Stapledon Memorial Trust Travelling Fellowship

Summary report

Comparing herbal leys with grass/clover mixtures

Dates: 28 Aug - 18 Sep, 2017 and 30 Apr - 25th May, 2018

Location: Institute of Grassland Science, University of Göttingen

Supervisor: Dr. Johannes Isselstein

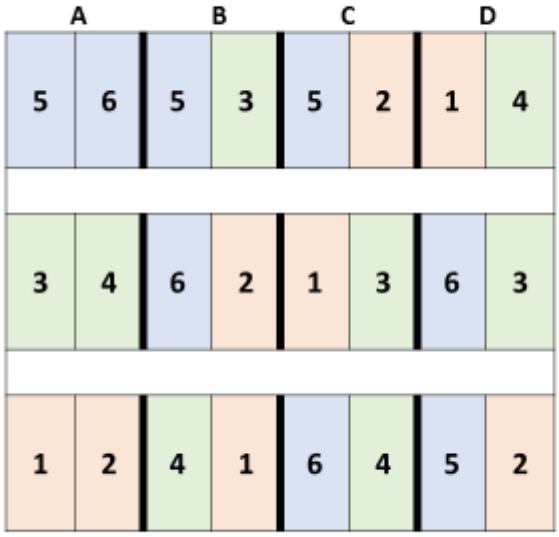
Participant: Paul Muto, Senior Specialist, Grassland Agronomy, Natural England
Paul.Muto@naturalengland.org.uk

Aims

- Develop skills in agronomic experimentation
- Collect data from experiment comparing herbal ley with grass/clover mixture
- Develop further collaborative opportunities with the University of Göttingen
- Explore agri-environment pilot, FRANZ (Future Resources, Agriculture and Nature Conservation)

Herbal ley trial plots

The experiment was based at the Institute of Grassland Science, Von-Siebold-Str. 8, Göttingen. The plots were sown on the 29th May, 2017 as a 2 x 3 factorial (2 seed mixtures, 3 defoliation treatments) with four replications. Plot size was 1.5m x 3.0m.



Treatment	Seed mix	Cut
1	D	STD.
2	S	STD.
3	D	Early
4	S	Early
5	D	Late
6	S	Late

→ N

The legume and herb-rich ley consisted of the following mix

Grasses (43%)

- Cocksfoot (*Dactylis glomerata* 'Treposno') - 2.5 kg/ha
- Perennial ryegrass (*Lolium perenne* 'Premium') - 2.5 kg/ha
- Timothy (*Phleum pratense* 'Promesse') - 1.7 kg/ha
- Meadow fescue (*Festuca pratensis* 'Laura') - 1.5 kg/ha

Legumes (35%)

- Red clover (*Trifolium pratense* 'Altaswede') - 1.2 kg/ha – 6.3%
- White clover (*Trifolium repens* 'AberHerald') - 0.7 kg/ha – 3.7%
- Sainfoin (*Onobrychis viciifolia* - commercial) - 1.2 kg/ha – 6.3%
- Birdsfoot trefoil (*Lotus corniculatus* 'Leo') - 1.2 kg/ha – 6.3%
- Lucern (*Medicago sativa* 'Plato' – covercoat rhizobium inoculated) - 1.2 kg/ha – 6.3%
- Persian clover (*Trifolium resputinatum* 'Laser') - 1.2 kg/ha – 6.3%

Forbs (22%)

- Forage burnet (*Sanguisorba minor* - agricultural) - 2.2 kg/ha – 11.5%
- Yarrow (*Achillea millefolium* - agricultural) - 0.2 kg/ha – 1%
- Sheeps parsley (*Petroselinum sativum* - agricultural) - 1.0 kg/ha – 5.2%
- Ribwort plantain (*Plantago lanceolate* 'Endurance') - 0.5 kg/ha – 2.6%
- Black knapweed (*Centaurea nigra*) - 0.2 kg/ha – 1%
- Common Sorrel (*Rumex acetosa*) - 0.05 kg/ha – 0.26%

The conventional grass/clover ley consisted of the following mix

- Perennial ryegrass (*Lolium perenne* - 50%)
- Meadow fescue (*Festuca pratensis* - 20%)
- Smooth meadowgrass (*Poa pratensis* - 10%)
- Timothy (*Phleum pratense* - 15%)
- White clover (*Trifolium repens* - 5%)

Cutting dates - 2017

2017	**First cut**	**Second cut**
All plots	**08 Aug**	**05 Sep**

Cutting dates - 2018

2018	**First cut**	**Second cut**	**Third cut**	**Fourth cut**
Standard	**10 May**	**20 Jun**	**10 Aug**	**15 Oct**
Early	**1 May**	**30 Jun**	**15 Aug**	**15 Oct**
Late	**1 May**	**1 Jun**	**30 Aug**	**15 Oct**

Harvest was taken with a Haldrup Harvester and each plot forage weight was recorded. Two subsamples were taken from each plot, one to determine dry matter and forage quality and the other to determine botanical composition by separation and dry matter determination.

Results

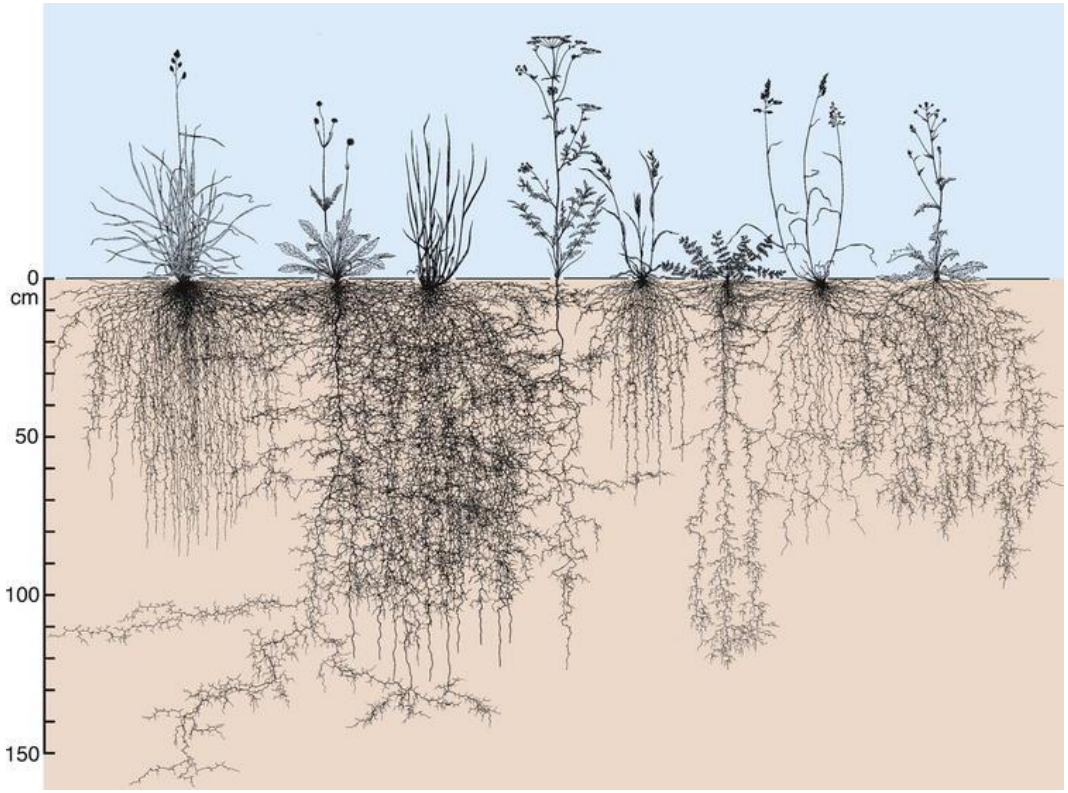
- Yields in herbal leys are higher (due to inclusion of Lucern)
- Weed pressure is lower in herbal leys, but by year two, weeds in both mixtures are minimal
- Plantago is most abundant herb, but salad burnet and yarrow also present.
- Results from 2018 for forage quality and effect of cutting dates is currently being analysed

Conventional grass/clover ley on left, herbal ley on right.

Lessons Learned

Biodiverse plant mixtures are agronomically complex. The variation in seed mixture composition and sowing rate for multi-species leys require extensive field experimentation to determine the optimal seed mixture for establishment. Shifts in botanical composition result from management factors, time and fertility management.

Diversity in forage mixtures is better understood by assessing plant functional groups rather than overall numbers of species. A functional group is determined by the specific functional traits shared by a group of plants. These can be physical, such as growth characteristics (height, rooting patterns), biological, for example, groups of plants that share the ability to fix atmospheric nitrogen or to share communities of mychorrizal associations, chemical, as in plants containing condensed tannins or with anthelmintic properties or taxonomic, those from the same plant family



Potential Applications

Grass, legume and forb combinations can support pollen and nectar dependent species, improve soil quality and produce forage for livestock or biomass for further processing. They can be produced on a field scale or within existing cropping as margins, strips or field corners. They can be short-term or permanent. Although versatile, establishment systems and management guidance need further investigation.

Further collaboration with the University of Göttingen is being sought in order to build a research platform focussed on the establishment and management of multi-species mixtures. An expanded research programme is being developed to investigate multi-species mixtures biofuel applications, both ethanol and solid fuel with initial tests to take place at the University of York in 2019.

Linked Projects

- Co-supervision of Jeremy Clarke, PhD student at the University of York under Dr. Kelly Redeker. The investigation is focussed on plant diversity effects on soil carbon in temporary agricultural grasslands.
- FRANZ Programme (agri-environment pilot)
- Herbal Ley Network - ADAS and AHDB have initiated a new farm network focusing on the use of grass and herbal leys – workshop in Coventry 19 Apr 2018.

Other engagement and collaboration while in Göttingen

A visit was made to the "Sustainable Intensification of Agriculture Through Agroforestry" project site in Reiffenhausen with Dr. Norbert Lamersdorf. This is a joint research programme managed by the University of Göttingen, University of Kassel and HelmholzZentrum München. The project is assessing the potential for woody biomass of willow, alder and poplar for multiple applications. In addition to the tree crops, low-input, multi-species grassland is being assessed for productivity and biodiversity provision in the field areas between the alley crops of trees.

Below left: Biodiverse forage mixtures are being grown between rows of coppice willow

Dr. Norbert Lamersdorf displays products manufactured from wood biom
ass.

Below: Structural material made from 60:40 wood plastic composite.

FRANZ Project - Future Resources, Agriculture & Nature Conservation

A field visit to several farms taking part in the pilot FRANZ project was taken during the first study leave. This pilot agri-environment scheme is taking place on ten demonstration farms nationwide and successful measures will be communicated and promoted in the farming community, with the intention to increase implementation on a national scale. Several land management options were visited including permanent grassland, arable options to support farmland birds and temporary leys for soil resource protection.

Left: participating farmer assesses undersown grass/legume ley in an arable rotation.

A key part of the FRANZ pilot is to work with farmers and other land managers to assess their engagement with the pilot scheme and to consider their feedback in helping to design to final agri-environment measures and scheme functionality. Farmer feedback is an important consideration in the recent DEFRA monitoring study, EK21/GS4 - Legume and herb-rich ley option assessment (RP04147), and this data is being summarised for publication as a social science paper.

Der Sukzessionversuch – Long-term succession experiment at the Neuer Botanischer Garten

A visit was made to the famous succession experiment established by Prof. Dr. Heinz Ellenberg at the Neuer Botanischer Garten in 1968. The original design consisted of 25 plots which started in a ploughed and sterilised state. Various treatments were then imposed including regular mowing, hay harvest, fertilisation or no management, thus allowing a succession of plants to establish and evolve. Data was collected on soil parameters, biomass yield and the appearance or disappearance of plant species.

The experiment continues to be managed and is used in a wide-range of investigations.

Three treatments of the long-term succession experiment: Far left, mowing in autumn with NPK fertilisation, Centre, mowed twice per year with NPK fertilisation and right, mowed four times per year with NPK fertilisation.

Below: Detail of plot mowed four times per year with no fertilisation

Conservation Goat Grazing, Herdegsen, Northeim, Lower Saxony

A visit was made to observe the use of goats for scrub control on a very steep limestone escarpment with species-rich grassland. The scrub consisted primarily of rose, hawthorn, *Cornus* sp., blackthorn, birch and pine. The grazing is supported by an agri-environment programme that supports goat grazing (>50% animals must be goats) on protected sites at a payment rate of €1,100/ha. The overall site is relatively small, 1.5 ha, but due to the very steep slopes, the actual area being grazed is larger than the documented field size. Over 500m of electric netting is used to manage the 52 meat goats which graze the site twice a year in Apr and Sep. Periods of no grazing are observed in order to protect the caterpillars of several target butterfly species.

Follow-up activities

- Currently analysing results from two years of data collection from Göttingen experiment
- Will make visit to Göttingen in early 2019 to collect soil samples for further analysis
- Aiming to publish results from Göttingen experiment in 2019
- Aiming to publish one or two papers from NE's monitoring and evaluation project, "EK21/GS4 - Legume and herb-rich ley option assessment (RP04147)"
- Would like to develop further agronomic trials investigating different herbal ley mixtures for specific applications