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Study of insect pest of family *Brassicaceae* in Prayagraj region

Monika and Kamin Alexander

Abstract
Four different location of Prayagraj, (Abadalpur, Kotwa, Naini, Ghurpur), Uttar Pradesh (INDIA), is taken to observed the insect pest of family *Brassicaceae crop i;e* Cabbage and Mustard. 1. *Brevicoryne brassicae.* 2. *Trichoplusia ni* 3. *Plutella xyllostella* is observed in cabbage crop and *Phyllotreta spp*. are observed in mustard crop. Severity level of all the insect pest are different at each location. This is due to high level of interaction between food availability and abundance of natural resources. Type of soil and temperature is also effect the severity of insect pest.
Brevicoryne brassicae is more severe than other pest. In this work we found Kotwa and Naini were 2 times higher than that of other two sites Abdalpur and Ghurpur.

Keywords: type of soil, temperature, cabbage, mustard, *Brevicoryne brassicae, Trichoplusia ni, Plutella xyllostella*

Introduction
The name *Brassicaceae* is derived from the include genus *Brassica*, it is one of eight plant family names without suffix – aceae that are alternative names, both Cruciferae and *Brassicaceae* are used.
The family contains species such as *Brassica oleracea* (broccoli, cabbage, cauliflower), *Brassica rapa* (turnip), *Brassica napus* (rapeseed), *Raphanus sativus* (common Raddish).
Pieris rapae and other butterflies of family Peridae are most common pest of commercial cropping of *Brassicaeae.*

Criteria for Study of Pests on Brassicaceae Crops
The pests causes the damage for the Brassicaceae crops were selected for detailed study because of:
a. The pests has a wide geographical range of infections,
b. Cause serious economic damage to Brassicaceae production of country, and
c. ause the economic crisis to farmers.

Insect Pests
1. Aphids
Cabbage aphid (*Brevicoryne brassicae*), Green peach aphid (*Myzus persicae*), Turnip aphid (*Lipaphis eryisimi*)

Group: Insect (Homoptera: Aphididae)

Damage
Aphids cluster on the leaves and suck sap causing infested foliage to curl, wilt, or become distorted. Heavily infested plants grow slowly, are stunted, and produce small unmarketable heads.
Aphids secrete a sweet substance called honeydew which drips onto leaves and causes blackening as fungal moulds grow on it. Aphids may also transmit plant viruses for example, the turnip mosaic virus.

2. Diamondback moth
Plutella xylostella
Group: insect, moth (Lepidoptera: Plutellidae)
Other host crops: broccoli, cauliflower, Brussels sprouts, radish, turnip, mustard, kale, collards

Damage
Initial damage is small incomplete holes caused by young larvae and larger complete holes caused by mature larvae. The holes become larger as the leaf develops. The entire plant may become riddled with holes under moderate to heavy populations. Larvae also feed in the developing heads of cabbage, causing deformed heads and encouraging soft rots.

3. Cabbage Looper
Trichoplusia ni
Group: Insect, moth (Lepidoptera: Noctuidae) Other host crops: broccoli, cauliflower, radish, turnip, mustard, kale, collards, pepper, tomato, bean

Damage
Larvae primarily feed on leaves causing irregular, rugged holes, bore through heads, and contaminate heads and leaves with their frass (excreta). Large larvae can burrow through 3-6 layers of tightly wrapped head leaves. Larvae can consume three times their weight in plant material daily. Plants can be severely defoliated and stunted, producing no head or be unfit for consumption.

4. Phyllotreta cruciferae
Group: Insecta (Coleoptera: Chrysomelidae)
Other host crops: broccoli, cauliflower, Brussels sprouts radish, turnip.

Damage
Flea beetles feed on seedlings. They usually feed on the underside of leaves leaving numerous small round or irregular shaped holes, although not generally all the way through the leaf. Because the beetle is small and active, it usually does not Cabbage flea beetle feed much in one spot. Larvae are root feeders. They trim the root hairs and make circular pits in tap roots.

Material and Methodology
Study Area and Sampling Site
The sampling sites were agricultural areas of concern sampling sites i.e Abdalpur, Naini (Shuats),
Ghurpur, Kotwa situated in Prayagraj district of eastern Uttar Pradesh. Four seasonal sampling were carried out during the months of post monsoon (January, 2018) and summer (April, 2018) in the selected locations of Prayagraj district. The list of sampling areas and their GPS positions are given below:

The list of sampling areas and their GPS positions are given below:

S. No.	Name of the location	Distance from Prayagraj civil lines	Lattidude	Longitude
1	Abdalpur (Location 1)	. 23.5 K.M	25.39669	81.89738
2	Naini (Shuats) (Location 2)	13.5 K.M.	25.3991	81.89604
3	Ghurpur (Location 3)	20.9 K.M.	25.41196	81.84989
4	Kotwa (Location 4)	23.6 K.M	25.41246	81.84976

Physical Parameters
Temperature: Temperature was measured *in situ* using accuweather report 720/470 (feb., 1st, 2019) to 1040 /780 (April, 30th, 2019).

Soil Type

Aes	Situation	Soil Type	Area IN%/x000ha	Block
AES 1	Black & coarse gray land (Jamunapar)	Clay loam to sandy loam	48% / 230.1	Bara, Shankargarh, Koraon, Manda, Meja
AES 2	Jamuna Khaddar & alluvial (Jamunapar)	Loam & Sandy Loam	10% / 51.1	Jasra, Karchhana, Chaka, Kaundhiar
AES 3	Ganag low land & sodic (Gangapar)	Sandy sodic To loam	15% / 92	Pratappur, Handia, Phulpur
AES 4	Ganga plane (Gangapar)	Sandy clay loam &	27% / 138.1	Phulpur, Saidabad, Soraon

Survey Method
The pests were surveyed on weekly basis on every Sunday of the week. Each places were visited once in a month and data were collected in morning and evening time. Usually the survey was conducted in good weather i.e. extreme cold and hot weather were ignored.

Identification of Pests
The photographs were taken and the morphological features were considered for identification of pests. They were identified according to Standard Taxonomic Keys. A taxonomic key is a simple tool used to identify a specific object. A taxonomic key is one of the most useful tools available to scientists trying to identify an unknown organism. Systematic rely on keys to help identify known organisms and determine whether they have discovered a new organism entirely. Taxonomic keys are useful tools guiding researchers towards the known name of an organism.

Assessment of Incidence and Infestation Rate of Insect-Pests
Assessment of infestation by insects on various crops were done as per the scale given by Vennila and his Co- author in National Centre for Integrated Pest Management, New Delhi in year 2010 i.e. 0-4 Scale infestation.
0 Grade: No insect/indecently seen
1. **Grade:** Scattered appearance of few insect-pests on the plants
2. **Grade:** Severe incidence of insect-pests on only one branch
3. **Grade:** Severe incidence of insect-pests on more than one branch
4. **Grade**: Severe incidence of insect-pests on whole plants was recorded.

Result

An extensive survey of the agricultural fields around Prayagraj was done for a period of four months from January 2018 to April 2018. Early assessment of my study showed that agricultural fields having economically important crops like Cabbage, Cauliflower, Mustard, were being damaged by a wide range of insect pests. Results are presented in form of tables and respective graphs. The number was reported from the collection and identification of insects from the severely damaged crops. The result of insect pest percentage within the agro ecosystem of Prayagraj reported the insect pests from order Hemiptera, Lepidoptera, Coleoptera. in each order in Prayagraj agricultural fields.

Identification of Insect Pests as Per Taxonomic Keys

Table 1: Showing the insect-pests along with their order and family and the severity of damages on respective crops in the agricultural fields of Prayagraj region.

Table 1: Insect-pests along with their order and family and the severity of damages.

Crop	Scientific Name	Name of the Insect Pests found	Scientific Name	Order	Family	Severity of Pests
Mustured	*Brassica sp.*	1. Flea beetle	1. *Phyllotreta spp.*	1.*Coleoptera*	1.Chrysomelidae	Grade 2
Cabbage	*Brassica oleracea*	1.Cabbage Aphid	1. *Brevicoryne brassicae*	1.Hemiptera	1.Aphididae	Grade 3
		2.Cabbage looper	2. *Trichoplusia ni*	2.Lepidoptera	2.Noctuidae	Grade 2
		3.black diamondback moth	3. *Plutella xyllostella.*	3. Lepidoptera	3.plutellidae	Grade 3

The results shows that in general, (a) *Phyllotreta spp*. (Flea beetle) were identified as insect pests affecting the crops of musturd. In terms of their severity of damage and infestation- flea beetle have been found most dominant for crops of musturd. (b) *Brevicoryne brassiceaea* (Cabbage Aphid), *Trichoplusia ni* (Cabbage looper), *plutella xyllostella. (*Black diamondback moth) were identified as insect-pests affecting the crops of cabbage. In terms of their severity of damage and infestation- Cabbage looper, black diamondback moth, have been found most sever for crops of Cabbage.

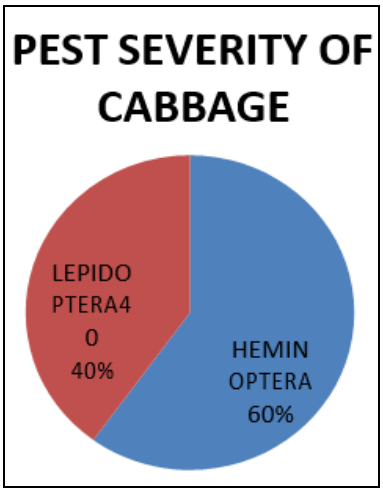

Fig 1: Describe the pest severity of cabbage

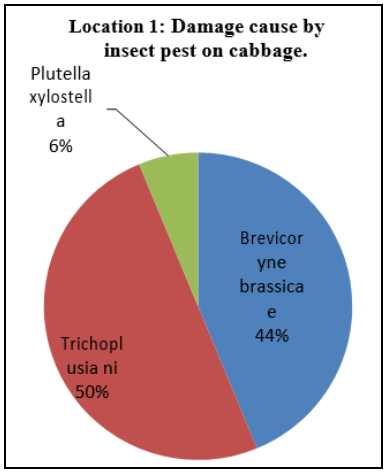

Fig 2: Describe the Damage cause by insect pest on cabbage on location 1.

Study Location 1: Abdalpur (Northern Region of Prayagraj). Location Wise Study of Insect Pests and Their Severity of Damage to Crops

Study Location 2: Naini, Shuats (Southern Region of Prayagraj).

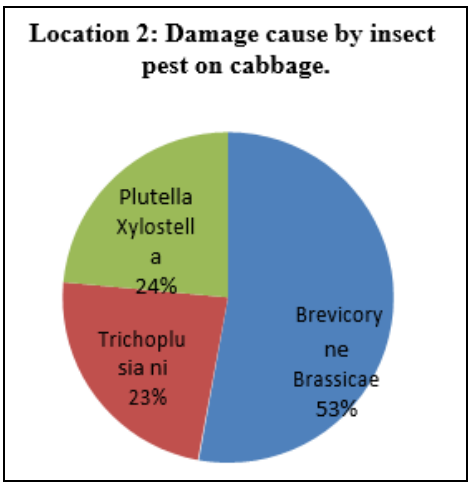

Fig 3: Describe the damage cause by insect pest on cabbage on location 2.

Study Location 3: Ghurpur (Western Region Of Prayagraj).

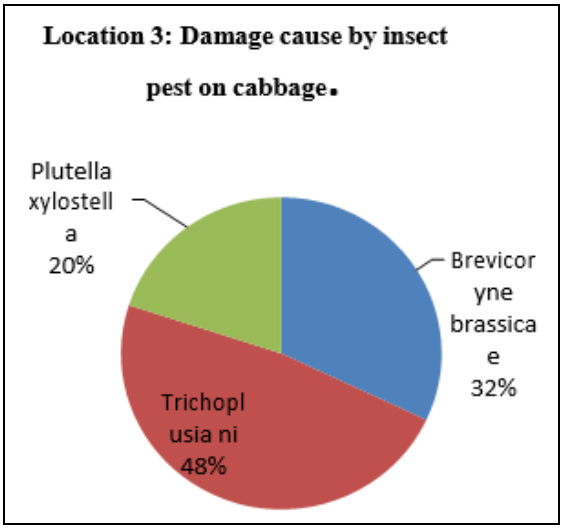

Fig 4: Describe the damage cause by insect pest on cabbage on location 3.

Study Location 4: Kotwa (Eastern Region of Prayagraj).

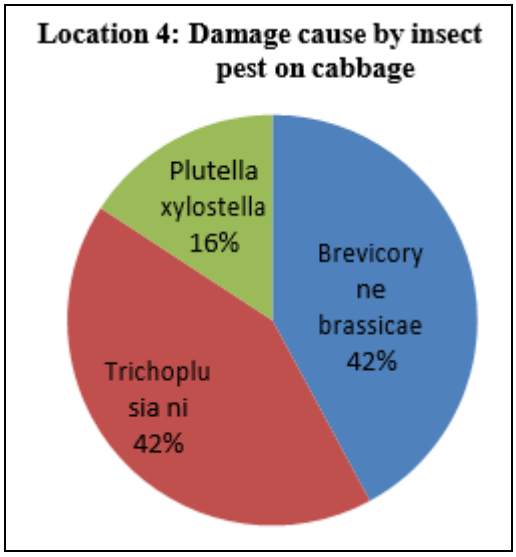

Fig 5: Describe the damage cause by insect pest on cabbage on location 4.

Discussion

Prayagraj has a rich bio-diversity of insects. There are large numbers of agricultural fields of 392.142 hectares surrounding the city (Prayagraj Krishi Vigyan Kendra, 2018). An extensive survey of the agricultural fields around Prayagraj region was conducted for a period of four months from January 2019 to April 2019. The results of this study presented in result section showed that a wide range of insect pests are found responsible for damaging the economically and vital *Brassicaceae* crops (mustard and cabbage).

The present study has identified 4 species of insects as pests. (Table1).

Results of Table No: 1 stated that the maximum insect pests were belongs to order Hemiptera i.e. 70-80% while, Hymenoptera 40-60% and the crop of mustard only infected only by order Lepidoptera in each order in Prayagraj region.

Location Wise Identification of Insect Pests and Their Severity of Damage to Brassicaceae Crops

Location wise in Abdalpur village (Northern region of Prayagraj), (a) Cabbage aphid (*Brevicoryne brassiceaea*) has been found most dominant insect-pest for crops of Cabbage (b) Cabbage lopper (*Trichoplusia ni.*) has been found top most insect-pest for crops of Cabbage (c) Diamondback moth (*Plutella xylostella*) has been found least insect pest for crop of cabbage followed *Phyllotreta spp.* respectively to Mustard, (Fig. 2).

In Naini Taluka (Southern region of Prayagraj), (a) cabbage lopper (*Trichoplusia ni.*) have been found most notable insect-pests for crops of cabbage followed by Cabbage aphid (*Brevicoryne brassiceaea*) least sever as compare to cabbage looper. (b) Diamondback moth (*Plutella xylostella*) has found most less sever for crop of cabbage. (c) Flea beetle (*Phyllotreta cruciferae goeze.*) have been found most dominant insect-pest for Mustard, (Fig.3).

In Ghurpur village (Western region of Prayagraj), (a) cabbage lopper (*Trichoplusia ni.*) have been found most notable insect-pests for crops of cabbage followed by Cabbage aphid (*Brevicoryne brassiceaea*) least sever as compare to cabbage looper. (b) Diamondback moth (*Plutella xylostella*) has found most less sever for crop of cabbage. (c) Flea beetle (*Phyllotreta cruciferae goeze.*) have been found most dominant insect-pest for Mustard, (Fig.4).

In Kotwa village (Eastern region of Prayagraj), (a) cabbage lopper (*Trichoplusia ni.*) and Cabbage aphid (*Brevicoryne brassiceaea*) found on same level of severity. (b) Diamondback moth (*Plutella xylostella*) has found most less sever for crop of cabbage. (c) flea beetle (*Phyllotreta cruciferae goeze.*) have been found most dominant insect-pest for Mustard, (Fig.5).

In general, insect pest abundance at Kotwa and Naini were 2 times higher than that of other two sites Abdalpur and Ghurpur.

It suggested that Kotwa (Highly Fertilized Land) and Naini (Near Yamuna bank) were more diversity of species than other sites. It might be due to the interaction between food availability and abundance of natural resources. Similarly the result agreed with Duffield (1995) [4] who reported that higher insect abundance might be due to soil quality and prevailing ecological factors and when the species richness was high, diversity index tended to have smaller values. It was assumed diversity indices from the three sites were distinct in terms of species abundance and the degree of dominance by the most to medium abundant species mainly determined by biotic and abiotic factors. Wang *et al*. (2000) [7] stated that the reduction in species richness was mainly caused by the loss of the rarely encountered species; therefore, distribution of insect pests and predatory species in the selected study areas seemed to be dependent on climatic factors such as temperature, relative humidity, rain fall and wind. The dominant species of Flea beetle (*Phyllotreta cruciferae goeze.*) exhibited the tendency to be the most serious key pest of mustard in U.P. It was possible to assume that the abundance and status of insect pests could be changed over the season and species diversity was directly affected by the fluctuation of individual species population. Comparing the diversity indices of three sites, the Naini seemed to have more diverse habitat. On another hand, since, Prayagraj has a humid subtropical climate common to cities in North Central India. The climate and weather was excellent (March-April, 2018), researcher has collect maximum insect-pests between these two.

Then there is question i.e. does climate change affecting crop pests and diseases? Yes, as the dynamics of crop diseases and pest influx are changing rapidly due to changing climate. Managing them has, therefore, become a huge challenge. The rising levels of CO2 and temperatures are having direct effect on pests and diseases in crops. But will the overall effect be negative or positive? more CO2, increase in pests and diseases i.e. elevated CO2 can increase levels of simple sugars in leaves and lower their nitrogen content. These can increase the damage caused by many insects, who will consume more leaves to meet their metabolic requirements of nitrogen. On one hand, warmer temperature lowers the effectiveness of some pesticides but on the other hand, it favours insect carriers of many disease pathogens and natural enemies of pests and diseases. In a study done by Lateef *et al*., (1990) more than 200 species of insects have been found feeding on cabbage and mustard, although only a few of these cause significant and consistent damage to the crop. Insects feed on all parts of the Cabbage and mustard plant. The most serious pests, and the primary focus of mustard pest management research, are those that attack reproductive structures, including buds, flowers, and seeds. mustard has a great capacity to tolerate and recover from early season losses of flowers and young pods, provided the general health of the

plant is good and that sufficient soil moisture is available. Thus, only pests that are continuously present or that attack at the middle or end of the crop cycle are economically important pest like aphids, white flies and mustard saw fly as emerging serious pest in India. Attle *et al*. (1987) [2] reported as high as 100% yield reduction of different Mustard crops due to aphid infestation and during 2006 the Mustard aphid caused economic damage, reducing yield by up to 40-50% in infested fields in several parts of Gujarat. The outbreak of Common Army Worm (*Spodoptra litura*) Cabbage lopper (*Trichoplusia ni.)* led to more than 90 percent yield loss of Cabbage (Sujatha and Lakshminarayana, 2007) [5]. To prevent yield loss farmers are mainly depend on chemical control method. Due to vigorous use of chemical caused resistance, resurgence, environmental hazards and discontinuation of it use Therefore the proper management of insect pests are needed as suggested by Gupta *et al*. (2004) integrating them with other proven methods of pest control against the target pests which replace insecticides to which the pest had developed resistance by reducing the number of spray and increases the yield (Ahuja, *et al*., 2012). Hence, the information provided by present study gives the important understanding of host *Brassicaceae*, their identification and assessment of damage by the insect-pests. Therefore, in future the proper control measures should be taken for effective and significant ecofriendly management of these harmful insect pests.

Conclusions

This review binds together broadly scattered literature on the chemical ecology of Brassica plants towards different insects, multiple defense mechanisms of these plants, their role towards the insect-pest complex that attacks brassica, their potential in insect- pest management and plant breeding towards insect resistance in Brassica. Several chemical ecology studies on different Brassica plants and insects attacking brassicae emphasise the importance of glucosinolates, breakdown products (isothiocyanates and nitriles), volatile compounds (Tarpenes, green leaf volatiles, aromatic compounds) and phytoalexins as key components of plant defence against insects. In addition, these studies show that the Brassica crops exhibiting multiple defence responses in response to different insects along with insect behaviour represent a complex system. In order to understand this complex system further and to identify differential responses triggered by different insects (herbivores, parasitoids/predators) as well as the underlying regulatory networks and signaling pathways, there is a need to perform gene expression studies on brassicas. Due to the availability of the *A. thaliana* genome, a lot of transcriptional/ecogenomics studies have been performed on Arabidopsis in recent years. Using a full genome microarray platform for studying early transcriptional responses in *A. thaliana* against *B. brassicae* infestation, (Kusnierczyk *et al*. (2008) [3] found strong indications that Camalexin is a hitherto unknown insecticide. This finding was further supported by the analysis of Camalexin induction and aphid fecundity experiments. Since Arabidopsis and Brassicas belong to the same family, Arabidopsis microarrays have been employed for the transcriptional studies in Brassica spp. and can also be used to perform economics studies to analyses insect infestation responses in Brassica crops. Moreover, with the availability of Brassica microarrays, it is now possible to perform more complete global transcription profiling studies of insect infestation of Brassica plants, providing another gateway towards insect pest management.

Future studies could also aim at manipulating plant secondary metabolites such as Camalexin, Glucosinolates and their breakdown products, volatile compounds, plant allelochemicals or other semiochemicals in order to control pests. This can be applicable through the production of transgenics, (Ahuja *et al*.) Through a combination of breeding methods and tissue culture techniques, and through the exploitation of wild Brassica germplasm. We end this review with a hope that future studies might also discover other aspects of plant-insect interactions, their chemistries in combination with eco-genomics studies, and utilization of brassicas towards insect- pest management, and will provide us with even more information and clues to understand the plant-insect world and its mysterious trophic interactions. This field of research has gained more and more attention in the past decade and attracted a huge number of scientists, who have spent years exploring the plant-insect world, and have already provided us with excellent information, sources and some natural solutions to overcome insect pest problems.

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