

Original Research Article

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Studied on Species Diversity of Rice Leaf Folder and their Natural Enemies in North Eastern Coastal Plains of Odisha

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ABSTRACT

In this study the species diversity of rice leaf folder and their natural enemies were studied in three different blocks of Odisha and three Research stations of Odisha University Agriculture & Technology, Bhubaneswar (under North Eastern Coastal plains) during the year 2015 and 2016 at different growth stages of paddy crop on the basis of morphological characteristics, wing marking, coloration, characters of pronotum, subdorsal spots on prothorax and size of the larvae as described by Barrion and Litsinger (1991) etc. The study revealed that three rice leaf folder species were noticed i.e. *Cnaphalocrocis medinalis* (Guenée), *Marasmia exigua* (Bradley) and *Brachimea arotraea* (Meyrick) with the predominance of *C. medinalis*. Among the Leaf folder species, the highest population of *Cnaphalocrocis medinalis* (Guenée) (83.34%), was recorded in each location followed by *M. exigua* (12.22%) and *B. arotraea* (4.43%) was very meager and all the three species were prevalent in all seasons. The common natural enemy fauna of rice leaf folder *C. medinalis* comprised of 10 species predatory arthropods. Out of which the predatory beetles belonging to the family Carabidae, Cocconellidae were dominant and among different parasitoids on rice leaf folder, the main spp. observed were, *Macrocentrus philippinensis*, *Cotesia angustibasis* and *Goniozus spp*, from larvae. The extent of parasitization was more in kharif season than in rabi. The mean parasitization during kharif 2015&16, rabi 2015&16 was in the order of 21.8 and 17.02 per cent respectively.

Keywords

Diversity of rice,
Leaf folder species,
Predators,
Parasitoids

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Introduction

Rice is one of the major sources of calories for half of the world's population. Rice is grown in more than 100 countries spread across six continents and in varying agro ecological and

socioeconomic conditions. The eastern india, consisting of about 60 % of rice growing area of the country (26.8 mha) possesses about 70 % of rainfed and including about 40 % of low lying area. Rice is the staple food of Odisha. During 2015-16, rice was grown over an area

of 40 mha with a total production of 104.32 million tonnes and average yield of 2570 kg/ha. Among the various biotic constraints to rice production, insect pests are of prime importance as the warm humid environment is conducive to survival and proliferation (Heong *et al.*, 1995). Among the rice pests, lepidopterans cause considerable damage to rice crop and have major importance. Insect pests damage rice crop at different stages of crop growth of which leaf feeding insect pests are of major importance because of their ability to defoliate or to remove the chlorophyll content of the leaves leading to considerable reduction in yield.

Rice leaf folder, *Cnaphalocrocis medinalis* (Guen.) was considered as pests of minor importance have increased in abundance in late 1980's and have become major pests in many parts of India including Odisha. The yield loss is from 30 to 80 per cent due to leaf folder epidemic situation (Nanda *et al.*, 1990; Han *et al.*, 2015). Every unit of increase in infestation by *C. medinalis* decreased the yield by 14 and 1.46 per cent during summer and wet season, respectively. Currently, leaf folders *Cnaphalocrocis medinalis*, *C. patnalis*, *C. ruralis* and *C. exigua* have attained pest status on rice (Pandya *et al.*, 1987). *Cnaphalocrocis medinalis*, *Marasmiaexigua*, *M. patnalis* and *M. ruralis* are the four superficially similar species common in rice ecosystem in Asia and Philippines. Similar to those present in the growing rice tracts of South and Southeast Asia (Khan *et al.*, 1988; Barrion *et al.*, 1991; Heong, 1993) and in entire Asia (Gurr *et al.*, 2012). The discovery of *Marasmiaapatnalis* by Bradley in 1981, first led to the realization that there was a complex of leaf folder species. In most of the rice eco systems studied more than one species of leaf folder exist in complex, thus the management of rice leaf folder is a complicated one. Hence, the identification of leaf folders fauna in Odisha is needed for the scientists to work out

for an Eco-friendly Integrated Pest Management, thus it will support the ultimate beneficiary the farming community for better control measures of this important pest species. By keeping this, the present studies were planned with an objective to study the species diversity and the natural enemies of leaf folder in North Eastern Coastal plains of Odisha (Table 1).

Materials and Methods

Species composition

The study was conducted from four rice growing blocks (Badachana, Dharmsala, Bhadrak, Simulia and Baliapal) of three districts, rice research stations (Ranital, Baliapal and Badachana) at 15 days intervals to find out the leaf folder species diversity in the North Eastern Coastal plains of Odisha. Leaf folder larvae were collected from leaves and adults were collected by using sweep net. The specimens were brought to the laboratory and examined under binocular microscope. The diversity of leaf folder species was expressed in percentage. The leaf folder species were distinguished based on the larval and adult characters viz., forewing venation, coloration, characters of pronotum, subdorsal spots on prothorax and size of the larvae as described by Barrion and Litsinger (1991) and Reissig *et al.*, (1985).

Adult moths of rice leaf folder were collected by using a light trap from the tillering to reproductive stages of the crop. The moths collected were brought to the laboratory and was examined under binocular microscope. The different species of Rice leaf folder were isolated based on wing venation, morphological features and size as described by Barrion and Litsinger (1985), Khan *et al.*, (1988). Leaf folder moths were collected from different blocks and different research stations of OUAT situated in this region during July –

2015 to Nov.2015 and Jan.2016-june.2016. The light trap fitted with mercury vapour lamp (160 W). 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 for identification. The individuals belonging to the genera *Cnaphalocrocis*, *Marasmia* and *Brachmia* differ basically from each other in forewing venation and morphological characters. These morphological features are used to differentiate the leaf folder species. *Cnaphalocrocis medinalis* (Guenee) moth were golden yellow with dark brown marking on the both the wing on mid costa is closely resembles *M. exigua* moth were light yellow with a broad 'C' shaped greyish brown band on terminal and sub terminal area of wing where as in case of *B. arotraea* the moths were yellowish white with whitish streak on the wings Finally the number of species was recorded separately and the percentage was find out.

Natural Enemies of rice leaf folder

Natural Enemies of Leaf Folders were collected monthly using sweep net. The observations were made on the important larval and pupal parasitoids and predators of leaf folders. And the extent of leaf folder larval parasitisation was studied during kharif 2015&2016, and summer 2015 &2016 at KVK, Jajpur. Leaf folder larvae were collected from the fields during the study period were transferred into glass tubes of size 15 x 2cm. Leaf pieces of 5cm length taken from the middle portion of the top leaves of 40 days old plants were provided for feeding, moistened cotton wool covered with filter paper cover was used to maintain the turgidity of leaf pieces. Every 24 hours leaf pieces were changed till the larvae pupated. The pupae were observed for the emergence of parasitoid which were identified under binocular microscope with help of Entomologist, at

OUAT insect laboratory and percent parasitisation was find out using following formula:

Parasitisation percentage (%) =

$$\frac{\text{Number of parasitized larvae}}{\text{Total number of larvae collected}} \times 100$$

Species diversity (%) =

$$\frac{\text{Total no. of individuals of each species}}{\text{Total number of individuals of all species}} \times 100$$

Results and Discussion

Species Diversity

During (2015&16) survey conducted on species diversity of rice leaffolder by light trap and sweep net collected of leaffolder moths in North Eastern coastal plains districts of Odisha (Balesore, Bhadrak and jajpur), one regional research and technology transfer stations of OUAT and two Krishi Vigyankendras (Jajpur, Bhadrak) at 15 days interval and results are presented here under, three species of rice leaffolders i.e., *C. medinalis*, *M. exigua* and *B. arotrea* were encountered at different growth stages (Table 2). Among different districts, *C. medinalis* numbers ranged from 79.30 to 88.10 per cent with an average numbers of 83.34 per cent was noticed in different districts. The maximum numbers was found in Dharamsala (88.1%) followed by Badachana (86.10 %), Chandabali (82.10 %), where as in Balesore district (79.30 %) *C. medinalis* was observed (Table 2 and Fig. 1). The *M. exigua* ranged from 8.40 to 17.20 per cent with an average numbers of 12.20 per cent was noticed in different districts. The maximum numbers of *M. exigua* was found in Bhadrak (16.80 %)

followed by simulia (17.20 %), Chandabali (12.5%) and Baliapal (12.1 %) (Table 2 and Fig. 1). The maximum numbers of *B. arotrea* was found in Baliapal (8.0 %) followed by Badachana (6.20 %), Chandabali (5.40 %) and Bhadrak (3.6 %). Among the regional research stations and KVKs the dominant species was *C. medinalis* (87.10%) followed by *M. exigua* (12.10%) and *B. arotrea* (5.60%). Padmavathi *et al.*, (2006), Babyrani *et al.*, (2007) also confirmed the dominance of *C. medinalis* in all rice agro eco systems in South and South Asia. The similar occurrence of leaf folder species complex with the dominance of *C. medinalis* was reported in Cuttack by Gunathilagaraj and Gopalan (1986) and Bhubaneswar by Mukherjee *et al.*, 2008. The occurrence of *C. medinalis* was significantly more than *M. exigua* and *B. arotrea* irrespective of seasons and places.

The present study revealed that of *C. medinalis* was the dominant species than *M. exigua* and *B. arotrea* irrespective locations and places in coastal plains of Odisha. Mukherjee *et al.*, (2008) was reported that three species of leaf-folder including, *C. medinalis*, *M. exigua* and *B. arotrea* were noticed among which *C. medinalis* is the dominant species. Padmavathi *et al.*, (2006) also confirmed the dominance of *C. medinalis* in all rice agro eco systems in South and South Asia. The occurrence of leaf folder species complex with the dominance of *C. medinalis* was also reported in Cuttack by Gunathilagaraj and Gopalan (1986) and Bhubaneswar by Mukherjee *et al.*, (2008). The occurrence of *C. medinalis* was significantly more than *M. exigua* and *B. arotrea* irrespective of seasons and places. In general, during kharif and Summer season harboured more *C. medinalis* population than *M. exigua* and *B. arotrea*. Among the leaf folders, *C. medinalis*, *M. exigua* and *B. arotrea* were predominantly collected from all surveyed places and such information was useful during 2015 to relook and identify the efficient

management practices for the management of all the three species through rescreening of existing practices. Mathew and Menon (1984) reported that seven species of rice leaf-folder viz., *C. medinalis*, *M. exigua* (Butler), *Ma. billinialis* (Hampson), *Ma. patnalis*, *Ma. ruralis*, *Ma. suspicalis* (Guenee), *Bradina admixtalis* (Walker) and gelechid leaf-folder, *Brachmia arotrea* (Meyrick) were found across the India.

Natural enemies of rice leaf folder

Cnaphalocrocis medinalis is the most important leaf folder species of rice crop and is attacked by a large number of natural enemies. In the present investigation during the study period on natural enemies complex (predators and parasitoids) in paddy ecosystem of north eastern coastal plain areas of Odisha are represented in the Table 3. The natural enemies were recorded on the crop from tillering stage to harvest of crop. A total of 8 predators were found associated with both the season rice crops and out of them the population of spiders out ranked all over predators. The dominant predators surveyed were the lady bird beetles, carabids and mirids were the most important natural enemies. Besides that dragon flies, damsel flies and predatory earwigs were also indentified as the Ariel predators of rice pests (Table 3). Other important natural enemies of the rice leaf folder recorded as parasitoid which belongs to the hymenopterans orders. The recorded hymenopterans were identified parasitoids such as, *Trichogramma chilonis*, *T. japonicum* (egg parasitoids), *Cotesia angustibasis* (Apanteles), *Macrocentrus philippinesis* (Ashmead), *Goniozustrian gulifer* (Kieffer), *Xanthopimpla* sp. and *A. panteles* sp. (Braconidae) (larval and pupal parasitoid of leaf folder) (Table 3).

In the present study, predators such as spiders, dragon and damselflies, mirid bugs, coccinellids, carabids and cicindellids were

found throughout the crop growing period with little fluctuation in the three methods. However, spiders, dragonfly, damselfly and coccinellids were more during the vegetative stage of the crop, where asmirids, Staphylinids and Cerambycidae were more during reproductive stage of the crop. All the recorded predators and their population are known to be directly related to their prey population. These observations are in agreement with studies by Parrassapa *et al.*, (2017), who reported peak population of spiders during tilling stage. The present finding of domination of spiders among predators was in accordance with Bhattacharya *et al.*, (2006), who reported 26 species of predators of which spiders and coccinellids were abundant. The predatory wealth of rice leaf folder was reported by Gunathilagaraj and Ganesh Kumar (1997) and revealed that dominant predators belong to Coleoptera, Araneae, Hymenoptera and Odonata. Vijay Kumar and Patil (2006) also confirmed the domination of spiders and mirids as predators in rice eco system.

Other important natural enemies of the rice leaf folder *C. medinalis* recorded at different stages of crop growth as parasitoid which belongs to the hymenopterans orders.

The recorded hymenopterans were identified parasitoids such as, *Trichogramma chilonis*, *T. japonicum* (egg parasitoids), *Cotesia angustibasis* (Apanteles), *Macrocentrus philippinensis* (Ashmead), *Goniozuztrian gulifer* (Kieffer), *Xanthopimpla* sp. and *Apanteles* sp. (Braconidae) (larval and pupal parasitoid of leaf folder) (Table 4). During the study period *T. japonicum* and *T. chilonis* were observed as only egg parasitoids. It was earlier reported in India by Baby rani *et al.*, (2007), Behera *et al.*, (2006) and Rubalgot and

Brar (2008), the egg parasitoid *Trichogramma* species, the larval parasitoids *Cadiochiles philippinensis*, *Apanteles* spp, *Goniozuz* spp, *Copidosoma psisnacoleiae* and *Trichoma cnaphalocrocis* Uchida and pupal parasitoid *Xanthopimpla flavolineata* Cameron and larval - pupal parasitoid *Brachymeria* spp were prevalent.

Extent of parasitisation

The extent of parasitisation of rice leaf folder studied from field collected leaf folder larvae during the both season kharif and summer crop of 2015 and 2016 under north eastern coastal plains conditions. A comparative study on the extent of *C. medinalis*, *M. exigua* and *B. arotraea* revealed that the maximum parasitisation of 16.66 per cent was recorded on *C. medinalis* in the first fortnight of October (Fig. 2).

The parasitisation gradually declined from mid-October reaching as low as 3.25 per cent towards the end of November. In case of *M. exigua* the extent of parasitisation varied from 1.84 to 10.95 percent during the above period with a maximum of 10.95 per cent in the first fortnight of November. This was due to late appearance of *M. exigua* on wet season rice crop. The *B. arotraea* recorded 3.10 to 6.92 per cent parasitisation, the maximum being in the first fortnight of October.

The parasitisation per cent gradually increased from first fortnight of September with peak incidence in the first fortnight of October for *C. medinalis* and *B. arotraea* and then gradually decreased, thereafter. On the other hand, parasitisation of *M. exigua* commenced from first fortnight of November after which the population was declined.

Table.1 Characteristics distinguishing larvae of *C. medinalis* and *M exigua* and *B. arotrea* are listed below (DRR, 1987).

Name of the insect	Larval		Characteristics
	instar	Duration(days)	
<i>C. medinalis</i>	1 st	3.5	Head black, posterior notch of head capsule prominent
<i>M exigua</i>	1 st	4.5	Head black flattened
<i>B. arotrea</i>	1 st	3.5	Head and prothorax black
<i>C. medinalis</i>	2 nd	4.0	Head brown, faint brownish mark on prothoracic shield
<i>M exigua</i>	2 nd	3.5	Head light brown, faint brownish mark on prothoracic shield absent
<i>B. arotrea</i>	2 nd	3.2	Head, pro and metathorax black
<i>C. medinalis</i>	3 rd	4.0	Brownish patch on either side of pronotum
<i>M exigua</i>	3 rd	4.0	Head light brown
<i>B. arotrea</i>	3 rd	3.2	Head and pro thorax black, meso and metathorax light black, a specific pattern of lines on the body which are faintly marked
<i>C. medinalis</i>	4 th	4.5	Dark brown patches on pro thorax prominent
<i>M exigua</i>	4 th	4.5	Head light brown
<i>B. arotrea</i>	4 th	3.2	Specific pattern of lines on body prominent and one lateral and two medium white markings on meso and metathorax observed
<i>C. medinalis</i>	5 th	5.2	Brownish patches prominent on meso and metathoracic segments also
<i>M exigua</i>	5 th	4.5	Head light brown
<i>B. arotrea</i>	5 th	5.5	Prothoracic shield chitinised.

Table.2 Species diversity of rice leaf folder in North Eastern Coastal plains of Odisha during 2015-16

S. No	District	Name of Block	Locations	Total no of moths Collected	<i>C. medinalis</i> (%)	<i>M.exigua</i> (%)	<i>B.arotrea</i> (%)
1	Jajpur	Badachana	KVK, Jajpur Badachana	201	87.1	10.8	2.1
2	Bhadrak	Ranital	RRTTS, Ranital, Bhadrak	188	83.2	11.2	5.6
3	Balesore	Baliapal	KVK, Balesore	192	84.3	12.1	3.6
4	Jajpur	Badachana	Badachana	245	85.4	8.4	6.2
5	Jajpur	Dharamsala	Achyutpur	195	88.1	10	1.9
6	Bhadrak	Bhadrak	Bhadrak	205	80.6	15.8	3.6
7	Bhadrak	Chandbali	Chandbali	285	82.1	12.5	5.4
8	Balesore	Simulia	Simulia	155	79.3	17.2	3.5
9	Balesore	Baliapal	Baliapal	235	80	12	8
	Mean				83.34	12.22	4.43

Table.3 Natural enemies (predators and parasitoids) of rice leaf folder in north eastern coastal plains of Odisha

S.No	Common name	Name	Family	Order	Stage to predates
1	Wolf spider	<i>Lycosapseudoannulata</i> (Boesenberg and Strand)	Lycosidae	Araneae	larvae and adults
2	Lynx spider	<i>Oxyopesjananus</i> (Thorell)	Oxyopidae	Araneae	larvae and adults
3	Orb spider	<i>Argiope catenulate</i> (Doleschall)	Aranidae	Araneae	larvae and adults
4	Orb spider	<i>Araneusinusustus</i> (L.koch)	Aranidae	Araneae	larvae and adults
5	jumping spider	Phidippus sp. (Koch)	Salticidae	Araneae	larvae and adults
6	Lady bird Beetles	<i>Micraspiscrocea</i> (Mulsant)	Coccinellidae	Coleoptera	egg and adult
7	Lady bird Beetles	<i>Menochilussexmaculatus</i> (Fabricius, 1781)	Coccinellidae	Coleoptera	egg and adult
8	Lady bird Beetles	<i>Coccinella repanda</i> (Thunberg)	Coccinellidae	Coleoptera	egg and adult
9	Ground beetle	<i>Chlaeniusposticalis</i> (Motsch ulsky)	Carabidae	Coleoptera	larvae
10	Ground beetle	<i>Ophineanigrofascinata</i> (Schmidt-Goebel)	Carabidae	Coleoptera	larvae
11	Damselfly	<i>Agriocnemispygmaea</i> (Ramb ur)	Coenagrionidae	Zygoptera	Adult
12	Dragon fly	<i>Orthetriumsabinasabina</i> (Drury)	Gomphidae	Anisoptera	Adult
13	Scarlet Skimmer	<i>Crocothemisservilia</i> (Drury)	Coenagrionidae	Odonata	Adult
14	Earwig	<i>Euborelliaastali</i> (Dohrn)	Carcinophoridae	Dermaptera	Egg and larvae
15	Crickets	<i>M. vittaticollis</i> (Stål)	Cerambycidae	Coleoptera	Egg
16	Mirid bugs	<i>C. lividipennis</i> (Reuter)	Miridae	Hemiptera	Egg
Parasitoids					
17		<i>Trichogrammachilonis</i>	Ichneumonidae	Hymenoptera	Egg parasitoides
18		<i>Trichogrammajaponicum</i>	Ichneumonidae	Hymenoptera	Egg parasitoides
19		<i>Cotesiaangustibasis</i> (Apanteles)	<i>Braconidae</i>	Hymenoptera	Larval parasitoides
20		<i>Macrocentrusphilippinesis</i> (Ashmead)	<i>Braconidae</i>	Hymenoptera	Larval parasitoides
21		<i>Goniozustriangulifer</i> (Kieffer)	<i>Bethylidae</i>	Hymenoptera	Larval parasitoides
22		<i>Apantelescypris</i> (Nixon)	<i>Braconidae</i>	Hymenoptera	Larval parasitoides
23		<i>Brachymeria sp.</i>	Chalcidae	Hymenoptera	Pupalparasitoides
24		<i>Cardiochiles philippinesis</i>	<i>Braconidae</i>	Hymenoptera	Larval parasitoides

Table.4 Estimation of Natural enemies (Predators) population of Rice Leaf folder *C. medinalis* under Coastal rice ecosystem

Sl no	Name of Predators	Predatory population (nos/m ²)*			
		Wet Season 2015		Summer 2016	
		75 DAT	85DAT	75DAT	85DAT
1	Spiders	87.25	52.75	45.25	40.50
2	Lady bird beetle	115.75	85.50	75.25	68.25
3	Carabid beetle	35.25	28.50	28.25	32.75
4	Damselfly	9.00	10.00	8.75	5.25
5	Dragon fly	5.15	9.245	2.25	4.25
6	Earwig	4.25	3.10	1.25	2.15
7	Crickets	7.25	5.25	3.25	7.25
8	Mirid bugs	18.25	16.85	24.25	19.40

*Means of 4 quadrates of one square meter each.

Fig.1 Species diversity of rice leaf folder in North Eastern Coastal plains of Odisha (values in %)

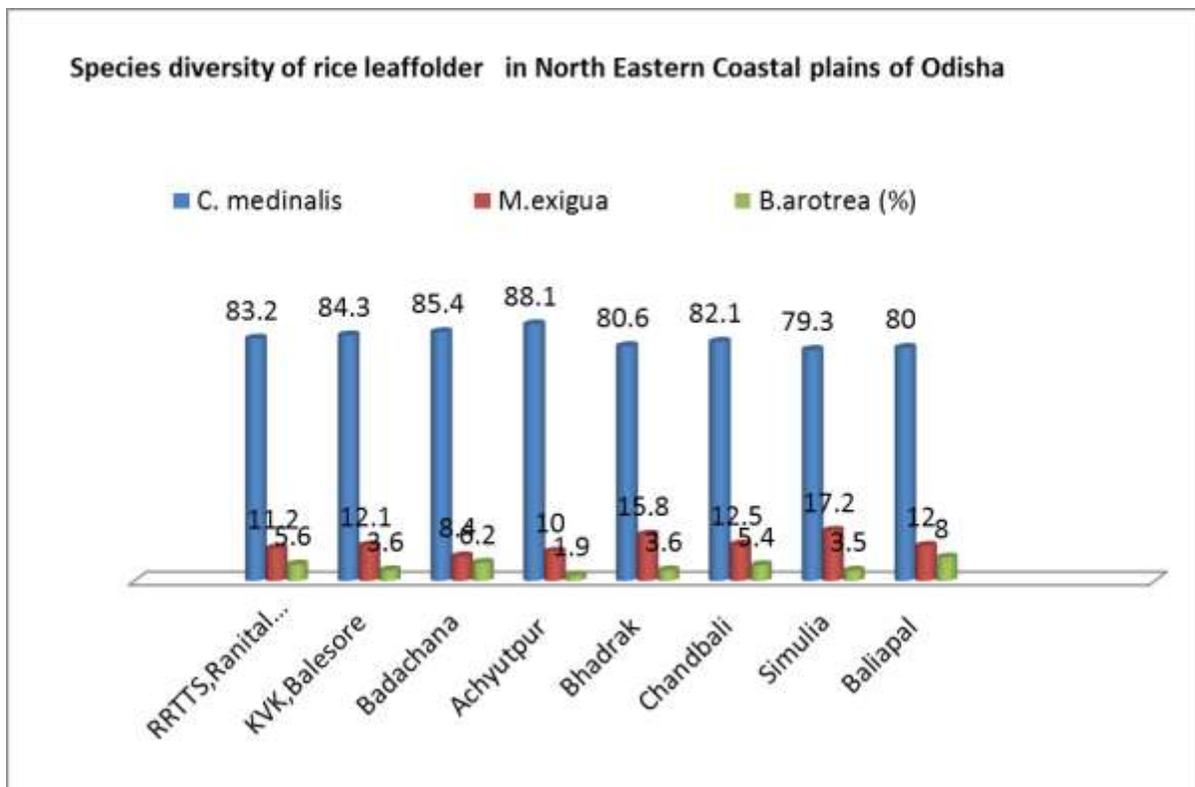
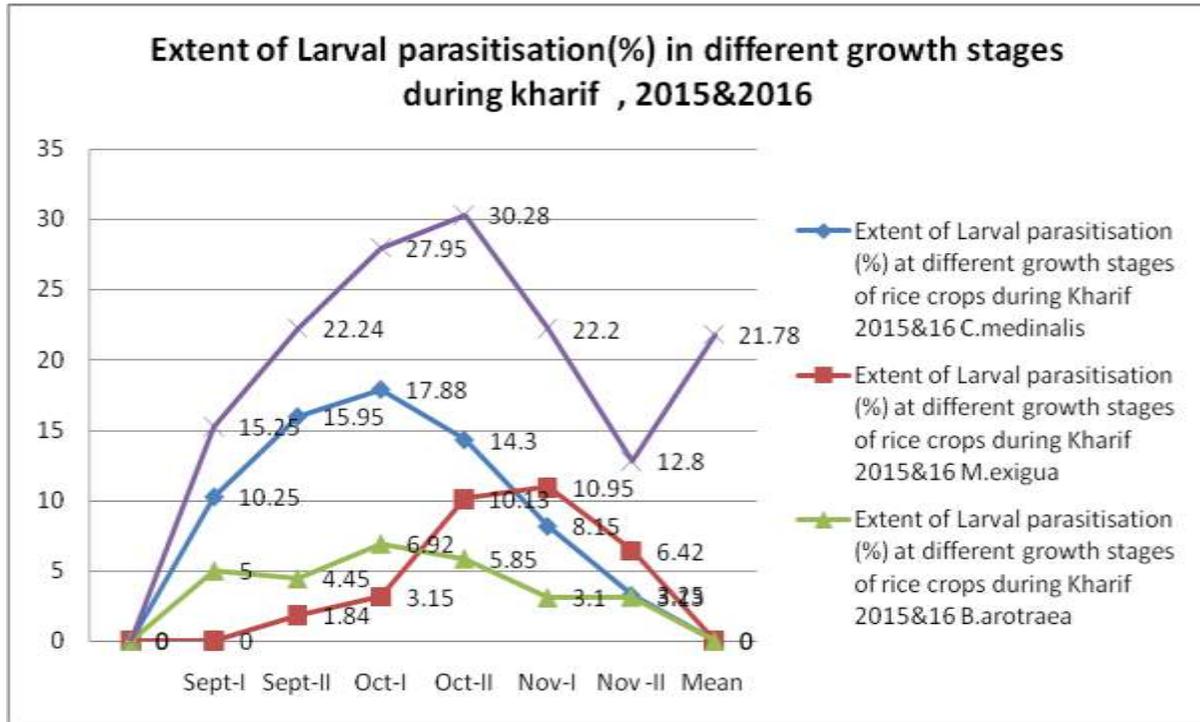


Table.5 Extent of Larval parasitisation (%) of rice leaf folder larvae by different species of parasitoids

Sl no	Extent of Larval parasitisation(%) in different growth stages during Summer , 2015&2016					Extent of Larval parasitisation (%) at different growth stages of rice crops during Kharif 2015&16				
	Fort night/Month	<i>C.medinalis</i>	<i>M.exigua</i>	<i>B.arotraea</i>	Total	Fort night/Month	<i>C.medinalis</i>	<i>M.exigua</i>	<i>B.arotraea</i>	Total
1	Mar-I	9.06	0	0	9.06	Sept-I	10.25	0	5	15.25
2	Mar-II	11.02	0	6.83	17.85	Sept-II	15.95	1.84	4.45	22.24
3	Apr.-I	10.25	2.15	4.6	17	Oct-I	17.88	3.15	6.92	27.95
4	Apr.-II	9	11.2	4.01	24.21	Oct-II	14.3	10.13	5.85	30.28
5	May-I	4.75	9.23	3.01	16.99	Nov-I	8.15	10.95	3.1	22.2
6						Nov -II	3.25	6.42	3.13	12.8
	Mean				17.02	Mean				21.78

Fig.2 Extent of larval parasitisation (%) in different growth stages of rice crop



In summer season both the year data revealed that all the rice leaf folder species were vulnerable to attack by parasites. The extent of parasitisation by different parasites varied from 9.06 to 24.21 per cent. Parasitised larvae were available in the field from first fortnight of March for *C. medinalis* and *B.arotraea* while from first fortnight of April for *M.exigua*. The relative susceptibility of different species of leaf folders to parasite attack indicated that the extent of parasitisation comparatively higher in case of *M.exigua* followed by *C.medinalis* and *B.arotraea*.

As regards to the extent parasitisation of *C.medinalis* hardly 4.75 to 11.02 per cent larvae of various instars found by different parasites species under natural conditions. Higher parasitisation recorded during second fortnight of March. Due to late appearance of leaf folder species *M.exigua*, no parasitisation was recorded during March. Only 2.15 per cent larvae were found to be parasitised in the

first fortnight of April which suddenly increased to 11.20 per cent in the second fortnight and parasitisation continued till May.

The extent of larval parasitisation of *B.arotraea* varied from 3.01 to 6.83 per cent, the maximum (6.83%) being in the 2nd fortnight of March. So the present finding of extent of parasitisation indicated that maximum parasitisation was recorded in the 2nd fortnight of March followed by 1st fortnight of April.

The species complex of rice leaf folder in different rice growing areas of Odisha was assessed on the basis of wing markings for adults. The present study indicated the occurrence of only three species viz., *Cnaphalocrocis medinalis* (Guenee), *i* (Bradley) and *Brachmiaarotrea* (Meyrick). Among them *C. medinalis* was the predominant species with 79.30 to 88.10 per cent incidence respectively. All the three species of rice leaf folder were found both the

season in all locations of north eastern coastal plains of Odisha.

During the present investigation the different natural enemies that encountered on rice leaffolder were recorded at different intervals of crop growth. Among predators the abundance was in the order of spiders, coccinellidae, ground beetles, damselflies, Dragon fly and earwigs. Among different parasitoids on rice leaffolder, main species observed were *Trichogramma japonicum* and *T. chilonis* from eggs, *Macrocentrus philippinensis*, *Cotesia angustibasis* and *Goniosus spp*, from larvae, and *Brachymeria* from pupae. The extent of parasitisation in three seasons at different growth stages indicated that in Kharif season the per cent was more compared to Rabi. The mean parasitization during kharif 2015&16 and Rabi 2015&16 was in the order of 21.78 and 17.02 per cent, respectively.

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