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EVALUATION OF ANNUAL FORAGE OPTIONS FOR EARLY AND LATE SPRING PLANTING

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Evaluation of annual forage options for early and late spring planting

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Introduction

Annual forages are a flexible way to add forages into annual cropping rotations or to break up perennial forage plantings. There is growing interest in using annual forage mixes as a way to add diversity to a cropping system, but the effects on yield and quality of forage is variable depending on mixes and competition. In 2016 and 2017, two small demonstrations of annual forages were planted each year.

The oat and barley demonstration was seeded during the usual spring seeding period to spring cereal like oat and barley. Oat and barley were grown with and without peas. There were also two forage blends that include more diverse species in a polycrop. Barley or oat intercrops with peas have been used for a long time as a way of increasing the protein of the annual forage. It also allows some nitrogen fixation and greater diversity in the cropping system. The challenge with intercrops of barley or oat with peas is that barley and oat are more competitive under most stations than peas. As long as barley and oat have good access to nitrogen, they tend to shade out peas when planted at close to normal densities. Even when seeding rates of oats and barley are lowered to allow more space for the peas, they can still tiller and crowd out the peas.

The millet demonstration was seeded in late June or early July using millet species and some mixes with broadleaf crops. Late-seeded millet forage crops can be an effective strategy when seeding is delayed due to excessive spring moisture. Millets are quite heat resistant and could be useful with increasing summer temperatures and more variability in growing season rainfall. Red proso millet was also grown with a mixture of different species of interest for soil health, fertility, and forage. Millets generally establish best when planted into warm soils, so June to mid-July seeding for forage use is suitable.

Japanese Millet (*Echinochloa utilis*) often used for wildlife plantings and cover crops. It is a tame relative of the weedy barnyard grass and looks quite similar. Japanese millet has excellent tolerance to flooding, poor drainage, and standing water, making it a useful species in cover crop mixes. It, like all millets, has no frost tolerance, but it is said to be better adapted to cool conditions than other millets. It is a preferred food source for ducks and geese and is often used in plantings to attract these species.

Teff (*Eragrostis tef*) is an Ethiopian millet species with very small seeds. It is used for a very fine-leaved premium hay for horses in the United States. It grows very quickly, but does not reliably produce seed in Western Canada. It is very susceptible to fall frosts. Grain varieties of teff are grown in Ethiopia.

Red proso millet and crown millet are both *Panicum miliaceum L.*types. They are relatively familiar species for western Canadian farmers. Crown millet is a forage type millet and red proso millet is often grown for grain for the birdseed market. They are sometimes grown when spring seeding is delayed. Both mature quickly and can produce grain when seeded in early July or late June.

Materials and Methods

All plots were seeded in an RCBD with four replicates on the SERF home quarter each year. Each plot was 20 ft long. Biomass of 1 meter row was collected in 2016 and 2 meter rows were collected in 2017. This was done at a stage where most of the treatments were at optimum quality for forage harvest. Biomass samples were bulked across replicates and sent for forage quality analysis by Down to Earth Labs.

The barley and oat demonstration was seeded on May 30, 2016 with 50 lb/ac N, 30 lb/ac P, 7 lb/ac S fertilizer side-banded on soybean stubble. There was good moisture conditions at seeding and through emergence. Biomass was harvested on Aug 2, 2016.

Barley / Oat Treatments - 2016

Treatment #		
1	Barley	120 lb/ac
2	Barley and Pea	60 lb/ac barley, 100 lb/ac pea
3	Oat	100 lb/ac oat
4	Oat and Pea	50 lb/ac oat, 100 lb/ac pea
5	Barley Blend 1	60 lb/ac barley, 20 lb/ac pea, 2.5 lb/ac crimson clover,
6	Barley Blend 2	60 lb/ac barley, 20 lb/ac pea, 2.5 lb/ac crimson clover,

The barley-oat trial was seeded in 20 ft long plots with 50 lb/ac N, 26 lb/ac P 4 lb/ac K, 3 lb/ac S on wheat stubble that had been cultivated the previous fall. It was seeded on June 1, 2017 after the initial trial seeded in early May was sprayed with the wrong herbicide. Biomass was harvested on Aug 10, 2017 by taking two half-meter of row samples from the front and back of the plot. No in-crop herbicides were used.

Barley / Oat Treatments - 2017

Treatment #		
1	Barley	120 lb/ac barley
2	Barley and Pea	72 lb/ac barley, 100 lb/ac pea
3	Oat	100 lb/ac oat
4	Oat and Pea	60 lb/ac oat, 100 lb/ac pea
5	Barley Blend 1	72 lb/ac barley, 30 lb/ac pea, 2 lb/ac Persian clover, 2 lb/ac subterranean clover, 1.5 lb/ac forage brassica
6	Barley Blend 2	72 lb/ac barley, 30 lb/ac pea, 2 lb/ac Persian clover, 2 lbac subterranean clover, .5 lb/ac forage brassica, 1.5 lb/ac chicory, 1 lb/ac phacelia, 1 lb/ac plantain

The 2016 millet forage demonstration was seeded on July 5 with 50 lb/ac N with good surface and subsoil moisture conditions on soybean stubble. The teff did not emerge when seeded at ¾ inch to 1 inch. It was harvested for biomass on Sept 6, 2016 by taking one half-meter row from the front and back of the plot and bulking them together. Samples were air dried and weighed after air drying 1 month later. There was a problem with the burn-off prior to seeding the millet trial in 2016. Small but established Round-leaf Mallow were not killed with the burn-off and choked out two of the replicates for the millet trial. Since no in-crop herbicides could be used on this trial, the burn-off was very important. The two remaining replicates had less weed pressure and were used for biomass collection. There was negligible growth of cow pea and mung bean in the millet blends. Radish did establish well but does not contribute much to forage yield, as most of the yield is in the tap root.

Millet Treatments 2016

Treatment #	Crop	Seed Rate
1	Red Proso Millet	30 lb/ac
2	Japanese Millet	10 lb/ac
3	Crown Millet	30 lb/ac
4	Teff	5 lb/ac
5	Blend 1	Proso 13 lb/ac, Cow Pea 8 lb/ac, Daikon Radish 2.2 lb/ac, Japanese Millet 4.3 lb/ac, Mung Bean 5 lb/ac
6	Blend 2	Proso 13 lb/ac, Cow pea 25 lb/ac, Diakon Radish 2.2 lb/ac

Millet Treatments 2017

Treatment #	Crop	Seed Rate
1	Red Proso Millet	30 lb/ac
2	Japanese Millet	10 lb/ac
3	Crown Millet	30 lb/ac
4	Teff	5 lb/ac
5	Blend 1	Proso 13 lb/ac, Cow Pea 8 lb/ac, Daikon Radish 2.2 lb/ac, Japanese Millet 4.3 lb/ac, Crimson Clover 2 lb/ac, Chicory 2 lb/ac, Plantain 2 lb/ac
6	Blend 2	Proso 13 lb/ac, Cow pea 25 lb/ac, Daikon Radish 2.2 lb/ac

The 2017 millet trial was seeded on June 27 under good moisture conditions. Biomass was collected on Sept 12, 2017 by taking two half meter rows from the front and back of the plot. Two subsamples were air dried for 1 month and weighed for each plot for 2017.

Statistix was used to do analysis of variance for biomass for the barley/oat trials and the 2017 millet trial. There was no statistically significant differences in biomass due to high variability.

Results

Table 4. Mean biomass and composite forage quality for 6 annual forage treatments. Relative Feed Value (RFV) and Total Digestible Nutrients (TDN) are included.

Treatment #	Biomass Yield (air dry, tonne/ac)	% Broadleaf Biomass	Protein %, DM basis	RFV	TDN %, DM basis
Barley /Oat 2016					
1	8.9	0	5.86	76.1	57.4
2	6.6	35.3	5.94	72.4	55.2
3	8.4	0	5.06	83.3	58.7
4	7.2	9.8	6.34	79.7	58.6
5	7.6	5.5	5.95	92.8	60
6	8.2	5.3	6.49	97.7	61.4
P<0.05	NS (CV=13.8)				
Barley/Oat 2017					
1	5.2	0 %	4.65	89.9	60.6
2	4.9	6.6 %	6.4	122	64.7
3	4.8	0 %	6.04	113	64.4
4	4.1	6.6 %	4.28	75.5	58.1
5	4.6	1.2 %	4.52	76.9	57.7
6	4.6	2.6 %	4.36	73.8	57.1
P<0.05	NS (CV=12)				

There are no strong yield or quality trends that would match with expectations for higher protein from the pea-oat intercrops. High variability may account for this. There were no statistically significant differences in biomass between treatments. It was difficult to reach a balance between high cereal biomass production and leaving sufficient room for the peas to actually contribute. The multi-species mixes did work, but the biomass production from the broadleaf species in the those blends (T5 and 6) was small. Farmers who are spending the money on seed for these species would expect to see more growth from them.

Table 5. Mean biomass and composite forage quality for 6 annual millet forage treatments. Relative Feed Value (RFV) and Total Digestible Nutrients (TDN) are included.

Treatment #	Biomass Yield (air dry, tonne/ac)	% Broadleaf Biomass	Protein %, DM basis	RFV	TDN %, DM basis
Millet 2016					
1	4.6	0	6.07	108	65
2	3.6	0	9.55	93.5	63.9
3	4.3	0	4.58	104	64.7
4	0	0	0	0	0
5	5.0	26	6.5	118	64.2
6	4.9	8.6	6.18	118	65
P<0.05	N/A	N/A	N/a	N/A	N/A
Millet 2017					
1	3.9	0	2.5	88.9	60.6
2	5.1	0	4.84	94.4	64.7
3	3.1	0	2.82	78.9	64.4
4	3.1	0	4.71	85	58.1
5	4.5	47	6.96	102	57.7
6	3.6	27	4.17	92.5	57.1
	4.632097		6.07	108	65
P<0.05	NS (CV=30)	N/A	N/A	N/A	N/A

This demonstration gave us some information about how to grow annual forage mixes. Some species used in blends like mung bean did not perform well in our area and are quite expensive to import. The yield data was quite variable, so differences in productivity between species can't be clearly evaluated.

However, the Japanese millet (T2 of Millet trials in 2016 and 2017) was relatively productive compared with the other varieties based on observations. It was later than the crown and red proso millets, so it continued to accumulate biomass for a longer period. In 2016 the biomass was harvested when the crown and proso millet were at milk stage, but the Japanese millet was just beginning head out. In 2017, the harvest was delayed to allow the Japanese millet to mature more, resulting in higher yield. The mixes of red proso, Japanese millet and broadleaf plants looked very good and competed well with weeds. The quality of the red proso and crown millet was not as good due to later biomass harvest.

Teff was difficult to establish in a monocrop. Even in 2017 the establishment of the teff was patchy in those plots. However, in a nearby pathway area, teff was used in a blend with sorghum-sudan, clovers, and radish. It emerged well and relatively evenly when it was used in a mixed planting. This is likely because the seed can't break through the soil well alone but could emerge with help of other larger-seeded plants.

The demonstration gave producers an opportunity to see unusual annual forage species and combinations of species. There was productive discussions at the field tour in 2016 and 2017 about use of annual forages to diversity crop rotations. This demonstration also gives producers an idea of productivity and quality of some different annual forage options.

Conclusions and Recommendations

Due to the maturity differences between the millets particularly, a single biomass collection date was not suitable. In future trials, there should be allowances for the differences in maturity of millet species to allow for optimum yield and quality for each. Japanese millet produced well and was slower growing than crown and red proso. A forage harvester is needed to do larger trials of annual forages.

The blends and the Japanese Millet looked like they would work well as stockpiled forage for grazing in late fall. The Crown and Proso Millet were productive and would have made good greenfeed in late August or early September. However, they would not provide much ground-cover or capture nutrients as well as the blends or the Japanese Millet. Overall, the Proso Millet blends with legumes were very productive in terms of yield relative to the other treatments. The radishes kept growing in the blends until November. Preference between these forages would depend on the desired end use: greenfeed vs. stockpiled grazing.

Extension and Communications

During the 2016 field day on July 20, Kevin Elmy from Friendly Acres Seed assisted with a discussion about the use of diverse annual forage mixes to improve soils.

At the 2017 SERF Plot Tour on July 19, Derek Axten was invited to talk about cover crop species and the goal of increasing biodiversity in annual cropping systems. Lana discussed the purpose of this trial and the advantages of growing annual forages in breaking weed cycles and reducing the negative impacts of excessive spring moisture.