ADOPT Final Report-Project # 20150369

Project Identification

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

2. **Project Number:** 20150369

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 2016 to December 2016

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 29 (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 29 (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.

The demonstration involved replicated plots and the reported results are the averages. Dry matter yield was evaluated and forage samples were collected throughout the year. Samples were then sent to the lab to be analyzed and the data compiled. 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. Yield reported in Table 1 is an average of four replicates per treatment except for Spredor 4 Early and During CFP which had three replicates.

This was year two of this demonstration project which occurred at one site only. 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 5/16	Yield (kg/ha^{-1}) July 29/16	Yield (kg/ha^{-1}) Sept 10/16	Yield (kg/ha^{-1}) Sept 30/16	Total Yield (kg/ha^{-1})
Equinox (Tap Root)	**Early**	4851	-	-	-	4851
	Late	-	6178	-	-	6178
	Early + During CFP	4759	-	4785	-	9545
	Early + After CFP	5328	-	-	4174	9502
	Late + After CFP	-	6141	-	2771	8911
Spredor 4 (Creeping Root)	**Early**	6171	-	-	-	6171
	Late	-	7024	-	-	7024
	Early + During CFP*	4614	-	4740	-	9354
	Early + After CFP	5279	-	-	4514	9793
	Late + After CFP	-	6053	-	3541	9593
AC Yellowhead (Creeping Root)	**Early**	5048	-	-	-	5048
	Late	-	6085	-	-	6085
	Early + During CFP	3391	-	2963	-	6354
	Early + After CFP	4243	-	-	3134	7376
	Late + After CFP	-	5501	-	1386	6887

CFB: Critical Fall Period **Three reps*

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	14.8	60.1	36.1
		Early + After CFP	15.1	59.5	36.7
		Early + During CFP	14.5	60.4	35.8
	July 29	Late	15.1	56.4	39.5
		Late + After CFP	15.3	57.3	38.7
	Sept 10	Early + During CFP	18.3	61.0	35.3
	Sept 30	Early + After CFP	15.0	56.8	39.2
		Late + After CFP	20.0	65.5	31.0
Spredor 4 (Creeping Root)	July 5	Early	13.8	55.3	40.6
		Early + After CFP	14.9	60.6	35.6
		Early + During CFP	13.5	60.4	35.8
	July 29	Late	16.4	55.6	40.3
		Late + After CFP	14.7	57.3	38.7
	Sept 10	Early + During CFP	18.0	61.6	34.7
	Sept 30	Early + After CFP	16.8	61.1	35.2
		Late + After CFP	20.4	68.4	28.3
AC Yellowhead (Yellow flowered creeping root)	July 5	Early	16.2	61.6	34.7
		Early + After CFP	15.1	62.9	33.4
		Early + During CFP	14.6	59.5	36.6
	July 29	Late	16.0	59.6	36.6
		Late + After CFP	16.3	57.3	38.7
	Sept 10	Early + During CFP	19.1	61.0	35.2
	Sept 30	Early + After CFP	15.4	57.1	38.9
		Late + After CFP	19.9	67.1	29.6

CFP: Critical Fall Period

Discussion

Monthly precipitation levels for the 2016 growing season at Melfort are provided in the table below. The growing season precipitation was below average for April, May, and June with May being particularly low. July precipitation was well above normal as was August. September precipitation was near normal for Melfort.

Table 3. Monthly Precipitation for 2016 Growing Season at Melfort, SK

Month	Precipitation (mm)
April	13.5
May	16.8
June	53.2
July	128.7
August	80.8
September	41.3

Yield

Yield data from 2015 (Year one of the demonstration) and 2016 (Year two of the demonstration) are both included in Appendix A to compare results and note any trends or impacts resulting from the different grazing treatments.

Total yield data is graphed in Chart 1 (Appendix A) for five treatments: Early (July 5); Late (July 29); Early + during CFP (Sept 10); Early + after CFP (Sept 30); Late + after CFP (Sept 30). In the treatments with just an early or late cut Equinox and AC Yellowhead had comparable total yields while Spredor 4 was more productive. In the two cut trials Equinox and Spredor 4 had comparable yields while AC Yellowhead had lower yields.

The highest yielding treatment in this demonstration was the early + after CFP treatment of Spredor 4 (creeping root) alfalfa. This two-cut treatment yielded 9793 kg/ha (kilograms per hectare). However, there are four other treatments that are very close in yield and do not appear to be significantly different. These are all two cut treatments of Spredor 4 and Equinox. Overall, AC Yellowhead (yellow flowered creeping root) had lower yields than the purple-flowered varieties (tap- and creeping-root).

The lowest total yields were from the July 5 single cut for Equinox and AC Yellowhead at 4851 kg/ha and 5048 kg/ha respectively. Late cut yields (July 29) for both those varieties are lower than the first cut yield for Spredor 4 which was 6171 kg/ha.

In Chart 2, the 2015 yield results for early and late cut show Spredor 4 yielding the highest followed by Equinox and AC Yellowhead respectively. When comparing the two cut results, Equinox and Spredor 4 continue to out yield AC Yellowhead. Chart 1 (2016) and Chart 2 (2015) show similar trends.

All five treatments for each of the three varieties had increased yields in year two. The only exception is AC Yellowhead Early and During CFP treatment where the yield was insignificantly different. AC Yellowhead showed the most gain in four of the five treatments compared to Equinox and Spredor 4. AC Yellowhead had increased yields of approximately 1,000 kg/ha- 1,800 kg/ha in the other four treatments (increases of 0-50%). Equinox had gains of 200 kg/ha-1,000 kg/ha (increases of 7-26%) and Spredor 4 had gains of 100 kg/ha-1,400 kg/ha (increases of 1-25%). With only two years of data it is difficult to tell if this was weather related and specific to the growing season, or indicates that AC Yellowhead is persisting better in the stands. More years of data in more locations would be needed to understand what factors are contributing to yield differences.

Quality

The quality of all three varieties (Equinox, Spredor, and AC Yellowhead) was similar in 2016. Both TDN and protein were highest for the September 30 treatment following the late first cut (late + after CFP) for every type of alfalfa. At September 30 the Equinox sample tested at 20.0% protein, Spredor 4 at 20.4% protein, and AC Yellowhead at 19.9% protein. Protein levels were also high for all three varieties for the September 10 treatment following an early cut (early + during CFP). Equinox tested 19.3%, Spredor 4 18.0% and AC Yellowhead 19.1% protein. Protein levels were relatively consistent across the other treatments and varieties with Equinox ranging from 14.5- 15.3 %, Spredor 4 ranging from 13.5- 16.8%, and AC Yellowhead 14.6- 16.3%. Last year's trend that showed lowest protein levels with the July 30 cutting analysis did not hold this year as this treatment showed protein levels similar or slightly increased.

Extension/Promotion Activities:

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

- Sign placed at the demonstration site
- 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 2017 edition of the SFC *Forage and Livestock eNews* as well as other Saskatchewan Forage Council publications.

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11. Conclusions and Recommendations

The later July cutting date resulted in higher yields than cutting early in July for all varieties under a one cut system. Under a two-cut system the early and after the critical fall period treatment was most likely to result in the highest yields. AC Yellowhead yielded less than Equinox and Spredor 4 under all treatments (except one) in both 2015 and 2016. There does not appear to have been any negative impact on yield to cutting during the CFP for any of the three varieties. More years of data may be necessary to determine if this is a result of the growing conditions in 2016 or if successive years of CFP cutting would show different results. Similarly, more years of data in a number of locations, is needed to show whether a one-cut system has added benefit for winter survival and persistence in stand over a two-cut system.

Protein levels amongst all three varieties for all treatments were very similar in both 2015 and 2016. The AC Yellowhead did not appear to maintain protein and energy levels longer than Equinox and Spredor 4 in the late cuttings in 2016. The increased TDN for AC Yellowhead in 2015 for the late and after CFP cuttings was not seen in the 2016 results. In general, 2016 protein levels were similar between the July 5 and July 29 cuttings while in 2015 the late July cuttings showed a drop-in percentage protein.

In the two years of trials, persistence in the stand and winter hardiness were not measured by parameters other than yield. To fully measure these a study including plant counts in straight alfalfa stands and/or mixed forage stands may be required. Two years was not sufficient time for these traits to show in yield data. Over a longer term these traits may express themselves and influence long term average yields for all three varieties. Differences in growth and quality may be only a reflection of growing conditions and stage of flowering at cutting times. Multiple years of testing at a number of sites is needed to verify whether demonstration results are consistent from year to year.

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 for five treatments: **1)** Early (July 5); **2)** Late (July 29); **3)** Early + during Critical Fall Period (Sept 10); **4)** Early + after Critical Fall Period (Sept 30); **5)** Late + after Critical Fall Period (Sept 30).

In the one-cut system, cutting in late July resulted in higher yields compared to cutting in early July for all types of alfalfa. AC Yellowhead had similar protein and energy levels for the early and late cuts. Equinox and Spredor 4 had higher protein levels in the late cut compared to the early cut. This is the reverse of what was seen in 2015.

Cutting in early July and again after the critical fall period produced the highest yields for two of the three varieties in the two-cut system in this project. The Sept 30th cutting for the late and after critical fall period treatment showed highest protein and energy for all three varieties. AC Yellowhead had the lowest first cut yield July 29th as well as the lowest yielding regrowth after each summer cutting date. Protein and energy levels were comparable among varieties across the treatments. Any effect of cutting during the critical fall period was not evident in the data.

The yield and quality data are a result of the growing conditions and variety. Both 2015 and 2016 growing seasons saw above average precipitation later in the season. This would influence stage of growth at the later cutting dates and thus would influence the quality as well as yield. This may also influence winter survival. Multiple years of data collection are needed to clarify results. Results and an article will be published in the Saskatchewan Forage eNews in 2017. Final results will also be posted on the SFC website (average hits of 2000+ per month).

Appendix A – Charts

Chart 1a. Total (sum of all cuts) Dry Matter Yield (kg DMY ha-1) 2016

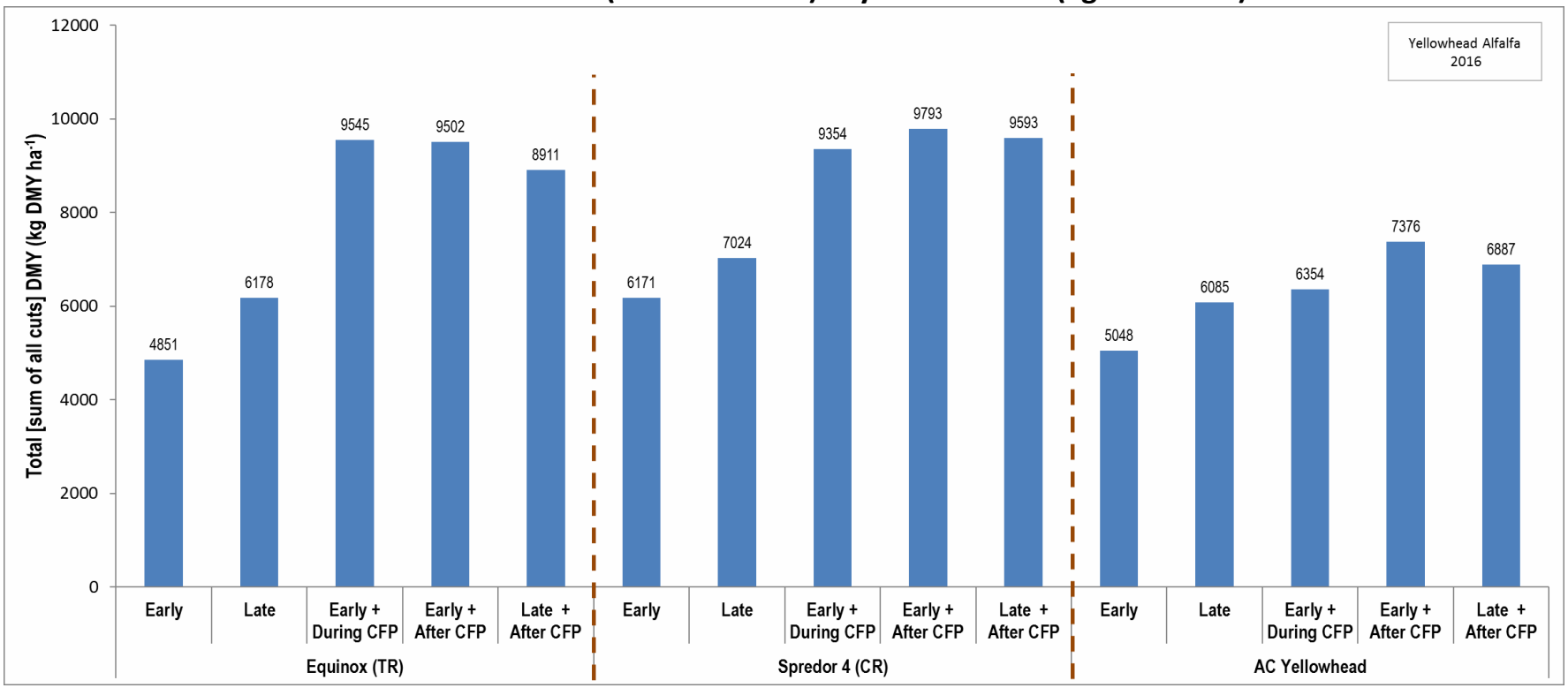

Chart 1b. Total (sum of all cuts) Dry Matter Yield (kg DMY ha-1) 2015

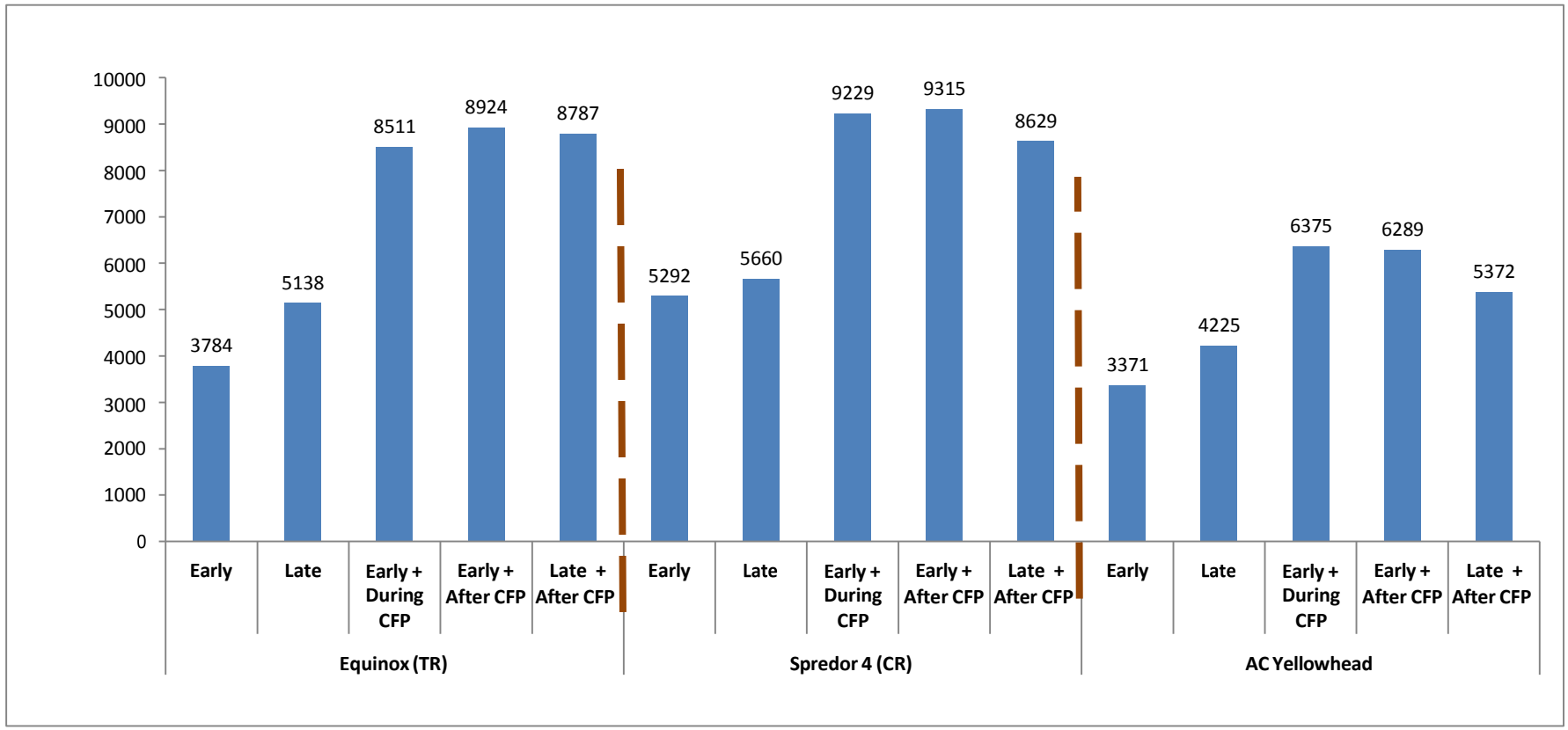

Chart 2a. Dry Matter Yield for each cut treatment (kg DMY ha-1) 2016

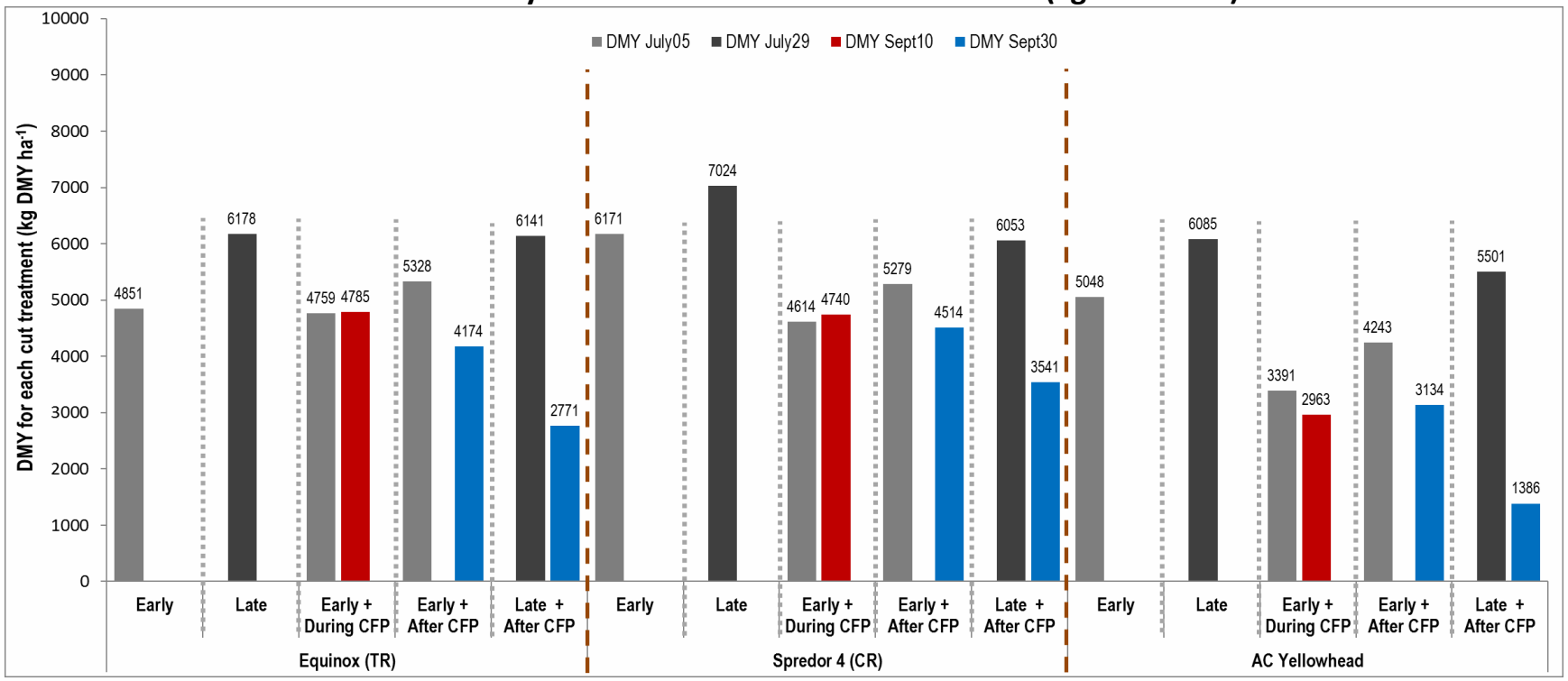

Chart 2b. Dry Matter Yield for each cut treatment (kg DMY ha-1) 2015

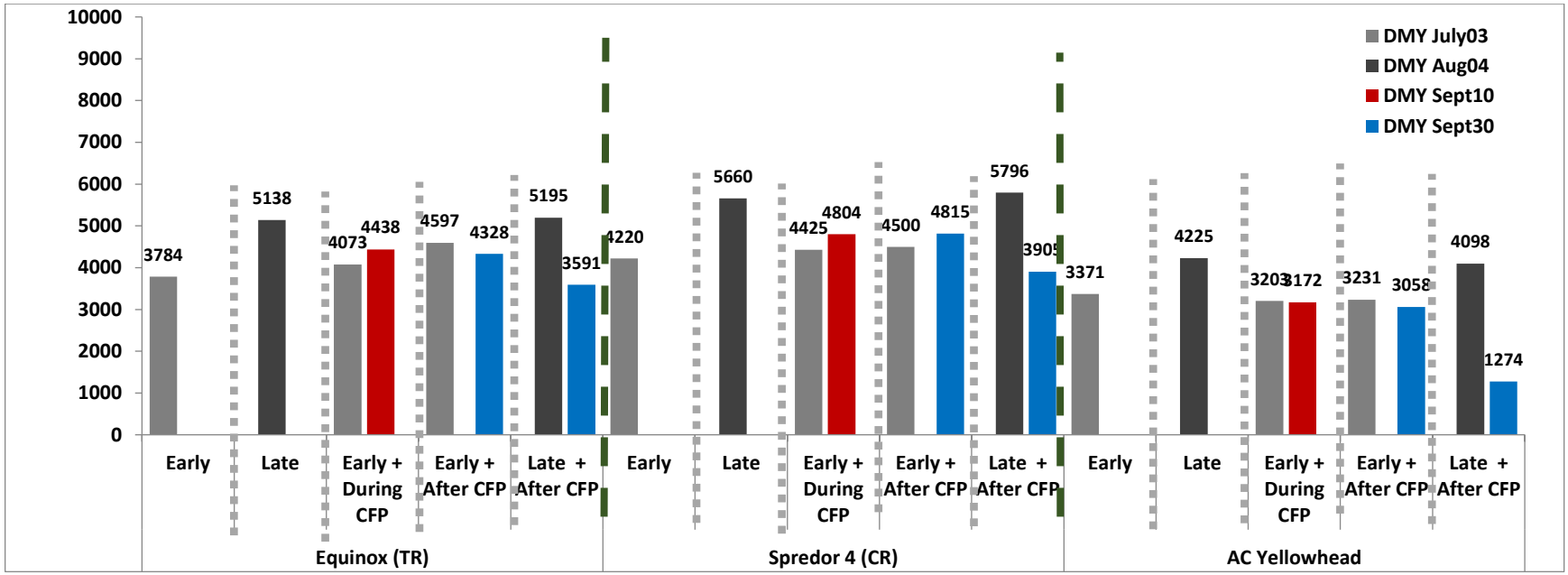

Chart 3a. Protein concentration of alfalfa (% Protein) 2016

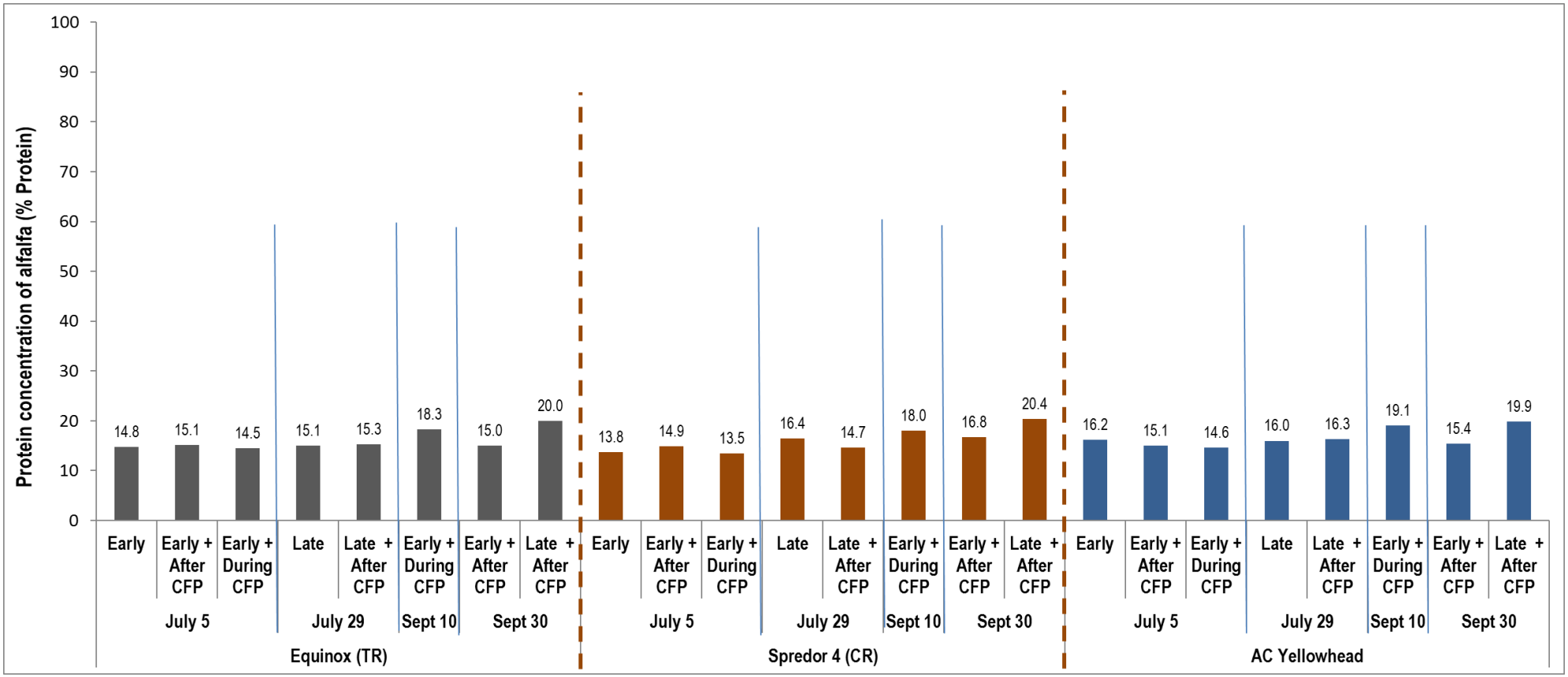

Chart 3b. Protein concentration of alfalfa (% Protein) 2015

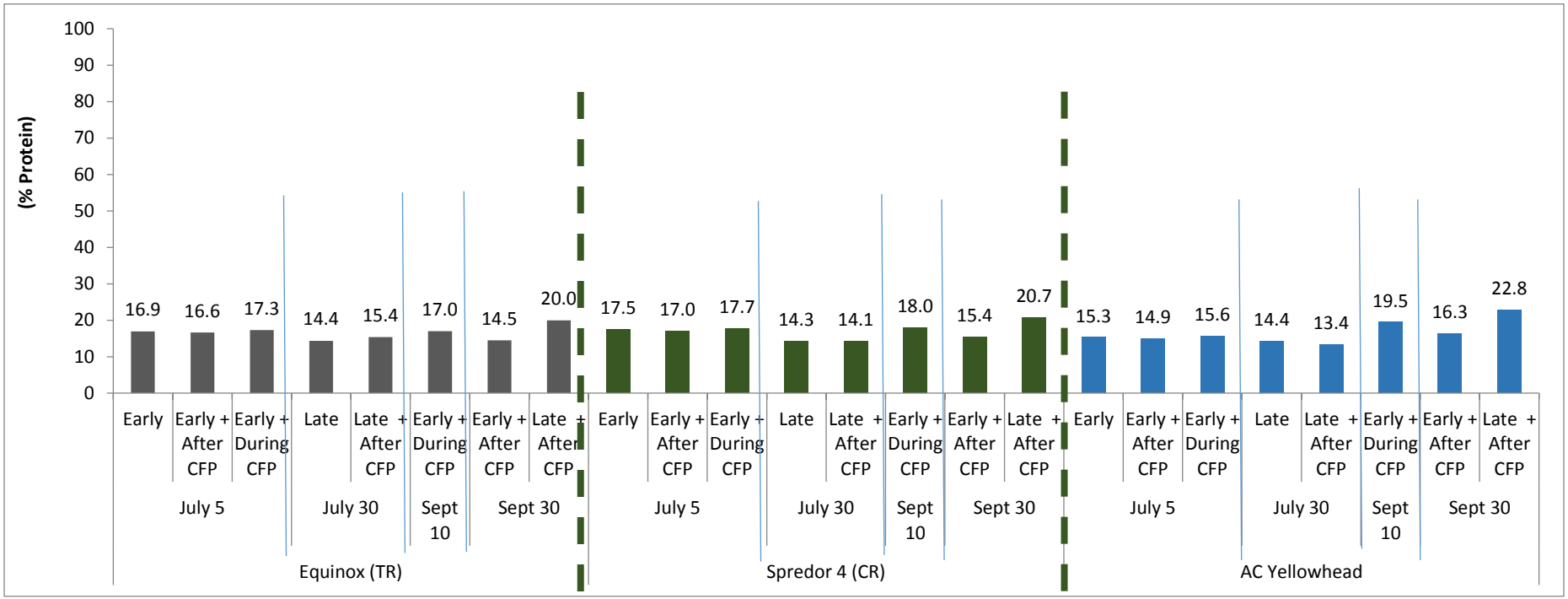

Chart 4a. Total Digestible Nutrient concentration of alfalfa (% TDN) 2016

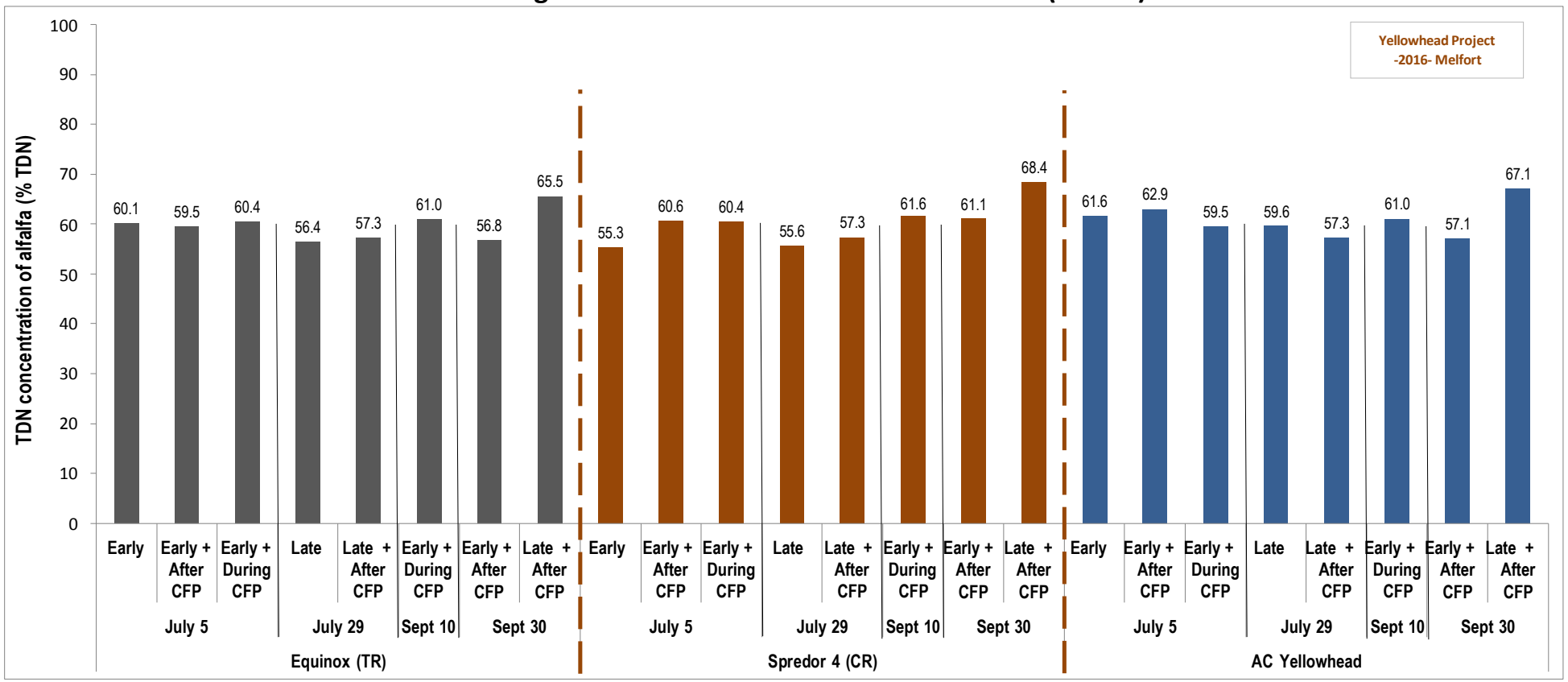

Chart 4b. Total Digestible Nutrient concentration of alfalfa (% TDN) 2015

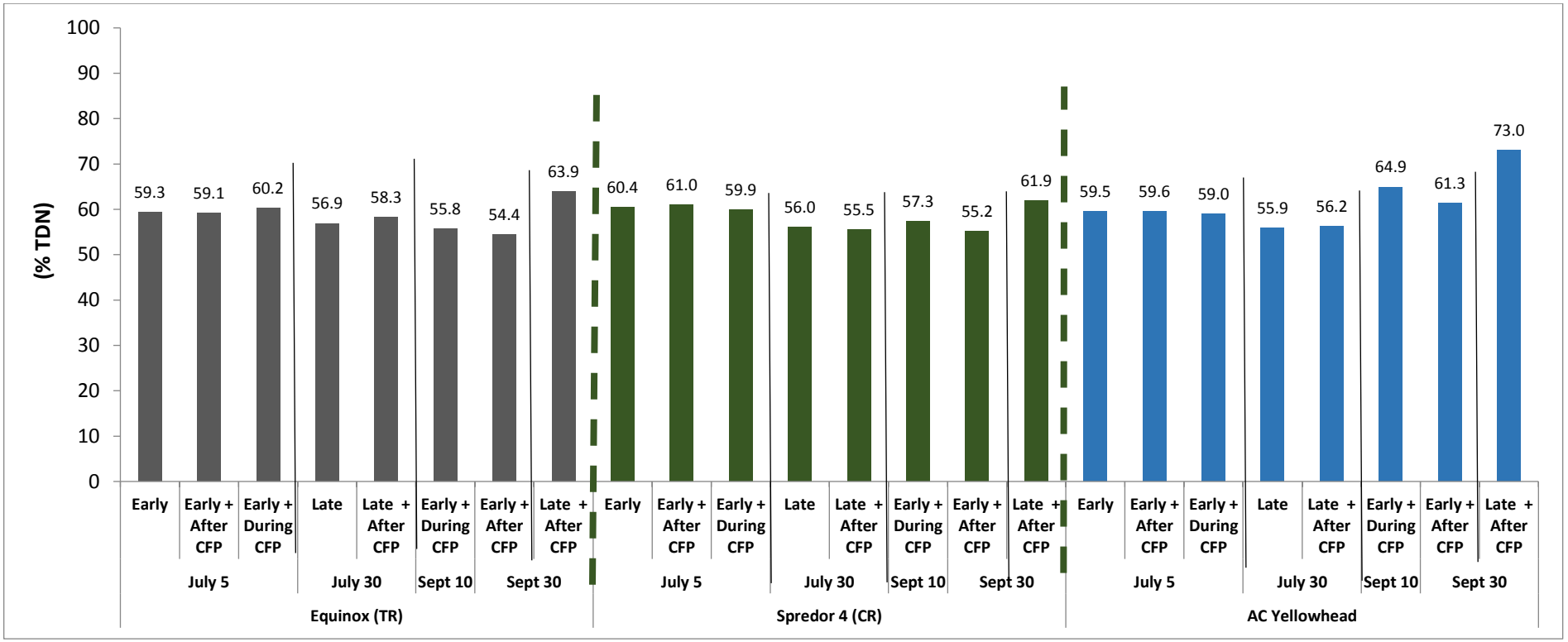

Chart 5a. ADF concentration of alfalfa (% ADF) 2016

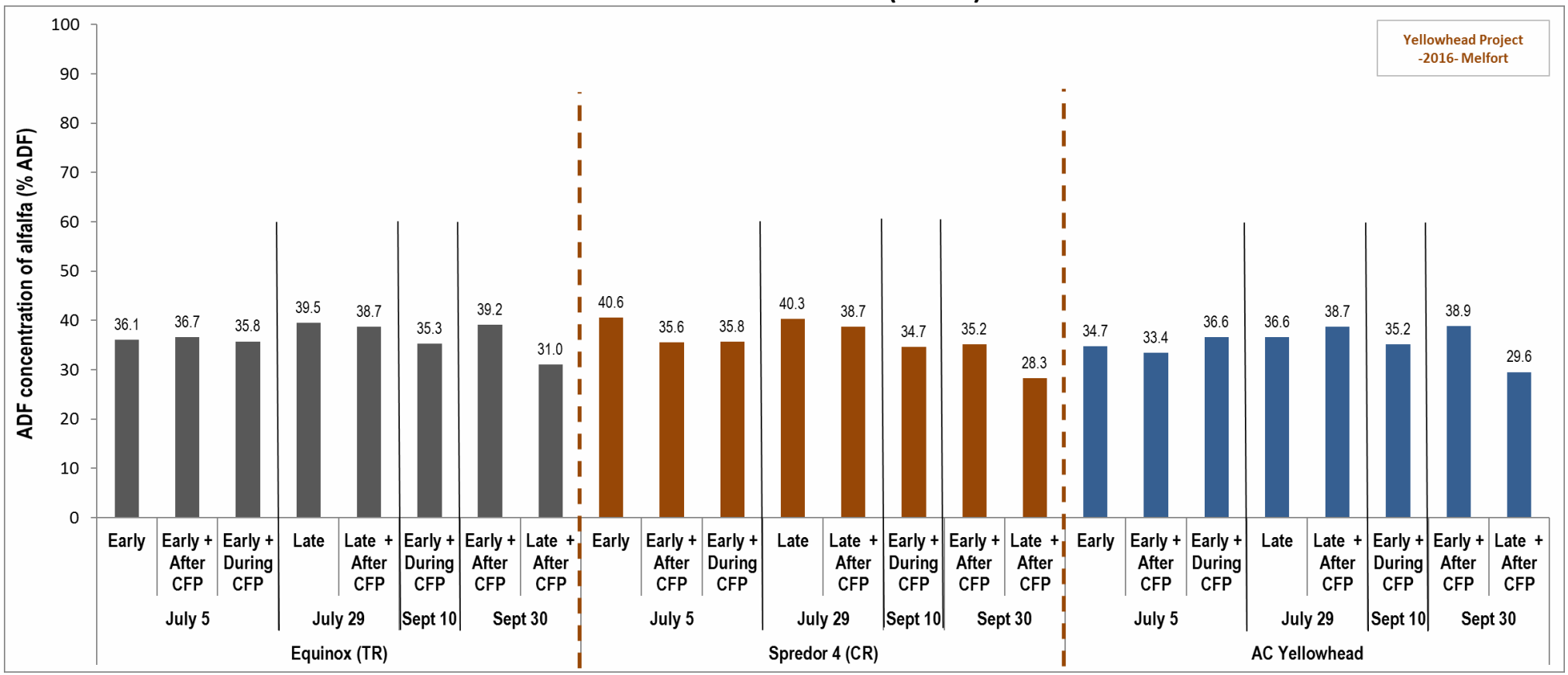

Chart 5b. ADF concentration of alfalfa (% ADF) 2015