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Diversity of high altitude insect pests in edible crucifers

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ABSTRACT

The Nilgiris in Indian subcontinent is one of the major Biodiversity hot spot in India and renowned for the endemism. Crucifers are the imperative cash crops cultivated in various parts of this high altitude. Insect pests diversity associated with cruciferous crops were evaluated at four different sample sites in Nilgiris district. Thirteen species of cruciferous crop pests belong to four orders such as, Lepidoptera, Homoptera, Coleopteran, and Hemiptera were recorded. Highest number of individuals was recorded in Lepidoptera and lowest number of species in Coleopteran and Hemiptera. Among the families, aphididae (Homoptera) was dominant followed by plutellidae, pyraustidae and noctuidae (Lepidoptera). Among the species, *Lipaphis erysimi* (Homoptera: aphididae) was eudominant, *Plutella xylostella* (Lepidoptera: plutellidae) was dominant and other species were subdominant, recedent, subrecedent. Total number of cruciferous insects found declined from October to December and there after a steady increase was observed up to March. However, such a variation was not observed in terms of species composition and diversity.

KEYWORDS

Cruciferous;
Species diversity;
Lipaphis erysim;
Plutella xylostella.

INTRODUCTION

Asia is the major producer of vegetables all over the globe. India alone accounts for the production of 2, 32,800 ha of cabbage and 2, 78,800 ha of cauliflower. Vegetable crops belong to the family Brassicaceae are generally referred as cruciferous vegetables. Crucifers are extensively cultivated; includes many genera, species, and cultivars like cabbage, cauliflower, broccoli and related green leaf vegetables. Through out the world agricultural crops are damaged by more than 10,000 species of insects. Among them not more than 1000 species are generally considered as major pests[4, 10]. The severity of pest problems has been changing with the developments in agricultural technology and modifications of farming practices[5]. During the last two decades considerable emphasis has been laid on increasing the production of vegetable crops in India[2].

Cruciferous vegetables especially cabbage (*Brassica oleraceae var: capitata* L) is economically important in India and also the cabbage and cauliflower are important cole crops grown on about 0.438 million hectares, producing about 6.335 million tonnes per annum[14, 16]. Nilgiris is the smallest district situated on the Northwestern part of Tamil Nadu known as the "Blue Mountain". It is located at an altitude above 2,286m

and it has the average annual rainfall of about 1778mm. The rich organically fertile soil condition existing in this hill district makes agriculture successful. Climatic conditions prevailing in this district favour the high value exotic vegetables throughout the year. In current days it is well-known that the temperature of land and ocean has increased thereby causing global warming[6]. There may be a substantial difference in the spatial distribution of insects in response to global warming[6, 9], both across the globe[9] and within individual regions[7, 18]. Listed the effects of temperature upon insects, including limitation of: geographical range, over-wintering, population growth rates, number of generations per annum, crop-pest synchronization, dispersal and migration, and availability of host plants and refugia. Keeping the importance of global warming and crop pest interaction in higher altitude a study has been undertaken to assess the density and diversity of crucifer pest in the Nilgiris, which is considered to be a hot spot if diversity.

MATERIALS AND METHODS

Field survey

Study was conducted in two phases from August to October, 2010 (pre winter) and from February to April 2011 (post winter). Four sample sites located at higher altitude (above 2400 MSL) having extensive crucifer cultivation is selected for the study. They are Koddapmund (11.415187N, 76.715319E) designated as site A., Theetukal (11.397071N, 76,690922E) designated as site B, Kilkoddapumund (11.391692N, 76.691866E) designated as site C and Lovedale (11.414493N, 76.716328E) designated as site D. The major crucifers cultivated in these areas are cabbage (Brassica oleracea var. capitata), Violet Cabbage (Moricandia ramburii), cauliflower (Brassica oleracea var. botrytis), Raddish (Raphanus sativus), turnip (Brassica rapa var. rapa), Chinese cabbage (Brassica rapa chinensis), noolkol (Brassica caulocarpa), brussels sprouts (Brassica oleracea var. gemmifera) and broccoli (Brassica oleracea var. botrytis). All the monoculture lands under consideration is fertile and using Organic manure, vermin compost and cow dung as basic manure with additional supplement of required nutrients in minimum amount The temperature fluctuate according to season and have an average temperature of 17.0 ± 2°C during the month of October and November it reaches below 8 ± 2°C in December and January and 21± 3°C during the late winter i.e., February and March during day time. An in-depth field survey was conducted in the fields during the study period at least four times a month. Insect pests were collected from the field by a roving survey in the places where crucifers are cultivated.

Assessment of insect pests

Diversity of insect pests in cruciferous crops was assessed mainly in cabbage, cauliflower, and broccoli monoculture fields. The field experiment was laid out in an exploded block design and methodology was followed by [13] and[11]. Cruciferous crops ecosystem was sampled by using a sweep net (30x60x45 cm). The insects were collected between 9.00 to 11.00am in the morning and 4.00 to 6.00pm in the evening from all four sites (as mentioned in field survey). The collection were made by sweeping the net diagonally across each plot for 25 times and samples were placed in separate plastic sachets (Flies and Moths) and other type of sucking pests, caterpillar, aphids etc., by visual counting[20]. The collected insects were kept in laboratory and identified using hand lens, microscope and keys.

Estimating Dominance

Dominant status of various species was described on the basis of relative abundance following Engelmann's scale[8].

Species diversity and evenness

In order to understand the diversity of species within the local community, species diversity was computed per the methodology described by[22] and evenness index as described by[19].

RESULTS

The present study evaluated the presence of insect pests on cruciferous plants at selected areas, such as, Koddapmund (A), Theetukal (B), Kilkoddapumund (C) and Lovedale (D) in the Nilgiris. The collected data were analyzed for relative abundance, species diversity and evenness index.

TABLE 1 : Dominance status of different species of Insect pests associated with cruciferous vegetable crops

SPECIES	NUMBER	RELATIVE ABUNDANCE (RA)%	DOMINANCE STATUS
Order – Lepidoptera			
Family – Plutellidae			
Plutella xylostella(DBM)	250	28.9	Dominant
Family – Pyraustidae			
Hellula undalis	25	2.3	Recedent
(cabbage borer)			
Crocidolomia binotalia	28	3.2	Subdominant
(Leaf webber)			
Family – Noctuidae			
Agrotis ipsilon	24	2.7	Recedent
(Black cutworm)			
Spodoptera litura	18	2.1	Recedent
(Armyworm)			
Trichiplusia ni	17	1.9	Recedent
(Cabbage green semilooper)			
Order – Coleoptera			
Family – Alticidae			
Phyllotreta downsei	18	2.1	Recedent
(Radish flea beetle)			
Order – Hemiptera			
Family – Pentatomidae			
Bagrada cruciferarum	7	0.8	Subrecedent
(Painted bug)			
Order – Homoptera			
Family – Aphididae			
Lipaphis erysimi	382	44.2	Eudominant
(Light brown lice)			
Myzus persicae	73	8.4	Dominant
(green lice)			
Other Insects			
Thrips tabaci	11	1.3	Recedent
Athalia lugens proxima	6	0.7	Subrecedent
Phytomyza atricornis	5	0.5	Subrecedent
Total no. of species	864		

RA <1= Subrecedent, 1.1 – 3.1 = Recedent, 3.2 – 10% Subdominant, 10.1 – 31.6 = Dominant, > 31.7% = Eudominant.

The present investigation revealed that 13 species of pest on cruciferous crops. They belong to four orders such as, Lepidoptera, Homoptera, Coleopteran, Hemiptera. Order Lepidoptera had six species, homoptera had two and coleoptera and hemiptera one each (TABLE 1). Notwithstanding the least number of species Lepidoptera was the most common group quantitatively representing 46% of the total cruciferous pests. Next to the Lepidoptera, homoptera was dominantly followed by (15%0, coleoptera (8%), hemiptera (8%) and other insects (23%) (Figure 1).

Homoptera was dominated by the family aphididae (53%) and Lepidoptera was represented by three families such as, plutellidae, pyraustidae and noctuidae constituting 29%, 6% and 7% of the total cruciferous crops respectively. Coleoptera and hemiptera were repre-

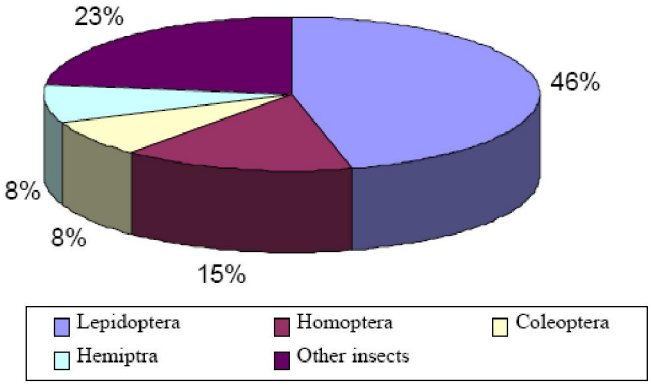

Figure 1 : Relative abundance of the orders of cruciferous insect pests

TABLE 2 : Monthly variation in number, species diversity and evenness indices in cruciferous vegetable crops

Number of individuals	Pre winter season			Post winter season		
	August	September	October	February	March	April
	179	165	56	86	148	230
Number of species	12	13	11	8	12	11
Species diversity(H)	1.35	1.37	1.22	1.29	1.32	1.38
Evenness Index (e)	0.97	0.98	0.85	0.91	0.94	0.99

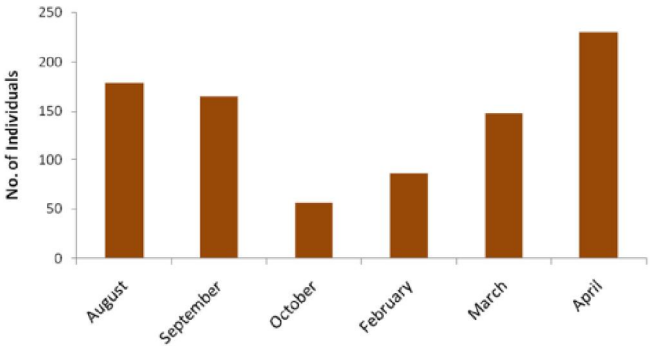

Figure 2 : Monthly variation in abundance of cruciferous insect pests (2010-11)

TABLE 3 : Species diversity and evenness indices of the sampling sites (A-D) in cruciferous vegetable crops

Species Diversity (H)	A	B	C	D
	1.633	1.54	1.54	1.728
Evenness index (e)	0.3939	0.3589	0.359	0.4684

sented by alticidae (2%) and pentatomidae (1%) respectively of the total of insect pests (TABLE 1).

Out of the 13 species, only one species, *Lipaphis erysimi* was eudominant and one species *Plutella xylostella* was dominant species. These species appear to be good exploiters of resource in cruciferous crops ecosystem. Only one specimen of, *Crocidolomia binotalia* was recorded, which is a subdominant specimen, six recedent species were recorded viz., *Hellula undalis, Spodoptera litura, Agrotis ipsilon, Trichiplusia ni, Phyllotreta downsei and Thrips tabaci* and two subrecedent such as, *Athalia lugens proxima* and *Phytomyza atricornis* (TABLE 1) also recorded.

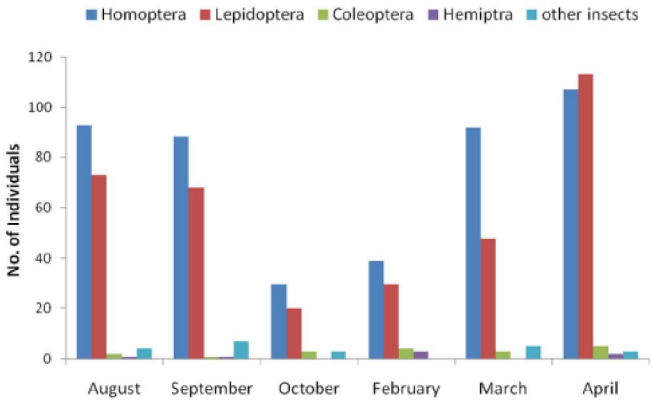

Figure 3 : Monthly variation in abundance of four orders and other insect pests of cruciferous crops

Total number of cruciferous insects declined from August to October and there after the number increased steadily in the second phase, i.e., from February to April (Figure 2). However, similar trend could not be seen for the number of species, species diversity and species evenness. Species diversity and species evenness were observed lowest in towards winter season and highest towards summer. (TABLE 2). When species diversity and evenness of sampling sites were compared (TABLE 3) it was noted that these were maximum in site D (Lovedale) and minimum in site B (Theetukal) and C (Kilkoddapumund). Minimum number of insect pests was recorded in October and February and maximum in April (Figure 3). Maximum number of individuals was recorded in lepidoptera and homoptera during April, whereas they were decrease in October and February.

DISCUSSION

The cruciferous crops such as, cabbage, cauliflower and broccoli etc, are widely grown mostly as vegetables in Nilgiris. These crops are mainly attacked by a number of insect pests including, diamondback moth, aphids,

black cutworm, cabbage borer, leaf webber, cabbage semi-looper etc. The importance of insect pests' assessment, using total number individuals, relative abundance, species diversity and evenness on cruciferous vegetables crops, can be useful to know the pest status and to take control measures.

In the present investigation 13 species of pests were recorded on cruciferous crops. They belong to four orders such as, Lepidoptera, homoptera, coleopteran, hemiptera. Order Lepidoptera had six species; homoptera had two and coleoptera and hemiptera only one species. Among the order, number of individuals of homoptera was recorded maximum and followed Lepidopteran species. These results are consistent with the earlier reports on insect pests associated with cruciferous crops[24]. Out of the 13 species, only one species, *Lipaphis erysimi* was eudominant and one species *Plutella xylostella* was dominant. These species appear to be good exploiters of resources in cruciferous crops ecosystem. Only one specimen of the subdominant species, *Crocidolomia binotalia* was recorded. There were six recedent species recorded viz., *Hellula undalis, Spodoptera litura, Agrotis ipsilon, Trichiplusia ni, Phyllotreta downsei and Thrips tabaci* and two subrecedent such as, *Athalia lugens proxima* and *Phytomyza atricornis* were also recorded. Similar kind of report was given by[11].

Total number of cruciferous insects declined from August to October and in the post winter there is a steady increase up to April. However, similar trend could not be seen for the number of species, species diversity and species evenness. Species diversity and species evenness were observed lowest in October and February and highest in April. When species diversity and evenness of sampling sites were compared it was noted that these were maximum in site D (Lovedale) and minimum in site B (Theetukal) and C (Kilkoddapmund). In the present study, species diversity index was always more than one. High species diversity indicates that such community has their resources more finely distributed among the individuals of the many species[23]. Diversity index can also be used to measure environmental stress[15].

The maximum number of individuals and species of insect pests was recorded in April and minimum number of individuals and species in October and February. In addition, both species diversity and evenness indices decreased when number of species was low in October and February but number of individuals was high in April. These findings might be due to hibernation or retardation of developmental process or due to low temperature or perhaps these keep themselves hidden from the frost. So it may be concluded that the cruciferous crops under investigation were under stress and disturbed due to climatic conditions. These findings are in agreement with the earlier reports of[1, 11, 12, 17, 21]. They have reported that seasonal incidence of DBM and other pests on cabbage has been studied in India at Kodaikanal, Udaipur, Anand, and Bangalore and high build-up of larval populations has been recorded in February-March[3]. In conclusion, total number of insect pests was maximum in April and minimum in October and February. Maximum species diversity and evenness was recorded in sampling site D and minimum in site B, which may be due to the influence of the temperature (Climatic changes) and fertility of soil pattern, particularly, usage of organic manure by farmers. So it is clear that the temperature is a controlling factor in controlling the insect abundance and diversity in the higher altitude. So it can also be concluded that the increase of temperature as an effect of global warming may not be beneficial for the farmers.

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REFERENCES

[1] E.V.Abraham, M.D.Padmanabhan; Indian J.Agric.Sci., **38**, 513 **(1968)**.

[2] K.L.Chadha; Pre and Post Harvest Technology of Fruits and Vegetables. In: Natioanl Workshop on Opportunities and Challenges in Fruit and Vegetables Processing Industries 13-14 Oct (2000). CFTRI.. Mysore, India, **(2000)**.

[3] S.Chelliah, K.Srinivasan; Madras Agric.J., **97**, 70 **(1984)**.

[4] G.S.Dhaliwal, A.K.Dhawan, R.Singh; Indian J.Ecol., **34(2)**, 100 **(2007)**.
[5] G.S.Dhaliwal, J.Vikas, A.K.Dhawan; Indian J.Ecol., **37(1)**, 1 **(2010)**.
[6] N.S.Diffenbaugh, H.K.Christian, A.W.Michael, E.A.Corinne; Environ.Res.Letter., **3**, 1 **(2008)**.
[7] N.S.Diffenbaugh, J.S.Pal, R.J.Trapp, F.Giorgi; Proc.Natl.Acad.Sci.USA., **102**, 15774-8 **(2005)**.
[8] Engelmann; Untersuchungen Zur Erfassung Predozoogener Komopentenim Definierten, Okosystem. Forschungen. Staal.Mus Naturkde., Gorlitz., Pp-587, **(1973)**.
[9] F.Giorgi; Res.Lett., **33**, L08707 **(2006)**.
[10] R.Hall; In: R. Reuveni (ed.) Novel Approaches to Integrated Pest Management. Lewis Publishers, Boca Raton, Florida, USA, pp.1-19. **(1995)**.
[11] S.Jana, P.R.Pahari, T.Kr.Dutta, T.Bhattacharia; J.Environ.Biol., **30(2)**, 283 **(2009)**.
[12] K.Jayarathnam; Studies on the Population Dynamics of the Diamondback Moth, Plutella Xylostella (Linnaeus) (Lepidoptera: Yponomeutidae) and Crop Loss Due to the Pest in Cabbage. Ph.D. Thesis. University of Agricultural Sciences. Bangalore. Pp-215. **(1977)**.
[13] M.Kandibane; Biodiversity of Arthropods in Irrigated Rice Ecosystem. Ph.D. Thesis, TamilNadu Agric. Univ., Coimbatore, Tamil Nadu. **(2003)**.
[14] H.K.Kumar, K.Srinivasan, C.L.Suman; Progressive Horticulture Journal, **18**, 104 **(1983)**.
[15] C.F.Mason. Biology of fresh water pollution. In: Longman Scientific and Technical. Pp-250. **(1981)**.
[16] M.Mohan, G.T.Gujar; Crop.Prot., **22(2002)**, pp. 495 **(2003)**.
[17] S.Nagarkatti, K.P.Jayanth; Population Dynamics of Major Insect Pests of Cabbage and of their Natural Enemies in Bangalore District (India) pp 325-347. In Proceeding International Conference of Plant Protection in Tropics. Malaysian Plant Protection Society. Kuala Lumpur, Malaysia. **(1982)**.
[18] J.H.Porter, M.L.Parry, T.R.Carter; Agric.Forest Meteorology.International Journal., **57**, 221-40 **(1991)**.
[19] Pielou; Ecological Diversity, Wiley Inter Science J, London, **(1975)**.
[20] B.S.Rekha, J.Ramkumar, M.Kandibane, S.Raguraman, M.Swamiappan; Madras Agric.J., **96(1-6)**, 251 **(2009)**.
[21] J.N.Sachan, B.P.Srivastava; Indian J.Entomol., **34**, 123 **(1972)**.
[22] C.E.Shannon, W.Weaver; The Mathematical theory of communication University of Illinois Press, Urbana. **(1963)**.
[23] T.Smith; Harper and Row, Newyork. Pp-158, **(1977)**.
[24] S.Vidya, A.Jeyasankar; Insect Pests Associated with Cruciferous Crops Pests in Nilgiris. In: National Seminar on Implication of Biotechnology in Conservation of Biodiversity. Department of Botany, Govt. Arts College, Ooty, TamilNadu, India. 20-21 August Pp-54, **(2009)**.