Diversifying the forage choices with alternatives and non traditional crops as a versatile solution for resilient integrated farming.

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With the intensifying effect of drought and erratic weather this year, the recovery of overwintering plant stands of perennial legumes like alfalfa showed a poor response resulting in poor yields of forage. Due to shortage in feed supply and higher cost of the winter feed, livestock producers have to make difficult decisions on how to manage the feed, grazing resources and thus their livestock over the winter months. As drought affected the grain crops too, the fields with failed crops are often used for grazing or the crop is salvaged as hay for addition in stockpiled feed. However, the quality of the feed doesn't always turn out to be good due to the presence of certain anti-nutritional factors like nitrates in cereals produced under stress environment. Apart from this, there is a potential risk of chemical residues present in salvaged grain crops which should also be considered while making such decisions. Managing through a drought season poses many challenges to the producers and to mitigate these challenges, various drought management strategies should be used as a part of the grazing plan. Taking stock of the feed options and diversifying the forage choices can help in extending the forage supplies through winter even in challenging years. It also can help in determining if it is required to buy more feed or reduce the cattle number on their farm. A bulk of annual maintenance cost of prairie cow-calf production systems comprises of winter feed cost only (Larson, 2010). Depending on the season, the winter can extend up to six or seven months and using diverse crops like combination of annuals and perennials can help meet the cattle feed requirements. Most silage and green feed on the prairies are made from annual crops, especially cereals (barley, oats, triticale, peas, soft white wheat). Cereals are also grown for swath grazing to end the grazing season. In Alberta, swath grazing of annual crops (e.g., barley, oats, and triticale) to extend the grazing season has shown an average total cost saving of 40-49% crops compared to cows fed a control total mixed ration (Baron et al., 2014; McCartney et al., 2004).

Seeding annual cereals for green feed has become a common practice across Alberta. Annual crops have been grown and delivered as quality silage or green feed bales in confined feeding situations. Diverse group of crops like soft white wheat and winter cereals are becoming more popular among beef cattle producers either as monocultures or in mixtures. In Alberta, past records showed that approximately 575,000 acres of annual crops were harvested as green feed, resulting in over 1.73 million tons of green feed harvested that year (Alberta Agriculture & Rural Development, 2011). Similarly, oats have shown to add significant value when used for swath grazing, back grounding and finishing beef cattle (Baron et al., 2012; Entz et al., 2002; McCartney et al., 2004; McCartney et al., 2008). In past few years, applied research associations (ARAs) have conducted various studies on the adaptability and production potential of annual crops in monoculture or mixes in livestock production systems across Alberta (Gill and Omokanye, 2016, 2018; Gill et al., 2013a, b). In addition to these diverse cereals, there are various options of using alternatives and mixture stands which can be used to benefit the livestock industry in providing valuable forage resources and replenishing lower feed inventory due to the extended drought like conditions in the Peace region for last three years.

Apart from supplementing the perennials, another advantage of using annuals in a mixed farming system, is that it serves flexibility to the producers in terms of short-term land commitment and fitting in their annual cash cropping systems. Annuals can be grown for silage or hay individually or mixed with other annuals as well as they can complement the perennial forages during inconsistent supply of forage due to extreme weather conditions. However, annuals are also affected adversely in terms of yield and quality during erratic weather conditions and diversification of forage choices, with alternatives and non-traditional crops can provide a versatile solution.

Mackenzie Applied Research Association tested four diverse groups of annual forages in small plot trials this year which performed relatively well despite the extreme dry season. The trial consisted of 4 blocks:

a) **Monoculture spring cereals:** it contained 15 cereal varieties consisting of oats, barley, spring triticale and soft white wheat **(Picture 1).**

b) **Spring and winter cereal mixtures (cereal mixtures):** it contained 12 mixtures of spring and winter cereals and 4 pure stands of barley, oats, triticale and soft white wheat. The mixture consisted of barley, oats, triticale, soft white wheat mixed with fall rye, winter wheat and winter triticale **(Picture 2).**

c) **Pulse-spring cereals mixture:** it consisted of 4 pure stands of wheat, barley, oats and triticale as checks and 12 mixtures containing barley, oats, triticale and soft white wheat with peas, faba beans and lentils **(Picture 3).**

d) **Cover crop cocktails:** it consisted of 8 commercial cover crop cocktail mixtures (CCC) which has been designed for silage production and pure stand of corn and sunflower. The CCC mixtures consisted of two CCCs suitable for swath grazing and annual crop pasture each **(Picture 4).**

After a pre burn application of round-up on June 3, the plots were seeded on June 8, 2023. The dimensions of the plots were kept at 1.0 m wide X 6.0 m long and each of the block was replicated 4 times in a Randomized Complete Block Design (RCBD). The seeding depth was kept at 1.00" for the cereals and 0.75" for the pulses and CCCs. Soil sampling was done before planting and the fertilizer application was done as per the recommendation based on soil test report. Seeding in blocks with cereals and cereal mixtures were done at recommended seeding rates based on the germination percentage, TKW and plants per square meter. For Pulse-spring cereal mixtures, cereals and pulses were seeded at 50% & 75% of recommended rate for respective monocultures.

The first two blocks containing cereal monocultures and cereal mixtures were harvested for yield and feed/silage quality analysis with a forage harvester on October 11. Although the germination of all these blocks were delayed due to moisture deficit, all the plots fared well through the season except cereals and pulses mixture block which had to be terminated due to excessive weed pressure after the rainfall in July. However, CCCs mixture block was not harvested due to high moisture content till mid-October and then it got covered under snow. Despite it was not harvested, CCCs showed promising biomass production especially the forbs and forage brassicas which had outgrown the cereals like corn and oats in the cocktail mix.

All the recommended practices were followed throughout the growing season. As there was very low weed pressure in the beginning, only one, in-crop herbicide spray was done on July 12th using Basagran Forte @ 0.71L/ac in cereals whereas Pardner was sprayed @ 450ml/ac in pulse-spring cereal mixture and CCCs, which also stunted the pulses and CCCs to some extent. Although CCCs recovered quite well, pulses in the mixture were taken over by weeds after the rainfall in July. The Pulse-spring cereals mixture was terminated at the end of July due to extensive weed pressure.

With the late season rainfall and some cooler nights in late August, the growth rate was relatively slower and it took longer for the cereals and cereals mixtures to reach the appropriate maturity stage (barley: soft-dough, Oats: milk, Triticale: late milk, CCCs at optimum moisture content of 60% or at the accepted developmental stage as recommended by the companies who kindly donated the seeds). The harvesting was done by flail type forage harvester and the fresh weight was recorded for each plot harvested and the samples were sent to A&L labs for quality analysis. The dry matter yield was calculated on the basis of per plot and the data were extrapolated to Kg/hectare basis.

Dry Matter yield

Figure 1 shows that yields of 15 spring cereals ranged from 3794.1 to 6653.5 Kg/ha with oats performing the lowest (CDC Murphy) and the highest yielding entries (CDC Nasser) on a dry matter basis in monoculture stands. Barley variety AB Advantage (6026.1 Kg/ha) also performed significantly better than some oats, wheat and triticale varieties **(Figure 1).**

In the spring-winter cereal mixtures, CDC Baler oats performed significantly well in combination with Luoma winter Triticale (6321.4 Kg/ha) and with Prima fall rye (6124.3) and the average yield ranged in this block ranged from 3451 to 6321.4 Kg/ha which is almost at par with the monoculture cereal stands **(Figure 2).** Although these yields were lower than the monocultures, the plots with winter cereals remained green for longer which can provide grazing options for an extended period of time. This also depends on the incidence of frost as the quality of the feed gets affected once a standing cereal forage crop is hit by frost.

Forage nutritional quality:

Crude Protein: Beef cattle require energy, protein and minerals in adequate quantities to provide proper nutrition for their health and also for the productivity of the operation. Protein is an essential nutrient in all beef cattle diets. Protein requirement for cattle varies with the stage of production, size of the herd and expected performance. Protein supplementation is often costly component in a beef cattle feeding program but protein supplementation is needed to meet animal requirements viz health and performance. For the spring cereals monocultures, the crude protein values ranged from 7.57% (AAC Awesome) to 18.79% (Taza) and all the varieties met the CP requirement for cattle in mid gestation stage. A few varieties showed sufficient CP to meet the requirement of late gestation, however, only two triticale varieties (Taza and AB Stampeder) had enough CP to meet the minimum requirement for calving cattle **(Figure 3).**

Total digestible nutrient (TDN): It represent usable energy contents of feedstuff and these are extremely important in order to provide adequate energy supply for cattle. Energy is necessary for maintenance (feed digestion, core body functions etc.) and to support growth, lactation and reproduction. For the current study, almost all the varieties met the minimum requirement for mid-gestation, late-gestation and calving stages except CDC Murphy, CS Camden, CDC Nasser and CDC Baler oats. CS Camden and Murphy didn't meet the TDN requirement for mid-gestation stage as well **(Figure 4).**

The crude protein and total digestible nutrients for the spring-winter cereal mixture is shown in **Figures 5 & 6** respectively. The CP in the mixture showed higher values than in monoculture checks in this block. The mixture containing CDC Baler oats and Fall rye showed highest concentration of CP followed by AAC Delight and Luoma Winter Triticale. Surprisingly AAC Delight in monoculture stand showed the lowest value of CP (%). As triticale is relatively more drought tolerant than other cereals, it can constitute a promising entry in a mixed stand for extending the grazing periods with higher CP content. In this block, almost all the variety mixtures showed enough CP levels to meet the requirement of late-gestation and calving requirement except AAC Delight triticale. Apart from this, CDC baler oats in a monoculture as well as in mixed stand with Luoma winter triticale didn't show enough CP required for calving stage, while rest all of the mixtures showed enough CP levels to meet the requirement at all the three stages. For the TDN (%) in spring-winter cereals mixes, all the varieties and mixtures met the requirements at all three stages of Mid- gestation, late-gestation and calving except CDC baler oats which didn't meet the TDN (%) requirement at calving stage.

Although, the spring-winter cereal mixtures didn't perform at par with the monocultures in terms of dry matter yield, the overall quality in terms of CP (%) and TDN (%) was relatively better as compared to spring cereals.

Although we were not able to harvest the block with CCCs mixes, it showed phenomenal growth over the season and produced maximum above ground biomass which could serve additional forage for cattle and livestock during fall. Brassica species like Kale and turnips germinated earlier than all other seeds and attained quite bigger leaves over the length of the season, especially after rainfall in July.

The weather this year was very erratic with a dry spring and a wet summer, data from this trial signifies the importance of diversifying the cropping options, especially in an integrated farming system. MARA has conducted similar trials in the past in collaboration with other ARAs and plans to continue similar studies in future to provide relevant information to the local producers. Diversifying the forage options, like adopting selected annual crops with great forage production potential could play a significant role in a drought management strategy to mitigate the impact of erratic weather conditions and tackle lower feed inventory for regional producers.

This trial was funded by RDAR and Mackenzie County. Similar trial with similar treatments were conducted at three other Applied Research Associations viz. GRO, BRRG and CARA but only the data from MARA is presented here.

Picture 1 Annual Forages (Cereal varieties)

Picture 2 Annual Forages (Cereal mixtures)

Picture 3 Annual Forages (Cereal & Pulses mix)

Picture 4

Fig. 1. Dry matter yield of Spring cereals varieties sown at MARA (2023)

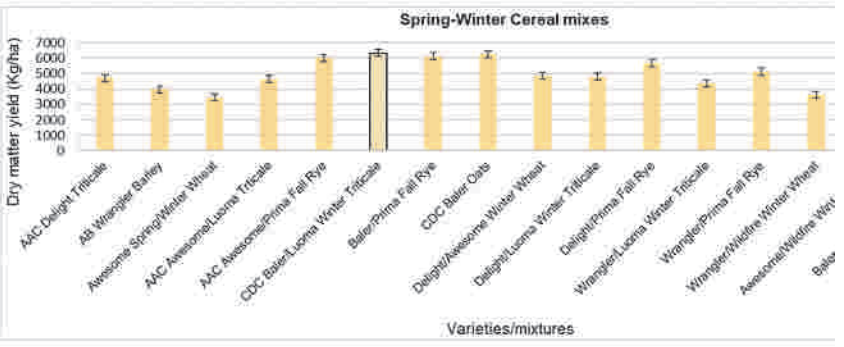

Fig. 2 Dry matter yield of spring-winter cereal mixes sown at MARA (2023)

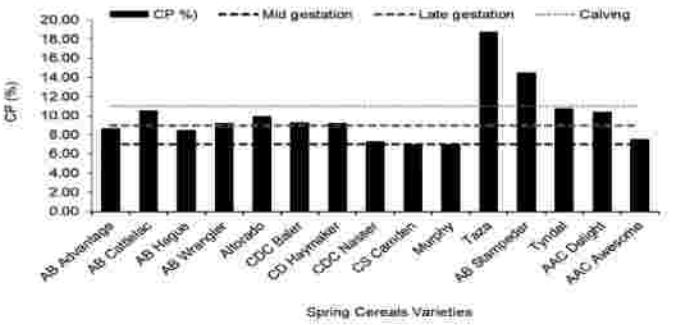

Fig. 3 Crude Protein content of spring cereal monocultures

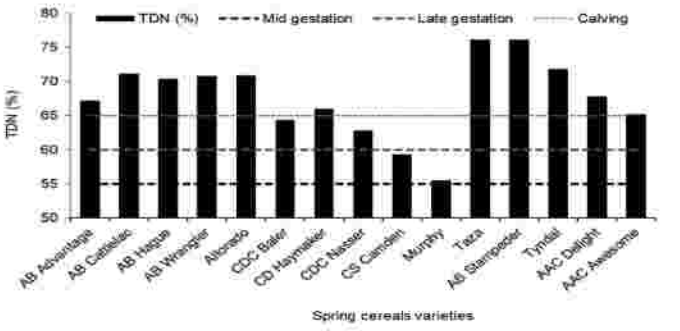

Fig. 4. Total Digestible Nutrient content of spring cereal monocultures

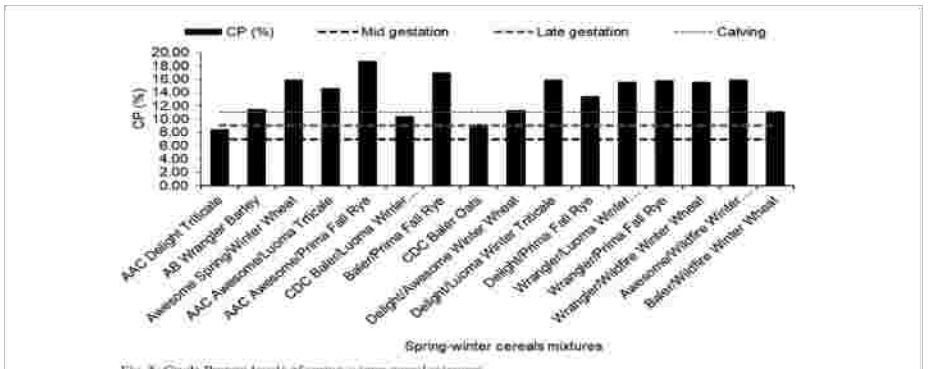

Fig. 5: Crude Protein levels of spring-winter cereal mixtures.

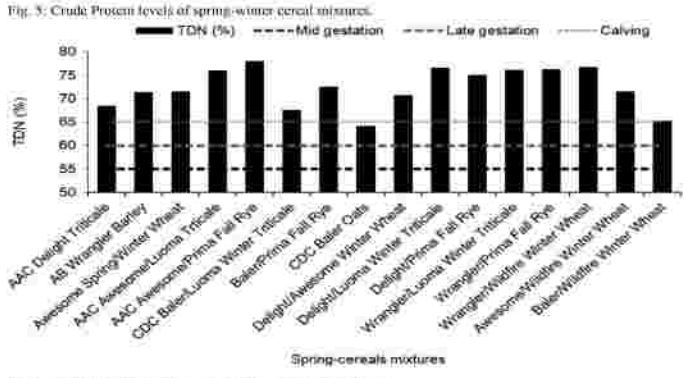

Fig 6. Total Digestible nutrient content of spring-cereal mixtures