ADOPT Final Report-Project # 20140393

Project Identification

1. **Project Title:** Demonstration the Use of Yellowhead Alfalfa in a One-Cut and Two-Cut Harvest System

2. **Project Number:** 20140393

3. **Producer Group Sponsoring the Project:** Saskatchewan Forage Council (SFC)

4. **Project Location(s):**

    - **Melfort Research Farm, Melfort SK**

5. **Project start and end dates**: April 2015 to December 2015

6. **Project contact person and contact details**:

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Objectives and Rationale

7. **Project Objectives**

This objective of this project is to demonstrate the effect that harvest schedule has on the yield and quality of Yellowhead alfalfa compared to two purple blossomed varieties, one a tap and the other a creeping rooted type.

8. **Project Rationale**

AC Yellowhead alfalfa was developed at the Semiarid Prairie Agricultural Research Centre (SPARC) of Agriculture and Agri-Food Canada (AAFC) in Swift Current, SK and is reported to have improved persistence under grazing and superior cold hardiness and winter survival as compared to standard purple-flowered alfalfa varieties. This variety was released in 2007 and seed is now commercially available in limited quantities.

AC Yellowhead has been shown to have similar yields to Beaver and Rambler in one cut systems. However, the stems and leaves of Yellowhead are finer and smaller than purple blossom varieties. This trait may

allow it to maintain protein and energy levels longer than other alfalfa types. If this is the case, AC Yellowhead would be useful in years when hay harvest is delayed due to precipitation such as experienced in recent summers in eastern Saskatchewan. Additionally, this project demonstrated the yield of one verses two cuts per season and the effect of cutting during the critical fall period (CFP) for these three alfalfa types.

Methodology and Results

9. Methodology

Replicated plots of three alfalfa types were seeded in 2012 at the Melfort Research Farm. The plots were cut in July and late September of 2013 and 2014 to manage growth and control weeds. Alfalfa types for this project included:

1) AC Yellowhead (yellow-flowered creeping root);
2) Equinox (tap root) and
3) Spredor 4 (creeping root)

Five cutting treatments were imposed on each of the three alfalfa types including:

1) July 5 (early);
2) July 30 (late);
3) July 5 (early) and Sept 10 (during the Critical Fall Period (CFP));
4) July 5 (early) and Sept 30 (after the Critical Fall Period (CFP)) and
5) July 30 (late) and Sept 30 (after the Critical Fall Period (CFP)).

The critical fall period for alfalfa is four (4) to six (6) weeks prior to the first killing frost, when alfalfa is regrowing from an initial harvest and has grown a sufficient amount of new leaves to replenish root reserves which will assist with winter survival and regrowth the following season. In Northeastern Saskatchewan, the first killing frost tends to be between mid and late September.

Samples were collected from the plots in duplicate for each treatment. For the first cut this resulted in 30 samples and 18 samples for the second cut for a total of 48 samples.

Dry matter yield was evaluated and forage samples were collected throughout the year and sent to the lab for analysis in the fall of 2015. Forage quality, including protein and energy estimation were evaluated on each of the three alfalfa types cut at each of the five cutting dates.

10. Final Results

Yield results for each of the three alfalfa varieties for the five treatments are listed in Table 1, on the following page. Yields are indicated by dry matter (kilograms per hectare) harvested in each individual cut and total yield (kilograms per hectare) for the entire treatment.

Please note, this was a one year demonstration project only. The results, although useful in illustrating the difference in growth and quality of these alfalfa types, may only reflect the growing conditions in 2015. Multiple years of testing at a number of sites is needed to verify if the results obtained in this demonstration are statistically significant.

Table 1. ADOPT Alfalfa Cutting Schedule Dry Matter (DM) Yield Results

Name	Treatment	Yield (kg/ha^{-1}) July 5/15	Yield (kg/ha^{-1}) July 30/15	Yield (kg/ha^{-1}) Sept 10/15	Yield (kg/ha^{-1}) Sept 30/15	Total Yield (kg/ha^{-1})
Equinox (Tap Root)	**Early**	3784	-	-	-	3784
	Late	**-**	5138	-	-	5138
	Early + During CFP	4073	-	4438	-	8511
	Early + After CFP	4597	-	-	4328	8924
	Late + After CFP	-	5195	-	3591	8787
Spredor 4 (Creeping Root)	**Early**	4220	-	-	-	5292
	Late	**-**	5660	-	-	5660
	Early + During CFP	4425	-	4804	-	9229
	Early + After CFP	4500	-	-	4815	9315
	Late + After CFP	-	5796	-	3905	8629
AC Yellowhead (Yellow flowered creeping)	**Early**	3371	-	-	-	3371
	Late	**-**	4225	-	-	4225
	Early + During CFP	3203	-	3172	-	6375
	Early + After CFP	3231	-	-	3058	6289
	Late + After CFP	-	4098	-	1274	5372

CFB: Critical Fall Period

See Appendix A, Chart 1 for the dry matter yield (sum of all cuts) by alfalfa variety (three varieties) and treatment (five treatments) represented in a bar graph. Chart 2 represents the yield for individual cuts by variety.

Nutritional quality of the three alfalfa types for the five treatments was measured and protein, total digestible nutrients (TDN) and acid detergent fibre (ADF) are compared in Table 2. Quality analysis is listed for the samples taken for each of the harvest dates. For example, for each alfalfa type, there will be two sample results listed for each of the two-cut treatments: quality results for the first cut and quality results for the second cut. The quality is represented individually for each cut and not as an average of the two samples taken per treatment.

TDN is directly related to digestible energy and ADF is inversely related to digestibility. For this reason, both values are included in Table 2. TDN provides a useful indication of energy value in diets such as those of beef cattle that are based primarily on forages. Acid detergent fibre (ADF) measures the plant components that are not easily digested such as lignin and cellulose. A diet high in ADF is therefore low in digestible energy. In general, as plants mature the ADF levels rise and TDN or energy levels decrease.

See Appendix A, Charts 3-5 for representations of the protein, TDN and ADF results by alfalfa type and treatment.

Table 2. ADOPT Alfalfa Cutting Schedule Dry Matter Nutritional Analysis Results

Alfalfa Type	Harvest Date	Treatment	Nutritional Analysis Variable		
			Protein %	**TDN %**	**ADF %**
Equinox (Tap Root)	**July 5**	Early	16.9	59.3	36.8
		Early + After CFP	16.6	59.1	37.0
		Early + During CFP	17.3	60.2	35.9
	July 30	Late	14.4	56.9	39.1
		Late + After CFP	15.4	58.3	37.7
	Sept 10	Early + During CFP	17.0	55.8	40.1
	Sept 30	Early + After CFP	14.5	54.4	41.4
		Late + After CFP	20.0	63.9	32.5
Spredor 4 (Creeping Root)	**July 5**	Early	17.5	60.4	35.8
		Early + After CFP	17.0	61.0	35.2
		Early + During CFP	17.7	59.9	36.2
	July 30	Late	14.3	56.0	39.9
		Late + After CFP	14.1	55.5	40.4
	Sept 10	Early + During CFP	18.0	57.3	38.7
	Sept 30	Early + After CFP	15.4	55.2	40.7
		Late + After CFP	20.7	61.9	34.4
AC Yellowhead (Yellow flowered creeping)	**July 5**	Early	15.3	59.5	36.6
		Early + After CFP	14.9	59.6	36.6
		Early + During CFP	15.6	59.0	37.1
	July 30	Late	14.4	55.9	40.0
		Late + After CFP	13.4	56.2	39.7
	Sept 10	Early + During CFP	19.5	64.9	31.6
	Sept 30	Early + After CFP	16.3	61.3	34.9
		Late + After CFP	22.8	73.0	24.0

CFP: Critical Fall Period

Discussion

Monthly precipitation levels for the 2015 growing season at Melfort are provided in the table below. Overall the growing season precipitation was either average to well above average for all months except May. April precipitation was slightly higher than normal followed by a very dry May. June precipitation was near normal with precipitation in July almost twice the normal.

August precipitation was again near normal and September about 30mm above the long term average for Melfort.

Table 3. Monthly Precipitation for 2015 Growing Season at Melfort, SK

Month	Precipitation (mm)
April	34.4
May	7.1
June	54.8
July	149.8
August	57.4
September	70

Yield

Total yield data is graphed in Chart 1 (Appendix A) for five treatments: 1) Early (July 5); 2) Late (July 30); 3) Early + after CFP (Sept 30); 4) Early + during CFP (Sept 10) and 5) Late + after CFP (Sept 20). The yield results for early and late cut (Chart 2) are quite similar for Spredor 4 and AC Yellowhead, reflecting consistency in those cuts. The Equinox plots appear to have more variability, which may have affected the yield results.

The highest yielding treatment in this demonstration was the early + after CFP treatment of Spredor 4 (creeping root) alfalfa. This two cut treatment yielded 9315 kg/ha (kilograms per hectare), with high yields in both the early cut on July 5 and the late cut on September 30. The creeping root variety also produced the second-highest yielding treatment (the early + during CFP treatment) at 9229 kg/ha total. Overall, AC Yellowhead (yellow flowered creeping root) had lower yields than the purple-flowered varieties (tap- and creeping-root).

The lowest total yields were achieved from the early, single cut treatments. The July 5 single cut for AC Yellowhead was least at 3371 kg/ha, while the July 5 single cut for the tap root alfalfa produced the second-lowest overall yield at 3784 kg/ha. Late cut yields (July 30) are higher than early cut yields (July 5) for all types.

The creeping rooted type yielded slightly higher than the tap rooted and AC Yellowhead in both the first and second cuts.

Quality

The quality of the purple-flowered varieties (Equinox and Spredor 4) appears to be similar. AC Yellowhead was higher in both TDN and protein during the late-season cuts than the other varieties in 2015. This is likely due to the fact that slower regrowth of AC Yellowhead resulted in it being less mature than the other varieties in September, which also resulted in lower yields in the late September harvest period.

The September 30 treatment following the late first cut (late + after CFP) produced the highest protein concentration for every type of alfalfa. At September 30 the Spredor 4 sample tested at 20.7 % protein, Equinox at 20.0% protein and AC Yellowhead at 22.8% protein. Protein levels were lowest at the July 30 (late first cut) date, producing a range from 13.4% to 15.4% protein for this date across all alfalfa types. All three varieties had slightly different protein levels in 2015. Another year of data would be useful to confirm the significance of this finding.

Extension/Promotion Activities:

The following extension activities were completed to communicate results and raise awareness of this demonstration:

- Sign placed at the demonstration site
- Al Foster, SMA Forage Specialist was featured on CK750/CJVR105 radio regarding this demonstration project on December 15, 2015
- Information regarding this project will be included on the Saskatchewan Forage Council website (average hits of 2000+ per month). With results now available, an article will be included in an early 2016 edition of the SFC *Forage and Livestock eNews* as well as other Saskatchewan Forage Council publications.

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11. Conclusions and Recommendations

There were yield differences measured between the alfalfa types in this project. Cutting in late July resulted in higher yields than cutting in early July for all alfalfa types in a one cut system. Cutting in early July and again after the critical fall period tended to produce the highest yields for the two cut system in this project. As expected protein and energy levels of the forage was higher at the earlier stages of cutting for all alfalfa types. Protein and energy closely reflected the plant stage regardless of calendar date.

The preliminary data recording in this demonstration shows yield and quality differences between cutting dates and varieties. AC Yellowhead (yellow flowered creeping root variety) has the lowest first cut yields at both July 5th and July 30$^{th.}$ AC Yellowhead also had the lowest yielding regrowth after each summer cutting date. Quality of the AC Yellowhead alfalfa was superior to that of the purple-flowered varieties on September 20th, after a late summer cut. This is likely due to slower regrowth (as seen in yield) and the plants being at a less matures stage at this date. These differences in yield and quality of the AC Yellowhead from the purple-flowered alfalfa varieties may be a reflection of the growing conditions in 2015 or of alfalfa type. An additional year of data from these plots would assist in making that determination.

As mentioned earlier, this was a one year demonstration project only. The results although useful in illustrating the difference in growth and quality of these alfalfa types may only reflect the growing conditions in 2015. Multiple years of testing at a number of sites is needed to verify

whether demonstration results are consistent from year to year. Additionally, impacts to yield or winter survival of alfalfa plants resulting from harvesting during the critical fall period or from taking two cuts versus one cut cannot be measured in one year. If funding can be obtained, these plots will remain in place in 2016 and the same treatments will be applied. This will provide valuable information regarding the impact of harvest timing on the three alfalfa types in Northeastern Saskatchewan, which can be shared with producers in that region.

Supporting Information

12. Acknowledgements

The Ministry's support for the project was acknowledged on signage displayed at each site and in all communication/extension materials.

In-kind support was provided by Saskatchewan Ministry of Agriculture Regional Forage Specialist to oversee the demonstration sites and assist with sampling and reporting.

13. Appendices

Appendix A – Charts

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14. Abstract

The ADOPT program provided funding to the Saskatchewan Forage Council and project partners to demonstrate the effects of harvest timing on AC Yellowhead (yellow flowered creeping-rooted) alfalfa as compared to purple-flowered (tap- and creeping-rooted) alfalfa varieties in one-cut and two-cut harvest systems in Northeastern Saskatchewan. Yield and quality were measured for AC Yellowhead, Equinox (tap root) and Spredor 4 (creeping root) alfalfa based on five (5) treatments: 1) Early (July 5); 2) Late (July 30); 3) Early + after Critical Fall Period (Sept 30); 4) Early + during Critical Fall Period (Sept 10) and 5) Late + after Critical Fall Period (Sept 20). There were yield differences measured between the alfalfa types in this project. Cutting in late July resulted in higher yields than cutting in early July for all alfalfa types in a one cut system. Cutting in early July and again after the critical fall period tended to produce the highest yields for the two cut system in this project. As expected protein and energy levels of the forage was higher at the earlier stages of cutting for all alfalfa types. The preliminary data recording in this demonstration shows yield and quality differences between cutting dates and varieties. AC Yellowhead had the lowest first cut yields at both July 5th and July 30th. AC Yellowhead also had the lowest yielding regrowth after each summer cutting date. Quality of the yellow flowered creeping root variety was superior to that of the purple-flowered tap root and creeping root varieties on September 20th, after a late summer cut, likely due to slower regrowth (as seen in

yield) and the plants being at a less matures stage at this date. These differences in yield and quality of the yellow-flowered from the purple-flowered alfalfa varieties may be a reflection of the growing conditions in 2015 or of alfalfa type. Multiple years of testing at a number of sites is needed to verify whether demonstration results are consistent from year to year. Communication was carried out through a radio spot describing the project and results and an article to be published in the Saskatchewan Forage Council eNews in early 2016. The final results will also be posted on the SFC website. If funding is obtained, this project will be continued on the same site in 2016 to determine if the results of 2015 were statistically significant and to improve the value of the information resulting from this demonstration.

Finances

15. Budget Report-please see attached expenditures spreadsheet

	Year 1 ($)	Year 2 ($)	Budgeted ($)
Salaries and Benefits			
• Students			
• Postdoctoral / Research Associates			
• Technical / Professional Assistants			
Consultant Fees & Contractual Services			
Rental Costs			
• Rentals			
Materials / Supplies			
Project Travel			
• Field Work			
• Collaborations/consultations			
Other			
• Field Day			
• Administration			
• Miscellaneous			
Total			

Appendix A – Charts

Chart 1. Total (sum of all cuts) Dry Matter Yield (kg DMY ha-1)

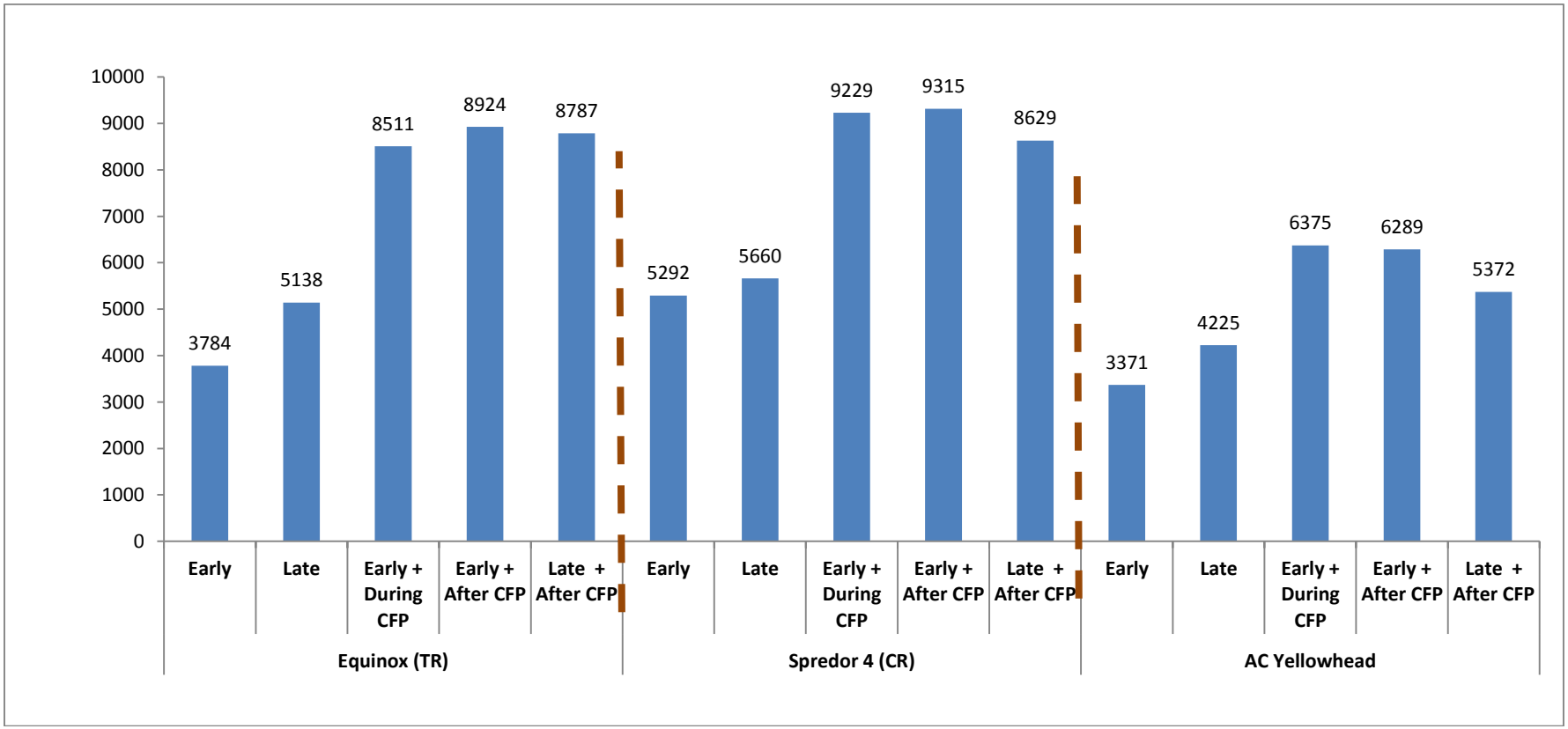

Chart 2. Dry Matter Yield for each cut treatment (kg DMY ha-1)

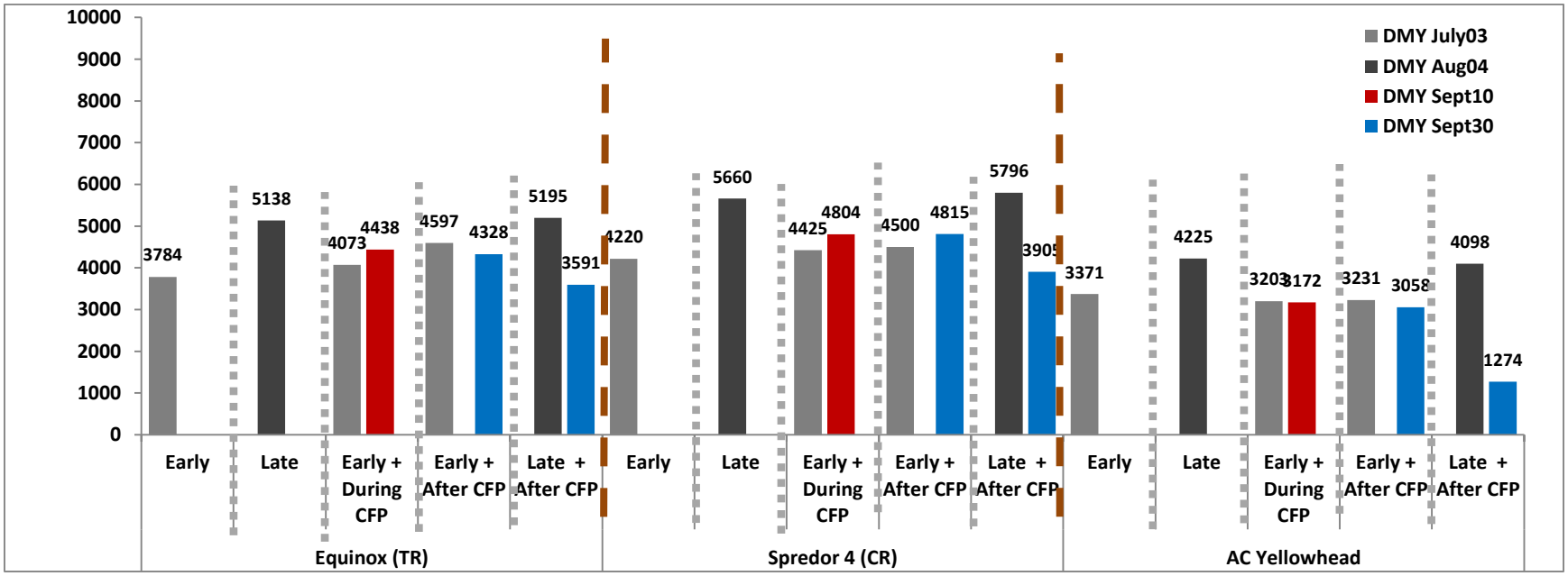

Chart 3. Protein concentration of alfalfa (% Protein)

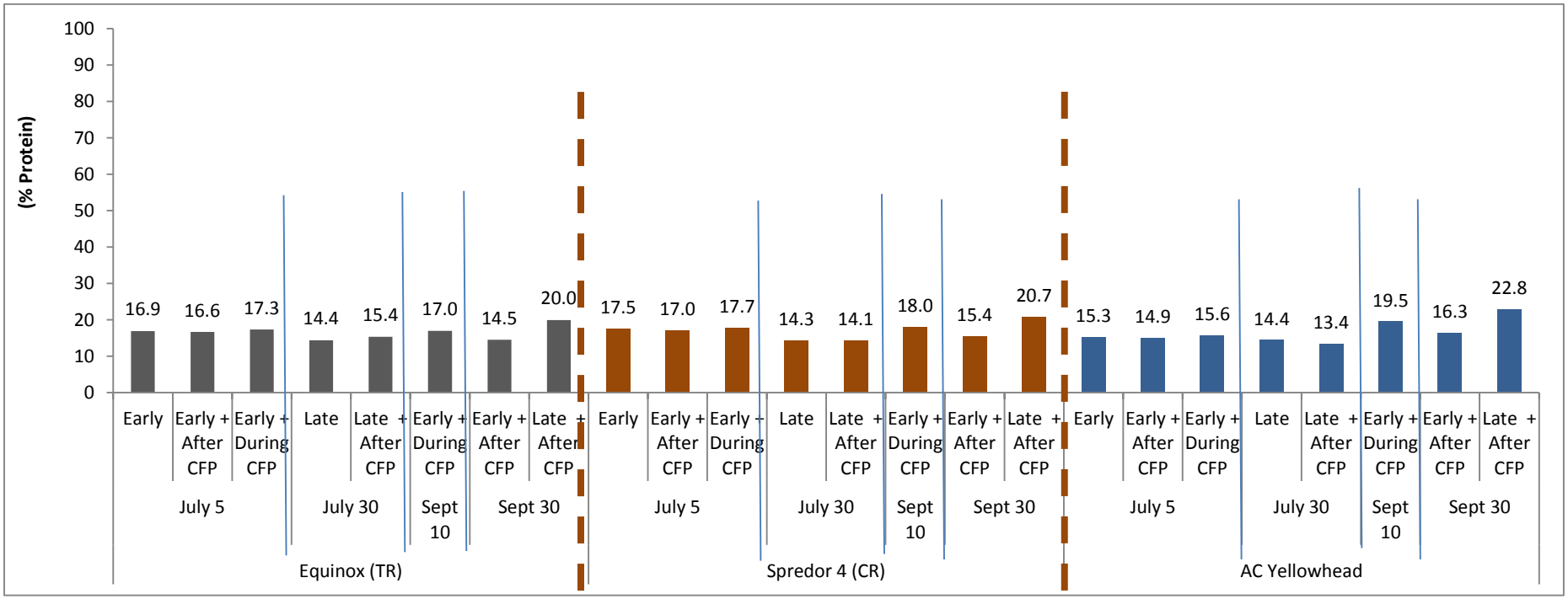

Chart 4. Total Digestible Nutrient concentration of alfalfa (% TDN)

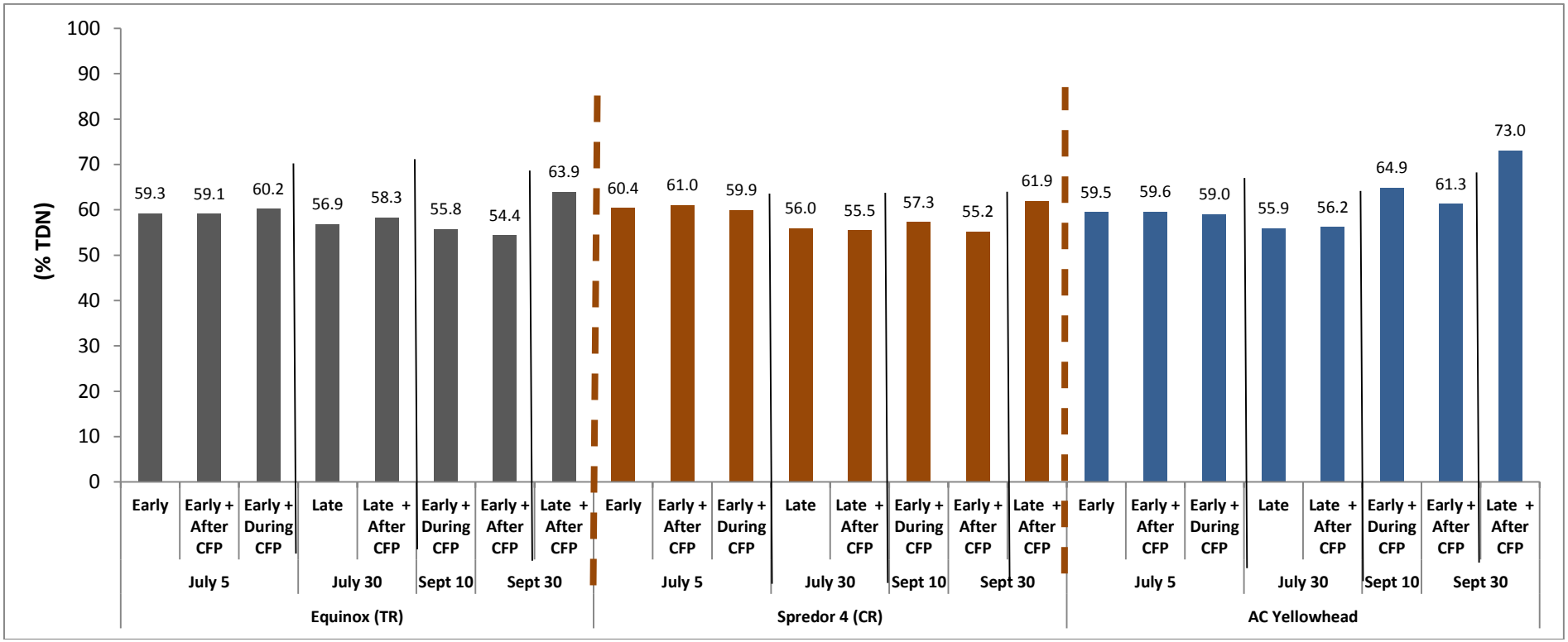

Chart 5. ADF concentration of alfalfa (% ADF)