

## AQUATIC AND SEMI-AQUATIC INSECTS OCCURRING IN THE EGYPTIAN RICE FIELDS AND HAZARDOUS EFFECT OF INSECTICIDES

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### Abstract

Aquatic and semi-aquatic insects occurring in rice fields and canals of Kafr El-Sheikh Governorate, Egypt, were surveyed during 2003 and 2004 rice seasons. A total of thirty-five insect species belong to nineteen families and six orders were identified. They belonging to Orders : Coleoptera, Hemiptera, Odonata, Ephemeroptera, Trichoptera and Diptera, most of which are belonging to Coleoptera. Identified species of Coleoptera (beetles), Hemiptera (true bugs) and Odonata (dragonflies and damselflies) are predators feeding mainly upon dipterous, stem & leaf borer larvae and leaf and plant hoppers. *Ischnura senegalensis* Ramb was the most dominant (433 individuals) exhibiting six peaks in rice season, *Crocothemis erythraea* Brulle. was less dominant (149 individuals) exhibiting five peaks, while *Hemianax ephippiger* Burm. was rare (28 individuals). Sumithion proved to be the most toxic insecticide against predators, as it removed 98-100% of coleopterous population. Mocap and Furan were less toxic (90-95% reduction) compared to other insecticides. Cartan, Bilarfuran, Furadan and Diazinox produced moderate hazard (95-98% population reduction). Other aquatic insects of different orders (mainly Hemiptera,, Odonata, Ephemeroptera and Diptera) were severely destroyed by all insecticides, resulting in population reduction of > 98-100% .

### INTRODUCTION

Aquatic and semi-aquatic species of many insect orders inhabiting paddy fields and canals have hardly been paid any attention in insect pest control carried out in the rice fields in Egypt. Many authors in rice growing countries such as Moretti (1932) in Italy, Fernando (1959) in Sri Lanka, Service (1977) in Kenya, Heckman (1974) in Laos and Thailand, Polhemus and Reisen (1976) in the Philippines surveyed the aquatic insects of rice nurseries and paddy fields. As well as El-Sherif *et al.* (1976) in Egypt investigated the aquatic insects of rice nurseries and paddy fields in Damietta Governorate and collected insect species belonging to Ephemeroptera, Odonata, Hemiptera, Coleoptera and Diptera. Fernando (1956) has reported the aquatic fauna of the rice water including fishes and insects. In the surveys of rice plant- and leaf-hoppers and their natural enemies made in the Philippines, Hirashima (1981) collected a variety of aquatic and semi-aquatic insects. However, Yano (1978) reported that

most of aquatic and semi-aquatic insects are predaceous and feed on various insect pests .

Relatively, little is known about the dragonflies and damselflies (Odonata) occurring in Egypt. So, activity of dragonflies and damselflies in the Egyptian rice fields was studied. Comstock (1940) indicated that dragonflies and damselflies are very common aquatic insects, their nymphs and adults are exclusively aquatic predators, feeding upon various forms of aquatic soft bodied insects. Shalaby (1958) and El- Sherif *et al* (1976) mentioned that *Ischnura senegalensis* Ramb. and *Hemianax ephippiger* Burm. are the most dominant species of Odonata in Egypt.

Rice seedlings in both rice nurseries and direct-seeded rice fields are attacked by bloodworms, *Chironomus* spp. larvae that feed on starchy contents of the rice seeds and the emerging rootlets of the young plants. Since the growers use different insecticides to control the bloodworms, there is an urgent need to fully understand the negative effects occurring to the co-existed untargeted organisms.

There have been numerous studies on the effects of pesticides and trace elements on aquatic invertebrates (Cain *et al* 1992, Fairchild *et al* 1992 Hare 1992, Kreutweiser and Capell 1992, Leland *et al* 1989, Shebunina 1990). Oho and Fuzii (1956) reported high population density of veliid aquatic bug, *Microvelia douglasi* (Veliidae) in less sprayed paddy fields of Saga Prefecture, Japan. On the other hand, Kobayashi (1961), in Japan, reported reduction in population density of the aquatic bug *Microvelia douglasi* by the insecticide applications against rice stem borer.

The current investigation was carried out to survey the aquatic and semi-aquatic insects occurring in rice fields. Since Odonata species are common insects ,their population fluctuations were thoroughly monitored . In addition , the hazardous effect of some insecticides applied in rice fields against the beneficial aquatic and semi-aquatic insects was considered.

## MATERIALS AND METHODS

### 1. Survey of Aquatic and Semi-aquatic Rice Insects:

The insects were collected in the morning from water using a fine fiber screen net (30 cm diameter) one week after rice sowing, and continued weekly till the drainage of water before harvest. Samples were placed in a plastic container (20x8x6 cm) filled directly with water of rice fields. The debris-free samples were preserved in 70% ethyl alcohol until identification. Insect classification was achieved by the aid of Taxonomy Research Department at Plant Protection Research Institute, Agricultural Research Center, Ministry of Agriculture, Egypt.

## 2. Population Fluctuation of Odonata Species:

Population fluctuations of three predatory adults *Ischnura senegalensis* Ramb, *Crocothemis erythraea* Brulle and *Hemianax ephippiger* Burm ( Odonata) were monitored using the sweep net. Fifty double strokes were practiced weekly from 3 May to 27 September.

## 3. Relative Hazard of Insecticides on Beneficial Insects:

The reseach area was divided into 32 plots (80m<sup>2</sup> each ) representing eight treatments (seven insecticides and check).Each treatment was replicated four times. Four days after broadcasting nurseries, water was drained, insecticides were applied and kept for 24 hours before restoring the water. The applied insecticides and their rates of applications are listed in Table (3 ). Dead and alive aquatic insects were counted using a small fine screen 24, 72 hours and six days after insecticide application.

# RESULTS AND DISCUSSION

## 1. Survey of Aquatic and Semi-aquatic Rice Insects:

The survey revealed the occurrence of 35 insect species in the rice fields and canals. These species were found belonging to six orders and 19 families. In the rice field, 20 insect species were recorded as rare, 7 as low, 6 as moderate and 2 species as very rare. In the canals, 9 spesies were found rare, 9 as low, 12 as moderate and 5 species as frequent. However, the current survey refers to richness of rice field and around canals with aquatic insects, due to no insecticide application. Hemiptera, Coleoptera and Diptera are abundant in the paddy fields. Most species belonging to Hemiptera and Coleoptera were predators, but the dipterous are pests attacking rice plants like *Chironomus* spp., *Atylotus agrestis* , *Eristalis* sp. and *Tipula* sp. Furthermore, *Anopheles* sp. , *Culex* sp. and Ceratopogonidae (medical insects) were recorded. Table (1) lists 9 aquatic species of hemipterans belonging to five families collected from paddy fields. They are Belostomatidae : *Lethocerus niloticus* Stael, *Limnogeton fieberi* Mayr and *Sphaerodema urinator* Duf, Corixidae: *Micronecta plicata* Costa, *Sigara* sp. and *S. lateralis* Leach, Gerridae: *Lemnogonus aegypticus* Puton , Nepidae: *Ranatra vicina* Sign , Notonectidae: *Anisops* sp. Polhemus and Reisen (1976) recorded 18 aquatic Hemiptera species in the Philippines mainly based on the material collected from Luzon and some from other islands. The species were collected from paddy fields and adjoining irrigation ditches. Pawar (1971) obtained *Lethocerus indicus*, from the paddy field using the light trap.

Table 1. Surveyed aquatic insects from rice fields and watering & drainage canals -  
2003 and 2004

Order	Family & Species	Relative abundance	
		Rice Field	Rice Watering & Drainage Canals
Hemiptera (true bugs)	<b>Belostomatidae: Giant Water Bugs,</b>		
	<i>Lethocerus niloticus</i> Stael	Rare	Low
	<i>Limnogeton fieberi</i> Mayr	Rare	Low
	<i>Sphaerodema urinator</i> Duf	Rare	Moderate
	<b>Corixidae: Water Boatman,</b>		
	<i>Micronecta plicata</i> Costa	Low	Moderate
	<i>Sigara</i> sp.	Moderate	Moderate
	<i>S. lateralis</i> Leach	Rare	Rare
	<b>Gerridae: Water Striders ,</b>		
	<i>Lemnogonus aegypticus</i> Puton	Rare	Rare
	<b>Nepidae: Water scorpions ,</b>		
	<i>Ranatra vicina</i> Sign	Rare	Rare
	<b>Notonectidae : Backswimmer ,</b>		
<i>Anisops</i> sp.	Moderate	Frequent	
Coleoptera (beetles)	<b>Dytiscidae:Predaceous Diving Beetle</b>		
	<i>Bidessus</i> sp.	Rare	Moderate
	<i>B. major</i> Sharp	Rare	Rare
	<i>Canthydrus notula</i> Erichson	Rare	Rare
	<i>Cybister</i> sp.	Rare	Moderate
	<i>Eretes sticticus</i> L.	Rare	Rare
	<i>Herophydrus guineensis</i> Aube	Rare	Rare
	<i>Hydrovatus</i> spp.	Rare	Rare
	<b>Hydrophilidae:Water Scavenger Beetle</b>		
	<i>Enochrus</i> sp.	Low	Moderate
	<i>E. tetraspilus</i> Reg	Rare	Rare
	<i>Hydrous</i> sp.	Rare	Low
	<i>Spercheus cerisyi</i> Guerin	Rare	Low
	<i>Sternolophus solieri</i> Solieri	Rare	Low

Table (1) Continued

<b>Odonata</b> <b>(dragonflies &amp; damselflies)</b>	<b>Aeschnidae: The Dragonflies</b> <i>Hemianx ephippiger</i> <i>Burm</i>	Very Rare	Moderate
	<b>Libellulidae: The Dragonflies</b> <i>Crocothemis erythraea</i> <i>Brulle</i>	Low	Moderate
	<b>Agrionidae: The Damselflies</b> <i>Ischnura senegalensis</i> <i>Ramb</i>	Moderate	Frequent
<b>Diptera</b> <b>( true flies)</b>	<b>Ceratopogonidae : Not identified</b>	Rare	Low
	<b>Chironomidae: midges</b> <i>Chironomus</i> <i>spp.</i>	Moderate	Moderate
	<b>Culicidae: mosquitoes</b> <i>Anopheles</i> <i>sp.</i>	Moderate	Frequent
	<i>Culex</i> <i>sp.</i>	Moderate	Frequent
	<b>Ephydriidae:</b> <i>Ephydra</i> <i>sp.</i>	Low	Moderate
	<b>Stratiomyidae:</b> <i>Stratiomysa</i> <i>sp.</i>	Rare	Moderate
	<b>Syrphidae , Hover flies</b> <i>Eristalis</i> <i>sp.</i>	Low	Moderate
	<b>Tabanidae:</b> <i>Atylotus agrestis</i> <i>Wied</i>	Low	Low
<b>Tipulidae: Crane flies,</b> <i>Tipula</i> <i>sp.</i>	Rare	Low	
<b>Trichoptera</b> <b>( caddis flies)</b>	Not identified	Very Rare	Low
<b>Ephemeroptera</b> <b>(mayflies)</b>	<b>Ephemeridae: The mayflies</b> <i>Polymitarcys</i> <i>sp.</i>	Low	Frequent

Fernando and Cheng (1974) stated that 6 species of 4 hemipterous families were found in Malayan *molestus* (*Sphaerodema molestum*), *Micronecta quadristrigata* and *M. punctata*. Service (1973, 1977) searched on the mortalities of the larvae of *Anopheles gambiae* complex in Kenya, and used 17 species including 3 unidentified

species of aquatic insects inhabiting in paddy fields. Among of these species are *Hydrometra aegyptica*, *Limnogonus severini*, *Micronecta scutellaris*, *Sigara hedenborgi*, *S. pectoralis*, *Sigara* spp., *Ranatra bottegoi*, *Diplonychus grassei* (*Sphaerodema grassei*) and, *Anisops* sp. Twelve aquatic coleopteran species belonging to two families in rice fields and canals are listed in Table (1) Insect of Dytiscidae are predaceous diving beetles, *Bidessus* sp., *B. major* Sharp, *Canthydrus notula* Erichson, *Cybister* sp., *Eretes sticticus* L., *Herophydrus guineensis* Aube and *Hydrovatus* spp. The second family is so-called as scavenger beetles (Hydrophilidae), *Enochrus* sp., *E. tetraspilus* Reg, *Hydrous* sp., *Spercheus cerisyi* Guerin and *Sternolophus solieri* Solieri. Fernando (1961) noted that many aquatic insects were common in paddy fields of Sri Lanka. Heckman (1974) studied the seasonal succession of species in a paddy field in Laos, and surveyed 12 unidentified species of Heteroptera. El- Sherif *et al.* (1976) surveyed eleven aquatic coleopteran species belonging to two families (Dytiscidae and Hydrophilidae) from rice nurseries and paddy fields in Egypt (Damietta Governorate).

## 2. Population Fluctuation of Odonata Species:

Data in Table (2) show population fluctuations of three predators belonging to order Odonata, *Ischnura senegalensis* Ramb., *Crocothemis erythraea* Brulle. and *Hemianax ephippiger* Burm. The first predator was the most dominant (433 individuals) exhibiting six peaks during rice season. The first and second peaks occurred by the end of rice nurseries, 12 individuals /50 double strokes on 24 May, and 22 individuals on 7 June, the third one occurred on 26 July (48 individuals), the fourth and fifth peaks occurred on 16 August (42 indiv.) and 30 August (16 indiv.). The last one (31 indiv.) occurred on 20 September. *C. erythraea* was less dominant (149 indiv.) exhibiting five peaks, the first and second peaks occurred by the end of nursery period (5 and 6 indiv.), the third peak occurred on 19 July (15 individuals), the fourth on 26 August (18 indiv.), while the fifth peak (9 indiv.) occurred on 20 September. The third predator, *Hemianax ephippiger* was rare and appeared as scattered numbers all round the season (28 indiv.), most numbers occurred by the end of rice season. Total of Odonata have five peaks around the rice season, the first occurred during the first week of June, the second was a bigger one (62 indiv.) by late July, the third peak occurred on 16 August (59 indiv.). Fourth peak occurred by late August (45 indiv.), while the last one occurred on 20 September (44 indiv.). El- Sherif *et al* (1976) indicated that *Ischnura senegalensis* Ramb. and *Hemianax ephippiger* Burm. are common species of Odonata in rice nurseries and fields. Shalaby (1958) mentioned that *I. senegalensis* and *H. ephippiger* are the most dominant Odonata species in Egypt.

Table 2 . Population fluctuations of three Odonata insects by sweep net in rice fields , 2004 season

Date of collection	Order Odonata			Total
	<i>Ischnura senegalensis</i>	<i>Crocothemis erythraea</i>	<i>Hemianx ephippiger</i>	
May 3	2	0	0	2
10	5	0	0	5
17	11	1	0	12
24	12	1	0	13
31	8	5	0	13
Jun.7	22	3	1	26
14	10	6	0	16
21	3	1	1	5
28	7	4	1	12
Jul. 5	26	4	3	33
12	34	9	4	47
19	39	15	1	55
26	48	14	0	62
Aug. 2	21	8	5	34
9	15	6	1	22
16	42	17	0	59
23	16	17	3	36
30	26	18	1	45
Sept. 6	13	4	1	18
13	19	5	0	24
20	31	9	4	44
27	23	2	2	27
Total	433	149	28	610

### 3. Relative Hazard of Insecticides on Beneficial Insects:

Rice fields and canals are rich in aquatic insects, many of which are beneficial (predators). Since there is a need to apply insecticides against bloodworms, especially in saline soils, it was observed that these insecticides may result in killing many of beneficial insects. Therefore, samples of aquatic insects were taken using fiber screen to find out the hazardous effect of applied insecticides (Table 3). Sumithion proved to be the most toxic insecticide, as it removed > 98-100 % of coleopterous population. Relatively, Mocap and Furan were less toxic (90-95 % reduction) compared to other insecticides. The remaining insecticides listed in Table (3) produced moderate hazard (> 95-98 % population reduction). Other aquatic insects of different Orders (mainly Hemiptera, Odonata, Ephemeroptera and Diptera) were severely destroyed by insecticides, resulting in population reduction of > 98-100 %. Oho and Fuzii ( 1956) found a rather high population density of *Microvelia douglasi* (Veliidae) in less sprayed paddy fields of Saga Prefecture, Japan, when they made investigations on the influence of chemical control. Kobayashi (1961) reported reduction in population density of veliid aquatic bug *M. douglasi* by the insecticide applications against rice stem borer.

Table 3. Relative hazard of insecticides applied against bloodworms on aquatic insects  
– 2004

Insecticides	Rate/fed.	Relative hazard to aquatic insects	
		Coleopterous	Other orders
Cartan 10 G	6 kg	++	+++
Bilarfuran 10 G	6 kg	++	+++
Furadan 10 G	6 kg	++	+++
Mocap 10 G	3 kg	+	+++
Furan 10 G	6 kg	+	+++
Diazinox 5 G	10 kg	++	+++
Sumithion 50 EC	1 L.	+++	+++
Control	0	0	0

0 100% survivals  
 + 90-95 % reduction  
 ++ > 95-98 % reduction  
 +++ > 98 – 100 % reduction

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## الحشرات المائية والنصف مائية في حقول الأرز المصرية والأثر الضار للمبيدات الحشرية عليها

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تم حصر أنواع الحشرات المائية والنصف مائية في حقول وقنوات الأرز في محافظة كفر الشيخ ، مصر، أثناء موسمي ٢٠٠٣ - ٢٠٠٤ يمكن حصر خمسة وثلاثين نوعا حشرياً تنتمي إلى تسع عشرة عائلة وست رتب حشرية هي : غمدية الأجنحة (Coleoptera) ، نصفية الأجنحة (Hemiptera) ، الرعاشات (Odonata) ، رتبة ذباب مايو (Ephemeroptera) وشعرية الأجنحة (Trichoptera) وذات الجناحين (Diptera). وجد أن أغلب الأنواع الحشرية تنتمي إلى رتبتي غمدية و نصفية الأجنحة. كما وجد أن معظم الأنواع المنتمية إلى غمدية الأجنحة (خنافس) ، Hemiptera (عائلة البق الحقيقي) و Odonata (الرعاشات بأنواعها) كانت مفترسات تتغذى بشكل رئيسي على الذباب Diptera، ونطاطات النبات والأوراق و الحشرات الأخرى التي تصيب نبات الأرز. الرعاش الصغير *Ischnura senegalensis* كان الأكثر تواجدا (٤٣٣ فرد) و له ست قُمَم في موسم الأرز ،بينما كان *Crocothemis erythraea*. أقل تواجدا. (١٤٩ فرد) و له خمس قُمَم، بينما كان *Hemianax ephippiger*. قليلا (٢٨ فرد) . مبيد Sumithion كان الأكثر تأثيراً ضد المفترسات من رتبة غمدية الأجنحة حيث أنه أباد من ٩٨-١٠٠%. مبيد، والمبيدان Mocap و Furan كانا أقل سميه (٩٠-٩٥%) مقارنة بالمبيدات الحشرية الأخرى (Cartan، Bilarfuran)، وكان خطر Furadan و Diazinox معتدل (٩٥-٩٨% تخفيض). أما رتب الحشرية المائية الأخرى (خصوصا Odonata، Ephemeroptera، Hemiptera و Diptera) فإنها تأثرت بشدة بكل المبيدات الحشرية، مما أدى إلى تخفيض أعدادها بحوالى ٩٨-١٠٠%.