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# Pasture rejuvenation with bloat-free legumes

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Direct seeding of productive and nutritive legume species into existing pasture is considered the most attractive option for pasture rejuvenation. For high performance grazing systems, identification of suitable bloat-free legumes and methods for direct seeding into old grass and legume stands will be essential strategies.

The objective of this review is to collate current information and research on benefits of mixed grass-legume pastures, identify appropriate pasture rejuvenation methods, and discuss recent improvements in bloat-free forage legumes and their potential contribution to production systems. Pasture rejuvenation refers to the improvement in biomass productivity and/or nutritional quality of existing pasture without removing the existing vegetation.

To determine the optimum proportion in legume-grass binary mixture, a western Canada research study (https://doi.org/10.2134/agronj2017.02.0069) looked at a combination of legume and grass at ratios of 0, 0.11, 0.22, 0.33, 0.67, and 1.0. The study demonstrated higher forage yield when the pasture mixture contained 11 to 33% legumes and the yield advantage decreased as the proportion of legume increased to 67% or more. Additionally, a higher proportion of legume in the mixture always increased crude protein, but not necessarily the biomass yield.

### Biological nitrogen fixation and nitrogen cycling

It is estimated that the amount of atmospheric N fixed in grass-legume pastures ranges from 100 to 380 kg N/ha/yr, but amounts greater than 500 kg N/ha/yr have also been reported. Research has found that a large fraction (~80%) of fixed N is transferred to the associated crop, which increases the grassland productivity.

While legumes in mixed pastures can be an alternative to N fertilization, for best economic return an optimum proportion of grass and legume needs to be maintained. Most research studies have found that an alfalfa/grass mix with a ratio of 1:1 showed the greatest economic and ecological potential by enhancing soil water and nitrate-N availability.

### Pasture rejuvenation methods

Pastures can be rejuvenated through fertilization, mechanical aeration and direct seeding. However, applying nitrogen (N) fertilizer brings risks, such as increased N accumulation, potential risk of N loss due to gaseous $N_2O$ emission and leaching, $NO_3$ accumulation and the up-front costs of fertilizer.

Mechanical aeration can be conducted to break up compaction, and can also decrease surface runoff and losses of soil P by allowing P to bind with minerals from a greater exposed surface area. But, the benefits can be short-lived, and are costly.

Direct seeding for pasture rejuvenation has been used in western Canada with some success. For optimum establishment of new legumes in the pasture, vegetation suppression (most easily accomplished with herbicide application) is necessary to create a favourable environment for new stand establishment. In a southwestern Saskatchewan study (https://cdnsciencepub.com/doi/pdf/10.4141/P96-149), sod-seeded alfalfa in grass pastures suppressed with glyphosate, showed increased productivity and forage quality.

### Pasture Rejuvenation Using Bloat-free Legumes

In a simulated grazing study (https://doi.org/10.2135/cropsci2012.10.0591) to determine survivability of different sainfoin populations in mixed alfalfa stands, new populations of sainfoin developed at Agriculture and Agri-Food Canada's Lethbridge Research and Development Centre (LRDC) survived in alfalfa pasture for 4 years under multiple harvests. This persisting ability of new multiple-cut- type sainfoin populations may be used to rejuvenate old and/or depleted alfalfa, grass or alfalfa-grass mixed stands.

In a three-year study (https://doi.org/10.4141/A06-009) at Lethbridge, Alberta, where alfalfa and sainfoin were planted in strips and sainfoin was about 35% of the alfalfa-sainfoin mix, bloat incidence was reduced by 77% in grazing steers.

In another study (https://doi.org/10.2134/agronj13.0378) at Lethbridge, a mixture of alfalfa and 25% sainfoin planted in alternate rows prevented alfalfa pasture bloat by 90 to 98% when tested under bloat maximizing conditions. In the same study, the mixed stand of alfalfa-sainfoin produced >20% DM at each harvest than alfalfa or sainfoin in pure stands. This study recommended that some new populations of sainfoin could be used in pasture mixtures with alfalfa for higher dry matter yield and average daily gain in steers while preventing bloat. It also suggested that new sainfoin populations have potential for transforming under-utilized alfalfa pastures with bloat potential to bloat-safe alfalfa pastures.

In summary, direct seeding of compatible legumes into a depleted pasture for rejuvenation can reduce cost of forage production and make bloat safe pasture, which ultimately can reduce cost of cattle production. Development of research based findings regarding the possibility of introducing appropriate legume in depleted pastures and simultaneous identification of compatible cultivar suitable for different pasture species would improve producer adoption of this new technology.

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