Field lab: Does red clover within grass leys impact ewe fertility?

Final report

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1 Field Lab Aims

The field lab aims to shape environmental solutions for farm businesses alongside improving farm profitability by establishing whether grazing ewes on grassland swards containing red clover has any effect on fertility. The project will benefit commercial sheep farmers and their advisers who are currently relying on out-of-date research.

2 Background

Red clover contains phyto-oestrogens which mimic oestrogen. Research conducted in the 1960s and 1970s in the southern hemisphere on pure clover swards found that phyto-oestrogens adversely affect ewe fertility. Industry advisers, including vets and grassland consultants, advise livestock producers not to allow breeding ewes to graze on leys that contain red clover before or during tupping, or for more than a few months. As long as this guidance remains unchallenged, the use of red clover enriched swards is restricted to non-breeding livestock for extensive periods of the grazing season. This limits the practical use of legumes and discourages sheep farmers from using red clover in their grass leys. Thus, the benefits of red clovers, such as drought tolerance, nitrogen fixation, and improved soil structure, are lost.

Despite the historic research being predominantly conducted on pure red clover swards; red clover is rarely grown as a monoculture in the UK. The percentage of legumes in a seed mix is typically 20-30%, and 10% for red clover. There is currently no farm-based research evidence nor a comprehensive investigation of on-farm practices to support changes in the guidance despite some farmers grazing multi-species grasslands which contain red clover before and during mating without experiencing adverse effects.

Receiving scientific support to robustly test red clover leys, will enable this field lab to develop the knowledge and technical understanding in this area in real-time and give farmers confidence in agroecological farming practices that can improve their bottom line, build farm resilience, and protect the environment.

3 Methodology and Data Collection

3.1 Experimental Design

Participants included four farmers from the West Midlands and Mid Wales who already had red clover swards in place on their farms, along with breeding ewes. Each of the four farms has between 500 and 2,000 breeding ewes and selected at least 160 of them for the trial. The chosen ewes were then randomly divided into two sub-flocks, taking into account age, breed, and past performance. One half was grazed on herbal leys containing red clover, and the other half (the control group) grazed grass leys with no red clover. The two groups of ewes contained a similar mix of ages, body condition scores and breeds.

3.2 Farmer Interviews

Interviews were conducted with the farmers before the trial commenced to gather farm background information such as soil type, the proportion of red clover on the farm, motivations for using red clover, establishment dates of swards used in the trial, and seed mixture and varieties sown. Previous fertility performance data and details of normal grazing policies were also recorded. Appendix 1

provides an example of the document used during the interview. A second interview was conducted at the end of the red clover grazing period to gather information on the treatment of the sward, stocking rate, length of time grazed before tupping, when the rams were removed from the ewes, when the ewes were moved off the red clover swards and recording requirements at scanning time. Appendix 2 provides an example of the document used during the interview.

3.3 Sward Assessment

The sward height was measured using an AHDB sward stick in each red clover and non-red clover trial field three weeks before tupping and at the beginning of the mating season to determine the total availability of forage. A total of 20 measurements were taken per field and an average was calculated. During the initial sward height assessment, a sample of each sward was also sent for lab analysis to determine the dry matter and nutritional content of the sward using the Near Infrared Spectroscopy (NIRS) technique.

Further assessments were carried out to assess the quantity of red clover contained in the sward. The fresh weight percentage of red clover in the sward was measured by cutting and weighing the sward from a 0.5m quadrant (0.25m^2), as shown in Figure 1. Figure 2 shows the red clover plant material being split from the non-red clover material which was then weighed to provide a percentage of red clover content by fresh weight. A second clover assessed the number of red clover plants in a 0.25m^2 quadrant to establish the number of plants per m^2, shown in Figure 3 and Figure 4. This was repeated 10 times in each red clover trial field.

Figure 1: Cutting sward within a 0.25m^2 quadrat.

Figure 2: Red clover material split from non-red clover material.

Figure 3: Measuring red clover per m^2.

Figure 4: Measuring red clover per m^2 on a second farm.

3.4 Treatments

All ewes were treated the same until three weeks before tupping when one subgroup was moved onto a sward containing red clover where they remained for the duration of the mating period. Control sub-flocks were grazed on swards which did not contain red clover. When the mating period ended, the sub-flocks were merged (where possible) to ensure the same management was applied for the remainder of the pregnancy.

3.5 Scanning

Each farm used its existing farm scanning technology to scan each subgroup individually and the scanning results were recorded separately. Scanning results captured the number of lambs each ewe was carrying, scoring 1-4 for singles, twins, triplets, and quadruples and 0 for any ewes that were scanned empty.

4 Results and discussions

4.1 Forage analysis

4.1.1 Quantity of Red Clover

Sward assessments carried out three weeks pre tupping found that the red clover fresh weight content of the herbal leys ranged from 8.9% to 36.9% producing an average of 17.6%, despite the seed mixes all originally containing 10% red clover by weight. The average number of red clover plants per m^2 was 47.3ranging from 21.2 to 86.0 plants per m^2. Higher rates of red clover are expected in the first year, with the plant usually being outcompeted by white clover as the sward gets older. This is demonstrated below in Table 1 which shows the youngest sward to have the highest population of red clover, measuring 36.9% fresh weight compared to the oldest sward which measured 8.9% fresh weight. Table 1 provides the overall results from the forage assessments which analysed clover content within the swards across each of the four participating farms.

Table 1: Herbal ley clover content for each participating farm.

	T Teague	S Jones	M Jones	G Goring	Average
Age of sward	30mths	3mths	12mths	18mths	
Red clover fresh weight % at entry	8.9	36.9	10.2	14.6	17.66
Red clover plants per m^2 at entry	43.5	86.0	38.5	21.2	47.30

A positive relationship was identified between the number of red clover plants per m^2, and the red clover fresh weight content of a sward as shown in Figure 5.

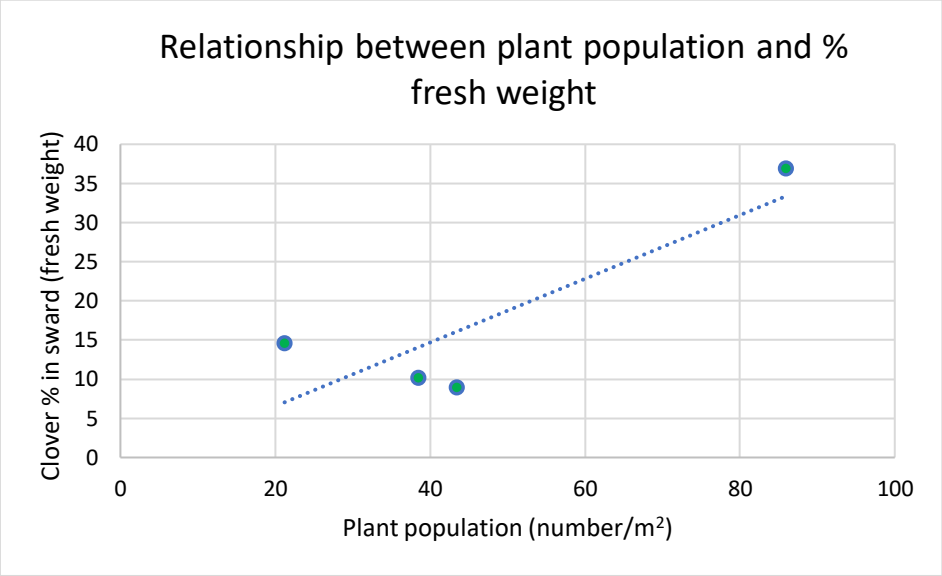

Figure 5: Relationship between red clover plant population and % clover fresh weight in the sward.

4.1.2 Sward Height

Both sward height and nutritional analysis were undertaken in case any negative effects of diet on scanning figures were identified and the availability and quality of forage was felt to be a significant factor. No negative effects on fertility were identified across the trial swards. For each of the participating farms, the height of the red clover sward and the non-red clover sward are shown in Table 2. The sward heights for red clover swards were higher than those for non-red clover swards and remained higher on each farm after the tups were added, as shown in Figure 6.

Table 2: Sward heights for each farm when the ewes went in, and the tups were added.

	T Teague		S Jones		M Jones		G Goring		Average	
	Grass	Red Clover	Grass	Red Clover	Grass	Red Clover	Grass	Red Clover	Grass	Red Clover
Sward height (cm) – entry to sward	13.7	14.8	4.2	9.1	9.8	11.6	4.8	8.0	8.12	10.89
Sward height (cm) – tups in	5.4	7.5	4.7	10.1	8.3	9.8	5.7	8.3	6.0	8.93

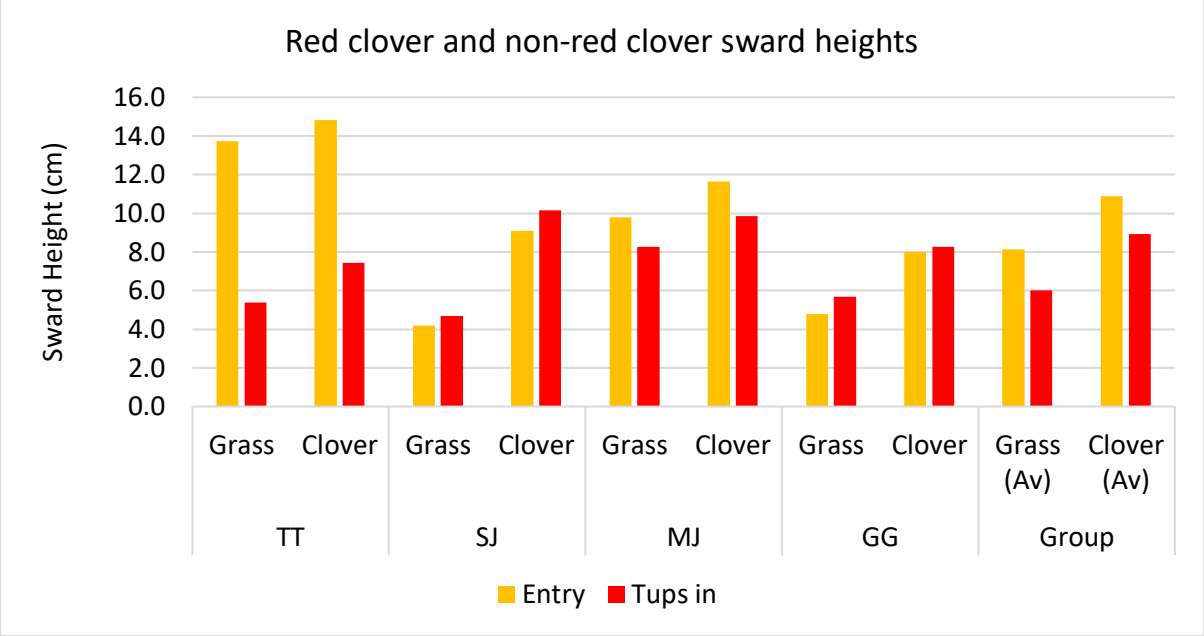

Figure 6: Comparison between the sward height at entry and when the tups were added to the ewes.

4.2 Pregnancy scanning

Table 3 shows the pregnancy scanning results for the control groups and the groups which grazed swards containing red clover. On average the ewes in the control group scanned at 170%, while the ewes mated on red clover swards scanned at 181%. It is thought that the groups of breeding ewes which grazed the red clover swards achieved a higher scanning percentage due to improved availability and quality of forage before and during the mating period.

The number of ewes which were empty at scanning varied between farms but there was no significant difference in the % of empty ewes between the groups grazed on swards containing red clover and the control groups.

Table 3: Pregnancy scanning results.

		Empty	Single	Twin	Triplet	Quad	Total no. of ewes	Lambs expected	Scanning Percentage
T Teague	**Grass**	9	83	91	5	1	189	284	**150**
	Red Clover	7	52	119	9	1	188	321	**171**
S Jones	**Grass**	1	10	53	31	2	97	217	**224**
	Red Clover	1	5	20	18	4	48	115	**240**
M Jones	**Grass**	8	20	61	11	0	100	175	**175**
	Red Clover	5	14	54	18	0	91	176	**193**
G Goring	**Grass**	5	54	20	5	0	84	109	**130**
	Red Clover	7	51	25	18	83	83	101	**122**
Group Average	**Grass**								**170**
	Red Clover								**181**

Three of the four farmers found that grazing ewes on these leys resulted in a positive effect on scanning percentages, although only one of these was deemed 'significant', proving that grazing ewes on swards with red clover had no significant adverse effect on fertility. This supports the conclusion that grazing swards containing red clover before and during the mating period does not negatively affect ewe fertility.

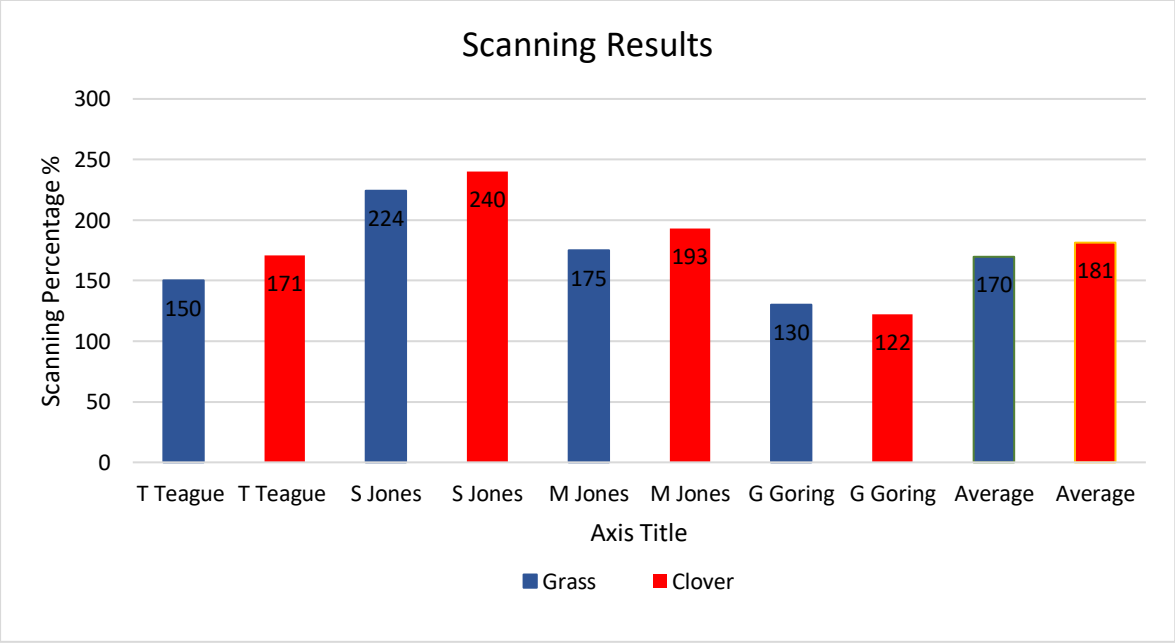

Figure 8: The effect of red clover swards on scanning percentages.

Discussion

Ewes grazing red clover swards had higher scanning rates than those grazing non-red clover swards, indicating that the inclusion of red clover within grass leys did not adversely affect ewe fertility.

Red clover content varied widely between trial swards, as evident in the sward assessment results. Although the percentage of red clover in each seed mix sown was the same on each farm, this finding suggests that the age of a sward and grassland management affect red clover persistence. The red clover content reached 36.9% fresh weight and 86 plants per m^2 on one farm. It is important to understand whether there is a point at which the presence of red clover, even if it is sown as part of a diverse seed mix, will begin to negatively impact the fertility of ewes. In the current trial only one farm had over 15% red clover in the fresh weight and there was no negative impact on scanning figures, but would the same results be obtained in ewes grazing silage leys with ryegrass which often contain 25% red clover (by weight sown)?

While the sward assessments were important to eliminate any negative effects between the two groups on availability and quality of forage, they were time-consuming. Visual assessments in the field were difficult since the differences between red and white clover were hard to discern when the plant wasn't flowering. In the future, fresh weight sward assessments should be replicated to improve accuracy, and the percentage of red clover content should ideally be calculated by plants per m^2 rather than fresh weight content as it is faster and more reliable.

Using a more uniform group of ewes could further improve this field lab. Among the four farms, one noticed a slight decrease in the scanning percentage of ewes grazing on red clover leys compared to the control group grazing on grass leys. The farmer, however, only used a small group of ewes and did not know their full history since they were purchased in the autumn. The scanning operative was not consistent across farms, which could also have led to inaccuracies in the results. To obtain more reliable results in future it is recommended that each farm use the same scanning contractor if possible. It is difficult to test a hypothesis that is focused on the relationship between a dependent and independent variable if there are too many things that differ within the field lab.

Considering the benefits red clover brings to a farm, as well as how it influences ewe fertility, is important. Using out-of-date research to support farming advisors' advice that breeding ewes should not graze leys containing red clover before or during tupping, or for more than a few months, means that farmers are losing out on a host of benefits.

As a nitrogen-fixing legume, red clover improves soil fertility for the next crop in a rotation. Cutting the reliance on nitrogen fertilisers, has the secondary benefit of lowering input costs. The deep roots of red clover help improve soil structure and make pastures more drought resilient. As an alternative to bought-in feeds, red clover provides greater grazing flexibility and reduces the risk of livestock running out of grass since livestock can be grazed in mixed red clover leys throughout the year. Furthermore, red clover can generate an income stream as legume and herb-rich swards are part of the Countryside Stewardship scheme (GS4 £309/ha) and are likely to qualify for the Environmental Land Management Scheme. The increased biodiversity from flowering red clover leys also encourages pollinating insects and other wildlife that depends on them. Finally, red clover contributes to lower emissions and carbon footprint by reducing the need for nitrogen fertilisers and bought-in feed, which in turn lowers greenhouse-gas emissions and helps build a circular economy on the farm.

5 Conclusions

The field lab aimed to disprove historic and out-of-date research which found phyto-oestrogen in red clover adversely affects ewe fertility. According to this ADAS-led study, ewes that grazed leys containing red clover had a higher scanning percentage than ewes that grazed non-red clover leys. Since this study did not show a negative effect on ewe fertility, it could have huge economic and

environmental benefits. The application of agroecological farming practices should give farmers greater confidence and lead them to integrate red clover into grazing swards, which in turn should reduce their input costs, reduce their carbon footprint, and improve farm sustainability. It is hoped that the findings from this study will encourage more businesses to establish legume and herb-rich swards as part of agri-environment schemes, benefiting from red clover's additional advantages as well as generating additional income.

If red clover is to be incorporated into a grass sward without adversely affecting ewe fertility, further work will be necessary to determine whether there is an upper limit to the proportion of red clover. For the conclusions of the study to be more robust, and to show applicability across a wider range of farm systems and soil types it must be conducted across more farms. Further research should also be performed to determine the best way to conserve red clover content in swards in livestock grazing systems, and what should be done regarding reintroducing or stitching red clover into existing swards without ploughing.

The research was conducted well, and the farmers were happy with the results obtained. The group also hopes to inspire others to reap the benefits of growing red clover by challenging and updating 50-year-old research from Australia and New Zealand.

6 Tips and recommendations

- Introduce on a small scale initially and research the species suitable for your farm and soil type
- Define the main objective and do not try to test too many things at once
- Try to control other management so that any differences between treatments can be reliably attributed
- Ideally repeat the trial for more than one year
- Have a trial plan/protocol in place if several farms are taking part to standardise methods

7 Further reading

British Grassland Society 13th Research Conference - Multi Species Swards 2-4th March 2021

FWI 7 top tips on establishing herbal leys

IBERS A review of the effect of legumes on ewe and cow fertility May 2011

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