

Thirteenth International Symposium on Scale Insect Studies: an Overview

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Abstract: A brief overview of the XIIIth International Symposium on Scale Insect Studies (ISSIS) is presented. The extraordinary diversity of scale insects and their biology is briefly summarised, followed by a short summary of previous ISSIS meetings. The wide range of papers presented at the meeting is then summarised. In honour of their contribution to scale insect studies, three tributes were read for colleagues who had died recently and three colleagues were presented with plaques.

Introduction

The scale insects (Coccoidea) are small, sap-sucking true bugs (Hemiptera), sister to the Aphidoidea in the suborder Sternorrhyncha. Their common name refers to the protective covering or 'scale' that is secreted by many species. Scale insects are more diverse in terms of evolutionary lineages (families), species richness, genetic systems, endosymbionts and morphology than any of the other sternorrhynchan groups (HODGSON, HARDY, 2013). The adult females are paedomorphic (resembling nymphs), perhaps due to neotony, mature through three or four instars, all of which are sap-sucking, and all lack wings; most can live for weeks or months. The males display complete metamorphosis (GULLAN, MARTIN, 2007), are generally dipterous (with one pair of wings, the hind wings modified as a hamulohalteres), mature through five instars, of which the last three do not feed, and adult males mostly live for no more than three or four days. Individual scale insects are small to minute, typically less than 5 mm long, and are cryptic in habit, often resembling parts of their host plant and are therefore easily transported and many pose very significant threats to agriculture, horticulture and forestry. More than

7700 species have been described (BEN-DOV *et al*, 2014) in 49 extant and extinct families.

ISSIS meetings

The holding of regular meetings of scale insect enthusiasts was first suggested by Prof. MICHAEL KOSZTARAB and the first was held in conjunction with the 1972 International Congress of Entomology in Canberra, Australia. Initially, these meetings, referred to as International Symposia on Scale Insect Studies (ISSIS), were held more or less every four years but, at the suggestion of Dr. ZVI MENDEL, this was reduced to approximately every three years from 1998 (Table 1). These meetings became independent of other International Meetings after ISSIS III and have been mainly well attended considering the specialised nature of the meetings. The popularity of these meetings is partly to 'advertise' the participants studies through the lectures and posters but the meetings also provide a forum for discussion and thus for new collaborations between researchers. This supplement (2014) represents the Proceedings of the XIIIth meeting held in Sofia, Bulgaria, organ-

Table 1. Some details of previous ISSIS meetings*

ISSIS	Time	Where	Organisers	Delegates	Papers	Posters
I	Aug. '72	Canberra	Banks, Brooks, Kosztarab	18	20	-
II	Aug. '76	Washington	Miller, Kosztarab, Davidson	30	29	-
III	Aug. '80	Kyoto, Japan	Takagi, Howell	12	5	-
IV	Aug. '83	Budapest	Kozár, Kosztarab	35	36	-
V	June '86	Portici	Viggiani, Tranfaglia	61	33	-
VI	Aug. '90	Cracow	Koteja	55	44	-
VII	June '94	Israel	Ben-Dov	60	63	67
VIII	Aug. '98	Wye, UK	Hodgson	70	59	19
IX	Sept. '01	Padua	Pellizzari	69	59	14
X	April '04	Adana	Erkeci, Kaydan	65	44	21
XI	Sept. '07	Oeiras	Branco <i>et al.</i>	93	41	50
XII	April '10	Xania	Gounari, Stathas, Milonas	75	42	52
XIII	Sept. '13	Sofia	Trencheva <i>et al.</i>	60	30	46

*With many thanks to Yair Ben-Dov for most of the above data.

ised by Dr. Katia Trencheva and Dr. Rumen Tomov of the Bulgaria University of Forestry. The current meeting was attended by 60 delegates who gave 30 lectures and presented 46 posters.

The wide breadth of scale insect studies

The lectures at this meeting were divided into six sessions covering a wide range of topics, with much overlap between subjects. Phylogeny and systematics of this superfamily included papers on the evolution of scale insects; the systematics of the mealybug genus *Peliococcus* and of the eriococcid species-group *Apiomorpha minor*; the molecular phylogeny of the soft scales (Coccidae); the paternal inheritance of mealybugs using behavioural and molecular markers; host-range evolution in scale insects; and sex, males and hermaphrodites in the monophlebid *Icerya purchasi*. There was also a phylogenetic discussion on the relationships of *Phenacoleachia*, *Steingelia*, *Pityococcus* and *Puto* (HODGSON, 2014) based on adult male morphology; the use of microsatellite markers and DNA sequences in a study of the spread of the mealybug *Pseudococcus viburni* worldwide; and on the ecology and taxonomy of the eriococcid genus *Cystococcus*. Endosymbionts were covered by papers on genome analysis of *Tremblaya princeps*, the primary endosymbiont of the rhizoicid

Xenococcus acropygae; and on the characterisation of the endosymbiotic bacteria associated with the Putoidae (GRUWELL *et al.*, 2014). Papers on dispersal and distribution included a study on the spread of the matsucoccid *Matsucoccus matsumerae* in China (LIU *et al.*, 2014); the invasive scale insects of the New World; and the scale insects of bamboo in Europe and Turkey (ÜLGENTÜRK *et al.*, 2014). The problem of cryptic species, which is likely to become increasingly important, was discussed in relation to the soft scales *Parasaissetia nigra* and *Saissetia coffeae*. Geographical distribution and fauna papers included the soft scale insects of Honduras; an updated check-list of the Rhizoecidae of Colombia (South America); distribution of rare scale insects in Poland (KALANDYK-KOŁODZIEJCZYK, SIMON, 2014); an up-dated check-list of the scale insects of Réunion Island (GERMAIN *et al.*, 2014); a checklist of the scale insects of Bulgaria (TRENCHVA, TOMOV, 2014); presence of exotic scale insects in Italy (MAZZEO *et al.*, 2014); the scale insects on fruit in Turkish markets (ÜLGENTÜRK, AYHEN, 2014); on an outbreak of the Hungarian spruce scale *Physokermes inopinatus* in Sweden (GERTSSON, ISACSSON, 2014); the biology of the diaspidid *Melanaspis deklei* in South Carolina, USA (CHONG *et al.*, 2014); the scale insects on *Pistacia* in Croatia (MILEK *et al.*, 2014); and the taxonomy and life history of the Kermesidae in Israel. Biological control was covered by stud-

ies on an entomophagous fungus attacking the soft scale *Saissetia formicarii* on tea in Assam; the effectiveness of the aphelinid parasitoid *Encarsia* in controlling diaspidid scale insects in Egypt (ABD-RABOU *et al.*, 2014); and on a classical biological control program for the control of the monophlebid *Crypticerya multicatrices* on San Andres Island, Colombia (KONDO *et al.*, 2014). Interactions with ants featured in a paper on the mutualistic interaction between honeydew producers and exotic ants in Japan, and another on the very unusual mutualism between armoured scale insects and *Melissotarsus* ants. Papers discussing behaviour included one on the mating system of mealybugs and another on the effect of mating, flight activity and sex pheromones on the longevity of adult male mealybugs. There

was also a paper on the microscopic structure of the dermal glands of the eriococcid *Eriococcus nematosphaerus*. Finally, there was a paper on the future and status of scale insect studies which discussed the balance between classical morphological studies, molecular studies and transcriptomics.

The meeting started with tributes to three significant figures who had died since the previous meeting, FERENC KOZAR (KAYDAN, PELLIZZARI, 2014); ROSA HENDERSON (HODGSON, 2014) and JACK MUNTING (BEN-DOV, GILIOME, 2014).. At the end of the meeting, tributes were also made to three workers who had made significant life-time contributions to coccidology: Dr. DANIELE MATILE (WILLIAMS, 2014), Dr. IMRE FOLDI (GULLAN, 2014) and Prof. JAN GILIOME (HODGSON, 2014).

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