Manifold green manures – Part IV: Large Birdsfoot Trefoil, Meadow Pea and White Sweet Clover

Continuing our series on green manures in fertility building leys, this article reviews the information on three leguminous species that are currently not used very widely: large birdsfoot trefoil, meadow pea and white sweet clover. The text is based on information gained in Legume LINK (LegLINK) project and literature sources.

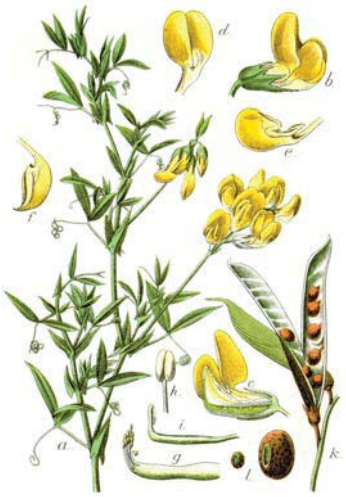
Large birdsfoot trefoil *(Lotus pedunculatus)*

Among forage legume species, large birdsfoot trefoil is characterised by slow growth and low productivity. In the LegLINK field trials it was the species with the lowest seedling biomass, and lowest seedling relative growth rate. Large birdsfoot trefoil showed low values for crop cover and, in terms of plant height was among the shortest species in year one, and among the shorter ones in year two of the replicated field trials. Thereby, the project results correspond with several studies that document Lotus species as having weak seedling emergence as well as slow establishment. Similar results were obtained from on-farm trials within the LegLINK project. In parallel with such findings, large birdsfoot trefoil plots had the highest weed cover in the first year of trials and were also among the most weed-infested in the second year.

Lotus swards are often invaded by broad-leaved weeds during establishment due to their non-aggressive early growth and Lotus species are known to grow poorly under shade, which indicates another disadvantage of slower emergence and growth rates. The slow establishment and poor competitive ability of large birdsfoot trefoil has led to them being overlooked by the farming sector for sown pastures. The plant also showed lowest re-growth after cutting in the first year.

On the farms, large birdsfoot trefoil showed a significantly better performance in the southwest of England than in the other three regional clusters. In terms of the plant residue profile, it showed a significantly higher C:N ratio than white clover, and in this respect it was similar to birdsfoot trefoil and white sweetclover. Among the legumes, large birdsfoot trefoil had the highest lignin content. Possibly because of its low overall productivity, it showed the lowest grain yield in subsequently sown cereals. In agreement with the literature, the response of large birdsfoot trefoil to soil pH was different from other legume species, in that the species thrived more on acid soils. With regard to other nutrients, large birdsfoot trefoil has higher phosphorus use efficiency than white clover.

Meadow pea *(Lathyrus pratensis)*



In the LegLINK study, meadow pea was one of the species with the lowest performance. With a relatively large seed size, the species showed a high seedling biomass and also a relatively high plant height in first trial year. However, after being cut several times, meadow pea almost completely disappeared from the trial plots; it showed very low crop cover after 12 months and compared to the other legume species, biomass of meadow pea was very low in year 1. As a consequence, meadow pea also showed poor weed suppression and even a significant increase of weed biomass from year 1 to year 2, in contrast to the trend of weed biomass reduction over time which was observed in most other tested legumes in this study. This weed increase carried on into the final trial year, with high weed biomass at the time prior to incorporation.

Probably because of low biomass production, meadow pea showed low nitrate content in the soil pre-incorporation as well as low available nitrogen post-incorporation. When grown in a species rich forage mixture in on-farm trials, meadow pea was among the legume species with the lowest presence; this may be due to a relatively low seed rate, or a consequence of a possibly inappropriate sowing depth, but may have also been to do with the relatively low competitiveness of the species or its inability to recover after cutting. The literature on meadow pea as a sown species is scarce, with many sources on forage legume not making any reference to the species at all. Already a century ago, an agriculture textbook stated that the low adoption of meadow pea is due to the higher productivity of lucerne and red clover.

White sweetclover *(Melilotus albus)*

White sweetclover is a biennial plant that can grow up to 2m high. It is indigenous to central Europe, eastern Mediterranean countries and northwest Asia, and has been introduced to many other temperate regions. It is mainly used in North America, though in

some regions there it is considered a weed, and volunteers can also be problematic in Europe. White sweetclover has a very strong taproot, which conveys high drought tolerance. It can tolerate occasional burning and is considered to be suitable for amelioration of soils.

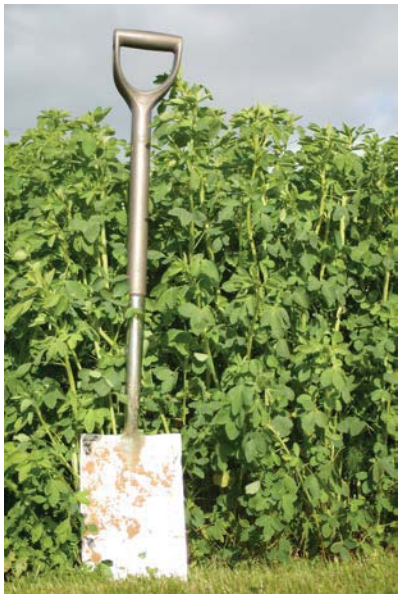


Photo: Cotswold Seeds

White sweetclover is said to have moderate seedling vigour with a spring to autumn growth season, and to show vigorous growth in the year after establishment where previous autumn management has allowed plants to develop strong root systems. This was only partly confirmed in the LegLINK study. With a medium seed size, it showed a relatively high seedling biomass in this study and high seedling relative growth rates. It was the tallest legume species in the first trial year, and it was among the tallest species in the second year - yet compared to other legume species, it showed low biomass in the first summer and low crop cover after the first 12 months.

The ability of white sweetclover to compete with weeds is said to be poor to moderate during early establishment but it improves with time as the legume canopy develops. While this assessment on early competitiveness was generally confirmed in the current study, the species also showed a high weed biomass at the end of the trials.

White sweetclover is adapted to a wide range of soils: it tolerates heavy clays to light sands and does especially well on calcareous soils. It responds to high fertility, particularly of P and K, and tolerates saline soils. The optimum pH range is given as 6.5–8.0, and it is recommended to lime acidic soils well in advance of seeding; however, this is only partly supported by the present study. At the trial site (Aberyswyth) where soil pH was lowest (5.9), white sweetclover biomass in the first year was poor (11.7% of the site's maximum), but it was even poorer at another site where the soil pH was 7.8.

White sweetclover is a winter hardy species, intolerant of shade, and has a low tolerance of flooding. There is a high degree of drought tolerance once established (though yellow sweetclover is considered to be even more drought tolerant), and because of its taproot, white sweetclover might be expected to mine nutrients from deeper soil strata. It does however require seed inoculation by an effective strain of Rhizobium meliloti for successful establishment and performance; the lack of a specific inoculant in the current study may explain why the species underperformed on some sites.

Regarding its residue profile, the current study showed that white sweetclover had a high lignin content (significantly higher than white and red clover) and a high C:N ratios, and it was ranked mid-range among the tested legume species in terms of resistance to decomposition. Hay yields of up to 7–8 t/ha are considered to be achievable - one UK study found yields of 9.4 and 5.5 t ha-1 for first and second seasons respectively. The species has good acceptability after stock have become used to the relatively bitter taste caused by the coumarin content of the forage. It does however carry bloat risk and produces an anti-coagulant from the coumarin, which can cause 'bleeding disease'; breeding aims include the development of low-coumarin cultivars. Defoliation by grazing is recommended to be lax in late autumn of the establishment year in order to allow sufficient root development.

In summary, all three species reviewed here are characterised by low to moderate productivity. As specialists on more acid soils (large birdsfoot trefoil) or on alkaline stony soils prone to drought conditions (white sweet clover), however, their inclusion in ley mixtures may complement more commonly used species.

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This is an edited excerpt from the final report of the LegLINK project. The full report with a full list of references is available at https://www.researchgate.net/publication/256294187.

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Photo: Cotswold Seeds

White sweetclover root system