

Soil seedbank diversity of different niches within arable farmland

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Introduction.

- Weeds that germinate from the soil seedbank are the best indicator of arable diversity ...
 - ..and indiscriminate herbicide use has caused a serious decline in farmland diversity.
 - Though germination methods use simple treatments to break seed dormancy.....
 - ..they may not be completely effective and dormant seeds (diversity) may remain in the soil.
 - We plan to use naturally occurring bioactive chemicals to assess the hidden dormancy.
- However, first we had to define the baseline levels of diversity for our study areas

Measuring the baseline levels of soil seedbank diversity.

Approximately 1 m³ of soil (20 cm deep) was extracted from four diverse locations (shown above).

- A Location 1: high pilmore: the fallow ground site.
- B Location 2: the standing ground. Use to store and access heavy farm machinery.
- C Location 3: a wildflower-meadow strip. This borders a field that is under crop rotation.
- D Location 4: within a barley crop.

- Soil was homogenised and fifty soil replicates were processed for each location.
- These were positioned in a randomised-plot design within a glasshouse (shown opposite).
- The numbers of each species that emerged was monitored over a four week period.



Biodiversity estimates using the Shannon Index.

Shannon diversity index (H') : fallow > wildflower strip > crop > standing ground (p < 0.05)

Shannon Evenness (H'E): fallow > wildflower strip = crop > standing ground (p < 0.05)

Table 1.

Location Number	Description	S	N	H'	H'E
1	Fallow	9.5 ± 0.36*	129.2 ± 5.86*	1.82 ± 0.03	0.81 ± 0.01
4	Cropped	8.8 ± 2.4	110.8 ± 5.85 ^{ns}	1.15 ± 0.05	0.63 ± 0.02
3	Wildflower margin	8.7 ± 0.47 ^{ns}	56.7 ± 1.9	1.37 ± 0.03	0.63 ± 0.01
2	Standing ground	6.6 ± 0.55	74.9 ± 2.89	0.72 ± 0.06	0.38 ± 0.02

S = Number of different species found within each replicate (species richness). N = Total number of individuals found within each replicate.
* = significantly greater p < 0.05 / NS = not significantly different.

Arguably, evenness (H'E; Table 1 above), is the best measure of diversity, and on this basis:

The fallow soil seedbank is most diverse.

- Shown by the greater number of different species and the total number of individuals (Table 1).
- Surprisingly, cropped = fallow soil seedbank: but the former is dominated by only 5 species (Table 2).

The wildflower-meadow strip = cropped seedbank.

- This is surprisingly and due to especially low number of individuals (N) in the wildflower meadow (Table 1).
- But, each site is dominated by a only 5 and 4 species respectively... (Table 2).
 - o ...3 of the species being in common to both sites! (Table 2).
- This may reflect the common cultivation histories for these sites.
 - o Both have been cropped and exposed to herbicides.
 - o The wildflower meadow strip is sown with a limited species and perhaps at low density.

The standing ground seedbank is least diverse.

- This indicates the positive impact of soil disturbance that allows viable seed to resurface.
- Disturbance should be followed for a period of non-disturbance to facilitate re-seeding.

Conclusions to promote the diversity of wild plants in agricultural landscapes.

- Avoid frequent heavy mechanical damage to the soil surface.
- Allow soil disturbance/turn-over, and allow time for re-seeding afterwards.
- Avoid herbicides and artificially sowing of annuals.
- Use the resources of the existing seedbank: these appear significant - even in cropped soils.
- Best-disturbance practice needs determined through empirical experimentation.

References.

- Hawes C., Begg G.S., Squire G.R., Iannetta P.P.M. (2005) *Oikos* 109, 521-534.
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Species above-ground at each sampling location.

Table 2	1 Fallow	4 Cropped	3 Wildflower-Meadow	2 Standing Ground
Species Common Name				
Annual Meadow Grass	368***	562***	345***	613***
Black-grass	272***	16	2	2
Chickweed			13	4
Orache	1	1	24	1
Forget-me-not		5	5	59**
Groundsel			2	7
Knotgrass	283***	46*	55**	2
Mayweed	91**		47*	5
Nipplewort	35*			
Red Deadnettle		37*	8	1
Sowthistle	50*		8	6
Spurrey	83**	1	3	1
Thistle	18	2	1	4
Yorkshire Fog		1		
Fat Hen		4	9	2
Common-field Speedwell	82**	392***	43*	24
Fumatory	1	35*	2	2
Mares tail	7			
<i>Epilobium</i> spp	1	6		2
Thalcress				14
Frequency Classification				
Over 100 (***)	3	2	1	1
50-100 (**)	3	2	1	1
30-50 (**)	2		2	
0-30	5	10	11	15



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