

THE FACTS OF LIFE

Imagine a planet where 29% of the surface is land, surrounded by salty sea, and where there are no living things on the land – no grasses, no trees, no lichen, no insects, no animals, no birds, no people, no soil – just rock and sand. That was what planet Earth was like 450 million years ago. There was nevertheless life in the sea and then some algae at the edge moved on to the shore, accompanied by bacteria on which the algae depended for nutrition (and the bacteria depended upon the algae for food in the form of carbohydrate and protein exudates). The rest of Evolution, as they say, is history.

However, we cannot get away from that link, the one between plant (in the original case algae) and bacteria. Today, **ALL** plants, whether they are vegetables, fruit bushes and trees, grasses etc, have this mutual dependency with bacteria and, these days, with fungi also. Around plant roots is a sticky slimy mess of plant exudates (carbohydrates and proteins), bacteria and fungi. The plant roots cannot obtain the nutrients they need directly. They have to depend upon two sources: nutrients from the bodies of dead bacteria, and nutrients directly from living fungi. In return, the bacteria and fungi cannot live without the exudates from the plant. A symbiotic relationship if ever there was one.

Bacteria are tiny; 500,000 can fit onto the dot on the i of “tiny”. They are single-celled organisms which propagate by dividing themselves into two all the time. If there is sufficient food around, one bacterium can become 500,000 in 12 hours. A lot die and thus provide nutrients for the plant. By comparison, the fungi are massive and longer-lived. They are also single-celled, but in their case the cells are joined together like a string of sausages and, vitally, nutrients pass easily from one cell to another. Thus, when the mother ship, anchored to the plant, senses that the plant would like a particular nutrient, the message goes out to the end of the chain which moves around to find the required nutrient, ingests it, then passes it back to the mother ship which gives it to the plant. The plant, in gratitude and in order to attract more bacteria and fungi, then expels some exudate in the form of carbohydrate and proteins. This symbiotic relationship continues, with different fungal strands seeking different nutrients, be they copper, zinc, molybdenum, phosphorus, nitrogen, potassium, calcium or whatever (and water). So, the conclusion is, the fact of life for us on earth is an absolute dependency upon the bacteria and fungi around plant roots. Without our friends we would be back to barren rock and sand as we were 450 million years ago.

Those bacteria and fungi are friends on which our very lives depend, so what do we do? We try to kill them with fungicides, bactericides, pesticides, artificial fertilisers (which burst cell walls), ploughing and digging (which chops up the fungi). We are evidently quite daft to do that to our friends. Take phosphorus fertiliser as a different example of daftness. Without phosphorus **NO** life forms can exist. Farmers pour phosphorus fertiliser onto the ground in a form which the plants can take up and is water-soluble. However, on contact with soil phosphorus fertiliser reacts chemically and changes into a form which is unavailable to plants, just to confound the farmer. Now, if bacteria and fungi are established around plant roots they can release enzymes to convert the phosphorus back to a form available to the plant and so a proportion can be taken up by the plant. (Even so, the majority of the phosphorus fertiliser ends up being leached from the soil into streams, rivers and the sea, causing immense algal blooms which are of constant concern.) If mankind were to kill off all the bacteria and fungi then all of the phosphorus fertiliser would end up in the sea and the plants would die. So the answer is quite clear, we must encourage the bacteria and fungi to proliferate and prosper; they are our true friends. That means no chemicals being applied to the land – and no digging and ploughing. On my allotment I have been completely organic since 1973 and have not dug since the year 2000. My crops are good and the amount of effort of growing the crops is much reduced.

The bacteria and fungi anchored to plant roots are not the only soil micro-organisms. We started 450 million years ago on land with just bacteria attached to algae. Today there are billions of species of soil micro-organism from archaea to bacteria to fungi to protozoa to nematodes to arthropods of various sizes to beetles and worms. They are all there, the soil micro-organisms, eating each other and at the same time releasing nutrients to be taken up by other species and eventually by plants. It is

general mayhem down there, a dog-eats-dog existence. Nevertheless, if undisturbed by Man, the soil micro-organisms work away to produce the right conditions for our plants to grow to provide food for us.

Good gardening!

MIKE MASON

NB. Archaea! I hear you cry! What the devil are archaea? Well, they are probably the most numerous life-form discovered to date. They are about the size of bacteria and were found in the year 2000, ie very recently indeed. That is what is amazing about soil micro-organisms, something can be the most numerous life-form on the planet yet remain undiscovered. It is too early to know the significance of archaea – but the sleuths are on to it. Similarly the true importance of mycorrhizal fungi was not recognised until the 1990s yet those fungi are essential to life on earth, attaching to plant roots along with bacteria to bring nutrients to the plants. Who knows what discoveries lie ahead, how many Nobel Prizes are to be gained from using soil micro-organisms to benefit mankind, to produce better conditions for growing food or as pharmaceutical products or whatever. Very exciting times lie ahead.