

Gas Leaks & Trees: the Science



15 Vista Ave
Boston, Massachusetts
Street View - Oct 2011

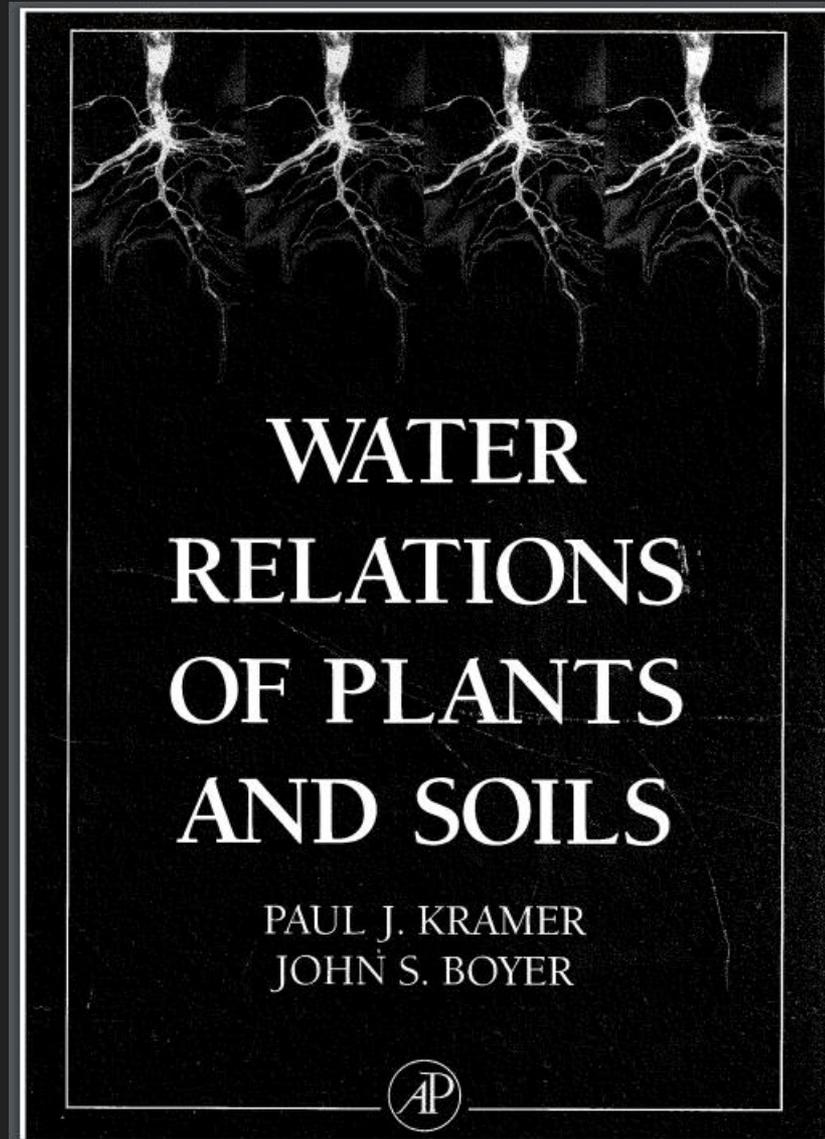
Myrtle Ave
Hawthorne Ave
Woodlawn Ave

Nathan Phillips, Bob Ackley



4:40 AM - 29 May 2017

The causes of tree damage by gas leaks are well-established



Decades of research have established the link between gas leaks and tree damage

SOIL SCIENCE
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CHANGES IN COMPOSITION OF SOIL AIR NEAR LEAKS IN NATURAL GAS MAINS

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The Hague, Netherlands¹*

Received for publication November 17, 1970

During the last four to five years, because of its disastrous influence on plantations in towns and villages leakage of natural gas from underground gas mains has become a real problem in the Netherlands and also in other western Euro-

mainly of hydrocarbons (table 1) which are non-toxic (5, 19). Concerning the eventual toxicity of the odor additive THT (tetrahydrothiophene), there is as yet little information. Pirone (19) found from his experiments, that

$O_2 \downarrow$ and $CO_2 \uparrow$ in gassed soils

Decades of research have established the link between gas leaks and tree damage

Journal of Arboriculture 3(8): August 1977

THE EFFECT OF NATURAL GAS ON TREES AND OTHER VEGETATION¹

by **Spencer H. Davis, Jr.**

- Excellent short summary of research

GANODERMA LUCIDUM, A PARASITE OF SHADE TREES

P. P. PIRONE¹

Some investigators believe that *Ganoderma lucidum* (Leys.) Karst. (*Polyporus lucidus*) is a saprophyte of hardwood and coniferous trees (Boyce 1938). This conclusion is based largely on the fact that the reddish, varnish- or lacquer-like coated conks are commonly observed on dead trees and timber. However, a number of reports have appeared in the literature (Reichert & Avizohar 1939, Bagechee & Bakshi 1950, Lohway 1942, Urquart 1945) which suggest that Ganodermas are parasites. The most recent one (Nickell 1952) suggests that a species of *Ganoderma* was involved in the death of a large sassafras at the Brooklyn Botanic Garden.

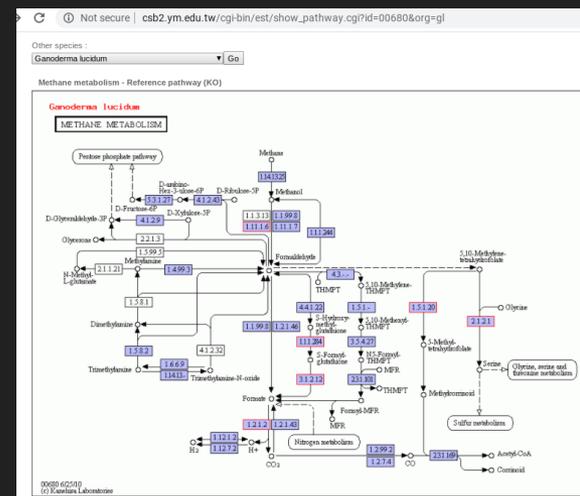
During the 1956 growing season the author had occasion to examine more than three hundred dead or dying shade trees, principally Norway maples (*Acer platanoides*), planted along New York City streets. All these trees were alleged to have been killed or damaged by natural gas escaping from leaking mains.

During the late summer of 1957 he examined 40 additional shade trees, mostly Norway maples and red or swamp maples (*A. rubrum*), growing along the streets in Atlantic Highlands, New Jersey. All of these trees were also alleged to have been killed or damaged by escaping gas.

In the course of diagnosing for the cause of the trees' death, on nearly 20 per cent of the trees the author observed the typical fruiting bodies of *Ganoderma lucidum* emerging either from the trunk base of affected trees or from their roots.

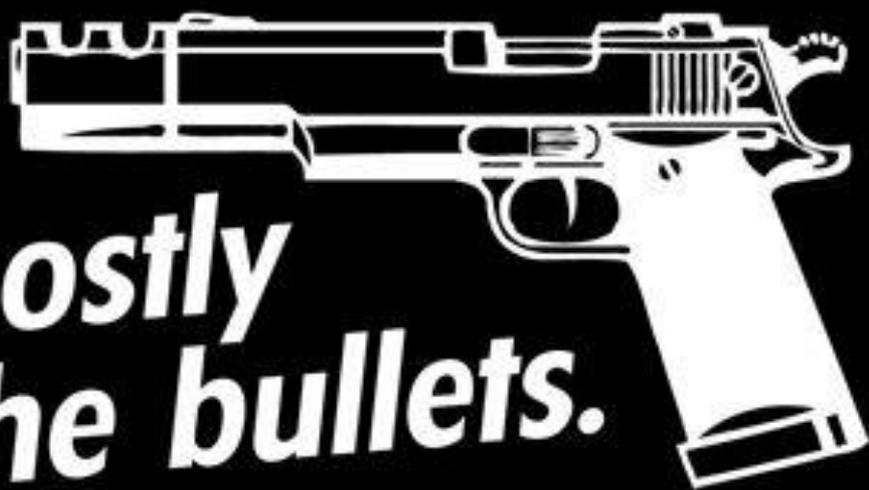
The majority of the trees exhibiting this fungus had been dead anywhere from a few weeks to two years or more.

Ganoderma conks were observed, however, on a considerable number of trees which were still alive. In the New Jersey survey involving 40 trees,



GUNS

DON'T KILL PEOPLE



***It's mostly
the bullets.***

The Science in a Nutshell

The Physics:

- Gas displaces oxygen

The Science in a Nutshell

The Physics:

- Gas displaces oxygen
- Gas dessicates soil

The Science in a Nutshell

The Physics:

- Gas displaces oxygen
- Gas dries soil

The Chemistry:

- Root metabolism inhibited by low oxygen
$$\text{CH}_2\text{O} + \text{O}_2 \rightarrow \text{CO}_2 + \text{H}_2\text{O} + \text{Energy}$$

The Science in a Nutshell

The Physics:

- Gas displaces oxygen
- Gas dries soil

The Chemistry:

- Root metabolism inhibited by low oxygen



- Methane oxidation by microbes



From Kramer & Boyer 1995

There is some uncertainty concerning the relative importance of low oxygen versus high carbon dioxide in inhibiting root growth and function in poorly aerated media, but it seems probable that under field conditions the inhibitory effects of low oxygen are more important than the effects of high carbon dioxide. It appears that bulk air oxygen concentrations above 10% are adequate for roots of most plants. However, it is difficult to determine the actual oxygen concentration at root surfaces from measurements of the oxygen concentration of the bulk air. Methods of measuring soil aeration are discussed by Stolzy *et al.* (1981) and in Glinski and Stepniewski (1985, Chapter 6). The oxygen diffusion rate to root surfaces is the critical factor in soil aeration and this is often measured with platinum electrodes simulating roots. In general it appears that oxy-

Typical Root Growth Impacts

Soil Aeration and Tree Health: Correlating Soil Oxygen Measurements With the Decline of Established Oaks¹

L. R. Costello J. D. MacDonald K. A. Jacobs²

https://www.fs.fed.us/psw/publications/documents/psw_gtr126/psw_gtr126_05_costello.pdf

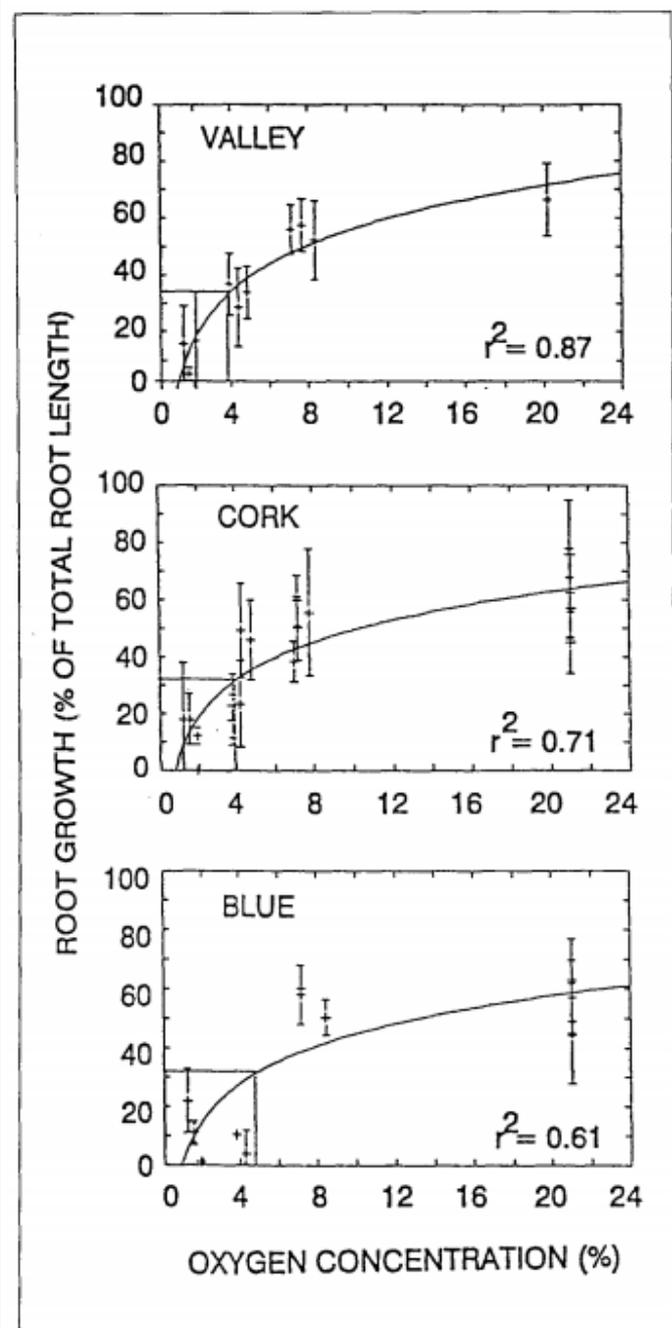
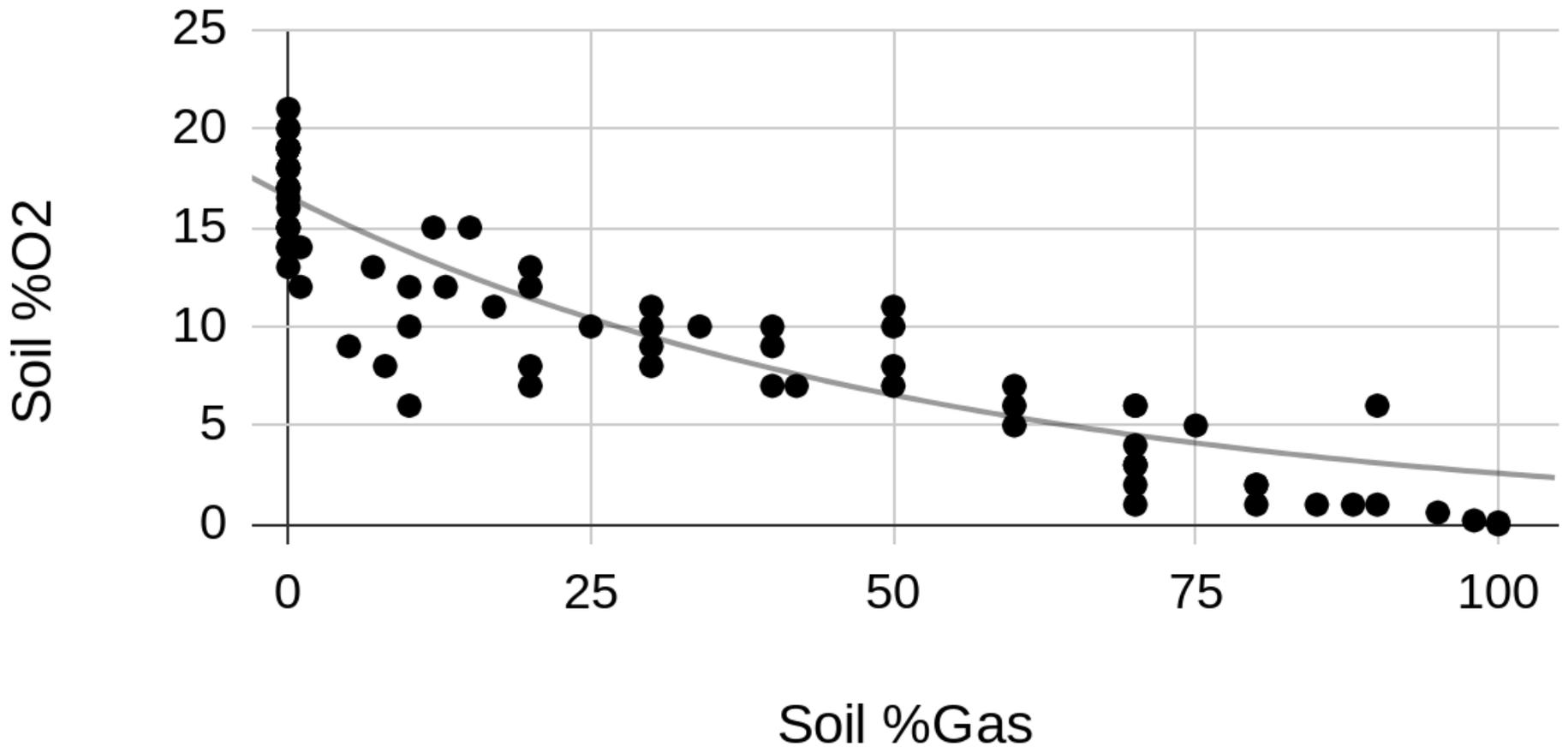


Figure 3—Effects of oxygen concentration on the root growth of three species of oak. Concentrations less than 5 pct inhibited root growth in all species.

Newton, MA

Soil %O2 vs. %Gas

● — $R^2 = 0.823$



Data: Bob Ackley, Gas Safety, USA



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Environmental Pollution

journal homepage: www.elsevier.com/locate/envpol

Natural gas leaks and tree death: A first-look case-control study of urban trees in Chelsea, MA USA[☆]

Claire Schollaert^a, Robert C. Ackley^b, Andy DeSantis^c, Erin Polka^a,
Madeleine K. Scammell^{a, *}

^a Boston University, School of Public Health, Department of Environmental Health, 715 Albany St., T4W, Boston, MA, 02118, USA

^b Gas Safety, Inc., 16 Brook Lane, Southborough, MA, 01772, USA

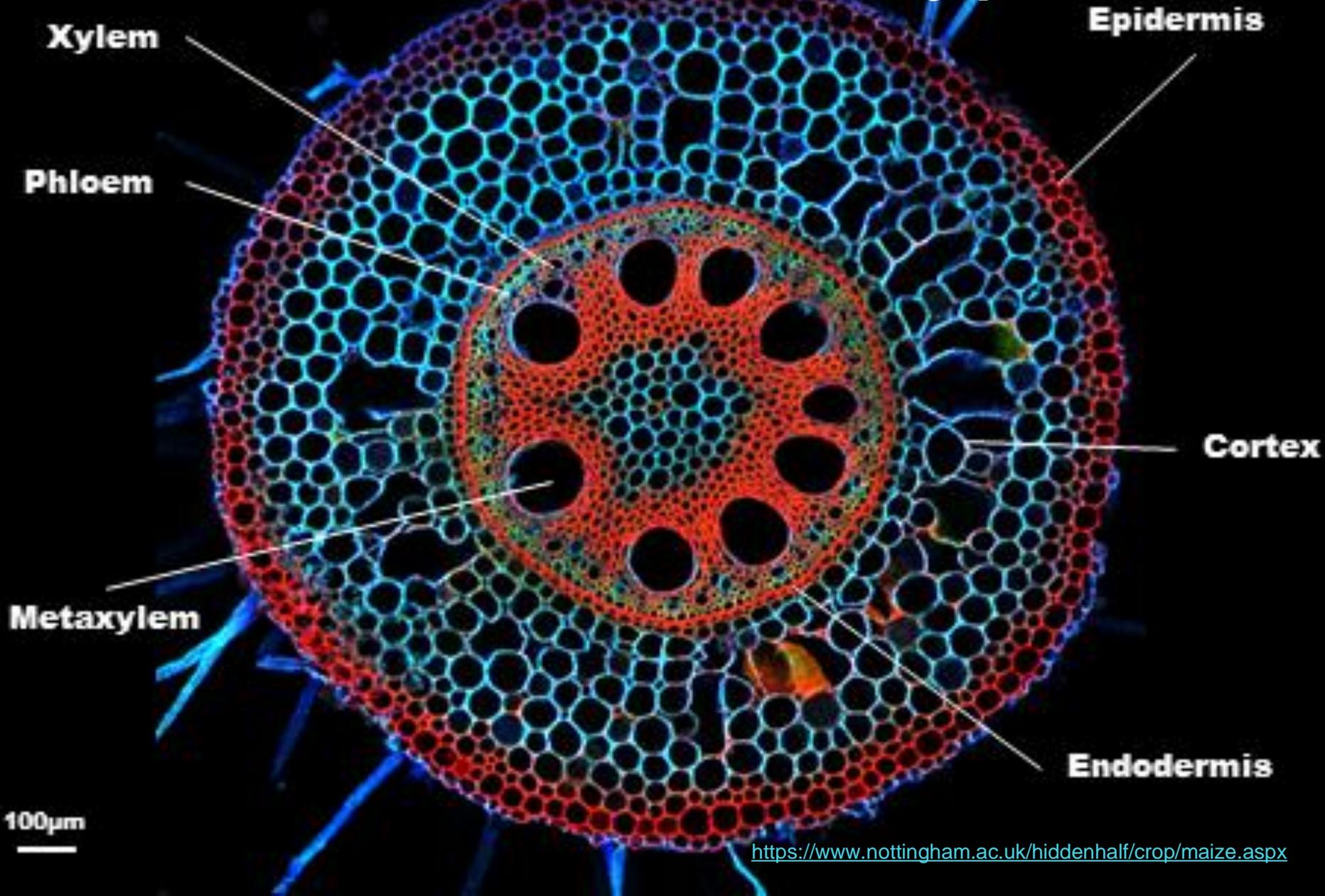
^c Department of Public Works (Retired), City of Chelsea 500 Broadway, Chelsea, MA, 02150, USA

- Dead/dying trees 30X more likely to have gas in root zone
- Dead/dying trees had less average oxygen in root zone

Unknowns



Root reactions to hypoxia



Root reactions to hypoxia

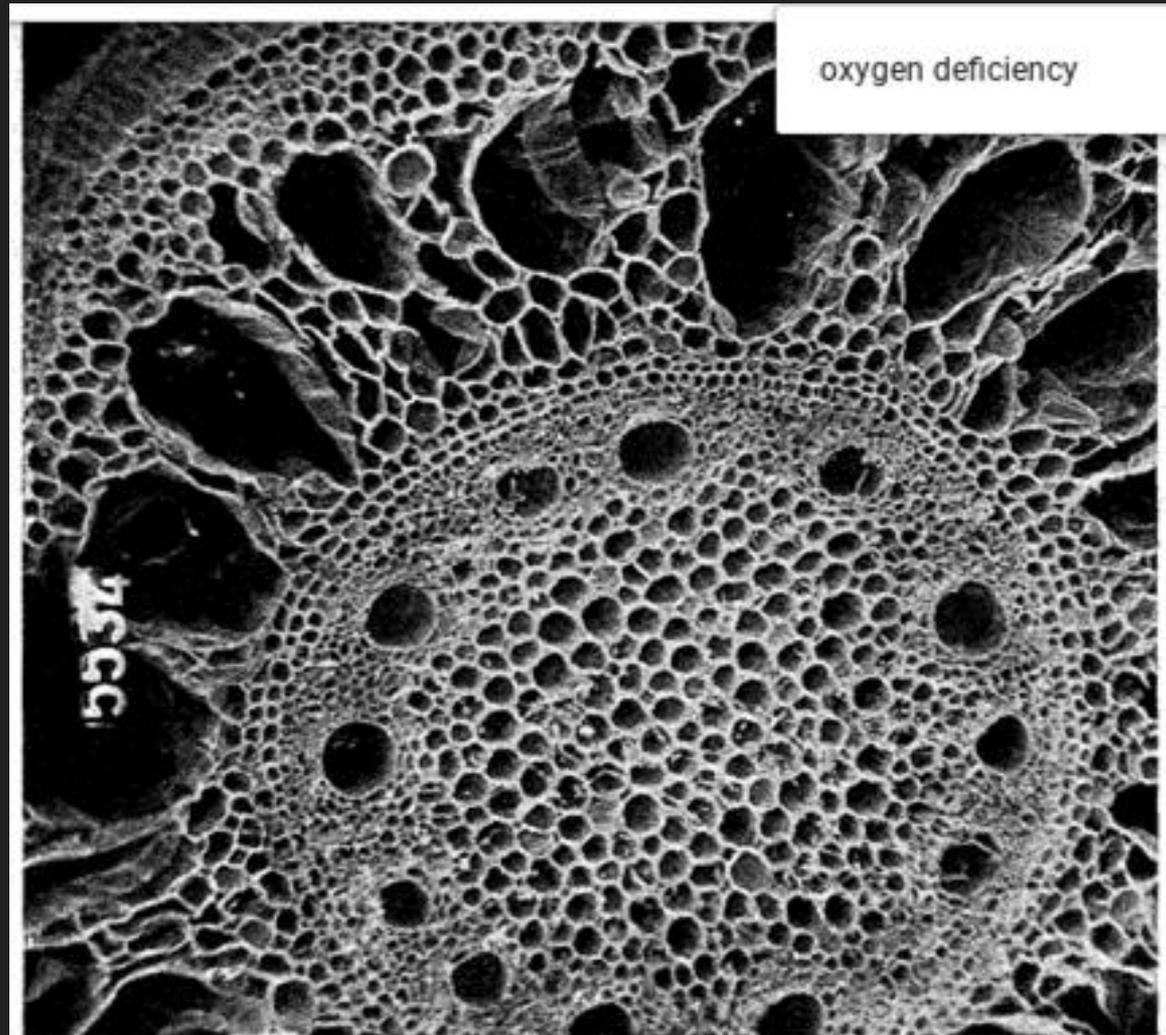
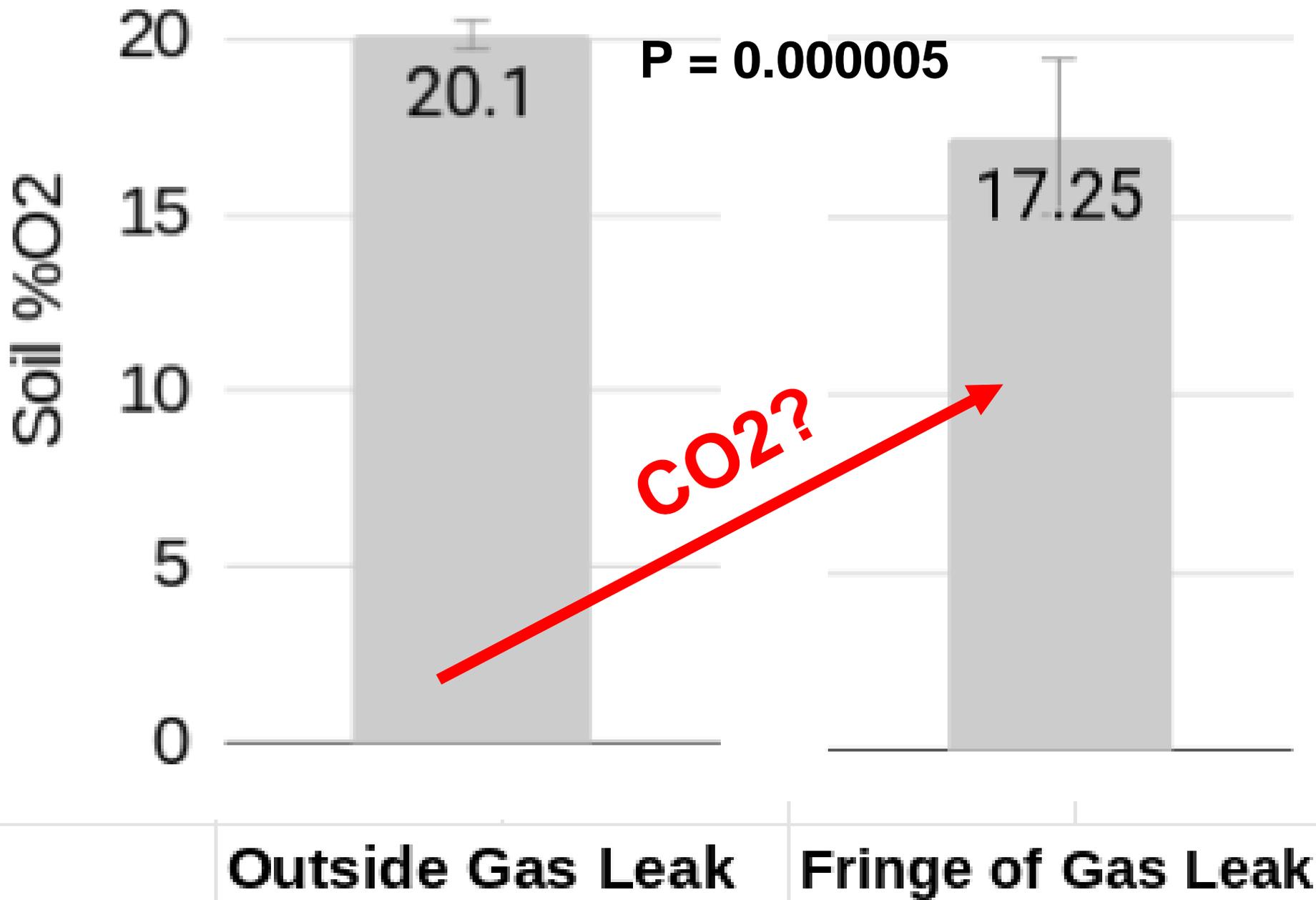


Figure 5.19 Scanning electron micrograph of an adventitious root of corn grown in an un-aerated nutrient solution. The section was made 8 to 10 cm behind the root tip. The air spaces in the cortex are formed lysigenously by the breakdown of cells. From Kramer (1983), from Agricultural Research Council Letcombe Laboratory Annual Report (1978, p. 42); courtesy of M. C. Drew.



METHANE

DOESN'T KILL TREES



*It's mostly
the anoxia.*

Thank You



Extra slides follow

jkdkd

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Gas Emergencies

If you smell gas anywhere, including in your home, go outside and call 1-800-233-5325 or 911 immediately.

Do not assume that someone else has already reported the emergency. Help us keep your community safe! We consider all of the below a gas emergency:

- You smell gas or suspect a gas leak
- There is abnormal pressure (high/low flame) or no gas in all your gas appliances
- Gas to an appliance or heating unit stays on and cannot be shut off
- There is a continuous flow of water leaking from your gas heating unit or water heater
- Gas pipes are making unusual noises like roaring, hissing or whistling
- You notice dead vegetation that does not have a cause to be there

Report a Gas Emergency!

1-800-233-5325 or 911

Assistance is available 24 hours a day, every day.

Did You Know?

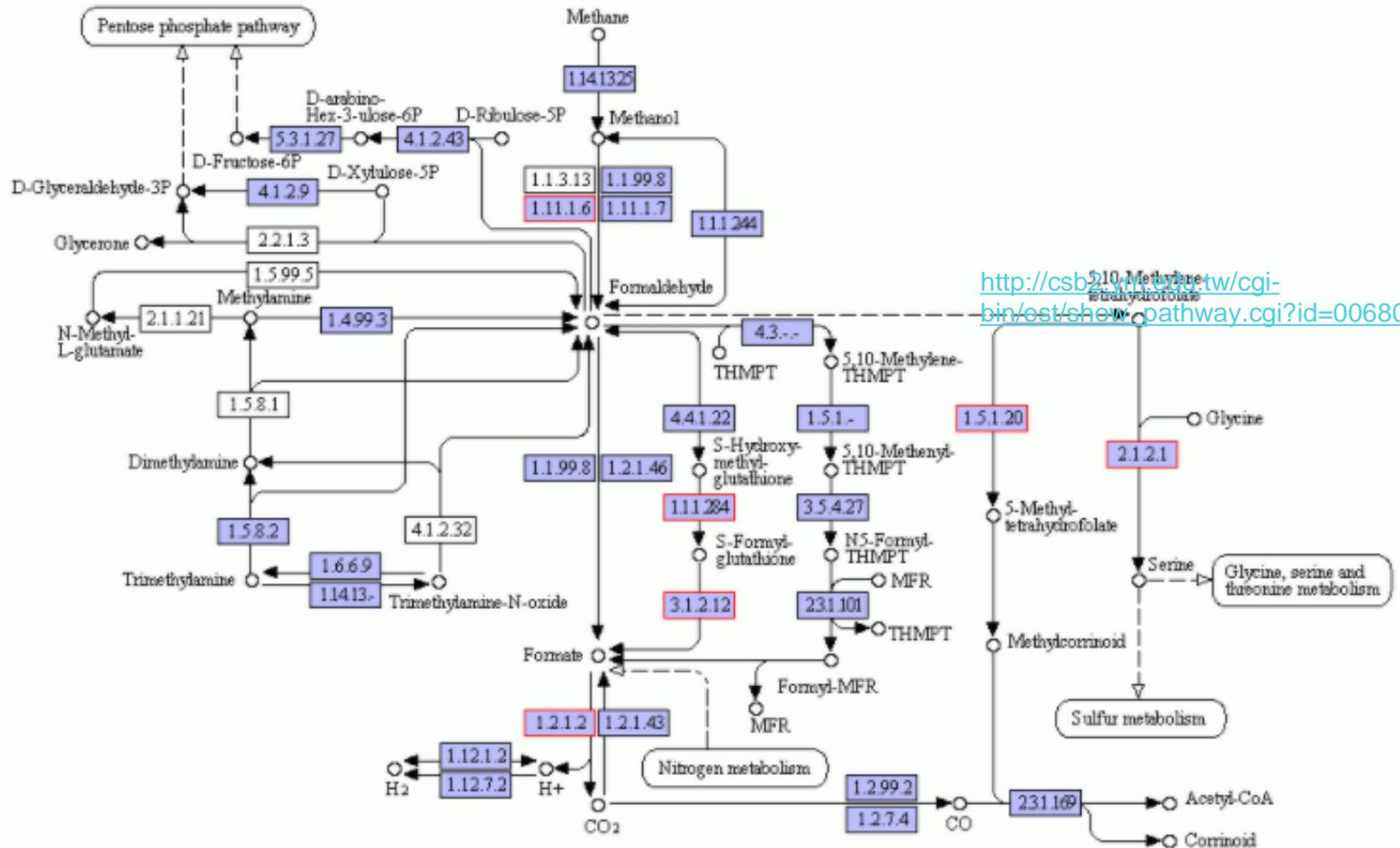
We add a sulfur-smelling chemical called mercaptan to our natural gas to help you recognize a leak immediately. Natural gas is naturally tasteless, colorless, and odorless.

Other species :

Methane metabolism - Reference pathway (KO)

Ganoderma lucidum

METHANE METABOLISM



http://csb2.ym.edu.tw/cgi-bin/est/show_pathway.cgi?id=00680&org=gl

jkdkd