

Plant Bioindicators

Notes by Dr Chris Maughan to accompany webinar held on 05.12.23 ([link to recording here](#))
for the North Pasture & Profit in Protected Landscapes Programme

What are 'plant bioindicators'?

- Bioindicators are living organisms which are 'utilized to screen the health of the natural ecosystem' (Parmar et al. 2016)
- This approach focuses on plants (especially 'weeds', or rather 'non-crop plants') as a way to evaluate and monitor soil 'condition'.



How do they work?

- All plants require specific 'germination conditions' (i.e. varying amounts of temperature, moisture, light, pH, etc.) in order to grow and thrive.
- By mapping the germination conditions of a 'weed community' (i.e. the sum total of all plants in an area) we can infer underlying soil conditions and monitor how they change over time.
- Looking systematically at 'weed communities' (rather than individual or conspicuous species) helps to build a more detailed picture of the soil being analysed.

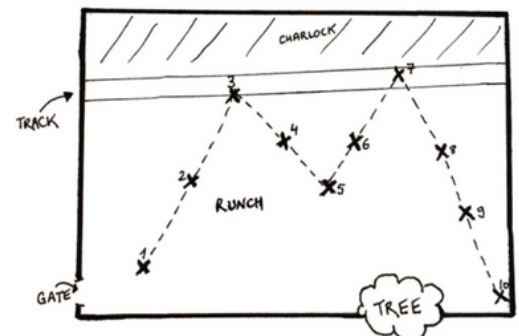
Why might they be useful?

- Compared to some other soil diagnostic tools, plant bioindicator analyses can be low-tech, and require small cost and time investments.
- They can also help us to increase and improve the visual monitoring of the land we manage and learn more about the ecosystems found there.
- Evidence suggests that the higher diversity of weed species in cropping systems the lower the the yield penalty (Storkey and Neve 2018).
- Plant bioindicators can therefore also help us foreground the ecosystem services provided by weeds, and more substantially consider them in farm system design, rather than simply removing them.

How can they be used?

We recommend a five step process based on the [DAFOR](#) botanical surveying technique. This process is detailed in full [here](#) (Maughan & Amos 2022), but in summary consists of the following:

1. Identify all plants in the study area.
2. Map out the area and sampling route.
3. Conduct a 10 sample botanical survey, noting the percentage cover of the most abundant species, and generating a score (0-5) for each species.
4. Using the [bioindicators species guide](#), look up the bioindicator characteristics for each to build a picture of the underlying soil conditions.
5. Conduct a 'spade test' or another type of soil test to compare and contrast findings.



Pointers for practice

- Conduct bioindicator surveys during the summer months, in order to coincide with plant flowering or 'anthesis', and thereby make species identification easier.
- Use plant bioindicators alongside other soil diagnostic tools to increase reliability and depth of understanding.
- Feel free to adapt the approach to your needs (i.e. in terms of sampling rate and time of year) but be consistent between samples and surveys!
- Conduct surveys with other farmers and growers to practice the technique and increase opportunities for joint learning.

Further reading

Beeby, J. (2013). *Test your soil with plants* (2nd ed). Ecology Action.

Ducet, G. (2014). *L'encyclopédie des plantes bio-indicatrices alimentaires et médicinales: Guide de diagnostic des sols. Vol. 1* (6. éd, Vol. 1). Ed. Promonature.

Maughan, C., & Amos, D. (2022). [*Weeds as Bioindicators: A Farmer's Field Guide*](#). Pearl Moss Press.

Parmar, T. K., Rawtani, D., & Agrawal, Y. K. (2016). Bioindicators: The natural indicator of environmental pollution. *Frontiers in Life Science*, 9(2), 110–118.

Storkey, J., & Neve, P. (2018). What good is weed diversity? *Weed Research*, 58(4), 239–243.

