World symbiosis day webinar – when living together is a win-win

Rudrani Dutta¹ · Shreya Pujari¹ · Sarthak Tyagi¹ · Manju M. Gupta¹ · Simon K. Davy² · David H.S. Richardson³

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Abstract

The following information is intended for those who were unable to attend the first webinar of the International Symbiosis Society (ISS) on - ‘When living together is a win-win’ – a celebration of ‘World Symbiosis Day’ on 30 July 2020. The objective of the webinar was to disseminate information about the Society, to gather feedback, and to encourage the audience to join the Society. This introduction presents a summary of the webinar, highlighting the keynote presentations, the panel discussion, the journal *Symbiosis*, and the next ISS conference to be held in Lyon in 2022. In addition, we report on the discussions and feedback from participants that were collected through polls and other aspects of the webinar.

1 Introduction

The webinar provided a forum for a detailed discussion on the multiple benefits of the various types of symbioses that are key contributors towards sustaining life on this planet. The webinar followed a preplanned structure marked by first, a formal welcoming, followed by keynote presentations by eminent scientists. As each speaker completed their presentation, questions from the audience were welcomed, and the speakers then provided answers. Some questions were live and some via the Q&A section of the Zoom meeting. The webinar further included opinion polls, and questions to find out more about participants and to collect suggestions. After this, there was a moderated session for discussion, amalgamated with Q&As, where each of the speakers responded further to questions posed by the audience. The final presentations about the journal ‘*Symbiosis*’, ISS, and its prospects, were specifically aimed at acquainting the audience about the Society.

The webinar received 598 registrations from 67 countries. The geographical distribution of participants covered almost the entire globe (Figs. 1 and 2). The largest number of participants was from the USA (23.7%), followed by India (19.7%) and Brazil (6.6%) (Fig. 2). Participants attended through Zoom and by YouTube. The attendance of the registrants on Zoom was 305 i.e., 51% who also participated in opinion polls

(Fig. 3). About 150 people watched the live stream of the webinar on YouTube after it commenced at 19:00 h GMT.

The webinar began with a celebratory tone and focused on why it was worthwhile to make this effort during COVID-19 times. The session was officially opened by ISS VP, Professor Manju M. Gupta and the inaugural address delivered by Professor Simon Davy (President ISS). He provided a history of the ISS which was established in 1996 at the second International Symbiosis Congress, a decade after the establishment of the journal ‘*Symbiosis*’ by Professor Margalith Galun in Israel. The Society has organized a series of congresses, the most recent, the ninth one being in Oregon, USA and the next one to be held in Lyon France in July 2022. It was specifically pointed out that the ISS executives and panelists are from diverse geographical locations. The appointment of a post-graduate student representative to the Society executive was acknowledged. It was emphasized how important the involvement of students is in the Society, especially with respect to spreading information about symbiosis on YouTube and Twitter. Professor Davy further stressed the importance of the webinar, a first in the history of the Society. He explained that the Society coordinates and brings together various activities, including those related to education, and briefly summarized the various types of symbioses and the goals of the Society. He also thanked Professor David Richardson, editor-in-chief of the journal ‘*Symbiosis*’ and acknowledged the sponsorship of Springer Nature. The journal agreed to publishing a topical collection of thematic articles based on the webinar as a special issue of the journal. The presence of Professor Chris Walker, Royal Botanical Garden, Kew, who joined the webinar at short notice, was also acknowledged.

✉ Manju M. Gupta
mmgupta@aurobindo.du.ac.in

¹ Sri Aurobindo College University of Delhi, Delhi 110017, India

² Victoria University of Wellington, Wellington 6140, New Zealand

³ Saint Mary’s University, Halifax, Nova Scotia, Canada

Fig. 1 Geographical distribution of participants

The Introductory session was followed by the first keynote presentation on ‘Perspective: Plant Endophytism, Rhizophagy Cycle, and Why the International Symbiosis Society is Important?’ by Professor James White from Rutgers University in New Jersey, USA. A short profile of Professor James White was read by Professor Sharon Doty, Vice President of ISS. Professor White spoke about how he has been associated with the ISS for a long time and was one of the pioneers in its establishment. He mentioned the founders and first president of the Society and provided an overview of the concept behind the establishment of the Society. Professor White then addressed the topic of ‘Endophytism’. Endophytes are microbes that invade plant tissues. He explained the

process of ‘Rhizophagy’ in detail and described the experiments which led to the discovery that plants internalize microbes in their roots. Co-investigators in this research tagged these microbes with GFP (green fluorescent protein) and then tracked them into the plant tissues. Over time, microbes lost their fluorescence and thus, they were not detectable anymore. This led to the suggestion that “plants consume microbes as a source of nutrients”. Professor White went on to explain the cycle of rhizophagy and presented various visuals to support this.

The second keynote address was by Professor Virginia M. Weis, Oregon State University, USA on the topic of ‘Coral Symbiosis Cell Biology in the Age of Climate Crisis: Turning

Fig. 2 Country wise registrations (%) received

Poll 1: The International Symbiosis Society appreciates your overwhelming response to our call of this webinar and is considering making the International Symbiosis Day webinar an annual event. Do you think this is a good idea?

Poll 2: Which of the following ISS-sponsored events would be most beneficial to you or your students/early career researchers?

Poll 3 : The experience provided by this webinar has encouraged me to join (or renew my membership of) the International Symbiosis Society

Poll 4 : Symbiosis publishes reviews, research papers, short communications, and book reviews in which category would you like to receive more submissions?

Fig. 3 Poll questions and their results

Discovery into Solutions for Saving Reefs'. Professor Simon Davy introduced Professor Weis. Coral reefs are hotbeds of productivity and biodiversity on the planet. These reefs are incredibly biodiverse. They cover a very tiny amount of the total marine environment, less than 1%, but they harbor 25% of all marine species. The benefit to humans is also huge; 11 trillion dollars are estimated annually to come from the services of coral reefs and about half a billion people rely directly on those services. Most of those people are from developing nations, who have little voice when expressing concern about the serious impacts that are happening to reefs. There are many threats to reefs, and they all act synergistically, with the 'big elephant' being global warming. The presentation focused on two issues: firstly, the regulation of the coral-algal symbiosis and the role of innate immunity in symbiosis, and secondly developing solutions to coral reef decline.

Dr. Silvana Munzi, Secretary of the ISS introduced Professor Marc-Andre Selsosse from National d'Histoire Naturelle, France for the third keynote presentation on "Origin and Evolution of Mycorrhizal Symbiosis". Professor Selsosse discussed the origin and evolution of mycorrhizal symbiosis in general, as well as the research conducted by his team. He presented several visuals depicting mycorrhizal symbiosis, one of which demonstrated how the fungus makes a sheath around the roots. Ectomycorrhizae are found in only 2% of plants whereas arbuscular mycorrhizae are the most prominent form and they are present in 71% of plants.

Professor Selsosse presented a slide depicting the fundamentals of the mycorrhizal symbiosis. He explained how it is "basically a nutrient symbiosis". There is a transfer of sugar from plants in exchange for minerals and water from the fungus. There is also a reciprocal protection of the two partners from pathogens and abiotic stresses. He then showed a flow diagram depicting the phylogenetic abundance of arbuscular symbiosis and said that it is a "kind of convergence in the evolution of plants". Professor Selsosse also presented a visual of a 400-million-year-old stone, which when examined, displayed a "black zone", which he explained was a cluster of arbuscules. These are believed to be the first evidence of the presence of this type of symbiosis in plants. He further explained the ectomycorrhizal symbiosis with reference to black truffles (*Tuber melanosporum*) and described the results of his own research team. It was found that arbuscular mycorrhizal fungi grew in very nutrient-poor regions. A study was conducted to find out whether there was any interaction between the ectomycorrhizae and arbuscular mycorrhizae. The discovery of minute traces of truffle DNA led to the conclusion that ectomycorrhizal fungi are detectable in non-ectomycorrhizal plants. The next question considered by Professor Selsosse was 'why ectomycorrhizal symbiosis emerges in evolution so often and so easily?' He then put forth the hypothesis that ectomycorrhizal fungi were the first to become endophytic fungi and then later became ectomycorrhizal (the hypothesis is called "The Waiting Room Hypothesis" and is, where

Fig. 4 A snapshot from the ongoing session on World Symbiosis Day. From left to right - Top row - Eric Hom (ISS treasurer, USA), Manju M. Gupta (ISS VP, India), Virginia Weis (Keynote speaker, USA), Silvana Munzi (ISS Secretary, Portugal), Simon Davy (ISS president); Middle row - Sharon Dotty (ISS VP, USA), James White (Keynote speaker, USA), Chris Walker (UK), Ashley Dungan (ISS students'

representative, Australia), David Richardson (Editor in chief Journal Symbiosis, Canada); Bottom row - Marc-Andre Selsosse (Keynote speaker, France), Saarthak Tyagi (India), Rudrani Dutta (India), Shreya Pujari (India), Cristina Cruz (ISS VP, Portugal) photocredit@saarthakTyagi

endophytism is a waiting room for becoming a tighter mycorrhizal partner). He ended his presentation with a discussion of another evolutionary trend, ‘changing the functioning of association.’ It is a shift from mutualism to cheating. Cheating is observed in plants that are not green. Lastly, Professor Seloase extended his gratitude to the ISS for the opportunity to address the webinar.

Professor David Richardson, editor-in-chief of the journal ‘Symbiosis’, briefed the audience about the journal ‘Symbiosis’ and what is special about it. ‘Symbiosis’ focuses on the interaction of partners in a wide range of associations. The journal is associated with the International Symbiosis Society (ISS) and is published by Springer Nature, one of the leading publishers in the world. Professor Richardson said that ‘Symbiosis’ has nine issues per year that are separated into three volumes. The regular issues of ‘Symbiosis’ cover a wide variety of published articles, ranging from research papers, reviews, short communications, and book reviews. There are also special issues of the journal devoted to topics and one issue is published every three years that is from the proceedings of each ISS congress. Professor Richardson acknowledged Professor James White’s efforts as a Review Editor of the journal. He mentioned the diversity of the Editorial Board comprised of 29 members from 15 countries who have expertise in a broad range of symbioses. Professor Richardson spoke about the contribution of Professor Margalith Galun, the founding editor of ‘Symbiosis’, who started the journal in 1985. He explained that this led to the first ISS congress in 1991, which was held in Jerusalem, Israel. He showed images of the cover pages of recent issues of the journal and provided the audience with the web sites where the content of both the early and current issues can be accessed (Richardson 2011, 2020).

Ms. Ashley Dungan is the ISS student representative and joined from Melbourne, Australia and she delivered the student address. She stressed the various activities of the ISS that can be instrumental in a student’s career. After all the presentations, an interactive session moderated by Dr. Cristina Cruz,

Vice President, ISS was held with questions being posed to the participating speakers.

Dr. Erik Hom, Treasurer, ISS, and Professor Manju M. Gupta concluded the webinar. Professor Gupta extended overwhelming acknowledgments to all the panelists, who made such a big effort to support the webinar by providing comprehensive presentations. Professor Gupta congratulated all her colleagues and the executive of the ISS for successfully arranging the webinar. She specifically thanked President Professor Simon Davy and Dr. Erik Hom for their support throughout the program. She also thanked Professor David Richardson for helping to involve Springer Nature in this endeavor as the publisher promoted extensive coverage across the globe. The students at Professor Gupta’s home institute, Sri Aurobindo College, namely Sarthak Tyagi, Shreya Pujari and Rudrani Dutta, were instrumental in making various arrangements and were acknowledged by her. They were invited to join on-screen for a memorable screenshot with guest speakers, Professor David Richardson, and the ISS executive team (Fig. 4). Professor Gupta’s colleague from her home institute, Delhi University, Ms. Hema Nagpal, who provided a helping hand in the event, was also acknowledged. These final remarks marked the successful completion of the webinar and lastly, Professor Gupta extended her gratitude to all the audience from around the world who had joined the webinar.

References

- Richardson DHS (2011) Editorial on the history of the journal *Symbiosis* and the international Symbiosis society. *Symbiosis* 53(2):47–52
- Richardson DHS (2020) *Symbiosis* volumes one (1985) to 39 (2005) now available on-line. *Symbiosis* 89(3):305

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