# Manifold green manures – Part III: Black medic and lucerne

As shown in the first two pieces of this series on green manures, there are several leguminous species available that could complement white and red clover in fertility building leys. This third part reviews the properties of two related species, black medic (*Medicago lupulina*) and lucerne (*M. sativa*), using information gained in the Legume LINK project and from literature sources.

## Black medic

Black medic also known as yellow trefoil, is an annual, biennial or short-lived perennial species. It is native to the UK and can be used as a fodder crop, a green manure and also as a hay crop. The species, which is morphologically very diverse, usually grows along the ground and has a thin wiry taproot.

Black medic flowers from April to August. Plants can flower within six weeks of emergence and may initiate new flowers throughout the growing season. Accordingly, the LegLINK project showed that it had a relatively long flowering period, indicating that it is an important source of pollen and nectar for insects. It is visited by bumblebees and honey bees. Seeds germinate readily and seedlings can emerge at any time of year.

In the growing season, seedlings may emerge from immature seeds that germinate beneath the parent plant. Premature germination allows black medic to produce more than one generation in a year. It is slow to establish and is not very competitive during the establishment phase. However, other studies have characterised it as a relatively fast developing species and compared with the other legumes species, the LegLINK study found it to be mid-range in terms of early development.

With regard to productivity, crop cover as measured at the start of the second growing season was highest in red clover and white clover, but among the other legume species black medic consistently showed the highest cover, thereby reflecting a good ability to put on new growth after the winter. Also it showed high values of crop biomass in the early autumn of the first trial year. Finally, above-ground biomass prior to incorporation into the soil was significantly higher than in white clover. Thus, our results are in contrast to the general view that black medic shows relatively low yields. It also showed good weed suppression, although it was not as good as red clover and white clover in this respect.

When sown as part of a complex species mixture (called the All Species Mix), black medic showed significantly lower crop cover than white clover. However, it showed good persistence in the sward, which is in contrast to the recommendation to use black medic for one-year leys only, rather than two years. With regard to its residue profile it had a high lignin content, while its polyphenol content and C:N ratio were similar to the values observed in white clover. Grain yield of the following cereal was not significantly different compared to white clover either.

*Black medic/yellow trefoil*

In terms of soil conditions black medic has a preference for fine, well-drained soils, low in organic matter with a pH from 6.0 to 7.5. For most species in this study higher soil pH was associated with larger presence values; indeed, black medic was the species where this effect was strongest among all investigated legumes. It is said to prefer warm and dry conditions; this may explain its relatively good performance in the current study, with dry and warm springs both in 2009 and 2010. It is more winter hardy than red clover and lucerne; only after spring sowing is it sensitive to frost. Black medic is occasionally used with white clover in undersowing. Regionally, in terms of presence in sampling quadrats it was found that it performed best in the South and worst in the West. However, these regional differences cannot be attributed to any single factor because environmental conditions are confounded by management factors.

Simulated grazing trials showed that it had substantially lower tolerance to being cut at a low height than white clover. However, it performed significantly worse on un-grazed than on grazed sites. Potential factors to explain these contrasting results are that it can tolerate treading damage, which was not simulated in the replicated trials and that it is characterised by a bitter taste, which could lead to it being deselected by grazing livestock. One reason why it is part of seed mixtures is its relatively low seed price. It is recommended to have a three year break between successive black medic crops. Black medic has been suggested for phytoremediation following contamination of soil with heavy metals.

To conclude, in the replicated plot trials, black medic showed significantly better performance than white clover with regard to several variables, namely pre-incorporation above-ground biomass, overall biomass production and length of flowering. According to the findings of this study, black medic therefore seems to be a species that is currently under-utilised.

*Lucerne*

*Photos: The Organic Research Centre*

# Lucerne

Globally, lucerne is one of the most important legumes species, grown on a vast scale in temperate regions around the world. Lucerne is an upright, relatively tall perennial with a strong deep taproot, which helps to make nutrients available from great depths and conveys good drought tolerance. Depending on soil type, the roots of lucerne usually go down to 2–4 m. It is mainly pollinated by honey bees and bumblebees but is also visited by several other bee species. In the LegLINK study, lucerne was the last to stop flowering in the first year. Although it thereby extended the provision of vital nectar resources for pollinators in the season, it was outscored on other flowering criteria (early nectar provision and length of flowering) by most other legume species.

Among the legumes, it showed a high pre-incorporation biomass, which tended to be higher than that of white clover. However, it was not significantly better than white clover with regard to plant re-growth after cutting and biomass in the first season. Also, white clover had a significantly higher crop cover than lucerne after winter. On balance, however, lucerne was characterised by very high productivity both at later stages in the field experiments (i.e. in years two and three), and by early development (in the first season), when it outperformed all other legume species except crimson clover. In line with its high productivity and tall height, results averaged across the six research hubs indicated that lucerne was highly effective at suppressing weeds.

Despite its high productivity, lucerne did not become the dominant species over time when sown as part of the complex all-species mixture in the on-farm trials. This may have been due to its low tolerance of grazing, relatively low competitiveness against grasses or low soil pH. The species increased its proportion relative to the seed density at two out of three sites, and became dominant in the all-species mixture on a further site. According to an ecological computer model, lucerne was found to be part of seven of the best ten multifunctional mixes.

Regarding the plant residue contents, lucerne showed relatively high lignin content (significantly higher than white clover and red clover). Its polyphenol content and C:N ratio pre-incorporation were moderate and not significantly different from that of white clover. Based on the residue profile and the effect on the grain yield components, lucerne was assessed to be slower to decompose than white clover, but was still ranked as having a relatively low resistance to decomposition. It showed comparatively high nitrate levels in soil pre- and post-incorporation. With regard to the grain yield of a cereal sown after incorporation of the legume species, it ranked second after white clover, but differences between the two species were not significant. Lucerne is among the legume species for which experimental evidence exists for a positive effect on N -fixation from the presence of grasses in the sward. In comparison with other legumes species, lucerne is reported to have a high ability to fix nitrogen, though it must be noted that reliable quantification of N fixing ability is notoriously difficult.

In the LegLINK trials, lucerne was sown at a seed rate of 20 kg/ha. The recommended rate is 8 kg/ha, but other sources suggest 15kg/ha, 20 kg/ha or even 34 kg/ha. Increased seed rates can be used to compensate fungal seedling diseases. Variety choice is seen to be crucial to avoid Verticillium wilt. The advised sowing depth of seed is given as 10-20 mm. It can be undersown into barley, spring wheat or maize, or it can be established on its own. Mature lucerne roots release chemicals (medicarpins) which are toxic to germinating lucerne seeds; therefore, a failed crop should not be re-sown except when roots are still young.

Lucerne shows adaptation to a wide range of climatic and soil conditions but shows stronger regrowth from frequent harvesting when grown in dry seasons and dry climates. The presence of lucerne on the farms participating in LegLINK showed a positive correlation with higher soil pH, but this only became evident in year three, with lucerne being unaffected by soil pH in the previous two seasons. However, in the third year, the effect of pH was dramatic; the frequency of lucerne in sampling quadrats was almost five times higher on sites with a pH above 6.0 than on sites with pH below 6.0. Nodulation of lucerne cannot occur below a pH of 6.2 and at pH levels below 5, lucerne starts to be affected negatively by Al and Mn toxicity. While a soil pH range for lucerne growth of 6–7 has been suggested, the present study found that in the third growing season, the highest frequencies of lucerne in sampling quadrats were only observed when soil pH was above a pH of 7. It also responded positively to the potassium content in the soil.

Although lucerne carries the risk of bloat, it is considered as an excellent element of forage for spring calving and dairy cows. Lucerne hay is also fed to racehorses, but British climatic conditions are thought to be risky for production of hay. It is said to be difficult to ensile it because it is low in soluble carbohydrates. Four cuts can be achieved per season, with the first recommended at the mid-bud stage. When cut low it showed only poor regrowth. This confirms previous research having found that its yield is significantly reduced by frequent cutting of the plant or cutting at immature stages, and it is normally not grazed except when growth has ceased after the first frost in winter. The nutritional value of it as a forage is likely to be highest during the early stages of regrowth; thereafter, its leaf to stem ratio and digestibility decrease rapidly.

In summary, lucerne showed high productivity and high pre-crop value, but to deliver its potential depends on appropriate conditions such as a relatively high soil pH, and it does not tolerate grazing.

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