Joseph Gale, J Plant Biochem Physiol 2018, Volume 6
DOI: 10.4172/2329-9029-C1-002

6th Global Summit on Plant Science

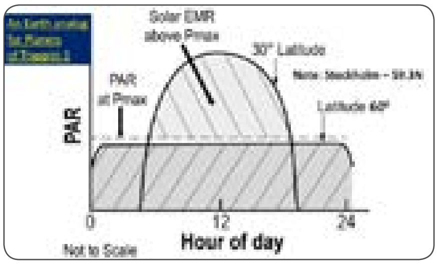
October 29-30, 2018 | Valencia, Spain

The environments of planets orbiting red dwarf stars and the potential for supporting oxygenic photosynthesis and complex life

Joseph Gale

The Hebrew University of Jerusalem, Israel

Seven planets have been detected orbiting the "nearby" Red Dwarf star Trappist-1. The star is relatively small (0.12 Rsun) and cool (2,550K) compared to our Sun (5,780K). Consequently its radiation flux is low (0.05% that of the Sun), mainly in the infrared, with a spectral peak at ~1μm, well above the Photosynthetically Active Radiation (PAR) waveband of 400 – 700nm. At least three of the planets are in the Habitable Zone (defined as regions where surface temperatures may support liquid water), but all six inner planets could have such temperatures, depending on their atmospheres. The six inner, closely orbiting planets (at 0.1-0.35AU), receive a radiation flux 0.3-4 that of Earth, but only ~10% of this is PAR, compared with ~40% on Earth. However, the star-facing hemisphere of tidally locked Trappist-1 planets would receive continuous PAR. Earth at high northerly or southerly latitudes, provides an analogy for the possible outcome (see Figure). During only 3-4 months per Earth year, the almost continuous low-level radiation, above 80° north or south, produces lush vegetation. The radiation intensity on such a tidally locked planet would be maximum immediately facing the star, falling off to zero, towards the terminator, at 90°. XUV radiation from Trappist -1 is ~103-104 that of the Sun. This radiation could (possibly, but not necessarily) erode the primary atmosphere and oceans, and directly endanger life, unless life evolves in water or under a dense atmosphere. In addition to PAR, dry land plants on Trappist-1 and other RDS planets could possibly evolve to utilize the infrared radiation between 700 and 1,000nm, which is energetically sufficient to drive water splitting oxygenic photosynthesis, an important precursor of complex life. These considerations and the abundance of RD and other star planets, enhance the chance of finding other life clement abodes in the Milky Way.



Recent Publications

1. Gale J. (2009), Astrobiology of Earth, Oxford U. Press.
2. Gale J. and Wandel A., (2017), The Potential of Planets orbiting Red Dwarf stars to support Oxygenic Photosynthesis and Complex Life., International Journal of Astrobiology 1: 1-8.
3. Wandel A. (2017), How far are Extraterrestrial Life and Intelligence after Kepler ?, Acta Astronautica 137, 498-503.
4. Wandel A., (2018), On the bio-habitability of M-dwarf planets, the Astrophysical Journal, 858, 165, 1-13.
5. Wandel A. and Gale J., (2019), The Potential for Complex Life on Tidally Locked Planets: a Critique and Update., submitted.
6. Ritchie R.J. et al, (2017), Could photosynthesis function on Proxima Centauri b. Int. J. Astrobiology, 1-30.

Biography

Joseph Gale is a professor emeritus of the Hebrew U. of Jerusalem. His original interests were in Environmental Plant Physiology. After a period of research and consultation at NASA, USA, working on their Life Support in Space project, he turned to Astrobiology. Together with his astronomer colleague, Prof. Amri Wandel of the Racach Inst., HU., they have developed courses in Astrobiology for undergraduate students, with both science and humanities backgrounds. He has published more than one hundred refereed papers and has authored/co-authored and edited four books.

gale.joe@mail.huji.ac.il