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OBSERVATIONS ON INSECTS ATTACKING WILD RICE IN THE WHITESHELL FOREST RESERVE

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1. INTRODUCTION

In 1957, a request for assistance in collecting and rearing species of Lepidoptera attacking wild rice, Zizania aquatica L., was received from Dr. T.N. Freeman, Insect Systematics and Biological Control, Ottawa. A program was undertaken at the Winnipeg Laboratory and notes on the occurrence and biology of eight species of insects found on wild rice are outlined in the following report.

2. LITERATURE REVIEW OF INSECTS ON RICE PLANTS

A review of the literature has indicated that records of insects on rice in North America are very limited. Two of the most common species, Apamea apamiformis (Guenée) and Chilo plejadellus Zinck were first known as pests of cultivated rice. Crumb (1) recorded the former on cultivated rice in Virginia as early as 1881, and Chilo plejadellus was reported on cultivated rice in 1920 in Louisiana and Texas (Chambliss 2) and in 1924 in Georgia (Webb 3). An undetermined species of noctuid caused considerable damage to wild rice twenty-five years ago in Ontario[1]. In 1927 Ingram (4) mentions insects feeding on wild rice in sections of the United States. According to Hammond (5) moderate stem and seed injury occurred on wild rice in Ontario, especially at Marmora and Madoc in 1957. The same year insects caused considerable damage to wild rice in the Port Arthur District of northern Ontario[2]. According to Hammond (6), Apamea apamiformis (Guenée) caused damage to wild rice in the summer of 1959 at Stony Lake, Marmora, and Madoc in Ontario. In 1957, A.E. Campbell, of the Winnipeg Laboratory, recorded high populations of insects on wild rice in the Whiteshell Forest

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[1] Freeman, T.N. 1957. Personal Communication.

[2] Sippell, W.L. 1957. Personal Communication.

Reserve. These records were substantiated by reports from many wild rice harvesters in that area. In 1958 populations showed a marked decline. The infestation subsided in the Whiteshell Forest Reserve in 1959, but the harvest was negligible because of the failure of the heads to develop. The drastic reduction of all insects on wild rice was thought to have been caused by high water levels caused by above average rainfalls. Water levels were so high that only five per cent of the rice plants at Lone Island Lake were able to develop to maturity. Young rice plants were not vigorous enough to overcome the increased depth of one foot of water that the lakes had risen. Plants that survived were very late in developing and were not available for oviposition during the peak of moth flight.

3. NOTES ON COLLECTIONS, BIOLOGY AND DESCRIPTION OF SPECIES

During the fall of 1957 rice beds at Lone Island Lake, Manitoba, were visited at regular intervals and collections of insects on rice plants were made. In 1958 this study was carried on again during the summer and fall at the same location. Collections were made in the spring of 1959 when the ice still remained in the Lake to determine the over-wintering habits of these insects on wild rice plants. A light trap was set up in June to determine the emergence dates of adults.

During the summer and fall, entire stalks of rice plants were pulled from rice beds and transported to the Laboratory in metal containers. Some of these rice plants were dissected for larval counts and the remaining plants were kept for rearing purposes. Hand picked collections of larvae were made in the field and these were used as material in the rearing program.

Early in the study it was apparent that more than one species of insect was involved in the infestation. The principal species belong to the families Pyralidae, Phalaenidae, Chrysomelidae, and Coccinellidae. In addition, a species of thrips was observed emerging from bags of threshed rice but the association between this species and the host plant is not understood at the present time. Colonies of aphids of wild rice were also collected in the field, and these were abundant on the rice heads in 1959.

Rearing larvae of the phalaenid and the pyralid was attempted and proved partially successful, with small numbers reaching the adult stage. Rice stalks, complete with root system and growing medium, were placed in a metal container at the Laboratory. The container was placed in a screen cage (3' x 3' x 6') (Fig. 1), which had a 3-inch layer of soil in the bottom. The rice stalks and soil were moistened once a week. The material was overwintered from October 15 to January 15 at a temperature of 35°F. The temperature was then raised 2°F every second day until a temperature of 67°F was attained. For all the following rearing techniques the above temperature control was used.

To assure a supply of adult material, another rearing method was attempted for pyralids and phalaenids. This method was found to be very successful in rearing pyralid larvae to the adult stage, but was not successful for phalaenids. At the Laboratory, entire stalks of rice were dissected for living larvae. Fresh stalks of rice were cut into 6-inch lengths, placed vertically in a quart jar. The jar was provided with a layer of moistened absorbent cotton on the bottom and a screened top (Fig. 2). The larvae from the dissected stalks were inserted in the freshly cut stalks. The cotton was moistened at weekly intervals to maintain high humidity in

the jars. Fresh green stalks were substituted periodically for old ones and the insects were transferred to fresh stalks about every ten days.

The rearing of the phalaenids on the heads of rice was attempted in the insectary by placing insects on clusters of wild rice. Six-inch stalks of rice were wrapped with absorbent cotton and the whole cluster set in a quart jar, partially filled with water. The quart jar was placed in a 12-inch glass jar, containing a layer of soil (Fig. 3). The rice heads and soil in the jar were moistened once a week. Some larvae pupated in the heads of rice and others in the soil layer in the jar. None of this material emerged as adults.

Pupae of a chrysomelid beetle were observed attached to the roots of wild rice plants and were brought into the Laboratory and reared to adult stage. The pupae were placed on moist absorbent cotton in petri dishes and placed in the cold room using the same temperature controls as previously described.

Trapping adults by means of a light trap was successful and twelve Chilo plejadellus Zinck and eight phalaenids were caught. The night light was set up in a tree over rice beds from June 30 to July 2, and specimens were collected each morning during this period.

3.1 Chilo plejadellus Zinck

3.1.1 Life history

Oviposition habits were not observed in the field. However, empty egg clusters were collected from the leaves of rice plants on July 17. The larvae at this time were in the first instar. Eggs laid by caged

females in the insectary required about eight days to hatch. Eggs are laid in clusters ranging from one to thirty eggs per cluster. The small whitish larvae feed for a period on the leaves and then bore into the stalk (Fig. 4). The entry hole is usually plugged with frass and webbing. This is considered a protective measure against high water and flooding during the period of larval development. The larvae tunnel down the stalk, feeding on horizontal plates of pith and inside surface of the stalk. Intermediate instar larvae of Chilo were observed feeding on the rice heads, indicating that they may move out of the stalks during this period of development. Pellets of frass and webbing are found in infested stalks. As many as four larvae per stalk have been counted. The mode of overwintering is not fully understood.

Late instar larvae were collected in November in the field and reared in the insectary under conditions described above. These larvae pupated in February and emerged as adults in March. Collections that were made in April, when ice still covered the lake, contained larvae and pupae. These larvae, under insectary conditions, pupated and emerged as adults in May. Insectary rearing conditions were not comparable to field conditions and the emergence dates were obviously advanced. Night light collections show that the peak of adult flight for this species in the field probably occurs in early July. It was difficult to find adults during the day in the field unless rice stalks were disturbed, indicating that they are nocturnal.

When populations of this insect are high, breakage to rice plants is severe. The entrance holes in the rice stalks weaken the plant and rice heads fail to mature. Weakened plants break prematurely during periods of high winds.

3.1.2 Descriptive notes

Material examined for descriptive notes consisted of many intermediate and late instar larvae collected in the field, six reared adults, labelled W59 Lone Island Lake, Man., wild rice; and thirty adults, labelled W59 Lone Island Lake, Man., light trap. Some adults have been retained in the Canadian National Collection.

Egg.- Oval, smooth, creamy white and deposited flat on the leaf. The eggs are usually laid in single clusters of about 25 eggs.

Late instar larvae.- Head about 2mm. in width. Body 22 to 25mm. in length and 2.5mm. in width. Skin smooth. Head reddish-brown with adfrontal area and area around ocelli darker brown. Light tan cervical shield split by greyish middorsal line with small brownish spots along cephalic, caudal and lateral margins. Body light tan with brownish middorsal, subdorsal and spiracular lines; a broken subspiracular line evident above the prolegs. The middorsal and subspiracular lines are not as broad as the other two lines. Spiracles black. Dark brown setae. Anal plate light tan covered with brownish spots.

Pupa.- Smooth and broadly tapered. Ten to 13mm. in length and 2mm. to 3mm. in width.

Adult.- Pale yellow elongated moth. Front wings covered with golden patches of scales. Apical end of front wing is gold with a row of black dots behind. No markings on hind wings. Front wings measure 20mm. to 25mm. from tip to tip.

Three hymenopterous parasites were recovered from Chilo

plejadellus Zinck and were identified by Dr. W.R. Mason of the Entomology Research Institute at Ottawa as Chelonus knabi Vier. (Braconidae). Only a single parasite was found on each host and was reared from last instar larvae overwintering in rice stalks. Adults emerged under laboratory conditions during June but under natural conditions this parasite would probably have emerged in late July.

Because of the small numbers of parasites reared it would appear that parasitism during this infestation was not a major control factor.

Overwintering larvae of Chilo plejadellus Zinck showed some mortality due to a fungus disease which was identified as Beauvaria sp. Diseased larvae were noticed when rice stalks were dissected for overwintering larvae. Because of the small numbers of diseased larvae recovered it is assumed that this form of mortality was not a major control factor in the past infestation.

3.2 Apamea apamiformis (Guenée)

3.2.1 Life history

The oviposition habits of this insect were not observed in the field. Empty egg clusters were collected on or inside the new flowers in July shortly after plants begin to joint. The larvae were in the first instar. Eggs are laid in rows ranging from one to thirty-five eggs per cluster. Larvae of all instars feed in the rice heads but also are found in the stalks of wild rice. During bright sunlight they conceal themselves in the leaf sheath and rice stalks and come out in the cool of the evening to feed on rice heads. Larvae usually mine each kernel of rice and when population levels are high the heads will be completely stripped. Infested rice heads appear yellow in the rice beds.

The site of pupation of this species is not known, and as yet adult moths have not been collected. Positive identification of this species was made from larvae submitted to M. MacKay, Ottawa. Observations in 1957 indicated that there was a marked decline in larval populations on the rice plants at the end of larval development period. It is suspected that at this time larvae float away from the host plant and pupate in plant litter along the shore line.

Some adults captured in light traps in the infestation area resemble Apamea. These have been submitted to Systematics for final identification.

3.2.2 Descriptive notes

Material examined for descriptive notes consists of many intermediate and late instar larvae collected in the field, and eight adults, labelled W59 Lone Island Lake, Man., night light.

The eggs and larvae of Apamea apamiformis (Guenee) have been adequately described by MacKay (7). The larvae of this species can be readily identified by the light brown head with brown reticulations and the brown dorsum with nearly continuous middorsal and subdorsal lines. Spiracles are rimmed with black and the larvae have a pale venter.

The early instars have a blackish dorsum, and the middorsal and subdorsal lines are more conspicuous.

A dipterous parasite was recovered from Apamea apamiformis (Guenee) and was submitted to Systematics for identification.

It was found singly on the host and was recovered on late instar larvae. The adults emerged in July. Because of the small numbers of parasites recovered from rearings it would appear that parasitism during this infestation was not a major control factor.

3.3 Poss. Catoclysta sp.

3.3.1 Life history

A number of aquatic pyralid larvae were found below water level in the mud at the crown level of rice plants. Larvae were also found on floating rice and appeared to be very good swimmers. There was evidence of feeding damage on the roots, but damage was more noticeable inside rice stalks. Larvae of this species could not be reared in the insectary and no adult material was collected for positive identification.

3.3.2 Descriptive notes

Material examined.- Ten intermediate instar larvae, collected from rice beds on Lone Island Lake, Manitoba.

Late instar larvae.- Head brown. Body 20mm. to 25mm. in length and 3mm. to 5mm. in width. Body brown covered with groups of lighter brown tracheal gills.

3.4 Donacia aequalis Say

3.4.1 Life history

Pupae of a chrysomelid beetle were found in low numbers attached to the root tubers of wild rice plants. No evidence of feeding damage was present on roots of plants examined. Pupae were collected in the field in August and emerged as adults under insectary conditions in September.

3.4.2 Descriptive notes

Material examined.- Six pupae collected from rice beds at Lone Island Lake, Manitoba, and insectary reared adults.

Pupae.- Subaquatic in habits. Creamy white in colour. Pupa encased in transparent cocoon attached to rice tubers. Body 8mm. to 14mm. in length and 5mm. to 7mm. in width. Body tapered at both ends.

Adult.- Body elongate, 6mm. to 8mm. in length and 3mm. to 4mm. in width, blue to metallic blue in colour. Elytrons minutely punctured. Antennae long, usually half the length of the body.

3.5 Donacia magnifica Lec.

3.5.1 Life history

Pupæ of a chrysomelid beetle were found in low numbers attached to root tubers of wild rice plants. No evidence of feeding damage was present on roots of plants examined. Pupae were collected in the field in August and emerged as adults under insectary conditions in September.

3.5.2 Descriptive notes

Material examined.- Four pupae collected from rice beds at Lone Island Lake, Manitoba.

Pupae.- Subaquatic in habits. Creamy white in colour. Pupa encased in transparent cocoon attached to rice tubers. Body 9mm. to 15mm. in length and 6mm. to 8mm. in width. Body tapered at both ends.

Adult.- Body elongate, 9mm. to 10mm. in length and 3mm. to 5mm. in width, bright metallic green in colour. Electrons minutely punctured. Antennae long, usually half the length of the body.

3.6 Hippodamia tredecimpunctata tibialis (Say)

3.6.1 Life history

Observations in the field provided only limited information on the life history of this species. Pupae and adults were found in very high numbers on wild rice plants in August and September. It apparently preys on an aphid, Rhopalosiphum sp., and on an unidentified thrips.

3.6.2 Descriptive notes

Material examined for descriptive notes consisted of pupae labelled W58 Lone Island Lake; nineteen adults labelled W57-2931; and twenty adults, labelled W57-2934 from Rice Lake, Manitoba.

Pupa.- End of abdomen attached to the plant. Light orange colour covered with blackened areas.

Adult.- Body elongate, 6mm. to 8mm. in length and 2mm. to 4mm. in width. Elytrons yellow with six black dots and one black dot divided between the two elytra.

3.7 Rhopalosiphum sp.

Some colonies of apterous females of these aphids were found on the stems and leaves of wild rice plants and were identified by G.A. Bradley. Infestations in 1959 were especially heavy at Wallace and Big Whiteshell lakes. No information was gathered on the life history of this species.

3.8 Unidentified Thrips

A species of thrips was found emerging from bags of recently threshed wild rice. No information on the life history of this thrip was gathered and material was submitted to Dr. R.S. Bigelow and has not yet been identified.

4. RELATIVE ABUNDANCE OF THE LEPIDOPTEROUS SPECIES

Examination of infested rice plants in the Lone Island Lake area in 1957 and 1958 gave some indication of the relative abundance of the three species of Lepidoptera. Counts for the two years are shown in the following summary:

Year	No. of infested plants examined	Numbers of each species collected		
		Chilo plejadellus	Apamea apamiformis	Poss. Catoclysta sp.
1957	25	10	5	10
1958	26	24	2	0

Apamea apamiformis (Guenée) was present in larger numbers than the above table indicates, because many larvae when disturbed fell off the rice plants when collections were made in the field.

Population counts based on the number of stems infested were made at Lone Island Lake, Manitoba, in 1957, 1958 and 1959 are listed below.

Year	No. of stems examined	Per cent of stems infested
1957	60	68
1958	80	49
1959	40	18

These records indicate that the heaviest damage occurred in 1957, but admittedly the samples were small. In 1958 populations showed a marked decline and by 1959 the infestation had subsided in the Whiteshell Forest Reserve.

5. SUMMARY OF SPECIES BY FEEDING SITE

Species	Leaves	Stems	Roots	Flowers	Kernels
Lepidoptera					
1. Apamea apaniformis (Guenée)	x			x	x
2. Chilo plejadellus Zinck		x			x
3. Poss. Catoclysta sp.			x		
Coleoptera					
1. Donacia aequalis Say			x		
2. Donacia magnifica Lec.			x		
3. Hippodamia tredecimpunctata tibialis (Say)	x				
Homoptera					
1. Rhopalosiphum sp.	x	x			
Thysanoptera					
1. Unknown sp.					x

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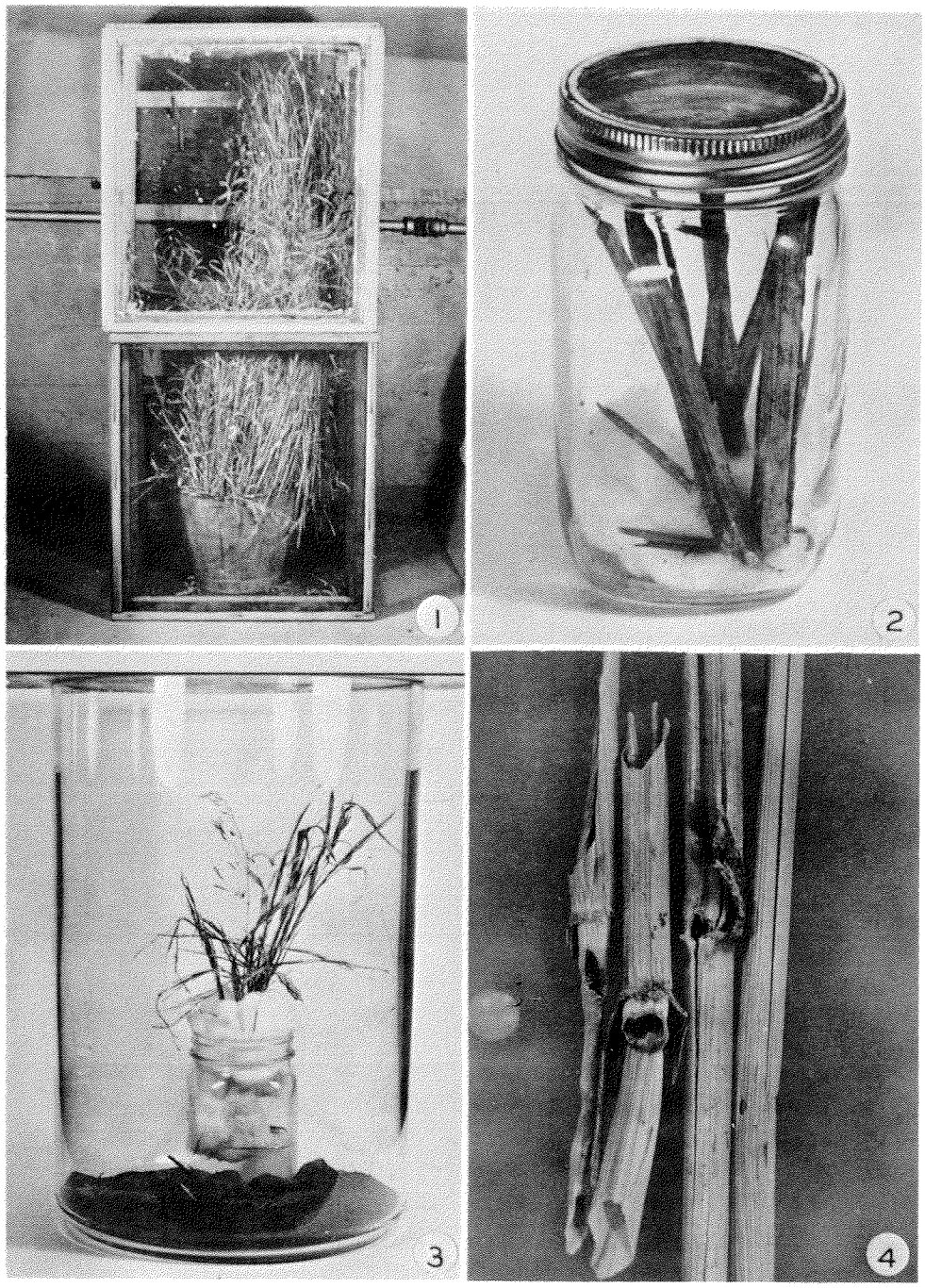

Fig. 1 - Rearing cage for *A. apamiformis* and *C. plejadellus*

Fig. 2 - Rearing jar with rice stalks infested with *C. plejadellus*

Fig. 3 - Rearing jar with rice stalks and heads infested with *A. apamiformis*

Fig. 4 - Rice stalks infested with *A. apamiformis* and *C. plejadellus*