MiSAC matters
MICROBIOLOGY IN SCHOOLS ADVISORY COMMITTEE
50th Anniversary Articles

What happens to poo?

Mike Richardson

Have you ever thought about the stuff that animals leave behind? Rabbit pellets, cowpats, horse apples and all the other intestinal 'leavings' of our wildlife. What stops us from being overwhelmed with smelly, squishy, brown stuff? The answer is decay and decomposition, recycling and reuse, brought about by fungi, bacteria and animals. Lift up a dried cowpat and look underneath - you might find worms, beetles and other invertebrates, which feed directly on the dung or on the other things that are living on or in it - a whole little world full of life.

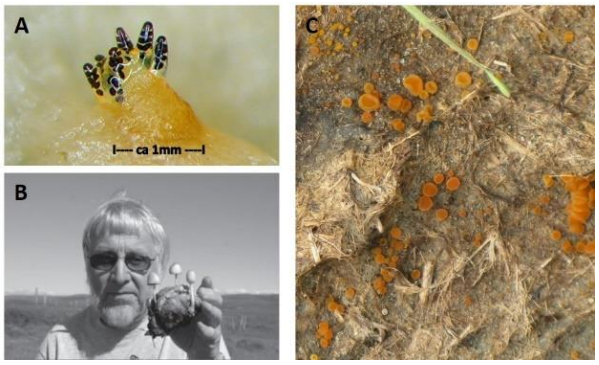

Figure 1. (**A**) *Ascobolus immersus* ready to discharge spores. Image PDD 95203 from https://scd.landcareresearch.co.nz/ ©JA Cooper. (**B**) Icelandic horse dung ('horse apple')' with toadstools. (**C**) *Cheilymenia granulata* (cup fungus) on a cowpat.

Some of the most accessible of organisms which grow on poo are members of that third and most important of Kingdoms – the Fungi. Coprophilous fungi [*kopros* (Greek) = dung, *philos* (Gr) = loving] form an ecological group that lives on dung, particularly that of herbivores, by secreting enzymes to break down organic compounds within it. The group contains fungi from all the main taxonomic groups – basidiomycetes [toadstools], ascomycetes [cup fungi] and 'zygomycetes' [pin-moulds and relatives] – so is ideal for learning about identification and classification, as well as aspects of ecology and distribution (**Figure 1**).

***Getting around – spore dispersal*.** The spores of many coprophilous fungi are present on grass eaten by herbivores, pass through the gut of the animal and emerge in the faeces. Their thick walls are partly broken down by digestive enzymes ensuring they will germinate readily. Since most animals do not feed close to where they deposit their dung it is necessary to get the spores away from the dung and to feeding areas. To achieve this the fungi have developed very elegant and efficient spore dispersal mechanisms. This is often done by explosively discharging spores into the air stream - the higher the better - so many have light sensors and discharge their spores around midday, shooting spores towards the sun when it is highest in the sky in order to have a better chance of getting into the air stream and being dispersed some distance. If those spores have a gelatinous coat or appendages they will stick where they land; if that landing place is a plant leaf or stem, then their future is bright. They may, however, be there for some time, in sunlight, so many spores have pigments to protect their genetic material from damage by ultra violet light.

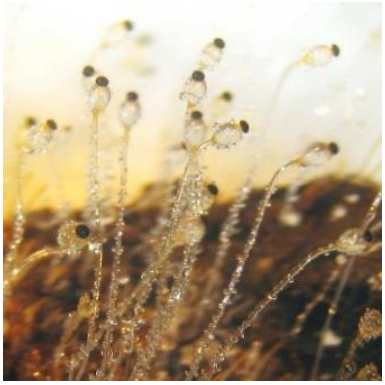

Figure 2. *Pilobus crystallinus* - pointing towards the light. See: https://www.youtube.com/watch?v=1KoKDCwJOJQ

Pilobolus is a good example of a fungus with an explosive spore discharge mechanism (**Figure 2**). The black sporangia, which are <1 mm diameter and contain hundreds of spores, are shot off around midday with an acceleration of 20000*g*, 'faster than a speeding bullet', to reach a speed of about 90km/h and travel <2.5 m in still air - a truly remarkable biological phenomenon.

Studying dung fungi. In order to study the fungi that grow on herbivore dung, and observe the succession of species as they develop, scientists put a sample of the chosen dung into a container with a transparent lid so the fungi can be readily seen and identified (**Figure 3**). The container provides a supply of air, is lined with damp paper towels and is then incubated in a place with suitable light and temperature. A succession of fungi grows without any further intervention over a period of 3-4 weeks. This is a procedure carried out by scientists but not permitted in schools at present.

Figure 3. Damp chamber incubation.

Growth and Succession. Different species of coprophilous fungi have different nutritional requirements; some can only use the simple nutrients that remain in the dung - residual carbon and nitrogen compounds - and appear quite quickly, in a day or two. Others which are able to use more complex compounds in the substrate, like the complex polysaccharides and lignin from undigested plant material, take longer to appear so an ecological succession can be demonstrated over several weeks of incubation. Usually it is the pin-moulds (including *Pilobolus*) that appear first, then the cup fungi (e.g. *Ascobolus*), and after a week or so small ink caps and flask fungi will appear. If the dung is not fresh when collected, then some fungi may well already be present.

***Research findings*.** Samples collected from a range of latitudes and across different continents in various parts of the world, to observe the ecology and diversity of coprophilous fungi on different dung types, show that some species are quite particular, others not; some like it warm, others like it cool. The phenomenon of an increase in diversity of organisms towards the equator, which is observed in plants, animals and larger fungi also applies to dung fungi. Such studies also reveal new species to be discovered and described and their metabolites investigated for novel chemicals, such as antimicrobials, useful to Man.

Find out more:

- *Keys to Fungi on Dung*. Richardson M.J. & Watling R. Can be downloaded from: http://www.gutenberg.org/files/57291/57291-h/57291-h.htm
- A classic overview: - Webster J. (1970). Coprophilous fungi: Presidential address. *Transactions of the British Mycological Society* **54**: 161-180.

AUTHOR PROFILE

Mike Richardson is a retired plant pathologist with the Scottish Civil Service, mainly researching on the importance of seed-borne pathogens of cereals and wider aspects of crop loss assessment. He continues to have an interest in most aspects of biology, fungi particularly, travel, photography and gliding. In retirement, he has concentrated on studies of coprophilous fungi and carried out research, with his wife, on invertebrate ecology and diversity in Caribbean rain forests, in particular Puerto Rico.

https://www.geograph.org.uk/profile.php