Contributions of Dr. Swaraj Ghai to the field of Entomology

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Many Indian scientists, from time immemorial, have made significant contributions for the society. Dr. Swaraj Ghai, an asset of the ICAR-Indian Agricultural Research Institute (ICAR-IARI), Pusa Campus, New Delhi is one of our country's treasured scientists. As a renowned scientist and insect taxonomist, Dr. Ghai, is known for her indisputable contributions to the field of entomology and has paved the path for many aspiring taxonomists. Her passion to the profession of Entomology runs deep throughout her life.

Early life of Dr. Ghai

Dr. Ghai was born on 15th August in the year 1932. Following India's partition, she and her sister chose to settle in India. They arrived in India as refugees from Pakistan. Despite the insecurities as a young immigrant girl, she believed in hard work and carried herself with confidence. She earned a bachelor's degree in Zoology and later developed an unending passion towards entomology and had post graduated with a specialization in entomology from the reputed Delhi University. She obtained her doctorate in 1965 from ICAR-IARI, New Delhi for Taxonomic studies on mites belonging to Phytoseiidae and Aceosejidae under the guidance of the legendary Dr. M.G. Ramdas Menon.

Her professional career

Dr. Ghai was notably a scientist with unique areas of research interest in different aspects of Entomology. She started to rise in her professional path and had worked initially on the aspects of insect physiology with renowned insect physiologist, Dr. N.C. Pant. Later, her curiosity and interest took a turn towards the aspects of taxonomy of mites, beetles and weevils. She worked along with one the pioneer of mite taxonomist in India, Dr. M.G. Ramdas Menon and gained expertise in it. Apart from her great research contributions, she was engaged in teaching challenging topics like Biosystematics and Acarology and was one of the finest teachers of those times. As a mentor, DR. Ghai had paved the path of many students by giving challenging aspects of research and bringing the best out of her students. She was the chief advisor to 14 students of which 5 had obtained master's degree and 9 have obtained their doctorate under her light of knowledge relating to the taxonomy of mites and Coleoptera. All of the students have attained great positions in their professional career and many of them marked Dr. Ghai as an inspiration and became eminent taxonomists of our nation and one of them is Dr. V.V. Ramamurthy, a taxonomist of international repute, presently Chief Editor of Entomological Society of India. With her excellence in research and mentorship, she was promoted to principal scientist at IARI. She rose to become the longest serving professor of the division of Entomology in 1983 and served as the most hardworking professor for a decade from 7-12-1983 to 31-10-1993. Later, she became the head of the division in 1993 and served for a year. She finally got retired on 14th August 1994.

Overview of research accomplishments

Dr. Ghai grew up to be an expert in taxonomy even though she had worked initially on insect physiology. She had given 39 research contributions of which 18 are related to mite taxonomy, 12 regarding the Coleopteran taxonomy, 4 relating to insect physiology and the rest 5 include research contributions on other group of insects such as Lepidoptera and Hemiptera. A comprehensive analysis of research contributions have been provided (Fig. 1, 2 and 3).

Major research accomplishments

National Pusa Collection (NPC) is one of the Asia's

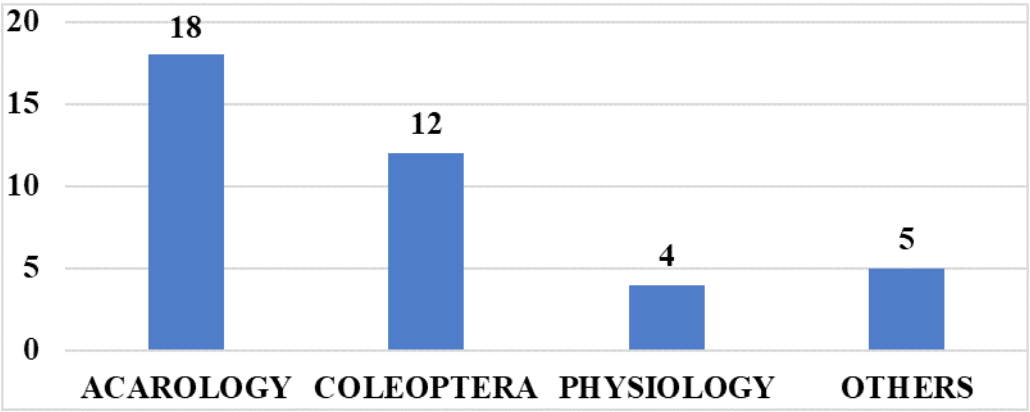

Fig. 1. Research contributions pertaining to different fields of entomology

largest insect repositories held as an integral part of the division of entomology (ICAR-IARI). As a national service for pest diagnostics, every year, on an average over 2000 specimens are identified by the NPC taxonomists. Over the last 50 years, NPC has contributed to the discovery and description of more than 1500 arthropod species which were new to science. Several taxonomic treatises on agriculturally important insects belonging to orders Lepidoptera, Coleoptera, Hemiptera, Orthoptera and Hymenoptera and class Acarina have been published. The incomparable efforts of Dr. Ghai had led to identification of 30 species of mites and 31 species of Coleopteran insects which were new to science and contributed to a substantial proportion of specimens at NPC which serve as an authentic reference for the identification of phytophagous mites, weevils and beetles of economic importance.

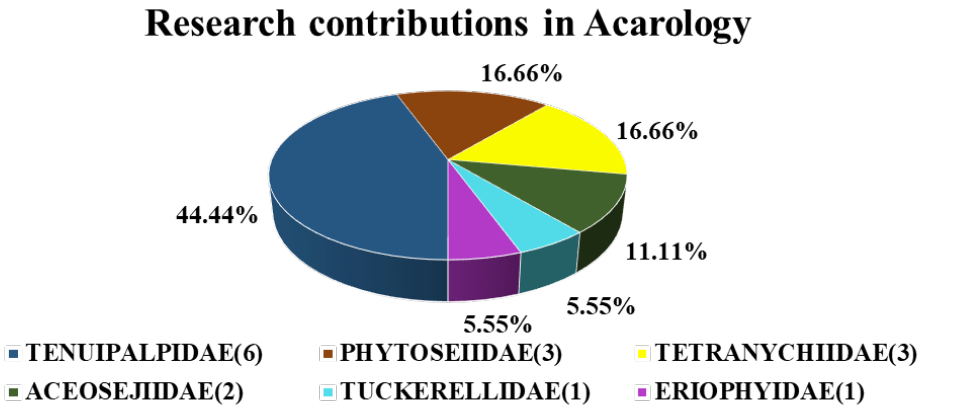

Fig. 2. Taxonomic studies on different families of mites

Vitamins of B-complex are very essential for the proper growth and reproduction of insects. The requirement of these vitamins like Nicotinic acid, Pantothenic acid and Choline chloride was studied by Dr. Ghai along with Dr. Pant. The quantitative requirement was assessed by rearing the larvae of *Trogoderma granarium* on a diet supplied with increasing concentrations of the vitamins to record the optimum concentration at which the maximum growth of the larvae is seen. Beyond a certain point of concentration, increasing the concentration will bring no change in the growth of the insect and this is said to be the optimum concentration where maximum growth of the larvae is obtained. Likewise, for all the three vitamins the quantitative requirement was analyzed which is still a very important study for diet-based rearing of the insects for any scientific research (Pant and Ghai, 1959).

Dr. Ghai recorded the distribution of brown wheat mite, *Petrobia latens* on wheat in India. It is a vector of barley yellow streak mosaic virus and causing nearly 30% of economic losses even in the current scenario. During her course of collections and thorough surveying, she had recorded these mites on wheat crop in Agronomy and

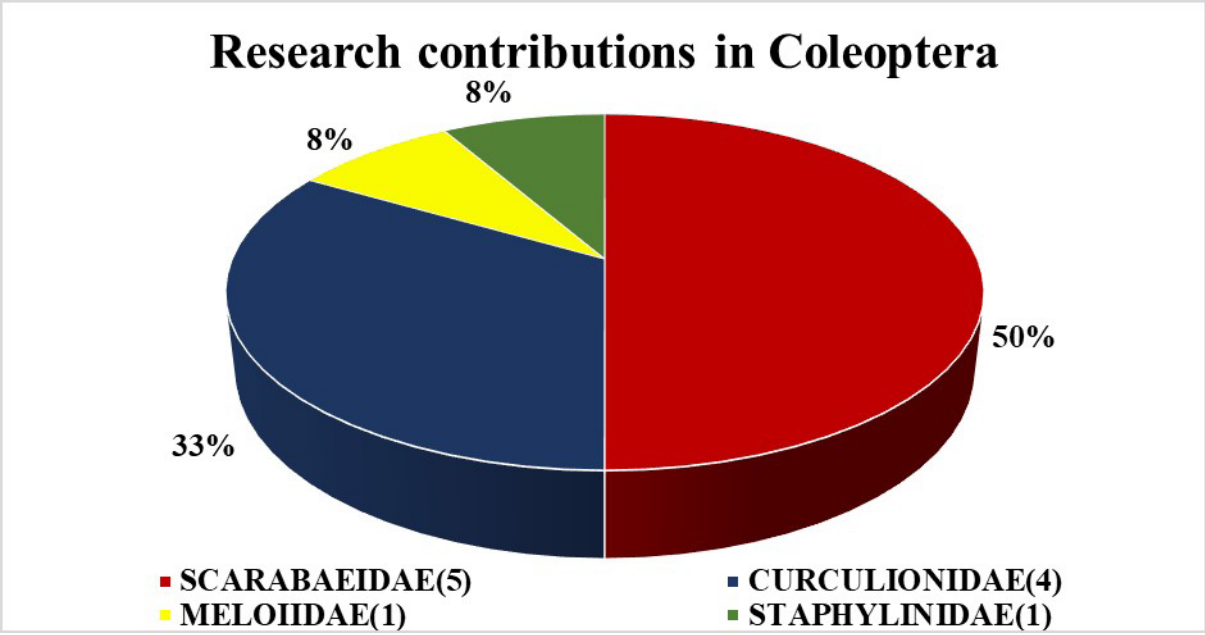

Fig. 3. Taxonomic studies on different families of Coleoptera

Botany fields of IARI. She had even got the specimens of this mite from nearby villages of Delhi, Haryana and Punjab for identification as they were new record from India as a pest of wheat. She has also studied the distribution of this mite in different parts of India thereby stating it as a worldwide pest. Surprisingly, she observed a predatory mite *Lasioseius terrestris* feeding on *Petrobia latens* which was a new record and gave a detailed taxonomic description of it (Ramdas Menon and Ghai, 1968).

Mango malformation was a very serious problem for mango growers of India and caused huge economic losses thereby attaining the status of national problem accounting for about 50 to 60% economic losses every year and in severe cases it may go up to 100 %. Mango malformation is a complex phenomenon which is caused by fungi *Fusarium moniliformae var subglutinans,* Eriophyid mite and physiological disorder of the plant. But, the exact biological entity which was causing the malformation in mango trees was not known at that time. Pioneers have recorded this malformation but never attempted to study the Eriophyid mite in detail. Dr. Ghai made the first successful appropriate description of the mite which is still being used for identification. The correct identification and record of the bud mite, *Aceria mangiferae* Sayed from mango orchards of ICAR-IARI is of profound importance. Along with the bud mite, they have identified 3 new predatory species of mites on the mango shoots that were new to science *viz., Typhlodromus roshanlali* Narayanan and Ghai, *Typhlodromus rhenanus* Narayanan and Ghai, *Typhlodromus nesbetti* Narayanan and Ghai. Dr. Ghai was a lady with golden heart who recognized the efforts of the person therefore *Typhlodromus roshanlali* Narayanan and Ghai was named in the honor of Roshanlal who helped them in procuring all the malformed shoots from mango orchards of IARI (Narayanan and Ghai, 1961).

Phytoseiidae is a prominent family of predatory mites and is known to be predacious on many phytophagous mites and form a quite good proportion of biotic community in the ecosystem. Knowledge pertaining to the predatory mites was not adequately established in those times and Dr. Ghai had comprehensively studied taxonomy of Indian Phytoseiidae which was an unexplored area of research in science. During the course of study, she had extensively collected mites from different parts of India like Bangalore, Delhi, Coimbatore and Bombay accounting for 16 species of mites belonging to the genus *Amblyseius* of which 7 species are new to science including *A. bambusae* Ghai and Menon, *A. coccosocius* Ghai and Menon, *A. eucalypti* Ghai and Menon, *A. ipomoeae* Ghai and Menon, *A. lablabi* Ghai and Menon, *A. mangiferae* Ghai and Menon and *A. sacchari* Ghai and Menon. 4 species are new records to India *viz., A. finlandicus* (Oudemans), *A. fraterculus* Berlese, *A. havu* Pritchard & Baker, *A. hibisci* (Chant) and 5 species were already

recorded from India. An elaborate key has been provided for all the species (Ghai and Menon, 1967).

The book "Insect Physiology and Anatomy" by Dr. N. C. Pant and Dr. Ghai was published in 1973. This is the most important contribution which stood as a milestone in her career. This book revolves around the physiological and anatomical aspects of insects and gives a very comprehensive and detailed information which is divided into 34 contents of which 6 were contributed by her including the insect integument and moulting, respiratory system, excretory system, circulatory system, male and female reproductive system and the histological techniques (Pant and Ghai, 1973).

As a result of survey of rice ecosystems in India for the lepidopterous pests, Dr. Ghai had described 85 species belonging to 11 different families of Lepidoptera of which the most dominating were the pyralids. Apart from their main host being rice, their alternate hosts were mentioned and provided morphological illustrations for identification (Ghai, 1979).

Holotrichia, the most commonly occurring genus was not adequately quantified with its status. The status of the genus was recorded and stated that it contained 66 species. *Holotrichia serrata* (Fabricius) and *H. consanguinea* Blanchard although being the most destructive and wide spread species of this genus were poorly described till then. Dr. Ghai provided fine descriptions along with illustrations of morphological characters including its elytral vestiture. Taxonomic descriptions of 5 species which were new to science were provided by her *viz*., *H. nagpurensis, H. akolana, H. longilamellata, H. undulata, H. setosifrons* and *H. serricollis* was a species that was new to record from India and it was detailed with all the taxonomic characters (Khan and Ghai, 1982).

Another major research contribution was review of the world fauna of Tenuipalpidae which includes the false spider mites. She has reviewed 562 species of 22 genera in a detailed way providing key to the world genera and throwing light on its distribution across different parts of the world and host preferences (Ghai and Shenhmar, 1984).

Myllocerus (Curculionidae: Coleoptera) is an economically important genus having wide distribution in Tropical regions and form a substantial part of pest complex in crops. Dr. Ghai along with Dr. V.V. Ramamurthy had reviewed the entire genus in the world in an exhaustive manner by acquiring specimens through field surveys and different renowned insect museums like British Museum, Copenhagen Museum, National Pusa Collection, etc. and compiled an annotated checklist of 336 species from world. 73 species were studied of which 15 species were identified new to science and provided with appropriate taxonomic descriptions. A profound key to 89 species was prepared and 58 already known species were supplemented with elytral vestiture characters. Genital structures of 43 male and 37 female insects were detailed (Ramamurthy and Ghai, 1988).

The conclusion we could draw through the contributions of Dr. Swaraj Ghai is that her pioneering research in taxonomy may not be recognised in the form of awards but the dedication she had towards research in the field of taxonomy is what that had made her an eminent taxonomist. Her impactful and worthful contributions will always cherish till the science of Entomology and Acarology exists. She is a lady of inspiration to all the younger generations and a candle light to all her students paving way through her wisdom.

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