

# The Evidence for Gamma Ray Photosynthesis

by T.D. Luckey

**Abstract.** Limited data indicate that gamma rays can support photosynthesis. Pure cultures of a photosynthetic bacterium, *Rhodospseudomonas capsulata*, and an alga, *Anacystis nidulans*, were exposed for several days, without light, to continuous gamma rays from a Co-60 source at the University of Missouri Research Reactor. Both organisms remained green and, within limits, increased in proportion to the radiation flux. The results indicate microbial use of the energy of ionizing radiation in deep sea vents, hydrocarbon utilization, prebiotic reactions, and early life metabolism.

\* \* \*

**Introduction.** "The longer my experiments continued, the more mysterious the whole subject seemed." This was O.F. Atkinson's reaction to the increased growth of algae irradiated with X-rays in 1898.<sup>1</sup> During the 20th Century, about 3,000 scientific reports showed a biopositive effect for many physiologic functions following low doses of ionizing radiation

in microbes, plants, invertebrates, and vertebrates, including humans.<sup>2,3,4</sup> Within limits, the response is directly proportional to the logarithm of the dose. When the dose exceeds the threshold for each set of parameters, a bionegative effect is observed. Increased photosynthesis was indicated by the increased mass of photosynthetic organisms following pulsed or continuous radiation with beta rays, gamma rays, X-rays, ultraviolet (UV) rays, or neutrons.<sup>2</sup> In the above experiments the plants were exposed to ambient light.

Would plants respond to ionizing radiation without light? A positive answer is indicated by the response of a photosynthetic bacterium, *Rhodospseudomonas capsulata*, and an alga, *Anacystis nidulans*, to continuous exposure of cobalt gamma rays without light. The implications of this finding are discussed below.

**Method.** Aseptic techniques were used throughout this study. Sets of tubes to be irradiated were put in an incubator which was placed at a convenient distance from

the Co-60 source in the University of Missouri Research Reactor. For *R. Capsulata*, the front of the incubator was 24 cm from the Co-60 source; it had a 1.8-cm lead plate between it and the source. Within the incubator radiation was attenuated by a series of lead plates providing a sequence of 0, 1.6, 3.1, 4.8 and 6.4 cm of lead between the five sets of tubes and the source.

The Co-60 was elevated from the pool to give continuous in-air irradiation, with no light, of cultures throughout the incubation periods. Dosimetry for the five positions included backscatter from incubator, lead plates, and concrete walls. Control cultures were maintained in the dark with no irradiation at the appropriate temperatures in incubators in a separate building.

*R. capsulata* (B100) stock cultures were maintained anaerobically at 32°C under fluorescent light of 50 foot-candles, following procedures outlined by Madigan *et al.*<sup>5</sup> The complete medium, RCVB, of Johansson and Gest was used for stock





