CHAPTER 17

Persistence of Alfalfa Genotypes in Mixed Stands

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Alfalfa is widely used in permanent forage stands for hay and pasture on the Northern Great Plains of Canada and the USA. Alfalfa is high yielding, deep rooted, N-fixing and highly nutritious for cattle, thereby adding great value to forage stands. It is most often planted in mixtures with one or two grasses because of its tendency to clause bloat and because it is somewhat prone to winter injury. On the Northern Great Plains, winter injury is attributed to low temperature and poor snow cover rather than freeze - thaw cycles and hypoxia as in the wetter regions of eastern Canada (see Chapter by Bertrand et al.). The decline of alfalfa populations in forage stands is a major reason that farmers reseed hay and pasture fields. Because sod-seeding of alfalfa (over-seeding into an existing stand) is not always successful, re-establishing alfalfa often requires tillage with or without chemical weed control. Reseeding forage stands is a very costly and risky (loss of soil and poor success in dry years) activity and, therefore, alfalfa persistence is of considerable economic interest to forage and cattle producers.

Plant breeders have for years been developing new alfalfa genotypes and using standardized trials to identify the most productive and adapted strains. Yet when these varieties are planted on farms they often decline over time, more rapidly in pastures than in hayfields. The decline of alfalfa in multi-species pastures is often attributed to grazing pressure, where the palatable alfalfa is selectively grazed and has less chance to grow and to recover than less palatable species. Indeed, controlled trials using a technique called mob grazing showed that increased grazing pressure did affect the persistence of alfalfa in mixed swards, and it seemed that more persistent and less persistent varieties declined at a similar rate; our mob grazing trials failed to identify grazing resistant varieties (Bittman et al. 1994) in contrast to findings in the southeastern USA (e.g. Alfagraze, Brummer and Broughton 1991). So is it possible to increase persistence of alfalfa in the pastures of the Northern Great Plains?

In the early 1990's, we completed two multi-year trials where we subjected alfalfa genotypes shown to be well

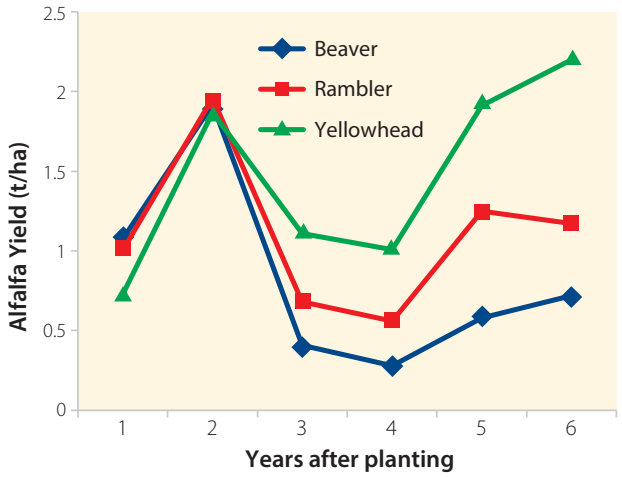

Figure 1. Yield of three alfalfa varieties with contrasting winter hardiness (Yellowhead>Rambler>Beaver) in mixed stands with smooth bromegrass over 6 years in the Parkland region of the Northern Great Plains (for T/ac multiply by 0.45) (Based on Bittman et al. 1991).

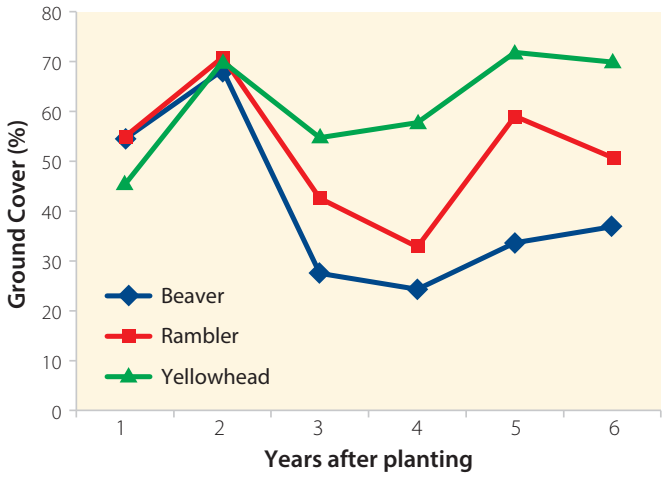

Figure 2. Change in ground cover of three alfalfa varieties with contrasting winter hardiness (Yellowhead>Rambler>Beaver), each in a mixed stand with smooth bromegrass, over 6 years in the Parkland region of the Northern Great Plains (Based on Bittman et al. 1991).

adapted in standardized monoculture trials to competition from hard, rhizomatous grasses under field conditions (Bittman et al. 1991, 1994). In standardized trials, yield and persistence are generally negatively correlated because the more winter-hardy varieties have a longer dormancy period.

The results of our trials were unexpected. In both trials, an overlooked, highly dormant genotype that had consistently low yields in the standardized trials, had greater yield (Fig. 1) more ground cover (Fig. 2) than any of the commercial varieties, especially in the later trial years.

This hardy strain has since been registered in Canada under the name 'Yellowhead' because it is a strain of the yellow-flowered *falcata* subspecies (Fig. 3) which was reputed to have poor yield potential (McLeod et al. 2009). However, with its greater winter dormancy, Yellowhead is less subject to injury from early freeze-ups and premature warming spells in late winter which frequently occurs. Therefore, the hardy strain is less prone to delayed spring growth caused by injured meristems or low reserves of carbohydrates to which less hardy strains are more vulnerable. Earlier spring growth gives the otherwise poor yielding variety the potential for greater yield after a tough winter.

In pure alfalfa stands, such as 'dehy' fields (or standardized trials), injured alfalfa may be harvested later providing a chance to recover, and the effect on yield of delayed spring growth is difficult to distinguish from the effects of conditions during growth. However, when the injured alfalfa plants are co-habiting with grasses, recovery of injured alfalfa plants may be forestalled due to competition

Figure 3. Yellow-flowered alfalfa (subspecies *falcata*) variety Yellowhead. PHOTO COURTESY OF D. MCCARTNEY

Figure 4. Strips of Yellowhead alfalfa 25 years after planting in mixture with smooth bromegrass in the Parkland region of northeast Saskatchewan. PHOTO COURTESY OF D. MCCARTNEY

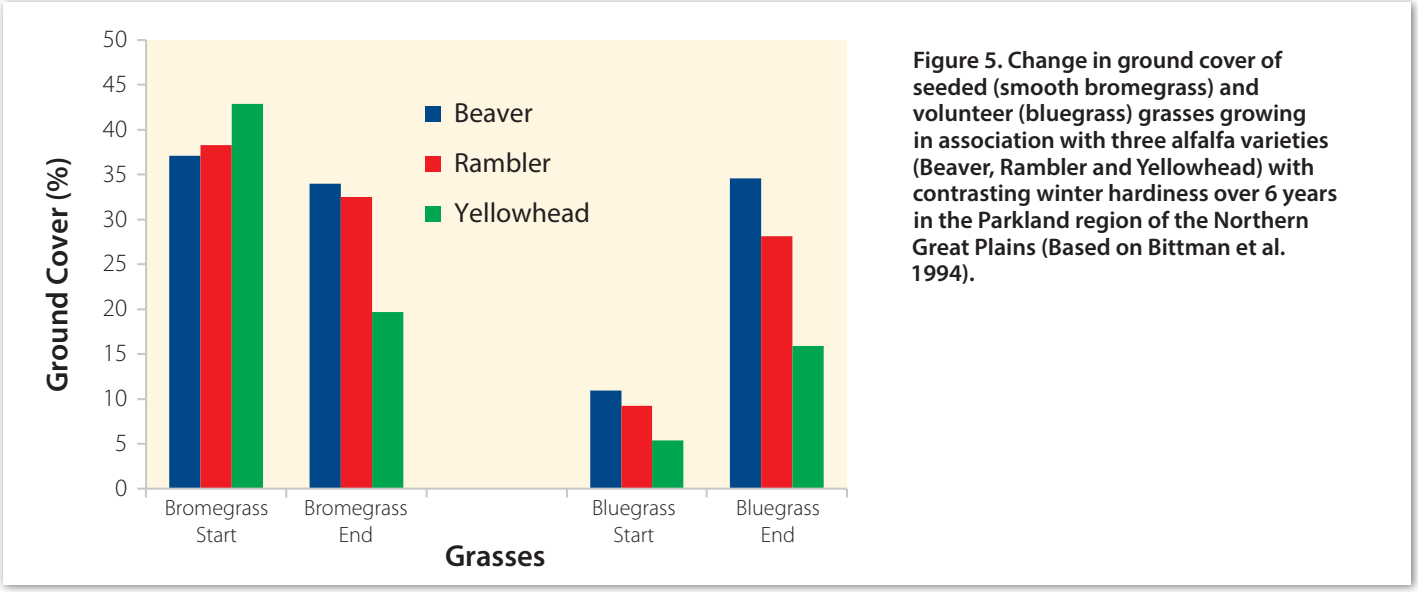

Figure 5. Change in ground cover of seeded (smooth bromegrass) and volunteer (bluegrass) grasses growing in association with three alfalfa varieties (Beaver, Rambler and Yellowhead) with contrasting winter hardiness over 6 years in the Parkland region of the Northern Great Plains (Based on Bittman et al. 1994).

from seeded and volunteer grasses which are typically hardier than most commercial alfalfa varieties. Here, there is a clear advantage for the very hardy Yellowhead genotype, which has shown itself to be much less subject to competition from associated grasses than the potentially higher yielding but less hardy genotypes, Beaver and Rambler (Fig. 4).

In our trials, the proportion of the hardy Yellowhead variety in the stand remained fairly consistent over years (Fig. 2). Instead, the proportion of smooth bromegrass declined, probably because it is slightly weakened by grazing or clipping during the stem elongation phase (Fig. 5). The lost smooth bromegrass in the Yellowhead plots was replaced by a rise in hardy, grazing-tolerant bluegrasses, which volunteered into the stand. Here the competition, in effect, was not between alfalfa and grasses but rather among the grass types. In contrast, the smooth bromegrass persisted well in the stands with the less hardy Beaver and Rambler, and the lost alfalfa was replaced by much larger amounts of bluegrass. Basically, large amounts of bluegrass replaced lost Beaver and Rambler, whereas bluegrass replaced only bromegrass in the Yellowhead plots. We surmise that the greater total forage yield in the Yellowhead plots (not shown) was due to both to less bluegrass and more N fixation (because of more alfalfa) than in Beaver and Rambler plots.

In summary, there were probably several interacting factors that affected the evolution of these stands: winter-hardiness of the alfalfa varieties, winter injury of alfalfa causing delayed spring growth, encroachment by short, grazing-tolerant grasses, and pressure on taller jointed grass by grazing or clipping during stem elongation. No doubt, the availability of N, P and S are also important but not examined in these trials; P and S favour alfalfa and jointed grasses relative to the short grazing -resistant types (see Chapter by Bittman et al. Nutrient Imbalances).

References available online at www.farmwest.com

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