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Research Article

An Assessment of Coleoptera Diversity in Agriculture Landscapes of Sialkot District, Pakistan

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Abstract

Agriculture is the primary source of income in Pakistan, underpinning the national economy. Insect biodiversity, specifically Coleoptera (beetles), provides critical ecosystem services within agroecosystem, including pollination, decomposition, nutrient cycling, biological control, seed dispersal and serving as predator. This study assessed Coleoptera diversity across major cropping systems in Sialkot District, Punjab, Pakistan. Over a sampling period from March- June 2023, total 1437 specimens of 29 species belonging to eight different families were collected from four crop types including wheat, mixed fodder crops, sunflower, and vegetables. Coccinellidae with 507 specimens of (*Coccinella septempunctata*) and Chrysomelidae with 124 specimens of (*Altica cyanea)* were recorded as most prevalent families and species. There was less significant difference among data of different tehsils of Sialkot district. Beetles' abundance varied significantly in different months, maximum in the month of May (40.5%). Canonical Corresponding Analysis (CCA) determines the impact of different environmental factors on presence of different species. The prominent species of Coleopteran are predator in nature, having capacity to control different pest species by acting as biological control agents. These findings will be helpful for their conservation in future for productive and functional agro-ecosystem and its sustainability.

Keywords: Coleoptera, diversity, agriculture, sialkot, *Coccinella septempunctata*

1. Introduction

Biodiversity, defined as the variability among living organisms from all sources, is essential for sustaining ecosystem services and overall ecological integrity [1,2]. Among various biological components, insect diversity plays a pivotal role in maintaining ecological balance and supporting functions such as pollination, organic pest control, nutrient cycling, biomass production, and carbon sequestration [1, 3, 4]. Insects form the foundation of many terrestrial food webs, acting both as prey and predator, and contribute significantly to the stability of ecosystems [5].

Among insect orders, Coleoptera—its members commonly known as beetles—represent the most diverse and species-rich group within the class Insecta, comprising approximately 40% of all known insect species [6]. The name "Coleoptera" originates from the Greek words koleos (sheath) and pteron (wing), referring to their characteristic hardened forewings (elytra) that protect the delicate hindwings beneath [7]. This order is classified into four suborders—Archostemata, Adephaga, Myxophaga, and Polyphaga—with Polyphaga representing nearly 90% of all beetle species [6].

Beetles inhabit almost every terrestrial ecosystem and occupy diverse ecological niches—ranging from decomposers and pollinators to predators and herbivores [8]. In tropical agroecosystems, beetles are recognized as the second most frequent floral visitors and the fourth most important pollinators, significantly contributing to plant reproduction and agricultural productivity [9, 10]. In addition, several beetle families, such as Coccinellidae (ladybird beetles), are beneficial

predators of agricultural pests like aphids, mealybugs, and scale insects [11, 12]. However, some Coleopteran species, particularly in their larval stages, may act as pests by damaging roots, stems, or stored products, thereby negatively affecting crop health and yield.

Despite their ecological and agricultural importance, the diversity and distribution of Coleopteran is not more specifically documented from district Sialkot, Only the record of dung beetles belonging to *Scarabaeidae* family and Ground beetles (*Carabidae*) was recorded in crop system of Sialkot [29, 30]. Agricultural intensification, habitat loss, and use of pesticides directly affect the abundance and composition of beetle communities, potentially reducing their beneficial services [31]. However, baseline data on Coleopteran diversity in agricultural landscapes of Sialkot is scarce, limiting our ability to implement effective conservation and integrated pest management strategies. While previous studies in Pakistan have focused on insect diversity in general, few have specifically addressed species richness, evenness, and diversity indices of Coleoptera in agricultural settings. There is a lack of localized assessments that can inform the association of different Coleopteran species with different crops as a habitat sustainable farming practices by identifying beneficial versus harmful beetle species within crop ecosystems.

This study aims to assess the diversity and community structure of Coleopteran insects in agricultural ecosystems of the Sialkot district. The main objectives as to estimate the diversity of Coleopterans species, their species richness, evenness in various agricultural fields, along with impact of environmental factors on their diversity. Association of species with different crops based on plant insect interaction. Most of the Coleopterans are natural predator, by studying their interaction with other prey species ultimately lead towards biological control of crop pests. Conservation of natural predators and Integrated Pest Management in agroecosystem.

2. Materials and methods

2.1. Study area

Sialkot is one of the major districts of province Punjab, Pakistan, which is located at 32.3811° N, 74.4995° E [13]. It is 256 meters above sea level and occupies 1200 square miles [14]. The winters of Sialkot are bitterly cold, while the summers are hot and muggy. Sialkot is in Pakistan's sub-humid, warm, and sub-tropical monsoon zone. The district receives almost 1000 mm of rainfall on average, with July through September seeing the maximum rainfall [15]. During the present study Coleopteran fauna was sampled from all four tehsils viz, Sialkot, Sambrial, Daska and Pasrur (Figure 1). Two croplands as sampling sites were selected on a random basis. Coleopteran fauna was collected from wheat, fodder, sunflower and vegetable fields fortnightly for a period of four months from March 2023 to June 2023.

2.2. Collection method

Beetles from the order Coleopteran were collected using various methods such as forceps, sweep nets, and hand picking [12]. Sweep net is made up of nylon mesh and metal handle [16]. A sweep net with a diameter of 32 cm and a length of 70 cm was used, employing a figure-of-eight pattern to measure from the margins towards the center of the one-acre field during sweeping. In the fields a total of 50 sweeps were applied, with 20 sweeps conducted horizontally and 30 executed diagonally [17].

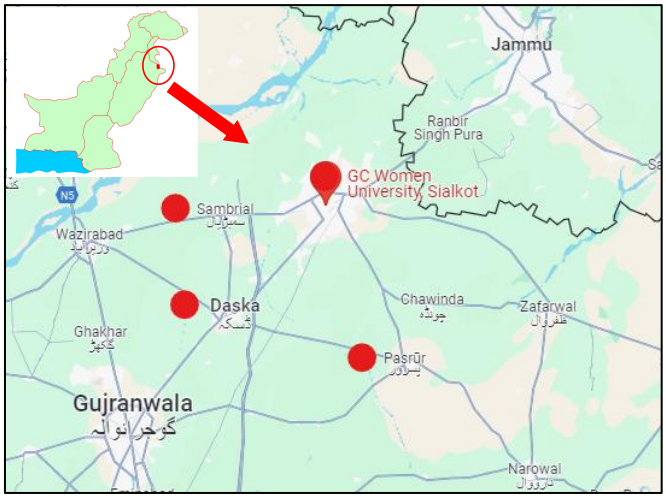

Figure 1. Map represents sampling sites in Sialkot district of province Punjab, Pakistan,

2.3. Insect preservation and identification

The collected samples were brought to the Zoology Research

Laboratory of Govt. College Women University, Sialkot. After sampling each specimen was preserved in solution of 70% ethanol and 2-3 drops of glycerin and stored in small vials with proper labeling [18, 17]. Collected Coleopteran fauna was identified up to species level by using different identification keys such as "Fauna of British India" [19, 20].

2.4. Statistical analyses

The relative abundance of Coleopteran fauna was calculated using Microsoft Excel 2013. Minitab (Version 2.0.4) was utilized to do an analysis of variance (ANOVA) to assess the Coleopterans collected with respect to various parameters such as tehsils and months. The diversity indices were calculated using PAST version 4.03.

3. Results

From all four tehsils of District Sialkot a total of 1437 specimens, representing 29 species belonging to eight different families. The collected families with their percentage-relative abundance were Coccinellidae (54.49%), Chrysomelidae (35.42%), Scarabaeidae (3.83%), Tenebrionidae (2.64%), Carabidae (2.23%), Meloidae (0.56%), Attelabidae (0.42%) and Cerambycidae (0.42%) (Figure 2).

Table 1. Diversity and % relative abundance of collected samples of order Coleoptera from all four tehsils of district Sialkot.

Family	Species	Sialkot	Sambrial	Daska	Pasrur	Total
	Scymus nubilus	0.84 (12)	0.56 (8)	0.42 (6)	0.7 (10)	2.51 (36)
	Cheilomenes sexmacultata	0.7 (10)	0.9 (13)	0.35 (5)	0.42 (6)	2.37 (34)
	Henosepilachna vigintioctopunctata	1.04 (15)	0.84 (12)	0.7 (10)	0.56 (8)	3.13 (45)
Coccinellidae	*Coccinella transversalis*	0.21 (3)	0.07 (1)	0.21 (3)	0.14 (2)	0.63 (9)
	Brumoides suturalis	0.49 (7)	0.35 (5)	0.28 (4)	0.35 (5)	1.46 (21)
	Propylea dissecta	1.74 (25)	0.7 (10)	0.35 (5)	1.04 (15)	3.83 (55)
	Coccinella septumpunctata	10.09 (145)	5.92 (85)	14.13 (203)	10.4 (150)	40.57 (583)
Total		15.1 (217)	9.32 (134)	16.42 (236)	13.6 (196)	54.49 (783)
	Altica cyanea	3.48 (50)	1.81 (26)	1.25 (18)	2.09 (30	8.63 (124)
	Monolepta signata	4.87 (70)	1.04 (15)	2.44 (35)	1.74 (25)	10.09 (145)
	Monolepta ongi	0.7 (10)	0.84 (12)	0.7 (10)	0.49 (7)	2.71 (39)
	Aulacophora foveicollis	0.35 (5)	0.21 (3)	0.14 (2)	0.35 (5)	1.044 (15)
Chrysomelidae	*Zygogarmma bicolorata*	0.7 (10)	-	0.35 (5)	0.35 (5)	1.39 (20)
	Colasposoma dauricum	0.7 (10)	0.07 (1)	-	0.77 (11)	1.53 (22)
	Colasposoma senegalense	0.35 (5)	-	-	0.14 (2)	0.49 (7)
	Colasposoma viridicoeruleum	0.7 (10)	-	0.21 (3)	1.04 (15)	1.95 (28)
	Charidotella egregia	0.21 (3)	0.21 (3)	0.14 (2)	-	0.56 (8)
	Cryptocephalus pusillus	1.39 (20)	1.04 (15)	1.11 (16)	3.48 (50)	7.03 (101)
Total		13.43 (193)	5.22 (75)	6.33 (91)	10.4 (150)	35.42 (509)
Meloidae	*Hycleus phaleratus*	0.07 (1)	-	-	0.49 (7)	0.56 (8)
	Protaetia niveoguttata	0.21 (3)	0.07 (1)	-	0.14 (2)	0.42 (6)
	Eophileurus chinesis	0.56 (8)	0.21 (3)	0.35 (5)	0.14 (2)	1.25 (18)
Scarabaeidae	*Mimela splendens*	0.49 (7)	-	0.21 (3)	0.14 (2)	0.84 (12)
	Maladera castanea	0.14 (2)	-	-	0.28 (4)	0.42 (6)
	Heteronychus arator	-	0.14 (2)	0.42 (6)	0.35 (5)	0.91 (13)
Total		1.39 (20)	0.42 (6)	0.97 (14)	1.04 (15)	3.83(55)

Table 1. Continued.

Tenebrionidae	*Alphitobius diaperinus*	1.39 (20)	0.14 (2)	0.28 (4)	0.56 (8)	2.37 (34)
	Opatrum sabulosum	0.07 (1)	-	-	0.21 (3)	0.278 (4)
Total		1.46 (21)	0.14 (2)	0.28 (4)	0.77 (11)	2.64 (38)
Attelabidae	*Heterapoderopsis bicallosicollis*	0.07 (1)	0.14 (2)	-	0.21 (3)	0.42 (6)
Cerambycidae	*Stromatium barbatum*	0.21 (3)	0.07 (1)	-	0.14 (2)	0.42 (6)
Carabidae	*Scarites subterraneus*	0.35 (5)	0.35 (5)	0.14 (2)	0.56 (8)	1.39 (20)
	Pheropsophus jessoensis	0.07 (1)	0.21 (3)	0.21 (3)	0.35 (5)	0.84 (12)
Total		0.42 (6)	0.56 (8)	0.35 (5)	0.9 (13)	2.23 (32)
Grand total		32.2 (462)	15.87 (282)	24.36 (350)	27.14 (390)	100 (1437)

Table 2. One way analysis of variance (ANOVA) applied on Coleopteran data collected from four tehsils of district Sialkot.

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Factor	3	1010	336.7	0.41	0.748
Error	112	92433	825.3		
Total	115	93444			

The collected data indicated the distribution of percentages among these families viz., Coccinellidae (54.49%) contained greater number of specimen but with seven species i.e., *Scymus nubilus* (2.50%), *Cheilomenes sexmacultata* (2.37%), *Henosepilachna vigintioctopunctata* (3.13%), *Coccinella transversalis* (0.63%), *Brumoides suturalis* (1.46%), *Propylea dissecta* (3.83%), *Coccinella septempunctata* (40.57%), the family Chrysomelidae (35.42%), included ten species i.e., *Altica cyanea* (8.63%), *Monolepta signata* (10.09%), *Monolepta ongi* (2.71%), *Aulacophora foveicollis* (1.04%), *Zygogarmma bicolorata* (1.39%), *Colasposoma dauricum* (1.53%), *Colasposoma senegalense* (0.49%), *Colasposoma viridicoeruleum* (1.95%), *Charidotella egregia* (0.56%), *Cryptocephalus pusillus* (7.03%), the other family belonging to this order was Meloidae (0.56%) with only single species representative i.e., *Hycleus phaleratus* (0.25%), family *Scarabaeidae* (3.83%) comprised five species i.e., *Protaetia niveoguttata* (0.42%), *Eophileurus chinesis* (1.25%), *Mimela splendens* (0.84%), *Maladera castanea* (0.42%), *Heteronychus arator* (0.90%), the family *Tenebrionidae* (2.64%) shared two species *Alphitobius diaperinus* (2.37%), *Opatrum sabulosum* (0.28%), *Attelabidae* (0.42%) family with single species *Heterapoderopsis bicallosicollis* (0.42%), also the family *Cerambycidae* (0.42%) shared one species *Stromatium barbatum* (0.78%), and the family *Carabidae* (2.23%) contained two species *Scarites subterraneus* (2.19%), and *Pheropsophus jessoensis* (1.03%).

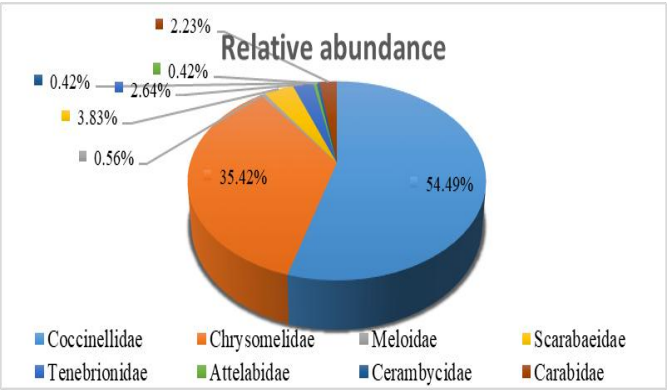

Figure 2. Percentage (%) based relative abundance of families categorized by family in Sialkot District.

3.1. Tehsil wise diversity of collected samples

From four different tehsils of district Sialkot, tehsil sialkot was rich in Coleopteran fauna with 32.20% relative abundance followed by tehsil Pasrur (27.1% relative abundance), Daska (16.42%) and Sambrial (15.87%), respectively. The most

abundant species from all four tehsils was *C. septumpunctata* with 40.57% relative abundance while the least abundant species was *O. sabulosum* with 0.27% relative abundance (Table 1).

A one-way ANOVA was employed to assess the means across the four tehsils. While maintaining a significance level of $\alpha < 0.05$, the means were compared, but the actual statistically significant threshold was 0.784, above the p-value this indicated that no significant difference was found (Table 2). This suggests that there is only a minor variation in insect abundance collected from different tehsils within Sialkot District.

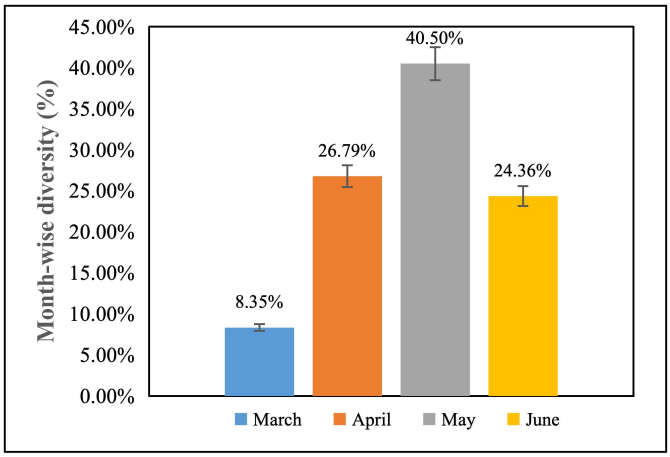

Figure 3. Diversity and % relative abundance of collected samples of order Coleoptera during the four months of sampling.

3.2. Month wise diversity of collected samples

During all four months of sampling duration the maximum abundance was found in the month of May (40.5%) followed by April (26.79%) while the least abundance was found during the month of March (8.35%). The most abundant species in March, according to present study, modest species diversity was recorded in the agro-ecosystem of district of Sialkot, with the diversity index, species dominance (0.194), richness (3.367), and evenness (0.367) of the Coleopteran fauna. Significant variation was found among the months of April, May, and June, showed the highest species diversity of the Coleopteran fauna in district of Sialkot (Figure 3)

The Tukey simultaneous test indicates correlations among the means of the four months. The overall line length in the confidence interval, the difference between the dotted line and the points, and the dotted line itself indicated the significance line and difference represent their respective meaning. Positive correlations were observed between April-March, May-March, June-March, and May-April, while June-April and June-May showed negative correlations with each other (Figure 4).

3.3. Crop wise diversity of collected samples

Coleopteran species were sampled from four different crops namely wheat (6.75%), fodder (58.73%), sunflower (8.63%) and vegetables (25.89%). *C. septumpunctata* was found as the predominant species in all selected crops wheat, fodder, sunflower, and vegetables, with counts of 45 (3.1%), 328 (22.83%), 20 (1.39%), and 190 (13.22%), respectively. Few species showed specific association with crops as *A. foveicollis* exhibited the lowest abundance in wheat and sunflower with the relative abundance of 0.07% (1). *H. phaleratus* recorded the lowest numbers in the fodder crop with relative abundance of 0.07% (1). The smallest proportion of *P. niveoguttata* was observed in vegetables, with a consistent relative abundance of 0.07% (Table 3).

To assess the means of various crops, a one-way ANOVA was applied. The resulting p-value was found to be statistically significant with 0.037value (Table 4).

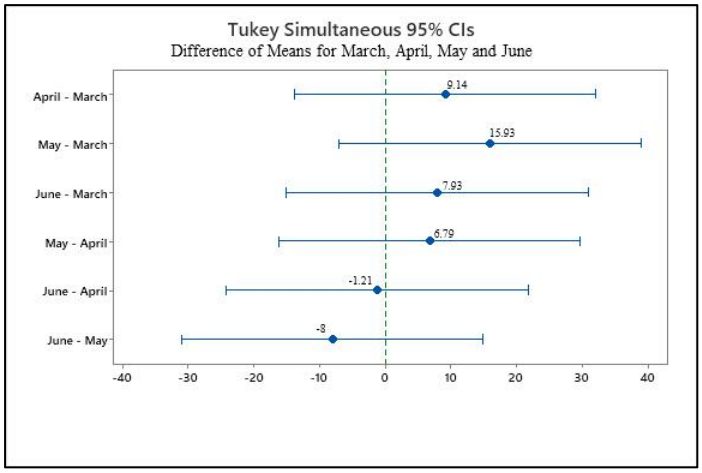

Figure 4. Tukey simultaneous test for difference of means between four months.

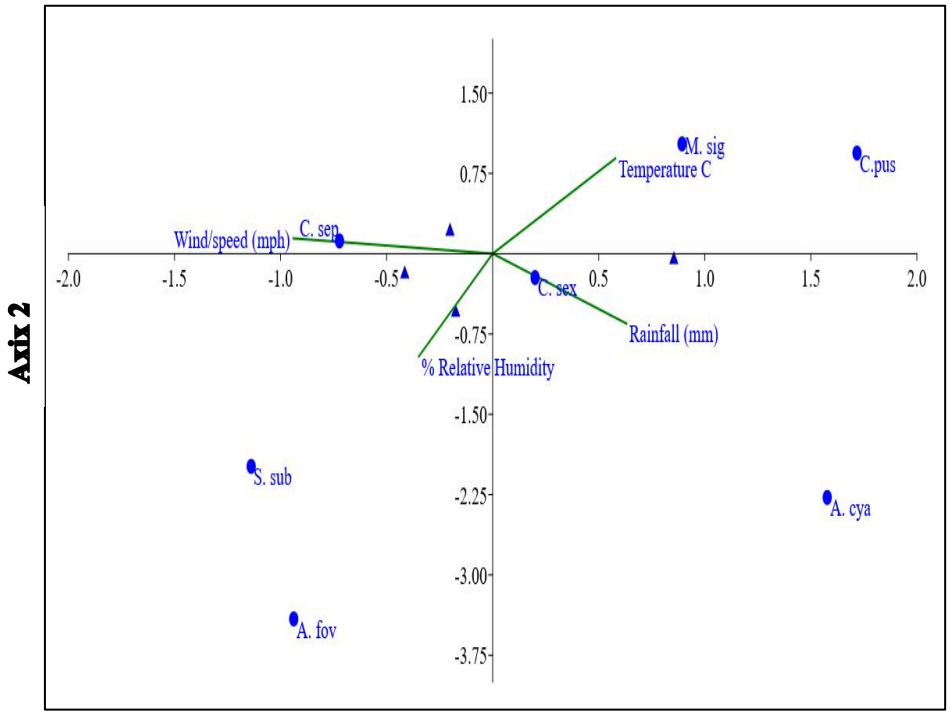

Figure 5. Canonical correspondence analysis (CCA) showing association of insect species (dots) with environmental factors in the months (arrows) of district Sialkot, Pakistan. Species guide: C. sex (*Cheilomenes sexmacultata*), C. sep (*Coccinella septumpunctata*), A. cya (*Altica cyanea*), M. sig (*Monolepta signata*), A. fov *(Aulacophora foveicollis),* C. pus (*Cryptocephalus pusillus*), S. sub (*Scarites subterraneus*).

Table 3. Diversity and %Relative abundance of collected species of Coleoptera from four selected crops.

Family	Species	Wheat	Fodder	Sunflower	Vegetables	Total
	Scymus nubilus	0.42 (6)	0.7 (10)	-	1.4 (20)	2.51 (36)
	Cheilomenes sexmacultata	0.28 (4)	1.39 (20)	0.21 (3)	0.49(7)	2.37 (34)
	Henosepilachna vigintioctopunctata	-	1.74 (25)	0.21 (3)	1.18 (17)	3.13 (45)
Coccinellidae	*Coccinella transversalis*	-	0.35 (5)	-	0.28 (4)	0.63 (9)
	Brumoides suturalis	-	1.46 (21)	-	-	1.46 (21)
	Propylea dissecta	-	2.78 (40)	0.35 (5)	0.7 (10)	3.83 (55)
	Coccinella septumpunctata	3.13 (45)	22.83 (328)	1.39 (20)	13.22 (190)	40.6 (583)
Total		3.83 (55)	31.25 (449)	2.16 (31)	17.26 (248)	54.5 (783)
	Altica cyanea	-	7.31 (105)	0.56 (8)	0.77 (11)	8.63 (124)
	Monolepta signata	-	9.05 (130)	0.35 (5)	0.7 (10)	10.01 (145)
	Monolepta ongi	-	2.44 (35)	-	0.28 (4)	2.71 (39)
	Aulacophora foveicollis	0.07 (1)	0.77 (11)	0.07 (1)	0.14 (2)	1.04 (15)
Chrysomelidae	*Zygogarmma bicolorata*	0.28 (4)	0.7 (10)	0.28 (4)	0.14 (2)	1.39 (20)
	Colasposoma dauricum	-	0.14 (2)	-	1.39 (20)	1.53 (22)
	Colasposoma senegalense	-	-	-	0.49 (7)	0.49 (7)
	Colasposoma viridicoeruleum	-	0.35 (5)	-	1.6 (23)	1.95 (28)

Table 2. continued.

	Charidotella egregia	0.14 (2)	0.42 (6)	-	-	0.56 (8)
	Cryptocephalus pusillus	-	2.3 (33)	4.59 (66)	1.14 (2)	7.03 (101)
Total		0.49 (7)	23.45 (337)	5.85 (84)	5.64 (81)	35.4 (509)
Meloidae	*Hycleus phaleratus*	-	0.07 (1)	0.35 (5)	0.14 (2)	0.56 (8)
	Protaetia niveoguttata	-	0.35 (5)	-	0.07 (1)	0.42 (6)
	Eophileurus chinesis	-	0.7 (10)	-	0.6 (8)	1.25 (18)
Scarabaeidae	*Mimela splendens*	-	0.56 (8)	0.14 (2)	0.14 (2)	0.84 (12)
	Maladera castanea	-	0.28 (4)	-	0.14 (2)	0.42 (6)
	Heteronychus arator	-	-	-	0.9 (13)	0.9 (13)
Total		-	1.88 (27)	0.139 (2)	1.8 (26)	3.83 (55)
Tenebrionidae	*Alphitobius diaperinus*	1.39 (20)	0.97 (14)	-	-	2.37 (34)
	Opatrum sabulosum	-	0.21 (3)	0.07 (1)	-	0.28 (4)
Total		1.39 (20)	1.18 (17)	0.07 (1)	-	2.64 (38)
Attelabidae	*Heterapoderopsis bicallosicollis*	-	0.21 (3)	0.07 (1)	0.14 (2)	0.42 (6)
Cerambycidae	*Stromatium barbatum*	-	-	-	0.42 (6)	0.42 (6)
Carabidae	*Scarites subterraneus*	1.04)15)	-	-	0.3 (5)	1.39 (20)
	Pheropsophus jessoensis	-	0.7 (10)	-	0.14 (2)	0.84 (12)
Total		1.04 (15)	0.7 (10)	-	0.49 (7)	2.23 (32)
Grand total		6.75 (97)	58.73 (844)	8.63 (124)	25.89 (372)	100 (1437)

Table 4. Crop-wise analysis of variance.

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Factor	3	12388	4129	2.93	0.037
Error	112	157785	1409		
Total	115	170174			

The maximum number of species was significantly associated with temperature and rainfall (Fig. 5) *C. sexmaculata* and *C. septempunctata* showed significant association with rainfall. Temperature was significantly associated with *C. sexmaculata*, *A. foveicollis*, *C. septempunctata*, and *A. cyanea*.

4. Discussion

Diversity, abundance and richness of the Order Coleoptera in the four tehsils (Pasrur, Sambrial, Sialkot, and Daska) of District Sialkot was estimated in present study. Coleopteran fauna was sampled for four months viz, March 2023 to June 2023. Across four crops (wheat, fodder, sunflower, and vegetables), a total of 1437 specimens of 29 species belonging to 8 families were recorded from different tehsils of the Sialkot district.

Among eight Coleopteran families the Coccinellidae with seven Species, Chrysomelidae with ten species shows more diverse species and, indicated their positive sign of tolerance to the environmental stimuli, followed by Scarabaeidae (three), Meloidae (three) and Carabidae with single species remarkably found in results. Similar representation of species and percent relative abundance was recorded in the study conducted in 2021 by Jana et al., [21]. In addition, Tom and Kaippallil, [22] focused on the diversity of different Coleopteran insect groups and the Coccinellidae family abundance, result revealed the

increased temperature impact the abundance of Coleopterans fauna, in the month of March (8.35%), April (26.79%) and May (40.50%) specimens of coleoptera were sampled. In June, the number decline (24.36%) due to an intense increase in temperature. the temperature variation in the months of April and May of the current study are likely to be temperature in January to April as recorded by Hussain et al., [23]; Ahmed et al., [24]. Ramzan et al., [12], also reported the effect of temperature variation on relative abundance of species. Present study results investigated that representative species of family Coccinellidae family *Coccinella septumpunctata* (583 specimen), *Propylea dissecta* (55), *Scymus nubilus* (36) *Cheilomenes sexmacultata* (34), *Brumoides suturalis* (21) are predators of aphids, whitefly, mealbugs except *Henosepilachna vigintioctopunctata* (45) that is herbivorus in nature [36]. carabidae *Scarites subterraneus* (20 specimens) and *Pheropsophus jessoensis* (12 Specimen) feed on other invertebrates as caterpillars, and other insects, even proved by gut content analysis [35]. *Heteronychus arator* (13 Specimen) belonging to the family Scarabaeidae is also predator of other insect pests. These predator Coleopterans play crucial role for natural pest control and ecosystem sustainability Chen, J. [32]. Highest diversity of species belonging to the Chrysomelidae family with (509 specimens) are herbivorous in feeding behavior. Meloidae (30 specimen) young act as predator, but adults are herbivore and occasionally act as crop pest Wael, E.A.and El-Sheikh [33]. Cerambycidae (06 specimen) mostly feed on flowers, bark, foliage, cones, fruit, roots, and fungi Haack, R. [34]. These findings are in line with the studies conducted by Bibi, . [25] in which it was demonstrated that the order Coleoptera is composed of multiple families, Results revealed that the most abundant presence of *C. septempunctata* in the month of May especially on crops including vegetables, wheat, and fodder are common results as recorded by Urooj and Ali, [26], in which it is reported that these beetles were highly active in May. The highest abundance of *C. septempunctata* was found in Wazirabad, Punjab, Pakistan [27]. These results concur with those of Suneela et al., [4], who discovered that *C. septempunctata* was abundant in fodder crops as revealed by present findings, which is in line with Liaqat et al., [28] findings. [15] discovered that *C. septempunctata* was the main predator. The present study highlights the abundance of Coleopteran fauna in agro-ecosystems of District Sialkot that is prerequisite to utilize these Coleopterans to use as biological control agents against different insect pests. Representative species of family Tenebrionidae *Alphitobius diaperinus* (34 specimens) and *Opatrum sabulosum* (04) feed on dead organic matter, and most of the foliage fauna plays other ecological role especially pollination for sustainable agro-ecosystem

5. Conclusion

Agriculture is an important sector for food and crop production in a country. Application of chemicals to increase production is a common practice, but these not only control the insect pest, but also affect natural predators and disturb the natural agro-ecosystem. Coleoptera is one of major order of insects, Present study revealed the diversity of beetles of order Coleoptera in crop system of district Sialkot. A total of 29 species belonging to eight different families of beetles were found with different crop habitat associations. Among crops Fodder was rich in Coleopteran diversity. The study explores the presence of Coleopteran species (predators in nature) with greater abundance, which is a fundamental step towards biodiversity conservation and their application in field (after rearing) as biological control agents against pests. While the other Coleopteran herbivores in nature should control during the ripening stages of crops in future, to reduce the utilization of chemicals and increased production through sustainable agro-ecosystem.

Conflicts of Interest

The authors report no conflicts of interest.

Data Availability statement

The data presented in this study are available on request from the corresponding author.

Author Contribution Statements

Sajida Mushtaq investigated, visualized and supervised the work. Zainab conducted the research, collected and organized the data and wrote the manuscript. Sadia Maalik helped in

conceptualization and Moazama Batool and Nazia Ehsan assisted in statistical analysis. Ayesha Hafeez edited and reviewed the manuscript.

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