WISCONSIN ALFALFA YIELD AND PERSISTENCE (WAYP) PROGRAM
2020 SUMMARY REPORT

Program Objectives:

1. To verify the yield and quality of alfalfa harvested from production fields over the life of the stand beginning with the first production year (year after seeding).
2. To quantify decreases in stand productivity of alfalfa fields as they age.

2020 Overview:

This summary has now reached fourteen years of project data. UW-Madison Division of Extension educators were asked to identify forage producers willing to weigh and sample forage from a 2019-seeded field and continue to do so for the life of the stand. A total of 6 new fields from 5 different farms were enrolled in the program in 2020 and 12 fields continued from previous years. The new fields were from farms and counties that have previously participated in the program. The current summary includes data for the first, second, third, and fourth production years from fields entered into the program in 2017 through 2020 (2016-2019 seeding). One fourth-year stand remained in the project, which is fortunate because they are valuable for obtaining long-term data. As is always the case in these types of studies, there is some attrition of fields over time. This is either because the farmer decided to terminate the field because of winterkill, declining productivity, or critical yield or forage quality data for a cutting or multiple cuttings could not be obtained. This year there were ten fields dropped from the project that participated in 2019. Four were planned because of rotation, five experienced extreme winterkill the previous winter, and one missed data collection from a cut. Production data was collected from 18 fields in 2020 with a total of 2,197 dry matter tons of forage harvested, weighed, and sampled from 643 acres. Over 14 years, data was collected from 115 fields with a total of 63,807 dry matter tons of forage harvested, weighed, and sampled from 6,964 acres. Background information of all project fields (current and past) is presented in Table 1. Two changes were made in the report this year. First, fall cuts taken after October 1 were separated from Cuts 1-5 when yield or quality is shown by cut. Generally the fall cut has lower yield and higher quality and this has the possibility of skewing averages as it had been previously included with Cut 4 or Cut 5. Fall cut from 25 harvests can now be seen on its own. Second, yield attained over the life of the alfalfa stand was not previously summarized. Table 4 contains a summary of overall field yield by number of seasons and Table 5 lists the Top 5 yielding fields by number of seasons of the stand.

2020 Weather

An early snow melt in March turned into a cool and dry pattern. This allowed for timely seeding of alfalfa and other crops, but slowed spring alfalfa growth and development. Many growers, especially in northeastern Wisconsin experienced winterkill resulting in lost or severely reduced stands. Temperatures in April and May were below normal. Summer temps were above normal and early fall was slightly below normal. Precipitation varied throughout the state. Early spring was generally drier than normal allowing for timely fieldwork and May through August was mostly normal, enough to provide crop needs and not interfere with timely harvest as in previous years. Some areas started to get dry by mid-summer and fall was normal to below normal. Summer-seeded alfalfa was planted on time and received enough moisture for adequate growth. A warm November (third warmest on record in Arlington) prevented stands from properly hardening-off for winter dormancy and green growing plants were still observed in December.

2019 Weather

The growing season was challenging for producers. A polar vortex caused record low temperatures in late January. Above average snowfall and spring rain caused flooding. Cold April and May temperatures combined with late snowstorms delayed spring greenup and new seeding. Winter injury was observed across the state, but was most severe in eastern and north central areas. Wet conditions persisted through much of the year, resulting in narrow windows to harvest without the threat of rained on hay or muddy fields. Precipitation records were set as alfalfa cutting was delayed. Temperatures were below normal to normal in June and August and above

normal in July, September, and early October. Alfalfa went dormant for winter under early snow, record cold, and saturated soils in November.

2018 Weather

The growing season overall was again marked by many extreme weather events. Very cold December temperatures with little snow cover followed by January rainfall and ice did not seem to hurt alfalfa. An April blizzard and below normal temperatures delayed spring greenup. Precipitation in southern Wisconsin was above normal and near record through most of the season. The central and eastern parts of the state were dry through much of summer and most of the state was above normal in late-August and September. Much of the state had normal or above normal temperatures through the growing season. This included several hot stretches in late May, June, and July. Fall weather was mostly cold and wet as alfalfa prepared for dormancy.

2017 Weather

The growing season overall was characterized by many extremes that ended up averaging out to a "normal" year. After a warm winter, the early season was generally cool and wet in most areas of the state. This led to delayed seeding as soils remained wet. Extreme winterkill was observed in NE Wisconsin counties where all 2nd production year fields and four of six 3rd year fields for this study were lost. This was regardless of a late fall cut being taken or not. First harvest timing was normal because spring growth was not as rapid as some previous years. Temperatures in June were generally near to above normal, while July and August were below normal. September and October were much above normal. Precipitation was variable, but generally wet until July and dry after. Some areas received very little rain in September. A very late killing frost allowed established stands and summer seeding time to recover and strengthen for the winter.

Table 1. Field background information (2017-2020)

Field #	1st Production Year	County	Seeding Mo/Yr.	Seeding Rate (lb/ac)	Field Size (ac)	Last Production Year
107	2007	Outagamie	05/06	15	103.7	2009
207	2007	Outagamie	04/06	16	79.3	2009
307	2007	Outagamie	04/06	16	37.0	2010
407	2007	Outagamie	04/06	16	156.7	2009
507	2007	St. Croix	08/06	NA	51.0	2009
607	2007	Waupaca	04/06	15	24.1	2007
707	2007	Fond du Lac	04/06	17	15.7	2007
807	2007	Fond du Lac	04/06	17	39.7	2010
108	2008	Chippewa	04/07	15	18.8	2009
208	2008	Marathon	04/07	15	5.2	2011
308	2008	Winnebago	05/07	15	115	2011
408	2008	Winnebago	08/07	15	36.0	2011
508	2008	Winnebago	05/07	15	22.0	2011
608	2008	Outagamie	05/07	20	83.7	2011
708	2008	Outagamie	04/07	16	147.8	2011
808	2008	Outagamie	04/07	16	53.0	2011
908	2008	Outagamie	05/07	15	50.3	2011
1008	2008	Outagamie	08/07	15	194.8	2008
109	2009	St. Croix	08/08	NA	41	2011
209	2009	Winnebago	04/08	15	67	2012
309	2009	Winnebago	08/08	15	78	2011
409	2009	Brown	08/08	18	75	2011
509	2009	Chippewa	04/08	15	16.2	2009
609	2009	Calumet	04/08	12	15	2011
709	2009	Outagamie	05/08	20	74.8	2010

Table 1. Field background information (**continued**)

Field #	1st Production Year	County	Seeding Mo/Yr.	Seeding Rate (lb/ac)	Field Size (ac)	Last Production Year
809	2009	Outagamie	05/08	20	63	2010
110	2010	Outagamie	05/09	16	48	2010
210	2010	Outagamie	05/09	16	110.2	2012
310	2010	Outagamie	05/09	16	61.7	2012
410	2010	Outagamie	05/09	16	111	2012
510	2010	Fond du Lac	04/09	17	50.3	2012
610	2010	Fond du Lac	04/09	17	19.3	2012
111	2011	Fond du Lac	04/10	17	10	2013
211	2011	Brown	04/10	17	35.7	2012
311	2011	Outagamie	05/10	20/+4 TF	75.8	2011
411	2011	Outagamie	05/10	20/+4 TF	72	2011
112	2012	St. Croix	08/11	16	73.9	2012
212	2012	Kewaunee	05/11	17	73.5	2014
312	2012	Outagamie	05/11	16	143.6	2014
412	2012	Outagamie	05/11	16	75	2014
512	2012	Outagamie	05/11	16	189	2014
612	2012	Outagamie	05/11	16	45.9	2014
712	2012	Outagamie	05/11	16	38.7	2013
812	2012	Dodge	05/11	16	59.6	2013
113	2013	Columbia	08/12	15	44.6	2015
213	2013	Outagamie	04/12	16	150.7	2014
313	2013	Outagamie	04/12	16	54	2014
413	2013	Outagamie	04/12	16	79.3	2014
513	2013	Brown	08/12	28	156	2013
114	2014	Fond du Lac	04/13	19	32.8	2016
214	2014	Fond du Lac	07/13	17	35.7	2016
314	2014	Fond du Lac	05/13	15	9.4	2016
414	2014	Fond du Lac	05/13	18	20.3	2017
514	2014	Kewaunee	05/13	21	32	2016
614	2014	Door	05/13	18	60.8	2016
714	2014	Columbia	04/13	14	9.4	2017
814	2014	Pierce	09/13	15	16.3	2015
914	2014	Marathon	07/13	12	14.2	2015
1014	2014	Marathon	06/13	15	32.5	2016
1114	2014	Outagamie	05/13	16	104.3	2014
1214	2014	Outagamie	05/13	16	156.8	2014
1314	2014	Outagamie	06/13	16	69	2014
1414	2014	Outagamie	05/13	20/+3.5 TF	38.9	2016
1514	2014	Outagamie	06/13	20/+3.5 TF	76.7	2015
115	2015	Manitowoc	06/14	16	19.3	2017
215	2015	Door	07/14	18	52.0	2016
315	2015	Outagamie	05/14	16	55.7	2016
415	2015	Outagamie	05/14	16	110.2	2016
515	2015	Outagamie	05/14	16	86.5	2018
615	2015	Outagamie	05/14	16	45.8	2016
715	2015	Outagamie	05/14	16	225.0	2016
815	2015	Marathon	06/14	18	11.4	2017
915	2015	Marathon	06/14	15	5.61	2016

Table 1. Field background information (**continued**)

Field #	1st Production Year	County	Seeding Mo/Yr.	Seeding Rate (lb/ac)	Field Size (ac)	Last Production Year
1015	2015	Columbia	04/14	15	15.9	2018
116	2016	Marathon	04/15	12	20.0	2017
216	2016	Outagamie	05/15	16	215.7	2016
316	2016	Outagamie	05/15	16	108.6	2016
416	2016	Outagamie	05/15	16	65.0	2016
516	2016	Outagamie	05/15	16	78.2	2016
616	2016	Outagamie	05/15	16	90.0	2016
716	2016	Columbia	05/15	16	11.9	2018
117	2017	Door	05/16	18	48.6	active
217	2017	Kewaunee	07/16	20	33.7	2019
317	2017	Outagamie	05/16	16	89.6	2019
417	2017	Outagamie	05/16	16	103.4	2018
517	2017	Outagamie	05/16	16	285.3	2019
617	2017	Columbia	05/16	16	16.5	2019
717	2017	Marathon	05/16	12	6.2	2018
817	2017	Marathon	08/16	12	42.4	2018
917	2017	Columbia	05/16	15	16.5	2019
1017	2017	Columbia	05/16	15	16.2	2019
118	2018	Kewaunee	05/17	18	40.0	2019
218	2018	Dane	08/17	18	102.5	2018
318	2018	Dane	08/17	20	52.6	active
418	2018	Manitowoc	05/17	18	53.9	2018
518	2018	Fond du Lac	05/17	18	38.0	active
618	2018	Fond du Lac	08/17	20	14.3	active
718	2018	Fond du Lac	05/17	17	8.0	active
818	2018	Fond du Lac	05/17	17	58.0	active
918	2018	Fond du Lac	05/17	17	57.0	active
1018	2018	Columbia	08/17	15	19.5	active
1118	2018	Outagamie	05/17	16	57.7	2019
1218	2018	Outagamie	05/17	16	46.7	2018
1318	2018	Outagamie	05/17	16	60.3	active
1418	2018	Marathon	08/17	15	9.7	active
119	2019	Columbia	05/18	16	22.3	active
219	2019	Marathon	05/18	15	10.3	2019
319	2019	Marathon	05/18	15	31.6	active
419	2019	Marathon	05/18	15	32.5	2019
120	2020	Fond du Lac	04/19	?	11.0	active
220	2020	Columbia	08/19	15	32.3	active
320	2020	Outagamie	05/19	16	46.2	active
420	2020	Outagamie	05/19	16	68.5	active
520	2020	Kewaunee	05/19	18/ +2 RC,2 MF	57.0	active
620	2020	Marathon	05/19	15	8.8	active

*TF= Tall Fescue, MF- Meadow Fescue, RC= Red Clover

Data Collection:
Project fields were identified and an accurate measure of field size was determined (if not previously known). Forage yield from an entire project field was weighed (usually this was done with an on-farm drive-over scale). Both empty and full weights for all trucks/wagons used were recorded. Beginning in 2008, two forage samples from each harvest were taken and submitted to the Marshfield Soil and Forage Analysis Laboratory (only one sample was submitted per harvest in 2007) for NIR analysis. Results from the two forage samples were averaged and recorded into a spreadsheet by the local coordinator. The data was then shared with the producer following each harvest. At the end of the season, all data was collected and summarized for this report.

Harvest Schedules:
Mean cutting dates by year are presented in Table 2 and cutting dates for all project fields harvested in 2020 are presented in Table 3. The 2020 season was marked by later than normal harvest dates for all cuts (Table 2). The average date of each cut was 2-4 days later than the fourteen-year average. First cut was tied for the fourth latest recorded after 2013, 2019, 2014. It was delayed by slow green-up and development, caused by a cool, dry spring and winter injury. Even with a later harvest, alfalfa had not yet obtained optimal growth. As usual with a later 1st harvest, cuts through the remainder the season were pushed back. Average first-cut date has ranged from May 16 in 2012 to June 10 in 2013. Regardless of first-cut date, the average fourth-cut date is generally within a week of September 1, with the exception of a few extreme weather years. This is usually necessitated by the impending corn silage harvest and producers not wanting to put the stand at risk with a late September cut. The majority of fields in this study and in 2020 were cut four times. Across years and sites and including fall cuts, 35 fields were cut three times, 220 fields were cut four times, and 23 fields were cut five times. A fall cut was taken 25 times.

First cut occurred over a 18 day range (May 29 to June 15) which is shorter than normal (Table 3). Typically, first cut occurred over 22 days because of varying location and weather, but ranged from 13 in 2007 to 45 in 2015. Three fields were cut in May and the majority were cut the first week in June. Throughout the season, cutting date was affected by weather and individual producer's decisions, contributing to wider ranges in subsequent cuttings. Five fields were cut 3 times (not including fall) this year and none were cut 5 times. The average days between cutting for 4-cut fields was 1st to 2nd- 31, 2nd to 3rd- 29, and 3rd to 4th- 32. The average days between cutting for 3-cut fields was 1st to 2nd- 31 and 2nd to 3rd- 36. These fields generally were in northern counties or had a late first cut. Two fields that had a third cut in mid-August had a fall cut taking in early October.

Table 2. Mean cutting dates by year

Year	1st Cut Date	2nd Cut Date	3rd Cut Date	4th Cut* Date	5th Cut Date	Fall Cut Date
2007	22-May	24-Jun	25-Jul	30-Aug		21-Oct
2008	3-Jun	2-Jul	1-Aug	30-Aug		29-Oct
2009	31-May	1-Jul	4-Aug	5-Sep		
2010	22-May	28-Jun	2-Aug	29-Aug		12-Oct
2011	31-May	1-Jul	31-Jul	31-Aug		21-Oct
2012	16-May	14-Jun	14-Jul	10-Aug	30-Aug	2-Oct
2013	10-Jun	11-Jul	6-Aug	7-Sep		
2014	4-Jun	9-Jul	7-Aug	13-Sep		
2015	3-Jun	2-Jul	3-Aug	27-Aug	12-Sep	
2016	29-May	26-Jun	26-Jul	19-Aug	1-Sep	1-Oct
2017	30-May	2-Jul	1-Aug	29-Aug		
2018	30-May	27-Jun	28-Jul	3-Sep	14-Sep	
2019	7-Jun	10-Jul	9-Aug	6-Sep		8-Oct
2020	3-Jun	4-Jul	4-Aug	1-Sep		5-Oct
MEAN	**30-May**	**30-Jun**	**31-Jul**	**30-Aug**	**6-Sep**	**12-Oct**

Table 3. Summary of 2020 Cutting Dates

Field ID#	County	1st Cut Date	2nd Cut Date	3rd Cut Date	4th Cut Date	5th Cut Date	Fall Cut Date
117	Door	5-Jun	6-Jul	5-Aug			
318	Dane	30-May	30-Jun	29-Jul	26-Aug		
518	Fond du Lac	15-Jun	13-Jul	28-Aug			
618	Fond du Lac	6-Jun	1-Jul	28-Jul	7-Sep		
718	Fond du Lac	4-Jun	6-Jul	4-Aug	2-Sep		
818	Fond du Lac	29-May	28-Jun	4-Aug	9-Sep		
918	Fond du Lac	30-May	29-Jun	4-Aug	7-Sep		
1018	Columbia	2-Jun	1-Jul	29-Jul	25-Aug		
1318	Outagamie	5-Jun	10-Jul	5-Aug	5-Sep		
1418	Marathon	3-Jun	7-Jul	12-Aug			6-Oct
119	Columbia	1-Jun	30-Jun	28-Jul	25-Aug		
319	Marathon	7-Jun	7-Jul	11-Aug			5-Oct
120	Fond du Lac	6-Jun	1-Jul	28-Jul	7-Sep		
220	Columbia	1-Jun	30-Jun	29-Jul	26-Aug		
320	Outagamie	5-Jun	10-Jul	5-Aug	5-Sep		
420	Outagamie	5-Jun	10-Jul	5-Aug	5-Sep		
520	Kewaunee	1-Jun	30-Jun	30-Jul	30-Aug		
620	Marathon	3-Jun	7-Jul	11-Aug			
MEAN		**3-Jun**	**4-Jul**	**4-Aug**	**1-Sep**		**5-Oct**
EARLIEST		**29-May**	**28-Jun**	**28-Jul**	**25-Aug**		**5-Oct**
LATEST		**15-Jun**	**13-Jul**	**28-Aug**	**9-Sep**		**6-Oct**

Forage Dry Matter at Harvest:
Alfalfa was harvested as haylage for all but 20 individual cuttings over the fourteen years. Harvest dry matter data from the dry hay harvests was not included in the forage dry matter data means. Although project participants are not asked about storage structure, there is good reason to believe most of the farms are storing this forage in bunkers, piles, or bags.

Throughout the duration of this project total season dry matter percentage of harvested forage has ranged from 40 to 50% (Figure 1), though individual cuttings and total-season field means sometimes exceeded 50%, especially later in the season. It's been questioned if this is too dry for obtaining optimum storage porosity in a bunker or pile. The trend has been toward higher dry matter percentages in recent years, but 2020 was an exception. Cuts 1-4 and average season dry matter was below normal. Cut 4 and season dry matter each ranked 3rd lowest. The 2020 season dry matter was 42% and ranged from 36 to 55%. Eight fields finished the season with total-season dry matter means under 40% and only one field was above 50%. This was attributed to wet environmental conditions. Normally, first cut tends be harvested at a lower dry matter than other cuts. This is likely because drying weather improves through the season. The distribution of individual cut dry matter % is shown in Figure 1A. Although the majority of the cuts were harvested between 35 and 45% DM, this chart shows the difficulty of harvesting alfalfa haylage in the ideal moisture range.

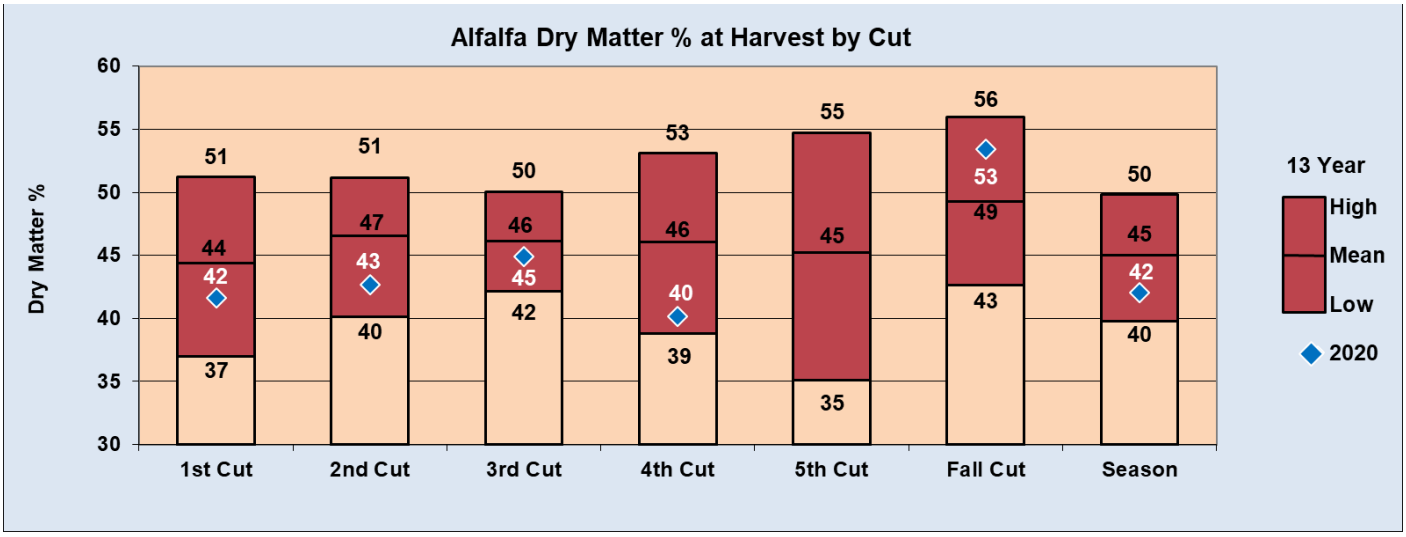

Figure 1. Average dry matter of harvested forage by cutting and as a weighted average for the total season (2007-2020).

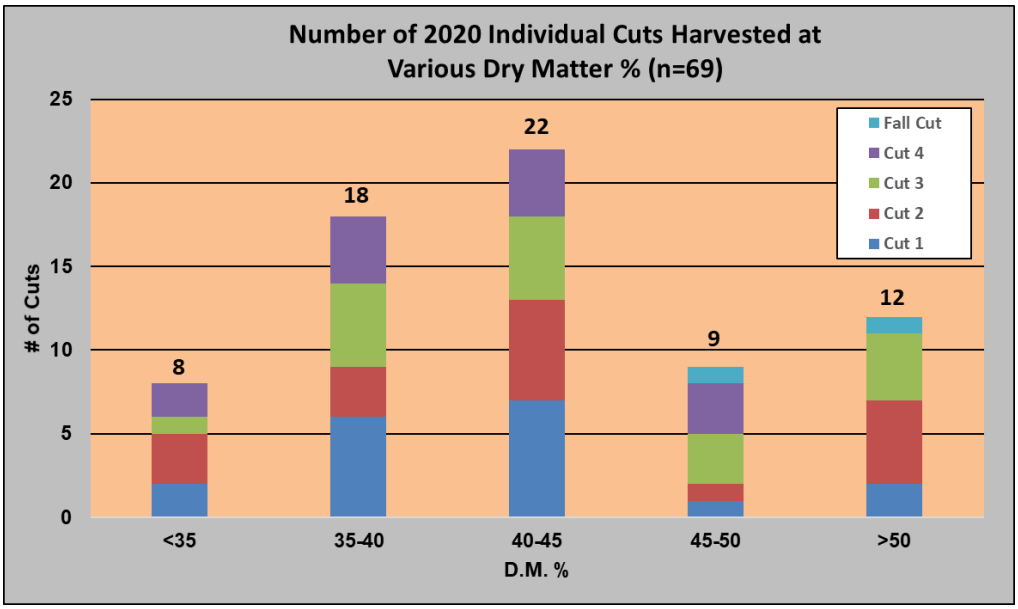

Figure 1A. Number of 2020 individual cuts harvested at various dry matter % (n=69).

Season Forage Dry Matter Yield:
Average yield by cutting and for the season in each project year are presented in Figure 2. The highest average dry matter yields of just over 5.0 tons per acre were obtained in 2007 and 2010. A record low total-season dry matter yield average was set in 2020 at 3.63 tons per acre, slightly below the previous low of 3.67 in 2013.

The average yield across all fields was 3.63 tons per acre in 2020, much below the fourteen-year average of 4.40 tons per acre. This yield was similar to 2013 which was a wet year with late harvest. First-cut yield of 1.22 tons per acre was the lowest seen, just behind 1.25 in 2013. This is because of delayed green up in May due to cold temperatures and producers having a favorable window to harvest, despite having optimal growth and development. This also resulted in record forage quality, which will be shown later. Other cut yields were also below normal. Cut 2 was the second lowest seen, just above 2011. Cut 3 and cut 4 were slightly below normal. Detailed yield data for each field by year are presented in Appendix A.

Once again there was extreme variation between fields in 2020 (Figure 3A). Yields ranged from a high of 4.92 to a low of 1.25 tons per acre (a record low). It is the first time no fields exceeded 5.0 tons per acre. 6.0 tons per acre is the benchmark for top yields in the study having only been reached 11 times over 14 years (Figure

3B). The highest yielding field since the project's inception was 6.55 tons per acre in 2012. Four fields were below 3.0 tons per acre in 2020. That level has now been reached by 21 fields in 14 years, but nine times in the last two years. (Appendix A). These fields likely received substantial winter injury in 2020 or previous winters, but were harvested because producers didn't have other options for forage.

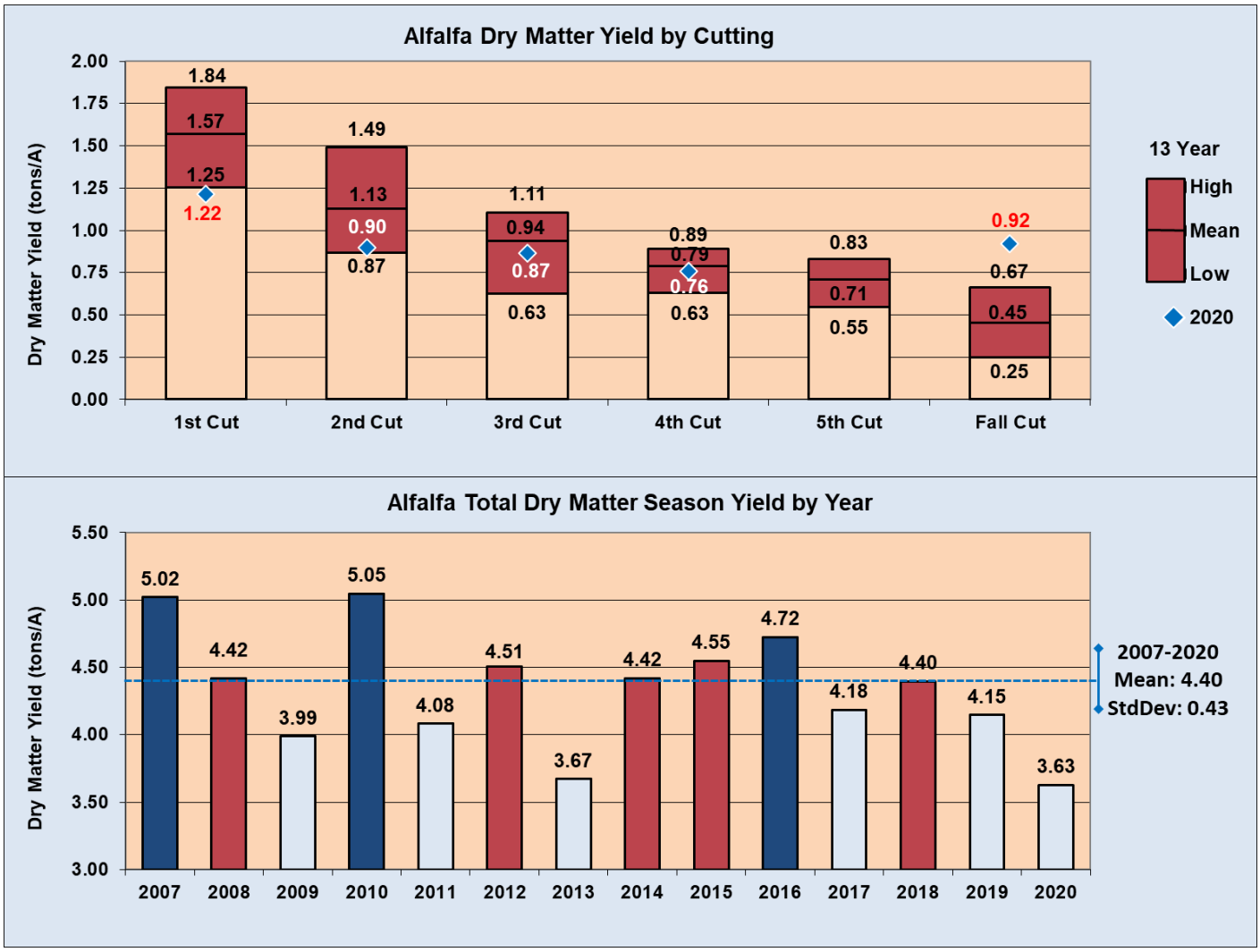

Figure 2. Average dry matter yield by cutting and for the total season yield by year. (2007-20)

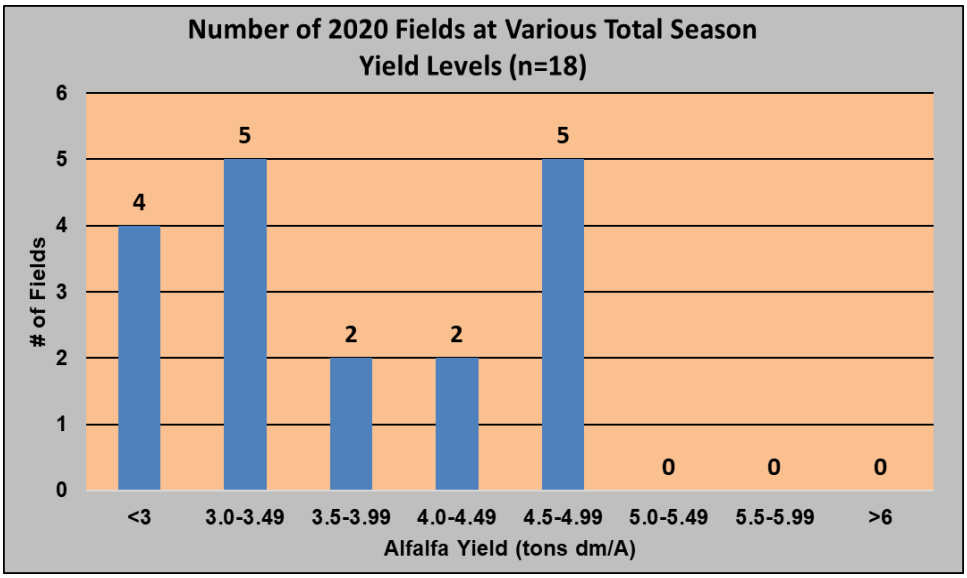

Figure 3A. Number of 2020 fields at various total season dry matter yield levels (n=18).

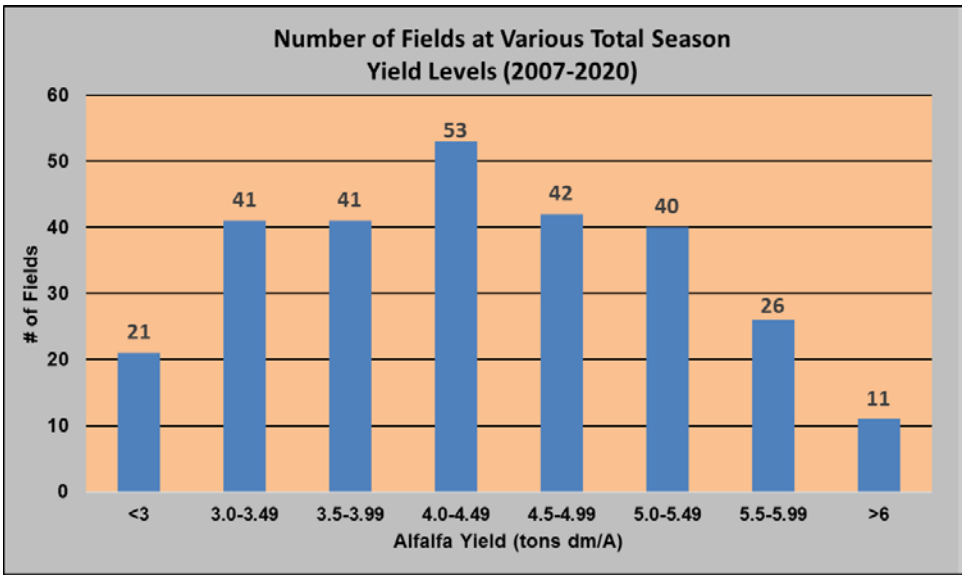

Figure 3B. Number of 2007-2020 fields at various total season dry matter yield levels (n=275).

Cumulative Forage Dry Matter Yield:

Previous summaries have focused on annual yield. Recent questions have been asked about yield attained over the life of the alfalfa stand. The total stand yield has been broken down by number of production years for the 111 fields that have complete data (Table 4). Fields still active were included with the current number of seasons. This summary is categorizing a field into its final season and not including the yield level through a previous season. Table 5 shows the top five yielding fields based on the number of seasons harvested. County, years in the project, and annual cut schedule are shown in addition to yield.

Table 4. Summary of overall field yield by number of seasons of the stand. (tn dm/A)

Seasons	Cuts	Fields	Mean	Min	Max
4	13-17	15	18.10	11.77	21.88
3	10-14	44	13.44	8.91	18.07
2	6-9	26	7.95	5.88	10.54
1	3-5	26	4.08	1.61	5.90

Table 5. Top overall yielding fields by number of seasons of the stand. (tn dm/A)

Seasons	Field ID	County	Years	Cut Schedule	Yield
4	414	Fond du Lac	2014-2017	4,4,4,4	21.88
4	714	Columbia	2014-2017	4,4,4,4	21.84
4	1015	Columbia	2015-2018	4,4,4,4	21.09
4	807	Fond du Lac	2007-2010	4,4,4,4	20.47
4	608	Outagamie	2008-2011	4,4,4,4	20.41
3	114	Fond du Lac	2014-2016	4,4,4	18.07
3	111	Fond du Lac	2011-2013	4,4,4	17.16
3	618	Fond du Lac	2018-2020	4,4,4	16.88
3	716	Columbia	2016-2018	4,4,4	16.73
3	113	Columbia	2013-2015	3,4,4	16.58

Table 5. continued

Seasons	Field ID	County	Years	Cut Schedule	Yield
2	1514	Outagamie	2014-2015	4,4	10.54
2	915	Marathon	2015-2016	3,3	10.21
2	709	Outagamie	2009-2010	4,4	10.17
2	812	Dodge	2012-2013	5,4	9.93
2	809	Outagamie	2009-2010	4,4	9.75
1	607	Waupaca	2007	4	5.90
1	311	Outagamie	2011	4	5.90
1	218	Dane	2018	4	5.56
1	418	Manitowoc	2018	5	5.39
1	110	Outagamie	2010	4	5.05

Alfalfa Persistence:

In-season: An analysis was done to determine the percent of total season yield for each cutting (Table 6). Data was summarized for 3-, 4-, and 5-cut systems for all project years. Five-cut fields were also included in the 4-cut summary with the final fall harvest not included in the total season yield. It's significant to note the wide variation in percent yield for an individual cutting. In some cases this is the result of environmental conditions (e.g. drought) previous to the harvest while in other situations it's simply a function of cutting date (Tables 2 and 3). The fifteen 4-cut fields in 2020 had a lower proportion of yield in the 1st cut compared to the study mean This was balanced by 3rd and 4th cuts having slightly more. Figure 2 previously showed that yield was much lower in early cuts and closer to normal in later cuts with a lower season yield. The six fields cut three times had very similar proportional yield to the long-term mean. No fields were cut five times this year.

Table 6. Average percent of total season yield by cutting for 3, 4 and 5 cut harvest systems* (2007-20)

3-cut system (3, 4-Fall) (n=41 site years)

	1st cut	2nd cut	3rd cut
2020	48	27	26
Mean	46	28	26
Low	26	15	13
High	72	43	49

4-cut system (4, 3+Fall, 5-Fall) (n=236 site years)

	1st cut	2nd cut	3rd cut	4th cut
2020	32	25	23	21
Mean	35	25	21	18
Low	20	14	5	5
High	58	42	36	34

5-cut system (5, 4+Fall) (n=23 site years)

	1st cut	2nd cut	3rd cut	4th cut	5th cut
2020					
Mean	31	23	18	16	12
Low	21	14	10	9	6
High	41	39	26	24	18

* high and low figures are for individual cuttings and will not add to 100%

Between years: Persistence is influenced over time by the age of the stand, cutting schedule, and environment. For this project, persistence is being measured as a percent of 1st production year dry matter yield. Persistence data in Table 7 consists of 2006 through 2017-seeded fields and is averaged over all cutting schedules. Although ranges indicate a wide variation, average forage yield in the 2nd (103%) and 3rd (95%) production

year have been comparable to the 1st production year. The yield for 4th-year stands drops to 77% of the 1st-production year. Record low overall 2020 yield slightly reduced these averages from previous years. To date it appears that keeping stands for at least three production years seems to be the prudent decision, but the condition and productivity of individual fields are the most important factors in determining when to rotate to a different crop. The numbers could also be somewhat misleading because not all fields are kept for a full 3- or 4-year production cycle. Those that are removed earlier at the producer's discretion no longer generate data which would likely result in lower averages. Therefore this should be viewed as data from fields that producer's judge good enough to keep.

Table 7. Percent of 1st production year yield by cutting and total season for 2nd, 3rd, and 4th production year stands. (2007-20)

2nd Production Year Stands (n=87 site years)

	1st cut	2nd cut	3rd cut	4th cut	Season
Mean	111	107	114	107	103
Low	44	39	23	39	63
High	275	291	491	279	236

3rd Production Year Stands (n=61 site years)

	1st cut	2nd cut	3rd cut	4th cut	Season
Mean	102	102	103	97	95
Low	34	43	32	23	63
High	250	299	370	172	183

4th Production Year Stands (n=16 site years)

	1st cut	2nd cut	3rd cut	4th cut	Season
Mean	82	80	91	77	77
Low	38	34	36	23	37
High	138	147	141	132	115

Forage Quality:

Forage quality, although extremely important, is not the primary focus of this project. However, it is impossible to evaluate changes in management to maximize yield and persistence without considering the impact on forage quality. Overall harvested forage quality (RFQ) of 206 (Figure 7) in the 2020 season was the best seen in the fourteen year study. The previous record was 196 in 2007, the first year. Results of the four cuts ranged from 192 to 223 with cuts 1, 2, and 4 also setting records and cut 2 only being 2 points below the record. Despite the weather and yield challenges, all producers were able to harvest high quality forage with individual field season RFQs ranging from 167 to 248.

Other notable forage quality results from 2020 include:

- Season crude protein (CP) percent was tied for 4th highest in 14 years (Figure 4). Season CP% had been at or below the mean in the past 6 years. All cuts were above average. Cut 2 was the tied with 2012 for second highest and trailed 2008 while Cut 4 was the second highest behind 2013. This was a result of immature alfalfa in the first cut and timely cuts and favorable weather for later cuts.
- NDF percent was below average for all summer cuts and for the season (Figure 5). The season average tied the 2012 average for second lowest, trailing only 2007. Cut 2 and 4 were each the third lowest seen. Two fields cut in fall had the second highest NDF, behind 2019.
- NDFD percent set new records across the board (Figure 6). The previous record for season average was in 2017 and individual cuts were set in 2017 or 2019. This is the consecutive straight year with above average NDFD levels. Three fields planted to reduced-lignin varieties have some influence, but improved conventional varieties and harvest timing are also likely factors.

- Milk/Ton was also set records for all cuts and for the season (Figure 8). The previous season average record in 2018 was improved on by 255 lbs. Cut 1 Milk/Ton was the highest seen in any summer cut and 333 lbs better than the previous Cut 1 record from 2007. This is also the seventh consecutive year with increasing milk/ton levels.
- Crude protein, NDF, and RFQ changes were tracked during 1st crop harvest since 2015 (Figures 9-11). Alfalfa had slower growth and development because of a cold, dry spring and winter injury in 2020. Harvest started later than normal with good quality parameters. Quality numbers were more variable (lower R^2) than other years, but trends were similar. A regression shows that crude protein dropped 0.17%/day, slightly lower than 0.18 - 0.24% in previous years and the expected change of -0.25%/day. NDF increased 0.28%/day, well below to 0.48 - 0.80% in previous years and below the expected change of +0.41%/day. RFQ decreased 5.5 points/day, on the high end of 1.8 – 5.5 points in previous years and the -4 to -5/day expected.

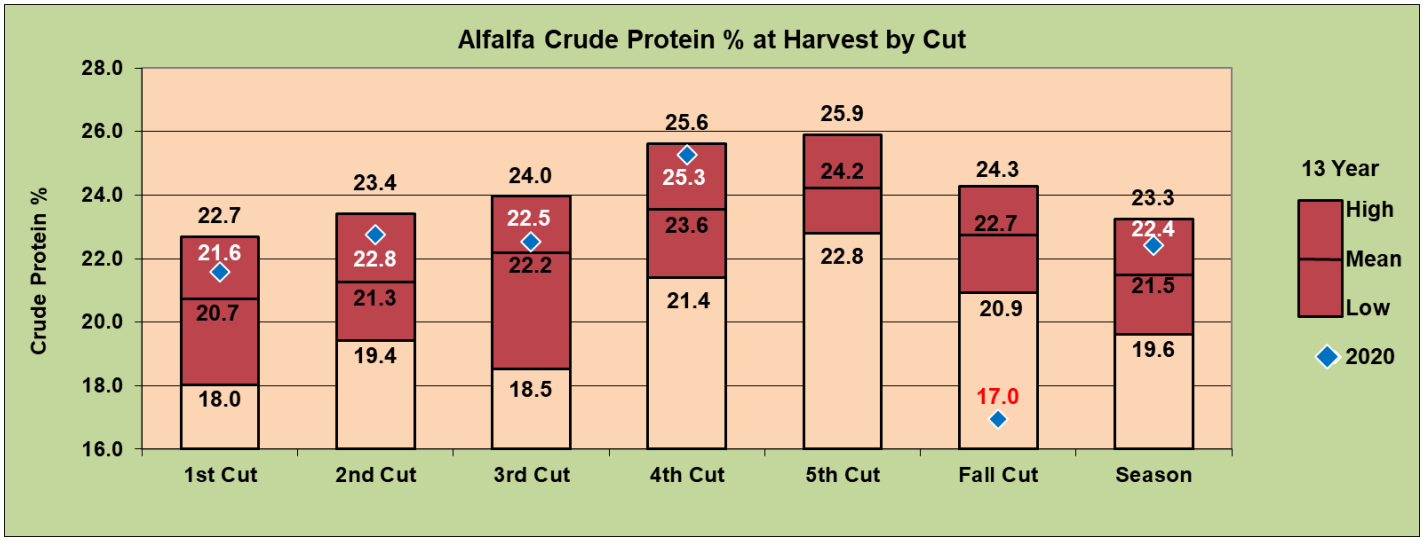

Figure 4. Average crude protein percent by cutting and weighted average for the total season (2007-2020).

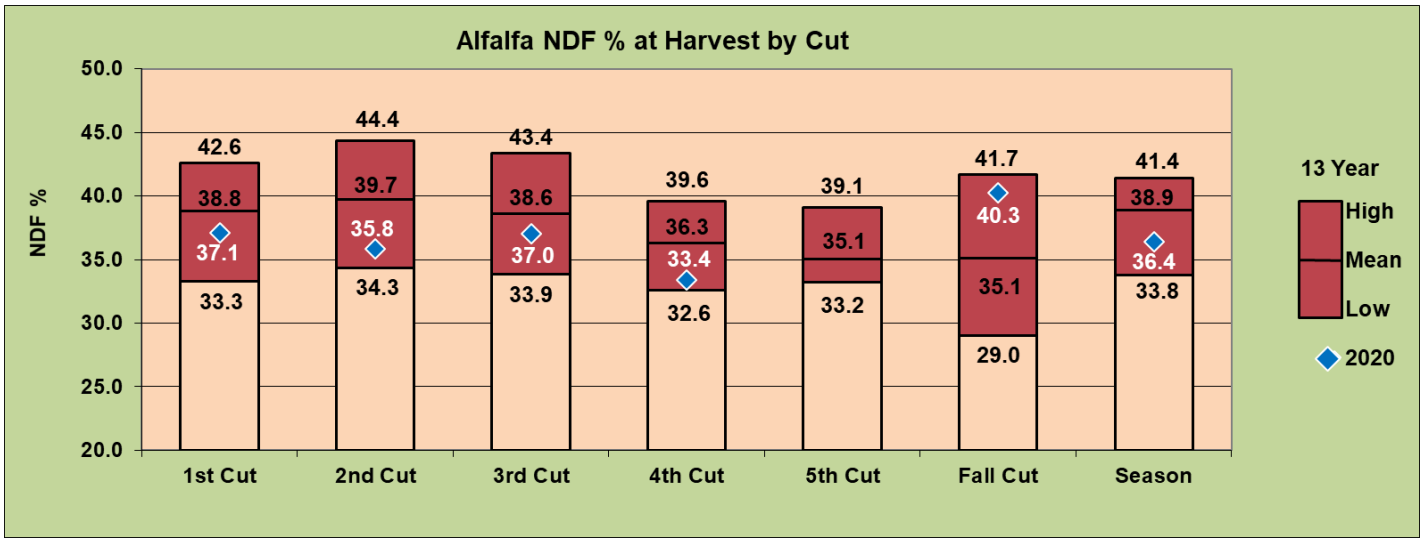

Figure 5. Average NDF percent by cutting and weighted average for the total season (2007-2020).

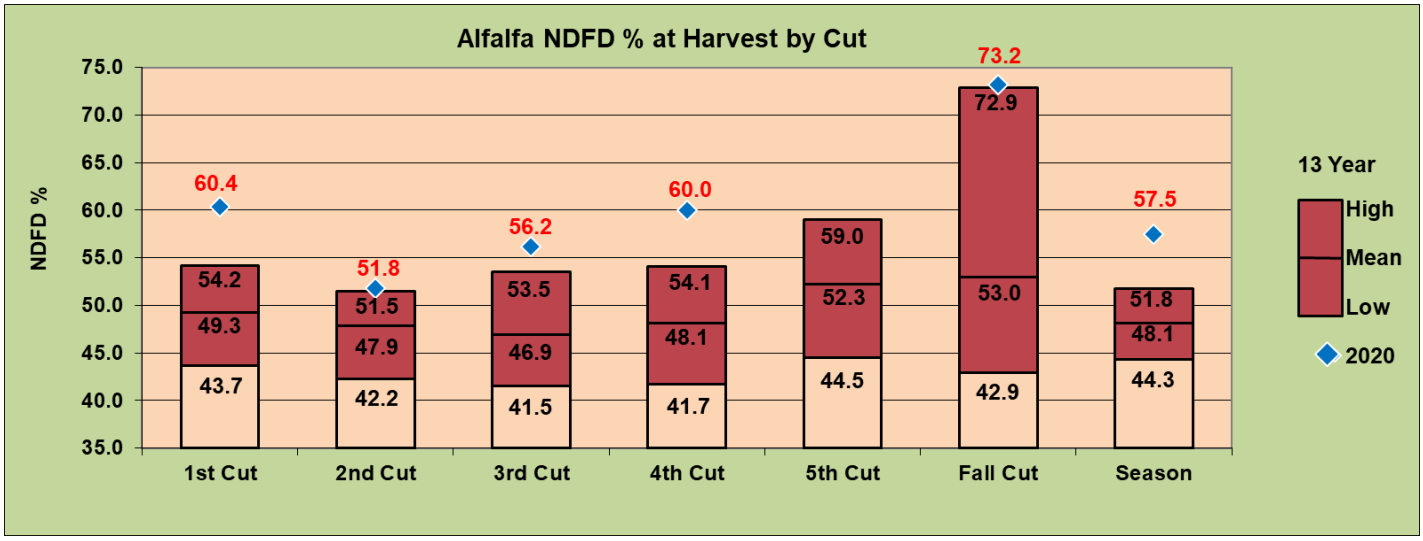

Figure 6. Average NDFD percent by cutting and weighted average for the total season (2007-2020).

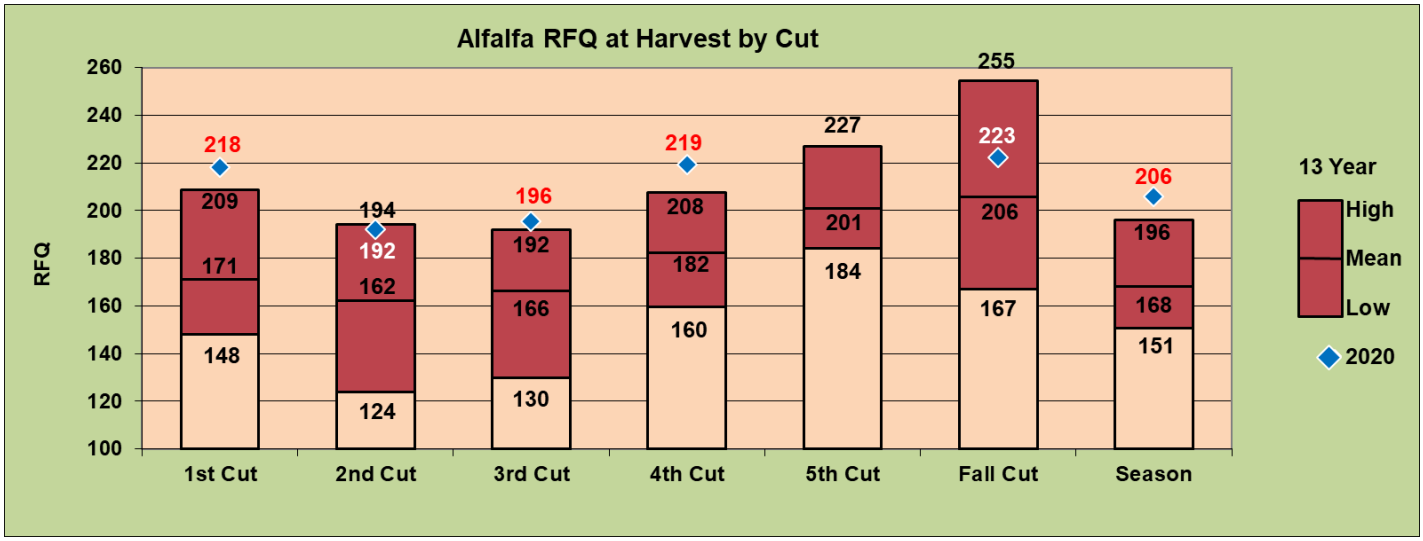

Figure 7. Average Relative Forage Quality (RFQ) by cutting and weighted average for the total season (2007-2020).

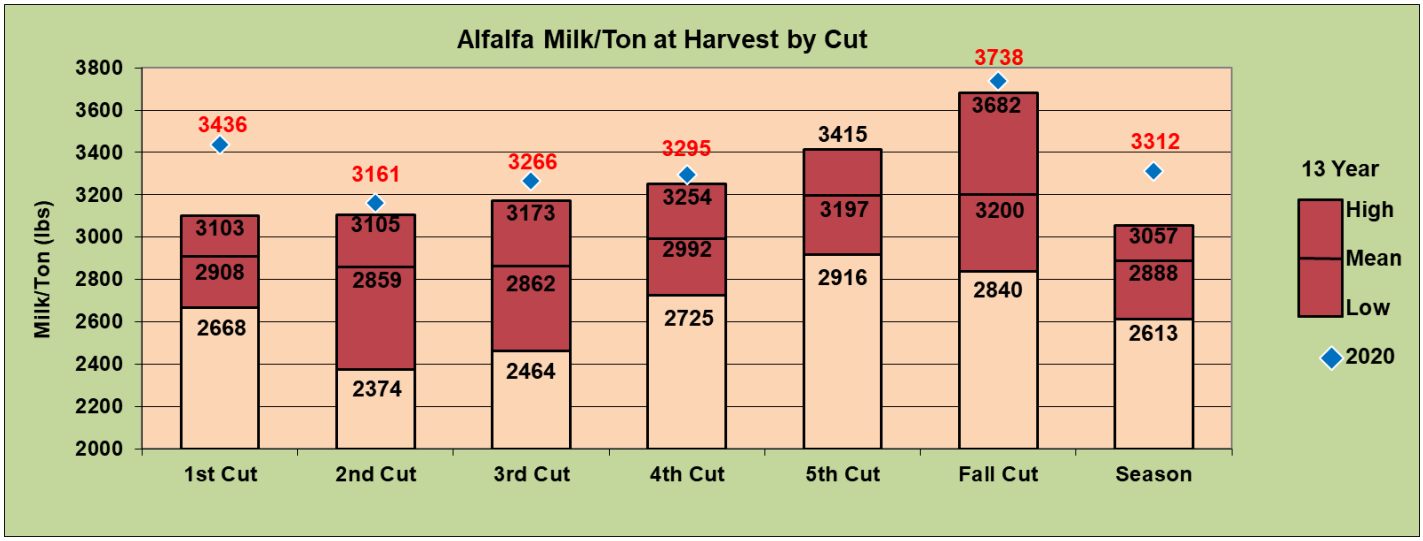

Figure 8. Average Milk per Ton by cutting and weighted average for the total season (2007-2020).

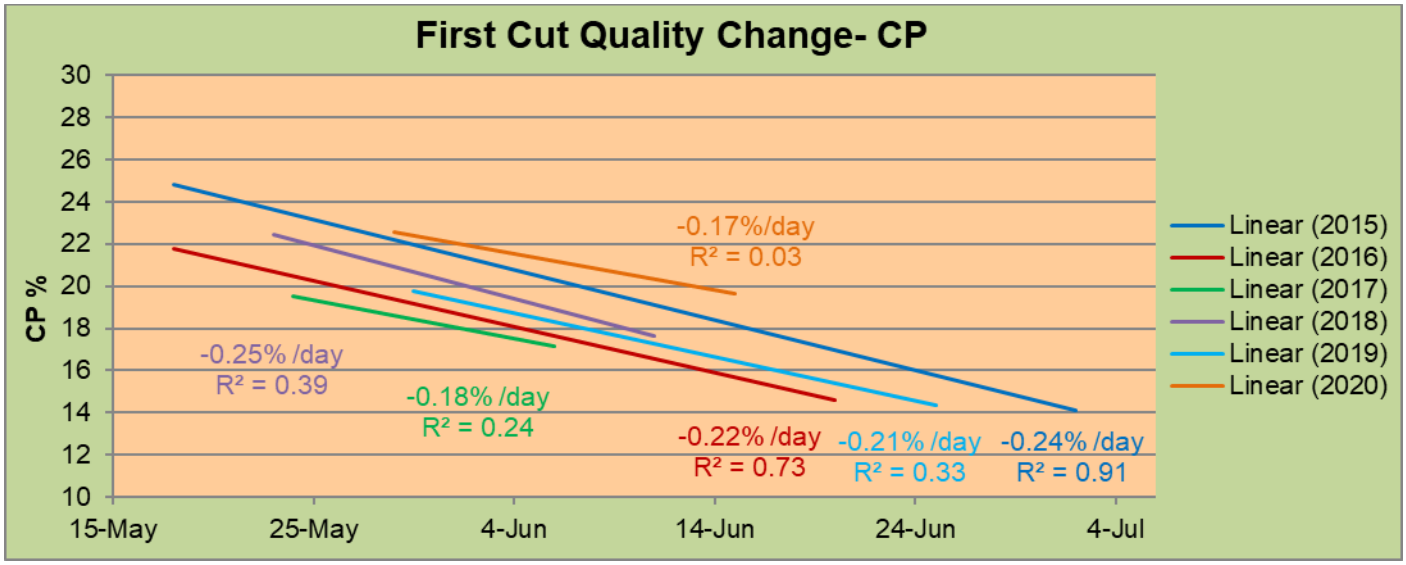

Figure 9. Change in Crude Protein percent during First-Cut Harvest (2015-2020).

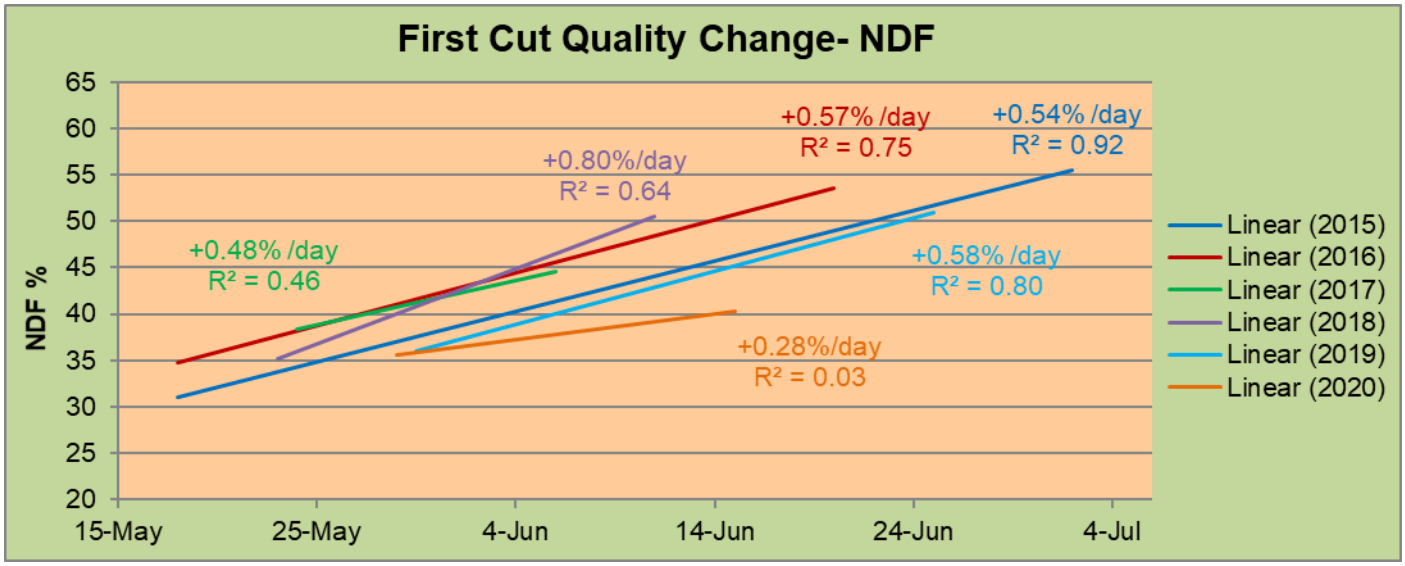

Figure 10. Change in NDF percent during First-Cut Harvest (2015-2020).

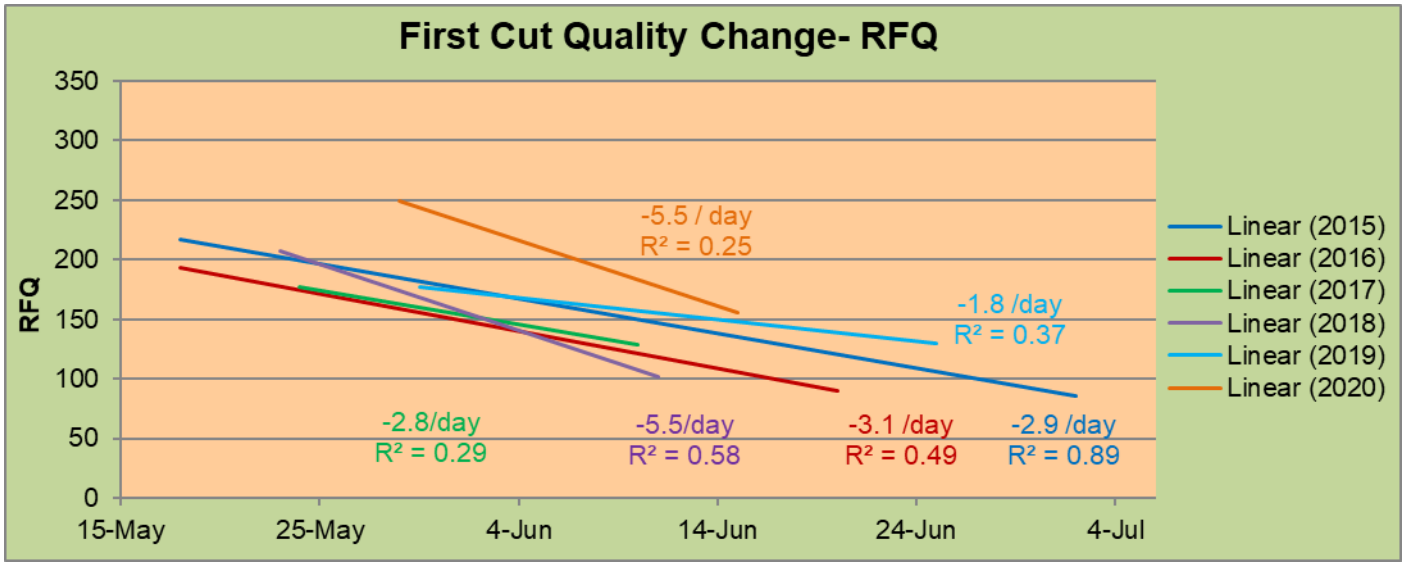

Figure 11. Change in RFQ during First-Cut Harvest (2015-2020).

Summary:
The Wisconsin Alfalfa Yield and Persistence Program is designed to provide forage growers and agricultural professionals a unique look at what is happening at the farm level. As more fields are entered and years pass, the reliability of information continues to increase. Environmental conditions have had a profound influence on both yield and quality with some years being similar, but no two years being exactly alike. Growers in 2020 experienced record low alfalfa yields, but this was cushioned by record high quality. It is important characterize these differences to know what has happened in the past and to plan for the future.

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Past and *Present UW coordinators for this project:

*Mike Bertram, Marathon & Columbia Counties
*Aerica Bjurstrom, Kewaunee & Door Counties
Greg Blonde, Waupaca County
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Jerry Clark, Chippewa County
Scott Gunderson, Manitowoc County
Mark Hagedorn, Brown County
*Kevin Jarek, Outagamie County
Heidi Johnson, Dane County
*Tina Kohlman, Fond du Lac County
David Laatsch, Dodge County
Bryce Larson, Calumet County
Mike Rankin, Fond du Lac County
Nick Schneider, Winnebago County
Ryan Sterry, St. Croix County
Amy Vandebrake, Pierce County
*Chelsea Zegler, Dane County
*Joe Zimbric, Fond du Lac County

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This report was written and data compiled by Mike Bertram, Superintendent, UW Arlington Agricultural Research Station. Questions may be directed to: mbertram@wisc.edu Reports from 2007-2014 were written by Mike Rankin, Emeritus Crops and Soils Agent, Fond du Lac County.

Appendix A. Dry matter yield by field, harvest year, cutting, and total season.

Field ID#	Harvest Year	1st Cut DM Yield	2nd Cut DM Yield	3rd Cut DM Yield	4th Cut DM Yield	5th Cut DM Yield	Fall Cut DM Yield	Season DM Yield
107	2007	1.57	1.53	0.95	0.59		0.34	4.98
207	2007	1.52	1.33	1.00	0.70		0.73	5.27
307	2007	1.54	1.51	1.30	0.90		0.88	6.12
407	2007	1.41	1.57	1.11	0.80		0.71	5.59
507	2007	1.00	1.02	0.37				2.39
607	2007	1.79	1.77	1.20	1.14			5.90
707	2007	1.75	1.23	0.81	0.63			4.41
807	2007	1.79	1.19	1.42	1.10			5.51
Mean	**2007**	**1.55**	**1.39**	**1.02**	**0.84**		**0.67**	**5.02**
Low	**2007**	**1.00**	**1.02**	**0.37**	**0.59**		**0.34**	**2.39**
High	**2007**	**1.79**	**1.77**	**1.42**	**1.14**		**0.88**	**6.12**
107	2008	1.28	1.11	1.07	0.43			3.89
207	2008	1.34	1.08	1.14	0.68			4.23
307	2008	NA	0.86	0.91	0.78			---
407	2008	NA	1.14	1.09	0.68			---
507	2008	1.95	1.08	0.76				3.79
807	2008	2.23	1.73	1.31	0.82			6.08
108	2008	1.38	0.74	1.15				3.27
208	2008	2.08	1.54	0.84				4.46
308	2008	1.46	0.83	1.27	0.93		0.45	4.95
408	2008	0.86	0.49	0.85	0.50			2.70
508	2008	2.01	0.72	1.20	0.98		0.37	5.29
608	2008	1.39	1.78	1.54	0.92			5.63
708	2008	1.28	1.05	1.18	0.89			4.40
808	2008	1.81	1.20	1.27	0.79			5.07
908	2008	0.73	0.94	0.89	1.12			3.68
1008	2008	NA	1.06	0.97	0.83			---
Mean	**2008**	**1.52**	**1.08**	**1.09**	**0.80**		**0.41**	**4.42**
Low	**2008**	**0.73**	**0.49**	**0.76**	**0.43**		**0.37**	**2.70**
High	**2008**	**2.23**	**1.78**	**1.54**	**1.12**		**0.45**	**6.08**
107	2009	0.95	1.06	0.30	0.99			3.31
207	2009	1.28	1.23	0.53	1.00			4.04
307	2009	1.02	1.23	0.69	0.93			3.87
407	2009	1.59	1.02	0.53	0.85			3.99
507	2009	1.38	0.90	0.49	0.76			3.53
807	2009	1.56	0.99	0.98	0.62			4.15
108	2009	1.52	0.83	0.80				3.15
208	2009	1.77	1.18	1.33				4.28
308	2009	1.24	0.94	0.56	1.15			3.89
408	2009	1.80	0.80	0.20	0.64			3.43
508	2009	1.74	1.00	0.59	0.98			4.32
608	2009	2.19	1.23	0.88	0.78			5.07
708	2009	1.40	1.34	0.63	0.98			4.35
808	2009	2.07	1.16	0.59	0.55			4.37
908	2009	1.88	0.99	0.30	0.95			4.13
109	2009	0.57	0.55	1.09				2.21
209	2009	1.92	1.60	0.69	1.06			5.27
309	2009	1.14	0.84	0.43	1.05			3.46
409	2009	1.45	1.24	0.35	0.32			3.37
509	2009	2.05	0.88	0.57				3.49
609	2009	2.36	0.58	0.20	0.95			4.10

Field ID#	Harvest Year	1st Cut DM Yield	2nd Cut DM Yield	3rd Cut DM Yield	4th Cut DM Yield	5th Cut DM Yield	Fall Cut DM Yield	Season DM Yield
709	2009	2.27	1.25	0.82	0.92			5.26
809	2009	2.08	1.03	0.85	0.72			4.68
Mean	**2009**	**1.62**	**1.04**	**0.63**	**0.85**			**3.99**
Low	**2009**	**0.57**	**0.55**	**0.20**	**0.32**			**2.21**
High	**2009**	**2.36**	**1.60**	**1.33**	**1.15**			**5.27**
307	2010	1.16	1.24	1.24	0.52			4.17
807	2010	1.38	1.32	1.22	0.81			4.74
208	2010	1.99	1.65	1.26			0.62	5.52
308	2010	1.65	1.66	0.85	0.41			4.57
408	2010	1.85	1.46	0.76	0.51			4.58
508	2010	1.88	1.81	0.69	0.48			4.86
608	2010	2.09	1.79	1.46	0.82			6.16
708	2010	1.45	1.33	1.39	0.67			4.84
808	2010	1.66	1.77	1.57	0.90			5.91
908	2010	1.83	0.84	1.27	0.51			4.45
109	2010	1.57	1.42	0.90	1.33			5.23
209	2010	1.91	1.80	1.09	0.91			5.71
309	2010	2.16	1.85	0.91	0.70			5.61
409	2010	1.43	0.96	0.55			0.39	3.33
609	2010	2.34	1.78	1.05	1.00			6.17
709	2010	2.32	0.94	1.08	0.57			4.90
809	2010	1.86	1.67	1.07	0.47			5.07
110	2010	1.46	1.65	1.40	0.54			5.05
210	2010	2.07	1.76	0.94	0.51			5.28
310	2010	1.59	1.21	0.97	0.57			4.33
410	2010	2.00	1.26	0.94	0.41			4.61
510	2010	1.87	1.69	1.05	0.62		0.39	5.62
610	2010	2.08	1.40	1.09	0.46		0.34	5.37
Mean	**2010**	**1.81**	**1.49**	**1.08**	**0.65**		**0.44**	**5.05**
Low	**2010**	**1.16**	**0.84**	**0.55**	**0.41**		**0.34**	**3.33**
High	**2010**	**2.34**	**1.85**	**1.57**	**1.33**		**0.62**	**6.17**
208	2011	0.78	0.90	1.05			0.45	3.18
308	2011	1.31	1.12	0.85	0.79			4.06
408	2011	1.19	0.72	0.67	0.51			3.09
508	2011	1.25	0.85	0.65	0.69			3.44
608	2011	1.10	0.83	1.16	0.45			3.54
708	2011	1.50	0.75	1.37	0.78			4.41
808	2011	1.07	0.65	1.15	0.90			3.77
908	2011	0.92	0.52	0.87	0.49			2.80
109	2011	1.29	0.97	1.03	0.76			4.05
209	2011	1.59	1.02	0.92	0.92			4.45
309	2011	1.53	1.15	1.14	0.95			4.77
409	2011	1.27	0.81	0.47	0.48			3.03
609	2011	1.76	0.90	1.68	0.78			5.12
210	2011	1.13	0.72	1.04	0.80			3.69
310	2011	1.25	0.63	0.97	0.78			3.63
410	2011	1.33	0.60	1.08	0.57			3.58
510	2011	1.47	1.08	1.07	0.73			4.35
610	2011	1.41	0.92	0.88	0.83			4.04
111	2011	2.45	1.29	1.32	1.19			6.26
211	2011	1.39	0.85	1.20	1.10			4.55
311	2011	2.30	0.94	1.66	1.00			5.90
411	2011	1.70	NA	1.68	0.64			---

Field ID#	Harvest Year	1st Cut DM Yield	2nd Cut DM Yield	3rd Cut DM Yield	4th Cut DM Yield	5th Cut DM Yield	Fall Cut DM Yield	Season DM Yield
Mean	**2011**	**1.41**	**0.87**	**1.09**	**0.77**		**0.45**	**4.08**
Low	**2011**	**0.78**	**0.52**	**0.47**	**0.45**		**0.45**	**2.80**
High	**2011**	**2.45**	**1.29**	**1.68**	**1.19**		**0.45**	**6.26**
209	2012	1.47	1.01	0.97	0.40			3.85
210	2012	1.46	0.75	0.43	0.80		0.76	4.20
310	2012	1.22	0.67	0.45	0.69		0.45	3.48
410	2012	1.14	0.62	0.38	0.66		0.56	3.36
510	2012	1.20	1.13	0.74	0.63	0.73		4.44
610	2012	2.33	1.18	1.12	0.66			5.30
111	2012	2.03	1.79	1.55	1.18			6.55
211	2012	1.11	1.10	0.78	0.79	0.48		4.26
112	2012	1.46	0.85	1.11	0.85	0.63		4.90
212	2012	1.74	1.21	1.32	1.27			5.55
312	2012	1.65	0.78	0.59	0.70		0.68	4.40
412	2012	2.06	0.81	0.64	0.86		0.64	5.00
512	2012	1.33	0.88	0.66	0.55		0.34	3.76
612	2012	0.84	0.63	0.88	0.93		0.58	3.86
712	2012	1.30	0.94	0.65	0.69		0.72	4.31
812	2012	1.02	1.88	0.84	0.78	0.34		4.86
Mean	**2012**	**1.46**	**1.01**	**0.82**	**0.78**	**0.55**	**0.59**	**4.51**
Low	**2012**	**0.84**	**0.62**	**0.38**	**0.40**	**0.34**	**0.34**	**3.36**
High	**2012**	**2.33**	**1.88**	**1.55**	**1.27**	**0.73**	**0.76**	**6.55**
111	2013	1.70	0.85	0.87	0.94			4.35
212	2013	1.89	1.47	1.06	0.99			5.40
312	2013	1.20	1.02	0.65	0.48			3.35
412	2013	1.26	1.16	0.74	0.63			3.79
512	2013	1.30	1.11	0.80	0.65			3.87
612	2013	0.86	0.86	0.63	0.43			2.78
712	2013	0.83	1.03	0.65	0.44			2.95
812	2013	1.94	1.26	1.03	0.84			5.07
113	2013	2.27	1.80	1.19				5.26
213	2013	0.82	1.08	0.62	0.76			3.28
313	2013	0.82	0.83	0.51	0.60			2.76
413	2013	0.92	1.11	0.72	0.50			3.25
513	2013	0.47	0.40	0.44	0.30			1.62
Mean	**2013**	**1.25**	**1.08**	**0.76**	**0.63**			**3.67**
Low	**2013**	**0.47**	**0.40**	**0.44**	**0.30**			**1.62**
High	**2013**	**2.27**	**1.80**	**1.19**	**0.99**			**5.40**
212	2014	1.76	1.53	0.77	0.88			4.93
312	2014	1.69	0.97	0.70	0.80			4.16
412	2014	1.56	0.89	0.75	0.70			3.90
512	2014	1.48	0.59	0.76	0.65			3.48
612	2014	1.41	0.66	0.54	0.59			3.20
113	2014	1.80	1.70	1.24	1.03			5.79
213	2014	1.39	0.51	0.64	1.05			3.58
313	2014	1.09	0.53	0.66	0.84			3.13
413	2014	1.87	0.68	0.67	0.90			4.12
114	2014	1.93	1.88	1.24	1.25			6.28
214	2014	1.49	1.77	1.36	0.88			5.50
314	2014	1.88	1.14	1.02	0.73			4.77
414	2014	1.74	1.99	1.19	1.09			6.02
514	2014	1.77	0.89	0.55	0.75			3.95
614	2014	2.13	0.88	0.35	0.73			4.09
714	2014	2.96	1.24	1.02	0.91			6.12

Field ID#	Harvest Year	1st Cut DM Yield	2nd Cut DM Yield	3rd Cut DM Yield	4th Cut DM Yield	5th Cut DM Yield	Fall Cut DM Yield	Season DM Yield
814	2014	1.42	1.22	0.42	0.70			3.75
914	2014	1.18	1.20	0.93				3.31
1014	2014	2.04	1.58	1.20				4.82
1114	2014	1.42	0.73	0.76	0.74			3.65
1214	2014	1.23	0.54	0.95	0.70			3.42
1314	2014	1.20	0.49	0.88	0.83			3.39
1414	2014	1.28	1.93	0.72	1.31			5.23
1514	2014	1.87	1.24	0.81	1.58			5.50
Mean	**2014**	**1.65**	**1.12**	**0.84**	**0.89**			**4.42**
Low	**2014**	**1.09**	**0.49**	**0.35**	**0.59**			**3.13**
High	**2014**	**2.96**	**1.99**	**1.36**	**1.58**			**6.28**
113	2015	1.59	1.50	1.61	0.85			5.55
114	2015	1.87	1.60	1.46	1.02			5.95
214	2015	1.25	0.88	0.88	0.72	0.66		4.40
314	2015	1.76	1.15	0.95	0.75			4.61
414	2015	1.67	1.60	1.24	0.64			5.14
514	2015	1.25	1.84	1.17				4.26
614	2015	2.89	1.21	0.86	0.70			5.67
714	2015	1.29	0.99	1.63	0.89			4.80
814	2015	1.30	0.77	0.95	0.35			3.37
914	2015	2.26	0.73	1.00				3.99
1014	2015	2.39	0.62	1.11				4.12
1414	2015	2.04	1.26	0.95	0.82			5.06
1514	2015	2.03	1.14	1.03	0.84			5.03
115	2015	1.16	1.30	0.87	0.77			4.10
215	2015	1.65	1.10	0.70				3.45
315	2015	1.53	0.76	1.19	1.07			4.55
415	2015	1.90	0.81	0.98	0.76			4.45
515	2015	1.98	0.91	1.02	0.76			4.66
615	2015	1.20	0.69	0.57	0.29			2.74
715	2015	1.51	0.83	0.95	0.63			3.92
815	2015	1.83	1.17	0.91				3.90
915	2015	2.33	1.05	1.91				5.28
1015	2015	1.81	1.36	1.49	0.95			5.60
Mean	**2015**	**1.76**	**1.10**	**1.11**	**0.75**	**0.66**		**4.55**
Low	**2015**	**1.16**	**0.62**	**0.57**	**0.29**	**0.66**		**2.74**
High	**2015**	**2.89**	**1.84**	**1.91**	**1.07**	**0.66**		**5.95**
114	2016	2.20	1.49	1.23	0.90			5.82
214	2016	1.74	1.12	0.76	0.45			4.06
314	2016	2.30	1.13	0.68	0.62			4.73
414	2016	1.97	1.47	1.12	0.80			5.35
514	2016	1.98	1.68	1.56				5.22
614	2016	2.22	1.12	1.28	1.07			5.70
714	2016	2.17	1.35	1.08	1.06			5.66
1014	2016	2.64	1.36	1.04			0.25	5.30
1414	2016	1.35	1.53	1.09	0.79			4.76
115	2016	1.57	1.40	1.00	0.67	0.80		5.44
215	2016	1.85	1.36	0.88	0.44			4.54
315	2016	1.61	0.88	0.79	0.42			3.70
415	2016	1.49	1.35	0.74	1.07			4.65
515	2016	2.37	0.88	0.83	1.03			5.10
615	2016	1.31	0.81	0.76	0.80			3.67
715	2016	1.28	1.09	1.10	0.84			4.31
815	2016	1.94	0.84	0.93				3.70
915	2016	2.54	1.17	1.21				4.93

Field ID#	Harvest Year	1st Cut DM Yield	2nd Cut DM Yield	3rd Cut DM Yield	4th Cut DM Yield	5th Cut DM Yield	Fall Cut DM Yield	Season DM Yield
1015	2016	1.92	1.40	1.31	1.07			5.70
116	2016	2.35	1.14	1.73				5.21
216	2016	1.24	0.94	0.86	0.89			3.94
316	2016	1.45	0.85	0.79	0.84			3.94
416	2016	1.30	0.85	0.71	0.57			3.43
516	2016	1.65	0.82	0.88	0.86			4.21
616	2016	1.36	0.71	0.67	0.89			3.64
716	2016	2.15	1.30	1.26	1.36			6.07
Mean	**2016**	**1.84**	**1.16**	**1.01**	**0.83**	**0.80**	**0.25**	**4.72**
Low	**2016**	**1.24**	**0.71**	**0.67**	**0.42**	**0.80**	**0.25**	**3.43**
High	**2016**	**2.64**	**1.68**	**1.73**	**1.36**	**0.80**	**0.25**	**6.07**
414	2017	1.97	1.47	1.12	0.80			5.35
714	2017	2.03	0.96	1.06	1.20			5.25
115	2017	1.12	1.14	1.04	0.94			4.23
515	2017	1.17	1.01	0.48	0.39			3.05
815	2017	1.97	0.61	0.75	0.57			3.89
1015	2017	2.04	0.98	0.58	0.79			4.39
116	2017	2.37	0.51	0.42				3.30
716	2017	2.00	1.33	1.10	0.90			5.32
117	2017	1.80	0.79	0.78				3.37
217	2017	1.64	1.50	1.10	0.89			5.13
317	2017	0.93	0.80	0.53	0.52			2.78
417	2017	0.97	0.83	0.39	0.42			2.60
517	2017	1.56	1.49	0.78	0.87			4.69
617	2017	1.75	1.15	0.97	0.92			4.79
717	2017	1.09	0.87	0.90				2.85
817	2017	1.99	1.12	0.88				3.99
917	2017	1.48	1.50	1.28	0.66			4.93
1017	2017	2.03	1.46	1.41	0.48			5.38
Mean	**2017**	**1.66**	**1.08**	**0.87**	**0.74**			**4.18**
Low	**2017**	**0.93**	**0.51**	**0.39**	**0.39**			**2.60**
High	**2017**	**2.37**	**1.50**	**1.41**	**1.20**			**5.38**
515	2018	1.03	0.56	0.92	0.59			3.10
1015	2018	1.74	1.29	1.43	0.93			5.40
716	2018	1.76	1.29	1.20	1.08			5.34
117	2018	1.32	1.76	0.86	0.26			4.20
217	2018	1.68	1.60	1.00				4.28
317	2018	1.07	0.85	0.62	0.71			3.25
417	2018	1.29	0.85	0.69	0.65			3.48
517	2018	1.54	1.02	0.78	0.82			4.15
617	2018	1.51	0.95	1.77	0.69			4.93
717	2018	1.43	0.63	1.14	0.78			3.99
817	2018	1.69	1.13	1.12	0.91			4.86
917	2018	1.62	0.76	1.13	0.82			4.33
1017	2018	1.48	0.84	1.42	0.98			4.72
118	2018	1.46	1.20	1.05	1.00			4.72
218	2018	1.73	1.00	1.44	1.39			5.56
318	2018	1.22	0.93	1.03	1.01			4.19
418	2018	1.19	1.22	0.99	1.16	0.83		5.39
518	2018	1.23	1.24	0.97	0.82			4.27
618	2018	2.01	1.67	0.81	1.20			5.69
718	2018	1.38	1.65	1.07	0.97			5.06
818	2018	1.43	0.72	0.50	0.65			3.30
918	2018	1.18	1.08	0.28	0.66			3.20
1018	2018	1.50	1.38	1.79	0.90			5.58

Field ID#	Harvest Year	1st Cut DM Yield	2nd Cut DM Yield	3rd Cut DM Yield	4th Cut DM Yield	5th Cut DM Yield	Fall Cut DM Yield	Season DM Yield
1118	2018	1.40	0.55	0.99	0.67			3.61
1218	2018	1.18	1.15	0.98	1.11			4.42
1318	2018	1.57	1.07	0.82	0.62			4.07
1418	2018	1.12	0.78	0.78	0.91			3.59
Mean	**2018**	**1.44**	**1.08**	**1.02**	**0.86**	**0.83**		**4.40**
Low	**2018**	**1.03**	**0.55**	**0.28**	**0.26**	**0.83**		**3.10**
High	**2018**	**2.01**	**1.76**	**1.79**	**1.39**	**0.83**		**5.69**
117	2019	1.42	0.88	0.65				2.95
217	2019	2.14	1.23	1.18				4.55
317	2019	0.80	1.01	0.41	0.66			2.89
517	2019	1.14	1.35	0.60	0.75			3.84
617	2019	1.30	0.92	0.76	0.64			3.62
917	2019	1.36	1.07	0.90	0.79			4.13
1017	2019	1.61	1.11	0.99	0.82			4.53
118	2019	1.04	0.91	0.57	0.86			3.37
318	2019	1.64	1.65	1.01	0.87			5.17
518	2019	1.53	1.44	1.18	1.83			5.98
618	2019	2.30	1.71	1.23	1.16			6.40
718	2019	1.72	1.24	1.13	0.74			4.83
818	2019	1.94	1.51	0.95	0.91			5.32
918	2019	1.79	1.18	0.91	0.62			4.50
1018	2019	1.56	1.72	1.27	0.66			5.22
1118	2019	0.61	0.93	0.52	0.75			2.81
1318	2019	1.14	1.16	0.53	0.73			3.55
1418	2019	1.66	1.09	0.63				3.38
119	2019	1.35	1.10	1.04	0.86			4.36
219	2019	1.54	1.18	0.86			0.46	4.04
319	2019	1.35	0.46	0.66			0.40	2.88
419	2019	1.14	0.85	0.67			0.23	2.89
Mean	**2019**	**1.46**	**1.17**	**0.85**	**0.85**		**0.36**	**4.15**
Low	**2019**	**0.61**	**0.46**	**0.41**	**0.62**		**0.23**	**2.81**
High	**2019**	**2.30**	**1.72**	**1.27**	**1.83**		**0.46**	**6.40**
117	2020	0.70	0.27	0.28				1.25
318	2020	1.48	1.35	1.06	0.50			4.39
518	2020	1.22	0.78	0.78				2.78
618	2020	1.92	1.01	0.82	1.04			4.80
718	2020	1.45	0.71	0.83	0.75			3.73
818	2020	1.15	1.02	0.29	0.68			3.15
918	2020	0.91	0.77	0.93	0.63			3.24
1018	2020	1.33	1.51	1.26	0.83			4.92
1318	2020	0.53	0.86	0.37	0.89			2.65
1418	2020	1.80	1.15	0.83			0.75	4.52
119	2020	1.35	0.59	0.96	0.83			3.73
319	2020	1.06	0.60	0.50			1.09	3.25
120	2020	1.53	0.99	1.28	0.85			4.65
220	2020	1.40	0.99	1.30	0.90			4.58
320	2020	0.68	0.85	0.77	0.65			2.95
420	2020	1.01	1.25	1.11	0.77			4.14
520	2020	0.99	0.58	1.14	0.55			3.26
620	2020	1.36	0.86	1.08				3.31
Mean	**2020**	**1.22**	**0.90**	**0.87**	**0.76**		**0.92**	**3.63**
Low	**2020**	**0.53**	**0.27**	**0.28**	**0.50**		**0.75**	**1.25**
High	**2020**	**1.92**	**1.51**	**1.30**	**1.04**		**1.09**	**4.92**