Manifold green manures – Part II: Alsike and crimson clovers

Many organic farmers and growers rely on the nitrogen fixing ability of well-known legume species such as white and red clover to build up soil fertility. However, there are many more leguminous species available with interesting traits. In the second part of a series on fertility building legumes not frequently being used by organic farmers, we review two further species, Alsike clover (*Trifolium hybridum*) and Crimson clover (*T. incarnatum*), using information from the literature and the Legume LINK project.

Alsike clover

In the Legume LINK project field experiments, Alsike clover came out as mid-range in many respects when compared to other legume species. Often its productivity was not as high as that of white clover and red clover, but it was still better than some other legume species such as meadow pea, winter vetch, white sweet clover or large birdsfoot trefoil (e.g. regarding crop biomass, weed biomass, or crop cover).

Alsike clover growing in pot, 30 days after sowing.

Alsike clover was further characterised by good grazing tolerance and a good presence on a large number of organic farms taking part in the Legume LINK project. Here, it was grown within a complex species mixture called the All Species Mixture (ASM), which contained ten different legume and four grass species. However, Alsike clover showed relatively low persistence on the participating farms, indicating that it was not as competitive as white or red clover. This echoes general observations that Alsike clover is relatively short-lived and persists in swards for only about two years, though it has the ability to regenerate from seed.

Normally, a seed rate of 2-5kg/ha is recommended for Alsike clover in seed mixtures; in the Legume LINK study, a seed rate of 1.25kg/ha was used in the ASM. This comparatively low rate was mainly chosen because of the large number of species in the ASM, but the comparison with the normally recommended rate indicates that for higher productivity of this particular species the seed rate in a less complex mixture may need to be adjusted upwards. As Alsike clover shows a small seed weight (between that of red and white clover), a shallow sowing depth of 10-15 mm is recommended. Since the species does not spread vegetatively (in contrast to white clover), the establishment phase is crucial for the productivity of Alsike clover. In the field trials where different legume species were grown in monoculture, establishment rates of Alsike clover were at the low end (26%, compared to 50.6% averaged over all other legume species). This may partly explain why the species' overall performance was mid-range.

Trials with a cereal crop following the legumes indicate that Alsike clover was similar to white clover and red clover in being relatively early to release nitrogen to the cereal, although the evidence for this is only indirect. In terms of root biomass and residue profile (polyphenol and lignin content as well as C:N-ratio) Alsike clover was not significantly different from white clover.

Alsike originates from Northern Europe; therefore, the species is said to be better adapted to northern conditions, with a minimal germination temperature lying between 2°C and 5°C. However, on the Legume LINK farm trials we did not observe better performance on the Scottish sites than in England or Wales.

In terms of soil pH, normally the species is recommended for conditions that are too acidic for growing red clover or lucerne. In accordance with this, we found a negative correlation between soil pH and Alsike clover presence in the farm trials in the first study year, i.e. Alsike clover tended to show higher presence on more acidic soils with a lower pH. However, this relationship was lost over the subsequent two years of the study. Also, among the six sites of the replicated field trials establishment rates of Alsike clover were highest (52%) at The Institute of Biological, Environmental and Rural Sciences (IBERS), Aberystwyth, which showed the lowest soil pH (5.9). It is possible however that Alsike clover might tolerate both more acidic and more alkaline conditions than many other clovers.

Regarding water requirements, Alsike clover is sometimes recommended for relatively wet conditions, but other sources indicate it is able to tolerate both wet and dry conditions. In contrast to this, however, greenhouse experiments showed Alsike clover to have only moderate flooding tolerance, being similar to red clover in this respect and tolerating flooding for not as long as white clover. It is estimated that while Alsike clover requires more water than red clover, it is not different from white clover in terms of both water requirements and drought tolerance. With respect to water requirements of Alsike clover, the picture currently remains inconclusive.

Alsike clover is currently mainly used to complement other species in mixtures; it has been noted for its compatibility with red clover and timothy. Its growth habit means that heavy stocking reduces productivity. Although Alsike clover is considered to be similar in nutritional value to red clover, it needs to be noted that Alsike clover can be toxic to horses and because of its apparently bitter taste is not recommended to be fed on its own.

Crimson clover

Crimson clover is an annual species. Native to Europe where it is grown as a winter annual for forage, Crimson clover can also be used as a summer annual for green manure in cooler northern latitudes. Crimson clover is self-fertile and pollinated by both bumblebees and honey bees; in the present study it was the first legume species to flower in year two, but not in year one.

The species has relatively large seeds; this may explain why it showed the strongest early development among the tested legume species, a finding confirmed in previous studies. According to the literature, it reaches heights of 30cm up to 100cm and data from the Legume LINK study found the maximum height of Crimson clover averaged 46cm.

Among the legumes, it showed a very strong regrowth after the first cut (one cm increase per day), being significantly higher than white clover. After 12 months, however, in spring 2010, crop cover was found to be low. Similarly, biomass production was good in year one (e.g. not being significantly different from that of white clover), but decreased over the course of the three study years. Within the ASM in the on farm trials, Crimson clover showed relatively high crop cover in the first year; it then self-seeded and produced a second generation on many farms in year two, but disappeared in year three. Thus, Crimson clover showed a relatively low persistence and its frequency significantly decreased over time. This phenological patterns explains why Crimson clover was mid-range regarding weed cover in year one (summer), but prior to incorporation in the third year, it showed a relatively high weed biomass. In terms of overall productivity, experiments from Germany have found dry matter yields of 4-8t/ha.

With regard to residue properties, the Legume LINK trials showed Crimson clover to have the lowest lignin rate among the legumes, as well as a low C:N ratio. Its polyphenol content was not different from white clover. It was characterized by a medium amount of available N in the soil post incorporation, with large variability among sites. With regard to grain yield of a following cereal, Crimson clover was mid-range, similar to red clover, differences between Crimson clover and white clover in this respect were not significant. According to its residue profile, Crimson clover was considered to have a low resistance to decomposition; however, this was not supported by the results of the grain yield components of the following cereal at Rothamsted where results indicated relatively slow decomposition in comparison to the other three tested clover species. Pre-incorporation, Crimson clover showed a similar root biomass as the other clovers.

Photo: Rob Brown

A bumble bee foraging on crimson clover

With regard to nitrogen fixing ability, a pure-sown stand was found to fix 155 kg N/ha. If used as a green manure, maximum N release (73 kg/ha) from Crimson clover has been shown to be achievable at late-bloom stage.

Crimson clover is adapted to a wide range of soil and climatic conditions, more so than other frequently used annual forage legumes. It is thought not to grow on poorly-drained or saline soils and it is not tolerant to shade. The target soil pH for Crimson clover is given as 6.0-7.0 or 5.5-6.5. This medium range is in line with the Legume LINK study, where no significant correlation between soil pH and presence of Crimson clover was found. Crimson clover will grow on soils of low fertility but according to the literature, it benefits from good soil phosphorus status. In the Legume LINK trials, however, we did not find any significant correlation between soil phosphorus and Crimson clover presence on the farms. The species is subject to chlorosis on strongly alkaline soils because of associated iron deficiency. Crimson clover shows low to medium tolerance to drought.

Crimson clover is considered to be only moderately winter hardy; experience in Germany shows it can survive temperatures down to -5°C. Interestingly, after establishment Crimson clover seems to make more growth at low temperatures than many other clovers.

The optimum sowing depth is given as 8-12 mm or 10-15 mm with a light but firm soil cover. Seed rate is recommended at 10-20 kg/ha or 24-45 kg/ha when sown as a mono-crop, with a lower rate (10kg/ha) used when sown in mixture with grass. Early maturity makes it highly suitable for no-tillage rotations. In mixtures, Crimson clover is usually combined with various grasses such as perennial ryegrass but also wheat and rye and a good companion legume species is red clover.

Crimson clover is known to show relatively poor re-growth after grazing, which is confirmed in this study. It is recommended that close grazing should be avoided in winter so as not to effect spring growth or seed production adversely. Flower heads are covered with stiff hairs, possibly causing digestive upsets if the sward is grazed during flowering. Also, Crimson clover is associated with risk of bloat. However, it is considered to be suitable for hay and silage especially at leafy growth stage because it provides protein rich forage; cutting of Crimson clover crop sown in September is recommended for the end of May.

In summary, Crimson clover is an annual species characterised by a vigorous establishment phase and high forage production. It shows adaptability to a wide range of soils and provides good resources to pollinators when it is flowering early.

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