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Biodiversity of insect pests of major cereal crops in mid hills of Meghalaya

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Abstract

Cereals are the staple food for most of the world's population. Among the cereals, rice and maize are two major food crops of India in general and North East region in particular. Several insect pests are associated with the cereal crop ecosystem which is a major threat to agriculture causing substantial economic losses. However limited information is available on insect pests of cereals ecosystem in mid-hills of Meghalaya. Therefore, this study was conducted to study the biodiversity of insect pest of major cereal crops viz., rice and maize in mid hills of Meghalaya. During 2015-16, a total of 23 insect pests were collected, identified and documented which were belonging to four insect orders viz., Hemiptera (12), Lepidoptera (6) Coleoptera (4), and Orthoptera (1). 6 species of insect viz., *Chiloptartellus*, *Helicoverpa armigera*, *Leptocoris vericornis*, *Nilaparvata lugens*, *Cnaphalocrocis medinalis* and *Paraponyx stagnalis* were found to be major pest of rice and maize and 17 species of insects viz., *Rhopalosiphum maidis*, *R. padi*, *Parnara ganga*, *Leucopholis lepidophora*, *Nezara viridula*, *Xylotrupes siamensis*, *Melanitis leda*, *Oxya hyla hyla*, *Monolepta quadriguttata*, *Nephotettix nigropictus*, *N. virescens*, *Cofana lineata*, *Menida versicolor*, *Cletus rubidiventris*, *Anomala grandis*, *Bothrogonia tibetana* and *Diostrombus* sp. nr. *carnosa* were found to be minor pests. All the collected species were identified based on taxonomic keys and from taxonomists. The comprehensive information generated on the biodiversity of insect pests associated with major cereal crops would be helpful in developing pest management strategies. It could also be used as a diagnostic guide for the identification of the pest species.

Keywords: Cereals, biodiversity, pests

Introduction

A cereal which includes wheat, rice, maize, sorghum, millet, barley, etc. is the staple food for most of the world's population. Cereals are grown over 73% of the total world harvested area and contribute over 60% of the world food production (Das *et al.*, 2012) [5]. Cereal crops are considered to be the world's most important sources of food, both for direct human consumption and indirectly as inputs to livestock production. India, basically an agricultural country with variable climatic regions owing to its geographic features is the world's second largest producer of rice, wheat, maize and other food grains. Insect pests are a major concern for farmers across the world and more than 10,000 species of insects causes economic damage to cereal crops (Dhaliwal *et al.*, 2007) [5]. The green revolution which has resulted in a considerable increase in agriculture production through the use of high yielding varieties, increased use of agrochemicals and irrigation has also favored changes in pest scenario (Dhaliwal *et al.*, 2010) [6].

Rice (*Oryza sativa* L.) is the most important crop in the world and grown in 117 countries, being the staple food of 2.7 billion people in Asia alone (Kumar *et al.*, 2009) [11]. In India, rice cultivation extends across diverse ecosystems such as irrigated (52.6%), upland (12%), rain-fed low land (32.4%), semi deep water and deep water (3%) as well as coastal saline regions (Krishnaiah and Varma, 2011) [10]. Rice is the staple food crop in the northeast region of India, followed by maize, occupying 3.51 million hectares which accounts for more than 80% of the total cultivated area of the region and 7.8% of the total rice area in India (Ghosh *et al.*, 2015) [9]. Rice is grown extensively in valleys, terraces, upland, hill and *jhum*. About 300 species of insects have been reported to infest rice crop alone in India and 20 species have been considered to be the major pests causing 21 to 51% yield loss (Pathak, 1977; Arora and Dhaliwal, 1996) [14, 1]. Rice crop in North East region of India is attacked by large numbers of insects. Among these, yellow stem borer, leaf folder, case worm, hispa, gundhi bug, swarming caterpillar, thrips, gall midge, and armyworm are the important pests in the region (Shylesha *et al.*, 2006) [18].

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Maize (*Zea mays* L.) is the third most important food crop after rice and wheat and it is the most versatile crop with wider adaptability in varied agro-ecologies. Globally, India ranks 5th in area, 4th in production and 3rd in productivity (Pal *et al.*, 2009) [12]. Insect pests attacked and damage maize crop under field and also at storage conditions. The major field pests are, maize stalk borer (*Chilo partellus* Swinhoe), pink stem borer (*Sesamia inferens* Walker), sugarcane leafhopper (*Pyrilla perpusilla* Walker), shoot bug (*Peregrinus maidis* Ashmead), armyworm (*Mythimna separata* Walker), shoot fly (*Atherigona* spp.), corn leaf aphid (*Rhopalosiphum maidis* Fitch), cob borer (*Helicoverpa armigera* Hubner) and termites (*Macrotermes* spp. and *Odontotermes* spp.) (Dhillon *et al.*, 2014) [7]. In the North Eastern region, maize crop is attacked by several insects. Patra *et al.* (2013) [15] studied on pest complex of maize in mid hills of Meghalaya and reported twenty four insect pests in maize, out of which, stem borer (*Chilo partellus* Swin.), cob borer (*Stenachroia elongella* Hamp.) and shoot fly (*Atherigona soccata* Rond.) were found to be major pests.

Damage caused by insect pests is one of the constraints in the production of cereals in India including North East region of India. Moreover, the Northeastern region is considered to be one of the biodiversity hot spots in the World which is rich in insect biodiversity. The climatic conditions are highly favorable for reproduction and development of insect species. Though few studies have mapped the biodiversity of insect fauna in rice, maize and other cereal crops, but still more research needs to be undertaken to reliably identify and document the biodiversity in cereal crops ecosystem. Keeping these views in mind, the present study was conducted to know the biodiversity of insect pests of major cereal crop ecosystem in mid hills of Meghalaya which would be helpful in developing pest management strategies and also as a diagnostic guide for identification of the pest species in the region.

Materials and Methods

Location and Site

Studies on “Biodiversity of insect pests of major cereal crops in mid hills of Meghalaya” was carried out during 2015-16 in the Entomology section of Crop Protection Division, ICAR Research Complex for North Eastern Hill (NEH) Region, Umiam, Meghalaya. The institute is situated at Umiam (Barapani), 25°41'-21" North latitude and 91°55'-25" East longitude having an elevation of 1010 m above the msl. The climatic condition in this area is of mid tropical zone, with an average annual rainfall of 2810 mm with a maximum temperature range of 20.9 °C to 27.4 °C and minimum temperature from 6.7 °C to 18.1 °C. The biodiversity of insect pests of major cereal crops in this area was observed during the experimental period.

Sample collection

A maximum of ten specimens were collected for each species from two major cereal crops *viz.*, rice (*Oryza sativa* L.) and maize (*Zea mays* L.) from Entomology experimental farms of ICAR Research Complex for North East Hill Region, Umiam (Barapani), Meghalaya during July 2015 to April 2016 (Table 1). Various collection methods were used for the collection of samples from cereal crops. Larvae (of butterfly and moths), several bugs and beetles were collected by handpicking. Medium-sized flying insects were collected with the help of insect net by sweeping, small flies and aphids were collected

by aspirator. In the case of larvae, the specimens were reared to adulthood on their natural host in laboratory and adult was used for identification. Information on the host plant, location, collection date and stage collected were recorded for all the individual species.

Species identification

Preliminary identification of the collected samples was done based on established taxonomic key and also by matching the characters with identified species in Insect Museum of Entomology section of Crop Protection Division, ICAR Research Complex for NEH Region, Umiam, Meghalaya. For further confirmation of the identified species, specimens were also sent to IARI (Indian Agricultural Research Institute), New Delhi and ICAR-NBAIR (National Bureau of Agricultural Insect Resources), Bengaluru and MPUAT, Udaipur for further identification.

Preservation

The multiple specimens of insect species which were identified were preserved in 100% ethanol. All the tubes were labeled with the name of species and other collections details. The voucher specimens of all the identified species were also maintained at Insect Museum, Division of Crop Protection of ICAR Research Complex for NEH Region, Umiam, Meghalaya. The dry specimen of insects were spread and pinned and kept in insect box for display with proper information about each species. A clear and close up photographs of various specimens was also maintained separately.

Results & Discussion

Biodiversity of insect pests of major cereal crops in mid hills of Meghalaya

Insect pests are a major threat to agriculture causing substantial economic losses. Several insect pests are found to be associated with the cereal crops ecosystem. Different studies conducted by different researchers on the biodiversity of insect pest in North East region have indicated the presence of rich insect biodiversity in the region. In this study, a total of 23 insect pests were collected, identified and documented from major cereal crops *viz.*, rice and maize (Table 2). The insect pest species collected were classified as major and minor pests based on the level of damage. Among the pests, stem borer (*Chilo partellus*), corn earworm (*Helicoverpa armigera*), rice gundhi bug (*Leptocoris vericornis*), brown plant hopper (*Nilaparvata lugens*), rice caseworm (*Paraponyx stagnalis*) and rice leaf folder (*Cnaphalocrocis medinalis*) were found to be major pest of cereal crops during 2015-16. *Chilo partellus* was observed infesting both maize and rice. The other pests such as common evening butterfly (*Melanitis leda*), corn aphid (*Rhopalosiphum maidis*), bird cherry-oat aphid (*Rhopalosiphum padi*), continental swift (*Parnara ganga*), white grub (*Leucopholis lepidophora*), green stink bug (*Nezara viridula*), elephant beetle (*Xylotrupes siamensis*), rice grasshopper (*Oxya hyla hyla*), leaf beetle (*Monolepta quadriguttata*), green leafhopper (*Nephotettix nigropictus*, *N. virescens*) white leafhopper (*Cofana lineata*), rice bug (*Menida versicolor*), stink bug (*Cletus rubidiventris*), green beetle (*Anomala grandis*) and hopper (*Bothrogonia tibetana* and *Diostrombus* sp. nr. *carcosa*) appeared to be minor pests. Among the 23 insect pests species collected, a total of 17 insect pest species were found infesting rice and 10 species were found infesting maize. 4 species *viz.*, *Chilo partellus*,

Cofana lineata, *Bothrogonia tibetana* and *Monolepta quadriguttata* were found to be a common pest of rice and maize.

Out of 23 pest species, 6 species were observed to be major pests and 17 were of minor pests (Table 2). The biodiversity of insects varies from region to region due to different ecological and climate factors. Different researchers have reported and documented the biodiversity of insect pests in rice and maize ecosystem and the insect species recorded varies from region to region. Pathak (1968, 1977) [13, 14] reported that more than 100 species of insects cause damage to rice across the world. Similarly, Sarup *et al.* (1987) [17] reported a total of 139 insect species that attacked and damage maize in India. In the present study the major pests observed in rice and maize crops were stem borer (*Chilo partellus*), gundhi bug (*Leptocorisa vericornis*), caseworm (*Paraponyx stagnalis*), leaf folder (*Cnaphalocrocis medinalis*), corn earworm (*Helicoverpa armigera*) and brown plant hopper (*Nilaparvata lugens*) (Table 2, Plate 1-6). Similar results were also obtained by Shylesha *et al.* (2006) [18], who studied the biodiversity of insects in rice crop and reported leaf folder, case worm, gundhi bug as important pests in the region. Moreover, Azad Thakur *et al.* (2012) [2] also studied the biodiversity of agriculturally important insects in the North Eastern region and reported maize earhead worm and stem borer as major pests. Patra *et al.* (2013) [15] also studied the pest complex of maize in mid hills of Meghalaya and reported 24 insect pests in maize alone of which, stem borer (*Chilo partellus* Swin.) was one of the major pests. In fact the number species recorded in the present investigation are comparatively less in number; however, it could be due to the variations in climatic condition and other environmental factors. Interestingly, stem borer *C. partellus* generally infest maize crop, but it was also observed infesting rice crop showing typical white ear symptom in the fields. Other stem borers like pink stem borer and yellow stem borer of rice were not encountered during the study period in mid hills of Meghalaya. The brown plant hopper *Nilaparvata lugens* was also observed to be a serious pest both in the field and green house condition. Rao and Chalam (2007) [16] studied the biodiversity of plant hoppers fauna in South India and

reported *Nilaparvata lugens* (Stal.) as the dominant population in rice ecosystems of Karnataka.

Ghosh and Singh (2000) [81] reported that about 653 species belonging to 208 genera represent Indian aphididae and Northeast India represents maximum number of aphid species with 414 subspecies. In this study, two aphid species *R. maidis* and *R. padi* (Table 2, Plate 7 and 8) were observed infesting maize. North east India, being a biodiversity hotspot, one can expect a large number of insect species in a given insect order or family or genus, which might have not been explored previously. Two green leafhopper species *N. nigropictus* and *N. virescens* (Table 2, Plate 16 and 17) were also recorded from rice crops. Chowdhury *et al.* (2011) [3] studied the leafhoppers fauna associated with rice ecosystem of Tripura region and reported *N. nigropictus* as the dominant species followed by *N. virescens*. Interestingly, as per the existing literature scan, *Bothrogonia tibetana* (Table 2, Plate 22) and *Diosmombus* sp. nr. *carnosa* (Table 2, Plate 23) were not reported yet from north east India. So this could be the first report of these two species from north east India. The duration of the present study was very short, so there might be many species in these two crop ecosystem which might have yet to be discovered or identified.

Conclusions

In this study, we have analysed and documented 23 insect pests of two major cereal crops *viz.*, Rice and Maize, but there may be more species harboured in this region. Therefore, additional studies have to be undertaken to know the insect pests diversity and the pest status in the region. The comprehensive information generated from the present study would be useful in further understanding of the biodiversity of arthropod fauna associated with cereal crops in other parts of the country. This study would certainly have implications in taxonomy, quarantine and trade, pest management and development of a diagnostic guide for identification of pest species.

Disclosure statement

No potential conflict of interest was reported by the author

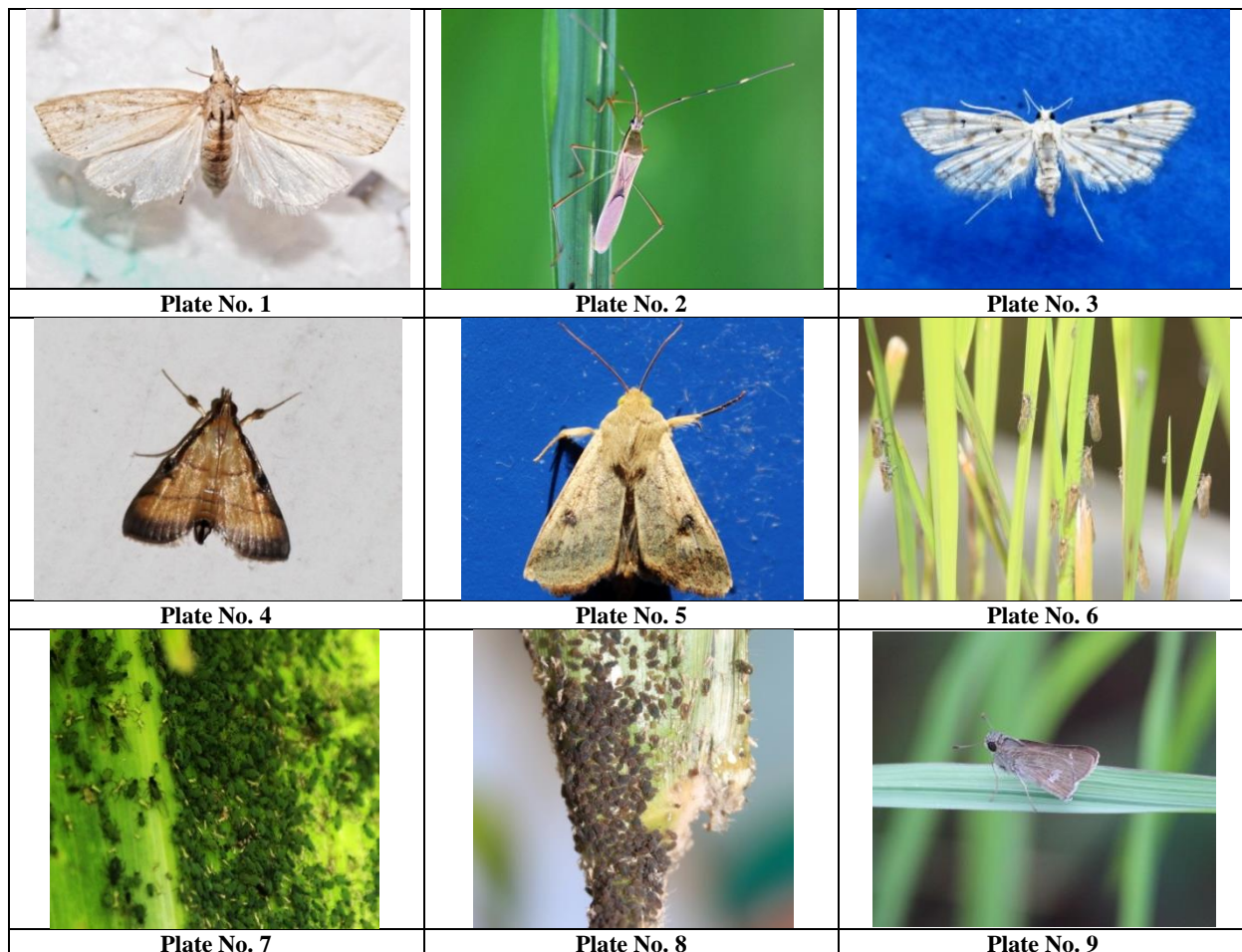
Table 1: Collection details of specimens during experimental period (2015-2016)

Sl. No	Name of insect species	Order	Family	Month of collection	Host	Location	No. of specimens
1	<i>Chilo partellus</i>	Lepidoptera	Crambidae	Jul. 2015	Maize, Rice	Ento. field	10
2	<i>Xylotrupes stamensis</i>	Coleoptera	Scarabaeidae	Jul. 2015	Maize	Ento. field	10
3	<i>Cletus rubidiventris</i>	Hemiptera	Coreidae	Jul. 2015	Rice	Ento. field	10
4	<i>Leptocorisa vericornis</i>	Hemiptera	Alydidae	Jul. 2015	Rice	Ento. field	10
5	<i>Rhopalosiphum maidis</i>	Hemiptera	Aphididae	Jul. 2015	Maize	Ento. field	10
6	<i>Parnara ganga</i>	Lepidoptera	Hesperiidae	Jul. 2015	Rice	Ento. field	10
7	<i>Oxya hyla hyla</i>	Orthoptera	Acrididae	Jul. 2015	Rice	Ento. field	10
8	<i>Cofana lineata</i>	Hemiptera	Cicadellidae	Jul. 2015	Maize, Rice	Ento. field	10
9	<i>Bothrogonia tibetana</i>	Hemiptera	Cicadellidae	Jul. 2015	Maize, Rice	Ento. field	10
10	<i>Leucopholis lepidophora</i>	Coleoptera	Scarabaeidae	Jul. 2015	Maize	Ento. field	10
11	<i>Diosmombus</i> sp. nr. <i>carnosa</i>	Hemiptera	Derbidae	Jul. 2015	Maize	Ento. field	10
12	<i>Melanitis leda</i>	Lepidoptera	Nymphalidae	Aug. 2015	Rice	Ento. field	10
13	<i>Nezara viridula</i>	Hemiptera	Pentatomidae	Aug. 2015	Rice	Ento. field	10
14	<i>Menida versicolor</i>	Hemiptera	Pentatomidae	Aug. 2015	Rice	Ento. field	10
15	<i>Monolepta quadriguttata</i>	Coleoptera	Chrysomelidae	Aug. 2015	Maize, Rice	Ento. field	10
16	<i>Nephotettix nigropictus</i>	Hemiptera	Cicadellidae	Aug. 2015	Rice	Ento. field	10
17	<i>Cnaphalocrocis medinalis</i>	Lepidoptera	Crambidae	Aug. 2015	Rice	Ento. field	10
18	<i>Paraponyx stagnalis</i>	Lepidoptera	Crambidae	Sept. 2015	Rice	Ento. field	10
19	<i>Anomala grandis</i>	Coleoptera	Scarabaeidae	Sept. 2015	Rice	Ento. field	10
20	<i>Helicoverpa armigera</i>	Lepidoptera	Noctuidae	Oct. 2015	Maize	Ento. field	10
21	<i>Rhopalosiphum padi</i>	Hemiptera	Aphididae	Nov. 2015	Maize	Ento. field	10

22	<i>Nephotettix virescens</i>	Hemiptera	Cicadellidae	Nov. 2015	Rice	Ento. field	10
23	<i>Nilaparvata lugens</i>	Hemiptera	Delphacidae	Apr. 2016	Rice	Ento. field	10

Table 2: Image and Biodiversity of insect pests of major cereal crops in mid hills of Meghalaya

Sl. No	Common name	Scientific name	Pest status	Plate no.
1	Stem borer	<i>Chilo partellus</i>	Major pest	1
2	Gundhi bug	<i>Leptocoris vericornis</i>	Major pest	2
3	Rice caseworm	<i>Paraponyx stagnalis</i>	Major pest	3
4	Rice leaf folder	<i>Cnaphalocrocis medinalis</i>	Major pest	4
5	Corn earworm	<i>Helicoverpa armigera</i>	Major pest	5
6	Brown plant hopper	<i>Nilaparvata lugens</i>	Major pest	6
7	Corn aphid	<i>Rhopalosiphum maidis</i>	Minor pest	7
8	Bird cherry-oat aphid	<i>Rhopalosiphum padi</i>	Minor pest	8
9	Continental swift	<i>Parnara ganga</i>	Minor pest	9
10	White grub	<i>Leucopholis lepidophora</i>	Minor pest	10
11	Green stink bug	<i>Nezara viridula</i>	Minor pest	11
12	Elephant beetle	<i>Xylotrupes siamensis</i>	Minor pest	12
13	Common evening butterfly	<i>Melanitis leda</i>	Minor pest	13
14	Rice grasshopper	<i>Oxya hyla hyla</i>	Minor pest	14
15	Leaf beetle	<i>Monolepta quadriguttata</i>	Minor pest	15
16	Green leafhopper	<i>Nephotettix nigropictus</i>	Minor pest	16
17	Green leafhopper	<i>Nephotettix virescens</i>	Minor pest	17
18	White leafhopper	<i>Cofana lineata</i>	Minor pest	18
19	Rice bug	<i>Menida versicolor</i>	Minor pest	19
20	Stink bug	<i>Cletus rubidiventris</i>	Minor pest	20
21	Green beetle	<i>Anomala grandis</i>	Minor pest	21
22	Hopper	<i>Bothrogonia tibetana</i>	Minor pest	22
23	Hopper	<i>Diotrombus sp. nr. carnosus</i>	Minor pest	23



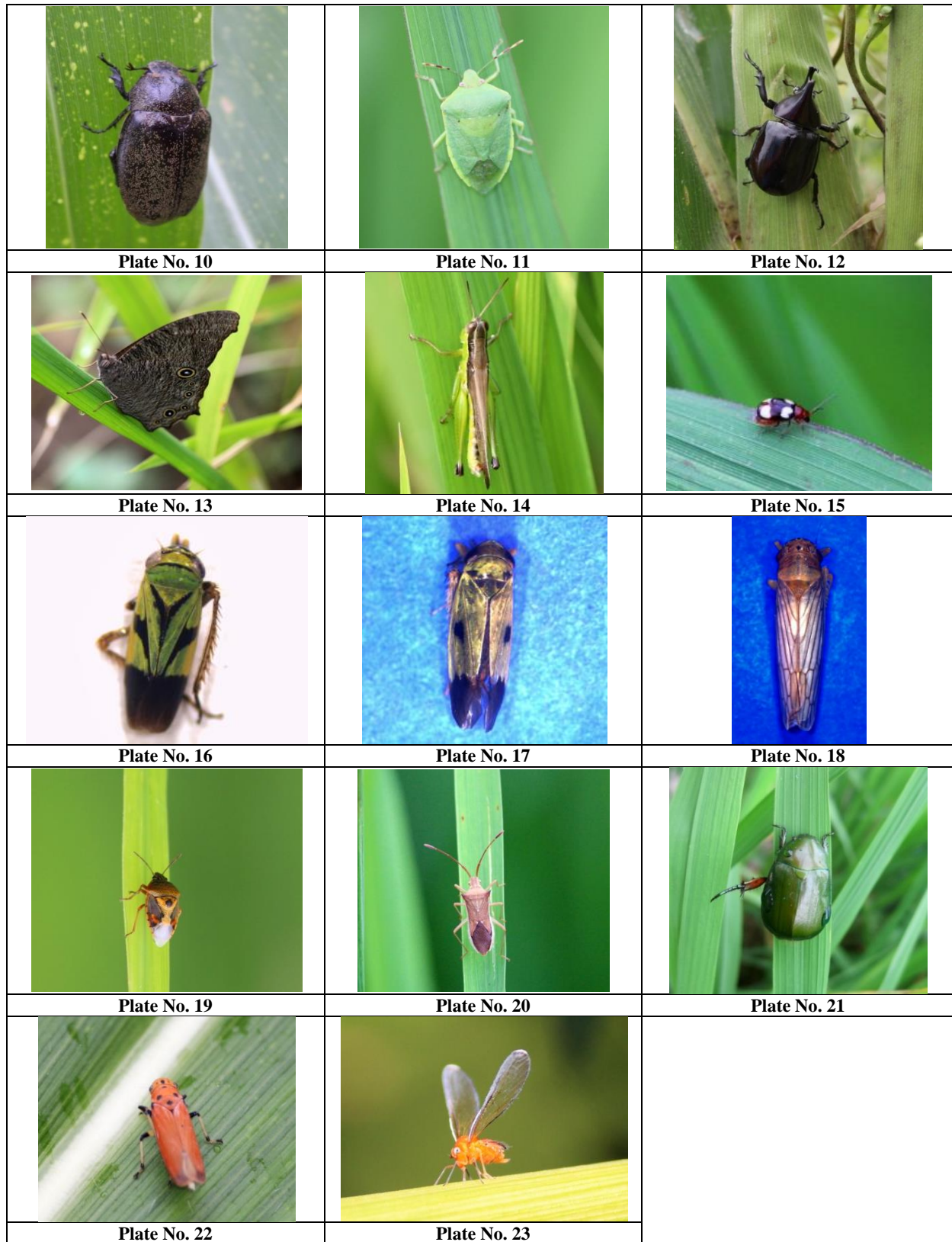


Fig 1: Image and Biodiversity of insect pests of major cereal crops in mid hills of Meghalaya (Plate 1-23)

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