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Diversity of insects in insecticide treated sweet corn ecosystem

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Abstract

Maize (*Zea mays* L.) is an annual cereal crop grown for supplementation of diet for human. Cultivation of sweet corn in Bangladesh is increasing with different hybrid varieties, and the crops are infested by fall armyworm. Farmers apply different insecticides to overcome the attack of fall armyworm without considering the impact of the insecticides on the diversity of pest and beneficial insect species. This study was undertaken from November 2023 to April 2024 to evaluate the effectiveness of eight different insecticides for managing fall armyworm in a sweet corn variety BU sweet corn 1 field, and investigated the biodiversity of the insects species in the sweet corn ecosystem. A total of 19 insect species were identified belonging to 17 families of 7 orders. The highest percentage was observed in minor pest (41%) followed by major pest (31%) and lowest was the beneficial insects (11%). In case of taxonomic orders, the highest abundance (24.3±3.3), richness (3.9±0.0), dominance (1.0±0.0) and diversity (0.7±0.0) were observed in Lepidoptera, Hemiptera, Ephemeroptera and Lepidoptera, Diptera order respectively. Vayego 20SC+Bio-chamak 1% E.W. yielded the highest beneficiary insect abundance (11.0±0.6), while control had the most minor insects (42.7±1.2) but Nitro 505EC alone attracted the highest casual insect count (16.3±0.9).

Keywords: *Spodoptera frugiperda*, sweet corn, beneficiary insects, taxonomic orders, abundance

Introduction

Corn, (*Zea mays* L.), cereal plant of the grass family (Poaceae) and its edible grain. Corn is used as livestock feed, as human food, as biofuel, and as raw material in industry. It is a third leading crop of the world after rice and wheat (Sandhu *et al.* 2007). It is known globally as queen of cereals. The center of origin for maize is the Mesoamerican region (Mexico and Central America) from where it spread rapidly (De Vries 2000). Invasive fall armyworm (*Spodoptera frugiperda*) is a polyphagous crop pest native to America and later reported in West Africa in 2016. In Bangladesh, the cultivation area, per hectare yield and total production of Rabi maize, in the fiscal year 2022-2023 was around 496549.3 ha, 10.1 ton and 4563 thousand MT (BBS 2023). The yield potentiality of maize in Bangladesh is low compared to other countries. This may be due to several abiotic and biotic constraints. Among the biotic factors, different insect pests cause serious damage to maize crops every year in Bangladesh resulting huge yield loss (Sarker and Dutta 2022).

In Bangladesh, approximately 30-35% of maize fields were affected by fall armyworm, leading to a 5% cob infestation in 2019 (CIMMYT 2020). Globally, the socioeconomic impact of fall armyworm is substantial, with crop losses ranging from 70% to 100% (Kirprop 2017, Shylesha *et al.* 2018). Prodhan *et al.* (2020) listed 12 species of insect pests including invasive fall armyworm (FAW) to be injurious to maize crop in Bangladesh. FAW has a wide host range of more than 353 recorded plants from 76 families, principally Poaceae (106), Asteraceae (31) and Fabaceae (31) (Wan *et al.* 2021). Among them, it has strong preference for maize, rice, sorghum, cotton, pasture grasses and sugarcane, which are all major cultivated crops in America, Africa and Asia (Montezano *et al.,* 2018). Therefore, this study was conducted to identify the insect species present in sweet corn fields treated with various insecticides and to assess their abundance, along with analyzing the diversity indices of these insect populations.

Materials and methods

The research was carried out between July 2023 and June 2024 in both the laboratory and field of the Department

of Entomology at Bangabandhu Sheikh Mujibur Rahman Agricultural University (BSMRAU) in Gazipur, Bangladesh. The study location is situated at 25°25′ North latitude and 89°05′ East longitude, in the heart of Bangladesh. Amin *et al*. (2015) reported that the average highest and lowest temperatures throughout the year are 36 and 12.7°C, respectively. The relative humidity is 65.8%, and the annual rainfall is 237.6 cm.

Experimental materials and design: The maize variety BU Misti Vutta 1 were cultivated in the experimental plots from November 2023 to March 2024. The experiment was conducted following randomized complete block design following three replications. The size of the experimental plots was of 4.0 m × 4.0 m. Plot to plot and block to block distance was 1 m.

Land preparation: Weeds and stubbles were removed from the land. The land was ploughed 3 times followed by laddering. The experimental plots were divided according to the experimental design. The land was divided into a total of 27 different plots for eight insecticidal treatments and one control.

Cultivation of maize: The maize seeds were sown in different plots. Intercultural operations such as irrigation, weeding, thinning etc. were done whenever necessary in the experimental field. The plants were regularly watered, especially during tasseling and cob formation stage. Fertilizers were applied according to the Fertilizer Recommendation Guide (Guide 2018).

Spraying of insecticides: There were four insecticides and out of which 8 treatments were prepared along with a control.

Observation of abundance of different insects and calculation of biodiversity indices: Following the emergence of seedlings, a weekly field survey was conducted. Visual observation as well as sweeping net was used to collect and identify different species of insect and counted every day. To asses the diversity and richness of insects, indices life Shanon-Weaver and Margalef Were applied following Amin (2023).

Statistical analysis: The statistical software package IBM SPSS 22.0 was used for data analysis. A one-way analysis of variance (ANOVA) was conducted, followed by a Tukey HSD post hoc test at a significance level of 5%.

Results and discussion

The table 1 provides details on trade names, active ingredients, modes of action, recommended doses, and toxicity categories for each insecticide.

In total of 1 species belonging to 1 family in 1 order (Lepidoptera) and 7 species belonging to 6 families of 4 orders (Lepidoptera, Coleoptera, Thysanoptera, Hemiptera) were found as major and minor pests respectively (Table 2).

In total of 6 species belonging to 6 families under 4 orders (Coleoptera, Hemiptera and Hymenoptera, Diptera) were found as beneficiary insects (Table 3).

In total of 5 species belonging to 5 families of 3 orders (Diptera, Hymenoptera, Ephemeroptera) were found as casual visitors (Table 4).

Table 1. Basic information of the studied insecticides

Trade name	Active ingredient	Mode of action	Recommended dose(ppm)	Toxicity category
Bio-chamak 1% E.W.	Celastrus angulatus	Contact and stomach action	2500	Class IV (Practically Non-Toxic)
Nitro 505EC	Chlorpyrifos + Cypermethrin	Contact, stomach and respiratory action	1000	Class II (Highly toxic)
Vayego 20SC	Tetraniliprole	Systemic and translaminar	400	Class II (Highly toxic)
Transform 24SC	Sulfoximine	Systemic, contact and translaminar	750	Class II (Highly toxic)

Table 2. List of the major and minor pests prevailed in sweet corn ecosystem treated with different insecticides

Pest		Taxonomic position
Major	Minor	
Fall army worm	-	*Spodoptera frugiperda* (Lepidoptera: Noctuidae)
	Stem borer	*Busseola fusca* (Lepidoptera: Noctuidae)
	Cut worm	*Agrotis ipsilon* (Lepidoptera: Noctuidae)
	Cob borer	*Stenachroia elongella* (Lepidoptera: Pyralidae)
	Aphid	*Rhodalosiphum maidis* (Hemiptera: Aphididae)
	Thrips	*Caliothrips phaseoli* (Thysanoptera: Thripidae)
	Brown stink bug	*Halyomorpha halys* (Hemiptera: Pentatomidae)
	Corn flea beetle	*Chaetonema pulicaria* (Coleoptera: Chrysomelidae)

Table 3. List of the predator insects prevailed in sweet corn ecosystem treated with different insecticides

Beneficial insects	Taxonomic position
Lady bird beetle	*Coccinela semptempunctata* (Coleoptera: Coccinellidae)
Minute pirate bug	*Orius insidiosus* (Hemiptera: Anthocoridae)
Damsel bug	*Nabis capsiformis* (Hemiptera: Nabidae)
Braconid wasp	*Aphidius colemani* (Hymenoptera: Crabronidae)
Minute wasp	*Trichogramma* spp. (Hymenoptera: Trichogrammatidae)
Robber fly	*Efferia aestuans* (Diptera: Asilidae)

Table 4. List of the pollinator insects prevailed in sweet corn ecosystem treated with different insecticides

Casual visitor	Taxonomic position
Horse fly	*Tabanus bovines* (Diptera: Tabanidae)
Blow fly	*Calliphora* spp. (Diptera: Calliphoridae)
House fly	*Musca domestica* (Diptera: Muscidae)
Ant	*Lasius niger* (Hymenoptera: Formicidae)
May fly	*Ephemera invaria* (Ephemeroptera: Ephemaridae)

A total of 19 species of insects were identified in the present study of which 1 species of insect was as major pest, 7 species as minor pest, 6 species as predator, and 5 species as casual visitors. The highest percentage was observed in minor pest (41%) followed by major pest (31%), casual visitors (17%) and lowest was the beneficiary insect (11%) (Figure 1).

A total of 19 insect species were identified belonging to 17 families of 7 orders. The percentage of insects in different taxonomic orders varied from 2 to 32%. Among the taxonomic orders, Lepidoptera was the most dominant order followed by Hemiptera, Diptera, Thysanoptera and Coleoptera. Other orders namely Hymenoptera and Ephemeroptera showed insignificant abundance (Figure 2).

The abundance, richness, dominance and diversity of different orders showed significant variation ($F_{6,14}$=24.2, $p \leq 0.001$, $F_{6,14}$=67.4, $p \leq 0.01$, $F_{6,14}$=66.7, $p \leq 0.001$ and $F_{6,14}$=569.7, $p \leq 0.001$ respectively) which ranged from 1.4±0.6 to 24.3±3.3, 0.0±0.0 to 3.9±0.0, 0.3±0.0 to 1.0±0.0 and 0.0±0.0 to 0.7±0.0 respectively. Highest abundance, richness, dominance and diversity was observed in Lepidoptera, Hemiptera, Ephemeroptera and Lepidoptera, Diptera order respectively (Table 5).

Significant variation was observed in the abundance of beneficiary ($F_{8,18}$=15.7, ≤0.001), minor ($F_{8,18}$=5.7, ≤0.001) and casual insects ($F_{8,18}$=6.7, ≤0.001) treated with different insecticides (Table 6). The highest abundance of predators was observed in Vayego 20SC+Bio-chamak 1% E.W. (11.0±0.6), followed closely by Nitro 505EC

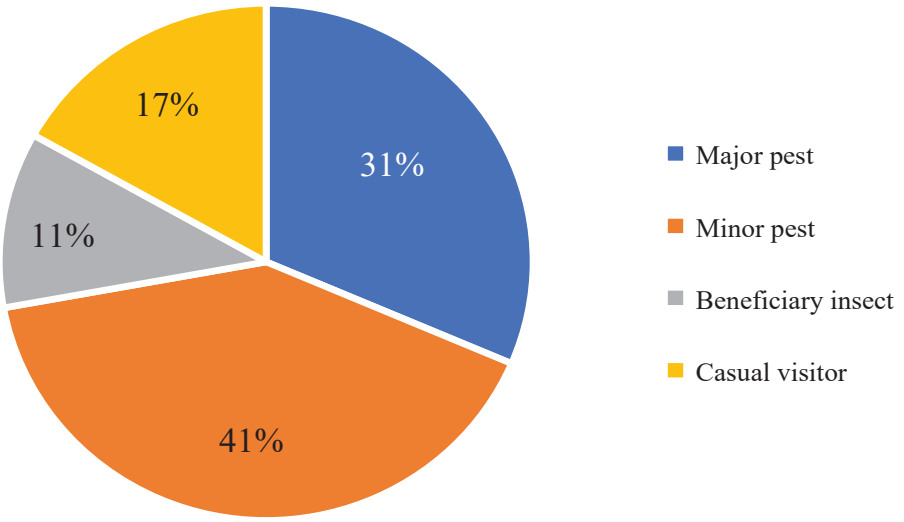


Figure 1. Percent Abundance of different categories of insect found in sweet corn ecosystem.

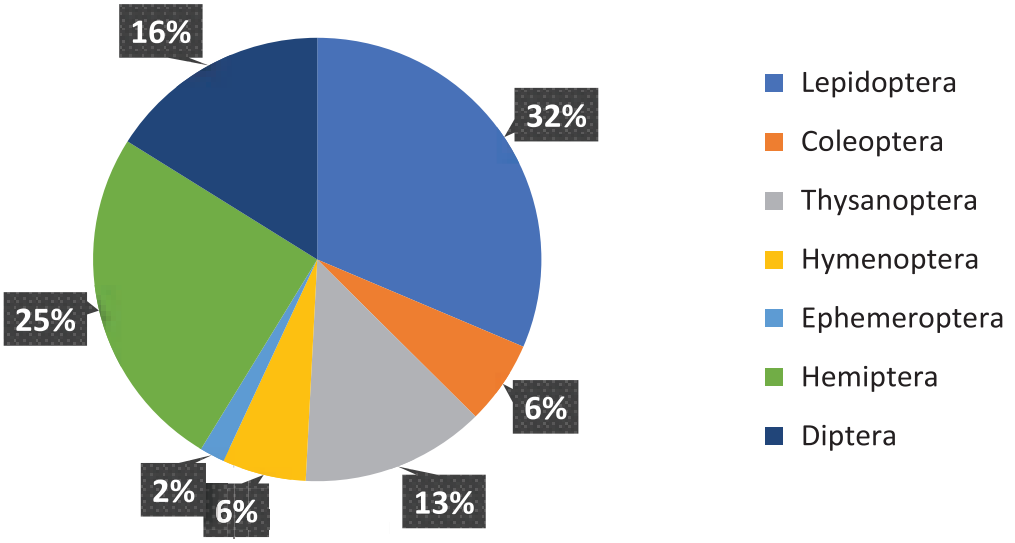


Figure 2. Abundance of insects belonging to different taxonomic orders found in sweet corn ecosystem.

(10.7±0.9). The control group had the lowest beneficiary insect abundance (2.7±0.7). The control group had the highest count of minor insects (42.7±1.2), highlighting the effectiveness of treatments in reducing their abundance. Casual insects were highest in Nitro 505EC (16.0±1.2), with other treatments like Bio-chamak 1% E.W. showing reduced counts, reflecting the treatments' varied effects on insect categories.

Conclusion

From the present study, it can be concluded that total 19 insect species across 17 families and 7 orders were prevailed in the sweet corn field where 1 species was a major pest, 7 were minor pests, 6 were predators, and 5 were casual visitors. Minor pests made up the highest proportion and the highest abundance were observed in the order Lepidoptera (24.3±3.3). The study highlighted the abundance and diversity analysis of insects found in the sweet corn field.

Table 5. Diversity indices of insects of different orders observed in sweet corn ecosystem

Orders	Abundance	Richness	Dominance	Diversity
Lepidoptera	24.3±3.3a	0.0±0.0c	1.0±0.0a	0.0±0.0d
Coleoptera	4.7±0.3cd	1.5±0.1b	0.6±0.4b	0.3±0.0c
Thysanoptera	10.3±2.3c	0.0±0.0c	1.0±0.0a	0.0±0.0d
Hymenotera	4.7±1.0cd	3.3±0.6a	0.5±0.1b	0.4±0.0b
Ephemeroptera	1.4±0.6d	0.0±0.0c	1.0±0.0a	0.0±0.0d
Hemiptera	19.5±0.5ab	3.9±0.0a	0.5±0.0b	0.6±0.0a
Diptera	12.4±1.6bc	3.7±0.2a	0.3±0.0c	0.7±0.0a

Data expressed as mean ± SE (standard error), DF=Degree of freedom, F statistic= Critical values of the F distribution, P value = Significance.

Table 6. Effect of different insecticides on the abundance of various categories of found in sweet corn ecosystem insects

Treatment	Beneficial insects	Pest insects	Casual visitor insects
Vayego 20SC+Nitro 505EC	9.0±0.6ab	36.7±6.2ab	13.7±0.7ac
Vayego 20SC+Transform 24SC	7.7±0.3b	26.7±2.2bc	11.7±0.3c
Vayego 20SC+Bio-chamak 1% E.W.	11.0±0.6a	35.0±2.6ac	10.3±0.9c
Nitro 505EC	10.7±0.9ab	36.7±2.7ab	16.3±0.9a
Transform 24SC	9.0±0.6ab	28.0±1.7ac	13.0±0.6ac
Bio-chamak 1% E.W.	9.0±0.6ab	32.3±0.3ac	11.3±0.7c
Vayego 20SC+Nitro 505EC+Bio-chamak 1% E.W.	9.7±0.7ab	21.3±3.8c	12.3±0.9bc
Vayego 20SC+Transform 24SC+Bio-chamak 1% E.W.	8.0±0.6ab	23.0±1.5bc	11.7±0.9c
Control	2.7±0.7c	42.7±1.2a	16.0±1.2ab

Data expressed as mean± S.E. Means within a column followed by no common letter(s) are significantly different by Tukey post hoc statistic at $P \leq 0.001$.

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References

Amin MR. 2023. Agricultural Entomology. Sowrov Media Products, Dhaka, Bangladesh. Pp. 33-60.

Amin MR, Namni S, Miah MRU, Miah MG, Zakaria M, Suh SJ and Kwon YJ. 2015. Insect inventories in a mango-based agroforestry area in Bangladesh: foraging behavior and performance of pollinators on fruit set. Entomological Research. 45: 217-224.

BBS Bangladesh Bureau of Statistics. 2023. Yearbook of Agricultural Statistics. Statistics and Informatics Division, Ministry of Planning, Bangladesh Secretariat, Dhaka. P. 41.

CIMMYT. 2020. New project strengthens capacity to fight fall armyworm in Bangladesh. https://www.cimmyt.org/news/new-project-strengthens-capacity-to-fight-fall-armyworm-in-bangladesh/.

De Vries GE. 2000. Crop gene diversity declining. Trends in Plant Science. 5: 8.

Guide FFR. 2018. Bangladesh Agricultural Research Council (BARC): Dhaka.

Kirprop V. 2017. Fall armyworm to cost more than $2bn in losses. https://www.theeastafrican.co.ke/tea/business-tech/fall-armyworm-to-cost-more-than-2bn-in-losses--1373894.

Montezano DG, Sosa-Gómez DR, Specht A, Roque-Specht, VF, Sousa-Silva JC, Paula-Moraes SD and Hunt TE. 2018. Host plants of *Spodoptera frugiperda* (Lepidoptera: Noctuidae) in the America. African Entomology. 26: 286-300.

Prodhan MZH, Sarker D, Dutta NK, Sarkar MA and Begum K. 2020. Insect pests of maize crop and their integrated management (in Bangla). Entomology Division, Bangladesh Agricultural Research Institute, Gazipur. P. 13.

Sandhu KS, Singh N and Malhi NS. 2007. Some properties of corn grains and their flours I: Physicochemical, functional and chapati-making properties of flours. Food Chemistry. 101: 938-946.

Sarker D and Dutta NK. 2022. Fall Armyworm-Status, Challenges and Experiences in Bangladesh. Fall Armyworm (FAW) Spodoptera frugiperda (JE Smith)-the status, challenges and experiences among the SAARC Member States. SAARC Agriculture Centre, SAARC, Dhaka, Bangladesh. 130*:* P. 11.

Shylesha AN, Jalali SK, Gupta A, Varshney R, Venkatesan T, Shetty P and Raghavendra A. 2018. Studies on new invasive pest Spodoptera frugiperda (JE Smith) (Lepidoptera: Noctuidae) and its natural enemies. Journal of Biological control. 32: 1-7.

Wan J, Huang C, Chang-you LI, Hong-xu Z, Yong-lin REN, Zai-yuan LI and Wan F. 2021. Biology, invasion and management of the agricultural invader: Fall armyworm, *Spodoptera frugiperda* (Lepidoptera: Noctuidae). Journal of Integrative Agriculture. 20: 646-663.