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PEST STATUS AND SEASONAL ABUNDANCE OF INSECTS ON CABBAGE CROP

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ABSTRACT

The study was conducted during November 2019 to March 2020 in the field and laboratory of the Department of Entomology of Bangabandhu Sheikh Mujibur Rahman Agricultural University (BSMRAU), Gazipur to find out the taxonomic position, pest status and seasonal abundance with richness and biodiversity of insect pests on cabbage. Among the seven arthropod pest's species, four were lepidopteran, two were coleopteran and only one was dipteran pests. According to the rate of plant infestation, flea beetles (100.0%), prodania caterpillar (33.3%) and diamondback moth (33.3%) were categorized as major pests whereas epilachna beetle, leaf miner, cut worm and cabbage worm were categorized as minor pests having percent plant infestation of 16.7%, 11.1%, 1.9% and 1.6%, respectively. The average population density of different arthropod pest of cabbage per plot (3m × 2m) in 7 observations was 0.14, 1.85, 2.00, 0.00, 0.71, 6.71, 9.85 for cutworm, epilachna beetle, flea beetle, leaf miner, cabbage looper, prodania caterpillar and diamondback moth (DBM), respectively. The abundance of insect pests was the maximum during the 3rd week of February (5.3±0.4 per 6m^2), the richness was the maximum (1.3±0.1) during the 3rd week of January, whereas the diversity was the maximum (1.0±0.0) during the 1st week of December and the 3rd week of January.

Keywords: Diamondback moth, prodania caterpillar, flea beetle, diversity, richness

Introduction

Cabbage, *Brassica oleracea* var. *capitata* L. is the most common and popular cruciferous winter vegetable crop in Bangladesh. In Bangladesh, the annual production of cabbage is 217 thousand tons and yield 16.8 ton ha^{-1} that contributes 23.5% of the total winter vegetable production which ranked fifth among the vegetables produced in Bangladesh (BBS 2017). The crop is extensively grown in the kitchen and commercial garden. However, the average yield of cabbage in Bangladesh is low. There are many reasons responsible for such poor yield, among them infestation of insect pests is considered as the most important ones. Biswas and Mian (1993) reported 14 different species of insect pests which infest cabbage. The cabbage crop during its growth period is attacked by a large number of insect pests every year including diamondback moth (DBM) (*Plutella xylostella*), whitefly (*Bemisia tabaci*), armyworm (*Spodoptera* sp), cabbage looper (*Trichoplusia binotalis*) and cabbage butterfly (*Pieris brassicae*) (Shuaib *et al.* 2007). In Bangladesh, Ahmed (2008) reported that cabbage caterpillar viz. prodania caterpillar and diamond back moth (DBM) cause damage 3.99% to 13.44% on leaves and 23.33% to 58.33% on plants depending on the varieties. This type of damage appears translucent of leaf. As a result of feeding, the plants either fail to form compact cabbage heads or produce deformed heads. It can reduce more than 50% yield in some cabbage genotypes (Bhat *et al.* 1994). The yield losses due to the infestation of diamondback moth was recorded up to 12.0-20.7 ton ha^{-1} in the first season and 27.0-48.7 ton ha^{-1} in the second season (Bhatia 1994). Cabbage looper (*Trichoplusia ni* Hub.) is another destructive pests, which destroys leaves of cabbage by voraciously feeding (Natwick *et al.* 2017). In case of seedling stage of cabbage, aphid and flea beetle can make considerable damage in farmers filed. The knowledge of seasonal incidence of insect pests at different growth stages of cabbage crop will be helpful in evolving proper management schedule. Climatic changes may lead to increase in severity of this pest in many regions of the country (Dhaliwal *et al.* 2010). The seasonal abundance of diamondback moth was studied on cabbage by Kumar *et al.* (2007) in India. However, in Bangladesh report on

a complete pest status of this crop with their seasonal abundance is scarce. Therefore, this study was undertaken to evaluate the seasonal abundance of insect pests on cabbage.

Materials and Methods

The experiment was conducted in the experimental field of Department of Entomology, BSMRAU, Gazipur 1706 during November 2019 to March 2020 having a total of 18 plots (3m × 2m). The cabbage seedling of variety Atlas-70 was transplanted in the field maintaining plant to plant distance 60 cm and row to row distance 45 cm. Before seedling transplantation, the land was well prepared by deep ploughing followed by laddering. One-month-old seedlings were transplanted in the main field. Application of manures and fertilizers was done according to the recommended fertilizer doses for cabbage production (BARC 2012). Intercultural operations such as gap filling, weeding, earthing up, irrigation, etc. were done as and when required for the normal growth of crops. The insect pests were identified through comparing to museum specimens as well as by relevant literature and photographs. The observations on the abundance of insect pests and their natural enemies were made visually and with the help of magnifying lens at 15 days interval recorded from their appearance on plants and continued until final harvest. Sample was taken from 5 plants per plot randomly and then converted to 18 plants (3m × 2m) for expressing rate of plant infestation and number of arthropods pests per plot. The arthropods pests were grouped into major (plant infestation >25%) and minor (plant infestation <25%) on the basis of the rate of infestation. Relative species abundance is calculated by dividing the number of species from one group by the total number of species from all groups. Shannon-Weaver diversity index (Shannon and Weaver 1963) and Margalef's richness index (Margalef l958) were calculated for the insect pests recorded on different observation days. The indices were computed using the following formulae:

Shannon-Weaver diversity index (H′):

$$H' = -\sum_{i=1}^{S} (Pi)(ln\ Pi)$$

Where, S = Total number of species = Species richness, Pi = The relative abundance of each species. P is the proportion (n/N) of individuals of one particular species found (n) divided by the total number of individuals found (N), ln is the natural log, and Σ is the sum of the calculations.

Margalef's species richness index (D^{mg}) is:

$$D^{mg} = \frac{S-1}{InN} \quad or \quad D^{mg} = \frac{S-1}{\log e(N)}$$

Where, S = Total number of species, N = Total number of individual in the sample, ln = Natural logarithm.

The data were analyzed statistically by analysis of variance (ANOVA) and the means were separated by using Tukey HSD posthoc statistic at 5% level of significance.

Results and Discussion

There were seven insect pests recorded in the cabbage field during the current study (Table 1). Among them, four insect pests were from Order Lepidoptera, namely cutworm (*Agrotis ipsilon,* Noctuidae), cabbage looper (*Trichoplusia ni,* Noctuidae), prodania caterpillar/ cabbage caterpillar/tobacco caterpillar (*Spodoptera litura,* Noctuidae) and diamondback moth (*Plutella xylostella*, Plutellidae). Epilachna beetle (*Epilachna dodecastigma,* Coccinellidae) and flea beetles (*Phyllotreta* spp., Chrysomelidae) from Order Coleoptera were observed and only one insect pest (*Liriomyza brassicae*, Agromyzidae) was found from Diptera order. According to Iqbal *et al.*

Table 1. Arthropod pests' in cabbage and their taxonomic position

Common name	Scientific name	Family	Order
Cutworm	*Agrotis ipsilon* Hufnagel	Noctuidae	Lepidoptera
Epilachna beetle	*Epilachna dodecastigma* Mulsant	Coccinellidae	Coleoptera
Flea beetles	*Phyllotreta* spp.	Chrysomelidae	Coleoptera
Leaf miner	*Liriomyza brassicae* Riley	Agromyzidae	Diptera
Cabbage looper	*Trichoplusia ni* Hübner	Noctuidae	Lepidoptera
Prodania caterpillar/cabbage caterpillar/ tobacco caterpillar	*Spodoptera litura* Fabricius	Noctuidae	Lepidoptera
Diamondback moth (DBM)	*Plutella xylostella* Linnaeus	Plutellidae	Lepidoptera

(2015), Lepidopterous insects such as cabbage semi-looper (*Trichoplusia ni* Hub.), diamondback moth (*Plutella xylostella* L.), tobacco caterpillar/prodenia caterpillar (*Spodoptera litura* Fab.) are the most destructive insect pests of cabbage.

Cutworm, epilachna beetle, flea beetles and leaf miner were found to infest the crop from transplanting to plant establishment stage, whereas cabbage looper infested the plant at head initiation stage (Table 2). Prodania caterpillar and diamondback moth infested the plant during head development to harvesting stage. According to the rate of plant infestation, flea beetles (100.0%), prodania caterpillar and/or diamondback moth (33.3%) were categorized as major pests. Epilachna beetle, leaf miner, cut worm and cabbage worm were categorized as minor pest having percent plant infestation 16.7%, 11.1%, 1.9% and 1.6%, respectively (Table 2).

Kumar *et al.* (2007) studied that cabbage butterfly, diamond back moth and tobacco caterpillar are the most destructive pests causing severe yield loss to cabbage every year. Flea beetle (*Phyllotreta* spp.) is becoming a major insect pest of cabbage now-a-days and considered as the major insect pest of Brassicaceae crop (Mayoori and Mikunthan 2009) all over the world as well as in Bangladesh. Adult feeding of that insect can be seen as characteristic shot-holing of the leaves. Plants infested with larvae lose vigour, becoming stunted, and die if the infestation is severe. Reddy *et al.* (2017) reported that, tobacco caterpillar (*litura*) is one of the important insect pests of crops in the Asian tropics and the pest was found to occur in cabbage growing areas and can reduce more than 50% yield in some cabbage genotypes. Ahmed (2008) reported that in Bangladesh, cabbage caterpillar causes damage 3.99% to 13.44% on leaves and 23.33% to 58.33% on plants depending on the varieties. Diamondback moth (*P. xylostella* L.) is reported as a primary pest that causes heavy loss of the cabbage field by larval feeding (Parajuli and Paudel 2019). The yield losses due to the infestation of diamondback moth was recorded up to 12.0 and 20.7 ton ha^{-1} in the first season and 27.00 and 48.7 ton ha^{-1}, respectively in the second season (Bhatia 1994).

The relative seasonal abundance of different arthropod pests' of cabbage per plot has shown in (Table 3). The average population density of different arthropod pests' of cabbage in 7 observations was 0.14, 1.85, 2.00, 0.00, 0.71, 6.71, 9.85 was for cutworm, epilachna beetle, flea beetle, leaf miner, cabbage looper, prodania caterpillar and diamondback moth (DBM), respectively.

The abundance of the recorded insect pests of cabbage in per plot fluctuated during the study period (Table 4). The abundance of insect pests was the maximum during the 3rd week of February (5.3±0.4), followed by the 1st week of March (4.6±0.3). The lowest abundance (0.9±0.1) was found during the 1st week of December which was also denoted as the early growing period. The richness of the insect pests was the maximum (1.3±0.1) during the 3rd week of January. The lowest richness of the insect pests (0.3±0.0) was found during the 1st week of March, the end of growing season. The diversity of the insects was the maximum (1.0±0.0) during the 1st week of December and the 3rd week of January, whereas the lowest and similar diversity (0.7±0.0) was found in both the periods of 3rd week of December and 1st week of March.

Bana *et al.* (2012) found that the infestation of diamondback moth started from the third week of November and reached peak in the first week of January. The maximum and minimum temperatures showed significant negative

Table 2. Status of arthropod pests in cabbage grown during Rabi season 2019-20

Common name	Crop stage of infestation	Starting of infestation	Rate of plant infestation (%)	Status
Cutworm	Transplanting to plant establishment	3 DAT	1.9	Minor
Epilachna beetle	Transplanting to plant establishment	7 DAT	16.7	Minor
Flea beetles	Transplanting to plant establishment	7 DAT	100.0	Major
Leaf miner	Transplanting to plant establishment	15 DAT	11.1	Minor
Cabbage looper	Head initiation stage	21 DAT	1.6	Minor
Prodania caterpillar	Head development to harvesting stage	45 DAT	33.3	Major
Diamondback moth (DBM)	Head development to harvesting stage	45 DAT	33.3	Major

Major arthropod pests (rate of plant infestation >25%) and minor arthropods pests (rate of plant infestation <25%).

Table 3. Relative seasonal abundance of arthropod pests' in cabbage per plot (3m × 2m) through visual searching during Rabi season 2019-20

Time	Arthropod pests						
	Cutworm	Epilachna beetle	Flea beetles	Leaf miner	Cabbage looper	Prodania caterpillar	Diamondback moth (DBM)
01 December	1.0	2.0	3.0	0.0	0.0	0.0	0.0
15 December	0.0	3.0	4.0	0.0	0.0	0.0	0.0
01 January	0.0	1.0	6.0	0.0	2.0	0.0	0.0
15 January	0.0	2.0	1.0	0.0	3.0	7.0	8.0
01 February	0.0	2.0	0.0	0.0	0.0	9.0	13.0
15 February	0.0	3.0	0.0	0.0	0.0	14.0	20.0
01 March	0.0	0.0	0.0	0.0	0.0	17.0	28.0
Mean	0.14	1.85	2.00	0.00	0.71	6.71	9.85

Only the symptoms of leaf miner was observed, but not the insect.

Table 4. The average abundance, richness and diversity of insect pests in cabbage per plot (3m × 2m) through visual searching during Rabi season 2019-20

Insect pests	Observation days						
	01 December	15 December	01 January	15 January	01 February	15 February	01 March
Abundance	0.9±0.1c	1.0±0.1c	1.3±0.2c	3.0±0.3b	3.4±0.3ab	5.3±0.4a	4.6±0.3a
Richness	1.1±0.2a	0.5±0.0b	0.9±0.1ab	1.3±0.1a	0.6±0.0b	0.6±0.0b	0.3±0.0b
Diversity	1.0±0.0a	0.7±0.0a	0.9±0.0a	1.0±0.1a	0.9±0.0a	0.9±0.1a	0.7±0.0a

Data expressed as mean ±SE. Means within a row followed by same letter(s) are not significantly different according to Tukey HSD posthoc statistic at < 0.05.

correlation with larval population of diamondback moth, whereas, relative humidity and sunshine hours showed non-significant correlation. The present finding get support from Sharma (2004) who reported diamondback moth as regular and major pest of cabbage. The infestation started from third week of November and reached to maximum (45.75 and 42.50 larvae on 710 plants) in the first week of January thereafter, population started declining (Bana *et al.* 2012).

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