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## Multi-species grassland swards



### Key external stakeholders:

Beef/sheep/dairy farmers, agricultural merchants and farm input providers, agricultural advisors and consultants, policy makers

### Practical implications for stakeholders:

Multi-species grassland swards, if optimally formulated, offer an opportunity to increase yields at low inputs of inorganic N or achieve similar yields at reduced inputs of inorganic N compared to monocultures of perennial ryegrass. However, challenges relating to mid-season digestibility, ensilability and possibly persistence still need to be solved.

### Main results:

- When grown without inorganic N input the largest yield increase across the progression from grass to grass-legume to grass-legume-herb swards derived from the inclusion of N-fixing legumes, with a relatively small additional benefit accruing from including complementary species from a third functional group (the herbs ribwort plantain and chicory).
- The magnitude of the yield advantage of two different multi-species swards over a perennial ryegrass sward declined as the rate of inorganic N applied increased. However, under the prevailing management, increasing the rate of inorganic N application reduced the persistence of the legumes and herbs within these multi-species swards.
- Compared to perennial ryegrass, multi-species swards had a slower decline in digestibility prior to the first-cut silage harvest, but they subsequently had lower digestibilities at mid-season harvests.
- Under favourable ensiling conditions unwilted grass-red clover binary mixture and multi-species mixture swards can preserve satisfactorily as silage, comparable to a perennial ryegrass sward receiving inorganic N fertiliser. However, when ensiled under more challenging crop conditions the binary mixture and multi-species mixture swards had a greater requirement than perennial ryegrass for effective preservative or wilting treatments in order to preserve satisfactorily.

### Opportunity / Benefit:

Optimally formulated multi-species grassland swards can markedly outyield perennial ryegrass monocultures when receiving low inputs of inorganic N fertiliser, or they can produce similar yields to perennial ryegrass with reduced inputs of inorganic N. This has potential cost and environmental attractions. However, issues related to mid-season digestibility and the ease of preservation as silage under some conditions need to be solved. Further issues can arise with the persistence of multi-species swards when prevailing management combines high inputs of inorganic N with no spring grazing prior to closing for silage production.

### Collaborating Institutions:

UCD

**Teagasc project team:** Thomas Moloney (Walsh Fellow)  
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**External collaborators:** Dr. Helen Sheridan, University College Dublin

### 1. Project background:

Perennial ryegrass has been the preferred species when reseeding grassland in Ireland during the past 50 years. In order to deliver on its potential, such swards usually require good soil fertility and the input of high rates of inorganic nitrogen. Including legumes such as white or red clover in seed mixes can increase herbage yields and facilitate reduced input of inorganic nitrogen through fixation of atmospheric nitrogen. Their palatable and nutritious nature is also beneficial for livestock. Progressing the species mixture in a sown grassland sward beyond perennial ryegrass plus white or red clover offers potential to provide further complementary competitive effects that can better optimise season-long production of quality herbage and reduce variability in yield between years. However, the species (and cultivars) included need to be appropriately matched to deliver these benefits. Persistence of such swards is also important.

### 2. Questions addressed by the project:

- What is the seasonal and annual herbage production for a number of monocultures, binary mixtures and multi-species mixtures managed for silage production?
- What influence does inorganic N fertiliser have on the yield, botanical composition and nutritive value of these swards?
- How does the number of spring grazing rotations impact on multi-species sward yield and nutritive value when subsequently harvested for silage production?
- When should multi-species swards be harvested for first-cut silage, and what implications has this for subsequent silage harvests?
- How readily do these multi-species swards successfully conserve as silage compared to perennial ryegrass?

### 3. The experimental studies:

- Replicated field plots provided an array of grass, grass-clover and grass-clover-herb swards, and these were subjected to different inorganic N inputs, spring grazing frequencies and first-cut silage harvest dates.
- The grasses studied were Italian ryegrass, perennial ryegrass and timothy, the legumes were white clover and red clover, and the herbs were ribwort plantain and chicory.
- Laboratory silos were used to assess the ensilage characteristics of herbage from selected field plot treatments.
- Herbage yield and both botanical and chemical composition were determined.

### 4. Main results:

- Grass species yield rankings are not universally consistent. When grown with inorganic N applied at 360 kg/ha/year, a monoculture of Italian ryegrass had a greater annual yield than perennial ryegrass or timothy. However, when grown in a binary mixture with red clover the timothy-based sward had a greater yield than the Italian or perennial ryegrass-based swards.
- When grown without inorganic N input the largest yield increase across the progression from grass to grass-legume to grass-legume-herb swards derived from the inclusion of N-fixing legumes, with a relatively small additional benefit accruing from including complementary species from a third functional group (the herbs ribwort plantain and chicory).
- The magnitude of the yield advantage of two different multi-species swards over a perennial ryegrass sward declined as the rate of inorganic N applied increased. However, under the prevailing management, increasing the rate of inorganic N application reduced the persistence of the legumes and herbs within these multi-species swards.
- The nutritive value of binary mixtures of grass and legume could be predicted from the nutritive values of their monocultures. However, the nutritive value of multi-species mixture swards could not be similarly predicted.

- Compared to perennial ryegrass the multi-species swards had a slower rate of decline in digestibility prior to the first-cut silage harvest, but they subsequently had lower digestibilities at mid-season harvests.
- Under favourable ensiling conditions unwilted grass-red clover binary mixture and multi-species mixture swards can preserve satisfactorily as silage, comparable to a perennial ryegrass sward receiving inorganic N fertiliser. However, when ensiled under more challenging crop conditions the binary mixture and multi-species mixture swards had a greater requirement than perennial ryegrass for effective preservative or wilting treatments in order to preserve satisfactorily.
- Increasing beyond a single grazing rotation in spring prior to closing a sward for first-cut silage production reduced the yields for first cut silage. Deferring the first-cut harvest date could allow silage dry matter yield to recover but at a markedly lower digestibility.
- When a multi-species sward containing two species of each of grass, legume and herb functional groups, and receiving 360 kg inorganic N/ha/year, was grazed in spring prior to closing for silage production, it showed no signs of not persisting under the prevailing conditions.

### 5. Opportunity/Benefit:

Optimally formulated multi-species grassland swards can markedly outyield perennial ryegrass monoculture swards when receiving low inputs of inorganic N fertiliser, or they can produce similar yields to perennial ryegrass at reduced inputs of inorganic N fertiliser. This has potential cost and environmental attractions. However, issues with mid-season digestibility and with the ease of preservation as silage under some conditions need to be solved. Further issues can arise with the persistence of multi-species swards when prevailing management combines high inputs of inorganic N with no spring grazing prior to closing for silage production.

### 6. Dissemination:

#### Main publications:

Moloney, T., O'Riordan, E.G., Sheridan, H. and O'Kiely, P. (2017) 'The effects of defoliating grass in winter or spring on herbage yields and ensilage characteristics' *Grass and Forage Science* 72: 22-37 [doi: 10.1111/gfs.12207].

Moloney, T., Sheridan, H., Grant, J., O'Riordan, E.G. and O'Kiely, P. (2019) 'Binary- and multi-species grassland swards relative to monocultures in intensive silage systems: 1. Yield' *Grass and Forage Science* (under review).

Moloney, T., Sheridan, H., Grant, J., O'Riordan, E.G. and O'Kiely, P. (2019) 'Conservation efficiency and nutritive value of silages made from grass-red clover and multi-species swards compared to grass monocultures' *Irish Journal of Agricultural and Food Research* (under review).

#### Popular publications:

Moloney, T., Sheridan, H. and O'Kiely, P. (2015) 'Species and nitrogen fertilisation effects on the yield of herbage managed for silage production' *Proceedings of the British Grassland Society 12<sup>th</sup> Research Conference*, Aberystwyth University, 7<sup>th</sup> September, p31-32.

Moloney, T., Sheridan, H., O'Riordan, E.G. and O'Kiely P. (2016) 'Nitrogen fertilisation effects on multi-species and *Lolium perenne* yields and composition under silage management' *Proceedings of the 26<sup>th</sup> General Meeting of the European Grassland Federation*, Trondheim, Norway, 4<sup>th</sup> September, 21: 188-190.

O'Kiely, P. and Moloney, T. (2015) 'Multi-species grassland swards for silage' *Forage & Nutrition Guide – Irish Farmers Monthly*, April, p7-8.

### 7. Compiled by: Pdraig O'Kiely