First report of *Carpophilus dimidiatus* Fabricius (Nitidulidae: Coleoptera) in stored groundnut and field maize from West Bengal

Abstract

Genus*Carpophilus*~~genus~~ belongs to the family N~~n~~itidulidae under the order C~~c~~oleoptera. Majority of the members under this genusare either sap ~~feeder~~ feeders or fungus ~~feeder~~feeders. A small number of these, however, is economically ~~categorised~~ categorized as stored grain pests, including ~~. The commonly known species under this genus are~~*C.dimidiatus*, *C.hemipterus*, *C.humeralis*, *C.marginellus*, *C.mutilatus*, *C.obsoletus*, *C.davidsoni*,*C.lugubris*etc.Among these, *Carpophilus dimidiatus* (Fabricius) has been reported worldwide as a pest causing significant post-harvest loss.In India, different cereals like bajra, rice products, sago flour,~~as well as~~and oil seeds have been found to be infested by this pest.This pest was reported earlier ~~from in our country~~India,~~. But~~ and the information on the identification of beetles ~~as well as~~and the name of the crop(s) infested by the pest ~~were~~ was ~~lacking~~relatively rare. ~~It was recordedwith proper identification in stored groundnut from Bangalore and Chennai for the first time from our country in the year 2022.~~This ~~report~~ study is ~~going to be~~ the first report ~~ever report~~ of *Carpophilusdimidiatus* on groundnut in storage and on maize in the field from West Bengal.

Keywords: First report, *Carpophilus dimidiatus*, nitidulid beetle, groundnut, maize, West Bengal

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1. Introduction

NitidulidaeNitidulids are the most diverse group of beetles distributed widely in all zoogeographical regions of the world. This family is represented by 350 genera with more than 4500 species [1]. They show tremendous diversity in their feeding habitat. Many species are associated with decaying materials, some are sap feeders found on sap-flows or wound of trees [2], some are pollinators[3], whereas andmany species are recorded as stored product insects [4]. These beetles also display great diversity in their morphological adaptations and general body form. As majority mostof the NitidulidaeNitidulids species are saprophagous and mycetophagous, they receive less importance attentionand are thought to be without anyhave no economic importance. However, a small group of nitidulids is regarded as economically important, particularly the genus *Carpophilus*, infesting different stored products like grain productproducts, cracked rough rice, wheat bran, nuts, and nut products, spoiled commodities, and vegetable products including the dry fruits. Some of these are *Carpophilusdimidiatus* (Fabricius), *C. hemipterus* (Linnaeus), *C. humeralis* (Fabricius), *C. marginellus* (Motschulsky), *C. mutilatus* (Erichson) and *C. obsoletus* (Erichson), *C. davidsoni* (Dobson), *C. lugubris* (Murray) etc.Among these, *Carpophilus dimidiatus* (Fabricius) has been reported from several countries, throughout the globe, to cause significant post-harvest loss [5].This beetle was found to infest corn fields around Uttar Banga Krishi Viswavidyalaya, Pundibari (26° 31' N, 89° 06' E) region (Block: Coochbehar II) from 2020. Afterwards, the infestation was decreased. Again, the infestation started from 2022 onwards. This time the infestation was not restricted toPundibari region, but also to other areas under Coochbehar – II block. Besides these records, the pest was also found to infest groundnuts in storage. The stored groundnut samples infested by this pest were also found in several parts of different districts under Sub-Himalayan region of West Bengal; i.e. Alipurduar, Darjeeling and Coochbehar. Afterwards, a study was initiated to record the presence of *C.dimidiatus* in the said region covering different areas.

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2. History of Nomenclature

Carpophilusdimidiatus was described originally as *Nitidula dimidiata* by Fabricius in the year 1792 [6]. Afterwards,this species strived a long path to arrive at *Carpophilusdimidiatus.Nitidula dimidiata*(Fabricius) was changed to *Carpophilus auripilosus* Wollaston, *Carpophilus lewisi* Reitter, *Carpophilus pusillus* Stephens, *Carpophilus vittiger* Murray, *Carpophilus biguttatus* Gemminger and Harold and finally *Carpophilus dimidiatus,* Grouvelle [7].The reason behind this was the close similarity between the species. Several misidentifications throughout the globe had happened earlier among the several species of *Carpophilus.*

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~~3. Background of this work~~

~~This beetle was found to infest corn fields around Uttar Banga Krishi Viswavidyalaya, Pundibari (26° 31' N, 89° 06' E) region (Block: Coochbehar II) from 2020. Afterwards, the infestation was decreased. Again, the infestation started from 2022 onwards. This time the infestation was not restricted to Pundibari region, but also to other areas under Coochbehar – II block. Besides these records, the pest was also found to infest groundnuts in storage. The stored groundnut samples infested by this pest were also found in several parts of different districts under Sub-Himalayan region of West Bengal; i.e. Alipurduar, Darjeeling and Coochbehar. Afterwards, a study was initiated to record the presence of *C. dimidiatus* in the said region covering different areas.~~

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34. Materials and methods:

Surveys were conducted in the different districts mentionedabove. Groundnut samples of 500g were collected from each of the grocery shops. Collected samples from storage were kept separately (within glassjars) in the laboratory. After a certain period, small beetles were found to emerge from the said samples.

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Under field condition, the infestation of the ~~said~~ pest was spotted only on maize.Cob samples with specific damage symptoms were collected from fields of Coochbehar district and put into plastic zip covers and ~~were~~ taken to the laboratory for further observation.

All the images and photographs were captured by Magnus TZM6 stereozoom microscope andSamsung Galaxy S21 FE handset. The specimens were stored at the laboratory of Department of Agril. Entomology, Uttar Banga Krishi Viswavidyalaya (*26° 31' N, 89° 06' E*), Pundibari, Coochbehar (West Bengal) for further identification. Regarding taxonomic identification, keys of different scientists were utilised [5, 7, 8]. The fragment of the mitochondrial 16S rRNA (ribosomal RNA) gene was also amplified ~~Identification of this beetle was confirmed on the basis of molecular characterisation~~for the identification of this beetle.~~, too.~~

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45. Results and Discussion

45.1Survey report

Table 1 and Table 2 describes the occurrence of *C. dimidiatus* from both storage and field condition –

Table 1. Survey report on *C. dimidiatus* infesting stored groundnut from Terai region of West Bengal

Name of District	Location	GPS Code	Damage (%)*
Coochbehar	South Khagrabari	$26^0$33'N$89^0$44'E	65-70%
	Malgudam Road	$26^0$31'N$89^0$45'E	
Darjeeling	Pradhan Nagar, Siliguri	$26^0$72'N$88^0$41'E	20-25%
	Bidhan Nagar, Siliguri	$26^0$71'N$88^0$42'E	

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Alipurduar	Sobhaganj	$26^0$49'N$89^0$52'E	55-60%
	Samuktala Road	$26^0$48'N$89^0$52'E	

* Damage (%) was calculated on the basis of how many seeds were damaged out of 100 after keeping it in laboratoryfor three months

Table 2. Survey report on *C. dimidiatus* infesting Maize under field condition in Coochbehar

Name of District	Location	GPS Code	Cob infestation (%)
Coochbehar	Kaminirghat	$26^0$33'N$89^0$43'E	
	Tengnamari	$26^0$34'N$89^0$42'E	25-30%
	Platoon Bridge	$26^0$36'N$89^0$37'E	
	Singimari Paschimpar	$26^0$46'N$89^0$36'E	

* Cob infestation (%) was calculated on the basis of how many cobs were infested out of 100

45.2 Identification of the pest

The identification of this pest was ~~done~~ done with ~~the help of~~ both ~~taxonomic~~ morphologicalcharacteristics and molecular ~~characterisation~~data.

54.2.1 ~~Taxonomic~~ Morphological identification

The key ~~taxonomic identifying~~diagnosed ~~characters~~ characteristics of this beetle are as follows –

i) Dorsum dark red-brown to black
ii) Each elytron contains large dull-orange yellow spot.
iii) Elytra short. It exposes two abdominal tergites and pygidium thereby. The tergite VII is visible dorsally, whereas the tergite VIII~~th one~~ is visible from ventral surface. In the case of ~~male~~males, the tergite ~~is~~ VIII~~th tergite~~ is ~~button like~~button-like.
iv) Males are smaller than the females.
v) Cuticle is clothed with light yellow hairs.
vi) Punctures on pronotum are very deep.
vii) Labrum is somehow visible and free.

Adults	A: Male B: Female

Fig. 1. Images of *Carpophilus dimidiatus* under stereozoom microscope

45.2.2 Molecular characterisationidentification

The taxonomic identification of this pest was also confirmed through molecular characterisationdata. Fragment The fragment of mitochondrial 16S rRNA (ribosomal RNA) gene was amplified and then sequencing sequencedprocess was completed. The submission of the said abovesequenceswere submittedto to National CenterCenter for Biotechnology Information (NCBI) database resulted in generation ofwith GenBank accession number**OP346785**. The sequence showed more than 99% match with species recorded or reported elsewhere and already submittedother*Carpophilusdimidiatus*sequences in the NCBI database.The submission of amplified 16S rRNA resulted in generation of GenBank accession number **OP346785**.

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45.2.3 Damage Symptom

In the maize field, it was observed that a good number of cobs remained partially opened (due to some unknown reason). That cobs were found harbouring harboring adult *C. dimidiatus* beetle. The adults were found to damage the seeds which, ultimately, turned brown and dried. The partial opening of the immature cob has been reported as a common symptom from by several maize growers in this region. Further investigation is needed to ascertain whether *C. dimidiatus* is the sole causal agent for this immature cob opening or if some other factors (like bird attack) are also present. But However,this was a confirmed observation that *C. dimidiatus* was found to be present in each and everyevery partially opened cob.

In storage, both the grubs and adults damage the groundnut seeds. These bore the seeds and the bore holesboreholes are prominently visible. In case of excessive damage, only shells are left and the internal content of the seed is converted into a powdery mass.

In stored groundnut	In field maize

Fig. 2. Damage caused by *Carpophilusdimidiatus*

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56. Summary and Conclusion

Naveena *et. al.* (2022) [9] reported this pest in stored groundnut (from Bangalore and Chennai) for the first time from our countryin India with proper identification. In the said article, the author clearly mentioned thatthe earlier authors like Sengupta *et. al.* (1984) [10] and Dasgupta *et. al.* (2013) [11] from West Bengalhad reported*C. dimidiatus*.But However,there were wasa lack of specific information regarding the grain infested by the pest as well as taxonomicthe keydiagnosed

characteristics of the pest. ~~That is why, t~~The present report of *Carpophilusdimidiatus* in both ~~field~~ fields(corn) and ~~store~~ stores(groundnut)is going to be the first report from West Bengal with ~~taxonomic~~ morphologicaland molecular identification.

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