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Short Note

Seasonal Abundance of Insect Pests of Broccoli in North Eastern Hill Region of India

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Broccoli crop was invaded by sixteen insect pests, one mite and eleven natural enemies in North Eastern Hill Region of India. The incidence of *Pieris* spp. was noticed from seedling stage to harvest and attained the peak level of infestation in second week of December (1.98 larvae per plant). *Pieris* spp. showed significantly negative correlation with *Plutella xylostella* (-0.419), *Lipaphis erysimi* (-0.376) and *Phyllotreta cruciferae* (-0.310), whereas *P. xylostella* exhibited significantly positive correlation with *L. erysimi* (0.536) and *P. cruciferae* (0.479) population. *L. erysimi* was noticed throughout the cropping period but attained the peak level of infestation in the first week of March (1010.20 aphids per leaf). *L. erysimi* showed non significant correlation with population of *P. cruciferae* (0.233). *P. cruciferae* was more abundant (5.38) during the month of February. *Tetranychus cinnabarinus* was more dominant and caused severe damage.

Key words: Broccoli, pest complex, natural enemy, seasonal incidence.

India is the second largest producer of vegetable crops in the world. The total area under vegetable crops in North Eastern Hill (NEH) region of India is 0.37 million ha, while the total production is 4.05 million tonnes. The area under vegetables in Mizoram was about 49,051 ha and total production was 1, 99, 186.3 MT during 2008 -2009 (Anonymous, 2008). Broccoli (*Brassica oleracea* Italica Group) suffers extensively from insect pests and it is attacked by more than 25 insect species. While there are some common pests across the globe, others are region specific and some of them are active vectors of deadly diseases besides causing direct damage to crops. Aphids, mites, *etc*. in particular, had the devastating effects on the broccoli. Pests like cabbage butterfly, diamond back moth and aphids cause havoc in North Eastern region of India and also in rest of the country. Pest succession studies are useful in devising economically feasible and ecologically sound integrated pest management. Hence, an investigation was undertaken to record the insect pests, non insect pest complex and their succession in broccoli in Mizoram.

Materials and Methods

Field experiments were conducted during *Rabi* season of 2008-09 to study the insect pests and non insect pest complex and their succession in broccoli at the ICAR Research Complex for NEH Region, Mizoram Centre, Kolasib, Mizoram, India. Six broccoli varieties were transplanted on 12th October 2008 in 4x5 m plots at a spacing of 45×35 cm in Randomized Block Design with four replications. No active plant protection measure was given throughout the crop season. Observations on the incidence of insect pests were recorded at weekly interval starting from initial appearance to crop harvest. Observations on the incidence of flea beetle, *Phyllotreta cruciferae* Goeze were recorded from 10 randomly selected plants from each plot by counting number of beetles per plant. Insect numbers were assessed from four replications. The number of *Pieris* spp. and diamond back moth, *Plutella xylostella* (Linn.) larvae were recorded by counting the number per plant from 10 randomly selected plants from each plot. The number of *Lipaphis erysimi* (Kalt.) was recorded by counting number of aphids (nymphs and adults) from 10 randomly selected leaves from each plot. The mean incidence of important insect pests was worked out taking into consideration their population in six varieties of broccoli. Statistical analysis of the data was done using Analysis of Variance (ANOVA) in AGRES. Square root transformation was used for *Pieris* spp., *P. xylostella*, *L. erysimi* and *P. cruciferae* of broccoli. Correlation was worked out using IRRISTAT software.

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Results and Discussion

Pest complex of broccoli

Sixteen species of insect pests and a mite were found to invade broccoli crop during the period of investigation (Table 1). Only *L. erysimi* and *P. cruciferae* were found to occur regularly in a sizeable population causing noticeable damage. *L. erysimi*

Table 1. Insect pests and non insect pest complex of broccoli

Systematic position	Stage of crop attack	Damage (%)
A. Insect pests		
Cabbage butterfly, *Pieris* spp. (Linn.) (Pieridae : Lepidoptera)	Seedling to harvest	20-100
Diamond back moth, *Plutella xylostella* (Linn.) (Plutellidae : Lepidoptera)	Vegetative, flowering and head formation stages	10-20
Cabbage aphid, *Brevicoryne brassicae* (Linn.) (Aphididae : Hemiptera)	Seedling, vegetative, flowering and head formation stages	20-25
Mustard aphid, *Lipaphis erysimi* (Kalt.) (Aphididae : Hemiptera)	Seedling, vegetative, flowering and head formation stages	10-100
Green peach aphid, *Myzus persicae* (Sulz.) (Aphididae : Hemiptera)	Flowering and head formation stages	20-25
Crucifer flea beetle, *Phyllotreta cruciferae* Goeze. (Chrysomelidae : Coleoptera)	Seedling to harvest	10-20
Striped flea beetle, *Phyllotreta striolata* (F.) (Chrysomelidae : Coleoptera)	Seedling to harvest	2-5
Cabbage borer, *Helulla undalis* (Fabr.) (Pyralidae : Lepidoptera)	Vegetative and head formation stage	5-10
Tobacco caterpillar, *Spodoptera litura* (Fb.) (Noctuiidae : Lepidoptera)	Vegetative stage to till harves	5-10
Painted bug, *Bagrada cruciferarum* and *B. hilaris* (Burm.) (Pentatomidae : Hemiptera)	Vegetative and head formation stage	20-50
Leaf webber, *Crocidolomia binotalis* Zell. (Pyralidae : Lepidoptera)	Vegetative and head formation stage	10-25
Leafminer, *Chromatomyia* (=*Phytomyza*) *horticola* Gour. (Agromyzidae : Diptera)	Vegetative stage to till harvest	2-5
Mustard sawfly, *Athalia lugens proxima* (Klug.) (Tenthredinidae : Hymenoptera)	Seedling and vegetative stage	5-10
Cutworm, *Agrotis ipsilon* (Hufn.)(Noctuiidae : Lepidoptera)	Seedling and vegetative stage	5-10
Green semilooper, *Trichoplusia ni* Hb. (Noctuiidae : Lepidoptera)	Seedling, vegetative and flowering stages	2-5
Grasshopper (Acrididae : Orthoptera)	Seedling and vegetative stage	1-2
B. Non insect pest		
Red spider mite, *Tetranychus cinnabarinus* Boisd. (Tetranychidae: Acarina)	Seedling and vegetative stage	10-25

was found most dominant and categorized as a major pest of broccoli. *Athalia lugens proxima* (Klug.) and *Pieris* spp. were the first to invade the crop at seedling stage. Bakhetia and Sekhon (1984) reported that thirty eight insect species were recorded in Brassica crops throughout India. *Tetranychus cinnabarinus* Boisd. causes severe damage to the crop and it also categorized as major pest of broccoli in Mizoram.

Natural enemy complex

Eleven species of natural enemies were recorded (Table 2). Three species of lady bird beetle were found to predate upon aphids. Both the grubs and adults were found abundantly during later stage of crop growth. Syrphid maggots were also found within aphid colony. One species of spider was found predating upon leaf webber larvae and aphid nymphs and adults. Singh and Rohilla (1997) reported six species of coccinellids and nine species of syrphid flies actively predating upon *L. erysimi*. Parasitoids like *Apanteles glomeratus*, *Cotesia* spp., *Hypersota ebeninius* and Tachniid parasitoid were also found abundantly during crop growth. *Pieris* spp. and *P. xylostella* were parasitized by *A. glomeratus* and *Cotesia* spp. *Pieris* spp. was parasitized by *H. ebeninius* and Tachniid parasitoid.

Table 2. Natural enemies complex in broccoli ecosystem

Common and scientific name	Family and Order	Host	Population Status (No. per plant)
A. Predators			
Ladybird beetle, *Coccinella septempunctata* Linn.	Coccinellidae, Coleoptera	Aphids	14 adults and grubs
Ladybird beetle, *Menochilus sexmaculatus* Fab.	Coccinellidae, Coleoptera	Aphids	8 adults and grubs
Ladybird beetle, *Coccinella transversalis* Fab.	Coccinellidae, Coleoptera	Aphids	7 adults and grubs
Syrphid fly *Ischiodon scutellaris* (Fabricius)	Syrphidae, Diptera	Aphids	24 maggots
Syrphid flies (Unidentified)	Syrphidae, Diptera	Aphids	16 maggots
Green lace wing, *Chrysoperla carnea*	Chrysopidae, Neuroptera	Aphids	9 grubs
Spider (Unidentified)	Acarina	Leaf webber larvae, aphids	5 adults
B. Parasitoids			
Apanteles glomeratus	Braconidae, Hymenoptera	Larvae of cabbage butterflies and DBM	38 pupae
Cotesia spp.	Braconidae, Hymenoptera	Larvae of cabbage butterflies and DBM	22 pupae
Hypersota ebeninius	Hymenoptera	Larvae of cabbage butterflies	6 pupae
Tachniid fly (Unidentified)	Tachniidae, Diptera	Pupae of cabbage butterflies	3 parasitized pupae

Seasonal incidence of insect pests of broccoli

During the crop season, *Pieris* spp. incidence started from the third week of November i.e., first week after transplanting and the population (1.98) reached the maximum during the fourth week after transplanting (Table 3). This result is in conformity with the findings of Pathak (2004) who reported that *P. brassicae* was more abundant during December and January. *P. xylostella* was more abundant (0.84) during February. Choudhury and Pal (2006) also reported that *P. xylostella* was more abundant during February and March on developing pods of mustard. The incidence of *L. erysimi* commenced from last week of November i.e., second week after transplanting and the population (1010.20) reached the peak infestation at sixteenth week after transplanting. These findings are similar to the results of Vekaria and Patel (1999); Singh and Lal

(1999) and Prasad (2003). The incidence of *P. cruciferae* started during first week of February i.e., twelfth week after transplant and it was more abundant (5.38) during February. The observation on seasonal incidence of flea beetle are in conformity with the findings of Nath and Saikia (2002) who reported that maximum infestation of flea beetle was observed during February in Assam, India.

Table 3. Seasonal abundance of major insect pests of broccoli during 2008-2009

Date of count	Standard week	Week after transplant	Mean number of insects pest per plant*				Mean
			Pieris spp.	*P. xylostella*	*L. erysimi*	*P. cruciferae*	
18.11.2008	46	1	0.40(0.63)	0.00(0.00)	0.00(0.00)	0.00(0.00)	0.10
25.11.2008	47	2	0.78(0.88)	0.00(0.00)	0.04(0.20)	0.00(0.00)	0.21
04.12.2008	48	3	1.24(1.11)	0.00(0.00)	0.36(0.60)	0.00(0.00)	0.40
12.12.2008	49	4	1.98(1.41)	0.00(0.00)	2.02(1.42)	0.00(0.00)	1.00
18.12.2008	50	5	1.42(1.19)	0.00(0.00)	1.24(1.11)	0.00(0.00)	0.67
26.12.2008	51	6	1.84(1.36)	0.00(0.00)	1.80(1.34)	0.00(0.00)	0.91
02.01.2009	52	7	1.84(1.36)	0.00(0.00)	3.20(1.79)	0.00(0.00)	1.26
09.01.2009	1	8	1.44(1.20)	0.00(0.00)	22.60(4.75)	0.00(0.00)	6.01
18.01.2009	3	10	1.24(1.11)	0.02(0.14)	19.72(4.44)	0.00(0.00)	5.25
29.01.2009	4	11	0.60(0.77)	0.00(0.00)	4.90(2.21)	0.00(0.00)	1.38
04.02.2009	5	12	0.42(0.65)	0.16(0.40)	22.16(4.71)	2.98(1.73)	6.43
15.02.2009	7	14	0.28(0.53)	0.50(0.71)	295.80(17.20)	2.16(1.47)	74.69
23.02.2009	8	15	0.24(0.49)	0.18(0.42)	179.90(13.41)	0.24(0.49)	45.14
02.03.2009	9	16	0.22(0.47)	0.20(0.45)	1010.20(31.78)	1.34(1.16)	252.99
Mean	1.00	0.08	111.17	0.48	28.32		
SE(d)	0.26	0.08	114.23	0.67			
CD (5%)	0.52	0.16	229.22	1.35			

*Figures in parentheses are square root transformed values and means of four replications

Correlation among insect pests of broccoli

During the study, *Pieris* spp. was significant negatively correlated with population of *P. xylostella* (-0.419), *L. erysimi* (-0.376) and *P. cruciferae* (-0.310) (Table 4). This negative association between *Pieris* spp. and *L. erysimi* may be due to the copious amount of honeydew secreted by *L. erysimi* resulting in growth of sooty mould which in turn probably would have hundred the activity of *Pieris* spp. larvae (Vekaria and Patel, 1999). The correlation coefficients of *P. xylostella* were highly significant with *L. erysimi* and *P. cruciferae*. It signifies that the activity of *P. xylostella* remained uninterrupted even with the increase of *L. erysimi* and *P. cruciferae* population that showed positive correlation with the population of *L. erysimi* (0.536) and *P. cruciferae* (0.479). *L. erysimi* showed positive non significant correlation with *P. cruciferae* (0.233).

Table 4. Correlation between insect pests of broccoli

Insect pests	*Pieris* spp.	*P. xylostella*	*L. erysimi*	*P. cruciferae*
Pieris spp.	1.000	-0.419**	-0.376**	-0.310**
P. xylostella		1.000	0.536**	0.479**
L. erysimi			1.000	0.233ns
P. cruciferae				1.000

** = significant at 1 %, * = significant at 5 %, ns = non significant

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