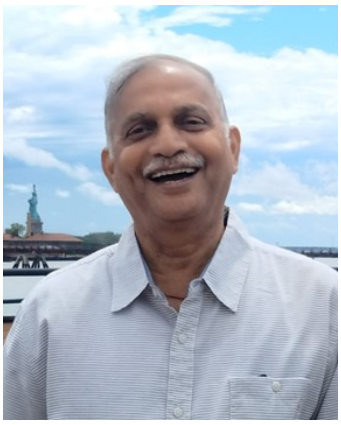
FROM CURIOSITY TO INVENTION: INSIGHTS FROM DR. S MOHAN

DR. S MOHAN, POPULARLY CALLED AS 'TRAP MOHAN', IS A WELL KNOWN PRACTICAL ENTOMOLOGIST IN THE FIELD OF STORED PEST MANAGEMENT IN INDIA.



Dr. Sarma Mohan (popularly known as 'Trap Mohan') is well-known figure among all the Indian entomologists and is a regular addition in the syllabus of any student preparing for the competitive exams. Because of his invention of the "probe trap," a novel and still-in-use trapping mechanism for managing stored grain insects at home and farm levels, our generation mostly knows him as *Trap Mohan*. I got the opportunity to interview him for the 'Indian Entomologist' magazine, I felt I was fortunate as I am also working in the field of post-harvest and storage entomology. To begin with his introduction, Dr. S. Mohan (SM), born in 1958. He earned his bachelor's, master's, and doctorate (in-service) degrees from Tamil Nadu Agriculture University (TNAU) in 1980, 1982, and 1993, respectively. He started his scientific career as Assistant professor in 1983, promoted to Associate professor (1997) and Professor (2000) at TNAU exclusively until retiring in 2018. He held a number of positions throughout his career, including Chairman of the Committee to Revamp and Revitalize the Agricultural School Education in Tamil Nadu, Dean of the School of Post Graduate Studies—In charge), Special Officer (Publications and Public Relations), and many more. He taught agricultural entomology to many students, organized various trainings, served in research, extension and education positions. His "TNAU-Stored Grains Insect Pest Management Kit," which featured all his devices, was a success in the 1990s. He published over 60 research publications in peer reviewed national and international journals and most of them are on non-chemical pest management. Dr. SM is a research-extension oriented scientist; he organized several training courses, published numerous popular articles and training manuals, and was awarded with a prestigious Swami Sahajanand Saraswati Outstanding Extension Scientist Award (2010), by ICAR. He has received numerous such honors, including the TNAU Best Researcher Award (2005), the NRDC, GoI's Technology Day Invention Award (2002), the TN government's Award for Stored Grain Insect Trap (1993), and others. In 1994, the Government of TN named the 'Probe Trap' developed by him as 'Mohan Trap' which is a matter of great honour. He is instrumental in successful establishment of five startups through licensing of his technologies and details of it is available at https://www.mohantrap.com/. Even after his retirement, Dr. SM is actively involved in popularizing the non-chemical stored product insect management technologies.

Dr. Guru P. N. (GPN): Sir, on behalf of Indian Entomologist Magazine, I thank you for accepting our invitation to share your experience with the magazine. Can you please tell us how you entered the field of Entomology?

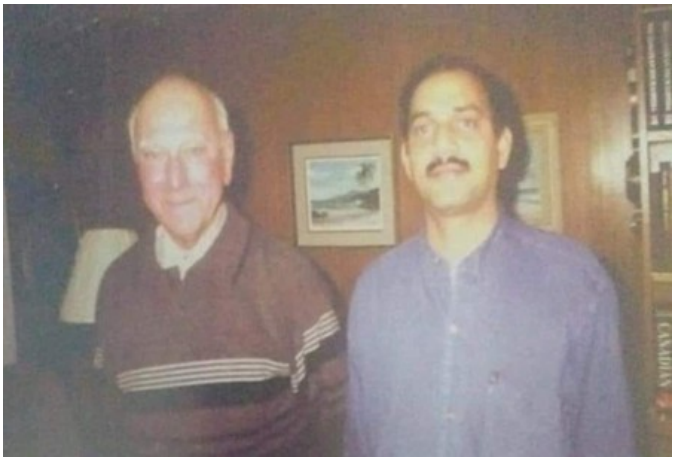
Dr. S. Mohan (SM): When I joined the undergraduate program in Agriculture in 1976, I was a 'memorising machine' - reproducing anything by heart as such even the comma (,) or any other symbols. It was an era of multiple-choice tests in agricultural curriculum, and I enjoyed it with my memorising skill. During this course of study, my entomology teacher used to bring one wall chart board with full of insects' scientific names which were like sweets for me to byheart and reproduce and get full marks. A turning point happened in 1979 when I was studying 'Pests of crops' course, where I could get only 17/20 marks. Something went wrong in my memorising machine, my system. Majority in my class got more marks than me, I was so upset and returned to the hostel and took my UG diary and wrote 'I was born for Entomology, live for entomology and I will die for Entomology'. Still, I remember this event of 1979 even today, which was my 3rd year graduation. In actuality, this marks the start of my path towards the study of "entomology." When we discover our skills, it awakens our inner selves and serves as a reminder of why we were born; in my case, to become *entomologist*.

GPN: How come an 'Extension Entomologist' turned into an 'Engineering Entomologist' in TNAU?

SM: 'A miracle…'. My research career in Tamil Nadu Agriculture University (TNAU) started in 1983 and I was posted in 'National Demonstration Scheme' of Indian Council of Agricultural Research (ICAR), wherein popularization and demonstration of proven entomological technologies to farmers was the main role. Writing popular articles was one of the components in transfer of technology. As I got good memorising skill, it helped me in writing many popular articles. Interestingly, the first article in my service was on '*Storage technologies for Paddy'*. I was unknown at that time in 1983, when I wrote this popular article on grain storage that this would be my research destination. I called it as my research destination (my home coming) i.e., 'Stored product insect management'. Research is a continuous journey where the path matters more than the destination and, on this journey, the right place of posting also matters a lot. I was transferred in 1986 to Post-Harvest Technology (PHT) Scheme of ICAR in the Agricultural Engineering College (AEC) of TNAU, Coimbatore. Spending 6 to 7 years in the PHT Scheme, ICAR in AEC, TNAU turned me in to an *'Engineering entomologist'*, and the place where all innovations of my carrier happened and are continuing even after retirement. I continued popularising all my technologies with the support of social media and my friends.

GPN: Sir, we all know you as 'Trap Mohan', please tell us the story behind it?

SM: It is a beautiful story. After my transfer to PHT scheme of ICAR, TNAU, unlike the present times, back then, we did not have a large-scale resource base as well as access to universal knowledge and information through the Internet etc. TNAU library was the only source of knowledge nd only hard copies of journals were available.



Dr. S. Mohan along with Dr. S.R. Loschiavo in Canada.

I was fortunate togo through the special issues of *Canadian Entomologist* Journal on topics like detection of stored grain insects written by eminent scientists across the world. One research paper I came across was 'Loschiavo S.R, Atkinson J.M 1967. A trap for detection and recovery of insect in stored grain, *Canadian Entomologist,* 99 (11): 1160 -1163'. I was impressed by the research paper and decided to adopt a similar approach for India, so that one day the subject of stored grain insect monitoring and management would be understood throughout the nation. It is a non-chemical method, which turned out to be my area of research. After reading this paper, the first device I developed was 'Probe Trap', a modified version and a suitable form for our country. This is a small gadget to remove insects from the grains for household users. It was merely ₹5 at the time, and TNAU introduced this technology in 1993. It was a fantastic event (I was not present because I was celebrating a festival in my hometown), and to my complete surprise, my guide sent me a telegram informing me that my first device had won ₹5000 and that it was proudly christened "Mohan Trap" and had been granted a government order. This was a great feel of happiness in my research career. It was very popular in my province as well as many parts of India as 'Mohan trap'. Although it was developed in 1993, it was first commercialised in 2000 and made available to various states within country and countries like France, Africa, Thailand and others. Later, many entrepreneurs taken license and started manufacturing and marketing of the device. Most of the people in India especially academicians including students remembered this 'Probe Trap' as 'Mohan trap'. It was an historical event where a technology named after a scientist, and this was a great gesture of government.

GPN: Can you please tell us about other technologies developed by you and your patents?

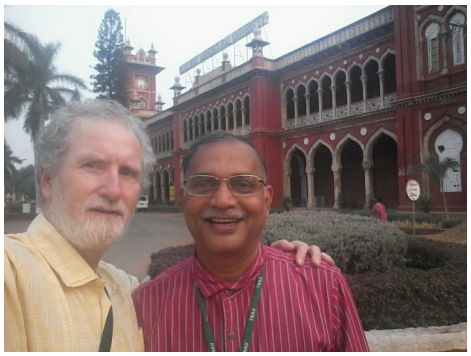
SM: Prior to discussing technologies, I would like to point out that in 2005, I was assigned to complete a six-month training program at McGill University in Quebec, Canada, as part of the TNAU-McGill Canadian International Development Agency Project on Food Security in South India. There, I received assistance from professors Dr. Venkatesh Sosle and Dr. G.S. Vijaya Raghavan in order to fulfil my goal of distributing the TNAU gadgets developed by me to students around my nation. They helped me fund my idea on developing a "Tool kit" for teaching and training. Thus, all my technologies came to one place, like probe trap, pit fall trap, two-in-one model trap, indicator device, automatic insect removal bin, and UV light trap, and my two patented technologies. The TNAU Kit was launched by Tamil Nadu Agricultural University, Coimbatore on September 15, 2005. Detailing of all these technologies are available at a fingertip on internet.

Secondly, people often asked me if I had patents for my inventions. Until then, I had never given it much thought, as there was little awareness about the importance of patenting. Later, in 2002, the Indian government decided that in order to apply for any invention award for a product / process, patenting is necessary. I got my first patent granted in 2006, and the path guided me towards patented innovation was credited to Dr. Paul Fields, Scientist, CRC, Canada. In 2000, I was deputed to Cereal Research Centre (CRC), Agriculture and Agri. Food Canada, Winnipeg, Manitoba under AHRDP (Agricultural Human Resource Development Programme) scheme of World Bank for training in the area of my specialization in stored product insect monitoring under the mentorship of Dr. Paul Fields. Initially he listened to me and understood my fervent desire and accommodated me to CRC library in 2000 Feb-March gave me an important research paper

(Quentin, M.E, J.L. Spencer and J.R. Miller. 1991. Bean tumbling as a control measure for the common bean weevil, *Acanthoscelides obtectus* (Say). *Entomologia Experimentalis et Applicata.* 60: 105 - 109). This paper was a precursor for my dream turning true. I got my two technologies patented *viz*., A Device to Remove Insect Eggs from Stored Pulse Seeds (IP No. 198434) and a device to monitor insects in bag stacks in warehouse without bait (IP No. 284727).

GPN: Can you please elaborate on the challenges you faced during your career and how you overcome from them?

SM: My journey has often felt like a hurdle race. At every step, I encountered obstacles, and each time I crossed one, I needed to regain stability to prepare for the next. Despite these challenges, my success in this field has helped raise awareness at various levels about the importance of this science. People slowly started discussing green technologies and non-chemical strategies, particularly for stored grain protection. Consumers are gradually accepting these methods, though it took time for my technologies to gain widespread recognition. The driving force behind my journey was motivation, as I firmly believe motivation propels a nation forward, while demotivation hinders its progress. I am deeply grateful to everyone who motivated me, directly or indirectly, as their support laid the foundation for my strong research career. During that time, the focus in pest management was primarily on Integrated Pest Management (IPM) for crops like cotton, sugarcane, vegetables, paddy, and other staples. Many of my peers and fellow researchers mocked me, asking, "Why are you working on such 'useless' technologies?" Yet, I remained determined. In the end, it was my determination, patience, perseverance, and persistence that led to my success. These qualities can help anyone overcome hurdles, just as they helped me.



Dr. S. Mohan with Dr. Paul Fields at TNAU.

GPN: Sir, Storage Entomology in India is very staggered and not collective, additionally I wish to mention that there are very few storage entomologists are there in India. Would you like to say something to them?

SM: Supply Chain Management (SCM) is an important topic everywhere, where we can manage and process the commodities in a scientific way, deliver the processed commodities in a safer way, but notorious insects thrive through SCM.

Dr. S. Mohan with students in 2010 (left) and 2024 (right).

These cannot be managed easily by common methods including chemical methods specially fumigation (most used). However, usage of chemicals also creates lot of problems, especially resistance development. In a country like India, we need sustainable and simpler technologies, which should be non-chemical, work as substitute/ alternative to chemical methods and compatibly integrate with the available management systems. Thus, role of an entomologist is crucial. As I can say, every university has post-harvest and processing division, and in all Indian institutions under ICAR, these divisions are common. I wanted to highlight that every unit of these schemes should have at least an entomologist who can work on post -harvest and storage entomology. At TNAU, I spent six years working in the post-harvest technology scheme, where a position was dedicated to stored product entomology. Unfortunately, that position was later dissolved. Interestingly, if you search online for "non-chemical methods for stored grain insect management," India prominently appears on the first page, with mentions of TNAU, ICAR, and PHT. This reflects the significant work done in the past and highlights the ongoing need for dedicated efforts, particularly by entomologists specializing in processed and stored grain commodities. Today, there is growing interest in organic farming, but the focus shouldn't end with cultivation. It is equally important to store organically produced commodities using non-chemical methods. This underscores the need for the development of tailored technologies, led by entomologists. Collaborative efforts with multidisciplinary teams, particularly involving engineers, are essential to drive a greater revolution in this field. I hope SAUs and ICAR will consider the insights of me and prioritize the development of skilled manpower in this field in India. Storage entomologists are required at many places like quarantine centers, storage agencies, processor level hubs, as many commodities are in import and export. In my case, the journey was tough however youngsters. Although the path was difficult for me, young people in this sector can interact across universities, work with less ego, and foster greater collaboration to accomplish the research goals. Senior brains should train their next lines (the second or third line) since the "journey" is always more significant than merit, status, or achievement. Since you (Dr. GPN) are one of the few persons working in this sector, I bless you. Try to take the initiative to follow the working team's recommendations and receive blessings from seniors.

GPN: Sir, along with training to farmers, you focussed mainly on guiding school and college students, can you mention how it is benefitted the students?

SM: There's a saying from Mahatma Gandhiji, "*If we are to teach real peace in this world, we shall have to begin with the children".* For me, realising this dream of the father of our nation adds a lot of meaning to my life. I went beyond the realm of college students and my outreach finally encompassed school children too. It was a very gratifying experience for me. Besides being useful to the farmers, households and warehouse managers, my TNAU insect trap technologies paved way for kindling scientific temper in school children. For example, a 7^{th} standard student won 2 Gold Medals in the INTEL- IRIS competition and a WIPO Award for young inventor by making TNAU traps using waste materials (Mineral Water Plastic bottles); A student group won a Medal at 10^{th} National Children's Science Congress – 2002, and many like this. The Tamil Nadu government, impressed by the creative talent of the school students and appointed me as the Chairman of the Committee to 'Revamp and Revitalize the

Agricultural School Education in Tamil Nadu' during 2010. The new 11th standard Agricultural Practices-I book has a chapter on the 'Importance of Post-Harvest Technology' in which the TNAU probe trap is highlighted. As the Chairman, I contributed for the significant reforms in Agricultural education in Tamil Nadu schools. The old curriculum structure followed in Tamil Nadu for the past 20 years was revamped in 2010-11 with the introduction of common textbooks, *Agricultural Practices-I* and *Agricultural Practices-II*, for 11th and 12th standard students. This updated curriculum remains in use to this day. Even now, I love teaching and motivating young minds to focus on science for novel inventions and innovations. I fervently hope and believe that my journey to kindle scientific temper among school children will continue ceaselessly.

GPN: What are your suggestions for young students/ researchers for their career in Entomology, especially Stored Product Entomology?

SM: Crucially, in contrast to my time, things have altered since then. Simply said, it is difficult to find employment in the university system as a lone researcher, and it is nearly impossible to work in the same field of study for ten years in a row. My recommendation in this dire circumstance is to, if at all feasible, continue with the research-focused degree program. If we get a research position in any field, then work on that field thoroughly and acquiring knowledge has become easy through internet so explore as much as we can. Try to create some fundamental technologies with real-world applications at the same time. If you are more passionate about the topic, I have no doubt that miracles will occur, just as they did for me. As a theist, I believe that both God and necessity are the sources of invention and innovation. Thus, continue your studies with a clear goal in mind, and you will eventually realize your dreams.

(From left to right) Sh. Sundaram, Dr. S. Mohan, Dr. Guru P. N., Sh. Balaji.

Dr. S. Mohan and Dr. Guru P. N. during a discussion on the UV light trap technology.

Dr. Guru, P. N. is a scientist (Agricultural Entomology) working at ICAR-CIPHET located at Ludhiana, Punjab. He is specialized in storage entomology with focus on developing practical and non-chemical strategies for monitoring and management of insect-pests infesting commodity in storage.

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