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DIVERSITY, RICHNESS, AND ASSOCIATED PREDATORS OF ARTHROPOD PESTS ON CANOLA CROP (*BRASSICA NAPUS* L.)

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ABSTRACT

Canola (*Brassica napus* L.) is one of the major cash crop and source of cooking oil in Pakistan. Due to succulence as well as shiny appearance, a variety of agricultural arthropods including insect pests, predators and parasitoids are attracted toward this crop. To protect the quality and yield of *B. napus*, it is important to understand the diversity of arthropods and their interaction. Therefore, the present study was carried out to investigate the diversity and abundance of insect pests and their predators on canola crop under sprayed and unsprayed conditions. The diversity of insects was assessed on weekly basis by using sweep net, plant inspection and beat bucket method. Suitable diversity indices were used to find out the species diversity and abundance of the insect community associated with canola crop. Among the insect pests that cause the economic damage on canola, aphid, mustard aphid and turnip aphid and these insect pests have been observed during December to February. Coccinellids and green lacewing was found to manifested variable seasonality trends which seem to relate to their preferable prey's abundance on the crop. The dominant role of green lacewing and coccinellids were found to lower down the diversity of aphids around the cropping season of *B. napus*. Based on this investigated it may be suggested that green lacewing and coccinellids have potential to combat the sucking pests of B. napus.

Keywords: Canola, Aphid, Maize Aphid And Turnip Aphid, Coccinellids, Green Lacewing, *Brassica Napus* L.

I. INTRODUCTION

In oilseed-producing crops, brassicas are the largest second group of crops after the soybean grown globally. Brassicas are generally derived from two species, *Brassica napus* and *Brassica campestris* [1]. The word canola means those species that have a low level of glucosinolates and erucic acid as compared to other rapeseed cultivars. Canola has 10% fiber, 8% fat, and 33% protein [2]. This characteristic of canola oil makes it safe for health [3]. It is used in the production of food as well as being a vital nutritional factor for people [4]. Canola is become one of the most important oilseed crops in Pakistan, serving as a source of animal protein supplements as well as edible oil for humans. Many oil-rich seed crops are grown in several regions of Pakistan. Pakistan's canola crop was grown there in 2020–21 over an area of 31,161 h, yielding 49,000 tons of seed overall [5,6]. Lower output of edible oil has been seen as a result of a significant fall in the area under oilseed crops being cultivated and an increase in the purchase price of wheat. Pakistan imports massive amounts of edible oil from many nations across the world to suit its needs. Pakistan produced about 0.46 million tons of edible oil domestically, which was approximately 23% of the country's entire requirement, while 2.754 million tons were imported [5]. The only way to stop rising imports is to encourage the domestic production of oilseed crops. Comparing Pakistan to other industrialized nations, the canola crop's production is noticeably lower. The main cause of its low production, among other contributing variables, is the harm done by several insect pests [7,8], including cabbage butterfly (*Pieris brassicae*), whitefly (*Bemisia tabaci*), cabbage semilooper (*Tauroscopa notabilis)*, cabbage aphid (*Brevicoryne brassicae*), green peach aphid (*Myzus persicae*), armyworm (*Spodoptera litura*), diamond-back moth (*Plutella xylostella*), painted bug (*Bagrada hilaris*), green bug (*Chinavia hilaris*), and mustard aphid (*Lipaphis erysimi*) [9,10]. The infestation reduces flowering and setting of pods and pod-filling on the infested recemes. During years of sporadic attack and severe infestation there may be no grain formation at all [11].

To manage the damage of these insect pests, there are several control measures have been recommended. The undiscriminate use of pesticides has resulted in the development of resistance and resurgence in the pest besides environmental and health hazards. Beneficial arthropods that are subjected to predation or parasitism die as a result of pesticide sprays that are applied with a high intensity [12]. Therefore, biological control is

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now, emerging as an important and eco-friendly component of insect pest management [13]. Furthermore, natural biological control is important in practically every agricultural habitat.

Predators from all around the world like *Chrysoperla carnea*, *Coccinella septempunctata*, *Ischiodons cutellaris* , and hymenopteran parasitoid, *Diaetetiella tapae* have been reported to restrain insect pests populations on brassica crops. The *Chrysoperla carnea* (Neuroptera: Chrysopidae) was found as the most competent predator of *B. barrica* and a single larva utilized 131.80 aphids during its development [14]. *C. carnea* was identified as the most prevalent predator in canola during the final stages of crop growth in Pakistan [15]. Surphids, coccinalid beetles, and lacewings have also been identified in Australia as natural enemies of *B. brassica* and *L. erysimi* on canola [16].

The existence, diversity, and richness of predatory arthropods have a substantial influence on ecosystem function [17]. Prey and predator biodiversity may combine to increase or decrease the likelihood of advantageous natural enemy complementarity [18]. When there are few prey species, predator species may frequently overlap in location and time as they chase the same prey [19]. This can render predator species functionally redundant, resulting in no gain in biological control when additional enemy species are introduced [20]. On the other hand, species-rich prey populations may allow natural enemy species to partition prey and migrate into other eating niches [18,21]. Thus, before initiating further biological control attempts in brassica crops, it is very essential to know the arthropod fauna in this ecosystem of the region, and it is also crucial to understand various tropic levels in these crops. Therefore, our studies were carried out to know the exact biodiversity and seasonal activities of an important group of predatory arthropod fauna canola crops. This information may help us in developing an integrated pest management strategy against insect pests in the canola-growing regions of Pakistan.

II. MATERIAL AND METHODS

Experimental site

The present study was conducted at the Entomological Research Area, University of Agriculture Faisalabad Punjab, Pakistan. The experimental plot was divided into two blocks. Each block was further divided into three replications. One block was sprayed with diafenthuron according to the condition of the pest while the other was left sprayed. The difference in abundance and diversity was checked between the sprayed and unsprayed plots. The insect community was sampled from emergence to harvest which is associated with canola. The insects collected were brought into the insect biodiversity lab and identified to possible taxonomic levels with the help of available taxonomic literature and by comparing them with already identified insect specimens. Arthropod population dynamics were recorded on weekly bases.

Data analysis

The data was correlated with metrological factors (temperature, humidity, and rainfall). Metrological data were obtained from Department of Crop Physiology, University of Agriculture Faisalabad. Data were analyzed with the help of statistix 8.1 software. Analysis of variance were performed to test the significance of time over population dynamics and Tukey's HSD were performed for the comparison of means.

III. RESULTS

The correlation between spiders and spiders is significant while the correlation of syrphid fly, green lacewing, coccinellids and pirate bug with syrphid fly is highly significant. There is no correlation between spiders and syrphid fly. The correlation of syrphid fly with syrphid fly is significant while correlation of green lacewing, coccinellids and pirate bug was highly significant. The spiders and syrphid fly showed no correlation with lacewing. The correlation was significant between coccinellids and coccinellids while pirate bug shows highly significant correlation. The spiders, syrphid fly, green lacewing and coccinellids showed no correlation with pirate bug, while pirate bug and pirate bug have highly significant correlation (Table 1). The results (Fig.1) indicated that there was a rich diversity of insect predators in plant inspection sampling method. The mean abundance of green lacewing was higher (4.5) followed by coccinellids (3.7) and minimum abundance was recorded of spiders (0.8) and pirate bug (0.8).

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Table 1: Correlation matrix between plant inspection variable of Predators on canola under sprayed conditions.

	Spiders	Syrphid fly	Green lacewing	Coccinellids	Pirate bug
Spiders	1.00000				
Syrphid fly	0.60999**	1.00000			
Green lacewing	0.65670**	0.50172*	1.00000		
Coccinellids	0.53621*	0.61462**	0.70897**	1.00000	
Pirate bug	0.45161	0.68101**	0.40582	0.34088	1.00000

* = significant (P<0.05), ** = Highly significant (P<0.01)

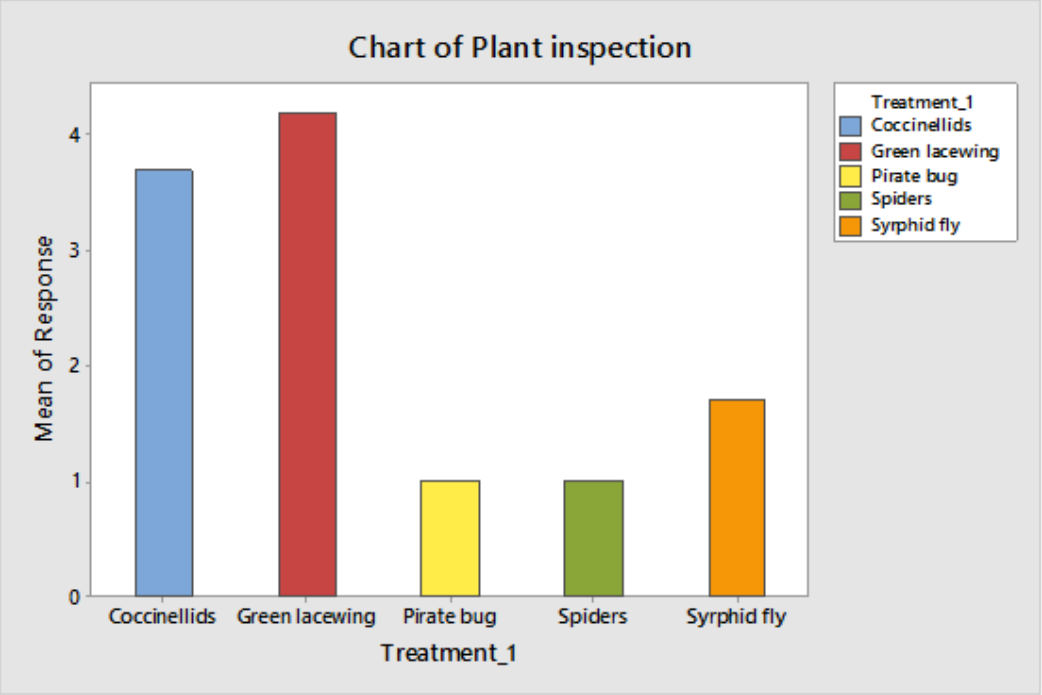

Fig.1: Mean abundance of predators on canola with plant inspection under sprayed condition

Mustard aphid and mustard aphid have significant correlation while remaining have highly significant correlation with mustard aphid. There is no correlation between mustard aphid and maize aphid while maize aphid and maize aphid have significant correlation and remaining has highly significant correlation with maize aphid. There is no correlation of turnip aphid with mustard aphid and maize aphid, while turnip aphid has significant correlation with turnip aphid. Remaining has highly significant correlation. Green bug has no correlation with mustard aphid, maize aphid and turnip aphid; while there is a significant correlation between green bug and green bug and remaining have a highly significant correlation. The painted bug a has a significant correlation with a painted bug while aphid a has a highly significant correlation with a painted bug and the remaining have no correlation with the painted bug. Aphid and aphid have a significant correlation while other have no correlation with aphid (Table 2). The results (Fig.2) indicated that there was a rich diversity of insect pests in plant inspection sampling method. The mean abundance of mustard aphid was higher (10.2) followed by aphid (8.5) and minimum abundance was recorded of green bug (0.4) and pirate bug (0.5).

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Table 2: Correlation matrix between Plant inspections of different variable of pests on canola under sprayed conditions.

	Mustard aphid	Maize aphid	Turnip aphid	Green bug	painted bug	aphid
Mustard aphid	1.00000					
Maize aphid	0.91308**	1.00000				
Turnip aphid	0.77070**	0.66194**	1.00000			
Green bug	0.62969**	0.64826**	0.63737**	1.00000		
painted bug	0.59724*	0.42613	0.40629	0.28055	1.00000	
Aphid	0.90600**	0.83068**	0.94122**	0.72422**	0.46679	1.00000

* = significant (P<0.05), ** = Highly significant (P<0.01)

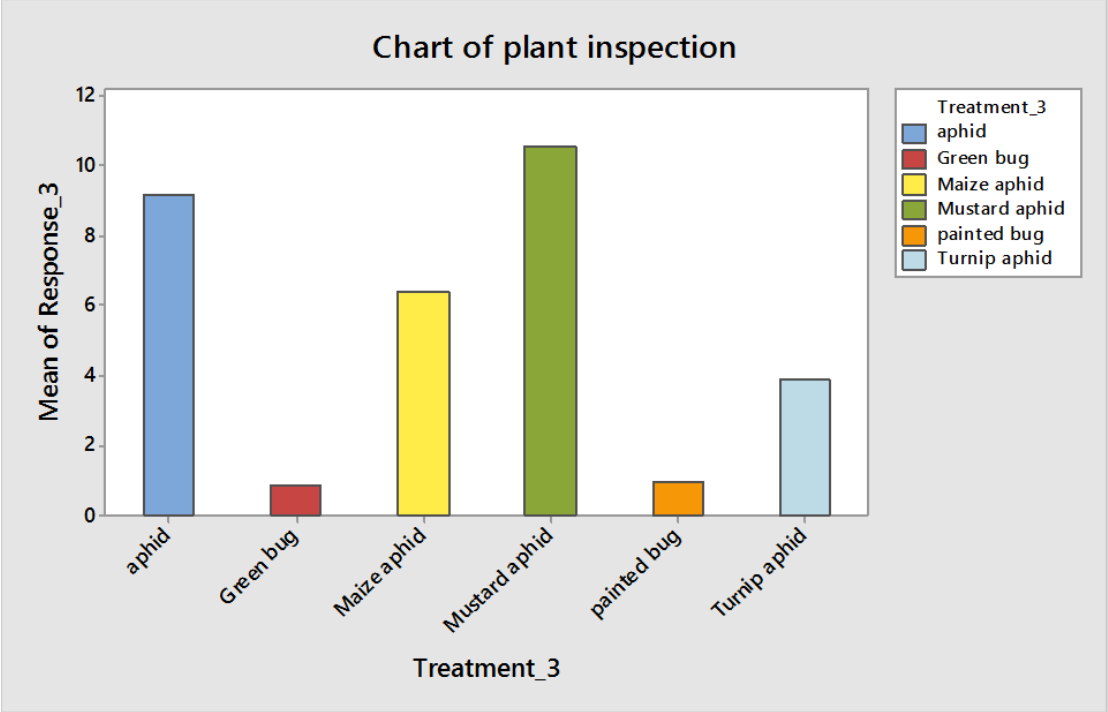

Fig 2: Mean abundance of predators on canola with plant inspection under unsprayed condition

Spiders have a significant correlation with spiders while with others are highly significant. Syrphid fly has no correlation with spiders and significant with syrphid fly with remaining highly significant. Green lacewing has no correlation with spiders and syrphid fly while with green lacewing significant and with remaining highly significant. Coccinellids have significant correlation with coccinellids while highly significant with pirate bug. Pirate bug has significant correlation with pirate bug and there was no correlation with others (Table 3). The results (Fig.3) indicated that there was a rich diversity of insect predators in plant inspection sampling method. The mean abundance of green lacewing was higher (8.6) followed by coccinellids (8.6) and minimum abundance was recorded for spiders (1.8) and pirate bugs (1.9).

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Table 3: Correlation matrix between Plant inspection variable of predators on canola under unsprayed conditions.

	Spiders	Syrphid fly	Green lacewing	Coccinellids	Pirate bug
Spiders	1.00000				
Syrphid fly	0.73603**	1.00000			
Green lacewing	0.75817**	0.71171**	1.00000		
Coccinellids	0.71772**	0.81686**	0.86620**	1.00000	
Pirate bug	0.72457**	0.70009**	0.74602**	0.79178**	1.00000

* = significant (P<0.05), ** = Highly significant (P<0.01)

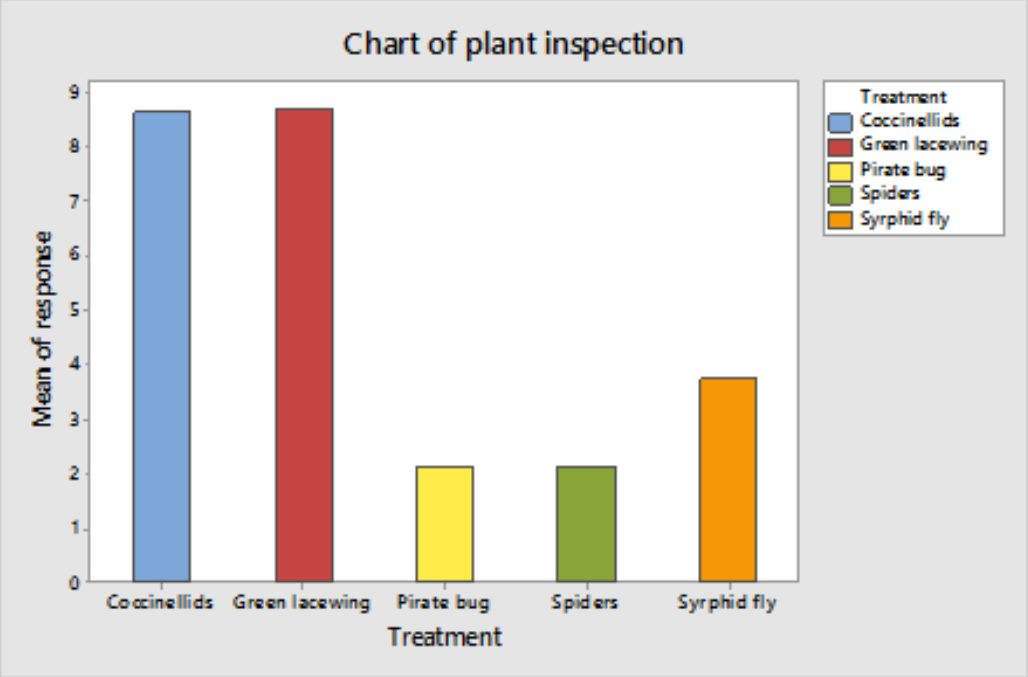

Fig 3: Mean abundance of predator on canola with plant inspection under unsprayed conditions

In the above analysis of the variance table of plants, inspection compares the treatment means and the P-value indicates that the treatments are highly significant. It means that all the treatments are not equal. One of these treatments is very important than the other (Table 4). The results (Fig.4) indicated that there was a rich diversity of insect pests in the plant inspection sampling method. The mean abundance of aphid was higher (34) followed by mustard aphid (26) and minimum abundance was recorded for the green bug (0.25) and painted bug (0.4).

Table 4: Analysis of variance for population dynamics of arthropods on canola.

Source	DF	SS	MS	F-Value	P-Value
Treatment	5	14500	2900.1	8.63	0.000
Error	90	30259	336.2		
Total	95	44760			

* = significant (P<0.05), ** = Highly significant (P<0.01)

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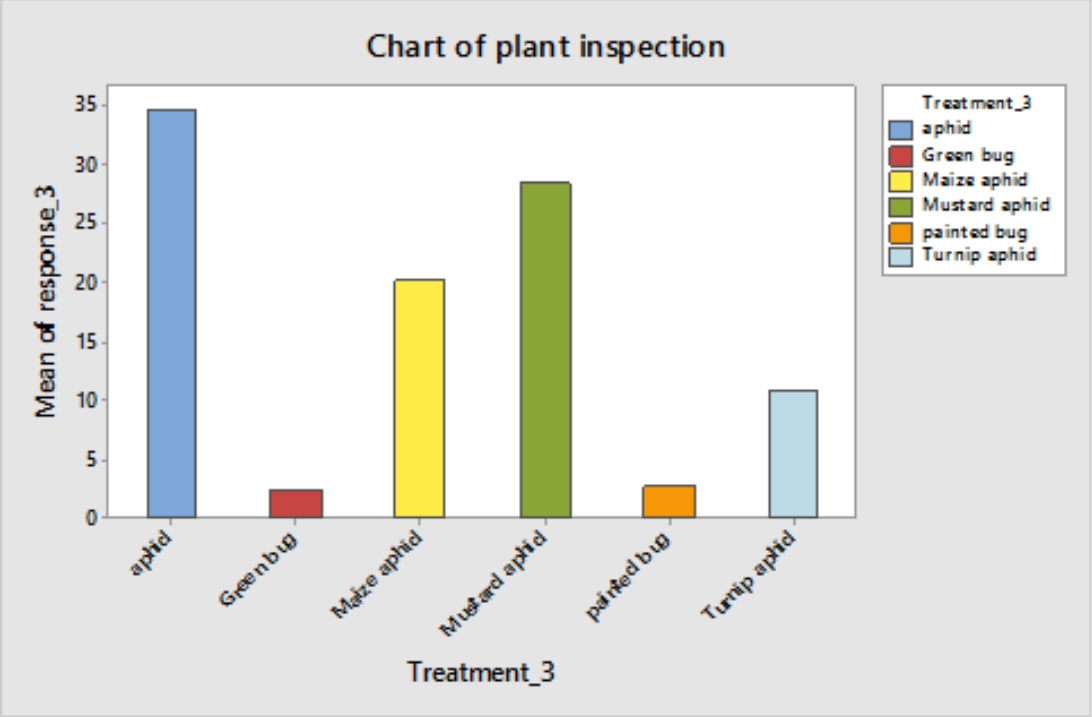

Fig 4: Mean abundance of pests on canola with plant inspection under unsprayed conditions.

IV. CONCLUSION

The experiment was performed in an area that was divided into two blocks sprayed and unsprayed in the university of Agriculture Faisalabad. One block was untreated while the other was sprayed with the pest emergence. The data was collected under sprayed and unsprayed conditions. Insect pests from emergence to till harvest was counted and collected for data purpose. The data was collected with the insect collection that was brought to the biodiversity lab and identified through a key according to their taxonomic characters. Saeed and Razzaq [11] reported that two aphid species made dense colonies on canola from November to January while results showed that aphid, mustard aphid, and field cricket population was maximum from November to February. Results showed that there was a maximum population of mustard aphids of about 10.2. at the start of the season while green bugs showed a minimum population of about 0.4. in sprayed conditions. Sarwar [22] reported that the aphid was the major destructive pest of the canola, and its predator ladybird beetle was also at maximum rate while the syrphid fly was minimum during pest attack season however, in the present study we also observed aphid population was maximum during January to February and its related predators i.e. coccinellids (3.8) and green lacewing (4.5) at higher abundance during sprayed conditions. By using the sweep net method, coccinellids and green lacewings showed higher abundance (2.26) and pirate bugs showed minimum abundance (0.7) under sprayed conditions. The results are in agreement with Sarwar [22] that mentioned that the ladybird beetle's population was high while here coccinellids population was also high during aphid attack season, coccinellids showed a high abundance (4.6) followed by green lacewing and spiders and pirate bug showed a minimum response (0.9,0.8). Pirate bugs showed minimum abundance during pest attack season i.e. 0.8 and remained low. Many insect pests attack canola that includes armyworm, cabbage semi looper, whitefly different species of aphids, cricket, and diamondback moth [23]. Results are in agreement with Hashmi (1994) maximum population of aphid was recorded during January to February (8.5) and mustard aphid (10.2) while minimum of green bug (0.4) and pirate bug (0.5) during plant inspection method.

Maximum abundance of mustard aphid (10.11) was observed during December –January (4.11) while minimum population of painted bug and green bug was observed. Under sprayed conditions population and abundance of field cricket was also high 2.0 and green bug (0.75). Aphid showed maximum population (8.8) and turnip aphid (4.5). Sarwar et al., (2011) reported that the aphid attacks on inflorescence and suck the sap and causes major losses, we also observed that aphid attacks on inflorescence and suck the sap and wilt the crop. In unsprayed conditions observed that four species of aphid was at maximum rate i.e. aphid, mustard

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aphid, maize aphid and turnip aphid. These four species attack on inflorescence and suck the phloem from the plant. Predatory insects kill their prey and feed on them, but sometime role of predators underestimated [25]. But in present study predators play a vital role in suppression of pests in unsprayed conditions i.e. coccinellids, Green lacewing, Spiders and syrphid fly was at maximum rate under unsprayed conditions.

Results showed that in unsprayed conditions aphid was higher (34) followed by mustard aphid (26) and minimum abundance was recorded of green bug (0.25) and painted bug (0.4). Saeed and Razzaq [11] reported that attack of three pests (aphid, army worm and white fly) was observed on canola crop but the attack of aphid was higher than these two pests and in present results the different pests (aphid, painted bug, mustard fly, green bug and field cricket) were observed but abundance of aphid was higher than others (34) followed by mustard aphid (26) and minimum abundance was recorded of green bug (0.25) and painted bug (0.4). According to the present results indicated that there was a rich diversity of insect pests in sweep net sampling method. The mean abundance of field cricket was higher (3.25) followed by mustard fly (2.7) and minimum abundance was recorded of green bug (0.25) under unsprayed conditions.

Sarwar [22] reported that the relative abundance of biological control agents (lady bird beetle, green lacewing) was higher in January to February while minimum in November December and other predators (spiders, syrphid fly) were low in abundance, here our results are in agreement the mean abundance of green lacewing was higher (8.6) followed by coccinellids (8.6) and minimum abundance was recorded of spiders (1.8) and pirate bug (1.9). The mean abundance of green lacewing was higher (8.5) followed by coccinellids (8.0) and minimum abundance was recorded of pirate bug (1.8).

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