



INDIAN NATIONAL SCIENCE ACADEMY
हिरण्मयेन पात्रेण सत्यस्यापिहितं मुखम्

TOPPUR SEETHAPATHY SADASIVAN

(1913-2001)

Elected Fellow 1955

FAMILY BACKGROUND AND EDUCATION

PROFESSOR TOPPUR SEETHAPATHY Sadasivan was born on 22nd May 1913 in Saidapet, Madras (now Chennai) as the third child of Dr Seethapathi, an illustrious medical practioner and Smt Kanakammal. Dr Seethapathi built a new house at Munda Kanni Amman Koil Street, Mylapore in 1918 and named it 'Gokulam' where Professor Sadasivan lived till his last days. He passed away on 18th August 2001 leaving behind his wife (who died in January 2002) and three daughters. Professor Sadasivan had his schooling at the PS High School, Mylapore and graduated from the Presidency College in 1934 with Botany as the major subject under the tutelage of Prof Fyson, a great Botanist. He went to Lucknow to do his Masters degree and became the favourite student of Professor Birbal Sahni, FRS.

PROFESSIONAL CAREER

Professor Sadasivan started his research under the guidance of Professor SN Das Gupta at Lucknow University but went to the University of London to do his PhD under Professor FC Bauwden and Professor SD Garret at the Rothamstead Experimental Station, Harpendan on plant virology and soil microbiology. He returned to India after obtaining his PhD 1940, was at Lucknow University and joined the Punjab Agricultural College, Lyallpur (now in Pakistan) as microbiologist in the Fruits Section in 1941. He joined the University Botany Laboratory succeeding Professor MOP Iyengar, first as Reader and became the Director in 1944. The University of London conferred on him the DSc degree in 1955 in recognition of his Contributions to Science.

SCIENTIFIC CONTRIBUTIONS

The research work carried out in Mycology and Plant Pathology under his leadership earned international reputation to the department and in 1964 the University Grants Commission elevated the status of the department to the Centre for Advanced Studies. His pioneering work in Plant Pathology made him one of the leading scientists amongst contemporary plant pathologists in the world. His patronage to Algology, the specialization of his predecessor continued during his leadership. He remained as the Director of the Centre till his retirement in 1973. He continued as Emeritus Professor of the Centre till his last days.

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Professor Sadasivan chose three long-range problems for in depth studies in Physiological Plant Pathology namely pathological wilts, rhizosphere and root diseases and the rice blast disease. Research work carried out for three decades by Professor Sadasivan and his students are given below in detail. *Fusarium vasinfectum,* a soil inhabitant in the wilt-prone black cotton soils causes the cotton wilt and this was chosen as model system for their investigations. The fungus required metals, pectin and nitrogen for the induction of the toxin. During pathogenesis there was a decline in non-protein nitrogen in both the host and pathogen. In the resistant varieties of cotton the organic nitrogen was in the form of proteins, this was the general pattern associated with the resistance. The shoots of the susceptible variety supported the toxin development by making available larger quantities of nitrogen as non-protein nitrogen. The symptoms of wilt diseases were vein clearing, yellowing and dechlorophyllation of leaves and is the aftermath of occlusion of vessels of the *in vivo* growth of the pathogen. This resulted not only in physical blockade but also release of products of fungal metabolism. Amendment of zinc to the soil controlled cotton wilt and in infected plants there is retardation in the rate of depletion of non-protein nitrogen. Zinc treatment also brought about decrease in the quantity of free amino acids in healthy susceptible plants. The α amino acid constitutions of the susceptible variety when grown in zinc amended soil showed cystine usually which is absent, is formed. This is considered to be of significance since it was shown that it could antidote the toxic effects of culture filtrates of the pathogen.

Resistance of tetraploids to wilt is hence attributed to detoxification of toxins by cystine. The diploid Asiatic cottons are known to be deficient in zinc compared to the new world tetraploids. The tetraploids have higher content of ascorbic acid, reducing sugar and total carbohydrates, than the diploids. Pectin content of the susceptible diploid cotton roots is considerably higher than the tetraploid. Zinc has also a marked inhibitory action on pectin methyl esterase enzyme of the pathogen *in vitro.* It was also demonstrated that zinc content of wilt sick soils is lower than that of the soils from the cotton belt. The toxin production by *Fusarium vasinfectum* is controlled by zinc, in which the fungus does not produce fusaric acid and in higher concentrations of zinc the production of fusaric acid is inhibited. It is considered that the zinc factor is important not only for production of toxin *in vivo* but also in soil *in situ.*

Studies were also made to understand the essentiality of zinc for the production of the enzyme pectin methylesterase *in vitro* and polygalcturanase. Besides, an optimal amount of zinc was necessary for the maximum production of fusaric acid. Comparative studies on pectinolytic enzyme activities in tissue homogenates of cotton by *F vasinfectum,* pigeonpea by *F udum* and rice plants by *F moniliforme* were also carried out. Diseased cotton plants showed higher enzyme activity than control plants and the development of wilt symptoms is also more rapid. There was a correlation between pectinolytic enzyme properties of the pathogen and severity of the disease development.

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Professor Sadasivan and his coworkers had put forward the view that fusaric acid should be considered as a vivotoxin. A technique was developed to detect the *in vivo* quantitative amount by its simple chelation as a copper complex on chromatogram and later by chromatography cum bioassay technique. In healthy plants the net effect of infection by pathogen resulted in higher respiratory rate whereas fusaric acid on cut shoots inhibited respiration. Studies on water loss and osmoregulation revealed that wilting plants had a heavy loss of key metabolite potassium as a consequence of loss of turgor. There was evidence to show that calcium and magnesium were increased in the flaccid tissues. *In vivo* tissue damage in the shoot was negligible in resistant plants as judged by the ionic imbalance in wilting plants.

One of the three long range problems was rhizosphere microflora and soil borne diseases. The concept of fungistasis was studied in detail. Fungal spores could not germinate when introduced into fresh fertile soils due to fungistasis but readily germinated when seedling roots grew in their vicinity. Fungistasis has been demonstrated in the top 12-15 inches of soil. The root exudates assumed importance in the understanding of pathogenesis and toxin production in the rhizosphere and rhizoplane by root infecting microbes. *F. lycopersici* which causes tomato wilt produces 7.5-11.2 mg of fusaric acid in the rhizosphere of a single tomato plant within 48h of infection. Apart from *F. vasinfectum* 15 other species of *Fusarium* are known from the black cotton soils of Tamil Nadu. It was shown that cotton cultivars of same species susceptible to fungi exerted a greater rhizosphere effect. Analysis of rhizosphere revealed that amino acid requiring bacteria were predominant in the rhizosphere of cereals and pulses. The effect of diploid and amphidiploid cotton strains were found to affect the bacterial population in wilt sick and wilt free soils. Correlation was found between aminoacid and vitamin exudation and the root influences on these bacteria. In cotton, soil types either promote or control infection by *F. vasinfectum.*

It is also demonstrated that there is a requirement of heavy metal for normal growth of Fusaria, iron and manganese being indispensable. Trace elements such as iron moves towards the roots in susceptible cotton. Preferential chelation of iron with fusaric acid in susceptible cotton was shown for the first time. Lesser quantity of zinc in wilt sick soils than wilt free soils may regulate the production of fusaric acid. The points that emerge from the studies on rhizosphere microflora are: a) the influence of metals on the flora in the rhizosphere and rhizoplane, b) formation of toxins/antibiotics by the pathogens, c) the identification of rhizosphere exudates and formation of metalochelates and d) *in vivo* changes brought about by metals in substrates that aid pathogenesis.

The blast disease of rice was also studied. Night temperatures of 20°C alternating with day temperature of 30-35°C under fixed illumination of 14L/10D period favoured infection whereas, even susceptible cultivars at night temperatures above 26°C are seldom infected. It is known that cultivars totally resistant in plains become susceptible in hills with a nyctotemperature about 15°C. Besides temperature, nitrogen also affects

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disease incidence in rice. At night temperatures of 20°C both resistant and susceptible cultivars succumb to infection. Nyctotemperature also effected the exudation of glutamine which stimulated germination of spores in susceptible cultivars. The marked influence of glutamine in promoting germination of *Pyricularia oryzae* and the effects of aminoacids on lesion development suggested that the night temperatures could alter the nitrogen metabolism of the host. The nyctotemperatures on rice plants favour greater nitrate production and the synthesis of glutamine and amino acids. Resistance of rice to *P. oryzae* can be annulled if the plants are subjected to low nyctotemperature of 20°C for some time. The blast disease is considered as not merely a case of facultative parasitism but one at a slightly lower level than obligate parasitism by rusts because of its exacting growth requirements and the capacity of *P. oryzae* to produce toxins such as piricularin and α-piconilic acid and the very many factors that determine host susceptibility at a physiological level.

Professor Sadasivan guided 52 students for their PhD degrees and there were over 600 publications in the area of rhizosphere, ecology of soil borne plant pathogen and physiological plant pathology. He was closely associated with the execution of research work by his students but he has never put his name as coauthor when the wok was published.

The research work at CAS in Botany reached international standards and most of the students of Professor TS Sadasivan occupied many good positions in various laboratories in our country and also other institutions all over the world. Professor Sadasivan organized several summer schools for revision of school curriculum and summer camps for University teachers. He also organized a UNESCO – sponsored training camp in Physiological Plant Pathology for scientists from South East Asia. He was the Chairman of the Biology Study Group of NCERT which brought out six graded texts in biology for 10+ and 15+ years school students. He served in many high power committees of the Ministry of Education, Ministry of Science and Techonology, CSIR and UGC to chalk out policies for development. Creation of the scientist pool in CSIR, Centers of Advanced Study and Departments of Special Assistance by UGC, the Faculty Improvement Scheme, and the Teacher Training Facility are some of his innovations.

MEMBERSHIPS, AWARDS AND HONOURS

Professor Sadasivan was the Fellow of the Indian National Science Academy and member of the council during 1958-59, 1962-64 and 1971-73. He was the Fellow of the Indian Academy of Sciences, Council member during 1956-76, Secretary during 1956-58, Vice president 1965-70, President 1971-73, Fellow of the Indian Botanical Society, Fellow of the Indian Phytopathological Society and Member of the Deutsche Akadamie der Naturforschung Leopoldina. He was Member of the International Advisory Board for the 3 Volume Treatise on Plant Pathology, Academic Press and Member of the Editorial Board of Phytopathological Zeitschrift. He was Vice President of International

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Botanical Congresses (1959, 1964, 1969, 1975), Vice President of the first International Plant Pathology Congress in London (1966), President of the Botany Section of Indian Science Congress 1958, President Indian Botanical Society 1963-64, Indian Phytopathological Society 1964 and Founder Member International Society of Plant Morphologists. He was Editor of Journal of Indian Botanical Society, the Journal of Madras University for many years and served on the Editorial Board of Phytopathologische Zeitschrift.

He was the recipient of Dr Shanthi Swarup Bhatnagar Award for Biological Sciences (1960), Prof. Birbal Sahni Medal of Indian Botanical Society (1962), The Jubilee Medal of the Birbal Sahni Institute of Paleaobotany (1971) and Sunderlal Hora Medal of INSA (1973). He received 'Padmabhushan' (1974) from the President of India and Professor Birbal Sahni Birth Centenary Medal (1999) at 86th Session of Indian Science Congress at Chennai.

He was Chairman in the Governing Body of Birbal Sahni Institute of Paleaobotany, Lucknow, and was the Birbal Sahni Professor (1977-1980). He was honoured at the Annual Meeting of the Phytopathological Society of India held at CAS in Botany, Chennai in January 2001.

EXTRAMURAL ACTIVITIES AND PERSONALITY

Professor Sadasivan retired from service in 1973, but continued to provide his invaluable advice for the progress and development of the Centre. He always remained as a source of inspiration and guiding force for the activities at the Centre for the past three decades. Professor Sadasivan was also actively engaged in the management of educational institutions under Sri Ramakrishna Mission and Bharathiya Vidya Bhavan. He firmly believed that improvement of science education should start at the school level and donated a substantial portion of his estate in Kodaikanal to establish Gandhi Vidhyashram under the aegis of Bharathiya Vidya Bhavan. He once remarked while explaining his role in the development of the Gandhi Vidyasram: "...I feel satisfied with advanced research in plant pathology and now like to concentrate on the younger group – 'the building blocks' of the future generation of our Country....". His passion for science education was never ending.

The author spoke to two of his nieces, Dr Bama and Dr Malini (a former student of UBL) staying at Chennai. Both were in full praise of their uncle. Professor Sadasivan was an upright human being and was affectionately called 'Sadhu' (a soft person). He was a great champion of women and wanted all women in the family to become independent; he used to advice that they should never give up the tradition of our country. He took care of all the children in the family as a godfather. Dr Malini remembered that his two good friends were Professor P Maheshwari and Professor

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Pandey who stayed in his house whenever they came to the University of Madras. He enjoyed driving his car for long distances as far up to Kodaikanal from Chennai. He was also a good car mechanic and his other hobby was repairing watches and clocks in the home. He was an admirer of Swami Chinmayananda, who, he recollected once to the author, as his hostel-mate at Lucknow. He lived as a true Gandhian, always wearing Khadhi clothes and used to wash clothes himself until he became ill, that is a month before his demise. One of his erstwhile colleagues Professor Swaminathan, Professor of Chemistry narrated that Professor Sadasivan was not only great but also a good person, a combination of both is rare. Professor HC Dube, former Dean of Science, University of Jamnagar, a Post Doctoral student at CAS during the 1970s concludes in his obituary note about Professor Sadasivan with the question: "... will there be another man like him?".

It is also worth mentioning the views of one of his erstwhile colleagues at CAS in Botany, Professor D Subramanian: "Professor Sadasivan always gave more to others than he got from them. He made every one feel important and close to him. He displayed remarkable self control, never raised his voice to hurt any one. He mellowed the ebullient, emboldened the meek and supported the bright. His flock followed him with reverence and shared his glory".

ACKNOWLEDGEMENTS

The author takes this opportunity to thank Professor Ramamurti, Editor (*INSA, Biographical Memoir*) IIT, Madras for entrusting this honourable assignment of writing about Professor Sadasivan. The author had an association with Professor Sadasivan for over three decades. The author is thanking all his senior colleagues for giving details about Professor Sadasivan besides personally thanking his daughter Ms Sheela, his nieces Dr Bama and Dr Malini for sharing certain personal information about Professor Sadasivan and thanks Professor R Balasubramanian for critically going through the manuscript, Mr Elango, Ms Padma Priya and Mr Ganesan in the preparation of this article.

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