OVERSEED WITH RED CLOVER FOR LONG-TERM SUCCESS

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Increasing growth of native, protein-rich plants in permanent grassland through improved land use and overseeding is one means of closing the current protein deficit. However, livestock farmers cannot easily increase protein yields by growing legumes because they use the cattle slurry to fertilise the land and the application rate of farm-produced nitrogen is restricted to 170 kg/ha. High nitrogen rates are known to inhibit the establishment of legumes in the long term. A joint study is being conducted by the LAZBW Aulendorf together with the University of Hohenheim to investigate, among other things, whether and how long legumes overseeded in permanent grassland can persist despite nitrogen fertilisation and what yield increase the components of grass-legume mixes may still achieve when the nitrogen input is 170 kg N/ha. This project is funded by the federal state of Baden-Württemberg, Germany.

Material and methods

As part of a multifactorial study (overseeding, level of fertilisation, number of cuts, type of fertiliser), in 2014 the varieties listed in Table 1 were grown on a permanent pasture in the intensive grassland region of Upper Swabia which was originally cut five times per year.

Before sowing, gaps in the canopy were created with a tine harrow. Only fertilisers approved for organic farming were used for the basal dressing. Slurry was applied with a drag hose applicator during the first and second regrowth period. From 2015 onwards, the proportion each species contributed to the overall yield was estimated each year before the first cut. The individual proportions of grasses, herbage and legumes in the overall yield were determined during each subsequent regrowth period by dividing the land into precise plots. The crude protein content was determined by near-infrared spectroscopy (NIRS).

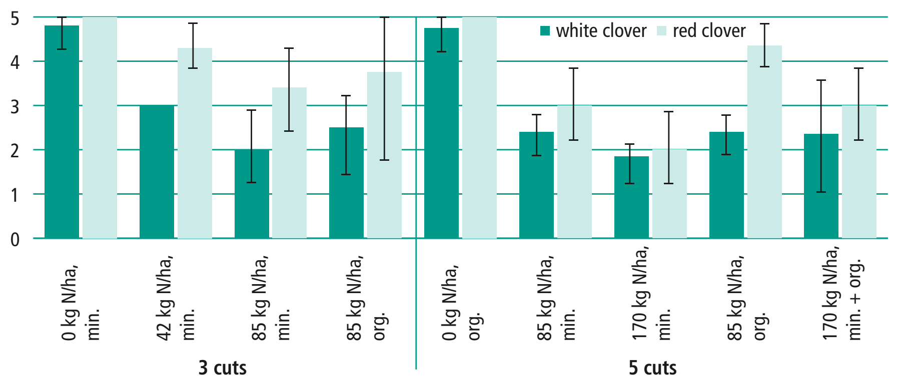
To measure the emergence of the overseeded legumes, a survey was carried out five weeks after overseeding using a purpose-made assessment scheme in which a score of 1 denoted "no visible seedlings" and a score of 5 "several adjacent rows of seedlings visible".

Table 1: Overview of factors and their characteristics

Factor	Characteristic
Overseeding on 12.5.2014	> no overseeding > white clover 10kg/ha (varieties: Merlyn and Riesling) > red clover 20kg/ha (varieties: Merula and Milvus)
Number of cuts	> 3 cuts > 5 cuts
Level of fertilisation	> no N > 35% of total N requirement > 75% of total N requirement
Type of fertiliser	> mineral > organic (slurry)

Extract from the German magazine „Innovation“

Fig. 1: Average emergence score for overseeded plots with different levels of fertilisation at 3 cuts (left) and 5 cuts (right)



Source: The bars show the standard deviation from the basic population (n=3). The black symbols above the bars indicate statistical difference ($p < 0.05$) between the level of fertilisation and fertiliser types for a given number of cuts.

Results and discussion

In 2014 white and red clover germinated equally well and scarcely differed when fertilised with the same fertiliser regime (Fig. 1). However, germination success declined when the fertiliser application rate increased. And vice versa - germination noticeably increased when no nitrogen at all was applied at the time of overseeding. This is because nitrogen stimulates grass growth. The grasses then compete with the legumes, having a particularly adverse effect on the low-growing white clover. Red clover seems to be more resilient.

Especially in a 5-cut regime, legumes were found to establish more successfully and persist in the crop when there was no nitrogen input (Fig. 2). For example, in the unfertilised plots white clover accounted for up to 50% during some regrowth periods and red clover as much as 90% in later regrowth periods. When high levels of nitrogen were applied, the proportion of white clover remained below 20% and that of red clover below 60%. The proportion of red clover in the crop remained high even when 5 cuts were carried out. At the start of the third harvest year (2017), it still achieved ratios of more than 60% on the unfertilised plots.

The **level of nitrogen fertilisation** had no significant effect on dry matter and crude protein yields on one type of overseeded plot, but there were significant differences between the various types of plots. For example, dry matter yields (not shown here) from an un-overseeded plot with a 3-cut regime ranged from 7.41 to 10.82t DM/ha, and from 9.42 to 13.17t DM/ha when overseeded with white clover and 13.56 to 14.31t DM/ha when overseeded with red clover. A 5-cut regime produced dry matter yields of between 8.29 and 10.45t DM/ha on an un-overseeded plot, between 10.33 and 11.87t DM/ha on plots overseeded with white clover and between 13.57 and 16.17t DM/ha on plots overseeded with red clover. This can be explained by the fact that the proportion of legumes declines as nitrogen inputs increase. Other studies show that nitrogen fixed by white and red clover is transferred to adjacent grasses and that this process increases in proportion to the increased share of legumes in the mix. Furthermore, Swiss studies show that a legume-grass mix made up of 40-60% legumes that is given nitrogen rates of 50 to 150kg/ha can produce the same dry matter yields as a grass monoculture fertilised at a rate of 450kg N/ha.

It's a similar picture for crude protein yields, since the un-overseeded plots, viewed as a whole, showed the lowest yields, whereas the plots overseeded with red clover showed the highest. Crude protein yields from un-overseeded plots in a 3-cut regime ranged from 0.88 to 1.15t XP/ha and from 2.01 to 2.19t XP/ha when overseeded with red clover. A 5-cut regime produced crude protein yields from 1.25 to 1.68t XP/ha on un-overseeded plots and from 2.47 to 2.90t XP/ha on plots overseeded with red clover (Fig. 3). Significant differences were found in the crude

Fig. 2: Proportions of overseeded white and red clover in the overall yield in 5-cut regime 2015 – 2017

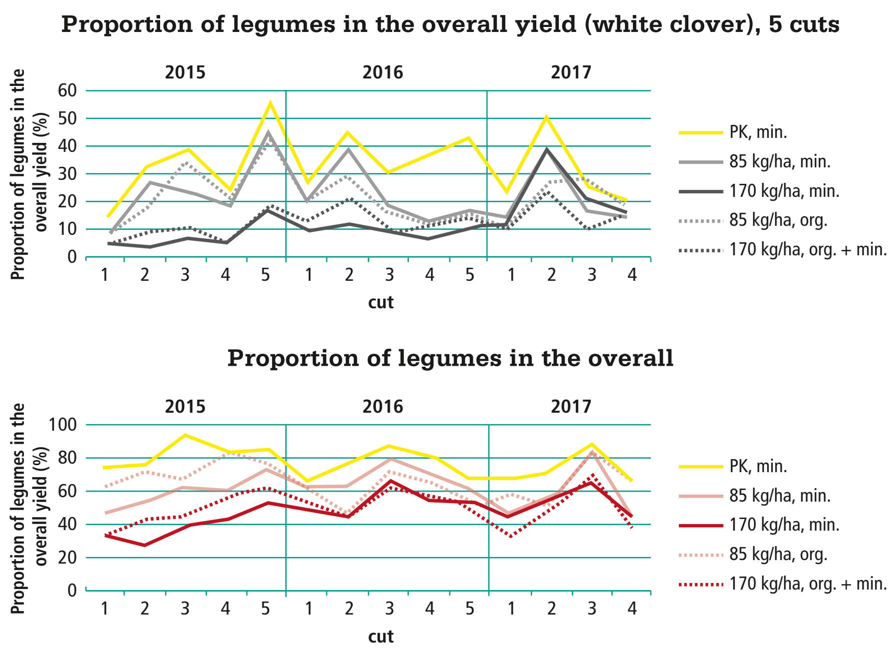
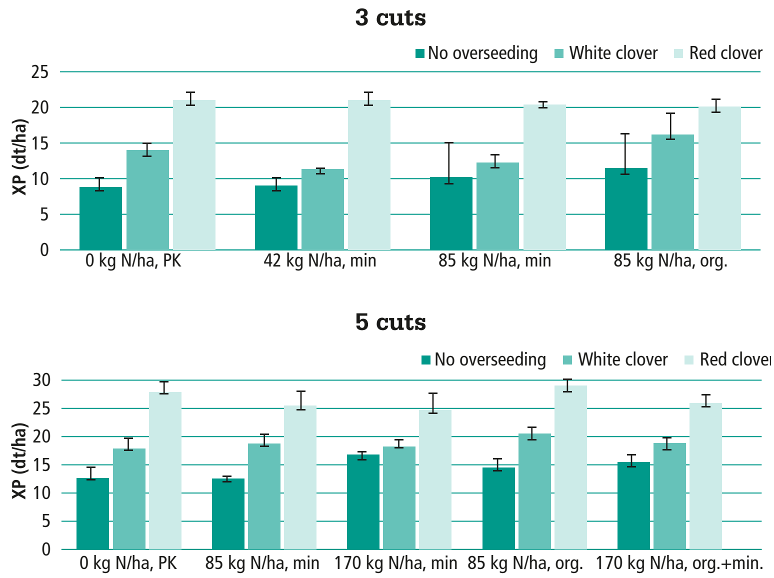


Fig. 3: **Crude protein yields in a 3-cut and 5-cut regime (averaged results from 2015 to 2016)**



protein yields of plots overseeded with red clover in comparison with un-overseeded plots. In contrast, there were no significant differences between un-overseeded plots and those overseeded with white clover. Unlike the dry matter yields, significant differences were found between the plots overseeded with red clover and the un-overseeded plots when N-rates were highest (70% of the requirement) and also when N-rates were lower (0% and 35% of the requirement).

It also seems to make a difference whether mineral or organic fertiliser is used. High inputs of organic fertiliser produced a significant difference between plots overseeded with red clover and un-overseeded plots, but this phenomenon was not replicated with a high input of mineral fertiliser (170kg N/ha).

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The results so far indicate that:

- good establishment of legumes can be achieved by overseeding if nitrogen inputs are reduced or dispensed with entirely
- white clover is more sensitive to nitrogen applications than red clover
- significant quantities of nitrogen fertiliser can be saved if legume overseeding is successful
- red clover persists for longer in the crop than white clover, regardless of the number of cuts.

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