**Forage Production and Economic Performance of Pasture Rejuvenation Methods in Northern Alberta, Canada**

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Producing high quality forage and maintaining productive pastures is a major challenge that beef producers encounter, as rejuvenation icomplex and costly. This article is excerpted from a paper that is part of a series looking at potential options and methods of rejuvenation to improve the productivity of older forage stands in northern Alberta.

The methods of rejuvenation investigated were sub-soiling; break and re-seeding; a combination of manure application plus subsoiling; high stock density grazing; bale grazing; pasture rest, as well as direct seeding in spring and fall. In this series, forage dry matter (DM) yield, forage nutritive value and economic performance are presented and discussed. The top 5 forage DM yielders were bale grazing, manure plus subsoil in fall, break and re-seeding, high stock density grazing and fertilizer application in that order. In both years, bale grazing consistently produced higher forage DM yield than other methods including control, with bale grazing giving up to 100% higher yield at site-1 and 219% at site- 2 for the 2-year total forage DM. Most forage nutritive value parameters measured were similar for the rejuvenation methods investigated. A simplified economic analysis done in this study showed that the direct input cost of rejuvenation an old forage stand was higher with the break and re-seeding method than other methods. However, for bale grazing, when the cost of hay bales used was factored in, then the cost of bale grazing far exceeded those of other methods including break and re-seeding.

Results of the study demonstrate that producing high quality forage and maintaining productive forage stands are major challenges for Alberta’s beef producers, as rejuvenation is a complex and costly challenge for producers. However, rejuvenation as a pasture management strategy for rapid improvement of high performance grazing should still have a significant positive impact on sustainability and competitiveness of the cattle industry.

In the present study, the top forage DM yielders were bale grazing; manure application plus subsoil in fall; break and re-seeding; high stock density grazing, and fertilizer application. Their performance in terms of forage DM yield could likely be associated in part to improved soil conditions such as infiltration rate, soil moisture and compaction; and soil nutrients (nitrogen, phosphorous and potassium in particular) earlier report as parts of the present study by Omokanye et al (2018).

Overall, bale grazing produced far more forage DM yield than other rejuvenation methods investigated here. Fertilizer application produced a forage yield advantage of up 2000 kg ha-1 forage DM in 2017 over control, indicating that fertilizer application can be used to bring the productivity of a stand back, without the expense of re-seeding. Using fertilizer has potential to substantially increase forage yield and quality, and has potential to improve condition of forage stand.

This study further confirms that manure can be a valuable source of plant nutrients and organic matter and when used as a fertilizer, will improve forage production and soil quality (as seen with manure application plus subsoil in fall as well as bale grazing and high stock density grazing, which were thought to have higher manure (fresh or stockpile) concentrations than other methods of rejuvenation. Forages offer an opportunity for manure application, though not all the nutrients in manure are immediately available to the crop. Depending on amounts of nutrients applied and growing conditions, improvement in forage yield and quality would usually last at least two to three years (Springer, 1999). The simplified economic analysis done in this study shows that the direct input cost of renewing or rejuvenating an old forage stand could be as high as $625/ha with the break and re-seeding method and as high as $2570/ha for bale grazing (cost of 60 hay bales/ha included). Bale grazing seemed to have higher direct input costs than other methods, but it is important to note that the effects of bale grazing on improved soil health conditions (infiltration, compaction, water holding capacity and soil N, P and K) and forage yield and quality could last far longer than other methods investigated here.

In this study, most rejuvenation methods investigated entailed significant financial risk over the study period, probably because moisture was limiting in 2015, a condition which did not seem to affect bale grazing system as the pastures in that system were able to bounce back easily following bale grazing in the following winter. Because of the long-term effects of bale grazing and high stock density grazing in terms of soil nutrients distribution and availability, both rejuvenation methods would not entail financial risk as they both appear to be cost effective.

Overall, without having to break and re-seed, the three top suggested methods of pasture rejuvenation that are expected to reduce time for rejuvenation and loss of productivity, are bale grazing, manure application plus sub-soiling and high stock density grazing (that is followed by a period of long pasture rest in the same year). Research will continue on methods of adding legumes in pastures for improving soil health, forage productivity, livestock carrying capacity and profit. The research will further help to identify appropriate legume species and cultivar that can give best complementary effects for different rejuvenation options.

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