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Promilleafgiftsfonden for landbrug

Yield and forage quality of 11 different grass clover mixtures during 5 years

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Abstract

Silage of mixtures of grass and clovers is in combination with maize silage the dominant source of roughage for dairy cattle in Denmark. Grass silage is predominantly produced on temporary grasslands which typically persist for 2-3 years as the yield typically decreases 10 % annually. To evaluate different grass mixtures, 2 trials were established in 2017 in Denmark with 11 different grass mixtures with different proportions of the grass species; i) perennial ryegrass, ii) hybrid ryegrass, iii) Festulolium and iv) tall fescue and legumes; v) white clover and vi) red clover. In 2018-2022 the plots were harvested 5 times annually with a Haldrup harvester. The results show that the highest yielding mixtures in metabolisable energy and crude protein in 1st and 2nd year contained a higher proportion of Festulolium and red clover, while mixtures containing tall fescue showed the highest yield in 4th and 5th year. However, the digestibility of organic matter and legume proportion were lowest in mixtures with an initial high proportion of tall fescue, while mixtures containing only white clover as legume showed the highest digestibility of organic matter during all trial years. The results indicate that mixtures with a moderate proportion of tall fescue in combination with perennial ryegrass and legumes can provide a more persistent mixture compared to a binary mixture of perennial ryegrass and white clover.

Keywords: multi-species, yield-stability, persistence

Introduction

Temporary grasslands in Denmark are mostly used for cutting and typically consist of mixtures of perennial ryegrass, festulolium, white clover and to some extend red clover as the yield and forage quality are more stable compared to monocultures of species (Lüscher *et al.*, 2008; Finn *et al.*, 2013). However, temporary grasslands in Denmark only persists for 2-3 years as the yield typically decreases 10 % annually. Hence, it is interesting to evaluate combinations of different grassland species in terms of yield and forage quality over a five-year period.

Materials and methods

2 trials were established in 2017 in Denmark with 11 different grass mixtures with different proportions of grass and legume species based on weight proportion in seed mixtures as shown in table 1. The seed rate of mixtures was adjusted according to seed weight to obtain same plant density. The soil type of the trial sites was predominantly sandy soils with 6 and 12 % clay and the trials were not irrigated. All mixtures were yearly fertilised with 270 kg N, 32 kg P, 268 kg K and 68 kg S per ha applied descending from 1st to 4th cut.

In 2018-2022 the plots were harvested 5 times annually with a Haldrup harvester. A subsample of each plot was mixed from the 4 replicates and dried at 60 degrees for 36 hours and subsequently milled at a Cyclotec mill with 1 mm sieve. Forage quality was determined by content of crude protein, sugars, neutral detergent fibers (NDF), digestibility of organic matter and the legume proportion using dry NIRS.

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Results and discussion

During 1st and 2nd year of growth the yield of metabolisable energy of mixtures containing Festulolium, red clover and/or tall fescue was slightly higher than of mixtures only containing white clover as legume. The legume proportion was highest in mixtures containing both white and red clover, while the digestibility of organic matter was higher in mixtures without red clover or tall fescue.

The legume proportion, and especially the proportion of red clover decreased markedly in 3rd year resulting in no significant yield differences between mixtures. During 4th year the legume proportion decreased further for nearly all mixtures. During 5th year the legume proportion stabilised or even increased as the grass sward was patched for most mixtures favouring an increasing white clover proportion. Hence the difference in digestibility of organic matter between mixtures with/without red clover diminished. The yield was throughout the experiment higher in mixtures containing a high proportion of tall fescue, which also had the lowest digestibility of organic matter and legume proportion as found by Cougnon *et al* 2013.

Table 2 only includes the relative yield of metabolisable energy to mixture 1 as reference. The absolute yield of mixture 1 was 95,2 crop units ha⁻¹ in 1st year in 2018. The yield was rather low due to severe drought in 2018. The yield increases 39 percent for 2nd year where growing conditions were nearly optimal. The following years, the absolute yield decreased 11, 18 and 15 percent respectively for 3rd, 4th, and 5th year. As the trials do not have yearly replicates, it is difficult to generalise these results to any growing period. Figure 1 illustrates the observed yield of metabolisable energy per ha. for selected mixtures.

Conclusion

Inclusion of a moderate proportion of tall fescue in combination with perennial ryegrass and white and red clover could be a promising mixture providing a good combination of a stable yield, a fair legume proportion and digestibility of organic matter.

Acknowledgements.

This study is supported by the Danish Foundation for farming 2019-2022.

References

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| Mixture | Perennial | Hybrid | Festulolium | Tall Fescue | Meadow | White | Red |
|---------|-----------|-----------|-------------|--------------|------------|------------|------------|
| no. | ryegrass | ryegrass | | (Festuca | fescue | clover | clover |
| | (lolium | (lolium | | arundinacea) | (Festuca | (Trifolium | (Trifolium |
| | perenne) | hybridum) | | | pratensis) | repens) | pratense) |
| 1 | 87 | | | | | 13 | |
| 2 | 52 | | | 30 | | 9 | 9 |
| 3 | 57 | | | 30 | | 13 | |
| 4 | 60 | 23 | | | | 9 | 8 |
| 5 | 47 | 40 | | | | 13 | |
| 6 | 42 | | 25 | | 15 | 9 | 9 |
| 7 | 37 | | 45 | | | 7 | 11 |
| 8 | 37 | | 50 | | | 13 | |
| 9 | 32 | | 33 | | | 5 | 30 |
| 10 | 15 | | | 70 | | 6 | 9 |
| 11 | 15 | | | 75 | | 10 | |

Table 1. Seed composition (%) of 11 mixtures based on weight basis

| Table 2. Legume proportion, | digestibility of organic n | natter and the relative | yield of metabolisable energy |
|--|----------------------------|-------------------------|-------------------------------|
| of 11 mixtures for 1 st to 5 th ye | ear of ley | | |

| | Legume proportion, % dry matter | | | | | Dige | estibilit | y orga | nic m | atter | Yield of metabolisable energy (relative) | | | | |
|--------------|------------------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|---|------------------------|------------------------|------------------------|------------------------|
| Mix- ture | 1. year 20 18 | 2. year 20 19 | 3. year 20 20 | 4. year 20 21 | 5. year 20 22 | 1. year 20 18 | 2. year 20 19 | 3. year 20 20 | 4. year 20 21 | 5. year 20 22 | 1. year 20 18 | 2. year 20 19 | 3. year 20 20 | 4. year 20 21 | 5. year 20 22 |

| ref: mixture 1 | | | | | | | | | | 95,2 | 132,7 | 117,1 | 96,3 | 82,2 | |
|----------------|----|----|----|----|----|------|------|------|------|------|-------------------|------------------|------|--------------------|-------------------|
| 1 | 18 | 16 | 12 | 8 | 18 | 76,8 | 78,8 | 76,4 | 78,3 | 79,4 | 100 ^{ab} | 100ª | 100 | 100 ^{abc} | 100 ^{ab} |
| 2 | 44 | 50 | 28 | 11 | 6 | 75,0 | 75,2 | 73,1 | 75,0 | 76,4 | 106ª | 97 ^{ab} | 97 | 103 ^{abc} | 105ª |
| 3 | 21 | 17 | 11 | 6 | 8 | 76,8 | 78,2 | 76,0 | 75,8 | 76,5 | 99 ^{ab} | 93 ^b | 97 | 108 ^{ab} | 96 ^{bc} |
| 4 | 31 | 45 | 29 | 19 | 20 | 73,9 | 75,4 | 74,4 | 76,6 | 78,2 | 100 ^{ab} | 97 ^{ab} | 95 | 94 ^{bc} | 94 ^{bc} |
| 5 | 16 | 24 | 19 | 18 | 33 | 75,4 | 77,1 | 75,9 | 76,4 | 75,4 | 97 ^b | 91 ^b | 94 | 96 ^{bc} | 93 ^{bc} |
| 6 | 35 | 48 | 32 | 21 | 34 | 74,0 | 75,7 | 74,9 | 76,4 | 76,9 | 95 ^b | 97 ^{ab} | 95 | 92 ^c | 89° |
| 7 | 34 | 42 | 24 | 21 | 22 | 73,3 | 75,1 | 74,6 | 76,6 | 77,1 | 103 ^{ab} | 102ª | 101 | 98 ^{bc} | 95 ^{bc} |
| 8 | 21 | 30 | 23 | 19 | 28 | 73,7 | 76,0 | 76,0 | 76,5 | 77,0 | 97 ^b | 97 ^{ab} | 96 | 89 ^c | 87° |
| 9 | 62 | 68 | 38 | 35 | 44 | 73,6 | 73,7 | 72,9 | 75,4 | 75,5 | 105ª | 94 ^b | 95 | 86° | 81° |
| 10 | 34 | 37 | 9 | 3 | 3 | 73,9 | 73,0 | 71,0 | 72,4 | 72,7 | 10 ^{2ab} | 101ª | 99 | 108 ^{ab} | 107 ^a |
| 11 | 5 | 5 | 2 | 1 | 2 | 74,9 | 74,7 | 73,3 | 72,9 | 73,8 | 104 ^{ab} | 100 ^a | 103 | 115 ^a | 107 ^a |

¹Different combinations of letters indicate significantly different means in different years (P<0.05, Duncan's test).

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