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Dynamics of entomo-fauna as documented in some sewage irrigated agro-ecosystems in and around Bikaner, Rajasthan, India

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Abstract

Ecologically, insects occupy diverse niches and play many different roles important in sustaining the dynamics of ecosystem process. They could be herbivores (some are pests), predators and parasites (maintaining the population dynamics of herbivore insects), pollinators, decomposers and scavengers- each group or species within groups have distinct feeding habit. As such they are closely associated with the habitat and factors within it. It is evident that their impact is considerable, and that the known or potential value stored in their diversity should be preserved for the future. Knowledge of the diversity of insects in agro-ecosystems therefore becomes important. During this century, the practice of irrigating agricultural crops with sewage waters in rural and peri-urban areas of our Country is becoming a common practice. Such agro-ecosystems have low pH and high organic matter and due to accumulation of humus the soil is very good as far as cropping is concerned. In a way, it is natural organic farming. The present work therefore was undertaken to study the insect scenario (diversity and density) in some sewage irrigated agro-ecosystems in and around Bikaner, Rajasthan during an annual cycle documenting the data for seventeen months. In all, of the total 102 insect species noted, most number of 82 insect species was documented during January, May and September and minimum diversity of 54 insect forms was observed in the month of April. Over all, density wise maximum numbers of 670 insects (per trap) were documented during September and minimum density of 222 insects was observed in the month of April.

Keywords: Insect diversity, Insect density, Sewage irrigation, Agro-ecosystem

Introduction

Ecologically, insects occupy diverse niches and play many different roles important in sustaining the dynamics of ecosystem process (Walker, 1992). They could be herbivores (some are pests), predators and parasites (maintaining the population dynamics of herbivore insects), pollinators, decomposers and scavengers- each group or species within groups have distinct feeding habit (Miller, 1993; Kim, 1993). They could be herbivores (some are pests), predators and parasites (maintaining the population dynamics of herbivore insects), pollinators, decomposers and scavengers- each group or species within groups have distinct feeding habit. As such they are closely associated with the habitat and factors within it. The substantial benefits to mankind from insects generally receive less publicity than the economic losses that result from their roles as vectors of diseases and as pests of agriculture, fibers and stored goods. The main benefits are ecological, economic, scientific and aesthetic. Because of their vast numbers and variety, insects are dominant components of many food webs in both the production and decomposition divisions of ecosystems. The biomass of insects in most freely – draining soils for exceeds that of the more evident birds and mammals above the surface. Because insects are small in size, yet so diverse and ecologically important. Since environmental quality has become of major concern, terrestrial and particularly aquatic insects have therefore been utilized as valuable indicators of ecological conditions. Conspicuous insects such as butterflies and dragonflies are particularly useful in monitoring changes. In both ecological and economic terms, insects are useful in pollinators. Many wild plants depend upon insects, and those plants are part of a genetic pool which may be of known or as yet undiscovered values. Bees are the major importance and are vital for the reproduction of many crops. Scientifically and aesthetically, insects make a substantial contribution in terms of their fascination, their beautiful or bizarre appearance, and their improvements to man's environment, their usefulness in teaching and in bio-geographical, environmental, synecological and autecological investigations. It is evident that their impact is considerable, and that the known or potential value stored in their diversity should be preserved for the future. Knowledge of the diversity of insects in agro-ecosystems therefore becomes important. During this century, the practice of irrigating agricultural crops with sewage waters in rural and peri-urban areas of our Country is becoming a common practice. Such agro-ecosystems have low pH and high organic matter and due to accumulation of humus the soil is very good as far as cropping is concerned. In a way, it is natural organic farming. Concern for human health and environment are the most important constraints in the reuse and before one can endorse this means, a thorough analysis seems to be a pre-requisite from social, economical and ecological standpoint. A base line study for every aspect is therefore of prime importance. Looking into this, it was proposed to document information relating to insect status through an annual cycle by observing their dynamics in such sewage irrigated farms which are coming up at alarming rates in and around Bikaner, Rajasthan.

Materials and method

a. The study area

The state of Rajasthan is located between 23º3'-30º12' N and 69º30'-78º17' E, while, Bikaner district lies in North–Western part of Rajasthan located between 27°11' and 29°03' North latitudes and 71°52' and 74°12' East longitudes. The district has a dry climate with large variation in temperature and has scanty rainfall. The summer months are extremely hot with the day temperature sometimes going up to 49.9°C, May being the hottest month. During winter the minimum temperature sometimes drops up to 0°C, January being the coldest month. The agro-ecosystems in the form of crop fields studied lie about 10 to 15 km away from the city, covering an area of 6 hectares each. These are irrigated by sewage water.

The crops in the agricultural fields comprised of radish, ridged gourd, cucumber during January to August; sugar beet during May to August; mint, pumpkin, brinjal, bottle gourd and sorghum during May to December; while, during September to April crops cultivated comprised of cauliflower, onion and coriander; okra during September to December; while, spinach and *Amaranthus* were cultivated throughout the year.

b. Methodology

The insect visitors were surveyed and collected for seventeen months every week from January to December and further up to May for two consecutive years (total 34 months) and results are tabulated as an average for seventeen months. For the study, the field area was divided into five stations. An indigenously designed cage (net) of 1m×1m×1m of nylon mesh was used for the purpose as also used by Saigal (2002). The cage covered the $1m^3$ volume while holding the crop inside. The fauna trapped within the cage was mechanically picked up. Using cage the insects were collected between 7A.M to 11A.M, and again in the afternoon from 4 P.M. to 6 P.M. Sampling was done fortnightly. Light-trap collections were made using 260 Watt mercury bulb (Saigal, 2002) in the field twice during each month and overnight collection was taken.

The insects collected by the above method were transferred to killing bottles, killed and preserved. The fauna were sorted out and identified following pertinent literature, help from the Section of Entomology, Department of Agriculture, Bikaner and Desert regional Station of the Zoological Survey of India, Jodhpur was also taken for identification and for confirmation. Besides, the reference collection in the Department of Zoology, Dungar College was consulted. The count of insect fauna collected using cage was averaged for each month and expressed as no/m^3 or number/trap. The collection made through light trap was expressed as number/trap/ night.

Results and discussion

In all, of the total 102 insect species noted, most number of 82 insect species was documented during January, May and September, and minimum diversity of 54 insect forms was observed in the month of April, as presented in Table 1.

Diversity wise most number of lepidopteran species were noted in the month of December, coleopterans in April, hymenopterans during May, June, December, January, February, hemipterans in August, orthopterans in March, odonates in September, dipterans in March and April, dictyopteran in January, March, September, while, minimum lepidopteran species were documented in the month of April, coleopterans in March and July, hymenopterans during April, hemipterans in January, orthopterans in December and February, April and May, odonates in January and July, dipterans in December, May, dictyopteran in February, April, August and March, April, May. In all of the total 102 insect species documented, diversity wise 54 species were noted throughout the study period; 34 species were intermittently observed, while, 14 insect species were reckoned in only few months during the period of study.

Over all, density wise maximum number of insects was documented during September and minimum density of insects was observed in the month of April. Density wise most number of lepidopteran, coleopteran, hemipteran and dipteran species were noted in the month of September, hymenopterans and odonates during December, orthopterans in the month of March, dictyopterans in January, while, minimum lepidopteran, coleopteran, hymenopteran, hemipteran and orthopteran species were documented in the month of April, odonates in June, July and August, dipteran in December and dictyopteran in February, April and March.

Kumar et al. (2009) observed the peak of *A. ferruginea* and *A. bengalensis* in the month of April- May and of *Adoretus* sp. from April to September. During the present study the density of coleopterans was noted to be highest during September and therefore in conformation with them. The population of *Epilachna* beetle grubs was observed to increase from April and then decline, the adults were observed from April to November and their maximum number was noted in July by Ramjan et al. (1990). The pest *Myllocerus laetivirens* was recorded by Kumar et al. (1996) during July to October in and around Jodhpur district of Rajasthan to cause damage to neem. Bhattacharyya & Mandal (2004) carried a two year study at Mandouri, Nadia, West Bengal, four species of coccinellids namely, *Coccinella transversalis* Fab., *Oenopia luteopustulata* Muls., *Cheilomenes sexmaculata* (Fab.) and *Harmonia arcuata* (Fab.), as important predators of the aphid *Aphis gossypii* Glov. infesting taro, *Colocasia esculenta* L. The beetles remained active from end of June to first week of October and their number varied from 0.14-0.67 and 0.13-0.40 per leaf during 1997 and 1998 respectively. Its peak populations were attained during second and third week of August in 1997 and second fortnight of July and end of August in 1998. The appearance and peak activity of the coccinellids coincided with that of aphid. Of the four species of coccinellids, *O. luteopustulata* and *C. transversalis* appeared in relatively higher proportions in both the years (54.71 and 25.61% and 33.20 and 22.69% respectively). *C. sexmaculata* was present in lower proportions (11.22 and 18.20% respectively), whereas *Harmonia arcuata* was the most dominant species in 1998 (33.76%). Singh & Singh (1977 a) recorded the incidence of grey weevil *Myllocerus undecimpustulatus* on pearl-millet during Kharif season and stated that heavy rain fall followed by bright sun shine under high humidity (85 ± 5%) and mean temperature of 28 ± 2ºC favoured the buildup of insect population which attained its peak during first week of August. Gupta & Yadava (1993) studied the distribution pattern of white grub in Rajasthan and observed significant differences in grub population and their survival in different field conditions and sand-dunes were found to have lower insect population as compared to even land. Maximum grub population was recorded in even land crop-fields followed by sand-dunes crop-field and minimum in water logged fields.

Gupta (1959) has also reported positive association of average maximum temperature coupled with moderately high humidity levels were most conducive factors for build up of root borer population on sugarcane crop and observed the peak population of the pest between July to October months. In studies conducted at Punjab by Singh & Singh (1975) *Heliothis armigera* was seen from July to August where it was recorded on maize (rainy season crop). Katiyar (1982) observed that cotton is damaged by three species of bollworms, the population of which is found to be profoundly influenced by different agro-climatic conditions. The author revealed the suitable temperature for population build up of pink bollworm was 28 ± 1ºC and relative humidity of 75 ± 10 percent. He further suggested that warm but not excessively hot weather, cloudiness and frequent light rains were conducive for multiplication of bollworms. A high incidence and peak activity was observed in the month of October. All these studies support the present findings.

Studies on seasonal incidence of insect pest of brinjal were carried out by Mall et al. (1992). It was observed that the incidence of jassids, aphids, *Epilachna* beetle and shoot and fruit borer were more prevalent up to the third week of September when the average temperature and humidity were more than 28ºC and 80 percent respectively while rainfall played a negative role. Studies on seasonal incidence of insect pest of cole crops were studied by Sachan & Gangwar (1990) at Shillong. They found that the cabbage butterfly from November to mid February the incidence was of minor nature indicating that extreme cold conditions during November to February ranging from 9.77 to 16.43ºC which were detrimental for the multiplication of the insects. But, during the present survey the density of lepidopterans was documented to be high during September to November. Sharma (1990) reported the lucerne caterpillar *Spodoptera exigua* to be an important pest of soyabean causing damage from November to March. Levin et al. (2004) recorded tomato fruit borer *Helicoverpa armigera* (Hubner) as sporadic pest of *Amaranthus*. Heavy incidence of all the instars of *H. armigera* was observed on the seed crop (irrigated) during the month of November and December. According to Parker (1946) temperature is the most important single abiotic factor influencing the life economy of any pest and it is rather difficult to establish a direct cause and effect relationship between any single climatic factor and pest activity, because the effects of weather elements on the insect is usually compounded. Khanna & Sharma (1969) observed the borer on sugarcane to be active when the temperature changed from 31.7 to 38.0º C with relative humidity varying from 50 to 80 percent and also reported positive association of average maximum temperature with borer population. Banerjee (1972) suggested temperature to affect the activity of a pest. In studies conducted at Punjab by Singh & Singh (1975) *Heliothis armigera* was seen from March to May. Bilapate et al. (1977) also reported the role of temperature for growth and multiplication of *Helicoverpa armigera.* Seasonal abundance of shoot and fruit borer *Earias* sp. on okra was observed by Radke & Undirwade (1981). The authors revealed that the pest intensity in summer increased rapidly and reached its peak while in Kharif the increase was gradual. Zaz & Kushwaha (1983) made a relative quantitative survey of the tobacco caterpillar, *Spodoptera litura* on cauliflower and cabbage crops during both kharif and rabi seasons. The authors recorded the pest from last week of June till last week of December on cauliflower, which shifted subsequently to cabbage wherein the incidence commenced from end of December or first week of January and lasted till the end of March. The pest activity on cauliflower crop got accelerated about middle of August and again in November. On cabbage its peak activity was recorded during March. The population pertaining to cauliflower depicted significant negative correlation with average and maximum temperature in first crops. The relative humidity in both phases of the two crops was positively correlated and on cabbage, temperature and relative humidity had no effect during first year but these factors were found to be positively correlated during second year. A study was conducted by Choudhary et al. (1986) dealing with pest complex of sesamum in a set of agro-climatic conditions as influenced by weather parameters. The effect of abiotic factors on population build up of various insects showed a negative correlation with maximum daily temperature, wind speed and sunshine while the minimum daily temperature, relative humidity and rainfall had a positive bearing on majority of insects. The ecological factors like temperature, relative humidity and photo-period play an important role in the buildup of pest population of the gram borer *Heliothis armigera*, suggested Kadu et al. (1987). Fitt (1989) also reported the role of temperature for growth and multiplication of *Heliothis armigera.* The results of the present work gets support from these findings.

The cotton white fly *Bemisia tabaci* was found to multiply rapidly at a temperature ranging from 29 to 33ºC on cotton while high rainfall was found to suppress the pest by Reddy et al. (1989). Shukla (1989) observed that the population of leaf hopper on brinjal was positively correlated with average maximum-minimum temperature, relative humidity and total rainfall. Falerio et al. (1990) ascertained the influence of different weather factors on insect pests of cowpea *Vigna unguiculata* at Delhi and found that most of the insects recorded had a negative association with maximum daily temperature, wind speed and sunshine and positive relationship with the minimum daily temperature, relative humidity and rainfall. Cutworms were more during July to November while diamond back moth was restricted from June to October and cabbage looper was recorded only during June to August. The effect of abiotic factors on key pests of groundnut by regression methods was made by Singh et al. (1990 b). The authors revealed that there is a close relationship between population build up of pests and weather parameters. *Empoasca kerri* Pruthi and *Caliothrips indicus* had a negative association with the minimum daily temperature, relative humidity, rainfall and wind speed (in summer only), while maximum daily temperature, sunshine had a positive bearing on the occurrence of jassids and thrips in groundnut as a sole crop. Singh et al. (1990 c) suggested that the population build up of any insect is closely associated with the weather parameters prevailing during the preceding and corresponding periods. Fairly high mean ambient temperature (around 32-34ºC) was found to be most conducive in the population build up of various insect pests of groundnut. High temperature prevailing during summer season contributed to decrease in pest population. Scattered rains followed by fairly high relative humidity favoured the population build up of pests in higher levels of incidence in kharif crops, whereas heavy rainfall decreased the population of various pests. Studies on population dynamics of white backed plant hopper in Punjab was carried out by Bhathal and Dhaliwal (1991) who observed that the decrease in the temperature favoured the population of insect whereas rainfall had adverse effect on population. Field trials were conducted by Pai & Dhuri (1991) in rabi season under irrigated conditions to study the insect species attacking pulse crop and recorded nine insect pests of which *Empoasca kerri* reached its peak during the second week of November, *Bemisia tabaci* during fifth week of October, *Aphis craccivora* in the second week of November and *Maruca testualis* appeared only in the last week of crop growth. Rote & Puri (1991) found that amongst the weather factors, maximum temperature and sunshine hours were positively associated with whitefly population while relative humidity, rainfall and rainy days were negatively associated. The study of population dynamics of insect pests associated with green gram *Vigna radiata* was made at Varanasi by Gupta & Singh (1993). Correlation between population of insect pests and various abiotic factors revealed that for thrips and white fly dry conditions are more favourable than rainy conditions while for galerucid beetle, jassids, leafminter and leaf eating caterpillars, the rainy conditions are more favourable.

Effect of abiotic factors on pests of pea was also studied by Bijur & Verma (1995 b). Correlation regression analysis revealed differential influence of weather parameters on the population of various pests. Leaf-miner, jassids and aphids showed significant negative correlation with wind speed. *Helicoverpa armigera* was significantly influenced by minimum temperature and rainfall and stem fly with maximum temperature. Effect on natural enemies and predatory coccinelids revealed negative correlation with maximum temperature. The authors also observed that the leaf-miner *Phytomyza horticola* attained peak during last week of December while the stem fly *Ophiomya phaseoli* appeared in last week of November and reached its peak after 57 days of sowing. Sugarcane is one of the most important cash crops in India and is attacked by several insect pests including the root borer *Emmalocera depressella*.

Sardana (1986) observed that among weather factors mean ambient temperature around 32ºC and relative humidity of 65±5 per cent were most conducive for the population build up of root borer which was found at its peak between August and October when the maximum and minimum temperature ranged from 31 to 34ºC and 26.6 to 25.5ºC respectively, and relative humidity from 48.2 to 78.4 per cent. The population of the borer was found to decline at low temperatures during winter months. The principal ecological factors that influence the diversity of grasshoppers are the monsoon rainfall pattern (mean annual rainfall, mean number of rainy days), atmospheric temperature, atmospheric humidity, vegetation, soil type and protection from external enemies. Of these the vegetation and soil types are perhaps more directly important than the others. Most of the grasshoppers are restricted to open vegetation of grasslands but some like *Poekilocerus pictus* and *Anacridicum rubrispinus* are found on free plantations (Bhargava, 1996). The population trend was observed at its peak in the month of September and the lowest in summer months from May to June. Population dynamics of cotton pests in relation to weather parameters was studied by Bishnoi et al. (1996). Significant relationships were observed between population build up of jassids, whitefly, *Heliothis* and pink bollworm with the mean air temperature and relative humidity. Jassids and white fly incidence was observed at vegetative stage and population increased with the advancement of the season attaining peak at maximum leaf area stage. The incidence of *Heliothis* and pink bollworm was recorded at flowering and boll formation stages respectively. The optimum temperature and humidity range for population build up of cotton pests were respectively from 27 to 34ºC and from 52 to 80 percent for jassids, from 25 to 30ºC and from 40 to 58 percent for whitefly from 20 to 24ºC and from 46 to 60 percent for *Heliothis* and from 22 to 23ºC and from 52 to 72 percent for pink bollworm during the growing season. Work on insect pest damage in forest nurseries of Rajasthan has been done by Kumar & Ahmad (1997) who recorded 24 insect pests. The authors observed that the maximum period of infestation ranged from July to October for most of the insect pests when the activity was at its peak. However, few insects were found to be active throughout the year, chafers were active during May to July. Multiple correlation studies were carried out by Prasad & Logiswaran (1997) in winter and summer to understand the influence of weather factors on population insect pests on brinjal at Madurai, Tamil Nadu. The incidence of damage by fruit and shoot borer revealed significant positive association with maximum temperature and relative humidity and negative association with minimum temperature during winter. In summer significant positive association was observed with relative humidity and rainfall. In winter the population of whitefly showed significant positive association with maximum temperature, relative humidity and wind velocity while during summer a significant negative association was observed with rainfall. Studies were carried out to know the seasonal incidence and distribution of the pest *Mylabris* by Singh (2001) and the study revealed that the beetles were initially seen in the first week of October. An increasing trend in the population and the peak was observed during October, declining thereafter and no population was seen after first week of November. A similar trend was also documented during the present study.

Thanki et al. (2003) studied population dynamics of leaf eating caterpillar *Spodoptera litura* Fabricius on castor *Ricinus communis* L. cultivated in agroclimatic conditions of Gujarat. The higher eggs and larval populations as well as leaf damage caused by *S. litura* to castor plants was found in the third and fourth week of November, where as the lower population and leaf damage was observed in the first and second week of October. Among the various abiotic factors minimum temperature, vapour pressure (morning & evening) and RH (evening) were found most influencing factors which showed negative effect on oviposition behaviour and larval development of *S. litura.* The maximum temperature showed significant negative influence on oviposition by *S. litura.* The experiments conducted at Research farm of Rajendra Agricultural University, Bihar, Pusa (Samastipur) during 1998-99 on pigeonpea *Cajanus cajan* (I) Millsp yielded a good amount of information on the trend of population build up of the borer species. The larval population/plant gradually increased from February (7^{th} standard week) till the first half of April (13^{th} standard week). Among the borers, the population of *H. armigera* and *A. claviceps* remained dominant. The maximum-minimum temperatures and relative humidity recorded at morning, evening and mean were found to be highly correlated with that of larval population of *M. obtuse*, *M. testulalis* and borer complex while, *H. armigera* remained unaffected as observed by Kumar et al. (2003). Jayappa et al. (2003) carried out a survey of insect pests of soybean during kharif and summer at Bangalore and observed the occurrence of 6 orthopteran species attacking the crop at different stages of crop growth. The field cricket *Gryllus sp.*, occurred only at seeding stage during both kharif and summer, the surface grasshopper *Chrotogonus* sp. damaged crop from seedling to pod maturing stage and up to pod setting stage in kharif and summer respectively, the population of paddy small grasshopper *Oxya* sp. ranged from 0.1 to 0.4 per sweep and reached peak at pod setting stage during kharif, the cotton grasshopper *Cyrtacanthacris tatarica* (Linn.) infested the crop from seedling to pod setting stage and up to harvesting in kharif and summer respectively, the green tobacco grasshopper *Attractomorpha crenulata* (Fab.) was found to feed on the crop in kharif from vegetative to flowering stage, similarly spotted grasshopper *Pyrgomorpha bispinosa* (Walk.) was found to attack the crop in kharif during vegetative and flowering stages. Sekhar &

Ramamurthy (2003) studied spatial distribution of grey weevil *Myllocerus undecimpustulatus* on soybean. It followed random distribution in the early stages and aggregated distribution in the later stages of crop growth. Poisson and negative bionomial models gave good fit to explain the weevil distribution on soybean respectively. Heavy rainfall in the preceding week followed by bright sunshine favoured build-up of grey weevil on soybean.

Pathak & Rizvi (2003) studied the different life parameters of the *Papilio demoleus* on two host plants viz., lemon and narangi and one alternate host plant, viz., *bel* at three different temperature regime i.e., two constant (30 ± 1^o C and 25 ± 1^o C) and one fluctuating (25/30 ± 1^o C). Highest apparent mortality of 23.91% was recorded at early stage on *bel* at 25/ 30 ± 1^o C. Generation survival fraction revealed that lemon was the most favourable host for overall survival of the insect. Maximum indispensable mortality (21.37) was encountered at early larval stage on *bel* at 25/30 ± 1^o C as compared to other stages. Data for k-values exhibited the highest value (0.12) on *bel* at early larval stage at 25/30 ± 1^o C, while the lowest (0.00) was encountered at pre-pupal and pupal stages, irrespective of host plant and temperature.

Mohapatra et al. (2004) studied influence of various weather factors on the incidence of cotton bollworms at Umerkote (Orissa). The study revealed positive relationship between population build up of *Earias vittella* and *Helicoverpa armigera* with mean maximum, minimum and average temperature whereas negative correlation between temperature and population build up of *Pectinophora gossypiella* indicated favourability of low temperature to this gelucid species. The morning and evening relative humidity and rainfall had adverse effect on all the three bollworm species as the relationship between them was negative. Tiwari & Rahalkar (2005) studied life cycle of *Helicoverpa armigera* at different temperatures i. e. 15ºC, 20ºC, 25ºC, 30ºC, 35ºC under laboratory conditions. The temperature showed significant negative correlation with different developmental stages i. e. incubation period, larval period and pupal period. While the hatchability and number of fed pod per day exhibited significant positive correlation with temperature and duration of feeding on the pod decreased due to short larval period. All these earlier findings support the present study.

Bhardwaj et al. (2014) recorded insect visitors to inflorescence of coriander in an agro-ecosystem, while, Bhardwaj & Srivastava (2012) documented insects on cucurbit crops and reported various insect orders on them. Sima et al. (2012) in another study noted floral visitors on different crops from desert region, while, Bhardwaj et al. (2012) documented hymenopteran floral visitors. Similarly, Sima et al. (2010) have surveyed the lepidopteran fauna. Entomo-fauna associated with Bajra crop have been documented by Sima & Srivastava (2012). A survey has also been conducted to compare the insect fauna collected employing two different methods of collection (Sima & Srivastava, 2014).

A positive relationship between number of Syrphid sp. and their abundance has also been observed by Sajjad & Saeed (2010). According to them abiotic i.e., availability of prey and floral resources or biotic (temperature, day length etc.) factors equally affect the abundance and diversity of Syrphid species. They further observed the syrphid flies to visit eight plant species belonging to Asteraceae six to Fabaceae, three each to Cucurbitaceae, Apiaceae and Brassicaceae. According to Jadav & Sathe (2014) the blow flies population increased during the monsoon season as compared to winter and summer season and diversity of blow flies was found to decrease with increase in altitude in the Western Ghats. All these reports corroborate the present findings. The results suggest that the fluctuations in insect populations are definitely effected by abiotic factors.

References

Banerjee, B. 1972. Rainfall and pest activity, "Two and a Bud". *Half year Newsletter*. The Tea Research Association, Toklai Experimental Station, Jorhat, 19(1): 44-45.

Bhardwaj, Harshwardhan, Thaker, Parul and Srivastava, Meera 2012. Hymenopteran floral visitors as recorded from an agro-ecosystem near Bikaner, Rajasthan. *Global J. Sci. Front. Res. Agric. Bio.* 12 (3): 19-34.

Bhardwaj, H. & Srivastava, Meera 2012. A study on insect visitors of certain cucurbit vegetable crops in an agro-ecosystem near Bikaner, Rajasthan, India. *Journal Academica*, 2(3): 99-126.

Bhardwaj, H., Dheeraj Bhati and Meera Srivastava 2014. Insect visitors to inflorescence of *Coriandrum sativum* as observed in an agro-ecosystem near Bikaner, Rajasthan (India). Asian Academic Research Journal of Multidisciplinary, 1 (27):396-408.

Bhargava, R.N. 1996. Grylloid fauna of Thar Desert. In: *Faunal diversity in the Thar desert: Gaps in Research.* Eds. Ghosh, A.K., Baqri, Q.H. and Prakash, I. Scientific Publ., Jodhpur.pp. 410.

Bhathal, J.S. & Dhaliwal, G.S. 1991. Studies on the population dynamics of white backed plant hopper and its natural enemies on rice. *Indian J. Ent.*, 53(1): 134-140.

Bhattacharyya, A. & Mandal, S.K. 2004. Population dynamics and relative density of coccinellid predators of *Aphis gossypii* Glov. infesting Taro. *Indian J. Ent.*, 66(2): 153-154.

Bijur, S. & Verma, S. 1995. b. Sequential appearance of insect pests and natural enemy complex on pea crop. *Indian J. Ent.*, 57(4): 337-377.

Bilapate, G.G., Pawar, V.M. and Raodev, A.K. 1977. Growth of population of *H. armigera* Hub. On Lucerne. *Indian J. agric. Sci.*, 47: 540-541.

Bishnoi, O.P., Singh M., Rao, V.U.M., Ram Niwas and Sharma, P.D. 1996. Population dynamics of cotton pests in relation to weather parameters. *Indian J. Ent.*, 58(2): 103-107.

Choudhary, R., Singh K.M. and Singh, R.N. 1986. Pest complex and succession of insect pests in *Sesamum indium* Linn. *Indian J. Ent.*, 48(4): 428-434.

Falerio, J.R., Singh, K.M. and Singh, R.N. 1990. Influence of abiotic factors on the population build up of important insect pests of cowpea *Vigna unguiculata*(L.) Walp. and their biotic agents recorded at Delhi. *Indian J. Ent.*, 52(4): 675-680.

Fitt, G.P. 1989. The ecology of Heliothis species in relation to agro-ecosystems. *Ann. rev. Ent.* 34: 17-52.

Gupta, B.D. 1959. Insect pests of sugarcane in India 1. The sugarcane root borers, *Emmalocera depressela* Swin. *Indian Sug*., 8: 775-782.

Gupta, B.M. & Yadava, C.P.S. 1993. Distribution pattern of white grub, *Holotrichia consanguinea* Blanch in semi-arid Rajasthan. *Indian J. Ent.,* 52(3): 465-469.

Gupta, P.K. & Singh, J. 1993. Population studies on insect pests of green gram (*Vigna radiate* (L.) Wilczek). *Indian J. Ent.*, 55(1): 45-51.

Jadav, D. & Sathe, T.V. 2014. Altitudinal Diversity of Forensic Blowflies (Diptera: Calliphoridae) of Western Ghats (Maharashtra). *Forensic Research*., 5(6): 251-254.

Jayappa, A.H. Kumar, N.G. and Srinivas, K.M. 2003, Insect Environment, 9(1): 2.

Kadu, N.R., Radke, S.G. and Borle, M.N. 1987. Effect of temperature on the development of *Heliothis armigera* (Hubner). *Indian J. Ent.,* 49(4): 535-543.

Katiyar, K.N. 1982. Incidence of cotton bollworm vis-a-vis ecological factors. *Indian J. Ent.,* 444(2): 125-128.

Khanna, S.S. & Sharma, S.S. 1969. Root borer, *Emmalocera depressela* Swinh. A serious pest of sugarcane in east. U.P. *Indian Sug.,* 19: 582-589.

Kim, Ke Chung 1993. Biodiversity, conservation and inventory: why insects matter. *Biodiversity and Conservation*, 2 (3); 191-214.

Kumar S. & Ahmed, S.I. 1997. Insect pests of forest trees in nurseries of Rajasthan. *Indian J. Ent.* 59(3): 331-335.

Kumar, S., Ahmed, S.I. and Chouhan, S. 1996. *Myllocerus laetivirens* Marshall (Coleoptera: Curculionidae), a new pest record on neem in arid zone of India. *Indian J. Ent*., 58(2): 195-197.

Kumar, S., Sankar, M., Sethuraman and Musthak, A. 2009. Population dynamics of white grub (Coleoptera: Scarabaeidae) in the rose environment of northern Bangalore, India, *Indian Journal of Science and Technology*, Vol. 2(1): 46-52.

Kumar, S., Singh, B. and Singh, P. P. 2003. Population build up and seasonal abundance of Borer species *Cajanus cajan Indian J. Ent*., 65(3): 379-381.

Levin, L., Ranjith, A.M. and Maicykutty P. Mathew. 2004 Record of *Helicoverpa armigera* (Hubner) on Amaranthus in Kerala. *Insect Environment*, 10(3): 108-109.

Mall, N.P., Pandey, R.S., Singh S.V. and Singk S.K. 1992. Seasonal incidence of insect pests and estimation of the losses caused by shoot and frit borer on brinjal *Indian J. Emt.*, 54(3): 241-247.

Miller, Jeffrey,C. 1993. Insect natural history, multi species interactions and biodiversity in ecosystems. *Biodiversity and Conservation*, 2(3):233-241.

Mohapatra, L.N., Senapati, B. and Sahu, B.B. 2004. Influence of weather factors on the incidence of cotton bol worms. *Indian of Entomology.*, 66(1): 85-87.

Pai, K.M. & Dhuri, A.V. 1991. Incidence of insect pest in early variety of cowpea, *Vigna unguiculata* (L) Walp. *Indian. J. Ent.*, 53(2): 329-331.

Parker, M.W. 1946. Environmental factors and their control in plant experiments. *Soil Sci.*, 62-109.

Pathak, M. & Rizvi, P.Q. 2003. Effect of different tempreatures and host plants on the Developmental Behaviour of Lemon Butterfly, *Papilio demoleus. Indian J. Ent.*, 65(4): 496-499.

Prasad, G.S. & Logiswaran, G. 1997. Influence of weather factors on population fluctuation of insect pests on brinjal at Madurai, TamilNadu. *Indian J. Ent.*, 59(4): 385-388.

Radke, S.G. & Undirwade, R.S. 1981. Seasonal abundance and insecticidal control of shoot and fruit borer, *Earias* spp. on okra *Abelmoschus esculentus* (Linn.) *Indian J. Ent.*, 43(3): 283-287.

Ramjan, M., Singh, D., Singh, G., Mann, G.S. and Bhalla, J.S. 1990. Comparative development and seasonal abundance of hadda beetle, *Henosepilachna viginitioctopunctata* F. on some solanaceous host plants. *J. Res. Punjab Agric. Univ.* 27: 253-262.

Reddy, A.S., Rosaiah, B. and Bhaskara Rao T. 1989. Seasonal occurrence of white fly (*Bemisia tobaci)* on cotton and its control. *Andhra Agric.J.*, 36: 275-269.

Rote, N.B. & Puri, N. 1991. Population dynamics of whitefly, *Bemisia tabacia* on cotton and its relationship with weather parameters, *J.Cotton Res. Dev*., 5(2): 181-189

Sachan, J.N. & Gangwar, S.K. 1990. Seasonal incidence of insect pests of cabbage, cauliflower and Knol-Khol. *Indian J.Ent*., 52(1) : 11-124.

Saigal, D. 2002. A study on entomofauna and its ecology in some agroecosystem in the arid around Bikaner (NW Rajasthan). Ph.D Thesis, Maharshi Dayanand Saraswati University, Ajmer. pp. 1-129.

Sajjad, Asif & Saeed, Shafqat 2010. Floral hostplant range of syrphid flies (Syrphidae: Diptera) under natural conditions in Southern Punjab, Pakistan. *Pak.J.Bot*., 42(2): 1187-1200.

Sardana, H.R. 1986. Preliminary studies on the prevalence of insect pests and their natural enemies on cowpea a crop in relation to weather factors at Delhi. *Indian J. Ent*., 48(4): 448-458.

Sekhar, J.C. & Ramamurthy, V.V. 2003. Spatial distribution of grey weevil *Myllocerus undecimpustulatus* in soybean. *Indian J. Ent*., 65(2): 233-236.

Sharma, A. N. 1990. Insect pests of soybean. In technology for increasing soybean production in India, *NRCs for soybean Tech: Bulletin*. 17-21.

Sharma, Manju & Srivastava, Meera 2010. Lepidopteran fauna of an agro-ecosystem in Western Rajasthan: A short-term surveillance. *J. ent. Research*, 34 (3): 249-258.

Shukla, R.P. 1989. Population fluctuation of *Leucinodes orbonalis* Guen. and *Amrasca biguttala* Ishida on brinjal in relation to abiotic factors in Meghalaya. *Indian J. Agri. Sci*., 54: 260-264.

Singh, H. & Singh G. 1975. Biological studies on *Heliothis armigera* (Hubner) in the Punjab. *Indian J. Ent.*, 52(3): 435-437.

Sima & Srivastava, Meera 2012. Entomo-fauna associated with Bajra crop as observed in an agro-ecosystem in Rajasthan, India. *International Journal of Theoretical & Applied Sciences*, 4(2): 109-121.

Sima, Dheeraj Bhati and Meera Srivastava 2014. Floral visitors of different crops as recorded from an agro-ecosystem near Jhunjhunu, Rajasthan (India). *International Journal of Science and Research*, 3(9): 1732-1738.

Sima & Meera Srivastava 2014. A comparative study of insect collection made by employing two different methods of collection in an agro-ecosystem near Jhunjhunu, Rajasthan (India). *International Journal of Science and Research*, 3(9): 1739-1748.

Singh, K.M. & Singh, R.N. 1977 a. The upsurge of *Myllocerus undercimpustulatus maculosus* Desb. on pearl-millet under dryland condition at Delhi. *Indian J. Ent.*, 39(3): 300.

Singh, T.V.K. Singh, K.M. and Singh, R.N. 1990b. Groundnut pest complex: IV. Regression studies to determine the association ship between jassid and thrips and weather parameters. *Indian J. Ent*. 52(4): 693-701.

Singh, U.C. 2001. Upsurge of bilster beetles (*Mylabris pustulata* and *Mylabirs phalerata*) on pigeon pea in Northern Madhya Pradesh. *Indian J.Ent.*, 63(1): 103-104.

Singh, T.V.K., Singh, K.M. and Singh, R.N.1990c. Groundnut pest complex iii. Incidence of insect pests in relation to agro-climatic condition as determined by graphical super imposition technique. *Indian J.Ent*. 52(4): 686-692.

Thanki, K.V., Patel, G.P. and Patel, J.R. 2003. Population dynamics of *Spodoptera litura* on castor, *Ricinus communis. Indian J. Ent*., 65(3): 347-350.

Tiwari, A. & Rahalkar, S. 2005. Effect of temperatures on the life cycle and feeding activity of Gram pod borer *Helicoverpa armigera* (Hunbner). *Indian J. Ent*., 67(1): 12-15.

Walker, B.H. 1992. Biodiversity and ecological redundancy. *Conservation Biol*., 5: 18-23.

Zaz, G.M. & Kushwaha, K.S. 1983. Quantitative incidence of tobacco caterpillar, *Spodoptera litura* (F.) and related natural enemies in cole corps. *Indian J. Ent*., 45(2): 201-202.

Table1. Dynamics of entomo-fauna (number/trap*) population as observed during the period of study

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Ap(r)
Order:Lepidoptera																
Family:Danaidae																
Danaus chrysippus Linn.	4	3	1	3	7	5	4	4	11	10	9	13	4	4	3	2
Family:Lycaenidae																
Lampides boeticus Linn.	7	7	4	3	1	2	2	3	4	5	10	10	7	3	3	-
Zizina sp.	5	4	3	1	4	3	4	6	7	10	9	8	8	6	3	3
Family:Pieridae																
Eurema hecabe Linn.	8	8	4	3	3	3	2	5	12	10	9	8	7	3	2	2
Anaphaeis aurota Fab.	6	2	1	-	2	2	-	1	3	3	5	4	4	2	-	-
Catopsila pomona Cramer	1	2	4	4	3	2	2	2	7	7	9	9	1	1	-	-
Colotis vestalis Butler	2	1	2	1	6	5	1	1	5	4	5	5	2	1	1	-
Colias fieldii Menetries	3	2	-	-	5	3	2	-	7	5	2	3	2	2	-	-
Family:Hesperiidae																
Hesperilla ornata Leach.	-	3	-	-	-	-	-	1	-	-	-	-	6	1	-	-
Family:Crambidae																
Leucinodes orbonalis Guenee	-	-	-	-	-	-	-	-	4	4	1	1	-	-	-	-
Cnaphalocrocis medinalis Guenee	2	6	5	2	8	12	8	11	16	14	8	1	2	2	1	-
Cryptographis indica Saunders	7	6	4	-	3	3	3	5	4	-	3	8	7	8	5	6
Hymenia recurvalis Fab.	-	7	3	15	24	23	27	24	15	13	13	8	-	6	-	-
Hymenia sp.	5	-	11	9	14	10	1	1	6	-	3	1	4	-	3	-
Family:Geometridae																
Tephrina sp.	3	2	5	5	2	2	9	17	20	25	29	5	8	6	6	5
Family:Sphingidae																
Acherontia styx	-	-	-	-	-	-	2	-	-	-	-	3	-	-	-	-
Family:Arctidae																
Utethesia pulchella Linn.	15	14	23	19	18	18	7	5	4	3	10	10	9	6	13	19
Family:Noctuidae																
Heliothis peltigera Schiff	8	8	6	7	18	18	17	15	23	18	11	11	5	6	3	3
Spodoptera exigua Hubner	9	9	5	3	4	-	-	2	14	15	19	26	4	9	3	2
Agrotis ipsilon Hufnagel	12	11	1	19	16	2	12	15	22	29	8	17	11	1	3	3
Pericallia ricini Fab.	-	3	-	-	1	3	-	-	-	-	-	-	-	2	-	-
Unidentified sp. A	8	8	-	6	9	-	20	25	25	20	-	7	6	-	6	-

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Ap
Unidentified sp. B	-	-	-	6	-	-	-	-	-	8	-	-	-	-	-	4
Order:Coleoptera																
Family:Cicindelidae																
Cicindella sp.	4	2	6	7	9	15	16	7	11	17	15	3	6	7	5	3
Family:Carabidae																
Unidentified sp. A	10	9	1	3	-	8	12	-	-	2	9	7	6	4	5	7
Family:Scarabaeidae																
Anomala bengalensis Blanch.	9	6	8	5	16	2	-	10	16	8	17	8	6	5	5	7
Onthophagus catta Fab.	11	12	4	5	15	16	21	18	15	11	4	9	7	6	10	1
Onthophagus bonasus Fab.	5	3	10	3	7	1	16	18	19	8	14	9	5	10	4	3
Adoretus sp.	3	6	8	8	5	7	12	10	4	8	8	3	5	6	9	7
Ochodeus sp.	4	9	8	7	10	8	9	4	4	3	6	10	3	2	5	9
Peltonotus nasutus Arrow	5	7	-	8	1	1	14	14	13	8	2	10	11	6	8	-
Apogonia ferruginea Fab.	7	2	7	12	11	2	10	13	12	11	12	10	9	4	3	3
Unidentified sp. B	12	7	-	7	2	1	-	-	2	10	4	2	4	8	8	-
Family:Elateridae																
Melanotus sp.	-	-	-	4	-	-	-	2	-	-	12	15	-	-	-	-
Family:Coccinellidae																
Coccinella septempunctata Linn.	6	6	5	12	4	9	3	16	17	8	11	21	16	13	5	3
Menochilus sexmaculatus Fab.	3	9	10	1	5	9	5	4	6	6	-	3	7	10	9	5
Family:Meloidae																
Cylindrothorax pictus Fab.	10	7	6	6	8	1	12	15	18	18	12	11	4	-	4	2
Family:Cerambycidae																
Plocaederus sp.	1	-	-	2	2	-	-	1	-	-	-	-	1	-	-	-
Family:Curculionidae																
Hypolixus truncatulus Fab.	1	1	-	3	7	6	6	-	15	11	1	-	4	2	2	2
Myllocerus sp.	1	-	1	1	-	-	-	-	-	-	-	-	-	-	2	3
Ordar:Hymenoptera																
Family:Ichneumonidae																
Enicospilus sp.	-	-	-	-	6	4	1	1	6	4	8	7	13	10	2	-
Family:Scoliidae																
Campsomeris sp.	5	5	-	1	7	6	2	3	2	3	8	10	3	4	1	-
Scoliasoror sp.	5	3	2	1	4	4	2	-	2	3	5	8	6	5	-	-
Family:Formicidae																

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Ap
Dolichoderus affinis Emery	9	8	-	-	3	3	1	5	6	2	6	8	8	8	3	-
Formica sp.	10	9	1	-	5	4	-	-	9	7	9	7	9	7	1	1
Dorylus sp.	5	5	6	6	-	-	-	8	9	8	8	9	-	-	-	-
Camponotus vagus	-	-	-	-	5	7	1	1	-	-	-	-	-	-	-	-
Family:Pompilidae																
Pepsis sp.	6	5	-	-	4	7	1	1	2	2	8	11	3	7	-	-
Family:Vespidae																
Polistes carolina	10	8	-	-	6	6	-	-	9	7	14	14	9	8	-	1
Polistes sp.	-	-	-	-	3	1	2	1	-	-	-	-	1	1	-	-
Family:Sphecidae																
Prionyx sp.	7	2	-	-	2	2	1	2	3	3	-	1	5	1	1	-
Family:Halictidae																
Halictus sp.	8	7	-	1	5	3	1	2	5	8	9	8	9	3	1	2
Family:Apidae																
Xylocopa fenestrata Fab.	12	8	5	3	13	9	2	1	6	11	10	12	14	6	1	3
Xylocopa violacea Linn.	5	5	2	-	6	9	2	-	9	5	4	7	5	4	-	-
Apis cerana Fab.	10	10	6	2	5	6	7	5	7	9	7	12	11	12	3	-
Apis mellifera Linn.	14	11	2	4	14	13	-	1	7	8	14	16	15	13	-	2
Apis dorsata Fab.	5	4	1	-	10	6	2	1	-	8	9	12	4	4	1	-
Apis florea Fab.	6	5	1	-	5	6	-	8	11	14	11	13	6	5	-	-
Amegila cingulata Fab.	5	1	-	-	-	-	-	-	-	-	-	1	5	3	2	-
Unidentified sp. A	8	7	1	2	5	6	-	1	5	6	3	7	9	6	2	-
Unidentified sp. B	7	4	-	1	4	4	-	-	5	5	7	6	4	7	-	-
Unidentified sp. C	8	-	-	-	7	6	-	-	7	6	7	4	1	7	2	-
Order:Hemiptera																
Family:Miridae																
Unidentified sp. A	1	5	-	-	-	-	-	2	-	-	-	-	-	-	1	-
Family:Pyrrhocoridae																
Dysdercus cingulatus Fab.	4	6	14	14	6	5	7	3	4	4	8	6	7	4	2	3
Dysdercus koenigii Fab.	2	5	2	4	-	-	1	2	2	5	6	3	2	2	2	4
Family:Coreidae																
Clavigrella sp.	3	2	3	1	6	3	6	5	3	1	1	3	12	4	4	2
Family:Pentatomidae																
Nezara viridula Linn.	7	9	11	6	5	5	5	5	12	10	4	2	8	4	6	2

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Ap
Bagrada hilaris Burmeister	3	6	5	-	2	4	2	2	2	-	2	1	-	3	-	1
Alcaeus sp.	1	2	3	1	4	3	6	1	1	2	3	-	-	3	2	2
Aspongopus janus Fab.	2	1	2	2	2	4	4	2	-	-	-	-	2	2	-	1
Andrallus spinidens Fab.	-	-	-	-	4	2	2	1	8	3	5	3	-	-	-	-
Piezodorus sp.	2	-	2	2	1	1	1	1	7	7	3	1	-	-	-	-
Oncocephalus sp.	1	1	1	1	5	3	2	4	7	3	7	-	1	2	2	-
Unidentified sp. B	-	1	4	4	6	4	5	5	5	5	1	1	8	2	3	1
Unidentified sp. C	3	5	1	1	-	-	-	-	4	6	4	-	-	1	1	2
Order:Orthoptera																
Family:Gryllidae																
Acheta domesticus Linn.	4	2	4	-	3	-	2	4	2	3	2	2	-	-	1	1
Gryllus assimilis Fab.	3	3	6	4	1	1	1	1	3	2	2	-	7	4	5	1
Family:Acrididae																
Chrotogonus sp.	4	3	6	4	6	5	3	2	5	4	-	3	2	-	2	1
Schistocerca gregaria Forskal	5	4	2	2	2	1	4	2	1	2	2	3	1	-	-	-
Ochrilidia sp.	2	2	1	4	-	2	1	1	3	2	5	4	2	1	3	3
Oxya chinensis Thunberg	2	1	3	3	1	2	7	3	1	1	3	3	4	3	1	-
Acrida sp. Linn.	-	-	2	-	-	-	-	-	-	-	-	-	1	1	1	1
Family:Pyrgomorphidae																
Pyrgomorpha sp.	2	1	2	4	4	1	-	-	4	4	1	3	4	3	1	2
Atractomorpha sp.	1	-	1	1	3	2	3	1	4	6	3	-	4	3	3	-
Unidentified sp. A	-	2	1	2	3	1	3	2	-	2	5	3	1	1	1	4
Order:Odonata																
Family:Lestidae																
Lestes sp.	-	-	-	-	-	-	-	-	1	2	1	-	-	-	-	-
Family:Coenagrionidae																
Agriocnemis femina Brauer	3	2	-	3	3	1	2	-	3	1	-	5	2	-	2	3
Rhodischnura nursei Morton	-	4	-	2	1	-	-	1	2	-	-	-	-	1	-	1
Family:Libellulidae																
Bardinopyga geminata Ramer	-	-	3	5	1	1	-	1	-	-	3	3	2	4	3	-
Pantala flavescens Fab.	-	-	3	-	-	-	-	-	2	2	3	3	3	2	1	-
Order:Diptera																
Family:Culicidae																
Culex quinquefasciatus Say	39	37	40	37	47	51	46	40	64	55	46	37	34	34	41	4[illegible]

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Ap
Family:Asilidae																
Stichopogon sp.	8	4	5	5	2	2	7	7	4	6	6	1	-	4	6	5
Family:Syrphidae																
Syrphid fly	1	1	6	4	4	2	5	4	3	7	2	1	-	3	1	-
Family:Calliphoridae																
Chrysomya megacephala Fab.	5	5	2	1	4	7	4	3	-	-	-	-	2	3	1	-
Chrysomya rufifacies Mucuqurt	2	4	4	4	4	7	6	1	-	-	-	-	6	-	4	2
Family:Tephritidae																
Dacus cucurbitae	5	2	3	2	6	6	3	1	5	5	1	1	3	4	4	3
Family:Sarcophagidae																
Sarcophaga peregrina	7	10	14	9	9	5	6	7	14	11	15	7	8	10	10	9
Family:Muscidae																
Musca domestica Fab.	14	9	9	10	16	16	13	11	18	15	11	7	10	11	6	3
Unidentified sp. A	-	-	1	1	-	-	-	-	2	2	2	-	2	2	3	2
Order:Dictyoptera																
Family:Blattidae																
Periplaneta americana Linn.	5	-	3	-	-	-	-	5	2	-	-	-	-	-	-	2
Family:Mantidae																
Mantis religiosa Linn.	1	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-
Deiphobe incise Werner	-	-	-	1	-	-	-	-	1	-	-	-	-	-	1	-

* Average of all the six crop fields

D-Dominant, D>100 F-Frequent, 100 >D>25 R-Rare R≤25