The families of hymenopterous parasitoids active in tropical rainfed paddies

Autor(en): **Jensen, Peter Bonde / Pewlong, Supang**

Objekttyp: **Article**

Zeitschrift: **Mitteilungen der Schweizerischen Entomologischen Gesellschaft = Bulletin de la Société Entomologique Suisse = Journal of the Swiss Entomological Society**

Band (Jahr): **71 (1998)**

Heft 1-2

PDF erstellt am: **28.04.2024**

Persistenter Link: https://doi.org/10.5169/seals-402694

MITTEILUNGEN DER SCHWEIZERISCHEN ENTOMOLOGISCHEN GESELLSCHAFT
BULLETIN DE LA SOCIÉTÉ ENTOMOLOGIQUE SUISSE
71, 21 – 26, 1998

The families of hymenopterous parasitoids active in tropical rainfed paddies

PETER BONDE JENSEN[1] & SUPANG PEWLONG[2]

[1] Department of Zoology, University of Aarhus, DK-8000 Aarhus C, Denmark
[2] Phatthalung Rice Research Center, Phatthalung 93000, Thailand

Small activity traps placed in young tropical rainfed rice paddies, during the wet crop seasons of 1994 and 1995, caught 25 families of hymenopterous parasitoids. About 88 % of all the collected individuals were egg parasitoids belonging to the families Mymaridae, Scelionidae and Trichogrammatidae. 42–46 % of all the species collected each year represented these three families. Omitting the species represented by low numbers of individuals resulted in an increase in the percentage of egg parasitoid species. This trait is discussed with reference to the "nasty host" hypothesis.

Keywords: rice, activity traps, egg parasitoids, nasty host hypothesis

INTRODUCTION

Many hymenopterous parasitoid species have been reported as natural enemies of insect pests of rice (REISSIG *et al.*, 1986). But while levels of activity and details on the population dynamics are known for several rice insect pests (DALE, 1994, and references therein) and for some generalist predators, e.g. spiders, bugs and beetles (OOI & SHEPARD, 1994, and references therein), knowledge about the activity of parasitoids in rice is very fragmentary. Either activity levels are assessed for hymenopterous parasitoids as a group (HEONG *et al.*, 1991), or activity of parasitoid species are indirectly assessed from their rate of parasitism (KAMRAN & RAROS, 1971; BENTUR *et al.*, 1982; CATLING *et al.*, 1983; FOWLER *et al.*, 1991).

Rice has been grown in Southeast Asia for at least three thousand years (BRAY, 1986), thus the interactions between the rice plants, insect pests and their natural enemies, thereby including the fauna of hymenopterous parasitoids, is assumed to be well established. Among the (specialist) natural enemies hymenopterous egg parasitoids have been observed to be very abundant in tropical paddies (WONGSIRI *et al.*, 1982). Nevertheless it has been shown that rice varieties may influence the egg size of the hosts, e.g. of the brown planthopper (LOU & CHENG, 1996), which ultimately means that different complexes of egg parasitoid species may be associated with (or develop on) different rice varieties (HIROSE, 1993). Thus the introduction of new (often high-yielding) rice varieties may have influenced the fauna of parasitoids or it may have changed the relative abundance of species.

This paper presents data on the activity of hymenopterous parasitoid families assessed by 96 activity traps in paddies, in the Phatthalung province of southern Thailand, grown with a long established local rice variety (Lepnok). The observed quantitative and qualitative compositions of hymenopterous parasitoids active in tropical rainfed paddies are discussed with reference to the "nasty host" hypothesis.

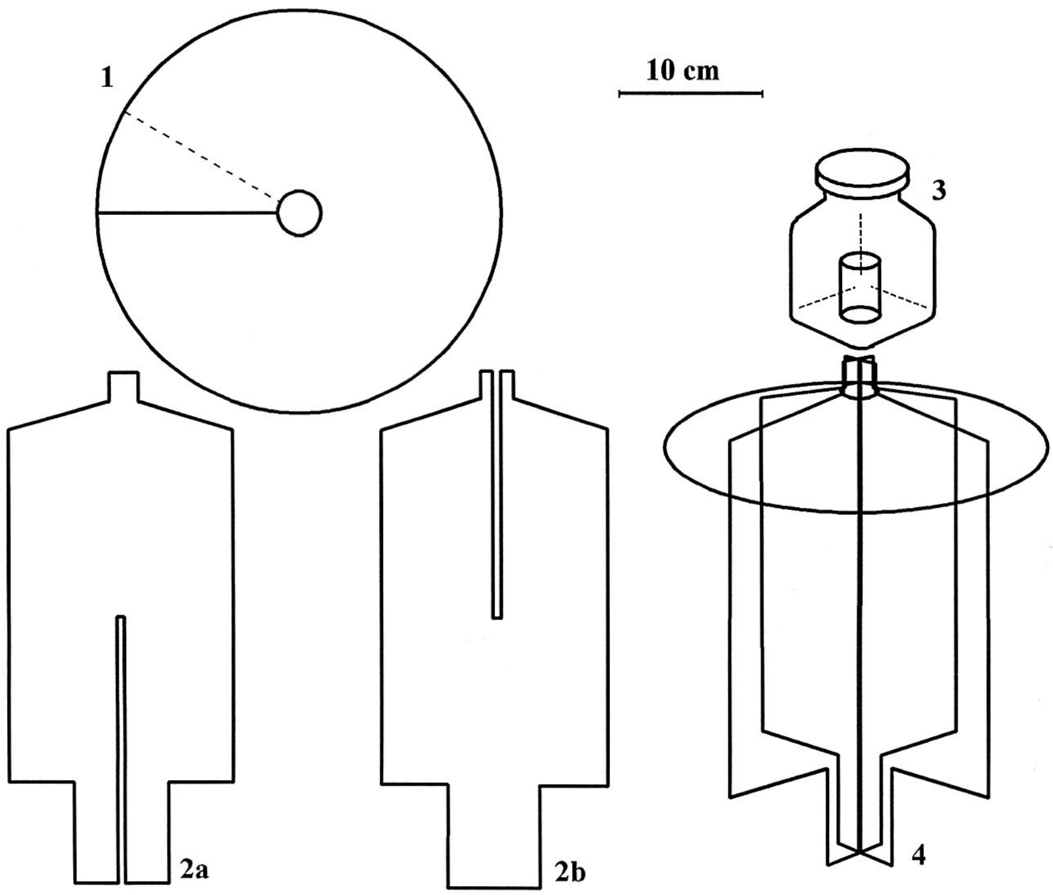
MATERIAL AND METHODS

In both 1994 and 1995 the activity of hymenopterous parasitoids was assessed in paddies of the Phatthalung province of Southern Thailand. This region of Thailand was chosen because an old (long established) low-yielding rice variety (Lepnok) is grown on the majority of paddies. Very little fertilizer is added and not every season, furthermore no pesticides are applied during the growth period.

The activity was assessed by 96 small activity traps each of which was placed in a seperate paddy, just after the transplanting of the rice plants and 8 m from the margin of the fields. The distance from the lower part of the traps to the surface of the water was 30 cm.

Since this trap type has not previously been used to assess the activity of insects in paddies, we describe it here in detail. The trap differs from other Malaise traps due to its smaller size and greater simplicity, and from the window trap type of TOGASHI (1990) in that it exploits the behavioural characteristic of many flying insects, namely that they move upward when meeting obstacles, e.g. vertical and/or sloping collision walls (MALAISE, 1937; TOWNES, 1962).

The trap was constructed from transparent PVC, since TOWNES (1972) has shown that the colour of a Malaise trap can have a dramatic effect on the catch of Hymenoptera. It consists of two interlocking plates, a conical top (cover), and a collecting cup (Fig. 4). Deep slits were cut into the 3 mm thick plates, allowing them to fit together (Figs 2a, 2b). The cover was made from thin (0.2 mm) flexible PVC



Figs 1–4. Activity trap for monitoring hymenopterous parasitoids in cereal fields. 1, top hat. 2a and 2b, trap sides with deep slits. 3, collecting cup. 4, complete trap.

which made an overlap of 7 cm possible (Fig. 1). The collecting cups were made from commercial plastic cups (Kautex) which were modified by cutting a hole in the bottom, to the edge of which a piece of a transparent pipe was attached (Fig. 3). The trap's dimensions were chosen to best suit the typical distances found between transplanted rice plants (ca. 20 cm). The trap was kept above water by pieces of piping. Four pieces of piping were placed along the intersections of the interlocking plates. Where they extended past the base of the trap an adjustable plastic grip was used to secure them in position. Only two pieces of piping needed to extend much beyond the trap for anchorage in the ground. Thin anchoring lines used to prevent the cover from flying away in wind are recommended.

In 1994 and 1995 the 96 traps collected insects during the periods 11/10–28/11 and 2/10–30/11 respectively, while in 1994 during the period 29/11–23/12 the number of traps was reduced to 48. In both years the traps were emptied once a week. In the Phatthalung Province it usually rains regularly (rainy season) during the second half of October and in November.

RESULTS AND DISCUSSION

In 1994 the traps collected 5,166 hymenopterous parasitoids, and the females of this material were sorted to 267 species (4,319 individuals), further two species were observed by males, since they were the only representatives of the families Elasmidae and Torymidae. Correspondingly, in 1995 the traps collected 10,038 hymenopterous parasitoids, and the females were sorted to 326 species (7,159 individuals) (Tab. 1).

Each year the collected material represented 24 families (but 25 families in total) and 22 of these families were also collected by HEONG *et al.* (1991) in rice paddies of the Philippines. In both years, 7 of the families were not included in the key to insects and spiders in rice fields by BARRION & LITSINGER (1994). The families not included in that key are: Agaonidae, Aphelinidae, Cynipidae, Diapriidae, Evaniidae, Mymarommatidae, Signiphoridae and Torymidae. These families which are hardly associated with any rice insect pests were represented by 143 individuals (34 species) and 138 individuals (31 species) in 1994 and 1995 respectively.

As observed by YANO *et al.* (1975) there are far more individuals of the superfamilies Chalcidoidea + Cynipoidea + Proctotrupoidea (sensu Ceraphronoidea + Proctotrupoidea + Platygastroidea in Tab. 1) than of Ichneumonoidea. In concordance with this WONGSIRI *et al.* (1982) observed relatively high activity of egg parasitoid species in paddies of Thailand. Both these traits are confirmed by this study, since in 1994 and 1995 the individuals of the families with egg parasitoids, viz. Mymaridae, Scelionidae and Trichogrammatidae, constituted 87.5% and 88.4% of the material respectively.

Even the number of species of these families is almost as high as the number of species of the remaining families, thus the percentage of egg parasitoids of all species was 45.4% and 42.0% in 1994 and 1995 respectively. Moreover a detailed study of the material revealed that omitting the species represented by few individuals resulted in an increase in the percentage of egg parasitoid species (Figs 5a, 5b).

Consider that in young paddies the ground is covered with water and that rice is the only and totally dominating plant (monoculture). Add that allelochemicals like aconitic acid, anthocyanin and pentadecanal seem to be important components in resistance of rice to insect pests (PRASAD *et al.*, 1987; DHALIWAL *et al.*, 1990; RUSTAMANI *et al.*, 1992), and that the content of allelochemicals in plants increase

Tab. 1. Numbers of species and individuals of each parasitoid family collected by the activity traps during 1994 and 1995. The number of species is based on females, except for 1994 where the species of Elasmidae and Torymidae are based on males (Classification after GOULET & HUBER, 1993).

	1994		1995	
	Species	Individuals	Species	Individuals
Ceraphronoidea				
Ceraphronidae	16	201	25	171
Proctotrupoidea				
Diapriidae	15	62	12	75
Platygastroidea				
Platygastridae	4	12	3	11
Scelionidae	82	1,226	86	1,141
Mymarommatoidea				
Mymarommatidae	1	3	1	1
Chalcidoidea				
Agaonidae	1	1	1	2
Aphelinidae	14	67	14	44
Chalcididae	3	34	3	18
Elasmidae	1	1	4	29
Encyrtidae	25	59	29	340
Eulophidae	30	83	37	170
Eupelmidae	2	2	3	6
Eurytomidae	3	8	2	4
Mymaridae	25	661	27	841
Pteromalidae	3	11	13	34
Signiphoridae	1	8	1	4
Torymidae	1	1	1	11
Trichogrammatidae	15	2,632	24	6,892
Ichneumonoidea				
Braconidae	14	28	18	72
Ichneumonidae	4	16	5	140
Evanioidea				
Evaniidae	1	1	0	0
Chrysidoidea				
Bethylidae	3	35	10	16
Dryinidae	3	11	5	14
Cynipoidea				
Cynipidae	0	0	1	1
Eucoilidae	2	3	1	1
Total	269	5,166	326	10,038

with decreasing latitude (LEVIN, 1976). Then the dominance in activity of egg parasitoids on young tropical rice paddies becomes particularly interesting with reference to the "nasty host" hypothesis (GAULD *et al.*, 1992). This hypothesis postulates that potential hosts in the tropics are less available to parasitoids than are extra-tropical hosts because their tissues are, on average, more chemically toxic than are the tissues of extra-tropical hosts. This hypothesis is based on another hypothesis which postulates that the overall greater chemical toxicity of tropical plants will result in the tissues of the insects that feed on them being more toxic in some way that is detrimental to parasitoids. Thus GAULD *et al.* (1992) predict that parasitoids of juvenile insect stages, which feed directly on living plants, will be less species-rich in

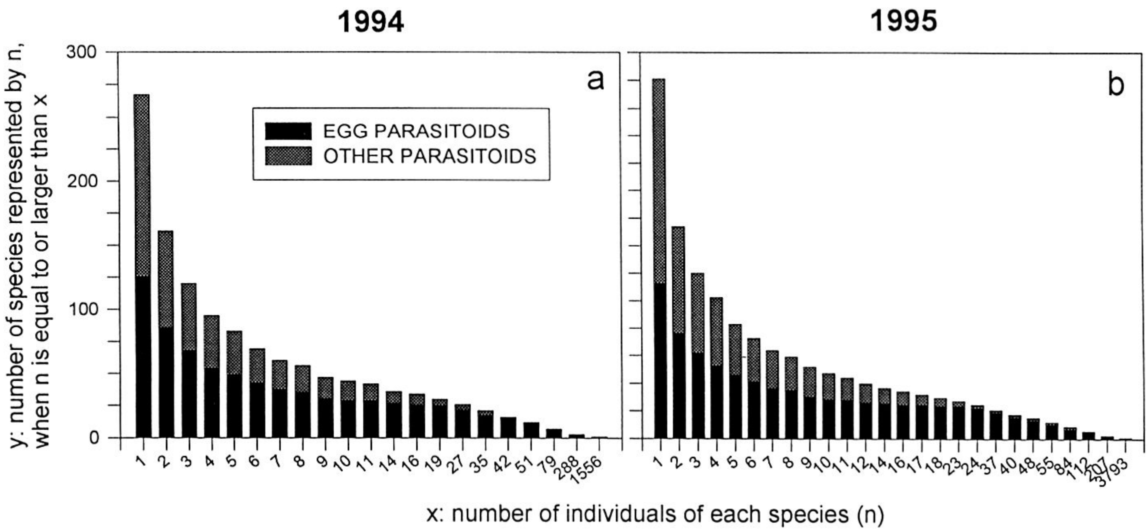


Fig. 5. The number of parasitoid species in 1994 (a) and 1995 (b) divided into egg parasitoids and other parasitoids. In both 1994 and 1995 the percentage of egg parasitoids increased with stepwise exclusion of species represented by low numbers of individuals (n small), e.g. when x=3 the column above x is made up by species represented by 3 or more individuals ($n \geq 3$) while the species with n<3 were omitted.

the tropics. Opposed to this egg and pupae parasitoids are hypothesized to be relatively more species rich.

This study is not a test of the "nasty host" hypothesis since it may be claimed that the observed quantitative and qualitative traits in the activity patterns of hymenopterous parasitoids are characteristic of young paddies only.

Moreover directly comparable data from extra-tropical cereal fields are not available, but traits in the quantitative and qualitative compositions of hymenopterous parasitoids collected by emergence traps in Danish barley fields (JENSEN, 1996), where the percentage of egg parasitoid species never exceeds 20%, imply that egg parasitoids are far less dominant in such temperate fields.

ACKNOWLEDGEMENTS

We thank everybody at the Phatthalung Rice Research Center for help with this experiment, and Dr. I. C. W. HARDY for reading the manuscript. Financial support was provided by the Danish Ministry of Foreign Affairs (RUF) to whom we are very grateful.

ZUSAMMENFASSUNG

Während der Regenzeit-Kultur 1994 und 1995 sammelten wir 25 Familien von parasitischen Hymenopteren mit kleinen Aktivitätsfallen, die in jungen tropischen Reisfeldern aufgestellt wurden. Etwa 88% der identifizierten Individuen und 42–46% aller vorgefundenen Arten, die in diesen zwei Jahren registriert wurden, waren Eiparasitoide der Familien Mymaridae, Scelionidae und Trichogrammatidae. Bei Herausnahme derjenigen Spezies, die nur in geringer Anzahl an Individuen präsent waren, entstand eine Zunahme des prozentualen Anteils von eiparasitierenden Arten. Dieses Merkmal wird mit Bezug auf die "nasty host" Hypothese diskutiert.

REFERENCES

BARRION, A.T. & LITSINGER, J.A. 1994. Taxonomy of rice insect pests and their arthropod parasites and predators. *In*: HEINRICHS, E.A. (ed.), *Biology and management of rice insects*, pp. 13–359. Wiley, New York.

BENTUR, J.S., SAIN, M. & KALODE, M.B. 1982. Studies on egg and nymphal parasites of rice planthoppers, *Nilaparvata lugens* (STÅL) and *Sogatella furcifera* (HORVATH). *Proc. Indian Acad. Sci. (Anim. Sci.) 91*: 165–176.

BRAY, F. 1986. *The rice economies*. Blackwell, Oxford, 254 pp.

CATLING, H.D., ISLAM, Z. & ALAM, B. 1983. Egg parasitism of the yellow rice borer, *Scirpophaga incertulas* (Lep.: Pyralidae) in Bangladesh deepwater rice. *Entomophaga 28*: 227–239.

DALE, D. 1994. Insect pests of the rice plant – their biology and ecology. *In*: HEINRICHS, E.A. (ed.), *Biology and management of rice insects*, pp. 363–485. Wiley, New York.

DHALIWAL, G.S., PATHAK, M.D. & VEGA, C.R. 1990. Effect of a rice allelochemical on insect pests, predators and plant pathogens. *J. Insect Sci. 3*: 136–140.

FOWLER, S.V., CLARIDGE, M.F., MORGAN, J.C., PERIES, I.D.R. & NUGALIYADDE, L. 1991. Egg mortality of the brown planthopper, *Nilaparvata lugens* (Homoptera: Delphacidae) and green leafhoppers, *Nephotettix* spp. (Homoptera: Cicadellidae), on rice in Sri Lanka. *Bull. ent. Res. 81*: 161–167.

GAULD, I.D., GASTON, K.J. & JANZEN, D.H. 1992. Plant allelochemicals, tritrophic interactions and the anomalous diversity of tropical parasitoids: the "nasty" host hypothesis. *Oikos 65*: 353–357.

GOULET, H. & HUBER, J.T. 1993. *Hymenoptera of the world: An identification guide to families*. Agriculture Canada Publication 1894E, Ottawa, Canada, 668 pp.

HEONG, K.L., AQUINO, G.B. & BARRION, A.T. 1991. Arthropod community structures of rice ecosystems in the Philippines. *Bull. ent. Res. 81*: 407–416.

HIROSE, Y. 1993. Determinants of species richness and composition in egg parasitoid assemblages of Lepidoptera. *In*: HAWKINS, B.A. & SHEEHAN, W. (eds), *Parasitoid community ecology*, pp. 19–29. Oxford University Press.

JENSEN, P.B. 1996. *The influence of non-spraying on parasitoids. Pesticides Research 19*. The Danish Ministry of Energy and Environment.

KAMRAN, M.A. & RAROS, E.S. 1969. Insect parasites in the natural control of species of rice stem borers on Luzon Island, Philippines. *Ann. ent. Soc. Am. 62*: 797–801.

LEVIN, D.A. 1976. Alkaloid-bearing plants; an ecogeographical perspective. *Am. Nat. 110*: 261–284.

LOU, Y. & CHENG, J. 1996. Influence of rice varieties on development, survival and fecundity of *Anagrus nilaparvata* PANG ET WANG. *Acta ent. sin. 39*: 28–36.

MALAISE, R. 1937. A new insect-trap. *Ent. Tidskr. 58*: 148–160.

OOI, P.A.C. & SHEPARD, B.M. 1994. Predators and parasitoids of rice insect pests. *In*: HEINRICHS, E.A. (ed.), *Biology and management of rice insects*, pp. 585–612. Wiley, New York.

PRASAD, G.S.V., SASTRY, M.V.S., SRINIVASAN, T.E. & KALODE, M.B. 1987. Linkage between brown planthopper resistance and morphological characters in rice. *J. Agric. Sci. 108*: 649–654.

RUSTAMANI, M.A., KANEHISA, K. & TSUMUKI, H. 1992. Aconitic acid content of some cereals and its effect on aphids. *Appl. Entomol. Zool. 27*: 79–87.

REISSIG, W.H., HEINRICHS, E.A., LITSINGER, J.A., MOODY, K., FIEDLER, L., MEW, T.W. & BARRION, A.T. 1986. *Illustrated guide to integrated pest management in rice in tropical Asia*. International Rice Research Institute, Los Banos, Laguna, Philippines. 411 pp.

TOGASHI, I. 1990. Symphyta (Hymenoptera) lured to benzyl acetate and alphapyrene in traps. *Trans. Shikoku ent. Soc. 19*: 117–125.

TOWNES, H. 1962. Design for a Malaise trap. *Proc. ent. Soc. Wash. 64*: 253–262.

TOWNES, H. 1972. A light-weight Malaise trap. *Ent. News 83*: 239–247.

WONGSIRI, T., WONGSIRI, N., TIRAWAT, C., NAVAVICHIT, S., LEWVANICH, A. & YASUMATSU, K. 1982. Abundance of natural enemies of rice insect pests in Thailand. *Trop. Agric. Res. Ser. 14*: 131–149.

YANO, K., MIURA, T., NOHARA, K., WONGSIRI, T., RESMA, P.W. & LEE, L.H.Y. 1975. Preliminary evaluation on the use of a modified Malaise trap in paddy fields. *Mushi 48*: 125–144.

(received July 2, 1997; accepted after revision October 22, 1997)