BIONOMICS OF LADYBIRD BEETLES IN DISTRICT BANNU OF KHYBER PAKHTUNKHWA, PAKISTAN

ATA UR REHMAN[1], ZIA UR RAHMAN AWAN[2*], ABDUL HALEEM SHAH[1], JABBAR KHAN[1]AND FALAK NAZ KHAN[3]

[1]Department of Biological Sciences, Gomal University, Dera Ismail Khan, Pakistan
[2]Department of Zoology,Govt. Post-graduate College Bannu, Pakistan
[3]Pakistan Council for Scientific Research, Islamabad, Pakistan
*Corresponding Author email: *ziabiotech78@yahoo.com*

خلاصہ

فیملی Coccinellidae جو Coleoetera کے خاندان سے تعلق رکھتی ہے، شکار خور ار نباتات خور فطرت کی وجہ سے انتہائی معاشی اہمیت کی حامل ہے۔ موجودہ تحقیقی مطالعے کا انتظام ضلع بنوں میں Coccinellid حیوانات نامہ کو بیان کرنے کے لیے کیا گیا ہے۔ مجموعی طور پر 530 Coccinellide Beetles کے نمونے جمع کیے گئے۔ یہ تمام چھ شکار خور اور ایک نباتات خور انواع سے تعلق رکھتے تھے۔ ان کے ذیلی خاندان میں Chillocorinae, Coccidulinae , Coccinellinae اور Epilachninae شامل ہیں۔ Coccinella septempunctata کی نوع کو تمام شکار خور Coccinellids میں غالب پایا گیا۔ جن کے 210 نمونے مختلف فصلوں اور نباتات سے اکھٹے گئے۔ اِس نوع کو نباتاتی سروے کی پوری مدت میں موجود پایا گیا۔ دوسری بہت عام نوع Coccinella undecimpunctata تھی۔ جن کے 130 نمونے موجودہ فصلوں اور سبزیوں سے اکھٹے کیے گئے۔ یہ نوع بھی پورے مطالعاتی علاقے میں موجود پائی گئی۔

Hippodamia variegata کے ارکان کو کھیرا، جھاڑیوں، برسیم اور گھاس سے اکھٹا کیا گیا۔ Psyllobora bisctonotata کے نمونے ضلع بنوں میں بہت کم پائے گئے۔ صرف پانچ نمونے جون کے مہینے میں توت سے حاصل کیے گئے۔ جو کہ Brumoides suturalis گھاس، برسیم اور بھنڈی کے کھیتوں میں سرگرم تھے۔ ان کو پورے ضلع بنوں میں پایا گیا۔ جن کے 33 نمونے اکھٹے کیے گئے۔ Rodolia fumida کے 46 نمونے اکثر توت کے درخت سے اور کچھ نمونے گھاس اور گندم کے کھیتوں سے چند مقامات سے اکھٹے کیے گئے۔ Henosepilachna elaterii کو اکثر گرم موسم میں حاصل کیا گیا۔ جن کے آٹھ نمونے زیادہ تر گندم، بینگن اور کھیرے سے اکھٹے کیے گئے۔ تمام مشاہدہ انواع کو ضلع بنوں میں پہلی مرتبہ تحقیق کے زمرے میں لایا گیا۔ Psyllobora bisoctonotata کی موجودگی زراعت کے لیے اچھا شگون ہے۔ کیوں کہ یہ ایک کھمبی خور نوع ہے۔

Abstract

Family Coccinellidae of order Coleoptera is of great economic importance because of its predatory and phytophagous nature.The present study was conducted to describe the Coccinellid fauna and their distribution in district Bannu. A total of 530 Coccinellid beetles were collected. All these belong to 6 predatory and one phytophagous species. Their subfamilies include Coccinellinae, Chilocorinae, Coccidulinae and Epilachninae. *Coccinella septempunctata* was found the dominant species of all the predatory coccinellids with 210 specimens collected from different crops and plants. This species was found throughout the survey period. The 2nd most common species was *Coccinella undecimpunctata* with 130 species specimens collected on available crops and vegetables. This species also was found throughout the study area.The members of *Hippodamia variegata* were collected from Cucumber, weeds, alfalfa and grasses.*Psyllobora bisctonotata*specimens were found quite rare in district Bannu. Only 5 specimens were found only in the month of June and from Mulberry plant only. *Brumoides suturalis* was active in grasses, alfalfa and okra fields. It was found throughout the district Bannu with 33 specimens being collected.*Rodolia fumida* with 46 specimens was mostly collected from Mulberry plant and some specimens were also collected in grasses and wheat from very few localities. *Henosepilachna elaterii* was mostly found in the warm weather, 8 specimens were collected, mostly from wheat, Brinjal and Cucumber. All the observed species have been described for the first time from Bannu district. The presence of *Psylloborabisoctonotata* was good sign for agriculture because it is fungivorous.

introduction

Ladybird beetles of family Coccinellidae, order Coleoptera (Lablokoff-Khnzorian, 1982) are small, usually 4-9 mm, or even as small as 1 mm insects (Koren *et al.*, 2012). They are mostly rounded, sometime elongate, oval or flattened in body shape. The body colour is mostly reddish, orange, black and straw colour. They live in all terrestrial ecosystems: tundra, forest, grassland ecosystems, plains, and mountains (Gordon, 1970; Skaife, 1979).

Taxonomically, there are six sub-families in family Coccinellidae, namely; Sticholotidinae, Chilocorinae, Scymninae, Coccinellinae, Coccidulinaena and Epilachninae. Among these, members of subfamily Epilachninae are phytophagous and are important pest of solanacious and cucurbitaceous crops such as Melons, brinjal, tomato, potato and bitter gourd. The members of the rest five subfamilies are predators and play important role as biological control agent in the suppression of important agriculture pests (Naz, 2012; Khan *et al*., 2006).

Six thousand species and 490 genera of ladybird beetles are described throughout the world. More than 300 species have been described from the Indo-Pakistan sub-continent (Chaudhry *et al.*, 1970; Agarwala and Dixon, 1992). In Pakistan, 75 species are predatory (Khan *et al*., 2006) and 15 are phytophagous (Ahmad and Ghani, 1972; Naz, 2012; Abbas *et al.*, 2013).

Ladybird beetles complete their life cycle usually in one month. They generally produce two or three generations in a year but this depends upon their food, location and temperature (Majerus and Kearns, 1989).

Coccinellids are important predators and major biological control agents of Hemipteran pests. They feed on both the larvae and adults of various important crop pests such as aphids, coccids and other soft-bodied insects (Gordon, 1970; Kring *et al.*, 1985). One larva can consume up to 50 aphids a day (Anwarullah *et al.*, 1966; Kring *et al.*, 1985).

In Pakistan, insect pests are mainly controlled by insecticides, which, in addition to high price, reside on the surfaces of crops or in the soil and are subject of concern as environmental pollutants. The indiscriminate use of pesticides leads to phytotoxicity and cause damage to many useful organisms like predators, and pollinators etc. (Luckman and Metacalf, 1978). Consequently, the utilization of natural enemies in biological control is an excellent pest management tactic to reduce the population level of persistent pests (Delfoss, 2005).

Coccinellidae is an important group of beetles as biological control agent and their diverse and adaptation nature to a number of conflicting habitats. These beetles are of great economic importance in agro-ecosystem through their successful engagement in the biological control of many injurious insects (Agarwala and Dixon, 1992). Despite vast exploration of the ladybird beetles in Pakistan, very little attention has been given to the ladybird fauna of North-West zone of Khyber Pakhtunkhwa.

This study was thus aimed to observe the ecological status of ladybird beetles in district Bannu to analyse their distribution, habitat and ecological niche.

Materials and Methods

The following strategies were adopted for elaborating the distribution of Coccinellids species in District Bannu.

Study Area

Coccinellidae were collected from various localities of the district Bannu. Bannu District is one of 24 districts that make up the Khyber Pakhtunkhwa province of Pakistan.The district land is drained by rivers Kurram and Tochi, both are originated in the hills of North Waziristan.Many kinds of crop and fruit can be grown here. Its banana, date, fig, guava and pomegranate are unique in taste, smell and shape.Total area of the district Bannu is 1,227 km^2. A total population in 2010 was 677,346 with the density of 552/km^2. Maximum temperature in Bannu reaches 37-40C°.

Sample Collection

To get knowledge about the ecology, identification and general characteristics of coccinellidae, ladybird beetles were collected from the four different localities of the district Bannu. The survey was made from November 2013 to May 2014 with 15 days of interval. All the available cultivation was searched for the sampling. Coccinellids specimens were collected randomly by netting and hand picking. The complete information's were recorded on a study-designed Performa.

Sample Analysis

The collected specimens were put in ethyl acetate and pinned in a collection box. Small-sized specimens were just mounted on triangular cards. The mounted specimens were properly placed in collection boxes. Naphthalene tablets were added wherever necessary to protect the specimen from insect pests. For further characterization, specimens were then brought to department of Zoology, Govt Post Graduate College, Bannu.

Identification

The specimens were identified on the basis of keys given by Kapur (1963a, 1963b, 1963c) and Kuznetsov (1977) and on the basis of male genitalia. Besides, identification was also made by comparison with already identified specimens preserved in the National Insect Museum, National Agriculture Research Council (NARC) Islamabad.

Description

Specimens were described on the basis of visual observation and their differentiable characters were identified following the protocol of Kapur (1963a-c).

Genitalia extraction

The modified methodology and protocol of Chelliah (1965) was followed to dissect and isolate the genitalia. The specimens were put in hot water for 1 to 2 minutes to make their bodies soft. Then, abdomen was detached from the body with the help of fine needles and the extra body tissues were dissolved by boiling in 10% potassium hydroxide solution for about half an hour. The abdomen was washed in hot water and transferred to pure glacial acetic acid for 5 minutes. The abdomen was first washed in 70% Ethanol and then in absolute alcohol for 5 minutes to completely dehydrate it. Finally, abdomen was put in clove oil. The processed abdomen was put in a cavity slide, adding drop of glycerine. It was dissected with fine needles under stereoscope and the genitalia were isolated.

Construction of identification keys

For the identification of coccinellids species, dichotomous keys were constructed using contrasting taxonomic characteristics of adults.

Results

The main objective of the present research work was to explore the fauna of coccinellids and their distribution in Bannu district. A total of 530 coccinellids beetle were collected. Six predatory and 1 phytophagous species were found.

1.*Coccinella septempunctata* (Linnaeus, 1758)

Adult 5.2-7.0 mm long and 4.0–5.6 mm wide. Body oval, convex and densely puntated. Elytra with seven spots, without hair and finely pitted. The junction of elytra and scutellum on the mid-dorsal line possesses a common visible spot. Head transverse, black, with a pair of yellow spots near eyes. Clypeus anteriorly truncated with small yellow anterior-lateral projection. Scutellum small and blackish. Abdomen black, densely punctuated with short yellow pubescence. Postcoxal line slightly curved meeting the posterior margin of 3rd sternite, 8th sternite in male bears four groups of very long setae on either sides of the depression (Fig. 1 a & b). Trabe is short. Median lobe much thick and broad at base deeply excavated when seen from dorsal side. Parameres relatively shorter than median lobe. Siphonal capsule bulged out and thick. Siphonal tube long, with sac like structure at distal end. Most of the specimens were collected from wheat, alfalfa, mustard, grasses, tomato, and cucumber (Table 1).

2.*Coccinella undecimpunctata*(Linnaeus, 1758)

Adult length 4.5 – 5.5 mm; width 2.7 – 4.1 mm. Body elongated, oval, convex, densely punctuate. Head black, eyes large with minute facets. Antenna shorter than head and segmented. Pronotum black with yellow spots at each anterior angle. Elytra is yellowish-red in colour that possesses 5 blackish colour spots on both sides. Scutellum also contains a big black spot (Fig. 1 c & d).Trabe thick and short. Basal piece large and narrow. Median lobe broad and deeply excavated, more wide at base than apical portion. Permerase cylindrical, slightly shorter than the median lobe provided with dense hair at tips.Siphonal capsule asymmetrical and elongated. Siphonal tube abruptly banded at base. These specimens were collected from mustard, wheat, coriander, alfalfa and grasses (Table 1).

3.*Hippodamia variegate* (Goeze, 1977)

Adult length 4.0 – 4.5 mm; width 2.8 – 2.9 mm. Body elongated and oval shape. Head is brown in colour that contains two prominent black eyes. Just behind the head, the black and white pattern is quite visible. Pronotum yellow white with central black spot. All the specimens of this species have common pattern of white lines present just behind the head. The raised and fine margins of pronotum are always conspicuous along its basal edge. Elytra red, without hair and finely pitted. Scutellum brownish black (Fig. 1 e & f).These specimens have short trab but quite thick and its dital end is expanded. Basal piece is reasonably large but is oblong shaped. Median lobe is comparatively longer than parameres, which are slightly compressed at base and possess short hairs dorso-apically.The specimens were collected from alfalfa, wheat, weeds, cucumber and mustard (Table 1).

4.*Psyllobora bisoctonotata* (Mulsant, 1850)

Only 5 specimens of this species were collected. Adult's length 3.0 – 3.3 mm, width 2.0 – 2.5 mm. Body elongate. Elytra brownish-yellow, more or less transparent on peripheral margins and possesses nine spots in four horizontal rows.It lacks hairs and is finely pitted. Pronotum and elytra are of the same colour. Pronotum is much broader and without spots. Eyes large, dark brown and coarsely facetted. Antenna 11 segmented. Maxillary palp 4 segmented. Labial palp 3 segmented. Tarsi 4 segmented. Body brownish yellow from below finely pitted and covered with very fine hair (Fig. 2-i & ii).Trabe; thin, promexiemely most swollen. Basal piece short and dorsally pointed. Median lobe robust, long and pointed apically. Parameres short and longer than the median lobe, cylindrical and tips provided with dense hair.Siphonal capsule large and thick. Tube thick and broadly curved. Tip slightly hairy. These species were also collected from mulberry tree and from some vegetables (Table 1).

5.*Brumoides suturalis* (Fabricius, 1798)

A total of 33 specimens of this species were collected.The adult's length ranged from 2.6 - 3.2 mm; width 2.2 – 2.4 mm. Body oval with yellowish elytra that possessed three beautiful longitudinal stripes of black colour, one on each elytron and one on the mid-dorsal line at the junction. Pronotum yellowish that was finely pitted but wasslightly projected on antero-laterally. Head brown, not much deeply inserted. Eyes large and brownish black. Antenna very small and 8 segmented. Abdomen consists of 6 visible sternites (Fig. 2-iii & iv).Trabe long, thin at base and swallowing at the tip. Basal piece short and sub circular, median lobe broad and distally rounded. Parmere comparatively thin, cylindrical and slightly shorter than the median lobe. Siphonal tube thin, equally thick throughout its length, forming broad loop, tips slightly swollen. These species were collected from grasses, alfalfa, and maize (Table 1).

6. *Radolia fumida* (Mulsant, 1853)

A total of 46 specimens of this species were collected during the survey period. Adult length 4.5 -5.0 mm; width 3.8 – 4.0 mm with oblong body. It is uniformly reddish brown in colour except the margins of elytra, which is light brown. Elytra without spots. Pronotum, head, legs and lower part of the body densely covered with yellow hair. Pronotum broader, head deeply inserted and not visible from above. Eyes prominent, large and black in colour. Antenna 8 segmented. Abdomen consists of 6 visible sternites (Fig. 2-v & vi). Trabe is long, equally thick, slightly curved at apex. Basal piece rounded. Median lobe comparatively thin, slightly shorter than parameres. Parameres long and cylindrical, apex rounded and without hair. Siphonal capsule equally thick throughout its length. These species were mostly collected from Mulberry tree. Besides, these were also found on wheat and in some vegetables (Table 1).

7. *Henosepilachna elaterii* (Rossi, 1794)

A total of 8 specimens were collected throughout the sampling period, which fall into a single species that *Henosepilachna elaterii.* The size of male is 6.25 mm while the size of the female is 6.08 mm. Ground colour red, spotless. Pronotum spotless, elytra six spotted surrounded by orange ring. Post-coxal line complete and rounded. Siphon of male genitalia with widened apex and with a fringe of bristles (Fig. 2- vii & viii).Median lobe of phalobase without basal knife-edged, curves up gently at apex. It is like a tube when seen from below, widened apically and forms deep oval cavity. Paramers slender with hairs and with no apical thorn.Siphon bent at 180 degree basally, widened at apex, and fringed with short bristles. Most of the specimens were found on cucumber and bottle gourd (Table 1).

Table 1: Crop/Plant relationship of ladybird beetles (Coleoptera: Coccinellidae) in Bannu.

Family	Sub family	Species	Habitat
Coccinellidae	Coocinellina	***C. septempunctata***	Wheat, Alfalfa, Coriander, Mustard, Cucumber, Grasses, Okra
		C. undecimpunctata	Wheat, Bottle-guard, Mustard, Alfalfa, Cucumber.
		Hippodamia variegate	Cucumber, Weeds, Alfalfa, Grasses
		Psyllobora bisoctonotata	Mulberry, wheat and from general vegetation.
	Chilocorinae	***Brumoides suturalis***	Alfalfa, Grasses, Weeds
	Coccidulinae	***Rodolia fumida***	Vegetables and mulberry tree
	Epliachninae	***Henosepilachna elaterii***	Brinjal, Wheat, Cucumber, Kadu, Tinda

Fig.1. *Coccinella septempunctata,* a) adult b) male genitalia c) *Coccinella undecimpunctata*-adult d) male genitalia of *C. undecimpunctata* *e)* adult of *Hipodemia variegata* and f) male genitalia of *H. variegata*

Fig.2. i) Adult specimen of *Psyllobora bisoctonotata*,ii) male genitalia of *P. bisoctonotata* iii) adult stage of *Brumoides suturalis*,iv) male genitalia of *B. suturalis*,v) adult of *Radolia fumida* vi) male genitalia of *R. fumida*, vii) *Henoepilachna elaterii's adult* and viii) male genitalia of *H. elaterii*

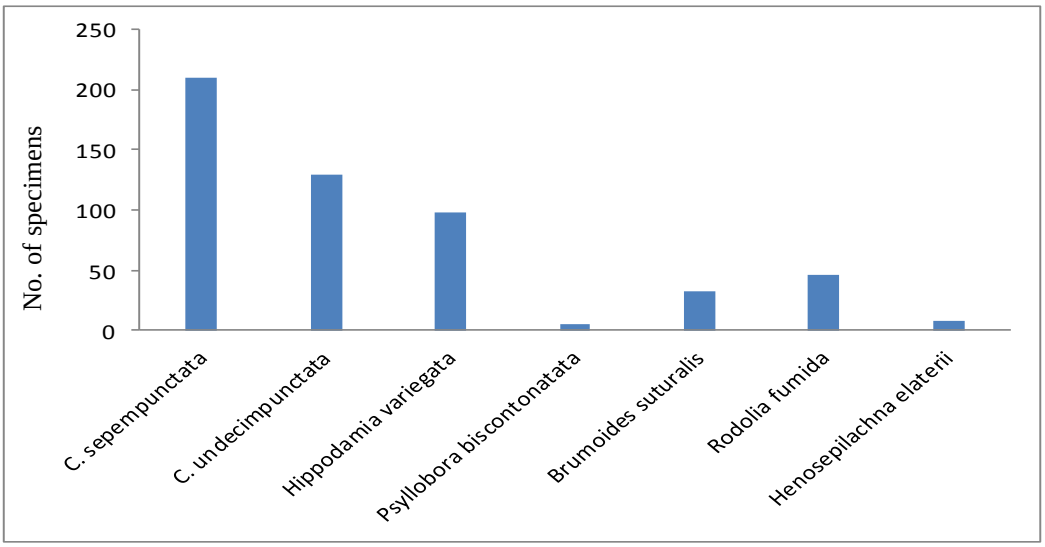

Fig.3. Histogram shows the number of specimens of each species found during the study

Discussion

The present study was conducted in district Bannu with main objective of exploring the Coccinellid species prevailing in the agro-ecosystem of the district. A total of 7 species of Coccinellid were found in vegetables, crop field and general vegetation of the study area. These species belong to 4 subfamilies and 6 genera.Among these species, *coccinella septempunctata* was collected in large numbers. This is very common species and has also been collected from other parts of the country as a generalized predator and widely distributed (Rehman 1940; Rahatullah *et al.,* 2011).

Coccinella undecimpunctata is another resembling species but smaller in size and was found throughout the selected area and found throughout the season. The species has previously been reported from Peshawar (Irshad, 2001), Malakand and Mardan (Rafi *et al.,* 2005), Faisalabad, Mandi Bahauddin and Azad Jammu Kashmir as well (Khan *et al*, 1999a; Khan *et al*, 1999b), Islamabad (Khan, 2008) and Chitral (Khan, 2007). This species is found as a general predator and well adapted to the area.

Hippodamia variegata is another common species of the study area, which is also highly polymorphic in nature with 98 specimens collected during the study. This species is abundant in wheat, Alfalfa and on grass. It is previously reported as widely distributed in Pakistan and has variation in size that is related with altitude (Gillani, 1976; Kapur, 1955; Irshad, 2001; Rahatullah *et al.,* 2011; Rehman and Inayatullah, 2011).

Psyllobora bisoctonotata is important species, which is mycophagous in nature, and therefore, has biological importance. Only 5 specimens of this species were collected from the Mulberry tree. It has been collected from very few localities in previous studies (Rafi *et al.,* (2005; Khan *et al.,* 2007).

Brumoides suturalis is a small to medium size beetle with remarkable lines over the body. It is purely oriental species. About 33 specimens were found throughout the sampling period and commonly found in weeds, alfalfa, and okra. Previous reports have shown that this particular species is restricted to only certain regions of KPK, especially the hilly areas, like Swat, Abbottabad (Mohyuddin *et al.,* 1982; Irshad, 2001; Rafi *et al.,* 2005).*Rodolia fumida* is medium size copper red ladybird beetle that was collected from Mulberry plant and wheat crop. Most of the specimens were interestingly collected in the month of June. The species has previously been reported from very few localities of Pakistan (Rafi *et al.,* 2005).

Henosepilachna elaterii is the only phytophagous ladybird beetle found in district Bannu. The specimens were similar in all respects to previously reported specimens except that these were larger in sizes compared to previously reported ones. It was reported as a serious pest of watermelon and mask-melon in the barrani area (Ashrafi *et al*, 1966; Rehman and Inayatullah, 2011; Naz *et al.,* 2012)

Conclusion

Coccinellids fauna of district Bannu is not so rich and is represented by only 7 species. The species *Coccinellia septempunctata* is more abundant and was found active in each crop ecology against soft-bodied insects.*Psyllobora bisoctonotata* as an important mycophagous insect among the beneficial fauna of the Bannu district.

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References

Abbas, M. N., Kausar, S. and Rana, S. A. (2013). Diversity and distribution of ladybird beetle in the cropland of Faisalabad district. *Int. J. Adv. Res*., 1**:** 27-33.

Agarwala, R. K., and Dixon, A. F. G. (1992). Laboratory study of cannibalism and inter-specific Predation in ladybirds. *Ecol. Entomol*. 17(3)**:** 303-330.

Ahmad, R., and Ghani, M. A. (1972). Coccidea and their natural enemy complex in Pakistan. *Tech. Bull. Commonwealth Inst. Biol. Contr*. 15: 59-104.

Ahmad, K. F., W. H. Shah, A. Iqbal and Jalali, S. (2004). Spatial and temporal distribution of *Chilocorus infernalis* (Mulsant) (Coccinellidae: Coleoptera) on apple trees in districts Bagh and Rawalakot Kashmir, Pakistan. Sarhad J. Agri. 20 (2): 261-264.

Anwarullah, M., Irshad, M. and Akhtar, T. (1960). Studies on the biological control of phytophagous mites (Acarina: Tetranichidae) and aphids (Aphididae). Pak. J. Sci. Ind. Res. 9:256-259.

Ashfaque, M And Farmanullah, (2012). Taxonomic studies of family coccinellids of Gilgit, Baltistan, Pakistan. PhD thesis. Department of Plant Protection, The University of Agriculture, Peshawar. Pp 196.

Ahmad, R.(1973). A new tribe of the family Coccinellidae (Coleoptera). Bulletin of Entomological Research. B62: 449-452.

Chaudhry, G.U., Chaudhry, M.I. and Malik, N.k. (1970). Survey of insect fauna of forests of Pakistan. Final Technical Report II. Pakistan Forest Institute. 205 pp.

Chelliah S. 1965. The male genitalia of a few predaceous coccinellids (Coleoptera: Coccinellidae) of South India. *Indian J. Entomol*. 27: 165–167.the united states. *J. Entomol. Soc.* B.C.5:73-80

Delfoss, e. S. (2005). Risk and ethics in biological control. Biol. Ctrl. 5: 19-329.

Gordon, R.D. (1970). Tribal and Generic Reassignments in the Coccinellidae (Coleoptera). Proceedings ofthe Entomological Society of Washington, 72: 217.

Gilani, W.A.1976.Studies on the predacious Coccinellidae of Lyallpur. M.Sc. thesis Dept. Agri.Entomol, Univ. Agri. Faisalabad.Pp. 81.(unpublished).

Hippa, H., Kepeken, S. D. and Laine, T. (1978). On the feeding biology of Coccinellahiero glyphica (Coleoptera: Coccinellidae). 14 (2):18–20.

Iablokoff-Khnzorian S.M. 1982. Les Coccinelles. Coléoptères-Coccinellidae.Tribu coccinellini des regions Palearcti queey orientale .Paris, 568 pp.

Irshad, M. (2001). Distribution, host, Ecology and biotic potential of coccinellids of Pakistan. Pak. J. Biol. Sci. 4:1259-1263.

Khan, M.R., Sheikh, M.K., Rafi, M.A. and Sharif, A. (1999a). Predatory coccinellid fauna (Coleoptera: Coccinellidae) of Sudhnuti District, Azad Jammu and Kashmir. *Pak. J. Entomol.* 14 (1-2): 5-7.

Khan, M.G.R., Inayatullah, M., Rafi, M.A. and Ashfaque, M. (1999b). Species composition, distribution and host plants of predatory coccinellids (Coccinellidae: Coleoptera) in District Bagh, Azad Jammu and Kashmir. *Pak. J. Entomol*. 14(1-2):1-4.

Khan, I., Din, S. and Khalil, S.K. (2007). Survey of predatory coccinellids (Coleoptera; Coccinellidae) in the Chitral District, Pakistan. *J. Insect Sci.* 7 (1):1-6.

Khan, I., Din, s., khalil and m, s. K., Rafi, A. (2006). Survey of predatory coccinellids (coleopteran: coccinellidae) in the Chitral district, Pakistan. *J. insect Sci*. 7-6.

Khan, MR., Irshad, M. and Rafi, MA. (2008). Insect fauna of Azad Jammu and Kashmir. M K Traders, Islamabad, p: 143.

Kapur A.P.1955.Coccinellida of Nepal. Record of Indian Museum.53: 309-338

Kapur, A.P. (1963a). The Coccinellidae of the third Mount Everest expedition, 1924 (Coleoptera). Bulletin of the British Museum. *Entomology*. 14: 1-48.

Kapur, A.P. (1963b). Confirmation of the occurrence of the lady beetle, *Coelophora pupillata* (Swartz) (Coccinellidae, Coleoptera), in India and its biological importance. *Science and Culture*. 29: 264.

Kapur, A.P. (1963c). The taxonomic status and further description of *Harmonia expallida* Weise (Col., Coccinellidae), feeding on *Adelges* species (Hem. Adelgidae) in North-western India. *Entomophaga*. 3: 199-203.

Kuznetsov, V.N. (1997). Lady Beetles of the Russian Far East. Memoir No. 1, Center for Systematic. *Entomology.* 248 pp.

Koren, T., Hlavat, D., Rojko, I. and Zadravec, M. (2012). First checklist of ladybird beetle of Croatia along with new faunistical records. *J. acta entomol serbica*.17**:** 101-122.

Kring T. J and Gilstrap F.E, (1985). Role of indigenous coccinellid in regulating green bugs on Texas grain sorghum. Journal of Economic Entomology.78(1): 269–273.

Lablokoff-Khnzorian S.M. (1982). Les Coccinelles. Coléoptères-Coccinellidae.Tribu coccinellini des regions Palearcti queey orientale .Paris, p 568.

LINNAEUS, C. 1758.Systema Nature.10th edition. Stockholm. 826pp.

Luckman, W. H., and Metacalf, R. L. (1978). The pest management concept. 3-35. In; introduction of insect pest management. Willey, New York. 57p.

Mohyuddin, A.I., Rahim, A. and Irshad, M. (1982). Studies on the Population Dynamics of *Pyrilla perpusilla* Walker, its Natural Enemies in Pakistan and Possibilities of its Control. Proc. 18th Conv. Pakistan Society of Sugar Technologies, Rawalpindi. 4-5:157-171.

Majerus, M. and Kearns, P. K. (1989). Lady Birds. University of Cambridge. pp. 1-101.

Naz, F., Inayatullah, M. Rafi, M. A., Ashfaque, M. and Ali, A. (2012). *Henosepilachna vigintioctopuncta* (Fab.) (Epilachninae; Coccinellidae); Its Taxononmy, Distribution and Host Plants in Pakistan. *Sarhad J. Agri*. 28(3): 421-427.

Rafi, A.M., Irshad, M. and Inaytullah, M. (2005). Predatory Ladybird Beetles of Pakistan. Rohani Art Press, Blue Area, Islamabad, Pakistan. 105pp.

Rahatullah, f., Haq, S. A. Mehmood, k. Saeed and Rehman, S, (2011). Diversity and Distribution of ladybird beetles in District Dir Lower Pakistan.Int.J. Biodiv. and conserv.3(12):670-675.

Rehman, k. A. (1940). Important Insect Predator of India. Processing of India academy of Science.

Rehman H and Inayatullah M. (2011). Species composition and Distribution of coccinellids of District Tank. M.Sc thesis. Department of Entomology, the University of Agriculture, Peshawar.

Skaife, S. H. (1979). *African Insect Life*. pp: 186–90. Struik Publishers (Pty) Ltd., Conelis Struik House, Cape Town 8001.

Slipinski, A. (2007). Australian ladybird beetles (coleopteran: Coccinellidae), their Biology and Classification. Australian Biological resources study.cll. illus. 288 pp.