

Winter Sweetclover to Improve Sustainable Switchgrass Biomass Production

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Introduction

Sweetclover (*Melilotus*) grown as a companion crop could improve sustainability by fixing carbon, reducing run-off, improving the soil and increasing biological diversity by comparison with single-crop farming. The sweetclover would also provide some nitrogen for the switchgrass (*Panicum virgatum*) biomass crop.

What is sweetclover?

Sweetclover is a name for the genus *Melilotus* which has 19 Eurasian species. They are in the Leguminosae family and they look similar to alfalfa (*Medicago*). The sweetclovers are herbaceous and biennial, annual, or winter annual. They are monocarpic, flowering then dying and not persisting as perennials. Sweetclovers are planted to vegetate low fertility soils, to provide bee pasture, and for benefits in crop rotations (Smith and Gorz, 1965). They are common wild plants of roadsides and un-mown grasslands.

Why sweetclover and not another legume?

Gettle et al. (1996a, p. 101) indicates that companion plantings of sweetclover increased the switchgrass stem density (stems/area); and alfalfa, birdsfoot trefoil (*Lotus corniculatus*), and red clover (*Trifolium pratense*) did not. We speculate that monocarpic (flower-and-die) cold-adapted legumes such as sweetclover are best adapted for companion plantings with switchgrass. Monocarpic legumes minimize competition with switchgrass and are therefore preferable to perennial or warm-season legumes for this use. Although other legumes could also serve as switchgrass companion crops, sweetclover is a strong candidate.



Fall germination of wild sweetclover, Ames, Iowa

Ideal companion sweetclover traits

We speculate that the ideal life cycle is fall germination with early spring flowering and death. There should be minimum competition with the early part of switchgrass growth. The ideal sweetclover would germinate in the fall and be winter hardy.

Biennial sweetclovers are adapted for the northern US. The best biennials would have short first-year growth to diminish competition with switchgrass if germination is in the spring. In the second year the plants should flower and die early. Generally *M. officinalis* plants flower before *M. albus*, however a useful early flowering type could be selected from either species.

Annual sweetclovers are susceptible to freeze injury. However, they are adapted to winters in the southern US. The annual *M. albus* varieties that are already used in agriculture such as 'Hubam' are selected for late flowering, and are therefore not ideal, early flowering *M. albus* annuals could be selected for this purpose. *Melilotus indicus* could also be useful since it is annual and has a history of agricultural use (Smith and Gorz, 1969, p. 179).

Where is the geographic sweet spot for switchgrass and sweetclover companion cropping?

We speculate that the best location has the highest frequency of winter weather that is warm enough for sweetclover to grow, but too cold for switchgrass growth. There should be enough moisture that the sweetclover's water use does not limit the switchgrass.

How much nitrogen for biomass switchgrass?

Application of 120 kg/ha nitrogen is optimal for biomass production without companion legumes (Vogel et al., 2002). Gettle et al. (1996b, p. 559) found yield equivalent to 60 kg/ha nitrogen in a forage oriented study of switchgrass with companion sweetclover. Stickler and Johnson (1959) estimated 163 kg/ha nitrogen production from a summer sweetclover crop. We do not know how much applied nitrogen a winter sweetclover crop can displace.

Sweetclover genetic resources

The National Plant Germplasm System's sweetclover germplasm collection is housed at the North Central Regional Plant Introduction Station in Ames, Iowa (Brenner, 2005). The collection includes 983 accessions and 18 species. The collection preserves a heritage of plant breeding from the early 1900s when sweetclovers were frequently used in crop rotations. Annual, winter annual, biennial, early or late flowering, large seeds, and many other useful traits are available in the collection. Information and germplasm are available at: www.ars-grin.gov/npgs/

How speculative is this poster?

There may be some practical difficulties. The most applicable research literature is in a forage context, newer research should be in a biomass context. A winter sweetclover crop that flowers and matures seeds may add less nitrogen to the soil than a crop that is plowed in before flowering. Furthermore, Ken Moore in an unpublished study, was unable to replicate the favorable data of Gettle et al. (1996ab), and Blanchet et al. (1995).

Selected References

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Sweetclover grown for seed production in a controlled-pollination cage

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