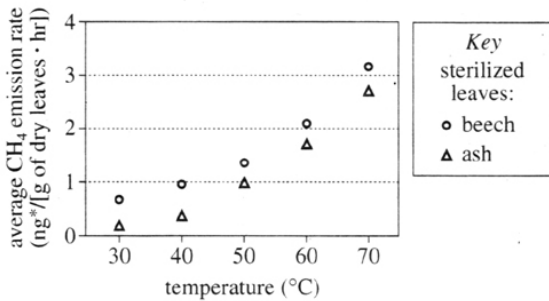


Passage 1

Scientists once thought that on Earth the methane (CH₄) from natural sources was produced only by *methanogens* (bacteria that cannot survive in the presence of O₂). It has been recently discovered that some plants emit CH₄ that is generated by an unknown process operating under *aerobic* conditions (O₂ present). Three studies examined CH₄ emission by plants.

Study 1

Beech tree leaves were collected, air-dried, and sterilized. A small quantity (1–6 g) of the air-dried, sterilized leaves was placed in each of 20 identical glass tubes. Each tube was then capped. Using a needle inserted through the cap, the air in each tube was replaced with CH₄-free air. The tubes were then separated into 5 groups of 4 tubes each. Each group of tubes was incubated in the dark for 16 hr at 30°C, 40°C, 50°C, 60°C, or 70°C. The average CH₄ emission rate was determined for each group at the end of the incubation period. This procedure was repeated using ash tree leaves (see Figure 1).



*ng = nanogram = 10⁻⁹ g

Figure 1

Study 2

The procedure of Study 1 was repeated except that air-dried, *unsterilized* beech and ash leaves were tested (see Figure 2).

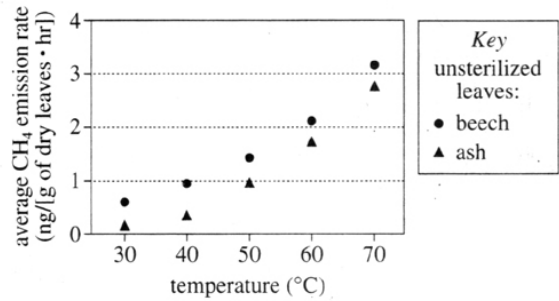
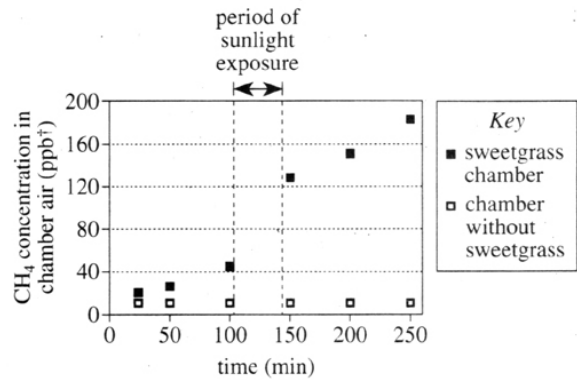


Figure 2

Study 3

Several sweetgrass plants were placed in a large Plexiglas chamber. This chamber and an identical chamber with no sweetgrass inside were then sealed. Using a pump, air in each chamber was replaced with CH₄-free air, after which the chambers were incubated in the dark at 30°C. At 102 min after incubation began, the chambers were placed in direct sunlight for a short period, then returned to the dark to continue incubation at 30°C. Beginning when the chambers were first placed in the dark, the CH₄ concentration in the air inside the chambers was measured every 25 or 50 min for 250 min (see Figure 3).



†ppb = parts per billion

Figure 3

Figures adapted from Frank Keppler et al., "Methane Emissions from Terrestrial Plants under Aerobic Conditions." ©2006 by Nature Publishing Group.

1. According to the results of Study 2, as incubation temperature increased, the average CH₄ emission rate:
 - A. increased for beech leaves, but decreased for ash leaves.
 - B. increased for both beech leaves and ash leaves.
 - C. decreased for beech leaves, but increased for ash leaves.
 - D. decreased for both beech leaves and ash leaves.
2. According to the results of Study 1, the average CH₄ emission rate for air-dried, sterilized beech leaves incubated at 60°C was closest to which of the following?
 - F. 1.5 ng/[g of dry leaves · hr]
 - G. 2.0 ng/[g of dry leaves · hr]
 - H. 2.5 ng/[g of dry leaves · hr]
 - J. 3.0 ng/[g of dry leaves · hr]
3. A complicating factor in interpreting the results of Study 3 was that exposing the chambers to sunlight probably also:
 - A. increased the mass of the plant material inside both chambers.
 - B. decreased the mass of the plant material inside both chambers.
 - C. increased the temperature inside both chambers.
 - D. decreased the temperature inside both chambers.
4. Which of the following served as a control in Study 3 ?
 - F. The tubes containing air-dried, unsterilized ash leaves
 - G. The tubes containing air-dried, unsterilized beech leaves
 - H. The sweetgrass chamber
 - J. The chamber without sweetgrass
5. Is the statement "Sterilization had no effect on the CH₄ emission rate for ash leaves" supported by Figures 1 and 2 ?
 - A. Yes, because at every incubation temperature, the emission rates for both the sterilized and unsterilized ash leaves were the same.
 - B. Yes, because at every incubation temperature, the emission rate for the sterilized ash leaves was less than half that for the unsterilized ash leaves.
 - C. No, because at every incubation temperature, the emission rates for both the sterilized and unsterilized ash leaves were the same.
 - D. No, because at every incubation temperature, the emission rate for the sterilized ash leaves was less than half that for the unsterilized ash leaves.
6. In Study 1, it was unnecessary to put an identical mass of air-dried, sterilized leaves in each tube because the average CH₄ emission rates were determined:
 - F. per g of dry leaves.
 - G. at 5 different temperatures.
 - H. for 2 different types of leaves.
 - J. after incubation in the dark.