diversity was recorded during the period of August i.e., 0.85 and 0.84 during 2021 and 2022, respectively.

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Keywords: Relative abundance; apple; burr-knot borers; mean percent density; high density plantation; insect-pests.

1. INTRODUCTION

Apple (*Malus domestica* Borkh) is one of the most predominately cultivated fruit crops of northwestern Himalayan region in India. In India, apple is cultivated in three hilly states i.e., Jammu and Kashmir, Himachal Pradesh and Uttarakhand. After Jammu and Kashmir, Himachal Pradesh stands second in apple production in India. In Himachal Pradesh, apple is produced in the high altitude of all districts except Una. Shimla district has highest contribution i.e., around 60 percent in apple production. Apples are cultivated in the upper regions of Shimla district mainly in Kotkhai, Jubal and Rohru. Especially, it covers 48.48% of total area under fruit crop and 89.14% of total fruit production in Himachal Pradesh [1]. It is reported that the area under apple production was raised from 400 hectares in 1950-51 to 106.23 thousand hectares on 2012-13 [2]. With advancement, the apple producers are adopting high density apple plantation because of its advantages i.e., good quality and productivity, precocious bearing, minimum labour intensive thus higher yield.

Like all other crops, biotic and abiotic factors affect apple plantation. Among, the biotic factors, insect pests and pathogens are well recognized to alter the quality and productivity of apple. Some of these insect pests cause very serious damage to apple crop and they need proper attention to control under high density apple ecosystem. According to Bharadwaj and Bharadwaj [3], insect pests like San Jose scale, European red mite, Thrips and Woolly apple aphids are major pests causing damage to apple trees. Along with these insect pests, weevils are also reported in damaging the apple crops. Heavy weevil infestation causes injurious effects on apple trees. These apple weevils sometime enter through the burr-knots produced on the trunk of the trees, feed on the tissue and lay eggs inside these burr knots. Hence, in the view of that the present study has been conducted for the quantitative estimation of burr-knot borers of apple under high density apple plantation.

2. MATERIALS AND METHODS

To obtain data, regular field visits were made under high density plantation apple ecosystem at farmers' field at Basantpur village Drahan (1498 m above mean sea level) at Shimla district during year 2021-2022 and farmers' field. Different methods were applied to study the entomofauna in the proposed agroecosystem. These methods were: the direct observation on plants, use of magnifying lenses, yellow traps, collection of insects and attacked parts of the plants and proper photography. Different apple varieties planted under HDP apple ecosystem were Red Velox and Auvil Early Fuji, Gale Gala and Super Chief with Redlum Gala as polinisers. The data on insect-pests were collected at weekly basis by visual counts during March 2021 to December 2022. During the survey period no chemical insecticides were applied on the plants. The intensity of insect-pests was calculated by number of insect pests attacking the plants' parts which were randomly selected from the experimental blocks from the different stratum of apple trees. Species diversity, abundance and species richness indices were computed with Simpson diversity index, mean and relative density. Simpson's Diversity Index is a diversity measure on account the number of species present and also find out the relative abundance of each species.

$$D = \frac{\Sigma n(n-1)}{N(N-1)}$$

Where,

D = Simpson's Diversity Index; n = total number of insect pest of particular species; N= total number of insect pest.

The value of *D* ranges between 0 and 1. With this index, 1 represents infinite diversity and 0 no diversity.

3. RESULTS AND DISCUSSION

Diversity and Abundance of Burr-Knot Borers in HDP: Burr-knot borers are reported to cause harm to the apple crops grown under high density plantation (Fig. 1).

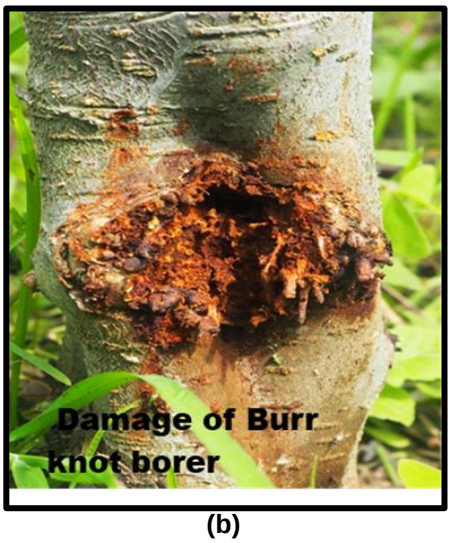
One apple burr-knot borer species reported to cause damage mainly belongs to the genus *Otiorhynchus* Germer, [4] of family curculionidae of order Coleoptera (Figs. 2,3). Backhaus [5] reported many species of family Curculionidae to be the pests on many horticultural crops. This *Otiorhynchus* species mainly cause damage to the burr-knots produced from apple trees on the above ground parts i.e., on the trunk (Fig. 4a, 4b). The overall insect-pest density was recorded higher in the cultivar Red Velox.

Fig. 1. High density apple plantation field

Fig. 2. Adult weevil: Dorsal view

Fig. 3. Adult weevil: Ventral view

(a)



(b)

Fig. 4a, b. Damage caused to apple burr-knots

The emergence of burr-knot borers started from the month of March coexisting with the pink bud stage of the apple. The insect-pests intensity and damage caused to apple burr-knots by were medium to low (Table 1). Kumari et al. [6] also reported harm caused by burr-knot borers to apple plants planted under high density apple plantation at Shimla district of Himachal Pradesh. Oatman et al. [7] reported 763 species of arthropods insect-pests using apple plants as one of their most suitable host plants. Different parts of apple plant i.e., leaves, stem, flowers etc. gives multiple acceptable environments for the growth of many arthropod insect-pests.

The peak abundance of apple burr-knot borers i.e., *Otiorhynchus sp.* was recorded during the month of August and September (Table 2) during 2021 and 2022 under high density apple plantation in Shimla district.

Westwood [8] also reported the damage to Sedmus and other plants cultivated in greenhouses in England. Smith [9] recorded 77 plant species as tolerable hosts in Pennsylvania and Masaki et al. [10] recently recorded 101 plant species belonging to 46 families as possible hosts in Japan. The highest mean per cent density (60.0%) and the relative density (10.5%) in burr-knot borers were reported during the year 2021 and the lowest per cent mean density i.e., 59.0% and relative density i.e., 8.5% were recorded during the year 2022 (Table 3). The insect-pests multiplex is checked as a whole, there is also another species of unrelated taxa that have same feeding habits.

Riedl et al. [11], Bergh and Leskey [12] reports apple burr-knots to be an attractive oviposition site for female *Synanthedon scitula* (dogwood borer). Weires [13] noticed that their infestation and larval feeding is in same manner and larval feeding for entire season can lead to the consumption of burr-knot tissue and cause tree death from girdling. Dickler [14] also records infestation by congeneric species *Synanthedon myopaeformis* on the burr-knots of Idared trees, which over a duration of 2 years caused 22.1% fall in yield in Europe.

Relative Abundance of Burr-knot Borers in Study Area: The diversity of insect-pests under high density apple plantation were measured by Simpson's Diversity Index which can be calculated by the number of species present and the relative abundance of each species present and the diversity index for burr-knot borers was recorded less than 1 during both the years in the study area. Highest diversity was recorded during period of August i.e., 0.85 and 0.84 during 2021 and 2022, respectively (Table 4), where, high scores i.e., close to 1 indicate high diversity. Moorhouse et al. [15] in their study reported this *Otiorhynchus* species as foremost apple pest worldwide.

Table 1. Nature of damage of burr-knot borers under high density apple plantation

Year	Month	Nature of damage	Level of damage
2021	April	Burr – knots	Low
	May	Burr – knots	Low
	June	Burr – knots	Low
	July	Burr – knots	Low
	August	Burr – knots	Medium
	September	Burr – knots	Medium
	October	Burr – knots	Medium
	November	Burr – knots	Low
	December	Burr – knots	Low
2022	April	Burr – knots	Low
	May	Burr – knots	Low
	June	Burr – knots	Low
	July	Burr – knots	Low
	August	Burr – knots	Medium
	September	Burr – knots	Medium
	October	Burr – knots	Medium
	November	Burr – knots	Low
	December	Burr – knots	Low

Table 2. Population dynamics of burr – knot borers in high density apple plantation during 2021 and 2022 showing mean number of burr-knot borers/plant per month

Month	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	SD	SEM
2021	0.0	0.0	1.5	2.5	2.5	3.0	2.75	1.0	0.0	1.14	0.40
2022	0.0	0.0	1.5	2.0	3.5	3.75	2.5	0.5	0.0	1.75	0.60

SD = Standard deviation; SEM = Standard error of mean

Table 3. Relative density of burr-knot borers in high density apple plantation during 2021 and 2022

Species	Mean density (%)	Relative density (%)
Burr-knot borers (2021)	60.0	10.5
Burr-knot borers (2022)	59.0	8.5

Table 4. Diversity indices of burr – knot borers in high density apple plantation during 2021 and 2022

Year	Aug.	Sept.	Oct.
2021	0.85	0.83	0.75
2022	0.84	0.81	0.78

Riley [16] was the first to mention the deleterious effects of *Otiorhynchus* species in North America.

4. CONCLUSION

The present study has been done on the new emerging weevil pest (burr-knot borer) of apple (*Mallus domestica* Borkh) grown under high density apple plantation during year 2021 and 2022 respectively in apple growing areas of Shimla district of Himachal Pradesh**.** These insect-pests mainly reported to cause harm to the burr-knots produced on the stem of apple trees. The identified insect-pest belonged to the genus *Otiorhynchus* Germer, [4] of family Curculionidae Latreille, [17]. The study mainly reports on the relative abundance of burr-knot borers (apple weevil pest) under high density apple growing regions for two consecutive years (2021-2022). The emergence of burr-knot borers started in March coexisting with the pink bud stage of apple. The population dynamic of this insect-pest was recorded maximum during August and September.

ACKNOWLEDGEMETS

The research work could not have completed without the guidance of my honourable and illustrious supervisor Dr. Neelam Kumari (Assistant Professor, Department of Biosciences, H.P. University, Shimla) who gave me her indispensable time in guiding the present work by way of giving suggestions, constructive criticism and much needed encouragement. I would also like to acknowledge my sincere gratitude to the chairperson, faculty members and laboratory staff of Department of Biosciences, Himachal Pradesh University Shimla for providing me necessary research facilities and their precious advices during this research work. I would also express special thanks to the owner of the apple orchards for giving permission to carry out field work and local peoples for their help during the field study.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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