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Species diversity and distribution of *Cnaphalocrocis* and *Scirpophaga* (Lepidoptera: Crambidae) species complex in rice in Tamil Nadu, India

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Abstract

Crambids are the main insect pests in rice eco-system. The present study is the record of *Scirpophaga* and *Cnaphalocrocis* fauna in different rice regions in Tamil Nadu. Collection was carried out during August - February 2015 in different colleges and research stations of Tamil Nadu Agricultural University (TNAU), Coimbatore. Among the *Scirpophaga* species, the highest population of *S. incertulas* was recorded in Thirur (76.79%), *S. fusciflua* recorded highest from Killikulam (5.88%) and *S. virginia* was only recorded in Thirupathisaram (1.90%) and reported first time from Tamil Nadu in India. In *Cnaphalocrocis* species, *C. patnalis* was recorded highest in Killikulam (31.37%) followed by *C. medinalis* in Killikulam (25.49%), *C. ruralis* in Coimbatore (23.84%), *C. exigua* in Thirupathisaram (14.28%), *C. poeyalis* in Coimbatore (6.62%) and the population of *C. trapezalis* was recorded highest in Coimbatore (1.98%). *Cnaphalocrocis* is used as synonym in place of *Marasmia* in present studies.

Keywords: crambidae, spilomelinae, schoenobiinae, species, tamil nadu

Introduction

Rice is the staple food of Tamil Nadu. In Tamil Nadu, during 2014-15, rice was grown over an area of 17.9 mha with a total production of 79.5 million tonnes and average yield of 4429 kg/ha^[1]. There are various insect pests damaging the rice crop at different stages of crop growth. Among the rice pests, lepidopterans cause considerable damage to rice crop and have major importance. Leaf folders and stem borers are widely distributed in various parts of the world. Currently, stem borer *Scirpophaga incertulas* and leaf folders *Cnaphalocrocis medinalis*, *C. patnalis*, *C. ruralis* and *C. exigua* have attained pest status on rice^[2]. Rice stem borer, *Scirpophaga incertulas* is the most serious pest of rice in rice growing tracts of the Asian mainland and Japan. In South India, it is common in the Northern Circars, Ceded districts, Ramanathapuram, Tanjore and Malabar. In rice ecosystems,^[3] observed that *S. incertulas*, a monophagous pest of paddy is considered as the most important nuisance of rainfed, low land and flood prone. Recently^[4] reported *S. fusciflua* from North India. *Cnaphalocrocis medinalis*, *Marasmia exigua*, *M. patnalis* and *M. ruralis* are the four superficially similar species common in rice ecosystem in Asia and Philippines. The rice leaf folder complex has changed from minor to major pest status in Philippines, South and South East Asia^[5]. The discovery of *Marasmia patnalis* by Bradley in 1981, first led to the realization that there was a complex of leaf folder species. In Madurai^[6] recorded diversity of *C. medinalis*, *C. patnalis* and *C. ruralis*. *Cnaphalocrocis* was used as a synonym of *Marasmia* in updated data in LEPINDEX^[7]. The identification of stem borers and leaf folders fauna in Tamil Nadu is needed for better control measures of these two important pest genera. By keeping this in view, the present studies were planned with an objective to study the species diversity and distribution of *Cnaphalocrocis* and *Scirpophaga* species complex in Tamil Nadu rice eco-system.

Materials and Methods

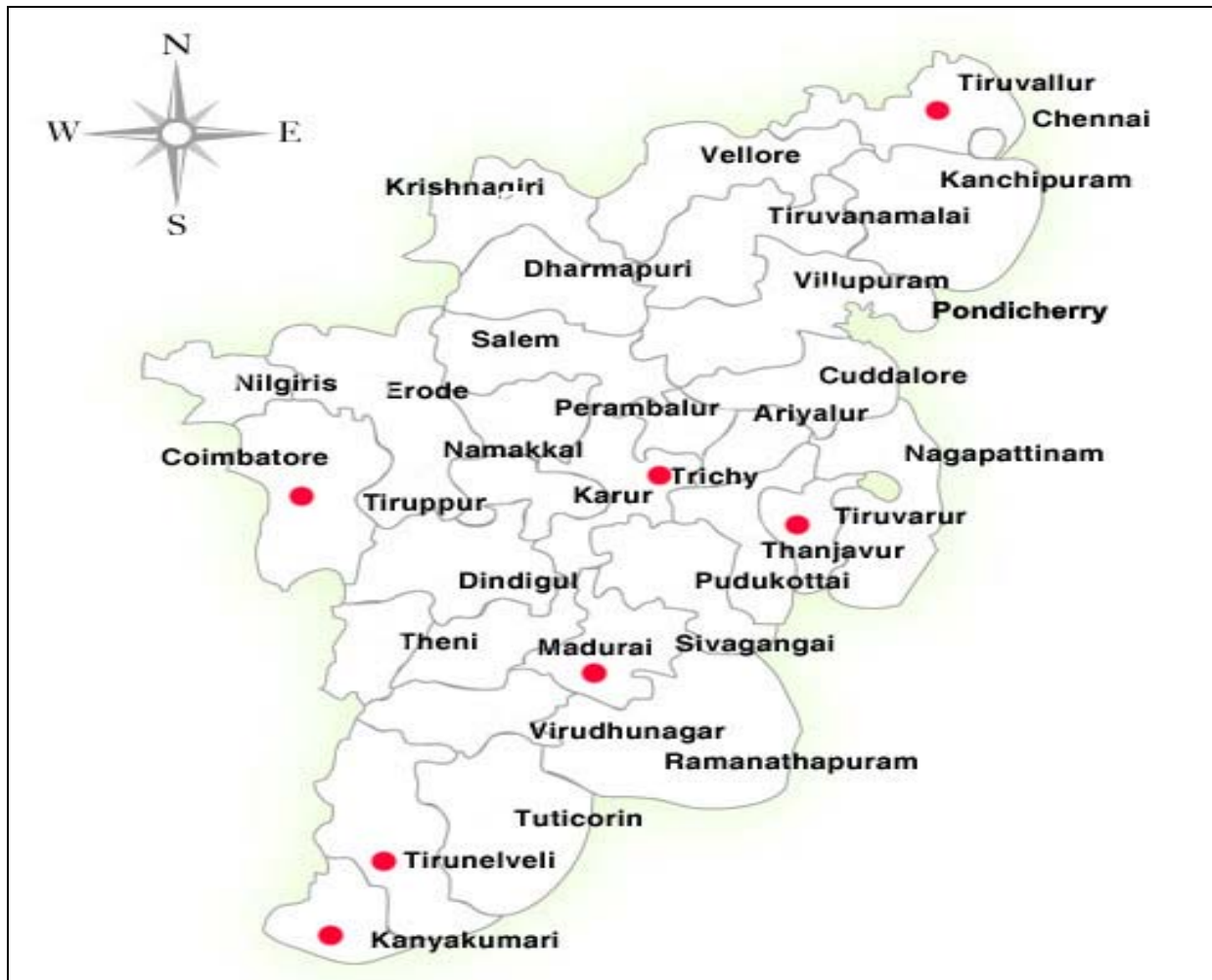
Different species of stem borers and leaf folders were collected from different colleges and RRS of TNAU, Coimbatore (Fig.1). Specimens were collected during August - February 2015. The collection was done with the help of light trap fitted with mercury vapour lamp (160 W) and from the host plants using sweep net. Stem borer and leaf folder moths abundance were determined by collection from light traps and sweep net sampling from different locations-

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TRRI, Aduthurai; AC & RI, Killikulam; AC & RI, Trichy; AC & RI, Madurai; ARS, Thirupathisaram; RRS, Thirur and PBS, TNAU-Coimbatore in Tamil Nadu. All collected moths were killed using ethyl acetate in a killing jar. Moths were then pinned by spreading the wings in an insect spreading box. Later, the moths were labeled and preserved in insect storage boxes. The specimens were identified in Insect

Biosystematics Laboratory, TNAU, Coimbatore through keys, available literatures like *Fauna of British India*, Moths volume IV [5, 8, 9, 10, 11, 12, 13, 14, 15]. *Cnaphalocrocis* was taken as synonym in place of *Marasmia* in present studies. The percentage of occurrence in the population in different regions and checklist of crambids in rice were also worked out.



- Surveyed Locations

Locations:

- PBS, TNAU, Coimbatore
- AC&RI, Killikulam
- ARS, Thirupathisaram
- AC&RI, Madurai
- AC&RI, Trichy
- RRS, Thirur
- TRRI, Aduthurai

Fig 1: Sampling locations of *Scirpophaga* and *Cnaphalocrocis* spp. in Tamil Nadu

Results

Survey and collection

A total of nine species of crambids belonging to two genera under two subfamilies namely, Spilomelinae (six species: *C. medinalis*, *C. patnalis*, *C. ruralis*, *C. trapezalis*, *C. exigua* and *C. poeyalis*) and Schoenobiinae (three species: *S. incertulas*, *S. fusciflua* and *S. virginia*) were recorded (Fig. 2). Among all the collected species, *S. incertulas* was the dominant one and collected from all survey places. *S. fusciflua* was only found in Killikulam and Thirupathisaram. *S. virginia* was recorded only from Thirupathisaram. Among the leafrollers, *C.*

patnalis and *C. medinalis* were predominantly collected from all surveyed places. *Cnaphalocrocis ruralis* was found only from Aduthurai, Thirupathisaram, Madurai and Coimbatore. *C. exigua* was collected from Thirupathisaram, Trichy and Coimbatore only. *Cnaphalocrocis trapezalis* was recorded from Madurai and Coimbatore only. *Cnaphalocrocis poeyalis* was collected only from Trichy and Coimbatore. Apart from genera *Cnaphalocrocis* and *Scirpophaga*, other crambids also exist in rice ecosystems with minor importance. These crambid species are presented in table 1.

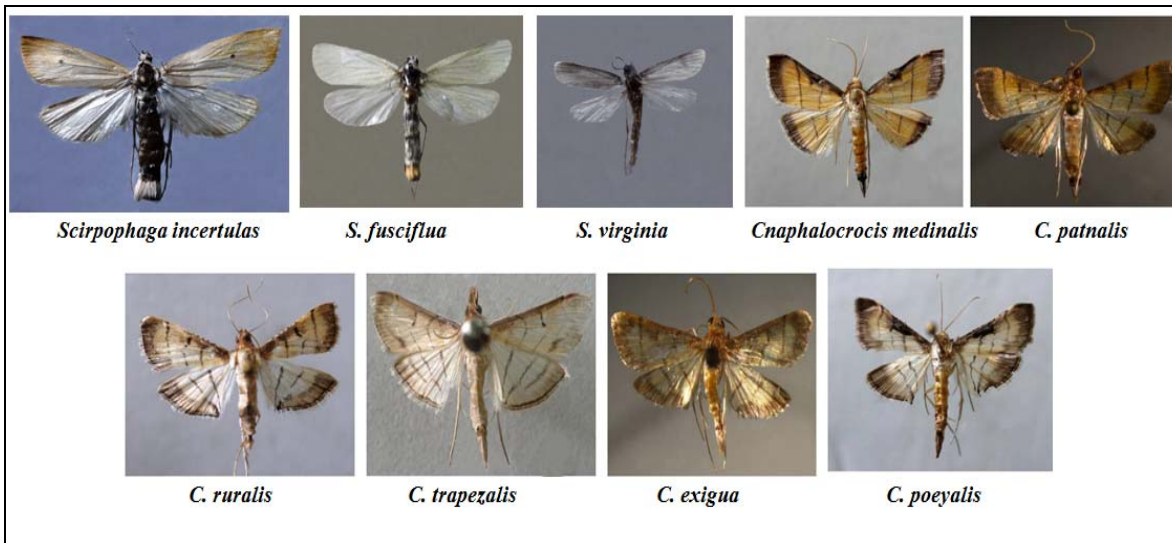


Fig 2: Diversity of Rice stem borers and leaffolders in Tamil Nadu

Table 1: Checklist of Crambidae recorded on rice

S. no.	Scientific Name
1.	<i>Adelpherupa flavescens</i> Hampson, 1919
2.	<i>Ancylolomia chrysographellus</i> (Kollar, 1844)
3.	<i>Ancylolomia irrorata</i> Bleszynski, 1970
4.	<i>Bradina admixtalis</i> (Walker, 1859)
5.	<i>Catagela adjurella</i> Walker, 1863
6.	<i>Chilo agamemnon</i> Bleszynski, 1962
7.	<i>Chilo aleniellus</i> (Strand, 1913)
8.	<i>Chilo auricilius</i> Dudgeon, 1905
9.	<i>Chilo diffusilineus</i> (J. de Joannis, 1922)
10.	<i>Chilo infuscatellus</i> Snellen, 1890
11.	<i>Chilo luniferalis</i> Hampson, 1896
12.	<i>Chilo mesoplagalis</i> (Hampson, 1919)
13.	<i>Chilo partellus</i> (Swinhoe, 1885)
14.	<i>Chilo plejadellus</i> Zincken, 1821
15.	<i>Chilo polychrysus</i> (Meyrick, 1932)
16.	<i>Chilo psammathis</i> (Hampson, 1919)
17.	<i>Chilo sacchariphagus indicus</i> (Kapur, 1950)
18.	<i>Chilo suppressalis</i> (Walker, 1863)
19.	<i>Chilo zacconius</i> Bleszynski, 1970
20.	<i>Cnaphalocrocis bilinealis</i> (Hampson, 1891)
21.	<i>Cnaphalocrocis exigua</i> (Butler, 1879)
22.	<i>Cnaphalocrocis medinalis</i> Guenee, 1854
23.	<i>Cnaphalocrocis patnalis</i> (Bradley, 1981)
24.	<i>Cnaphalocrocis poeyalis</i> (Boisduval, 1833)
25.	<i>Cnaphalocrocis ruralis</i> Walker, 1859
26.	<i>Cnaphalocrocis suspicalis</i> Walker, 1859
27.	<i>Cnaphalocrocis trapezalis</i> Guenee, 1854
28.	<i>Cnaphalocrocis trebiusalis</i> Walker, 1859
29.	<i>Cnaphalocrocis veniialis</i> Walker, 1859
30.	<i>Coniesta ignefusalis</i> Hampson, 1919
31.	<i>Crypsitya coclesalis</i> (Walker, 1859)
32.	<i>Diatraea lineolata</i> (Walker, 1856)
33.	<i>Diatraea saccharalis</i> (Fabricius, 1794)
34.	<i>Elasmopalpus lignosellus</i> (Zeller, 1848)
35.	<i>Eldana dichromellus</i> (Walker, 1865)
36.	<i>Eldana saccharina</i> Walker, 1865
37.	<i>Eoreuma loftini</i> (Dyar, 1919)
38.	<i>Herpetogramma licarsisalis</i> (Walker, 1859)
39.	<i>Lygropia obrinusalis</i> Walker, 1859
40.	<i>Mabra eryxalis</i> (Walker, 1859)
41.	<i>Maliarpha separatella</i> Ragonot, 1888
42.	<i>Metoeca foedalis</i> (Guenee, 1854)
43.	<i>Niphadoses palleucus</i> Common, 1960
44.	<i>Paraponyx diminutalis</i> Snellen, 1880

45.	<i>Paraponyx fluctuosalis</i> Zeller, 1852
46.	<i>Paraponyx stagnalis</i> Zeller, 1852
47.	<i>Pleuroptya balteata</i> (Fabricius, 1798)
48.	<i>Rupela albino</i> Becker and Solis, 1990
49.	<i>Saluria inficita</i> Walker, 1863
50.	<i>Schoenobius immeritalis</i> Walker, 1859
51.	<i>Schoenobius scirpus</i> Chen and Wu, 2014
52.	<i>Scirpophaga aurivena</i> (Hampson, 1903)
53.	<i>Scirpophaga fusciflua</i> Hampson, 1893
54.	<i>Scirpophaga gilviberbis</i> Zeller, 1863
55.	<i>Scirpophaga incertulas</i> (Walker, 1863)
56.	<i>Scirpophaga innotata</i> (Walker, 1863)
57.	<i>Scirpophaga lineata</i> (Butler, 1879)
58.	<i>Scirpophaga melanoclista</i> Meyrick, 1935
59.	<i>Scirpophaga nivella</i> (Fabricius, 1794)
60.	<i>Scirpophaga occidentella</i> (Walker, 1863)
61.	<i>Scirpophaga subumbrosa</i> Meyrick, 1933
62.	<i>Scirpophaga virginia</i> Schultze, 1908
63.	<i>Scirpophaga whalleyi</i> Lewvanich, 1981

Species diversity

The species diversity data of light trap and sweep net collected of rice stem borers and leaffolder moths are presented in Figure 3 and 4. The highest population of *Scirpophaga incertulas* was recorded in Thirur (76.79%) followed by Trichy (64.94%), Aduthurai (54.86%), Killikulam (43.13%), Madurai (36.36%), Thirupathisaram (20.95%) and Coimbatore (19.86%). *S. fusciflua* was recorded from Killikulam (5.88%) followed by Thirupathisaram (3.80%). *S. virginia* was only recorded in Thirupathisaram (1.90%) and the population density was negligible.

Among the rice leaffolder species collected, the highest population of *C. medinalis* was recorded in Killikulam (25.49%) followed by Thirupathisaram (21.56%), Coimbatore (17.88%), Aduthurai (15.04%), Thirur (11.43%), Trichy (7.38%) and Madurai (6.81%). The highest population of *C. patnalis* was recorded in Killikulam (31.37%) followed by Madurai (27.27%), Trichy (21.03%), Aduthurai (20.35%),

Coimbatore (18.54%), Thirupathisaram (16.19%) and Thirur (7.84%). The highest population of *C. ruralis* was recorded in Coimbatore (23.84%) followed by Thirupathisaram (19.04%), Madurai (18.18%) and Aduthurai (9.73%). There was no *C. ruralis* moths recorded in Killikulam, Trichy and Thirur. The highest population of *C. exigua* was recorded in Thirupathisaram (14.28%) followed by Coimbatore (11.25%) and Trichy (4.79%). There was no *C. exigua* moth occurrence recorded in Aduthurai, Madurai, Killikulam and Thirur. The population of *C. trapezalis* was recorded in Coimbatore (1.98%) followed by Madurai (1.51%) and There was no *C. trapezalis* moths occurrence recorded in Aduthurai, Thirupathisaram, Killikulam, Trichy and Thirur. The population of *C. poeyalis* was recorded in Coimbatore (6.62%) followed by Trichy (3.32%) and Aduthurai, Thirupathisaram, Killikulam, Madurai and Thirur were free from *C. poeyalis* moth occurrence.

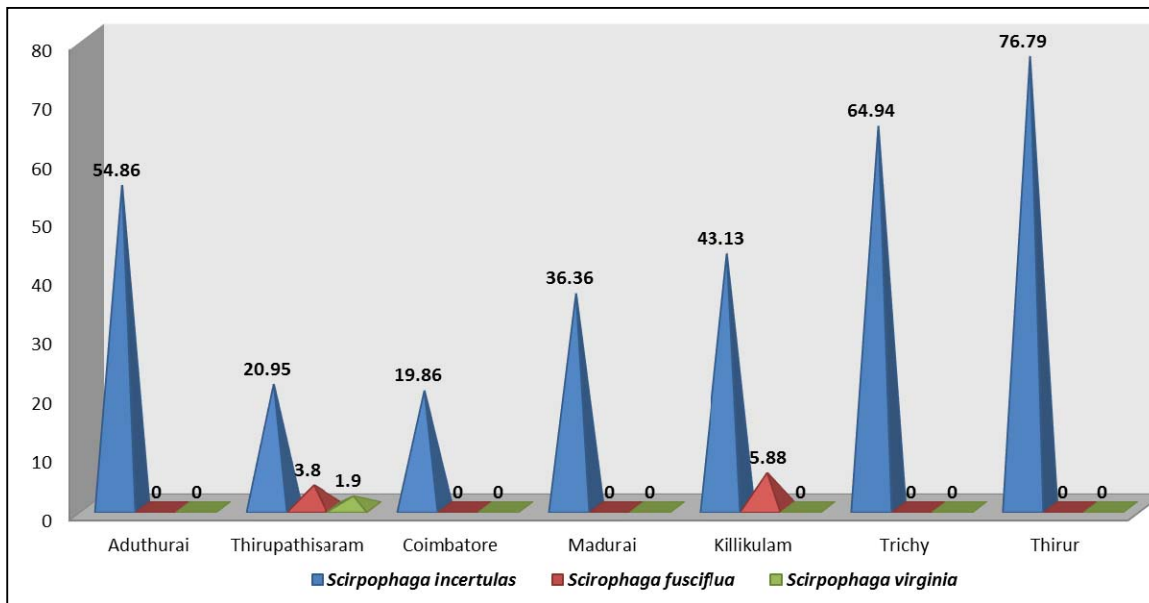


Fig 3: Population diversity of rice stem borers in different locations of Tamil Nadu (Values in %)

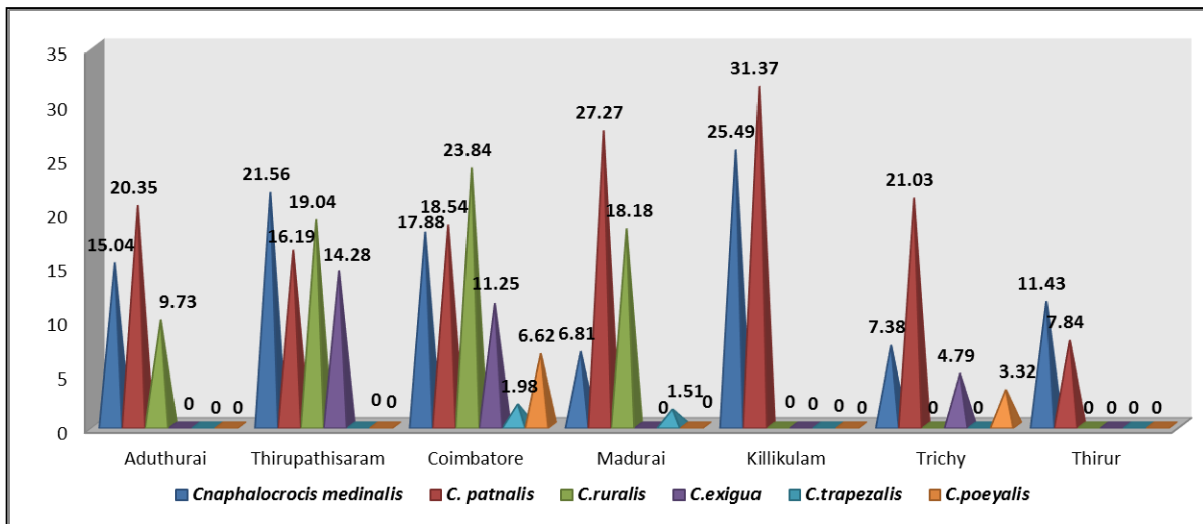


Fig 4: Population diversity of rice leaffolders in different locations of Tamil Nadu (Values in %)

Discussion

A total of 9 crambid species were collected and among the species, subfamily Spilomelinae was the predominant one and comprising 67 per cent of species complex (six species, namely, *C. medinalis*, *C. patnalis*, *C. ruralis*, *C. trapezalis*, *C. exigua* and *C. poeyalis*) followed by Schoenobiinae with 33 per cent (three species, namely, *S. incertulas*, *S. virginia* and *S. fusciflua*). Among the rice stem borers, the populations of *S. incertulas* were dominant in all selected places. The occurrence of stem borer was high in Thirur followed by Trichy, Aduthurai, Madurai, Coimbatore, Thirupathisaram and Killikulam. The population was highest in Thirur and Trichy and maximum number of moths were collected from light trap catches because of availability of *Samba* crop in their panicle emergence stage. Similar occurrences were recorded by different workers in Cuttack [16] and [17], Jagdalpur [18], Karaikal [19], West Bengal [20], North India [4], Gujarat [21] and Kanyakumari [22]. The population of *S. fusciflua* was recorded from Killikulam and Thirupathisaram. The occurrence of *S. virginia* was also recorded from Thirupathisaram.

The results for leaffolders revealed that *C. patnalis* > *C. medinalis* > *C. ruralis* rice leaffolder species are more prevalent in selected regions of Tamil Nadu. The present study also revealed that the maximum population of rice leaffolders occurred in *Samba* crop at boot leaf stage. Similar occurrences were also recorded in Madurai [23] and [24], North Arcot district [25], Coimbatore [26], Killikulam [27], Tirurkuppam [28] and Cauvery Delta Zone [29]. Two *Scirpophaga* species, viz., *S. fusciflua* were recorded for the first time from Tamil Nadu and *S. virginia* was recorded for the first time in India from Tamil Nadu [30]. One leaffolder species viz., *C. poeyalis* was also first recorded from Tamil Nadu.

Conclusion

Among the various rice pests, lepidopterans like stem borers and leaf folders assume greater economic importance and cause considerable damage to rice crop. But, because of incorrect identification and existence of many species, most of control measures are ineffective. This work will serve as a rapid and precise identification approach for the discrimination of rice leaffolders and stem borers species. Further studies need to be conducted to confirm different species of leaffolders and stem borers occurring in rice

ecosystems of Tamil Nadu for correct identification.

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Abbreviations

TNAU- Tamil Nadu Agricultural University, AC & RI- Agricultural College and Research Institute, FAO- Food and Agriculture Organization, ARS, Agricultural Research Station, PBS- Paddy Breeding Station, RRS- Rice Research Station, TRRI- Tamil Nadu Rice Research Institute, LEPINDEX- Lepidoptera Index.

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