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Diversity of Insect pests associated with *Bhut jolokia* (*Capsicum chinense* Jacq.) in Assam condition

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Abstract

Bhut Jolokia is one of the most sought after chilli because of its pungency due to high capsaicin content which production affected to a great extent by the infestation of insect pests. Insect pest associated with this crop recorded at weekly interval at *rabi* season for two consecutive year 2017-18 and 2018-19 at Horticultural Research Farm of Assam agricultural University located at Jorhat, Assam to find out the insect pest and natural enemies associated with the crop and a total of 23 insect pest found to be affecting the crop during the studies and among it twenty two pests under class Insecta while one under Arachnida. Among the insect pest order Hemiptera found to be dominant pest in terms of relative abundance in both years 43.47 and 42.85 per cent. In diversity studies, Simpson's index and Shannon-Weaver's index revealed clearly that the pests were quite diverse with evenly distributed having low dominance of any particular species. During the study, 14 nos. of natural enemies associated with the crop of which 7 nos. under class Insecta and 7 nos. under Arachnida, while 12 nos. of casual visitor under class Insecta.

Keywords: Aphid, *Bhut Jolokia*, diversity indices, mite, thrips, whitefly

1. Introduction

Bhut Jolokia (*Capsicum chinense* Jacq.) is an important chilli cultivated to a wide extent especially in Assam, Nagaland Manipur and Arunachal Pradesh of north eastern region of India. It is most sought after chilli, cultivated in this region because of its titillating pungency and aroma. Because of its high capsaicin content it demand increase several fold after it was reported as World's hottest chilli during 2006 by Guinness Book of World Record ^[1], although later it was replaced by other chilli and at present in the list of hotness it occupies 7th position. In Northeast India, there are two planting time, *Kharif* and *Rabi*. *Kharif* cultivation is mainly done in the hilly states of the region which starts in February - March and harvesting is done from May-June onwards. As a *Rabi* crop, it is grown in the plains of Assam during September-October onwards. *Bhut Jolokia* has got great export potential besides huge demand in domestic market. However, like other chilli varieties it also suffered from several production constraints which leads to poor yield. A number of limiting factors had been attributed for low productivity in the growing areas among them damage caused by insect pests as well as occurrence of viral diseases were significant one. The diversity, prevalence and build-up of insect pests mostly governed by the crop and also by weather parameters. In North Eastern region, *Bhut Jolokia* being cultivated as monoculture which leads to very high pest build up. In Assam, cutworm (*Agrotis ipsilon* Hufnagel), aphid (*Aphis gossypii* Glover), thrips (*Schirtothrips dorsalis* Hood) and mite (*Polyphagotarsonemus latus* Banks) were the major pests, while, flea beetle (*Monolepta signata* Oliveir) and jassid (*Amrasca biguttula biguttula* Ishida) were minor ones under Jorhat condition ^[2].

As *Bhut Jolokia* being cultivated in different location of North Eastern India there is great variation in agro climatic conditions in various regions, the pests showed varying degree and trends in their distribution, incidence, nature and extent of damage to the crop. Knowledge on diversity, distribution and peak period of incidences could help in adopting pest management practices more effectively with less dependence on highly toxic chemical insecticides in the field. Based on these, an investigation was carried out to study the insect and mite diversity and their build up in Assam condition.

2. Materials and methods

2.1 Study site

The experiment was carried out at Horticultural Research Farm of Assam agricultural University located at Jorhat, Assam during 2017- 19 for two consecutive years. The geographical details of the site were 26°47' N latitude and 94°12'E longitude at an elevation of 86.8 m above mean sea level and the area conducted. The topography of the experimental plot was uniform with mostly alluvial and sandy loam soil and the region falls under Upper Brahmaputra Valley Zone of Assam.

2.2 Raising of seedling

Seedlings of *Bhut Jolokia* cultivar "King" was used for the study which was more predominantly used by the farming community in Jorhat district of Assam and raised in V type nursery of Experimental Farm, Department of Horticulture, College of Agriculture, Assam Agricultural University, Jorhat following all the recommended practices of raising nursery^[3] for both the experimental season (2017-18 and 2018-19). Seedlings at the ages of 20 days after emergence were transferred to polybags covered with agro-shade nets to protect them from initial infestation of insect pests and diseases in the nursery level.

2.3 Experimental layout

The study was conducted in Experimental Farm, Department of Horticulture, College of Agriculture, Assam Agricultural University, Jorhat following Randomized Block Design (RBD) with five treatments and replicated four times. Seedlings age of 6 week transplanted in the raised bed of main field with plot size 3m x 2m at plant spacing of 90 cm between plant and rows, respectively and raised the crop following all the recommended package of practices of AAU^[3] for two consecutive *rabi* seasons (2017-18 and 2018-19), except application of pesticides to manage the incidence of pest.

2.4 Monitoring of insect pests and natural enemies

For monitoring purpose, experimental plots of *Bhut Jolokia* was examined on weekly intervals for counting the insect and mite populations encountered and categorized into target and non-target insects.

The population of the sucking pest *viz.*, aphids, whitefly, thrips and leaf hopper were recorded from ten leaves randomly selected from plants in each plot, considering upper, middle and lower leaves of each plant. Moreover, to determine the population of mites, ten leaves from upper, middle and bottom canopy from each selected plant were plucked and kept in a separate polythene bag which were marked properly and brought to the laboratory to observe the mite population under stereo zoom binocular microscope at 4x magnification. The number of aphids, whitefly, thrips, leaf hoppers and yellow mite recorded from ten leaves was summed up and converted to numbers per three leaves basis.

The population of fruit borer, flea beetle, coccinellid predators and spiders were recorded by counting their numbers on 30 plants selected randomly and expressed in numbers per plant. Different flea beetle and coccinellid predators were counted and their numbers were recorded as grouped in flea beetle and coccinellid predator as a whole for diversity studies. Different spider species encountered during the study were also grouped as Spiders as a whole for diversity study.

2.5 Identification of specimens

The insect – mite pests and other non target insects and natural enemies were identified with the help and guidance of various experts at Department of Entomology, Assam Agricultural University, Jorhat and also sent to NBAIR, Bangalore for unknown species.

2.6 Statistical analysis for monitoring

The mean populations for each insects, mites and natural enemies were calculated in Microsoft Excel. Percentage of number of species encountered was calculated order-wise to find out relative abundance. Diversity, evenness and dominance indices and these were calculated based on the formula mentioned below:

(i) Simpson's index of diversity^[4]

$$\text{Simpson's index (Ds)} = 1 - \frac{\sum n(n-1)}{N(N-1)}$$

Where, n = number of individuals in the nth species
N = total number of individuals in the sample

Reciprocal of Simpson's index of diversity (1/Ds) was used to express the diversity of species so that as the index goes up, so does the diversity.

(ii) Index of species diversity^[5]

Shannon-Weaver's index (H') = - $\sum p_i \log_e p_i$

where, p_i = the proportion of individuals of species i (n_i/N)

n_i = number of individuals in the ith species

N = total number of individuals of all the species

(iii) Evenness index^[6]

Evenness index (J) = H' / loge S

Where, H' = Shannon-Weaver's index

S = number of species

(iv) Index of Dominance^[7]

Index of dominance (D) = 1-J

where, J = Evenness index

3. Results and discussion

3.1 Insect pests of *Bhut Jolokia* and their relative abundance

During the course of study, 23 numbers of pests were found to be associated with *Bhut Jolokia* at Assam Agricultural University, Jorhat, Assam condition and among them the crop was found to be attacked mainly by aphids *Aphis gossypii* (Glover)/*Myzus persicae* (Suzlar), whitefly *Bemisia tabaci* (Gennadius), thrips *Scirtothrips dorsalis* (Hood), mite *Polyphagotarsonemus latus* (Banks), black cut worm *Agrotis ipsilon* (Hufnagel) and fruit fly *Bactrocera dorsalis*. Based on high population as well as their presence during the entire crop period in the field during both the years of study, these insect pests were categorized as major pests, whereas the insect appeared in the crop with negligible population with minor incidence were considered as minor pest. The minor insect species comprised of four species of leaf hoppers *viz.*, *Amarasca biguttula biguttula*, *Empoasca* sp. *Cofana* sp. and *Sogatella* sp. and 3 species of leaf beetle *viz.*, *Monolepta signata*, *Chaetonema* sp. and *Altica* sp. along with other insect pests of minor importance on *Bhut Jolokia* were soft scale

insect (*Coccus* sp.) mealy bug (*Phenacoccus* sp.), leaf miner (*Liriomyza* sp.) tussock caterpillar (*Orvasca* sp.), tobacco cut worm (*Spodoptera litura*), cotton leaf roller (*Hartalodes derogata*), mole cricket (*Gryllotalpa africana*) and tobacco grass hopper (*Attractomorpha crenulata*). During the study, a new invasive pest spiraling whitefly, *Aleyrodicus dispersus* (Russel) was also identified infesting *Bhut Jolokia* for the first time in Assam.

Among different insect pests infesting *Bhut Jolokia*, maximum 11 species under order Hemiptera representing 6 families followed by Lepidoptera with 4 species (3 families), 3 species of Coleoptera (1 family), Diptera and Orthoptera 2 species and each representing 2 families, Thysanoptera and Trombidiformes, 1 species each. In *rabi* season of both 2017-18 and 2018-19, the relative abundance of pest under order Hemiptera found to be highest with 43.47 and 42.85 per cent followed by order Lepidoptera with 17.39 and 14.28 per cent, respectively. Order Coleoptera comprised of 13.04 and 14.28 per cent in 2017-18 and 2018-19, respectively. The relative abundance of order Diptera and Orthoptera were recorded as 8.69 and 9.52 during 2017-18 and 2018-19, respectively, while 4.34 and 4.76 per cent abundance found in case of Thysanoptera. Relative abundance of mite, which comes under family Tarsonemidae and order Trombidiformes found to be only 4.34 and 4.76 per cent (Table 1 and Fig. 1).

The results of the study were in conformity with previous study conducted by other researchers where they already been identified *A. gossypii*, *S. dorsalis*, *B. tabaci* and *P. latus* as key pests, while *A. biguttula biguttula*, *A. epsilon* and *M. signata* were as minor [1&8]. However, in another study on *Bhut Jolokia*, 19 species of pests association was reported in Assam condition [9]. Similar study conducted in Karnataka on chilli reported a total of 57 species of insect and 2 species of mite damaging the crop belonging to 27 families under 9 orders and the major pests included sucking pests, like thrips, *S. dorsalis* (Hood), yellow mite, *P. latus* (Banks) and lepidopteran pests like fruit borer, *Helicoverpa armigera* (Hübner) and *S. litura* (Fabricius) [10&11]. In a study at Izmir province, Turkey it was reported that in pepper, spider mite (*Tetranychus urticae*), aphids (*A. gossypii* and *M. persicae*), whiteflies (*B. tabaci* and *Trialeurodes vaporariorum*), leaf hoppers (*Asymmetrasca decedens* and *Empoasca decipiens*), thrips (*Haplothrips distinguendus*) and leaf miners (*Liriomyza trifolii*) were the key pest [12]. In a study conducted at West Bengal 21 insects and non-insect pests in chilli crop were reported and among those, *P. latus*, *S. dorsalis* were the most devastating pests followed by *A. gossypii* and *B. Tabaci* [13]. Extensive damage by fruit flies (*Bactrocera* sp.) in capsicum also reported from Mizoram [14]. 10 species of insect and mite pests associated with capsicum in Bangalore also indicated the similarity of present findings and the insects were *S. dorsalis*, *M. persicae*, *Trialeurodes vaporariorum*, *Attractomorpha crenulata*, *M. signata*, *Mylocerus discolor*, *Thysanoplusia* sp., *S. litura*, *H. armigera* and one mite pest *P. Latus* [15]. From PAU, Ludhiana 41 arthropod species found to be associated with chilli crop, out of different arthropods, 14 species were identified as pest and natural enemies, 12 species as casual visitors and 1 species as pollinator [16] and they also observed that among the different orders, although Coleoptera occupied maximum share (26.83 %) in arthropod fauna in chilli ecosystem but highest pest of chilli found to be in order Orthoptera followed by Hemiptera. In another study at Pravani, Maharashtra more than 39 genera and 51 species of insects and mites found to be caused damage to chilli crop

and according to them, aphid, *A. gossypii* (Glover), thrips *S. dorsalis* (Hood) and jassids, *A. biguttula biguttula* (Ishida) were the major one [17]. In an earlier study, 19 species of arthropod pests found causing damage to *Bhut Jolokia* and out of which *A. gossypii*, *M. persicae*, *B. tabaci*, *Bactrocera latifrons*, *S. dorsalis* and *P. latus* were identified as major pest causing damage to the *But Jolokia* in Assam condition [9]. The relative abundance of different insect pests of *Bhut Jolokia* during present investigation was almost in conformity with the result of previous worker on *Bhut Jolokia* where he reported that the Hemipteran pests showed the highest relative abundance with 42.86 and 47.06 per cent followed by lepidopteran pests with 21.43 and 17.65 per cent, respectively [9].

3.2 Diversity of *Bhut Jolokia* pest during 2017-18 and 2018-19

Diversity indices of *Bhut Jolokia* pest during the *rabi* season of 2017-18 and 2018-19 were presented in the table 2 and fig.2 respectively. Reciprocal of Simpson's index (1/Ds) of diversity was calculated to be ranged from 1.52 to 2.05 during *rabi* season of 2017-18 and found maximum of 2.05 on January, 2018 and minimum 1.52 in May, 2018. On the other hand, Shannon-Weaver's diversity index (H'), varied from 0.87 to 1.40 with maximum diversity of pest during May, 2018. However, in *rabi* 2017-18, the species were observed to be evenly distributed with evenness from 0.59 to 0.71, whereas low dominance index ranged from 0.28 to 0.41. During 2018-19, the reciprocal of Simpson's index (1/Ds) of diversity ranged from 1.38 to 1.87 and maximum was 1.87 on February, 2019 and minimum of 1.38 in May, 2019. Similarly, Shannon and Weaver's diversity index (H') ranged from 0.95 to 1.54 with maximum diversity during May, 2019. It was found that during 2018-19 also, the species were evenly distributed with low dominance index ranged from 0.21 to 0.47, whereas the higher evenness index ranged from 0.53 to 0.79 throughout the *rabi* season. Overall, in the year 2017-18 and 2018-19, Simpson's index and Shannon-Weaver's index clearly showed that the pests associated with *Bhut Jolokia* were quite diverse with evenly distributed having low dominance of any particular species.

The result of the investigation was more or less similar with the study conducted at PAU, Ludhiana where it was reported that during *rabi* season chilli ecosystem, represented a relatively diverse community of arthropod fauna with Simpson's index values of 4.92 and Shannon Weaver's index of 1.76 in relation to higher evenness index (0.80) which clearly demonstrating that the insect species recorded were more evenly distributed with lower dominance (0.19) [18].

3.3 Natural enemies of insect pests of *Bhut Jolokia*

During the investigation, 14 numbers of natural enemies were recorded, out of which 9 species under class insecta and 5 species were under Arachnid. Among the class insecta, order Coleoptera, family coccinellidae comprised maximum of 7 species viz., *Coccinella transversalis*, *Brumoides suturalis*, *C. septempunctata*, *Micraspis discolor*, *Menochilus sexmaculatus*, *Cryptogonus orbiculus* and *Hermonia dimidiata* followed by order Diptera under family syrphidae with 2 species, *Ischiodon scutellaris* and *Lathyrrophthalmus arvorum*. Among class arachnid, order Araneae with family oxypidae represented two numbers of spider viz., *Oxyopes* sp. and *Lynx* sp., while family Lycosidae, Araneidae and Salticidae had only one each with *Neoscona* sp., *Lycosa* sp.

and *Myrmarachne orientalis*, respectively (Table3). The coccinellid predators were found in *Bhut Jolokia* eco-system, they consumed the small soft bodied insects like aphids and whitefly which were found in abundance than other insect pests of *Bhut Jolokia*. It was observed that Dipteran predator during maggot stage acted as a natural enemy feed upon nymphs and adult of aphids. The result of present study on natural enemy complex on chilli eco-system was in conformity with the report from Raipur, Madhya Pradesh where he mentioned that coccinellids viz., *C. rependa*, *C. septempunctata*, *Chysoperla cornea*, *Brumus* sp. and predatory spiders were preying upon chilli thrips and aphids [19]. In a similar study from Raipur it was reported that 3 major predator Coccinellid (*M. sexmaculatus* and *C. septempunctata*), syrphid (*Syrphus* sp.) and spiders were observed to be associated with insect pests of chilli crop [20]. In previous study conducted on insect pest of *Bhut Jolokia* reported 6 species of coccinellids viz., *C. transversalis*, *C. septempunctata*, *C. sexmaculatus*, *B. suturalis*, *M. discolor* and *H. dimidiata*, associated with the pests of *Bhut Jolokia* [8, 21].

3.4 Casual visitors of *Bhut Jolokia* ecosystem

During the investigation periods, 12 species of insects were found to be as casual visitors of *Bhut Jolokia*. Out of these, 6

species were Hymenoptera (*Ceratina hieroglyphica*, *Occophylla smaragdina*, *Tapinoma* sp., *Polyrachis* sp., *Technomyrmex albipes* and *Dolichoderus* sp.), 3 species belong to Hemiptera (*Cletus punctiger*, *Dysdercus koenigii* and *Leptoglossus phyllopus*), whereas one each from Diptera, Blattodea and Orthoptera and they were *Chrysomya megacephala*, *Blattella* sp. and *Trilophidia annulata*, respectively (Table4).

The study was in conformity with the experiment conducted on insect visitor of chilli, from Ludhiana Punjab [16], reported 12 species as casual visitor and 1 species as pollinator, while in case of *Bhut Jolokia* from Assam, 27 species of insects as casual visitors and out of which 10 species were Hymenopteran, 6 species Hemipteran, 4 species belongs to Diptera and coleoptera each and 2 species of Lepidoptera and 1 species Orthoptera [9].

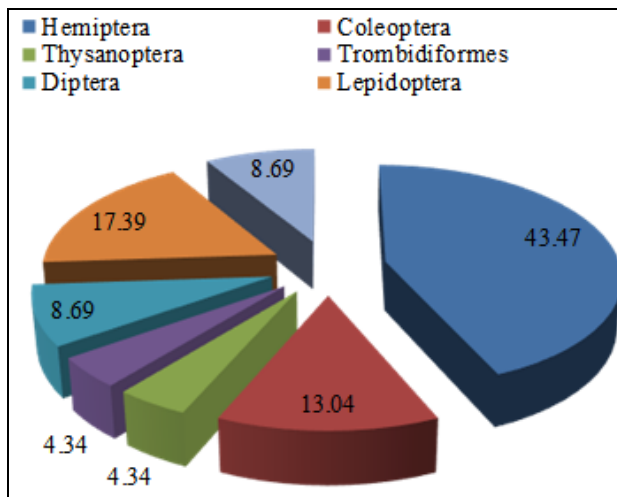
Researchers working on *Bhut Jolokia* reported various insect pests infesting the crop, however, diversity study of insect pests associated with this crop in Assam condition might definitely help to know the status of insect pests in different growth stages of the crop and this leads utilization the services of the beneficial insects in natural condition along with formulating proper management practice for keep the insect pests infestation at check.

Table 1: Order wise relative abundance of insect pests of *Bhut Jolokia* in rabi season (2017-18 and 2018-19)

S. No.	Order	Common Name	Scientific name	Family	Crop stage	Status	2017-18	2018-19
1.	Hemiptera	Cotton aphid	<i>Aphis gossypii</i> (Glover)	Aphididae	Seedling to maturity	Major	√	√
		Green peach aphid	<i>Myzus persicae</i> (Sulzar)	Aphididae	Seedling to maturity	Major	√	√
		Silver leaf whitefly	<i>Bemisia tabaci</i> (Gennadius)	Aleyrodidae	Seedling to maturity	Major	√	√
		Spiralling whitefly	<i>Aleyrodicus disperses</i>	Aleyrodidae	Vegetative to fruiting	Minor	√	-
		Leaf hopper	<i>Amrasca biguttula biguttula</i> (Ishida)	Cicadellidae	Seedling to fruiting	Minor	√	√
		Leaf hopper	<i>Empoasca</i> sp.	Cicadellidae	Seedling to fruiting	Minor	√	√
		Leaf hopper	<i>Cofana</i> sp.	Cicadellidae	Seedling to fruiting	Minor	√	√
		White backed plant hopper	<i>Sogatella</i> sp.	Delphacidae	Seedling to fruiting	Minor	√	√
		Soft scale insect	<i>Coccus</i> sp.	Coccidae	Vegetative to fruiting	Minor	√	√
		Mealy bug	<i>Phenacoccus</i> sp.	Pseudococcidae	Vegetative to fruiting	Minor	√	√
Relative abundance							43.47	42.85
2.	Coleoptera	Leaf beetle	<i>Monolepta signata</i> (Oliver)	Chrysomelidae	Seedling to maturity	Minor	√	√
		Flea beetle	<i>Chaetonema</i> sp.	Chrysomelidae	Seedling to maturity	Minor	√	√
		Flea beetle	<i>Altica</i> sp.	Chrysomelidae	Seedling to maturity	Minor	√	√
Relative abundance							13.04	14.28
3.	Thysanoptera	Chilli Thrips	<i>Scirothrips dorsalis</i> (Hood)	Thripidae	Seedling to maturity	Major	√	√
Relative abundance							4.34	4.76
4.	Trombidiformes	Yellow mite	<i>Polyphagotarsonemus latus</i> (Banks)	Tarsonemidae	Seedling to maturity	Major	√	√
Relative abundance							4.34	4.76
5.	Diptera	Fruit fly	<i>Bactrocera dorsalis</i> (Hendle)	Tephritidae	Fruit	Major	√	√
		Leaf miner	<i>Liriomyza</i> sp.	Agromyzidae	Leaves	Minor	√	√
Relative abundance							8.69	9.52
6.	Lepidoptera	Black cut worm	<i>Agrotis ipsilon</i> (Hufnagel)	Noctuidae	Seedling	Minor	√	√
		Tussock caterpillar	<i>Orvasca</i> sp.	Lymantriidae	Fruit	Minor	√	√
		Tobacco cut worm	<i>Spodoptera litura</i> (Fabricious)	Noctuidae	Seedling to fruiting	Minor	√	-

		Cotton leaf roller	<i>Haritalodes derogata</i> Fabricious	Crambidae	Vegetative stage	Minor	√	√
							17.39	14.28
7.	Orthoptera	Mole Cricket	<i>Gryllotalpa africana</i> (Palisot de Beauvois)	Gryllotalpidae	Seedling	Minor	√	√
		Tobacco grass hopper	<i>Atractomrpha crenulata</i> (Fabricious)	Pyrgomorphidae	Vegetative	Minor	√	√
							8.69	9.52

2017-18



2018-19

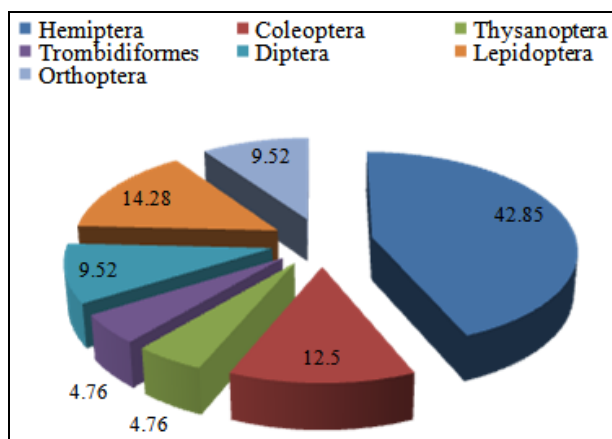


Fig 1: Relative abundance of *Bhut Jolokia* insect pests observed during *rabi* season of 2017-18 and 2018-19

Table 2: Month wise diversity indices pests of *Bhut Jolokia* during 2017-18 and 18-19

Month	Simpson's index (1/Ds)	Diversity index (H')	Evenness index (J)	Dominance index (D)
January, 18	2.05	0.87	0.63	0.37
February, 18	1.62	1.20	0.67	0.33
March, 18	1.59	1.14	0.64	0.36
April, 18,	1.60	1.15	0.59	0.41
May, 18	1.52	1.40	0.72	0.28
January, 19	1.49	1.03	0.57	0.43
February, 19	1.87	0.95	0.53	0.47
March, 19	1.55	1.16	0.59	0.41
April, 19	1.55	1.18	0.61	0.39
May, 19	1.38	1.54	0.79	0.21

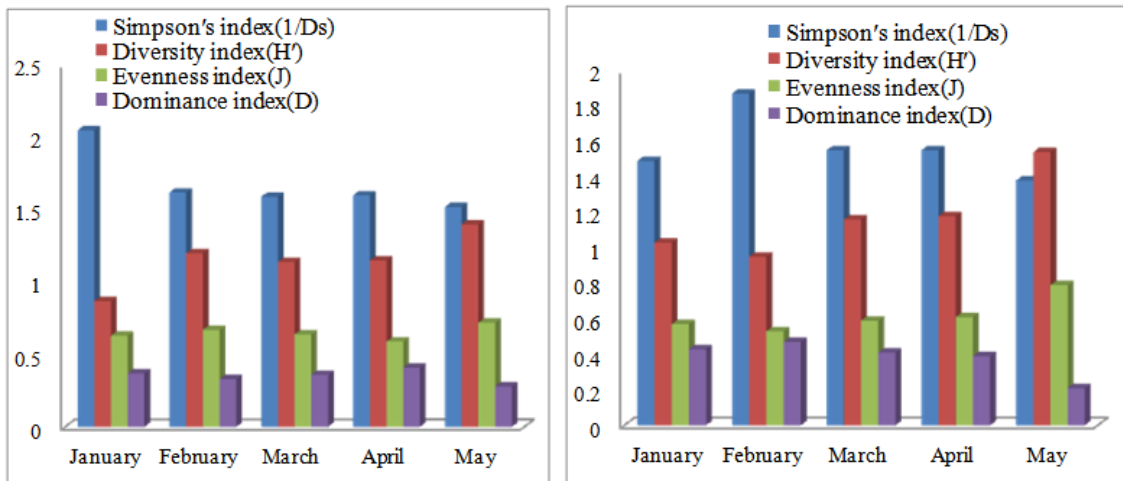


Fig 2: Diversity indices of pests of *Bhut Jolokia* during 2017-18 and 2018-19

Table 3: Natural enemies of insect pests observed on *Bhut Jolokia* during 2017-18 and 2018-19 (*Rabi* season)

S. No.	Scientific name	Family	Order	Harboured on
1.	<i>Coccinela transversalis</i> (Fabricius)	Coccinellidae	Coleoptera	Soft bodied insect
2.	<i>Brumoides suturalis</i> (Fabricius)	Coccinellidae	Coleoptera	Soft bodied insect
3.	<i>Coccinella septempunctata</i> (Linnaeus)	Coccinellidae	Coleoptera	Soft bodied insect
4.	<i>Micraspis discolor</i> (Fabricius)	Coccinellidae	Coleoptera	Soft bodied insect
5.	<i>Menochilus sexmaculatus</i> (Fabricius)	Coccinellidae	Coleoptera	Soft bodied insect
6.	<i>Cryptogonus orbiculus</i> (Gyllenhal)	Coccinellidae	Coleoptera	Soft bodied insect
7.	<i>Hermonia dimidiata</i> (Fabricius)	Coccinellidae	Coleoptera	Soft bodied insect
8.	<i>Ischiodon scutellaris</i> (Fabricius)	Syrphidae	Diptera	Aphid and whitefly
9.	<i>Lathyrophthalmus arvorum</i> (Fabricius)	Syrphidae	Diptera	Aphid and whitefly
10.	<i>Neoscona</i> sp.	Araneidae	Araneae	Small insect
11.	<i>Oxyopes</i> sp.	Oxyptidae	Araneae	Small insect
12.	<i>Lycosa</i> sp.	Lycosidae	Araneae	Small insect
13.	<i>Myrmarachne orientalis</i> (Tikader)	Salticidae	Araneae	Small insect
14.	<i>Lynx</i> sp.	Oxyptidae	Araneae	Small insect

Table 4: Casual visitors observed on *Bhut Jolokia* during 2017-18 and 2018-19 (*Rabi* season)

S. No.	Common name	Scientific name	Family	Order
1.	Squash bug	<i>Cletus punctiger</i> (Dallas)	Coreidae	Hemiptera
2.	Red Cotton bug	<i>Dysdercus koenigii</i> Fabricius	Pyrohocoreidae	Hemiptera
3.	Leaf footed bug	<i>Leptoglossus phyllopus</i> (Linnaeus)	Coreidae	Hemiptera
4.	Bow fly	<i>Chrysomya megacephala</i> (Fabricius)	Calliphoridae	Diptera
5.	Cockroach	<i>Blattella</i> sp.	Blattellidae	Blattodea
6.	Grass hopper	<i>Trilophidia annulata</i> (Thunberg)	Acrididae	Orthoptera
7.	Small Carpenter bee	<i>Ceratina hieroglyphica</i> (Smith)	Apidae	Hymenoptera
8.	Weaver ant	<i>Occophylla smaragdina</i> (Fabricius)	Formicidae	Hymenoptera
9.	Ant	<i>Tapinoma</i> sp.	Formicidae	Hymenoptera
10.	Ant	<i>Polyrachis</i> sp.	Formicidae	Hymenoptera
11.	Ant	<i>Technomyrmex albipes</i> (Smith)	Formicidae	Hymenoptera
12.	Ant	<i>Dolichoderus</i> sp.	Formicidae	Hymenoptera

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