

Sadao Takagi, world authority on armoured scale insects

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Introduction

Dr. Sadao Takagi was honored in absentia during the Xth ISSIS meeting held in Adana, Turkey, from April 19th–23rd, 2004. It is a great pleasure to honor him for his tremendous achievements in the field of coccidology. He was born in 1932 in Toyama Prefecture. He earned the degrees of Bachelor, Master, and Doctor of Agriculture at Hokkaido University, and then joined the faculty there. Currently he is Professor Emeritus in the Laboratory of Systematic Entomology, in Hokkaido University's Graduate School of Agriculture.

Although Dr. Takagi retired from the university at the end of March, 1996, he is still very active and publishes at a steady pace. When asked about personal information to include in this article, Dr. Takagi answered: "I retired from the university, but I have not yet retired from working on my research. It is too early to publish my biography!" (Masaaki Suwa, personal communication).

To our knowledge, from 1956 to 2007, Dr. Takagi has published 118 papers on scale insects (Table 1). Most of these are on Diaspididae and scale insect parasitoids, but many cover other scale families such as Beesoniidae, Coccidae, Conchaspidae, Eriococcidae, Ortheziidae, and Pseudococcidae (Table 2). His taxonomic works on the gall-inducing beesoniids and the conchaspids (false armored scale insects) qualifies Dr. Takagi as an authority of these two groups as well.

Table 1. Number of scale insect related papers by S. Takagi from 1956 to 2007

Date	Papers/Year	Pages/Year	Species/Year
1956–1965	2.4	19.0	3.4
1966–1975	1.9	46.5	10.5
1976–1985	2.1	31.1	2.3
1986–1995	2.5	71.6	2.9
1996–2005	2.5	66.6	5.5
2006–2007	2.0	34.5	2.5

For the Diaspididae, Dr. Takagi's careful work has greatly expanded and clarified our understanding of relationships within the family. Beginning in 1967, he showed how taxonomy in some important armored scale genera was confounded by what we would now call polyphenism -- the occurrence of very different morphological phenotypes depending upon whether an individual develops on bark or on a leaf (Takagi & Kawai,

1967; Takagi, 1983; Takagi, 1990). In 1969, he proposed a new tribal-level classification of the Diaspididae, backed up by discussion of the characters of immature forms (Takagi, 1969). His classification became highly influential (Rosen, 1990; Ben-Dov & German, 2003). In recent decades Dr. Takagi has described more new genera and species of diaspidids than anyone else. In his descriptive work he has focused on poorly understood and biogeographically important regions, especially in the Himalayas and Southeast Asia, and on problematic and evolutionarily significant taxa. His descriptive papers include beautiful, minutely detailed drawings of every life stage, and deep discussion of the implications of the new taxon for our understanding of the evolution of Diaspididae. Therefore the numbers alone (Table 1), impressive though they are, do not do justice to the importance of Dr. Takagi's descriptive work.

Table 2. Number of Genera and Species currently described by S. Takagi (1956–2007)

Family	No. of genera	No. of species
Beesoniidae	3	7
Coccidae	0	1
Conchaspidae	0	2
Diaspididae	61	233
Eriococcidae	1	3
Ortheziidae	0	1
Pseudococcidae	0	4
Total	65	251

In 2002, he published a new classification of Diaspididae (Takagi, 2002). By this time, his deep understanding of character evolution allowed him to recognize one of his 1969 tribes as artificial (Rugaspidiotini, based on Balachowsky's Rugaspidiotina). In part due to his own discoveries in the Asian fauna, he also had come to recognize new tribes (Smilacicolini, Thysanaspidiini) and even a new subfamily (Ulucoccinae).

It is a pleasure to read Dr. Takagi's papers, in part because of his perfect mastery of the English language. This skill far from universal among scientists whose first language is Japanese. Dr. Takagi's facility for languages is legendary: according to one story, when he was a student he handed in a report written in Esperanto, much to his teacher's consternation.

Dr. Takagi's love of nature began in childhood and extends well beyond scale insects. His native Toyama Prefecture is renowned for its natural beauty, surrounded by the Japan Sea and by green mountains such as the Tateyama range. Toyama is home to the Tateyama cedar, the Japanese antelope and the rock ptarmigan. Growing up in such a rich environment, Dr. Takagi was always fascinated by nature and especially loved beetles, butterflies and the many other insects he saw around him. Though he wisely chose scale insects for his studies, he has never really given up his passion for "normal" insects. As evidence of this, we can point to his wonderful taxonomic work on long-legged flies (Dolichopodidae) of Taiwan (Takagi, 1967). Dr. Takagi is said to have a passion for ornamental plants, and in particular has been an avid collector of German Iris bulbs. On one occasion, when the Annual Meeting of the Entomological Society of Japan was held near Tokyo, Dr. Takagi bought a rare orchid, *Calypso bulbosa* (an orchid found in the subalpine regions of Japan) in a department store in Tokyo, and the first author clearly remembers how Dr. Takagi carefully held the small pot containing this orchid.

Dr. Takagi takes what he calls a classical approach to taxonomy (Takagi, 1978), and has principled objections to the quantitative phylogenetic methods that are now widely used (Takagi, 2002). Although Dr. Takagi does not support quantitative phylogenetic methods, quantitative methods do support Dr. Takagi. The first molecular-phylogenetic study of Diaspididae (Morse & Normark 2006), employing parsimony and Bayesian analytical methods, corroborated Dr. Takagi's classification and his evolutionary hypotheses to a remarkable degree. The best-supported internal branch in Morse & Normark's (2006) tree neatly separates Dr. Takagi's (2002) two major subfamilies, Diaspidinae and Aspidiotinae, from each other. (This result was also anticipated by Danzig [1993], who was honored at the previous ISSIS meeting, Padua, 2001.) A number of novel suggestions by Dr. Takagi were also borne out by the molecular results, including the placement of *Howardia* in the Lepidosaphedini, and the close relationship of *Pseudaulacaspis* to *Fiorinia*. Dr. Takagi's classification and his insights into diaspidid evolution will form the basis for armoured scale insect systematics for decades to come. But as Dr. Takagi says, he has not retired from his research. His papers continue to appear at a prodigious rate, and we look forward to many more of them in the future. We apologize to Dr. Takagi for our impatience in honoring him so early in his career!

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