Annual Management Practice Implementation and Nitrogen Application Report

2018 Crop Year

Westside San Joaquin River Watershed Coalition

Central Valley Regional Water Quality Control Board

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LIST OF ACRONYMS

A	Nitrogen Applied
A/R	Nitrogen Applied over Nitrogen Removed
A/Y	Nitrogen Applied over Yield
A-R	Nitrogen Applied minus Nitrogen Removed
APN	Assessor Parcel Number
AR	Nitrogen Applied and Removed
C_N	Crop-Specific Nitrogen (Coefficient)
CY	Crop Year
FE	Farm Evaluation
GQMP	Groundwater Quality Management Plan
GW	Groundwater
HVA	High Vulnerability Area
INMP	Irrigation and Nitrogen Management Plan
MPIR	Management Practice Implementation Report
MU	Management Unit
NB	Non-Bearing
NMP	Nitrogen Management Plan
NR	Not Reported
NY	No Yield Harvested
QC	Quality Control
R	Nitrogen Removed
SQMP	Surface Water Quality Management Plan
SR	Summary Report
SW	Surface Water
TR	Township and Range
WDR	Waste Discharge Requirements
WSJRWC	Westside San Joaquin River Watershed Coalition
Y	Yield

INTRODUCTION

The Westside San Joaquin River Watershed Coalition (WSJRWC or Coalition) is submitting the Annual Report on Management Practice Implementation and Nitrogen Applications for the 2018 Crop Year (CY) as required by the Waste Discharge Requirements General Order for Growers within the Western San Joaquin River Watershed (WDR or Order; Order No. R5-2014-0002-08, approved February 7, 2019).

This report includes the following required elements listed within the WDR for the 2018 CY:

- Summary of Management Practice Information (2018 CY)
- Nitrogen Management Plan Summary Report Evaluation (2018 CY)

The following Excel file is included with this report:

- Attachment A: Nitrogen Management Plan Summary Report (NMP SR) Data

AVAILABLE DATA

For the 2018 CY, members in groundwater High Vulnerability Areas (HVAs) were required to submit an NMP SR and Farm Evaluation (FE) to the Coalition. Members are required to submit a Management Practice Implementation Report (MPIR; either surface or groundwater) by April 15, 2021. Included in this report are 1) a summary of the 2018 CY FE data, 2) NMP SR evaluations, and 3) an update on the MPIR template development.

FARM EVALUATION REPORTS

The Westside Coalition prepared and mailed FE/MWE surveys to all members in high vulnerability areas in December of 2018. The FE/MWE surveys were pre-populated with Assessor's Parcel Number (APN) and a map of those parcels was included with the survey. The completed forms were due by March 1, 2019. The Coalition received 97% of the Farm Evaluation Surveys. A summary is shown below in Table 1.

Table 1. Summary of acreage and membership counts for received and not received 2018 Farm Evaluation Plans & Managed Wetland Evaluations.

FE/MWE Survey Status	Count of Members	Sum of Acreage
Not Received	60	9,875
Received - Not Required	21	2,546
Received - Required	1,962	369,954
Total Received	**1,983**	**372,500**
Total Required	**2,043**	**379,828**
% of Required Reports Received	**97%**	**97%**

Aggregated and summarized information collected from FE/MWEs, a quality assessment of collected information by township and a description of corrective actions taken regarding deficiencies in data quality are included in Appendix I.

As a result of the most recent revisions to the WDR, the Coalition will begin using a revised FE template which was approved by the Regional Board on April 30, 2019. Starting with the 2020 CY, all members will submit a FE every 5 years using the new template due April 15, 2021.

NITROGEN MANAGEMENT PLAN SUMMARY REPORTS

All Coalition members are required to prepare and implement a Nitrogen Management Plan (NMP) for their farms by April 15 of each year (template approved December 23, 2015). Growers in HVAs are required to have their NMP Worksheets certified. Worksheets can be certified by either a nitrogen specialist, a crop specialist, or self-certified if the member passes the NMP self-certification course. Growers in HVAs are then required to utilize information from the NMP Worksheets to complete an NMP SR, due the following year.

On October 19, 2018, a new template was approved by the Regional Board for an Irrigation and Nitrogen Management Plan Summary (INMP SR). The INMP SR must be completed by Coalition members by April 15, 2021 for the 2020 CY.

The NMP SRs were sent to members in groundwater HVAs and, as of October 28, 2019, the WSJRWC received NMP SRs for the 2018 CY from 97% of the members representing 98% of the acreage (Table 2). The WSJRWC will continue to reach out to members to receive the remaining 2018 CY NMP SRs.

Table 2. Summary of acreage and membership counts for received and not received 2018 NMP Summary Reports.

NMP Summary Reports Status	Count of Members	Sum of Acreage
Not Received	42	3,375
Received - Not Required	106	5,256
Received - Required	1,333	193,165
Total Received	**1,439**	**198,420**
Total Required	**1,375**	**196,539**
% of Required Reports Received	**97%**	**98%**

The WDR requires that the Coalition submit an evaluation of the ratio of nitrogen applied to removed (A/R) and the difference between nitrogen applied and nitrogen removed (A-R). The evaluation for A/R must include, at a minimum, a comparison of A/R ratios by crop type.

Growers report their nitrogen use by Management Unit (MU). An NMP MU consists of a field and a parcel (or a group of parcels) that are comprised of the same crop and are managed the same way with respect to nitrogen applications.

The MU data are associated with a specific Assessor Parcel Number (APN). The NMP SRs for the 2018 CY include the total available nitrogen applied (A) in pounds per acre, and the ratio of total available nitrogen applied to yield per acre (A/Y). Growers can also provide their yield per acre (Y), though this information is not required for the 2018 CY. The A/Y ratio is an indicator of the proportion of nitrogen removed from the field at harvest.

The NMP Summary Report Evaluation section includes a reporting of A/R and A-R values by crop type and histograms illustrating the mean and standard deviations are included in Appendix II. When possible, the Coalition converts the reported yield to the amount of nitrogen removed (R),

and evaluates A/R and A-R. All methods and calculations are explained in the Methods section below.

Once the data are analyzed, the Coalition provides a Nitrogen Use Evaluation Report to each member. The Nitrogen Use Evaluation Reports provide summary statistic information to the member on a crop-specific basis and allow the member to see their reported nitrogen applied and the calculated nitrogen removed relative to other growers' data. When outliers are calculated, members are notified in their Nitrogen Use Evaluation Report. These efforts are explained in the Nitrogen Use Evaluation Reports section.

MANAGEMENT PRACTICE IMPLEMENTATION REPORTS

The MPIR is to be completed by members in areas subject to a Surface Water Quality Management Plan (SQMP) or Groundwater Quality Management Plan (GQMP) according to a schedule specified in the SQMP and GQMP. The purpose of the MPIR is to document management practices implemented by members to comply with requirements of the SQMP and GQMP.

Management Practice Implementation Reports are due from members on April 15, 2021 and the data will be included in the November 30, 2021 report. The Coalition will submit MPIR templates for approval in 2020.

NMP SUMMARY REPORT EVALUATION

DATA QUALITY CONTROL

Completeness

Coalition members can submit their NMP SRs as a hardcopy or through the online WSJRWC Member Portal. The WSJRWC Member Portal only allows submission if all required fields are populated. Any NMP SR received as a hardcopy is reviewed for completeness. An NMP SR is considered incomplete and follow-up with the grower is required if one or more of the following occurs:

1. Not all APNs designated as high vulnerability to groundwater were reported.
2. A crop was not provided. For example, a grower may have reported "row crops" and therefore the Coalition could not determine the specific crop type to assign to the field.
3. Acreage of an APN was not provided and/or could not be determined through enrolled acreage.
4. NMP SR data could not be associated with a specific APN.
5. The NMP SR was missing any of the requisite NMP data, including amount nitrogen applied per acre, A/Y ratio, or a production unit for the yield.

Once received, completed data are further reviewed for consistency by ensuring all reported APNs are associated with the correct membership ID and are within the WSJRWC boundary. Duplicated entries based on APN or MU are reconciled or removed from the analysis.

Data Verification and Corrections

The Coalition reviewed the yield per acre and the nitrogen applied per acre to determine if the reported 2018 CY data appeared reasonable. Yields varied by orders of magnitude across all crops, ranging from 0 pounds per acre to more than 100,000 lbs/acre for some crops. Yields reported at higher than 250,000 lbs/acre and nitrogen application rates higher than 1,000 lbs/acre were determined to likely represent errors in the reporting and were flagged for review and follow-up. Additionally, the Coalition identified MUs with data quality concerns by comparing reported A and Y values to the distribution of values reported for each crop. The Coalition estimated that any NMP MU with an A or Y value greater than twice the 75th percentile of all other data for the same crop was most likely reported incorrectly. The MUs identified as having an unlikely A or Y were flagged for review and follow-up; suspect data that were not reconciled were marked as incomplete and excluded from the analysis.

All data flagged for follow-up due to incompleteness, inconsistencies, or unlikely yields or nitrogen applications were reviewed against the original submission to ensure these values were not the result of data-entry errors.

Data Excluded from the Analysis

Some data received by the Coalition cannot be analyzed due to the type of crop reported. Such exclusions may occur due to one or more the following situations:

1. APNs were reported as not farmed (fallow, open, or non-agriculture).
2. Cover crops (because they receive no nitrogen applications and have no yield).
3. Nurseries and grass sod (have no yield in the traditional sense).
4. Crops grown for seed or research purposes (do not harvest yields that can be compared to traditional production yields or accurately converted to nitrogen removed).
5. Pastures have no yield in the traditional sense, but farmers can estimate yields using available tools. Currently growers with irrigated pasture are not required to submit NMP SRs if fertilizers are not applied. The Coalition excluded pasture fields without nitrogen applications.

A total of 283 MUs covering 12,213 acres were not analyzed because of one of the above reasons. Additionally, NMP MUs with incomplete data or data flagged as suspect (see Data Verification and Corrections) that could not be updated or verified were also excluded from the analysis. The number of NMP MUs and acreage excluded due to quality concerns are listed in Table 3.

Table 3. Number of reported MUs and associated acreage excluded from the analysis due to incomplete data or unverified yields or nitrogen applications.

Crop	Count of MUs	Total Acres
Alfalfa Hay	8	419
Almonds	5	276
Apricots	1	209
Olives	2	228
Squash	1	40
Walnuts	1	20
Alfalfa Hay	8	419
Total	**18**	**1,192**

METHODS

Yield Estimation and Units

Growers were not required to report their yields on their 2018 NMP SRs. In cases where yield was not provided, the Coalition used nitrogen applied and the A/Y ratio values submitted on the NMP SR to calculate the yield per acre. If the crop yield was reported in a production unit other than pounds, the Coalition converted the yield to pounds prior to analysis.

Crop Classification

The statistical analysis of NMP SR data and the identification of outliers are strongly dependent on comparing NMP SR data from similar crops, necessitating an accurate classification of crops. In addition to the crop type (e.g., corn, alfalfa), many of the crops grown in the region can be harvested in different ways (e.g., hay vs. silage) or from different varieties (e.g. corn grain vs. sweet corn). Some of these differences in harvest types and varieties have important implications for this analysis.

Field or row crops may have different harvest types which can result in significantly different yields. For example, field crops harvested as hay have lower moisture content (usually around 12%) than the same crop harvested as silage (usually around 70%). As a result, the yields reported for hay harvests are significantly lower than the yields reported for silage harvests, even if both harvests remove the same dry matter and nitrogen content from the field. Therefore, hay and silage harvests cannot be directly compared to each other. Additionally, the amount of nitrogen removed may differ depending on the harvest type. For example, corn harvested as grain has a higher nitrogen content than that harvested as silage. Therefore, field crops harvest types must be reported for the data to be useable in the analysis and correctly calculate A/R and A-R.

Some fruit crops are grown and harvested for different purposes (e.g., wine grapes vs. table grapes; or processing tomatoes vs. fresh market tomatoes). These fruit varieties may differ in moisture content and nitrogen concentration, making the distinction important for the correct analysis and identification of outliers. Current crop-specific nitrogen (C_N) coefficients and preliminary analysis of the yields suggest that these differences are not as large as the differences seen among field crop harvest types. However, as the quality of the data improves over time, some distinctions may become more apparent.

To facilitate an accurate analysis, the Coalition classifies crops using a specific crop type that includes the harvest type, crop variety, and crop age, when applicable. When a grower provided an ambiguous crop name associated with a field crop for which different harvest types can result in vastly different yields and nitrogen removal contents (e.g., “Corn” with no harvest information), the Coalition must exclude the MUs from the statistical analysis (see “Ambiguous Crop Types” on Table 5). However, when a grower reported ambiguous crop names for crops that are less variable (e.g., grapes or tomatoes), the Coalition included them in the analysis. For example, the specific crop options for tomatoes includes “tomatoes, processing” and “tomatoes, fresh market”. If a grower just reports “tomatoes”, the Coalition classifies the crop as “tomatoes, NR”, where “NR” indicates not recorded. The Coalition expects that crop classification will become more accurate over time.

Nitrogen Removal Calculations

All C_N coefficients were obtained from "Nitrogen concentrations in harvested plant parts" (Geisseler, 2016),with the single exception of strawberries. The C_N coefficients used for the nitrogen removal calculations for strawberries come from CDFA, as no values were reported by Geisseler for this crop. In his report, Geisseler performed an extensive literature review of nitrogen concentrations for a wide variety of crops, providing an average nitrogen removal value for each crop studied. In addition, Geisseler provided a coefficient of variation to assess the variability of the data around each mean, and an assessment of the quality, completeness, and relevance of the dataset. According to this assessment, many of the values are poor or unreliable estimates for crops grown in the Central Valley.

The Coalition utilized the average C_N coefficients from the Geisseler report with the understanding that many of the values are poor estimates and will change in the future. The Coalition also conducted its own assessment of variability using the range of values from all studies reviewed by Geisseler for each crop. A summary of Geisseler's mean C_N coefficients and the Coalition's quality assessments are provided in Table 4. The Coalition plans on updating and improving these values over time, as more, higher quality data become available.

In some cases, the crop types reported by Geisseler were more specific than those used by the Coalition. For example, while the Coalition reported wheat as a single crop type, Geisseler utilized two separate (albeit similar) values for durum and common grain wheat. In such cases, the Coalition calculated an average of the multiple values provided by Geisseler. Averages calculated by the Coalition are identified in Table 4.

In some cases where the Coalition calculated average C_N coefficients for groups of similar crops, the Coalition's quality assessment of the average differed from Geisseler's individual assessments of the more specific crops. For example, Geisseler noted that there are insufficient data for black-eyed and garbanzo beans from the Central Valley and indicated that it is not possible to determine if the average provided is a good estimate for the region. However, the Coalition observed that those values overlap substantially with values from lima beans, which are considered by Geisseler to be reasonable estimates for the region. Given the strong overlap in means and ranges, the Coalition considered the average coefficient for dry beans to likely be a reasonable estimate for the region. The same group quality assessment was made for citrus based on the overlap in values between grapefruit, lemons, oranges, and tangerines as well as market tomatoes based on its overlap with processing tomatoes from California.

The specific C_N coefficients applied to each specific crop type reported by Coalition members are included in Table 4. Crops with available C_N coefficients in this report covered 180,068 acres within the Coalition region and comprised 95% of the available data (based on the total number of received and complete reports).

Table 4. C_N coefficients applied to each of the specific crop types used by the Coalition.

Some of the values used are not good estimates. The C_N coefficients and their quality assessments are sourced directly from Geisseler (2016) or are combined Coalition averages of multiple coefficients provided in Geisseler (2016).

Coalition Specific Crop type	C_N Coefficient Commodity	C_N Coefficient Source	Quality Assessment	C_N Coefficient	Units
Alfalfa Hay	Alfalfa - Hay	Geisseler (2016)	Good	0.0311	lbs N/lbs @ 12% moisture
Almonds	Almonds	Geisseler (2016)	Good	0.068	lbs N/lbs of marketable kernels

Coalition Specific Crop type	C_N Coefficient Commodity	C_N Coefficient Source	Quality Assessment	C_N Coefficient	Units
Apple	Apples	Geisseler (2016)	Poor	0.0005	lbs N/lbs of fruits
Apricots	Apricots	Geisseler (2016)	Poor	0.0028	lbs N/lbs of fruits
Apriums	Apricots	Geisseler (2016)	Poor	0.0028	lbs N/lbs of fruits
Barley Grain	Barley - Grain	Geisseler (2016)	Reasonable	0.0168	lbs N/lbs of grain @ 12% moisture
Beans	Beans, dry - average	Coalition average	Reasonable	0.0354	lbs N/lbs of mature dry beans @ 12% moisture
Beans Garbanzo	Beans, dry - Garbanzo	Geisseler (2016)	Poor	0.0336	lbs N/lbs of mature dry beans @ 12% moisture
Beans Lima	Beans, dry - Lima	Geisseler (2016)	Reasonable	0.0362	lbs N/lbs of mature dry beans @ 12% moisture
Broccoli	Broccoli	Geisseler (2016)	Poor	0.0056	lbs N/lbs of fresh weight
Cantaloupe	Melons - Cantaloupe	Geisseler (2016)	Poor	0.0024	lbs N/lbs of melons
Cherries	Cherries	Geisseler (2016)	Poor	0.0022	lbs N/lbs of fruits
Corn Grain	Corn - Grain	Geisseler (2016)	Poor	0.012	lbs N/lbs of grain @ 15.5% moisture
Corn Silage	Corn - Silage	Geisseler (2016)	Good	0.0038	lbs N/lbs @ 70% moisture
Corn Sweet	Corn - Sweet	Geisseler (2016)	Reasonable	0.0036	lbs N/lbs of fresh ears
Cotton	Cotton	Geisseler (2016)	Good	0.0219	lbs N/lbs lint & seed
Cotton Acala	Cotton	Geisseler (2016)	Good	0.0219	lbs N/lbs lint & seed
Cotton Pima	Cotton	Geisseler (2016)	Good	0.0219	lbs N/lbs lint & seed
Cotton Upland	Cotton	Geisseler (2016)	Good	0.0219	lbs N/lbs lint & seed
Forage	Foragegrass - Hay, average	Coalition average	Poor	0.0267	lbs N/lbs @ 12% moisture
Forage Mix	Foragegrass - Hay, average	Coalition average	Poor	0.0267	lbs N/lbs @ 12% moisture
Garlic	Garlic	Geisseler (2016)	Poor	0.0076	lbs N/lbs of bulb weight
Grapes Raisin	Grapes - Raisins	Geisseler (2016)	Reasonable	0.0051	lbs N/lbs of grapes @ 15% moisture
Grapes Table	Grapes - Table	Geisseler (2016)	Reasonable	0.0011	lbs N/lbs of grapes
Grapes Wine	Grapes - Wine	Geisseler (2016)	Poor	0.0018	lbs N/lbs of grapes
Grapes, NR	Grapes - average	Coalition average	Reasonable	0.0015	lbs N/lbs of grapes
Honeydew	Melons - Honeydew	Geisseler (2016)	Reasonable	0.0015	lbs N/lbs of melons
Jalapenos	Pepper - Bell	Geisseler (2016)	Poor	0.0017	lbs N/lbs of fresh weight
Lemons	Lemons	Geisseler (2016)	Reasonable	0.0013	lbs N/lbs of fruits
Mandarins	Citrus, average	Coalition average	Reasonable	0.0014	lbs N/lbs of fruits
Melons, NR	Melons - average	Coalition average	Poor	0.002	lbs N/lbs of melons
Nectarines	Nectarines	Geisseler (2016)	Reasonable	0.0018	lbs N/lbs of fruits
Oats Grain	Oat - Grain	Geisseler (2016)	Poor	0.0189	lbs N/lbs of grain @ 12% moisture
Oats Hay	Oat - Hay	Geisseler (2016)	Good	0.0109	lbs N/lbs @ 12% moisture
Oats Silage	Small grains - Silage, average	Coalition average	Good	0.0049	lbs N/lbs @ 70% moisture
Olives	Olives	Geisseler (2016)	Reasonable	0.0031	lbs N/lbs of olives
Onions	Onions	Geisseler (2016)	Poor	0.002	lbs N/lbs of bulb weight
Oranges	Oranges	Geisseler (2016)	Reasonable	0.0015	lbs N/lbs of fruits
Peaches	Peaches	Geisseler (2016)	Reasonable	0.0011	lbs N/lbs of fruits
Peppers, Bell	Pepper - Bell	Geisseler (2016)	Poor	0.0017	lbs N/lbs of fresh weight
Pistachios	Pistachios	Geisseler (2016)	Good	0.0281	lbs N/lbs dry yield (CPC)
Pomegranates	Pomegranate	Geisseler (2016)	Poor	0.0076	lbs N/lbs of fruits
Pomelo	Citrus, average	Coalition average	Reasonable	0.0014	lbs N/lbs of fruits
Prunes	Prunes	Geisseler (2016)	Good	0.0056	lbs N/lbs of dried fruits
Pumpkins	Pumpkin	Geisseler (2016)	Poor	0.0037	lbs N/lbs of fresh weight
Squash	Squash	Geisseler (2016)	Poor	0.0018	lbs N/lbs of fresh weight
Strawberries	Strawberries	http://apps.cdfa.ca.gov/frep/docs/N_Strawberry.html		0.0013	lbs N/lbs of fruit
Sudan, Silage	Sorghum - Silage	Geisseler (2016)	Reasonable	0.0037	lbs N/lbs @ 65% moisture

Coalition Specific Crop type	C_N Coefficient Commodity	C_N Coefficient Source	Quality Assessment	C_N Coefficient	Units
Tangerine	Tangerines	Geisseler (2016)	Poor	0.0013	lbs N/lbs of fruits
Tomatoes Market	Tomatoes - Fresh market	Geisseler (2016)	Poor	0.0013	lbs N/lbs of fresh weight
Tomatoes Processing	Tomatoes - Processing	Geisseler (2016)	Good	0.0014	lbs N/lbs of fresh weight
Tomatoes, NR	Tomatoes - average	Coalition average	Good	0.0013	lbs N/lbs of fresh weight
Walnuts	Walnuts	Geisseler (2016)	Reasonable	0.016	lbs N/lbs with shells
Watermelon	Melons, Water	Geisseler (2016)	Poor	0.0007	lbs N/lbs of melons
Wheat Grain	Wheat - Grain, average	Coalition average	Good	0.0213	lbs N/lbs of grain @ 12% moisture
Wheat Silage	Wheat - Silage	Geisseler (2016)	Reasonable	0.0053	lbs N/lbs @ 70% moisture
Zucchini	Squash	Geisseler (2016)	Poor	0.0018	lbs N/lbs of fresh weight

[1] CDFA FREP values were obtained from http://apps.cdfa.ca.gov/frep/docs/N_Strawberry.html. No data quality assessment exists for this value.

Statistical Methods

Histograms of A/R and A-R data for the 2018 CY and associated summary statistics are provided in Appendix II for each specific crop type.

Graphics of A and R value distributions are provided for specific crop types with an available C_N coefficient (Table 4). Reported crops that did not have a C_N coefficient are reported with summary statistics for A/Y in the "Other Crops" section of the results. Summary statistics for crops that did not have a sufficient number of management units reported to create a histogram are also included in the "Other Crops" section. The data analysis was performed using R software for statistical computing.

Data were also aggregated by Township and Range (TR) to comply with the Order requirements. Each TR represents 36 sections (23,040 acres). The NMP data were associated with a TR location using ArcGIS software by overlaying the TRS layer with the county parcel layers. There were 88 APNs that could not be associated to a TR, which were labeled as TR unknown and treated as a single TR. Some NMP parcels were associated with more than one TR because different parcels or parts of a parcel overlapped with multiple TRs. These data were assigned to the TR that included most of the parcel area to avoid duplication. The TR aggregations results are provided in Attachment A, Nitrogen Management Plan Summary Data.

RESULTS

Results were reported by growers at the MU level, which represents field-level management of nitrogen by Coalition members. Table 5 includes the specific crop type associated with a C_N coefficient (see Table 4), a crop group which is used for grouping crops into categories in Appendix II, and the following summary information: number of management units reported per specific crop, the total nitrogen applied and yield harvested, the total acreage and the total nitrogen removed.

After Quality Control (QC), there were 2,585 NMP MUs with complete data (Table 5). Of these, 298 MUs were associated with non-yield (NY) or non-bearing (NB) crops that have no nitrogen removed value due to no harvest. The NY/NB crops from the 2018 CY represent 20,637 acres and had reported applications of approximately 845,000 lbs of nitrogen (Table 5). In addition, there

were 101 MUs (6,279 acres, Table 5) that were reported with ambiguous crop types that excluded them from the analysis (e.g. only reporting "Corn" without a harvest type; see Crop Classification). After the Coalition excluded MUs with NY/NB crops or those with ambiguous crop types, the data analysis includes nitrogen applied and removed values of 2,186 NMP MUs associated with 3,603 parcels covering 160,754 acres (Table 5).

Table 5. List of crop groups and specific crop types (not including permanent crop age) reported by growers in the Coalition region.

Additional information includes the total number of MUs reported, total nitrogen applied, yield, nitrogen removed, and acreage for each Specific Crop Type. Sorted alphabetically by Crop Group.

Crop Group	Specific Crop Type	Number of MUs	Total N Applied (lbs)	Total Yield Harvested (lbs)	Total N Removed (lbs)	Total Acres
Alfalfa Hay	Alfalfa Hay	282	642,217	158,866,698	4,948,698	15,112
Almonds	Almonds	648	12,532,365	131,434,604	8,937,553	59,628
Apple	Apple	1	636	190,404	103	12
Apricots	Apricots	64	264,133	34,962,700	97,196	2,866
Beans	Beans	60	50,826	4,492,157	159,097	6,266
Beans	Beans Garbanzo	2	0	481,300	16,172	177
Beans	Beans Lima	37	63,880	8,820,045	318,845	3,083
Beets	Beets	1	354	2,453	--	22
Berries	Strawberries	1	350	56,000	73	1
Broccoli	Broccoli	26	328,573	32,963,584	184,596	2,536
Cherries	Cherries	65	79,764	9,935,936	21,958	1,730
Citrus	Lemons	2	6,550	3,557,455	4,589	51
Citrus	Mandarins	2	24,570	12,788,193	17,648	273
Citrus	Oranges	6	5,425	3,689,482	5,460	69
Citrus	Pomelo	1	200	80,000	110	4
Citrus	Tangerine	1	50	16,000	20	1
Corn Grain	Corn Grain	13	97,550	5,071,424	60,857	521
Corn Silage	Corn Silage	108	1,126,478	281,468,145	1,063,950	5,450
Corn Sweet	Corn Sweet	2	11,246	46,340	166	105
Cotton	Cotton	97	733,687	8,932,256	195,170	5,100
Cotton	Cotton Acala	43	375,141	2,818,168	61,577	1,698
Cotton	Cotton Pima	131	1,749,645	22,445,481	490,434	9,831
Cotton	Cotton Upland	7	105,489	1,968,765	43,018	962
Garlic	Garlic	9	216,775	17,044,123	128,683	1,288
Grains	Barley Grain	1	0	--	--	9
Grains	Oats Grain	2	3,150	252,000	4,750	25
Grains	Wheat Grain	9	238,229	5,673,754	120,709	977
Grapes	Grapes Raisin	2	5,695	455,600	2,301	114
Grapes	Grapes Table	1	2,650	1,272,000	1,437	53
Grapes	Grapes Wine	16	115,269	27,496,834	49,494	1,480
Grapes	Grapes, NR	5	21,192	5,514,713	8,079	443
Grass	Grass Teff, NR	1	1,196	230,000	--	23
Hay	Forage	3	10,126	1,350,080	36,047	204
Hay	Forage Mix	5	9,771	2,703,825	72,192	145
Hay	Forage Mix, NR	11	97,139	6,150,701	--	487
Hay	Oats Hay	16	25,518	3,449,942	37,432	538
Hay	Sudan Hay	4	3,516	325,965	--	58
Hay	Wheat Hay	39	64,027	8,366,886	--	1,741
Melons	Cantaloupe	29	217,972	54,327,152	132,287	1,751
Melons	Honeydew	5	12,720	2,001,296	2,952	97
Melons	Melons, NR	8	78,750	21,274,695	41,592	708
Melons	Watermelon	8	89,469	40,077,432	27,854	544
Nectarines	Nectarines	1	375	19,200	35	5
Olives	Olives	8	54,710	5,607,040	17,606	656
Onions	Onions	1	15,600	2,653,092	5,227	78

Crop Group	Specific Crop Type	Number of MUs	Total N Applied (lbs)	Total Yield Harvested (lbs)	Total N Removed (lbs)	Total Acres
Pasture	Pasture	14	3,480	0	--	283
Peaches	Peaches	2	10,959	456,000	515	59
Peppers	Jalapenos	1	3,451	608,000	1,006	16
Peppers	Peppers, Bell	1	7,329	1,093,943	1,810	36
Persimmons	Persimmons	2	1,200	341,380	--	30
Pistachios	Pistachios	22	589,143	7,280,742	204,225	3,364
Plums	Apriums	3	2,146	260,440	724	34
Pomegranates	Pomegranates	2	151,946	45,320,420	344,435	1,771
Prunes	Prunes	3	7,509	699,233	4,195	109
Pumpkins	Pumpkins	3	5,856	2,571,462	9,463	57
Silage	Oats Silage	12	85,778	17,893,532	87,365	663
Silage	Sudan, Silage	1	0	396,000	1,453	18
Silage	Wheat Silage	6	69,957	22,341,858	117,295	867
Squash	Squash	1	371	161,088	296	3
Squash	Zucchini	1	11,400	6,935,000	12,726	95
Tomatoes	Tomatoes Market	19	476,964	109,731,002	143,199	1,967
Tomatoes	Tomatoes Processing	99	2,627,021	1,153,974,287	1,575,175	11,907
Tomatoes	Tomatoes, NR	37	605,325	289,737,851	386,800	2,986
Walnuts	Walnuts	181	1,323,418	34,354,333	547,952	9,678
Total		**2,194**	**25,466,231**	**2,625,490,491**	**20,754,601**	**160,865**
EXCLUDED FROM ANALYSIS						
Ambiguous Crop Types1	Corn, NR	47	426,685	123,921,027	--	2,665
	Oats, NR	20	29,437	13,091,943	--	826
	Sudan, NR	11	13,848	2,733,824	--	183
	Wheat, NR	23	74,015	5,243,561	--	2,605
Ambiguous Crops Subtotal		**101**	**543,985**	**144,990,355**	**--**	**6,279**
NB[2]	NON-BEARING	263	671,133	0	0	18,731
NY[2]	NO YIELD	35	173,762	0	0	1,906
NB and NY Subtotal		**298**	**844,895**	**0**	**0**	**20,637**

NR – Crop or crop age not reported.

[1]Not included in the analysis because the harvest type is necessary to compare data appropriately.

[2] Not included in the analysis because these MUs have no A/Y.

Multi-Year AR Calculations

The Order requires that the Coalition include reporting on the Individual Field AR data by Anonymous Member ID Table beginning November 2020 and annually thereafter. As part of the Individual Field AR data, it is required to include 3-year A/R ratios (if available). The Coalition will provide multi-year AR calculations starting with the November 2020 report.

Identification of Outliers

The Coalition must propose an approach for defining outliers by December 31, 2019. Once the approach is approved by the Executive Officer, the Coalition will use this approach for identifying outliers in the November 2020 report.

Further Evaluations

The Order states on page 30 of Attachment B, "As directed by the Executive Officer, initial further evaluations within each crop type comparing the irrigation method, the soil conditions, and the farming operation size shall be developed." In previous NMP SR analyses, the Coalition has

performed statistical comparisons of the nitrogen applied and yield information for soils, irrigation practices, and nitrogen management practices. None of these factors were useful in defining trends with nitrogen applied, yields or outlier status.

Beginning with reporting for the 2020 CY, INMP SRs returned by growers will include irrigation and nitrogen management practices directly associated with the reported nitrogen applied and yield data. Future analyses will be able to draw more meaningful conclusions regarding the relationship between nitrogen data and management practices once these data are consistently reported and can be reliably compared. The Coalition will also evaluate other approaches for evaluating the effect of soil on the nitrogen applied and/or crop yield.

Caveats

There are several caveats that compromise our interpretation of the results including:

1. Even with an NMP SR return rate of 97%, many crops still have only a few (five or less) MUs with data that meet the criteria to conduct AR calculations. Meaningful evaluations are difficult to make with so few data points.
2. Some of the reported information is clearly in error. The Coalition made every effort to flag data with quality control (QC) concerns. It is likely that some errors were not identified which now contribute to the variability and uncertainty of the data. Summary statistics and histogram plots could change as better data become available over time.
3. The Coalition has made a concerted effort to verify the C_N coefficients used in this report. However, Dr. Daniel Geisseler, the author of the document from which the C_N coefficients were obtained, points out that a large number of the coefficients are only rough estimates, and it is unknown the extent to which some values are a good representation of nitrogen removal in the Central Valley.

NITROGEN USE EVALUATION REPORTS

The Coalition informs its members about the potential effects of nitrogen applications on groundwater quality by mailing Nitrogen Use Evaluation Reports to each member for whom NMP data were received and analyzed.

In January of 2019, the Coalition mailed Nitrogen Use Evaluation Reports for 2017 CY data to 756 growers. An example of the report that these growers received is provided in Appendix III. These reports included the NMP SR data reported for the 2017 CY, summary statistics by crop type for all MUs across the Coalition, nitrogen removal estimates for crops with available R values, bell curves comparing each member's MUs to others reporting on the same crop across the Coalition, and identification of outlier status for members with A/Y values above the 90th percentile by crop.

The Nitrogen Use Evaluation Reports are meant to illustrate nitrogen use efficiency for each grower who has the potential to leach nitrates into groundwater. The analysis places each of these grower's practices within the context of other growers of the same commodity in the Coalition. Additionally, reporting the data back to each grower provides the opportunity for growers to address any data quality concerns that may not have been identified in the quality control and

follow-up processes outlined above. Growers are encouraged to contact the Coalition with data change requests, questions, and concerns with their Nitrogen Use Evaluation, and as such, the reports will aid in more accurate and comprehensive data over time. Reports containing the results of the current analysis will be mailed to growers in early 2020.

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Appendix I

SUMMARY OF MANAGEMENT PRACTICE INFORMATION COLLECTED FROM FARM EVALUATIONS AND MANAGED WETLAND EVALUATIONS (2018 GROWING SEASON)

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EXECUTIVE SUMMARY

The Westside San Joaquin River Watershed Coalition (Westside Coalition) serves as the Third Party Group for member growers in the western part of the San Joaquin River watershed, for the purpose of implementing applicable portions of the Irrigated Lands Regulatory Program (IRLP) as specified in Order Number R5-2014-0002 (Order). Members with lands located in high vulnerability areas for surface water and groundwater were required to submit a Farm Evaluation (FE) or Managed Wetland Evaluation (MWE) Survey for all lands irrigated to produce crops or pasture for commercial purposes, nurseries and private/public managed wetlands.

To satisfy this requirement, the Westside Coalition prepared and sent FE/MWE surveys to all current members in high vulnerability areas. Approximately 1,600 sets of forms were prepared for approximately 6,700 parcels.

Over the past few months, updates to the general order have brought about changes to both the format and the survey interval of the Farm Evaluation Survey. Because FE/MWE Data is available 2018 growing season, the following summary of management practice information has been prepared. On November 30, 2020, the Coalition will submit to the Central Valley Water Board management practice implementation data form the most recently submitted Farm Evaluations in Excel workbook format.

Information presented herein will be used, in conjunction with other data, to develop the Management Plan Status Report, a component of the Coalition's annual monitoring report in June 2020.

The 2018 Farm Evaluation Surveys included these four sections:

- Part A - Whole Farm Evaluation
- Part B - Irrigation and Nitrogen Practices
- Part C - Well Information
- Part D - Sediment and Erosion Control Practices

The Managed Wetland Evaluation Survey included:

- Section 1 - APNs associated with survey
- Section 2 - Habitat Types
- Section 3 - Irrigation Practices
- Section 4 - Management Practices
- Section 5 - Herbicide Practices
- Section 6 – Irrigation Well Information
- Section 7 - Sediment Control Practices
- Wellhead protection and abandoned well practices

FARM AND MANAGED WETLAND EVALUATION PARTICIPATION SUMMARY

The Westside Coalition's 2018 membership roster submitted to the State Water Resources Control Board on July 31, 2018, was used as a baseline. The membership list was revised as surveys were received to a total acreage of 420,370 acres. This total reflects the enrolled acreage of all parcels in the Westside Coalition for the 2018 growing season. FE/MWE surveys were returned for a total of 369,954 acres. The remaining 9,875 acres did not respond. A total of 40,752 acres were not surveyed, this acreage includes lands in low vulnerability areas and lands in high vulnerability areas that were not irrigated in 2018.

Table 1. FE/MWE Participation Summary

Total Acreage	420,370	acres
Acreage not Surveyed	40,541	acres
Total Surveyed Acreage	379,828	acres
FE/MWE Survey Returned	369,954	acres
FE/MWE Survey Not Returned	9,875	acres

For the 2018 growing season, only High Vulnerability Areas (HVAs) were surveyed. High Vulnerability areas included both Surface Water High Vulnerability Areas (SWHVA) and Groundwater High Vulnerability Areas (GWHVA). Survey participation for SWHVA & GWHVA are listed below in Table 2 and Table 3. Due to the fact that many parcels are located in both SWHVA & GWHVA, the total surveyed acreage listed in Table 1 cannot be reconciled from Table 2 and Table 3. Table 2 and Table 3 summarize survey completeness from the perspective of SWHVA and GWHVA.

Table 2. Participation in Surface Water High Vulnerability Areas

SUBWATERSHED	SURVEY RETURNED	SWHVA ACREAGE	PERCENTAGE
Blewett Drain	2,345	2,345	100.0%
Del Puerto Creek	10,781	11,484	93.9%
Hospital Creek	7,115	7,228	98.4%
Ingram Creek	8,780	9,138	96.1%
Los Banos Creek	17,869	20,481	87.2%
Marshall Road Drain	11,424	11,437	99.9%
Mud Slough	13,619	14,910	91.3%
Newman Wasteway	32,917	33,189	99.2%
Orestimba Creek	22,053	22,276	99.0%
Ramona Lake	3,094	3,114	99.4%
Salt Slough	111,329	113,831	97.8%
Spanish Land Grant Drain	4,211	4,211	100.0%
Westley Wasteway	6,892	7,019	98.2%

Table 3. Participation in Groundwater High Vulnerability Areas

Survey Returned	Total GWHVA Acres	Percentage
200,763	203,701	98.6%

COALITION CROP INFORMATION

Cropping patterns for the 2018 growing season were developed from the FE and MWE surveys. Some crops, when considered on their own, constituted small acreages. These crops were grouped together in combined categories.

Table 4. Crop Summary

Primary Crop	Acres
Almonds	82,877
Cotton	44,558
Alfalfa	32,849
Tomatoes	32,212
Corn	13,232
Wheat	11,262
Walnuts	10,892
Beans	9,655
Pistachios	9,513
Fruit Trees*	8,914
Pasture	5,284
Melons*	3,376
Cantaloupe	3,312
Forage	2,470
Other Row Crop*	2,111
Vines	1,959
Oats	1,875
Garlic	1,290
Olives	1,074
Rice	645
No Crop Specified	616
Nursery	489
Onions	479
Citrus	426
Carrots	263
Lettuce	161
Specialty*	160
Fallow	9,508
Not Irrigated	663
Wetlands (reported via FE)	2,049
2018 Total Reported Acreage (via FE)	294,176
Managed Wetlands (reported via MWE)	64,624
Response Acreage	358,799

*Combined Categories

The crop data was normalized so meaningful summaries could be developed. In event multiple crops were reported, the first crop listed for a given site was selected. In some cases, it was appropriate to deviate from this convention based on reported management practices. For example, if a grower farmed tomatoes and wheat on a given field and drip irrigation was indicated as the primary irrigation practice, it was assumed that tomatoes were the primary crop, even if wheat was listed first.

PART A – WHOLE FARM EVALUATION

The management practices for Part A of the FE survey are summarized below. These management practices are not crop-specific but apply on an operation-wide basis. Westside Coalition members were asked to list their pesticide application practices, the consultants they utilize and assess their farm's potential to discharge sediment off-site.

Table 5. Whole Farm Evaluation

QUESTION/RESPONSE	ACREAGE
Pesticide Application Practices	
County Permit Followed	287,650
Follow Label Restrictions	282,769
Monitor Wind Conditions	280,158
Attend Trainings	271,023
Use PCA Recommendations	270,484
End of Row Shutoff When Spraying	267,996
Monitor Rain Forecasts	263,015
Avoid Surface Water When Spraying	260,839
Use Drift Control Agents	257,641
Use Appropriate Buffer Zones	255,282
Reapply Rinsate to Treated Field	184,886
Sensitive Areas Mapped	160,825
Chemigation	114,516
Use Vegetated Drain Ditches	92,155
Target Sensing Sprayer used	55,217
No Pesticides Applied	5,930
Other - See Note 1	3,243
No Selection	146
Who do you have help develop your crop fertility plan?	
Pest Control Advisor (PCA)	273,207
Certified Crop Advisor (CCA)	180,774
Professional Agronomist	115,240
Professional Soil Scientist	75,705
Independently Prepared by Member	55,920
UC Farm Advisor	33,562
Certified Technical Service Providers by NRCS	25,487
None of the above	5,934
No Selection	2,583
Does your farm have the potential to discharge sediment to off-farm surface waters?	
No	257,903
Yes	95,692

Question/Response	Acreage
No Selection	5,205

Note 1 - These are survey responses written in by the member. The most common written-in response indicate that a hired consultant applied chemicals on-farm. Other members indicated that they utilize advanced spraying equipment, do not apply pesticides.

PART B – IRRIGATION AND NITROGEN MANAGEMENT PRACTICES

The responses from Part B are summarized in Table 6 and Table 7. About 60% of the surveyed acreage is irrigated using high-efficiency irrigation systems (drip and micro sprinkler) and the remainder using conventional irrigation methods. Similar to the data collected in past years, a majority of tomatoes and almonds were irrigated using high-efficiency systems, while the majority of cotton and alfalfa was irrigated with conventional irrigation methods.

The acreage total associated with primary irrigation practices is equal to the response acreage shown in Table 4. This result was achieved because one primary irrigation was reported for each management unit. In prior years, the irrigation practices acreage has exceeded the response acreage because multiple primary irrigation methods were reported for some management units. The 2018 FE data has one primary irrigation method selected for each management unit, indicating a higher data quality overall and an improved understanding of the Coalition's data needs by its members.

Table 6. Irrigation Practices

Question/Response	Acreage
Irrigation Practices	
Drip*	125,861
Furrow	63,185
Micro Sprinkler*	51,772
Flood	26,116
Sprinkler	9,976
Border Strip	9,226
No Selection	8,039
Secondary Irrigation	
No Selection	195,064
Sprinkler	38,410
Drip	16,829
Flood	13,573
Furrow	12,526
Micro Sprinkler	12,214
Border Strip	5,748

*High-efficiency irrigation system

Table 7. Irrigation Efficiency and Nitrogen Management

Question/Response	Acreage
Irrigation Efficiency Practices	

Question/Response	Acreage
Water application scheduled to need	275,866
Use of moisture probe	163,453
Use of ET in scheduling irrigations	159,414
Laser Leveling	142,206
Pressure Bomb	41,320
Soil Moisture Neutron Probe	23,222
Other: Drip	11,678
No Selection	6,786
Other - See Note 2	6,988
Nitrogen Management Methods to Minimize Leaching Past The Root Zone	
Split Fertilizer Applications	235,478
Soil Testing	234,753
Tissue/Petiole Testing	194,120
Irrigation Water N Testing	156,083
Fertigation	155,204
Foliar N Application	152,661
Cover Crops	81,259
Do Not Apply Nitrogen	18,992
Variable Rate Applications using GPS	16,381
No Selection	10,201
Other - See Note 3	3,628

Note 2 – Write-in responses for the 2018 growing season typically provided more information pertaining to soil moisture monitoring techniques. For example, many growers indicated they monitor soil moisture visually by digging with hand augers or shovels. Also, many growers indicated that the property was not irrigated in 2018.

Note 3 – Write-in responses for this category included the use of organic or specialized fertilizers, fertilizer application was performed and/or application rates were determined by a consultant, or fertilizer application methods not listed were used (ex. side dressing).

PART C – WELL INFORMATION

A total of 1,069 irrigation wells were reported on the FE/MWE surveys and 969 wells were protected. A well is considered "protected" if a backflow prevention device or air gap is present, and the ground is sloped away from the wellhead or standing water is avoided around the wellhead. The Coalition will outreach to growers with unprotected wells and suggest that they incorporate the additional practices needed to achieve "protected" status described above.

A total of 48 abandoned wells were reported in 2018. Of the 58, 16 had "Destroyed – certified by County" or "Destroyed by licensed professional" selected. The Westside Coalition sent an outreach packet to members with abandoned wells. Members that marked "Destroyed - Unknown method" or did not select any abandoned well practices were given an informational packet outlining proper well destruction. In the past, growers have indicated that well was abandoned

when it is actually idle or out of service. Information packet will include a questionnaire requesting that confirmation that the well is indeed abandoned.

In the past, some wells were assigned both abandoned well practices and wellhead protection practices. In 2018, this did not occur.

Table 8. Well Information

Question/Response	Count of Wells
Wellhead Protection Practices	
Good "Housekeeping" Practices*	1040
Standing water avoided around wellhead	1021
Ground Sloped Away from Wellhead	1014
Air Gap (for non-pressurized systems)	741
Backflow Preventive / Check Valve	644
Cement Pad	167
Out of service*	4
No Data Entered	3
Abandoned Well Practices	
Destroyed – certified by county	7
Destroyed - Unknown method	17
Destroyed by licensed professional	18
No Data Entered	28

*Out of service indicates that the well is currently not in use but not abandoned.

PART D – SEDIMENT MANAGEMENT PRACTICES

Sediment management practices are summarized below. Many growers utilize some form of sediment control practices.

Table 9. Sediment and Erosion Control Practices

Question/Response	Acreage
Irrigation Practices for Managing Sediment and Erosion	
The time between pesticide applications and the next irrigation is lengthened as much as possible to mitigate runoff of pesticide residue.	216,648
Use drip or micro-irrigation to eliminate irrigation drainage.	177,397
Shorter irrigation runs are used with checks to manage and capture flows.	123,314
No irrigation drainage due to field or soil conditions.	96,561
In-furrow dams are used to increase infiltration and settling out of sediment prior	62,022
Catchment Basin.	50,379
Tailwater Return System.	46,133
Use of flow dissipaters to minimize erosion at discharge point.	20,013
PAM (polyacrylamide) used in furrow and flood irrigated fields to help bind sediment and increase infiltration.	16,952
No Selection	4,773
Other	3,474
Cultural Practices to Manage Sediment and Erosion	
Soil water penetration has been increased through the use of amendments, deep ripping and/or aeration.	226,602

Question/Response	Acreage
Crop rows are graded, directed and at a length that will optimize the use of rain and irrigation water.	158,675
Minimum tillage incorporated to minimize erosion.	155,192
Storm water is captured using field borders.	139,765
Berms are constructed at low ends of fields to capture runoff and trap sediment.	127,663
Cover crops or native vegetation are used to reduce erosion.	110,303
No storm drainage due to field or soil conditions.	74,980
Vegetated ditches are used to remove sediment as well as water soluble pesticides, phosphate fertilizers and some forms of nitrogen.	68,410
Sediment basins / holding ponds are used to settle out sediment and hydrophobic pesticides such as pyrethroids from irrigation and storm runoff.	57,807
Field is lower than surrounding terrain.	55,409
Creek banks and stream banks have been stabilized.	45,724
Subsurface pipelines are used to channel runoff water.	39,803
Vegetative filter strips and buffers are used to capture flows.	28,887
Hedgerows or trees are used to help stabilize soils and trap sediment movement.	28,792
No Selection	3,886
Other	2,501

MANAGED WETLANDS EVALUATION DATA SUMMARY

Of the total response acreage listed in Table 4, 64,624 acres were considered managed wetland. The management practices reported on the MWE surveys are presented below. Well information from the MWE surveys is included in Table 8. The total acreage from Table 10 exceeds the acreage listed in Table 4. This is due the occurrence of multiple habitat types reported for a parcel group with no acreage distinction. The data listed in Table 10, while imperfect, is still a reasonable representation of habitat types present. The managed wetland acreage does not include crops listed as wetland (or variant thereof) on the FE surveys. These instances of wetland were typically Gun/Duck clubs and are not included in the summary of managed wetland habitat types shown below, but are included in Tables 5-9.

Table 10. Managed Wetland Habitat Types

Question/Response	Acreage
Habitat types found on your property	
Seasonal Wetland (Flooded August-April)	57,239
Brood Pond/Reverse Cycle (Flooded March-August)	13,301
Permanent Wetland (Flooded Year Round)	4,498
Irrigated Upland	4,431
Semi-Permanent (Flooded September-July)	4,385
Irrigated Pasture (Grazing)	1,399
Irrigated Crop	700
No Selection	114

Table 11. Managed Wetland Management Practices

Question/Response	Acreage
Management Practices	
Mowing	59,824
Disking	54,822
Herbicide Application	35,896
Burning	20,858
Grazing	12,810
No Selection	2,729

Herbicide application practices are summarized below. The MWE survey requested that wetland managers list the herbicides used on property. Of the herbicides listed, glyphosate (roundup) was listed a majority of the time.

Table 12. Managed Wetland Pesticide Application Practices

Question/Response	Acreage
Herbicide Practices	
List any herbicides used	42,033
County Permit Followed	39,662
Follow Label Restrictions	39,607
Use PCA Recommendations	31,994
Avoid Surface Water When Spraying	31,407
Monitor Wind Conditions	30,406
Monitor Rain Forecasts	28,823
Attend Trainings	27,115
Other	25,328
Sensitive Areas Mapped	24,850
No Selection	18,772

Sediment control practices are shown below. The MWE survey also requested that members evaluate their property's potential to discharge sediment to off-site surface waters. The responses to this question are summarized in Table 5.

Table 13. Managed Wetland Sediment Control Practices

Question/Response	Acreage
Sediment Control Practices	
Native vegetation are used to reduce erosion.	54,454
Storm water is captured on wetland areas before discharge.	53,133
Ditches and conveyances vegetated and prevent suspension and discharge of sediment.	44,884
Vegetation prevents discharge of sediment.	44,073
Vegetation prevents suspension of sediment.	40,667
Sediment basins/holding ponds are used to settle out sediment from irrigation and storm runoff.	23,303
Hedgerows or trees are used to help stabilize soils and trap sediment movement.	20,330

Question/Response	Acreage
Vegetative filter strips and buffers are used to capture flows.	19,795
Creek banks and stream banks have been stabilized.	16,476
Field is lower than surrounding terrain.	6,079
No storm drainage due to field or soil conditions.	334

DATA QUALITY ASSESSMENT OF COLLECTED INFORMATION

The quality of the management practice data was assessed on a township/range (township) level and is summarized in Table 15. The assessment quantifies both missing data and incorrect/inaccurate reporting as an acreage percentage by township. For 2018, the surveyed acreage (HV only) in Westside Coalition spans 43 townships. Each township was assigned a ranking corresponding to the total enrolled acreage in the Coalition (number 1 having the highest enrolled acreage and 43 having the lowest). The townships ranked in the top 20 cover roughly 75% of the surveyed acreage with the top 10 comprising around 50%.

There are discrepancies between the survey result acreage and enrolled acreage due to double cropping and fallowed lands. To correct this issue, both the response acreage and the total surveyed acreage were normalized using gross parcel acreage. Once the acreage was normalized, it was possible to quantify data gaps as a percentage of response acreage versus surveyed acreage on a township level.

The incorrectly and/or inaccurately reported data was identified and categorized based on crop designation. Some members did not designate management practices in a crop-specific manner. The criteria in Table 14 were used to identify problematic crop designations. To develop a percentage of valid responses per township, each data record was validated or said to be unclear.

Table 14. Data Validation Criteria

Criteria	Designation
Managed Wetland habitat types	valid
Single crop listed	valid
Multiple crops listed	
Permanent Crops	
Single permanent crop with grain/forage crop (ex: almonds and wheat)	valid
Multiple permanent crops of same type (ex: nut trees, fruit trees etc.)	valid
Multiple permanent crop types (ex: nut trees and fruit trees, nut trees and vines)	unclear
Permanent crop types with row crops (ex: almonds and tomatoes)	unclear
Row Crops	
Single row crop with grain/forage crop (ex: tomatoes and wheat)	valid
Multiple row crops	unclear
Outlier crop designations (ex: fish)	unclear
Other Crop Designations	
No Irrigated Agriculture	valid
Fallow	valid

Table 15. Quality Assessment by Township

Township	Ranking	Percent Complete	Percent Valid
03S 05E	35	100%	100%
03S 06E	26	89%	100%
03S 07E	37	49%	100%
04S 06E	13	100%	99%
04S 07E	10	94%	100%
04S 08E	40	88%	100%
05S 06E	43	100%	100%
05S 07E	15	96%	100%
05S 08E	18	98%	100%
06S 07E	30	57%	100%
06S 08E	1	98%	100%
06S 09E	28	98%	100%
07S 08E	7	98%	100%
07S 09E	23	99%	100%
08S 08E	17	100%	100%
08S 09E	11	95%	100%
08S 10E	24	86%	100%
08S 11E	36	100%	100%
08S 12E	41	100%	100%
09S 08E	34	100%	100%
09S 09E	22	85%	100%
09S 10E	9	91%	100%
09S 11E	6	100%	100%
09S 12E	5	100%	100%
09S 13E	25	100%	100%
10S 09E	33	100%	100%
10S 10E	14	99%	100%
10S 11E	8	100%	100%
10S 12E	2	99%	100%
10S 13E	19	99%	100%
11S 10E	20	95%	100%
11S 11E	21	92%	100%
11S 12E	4	100%	100%
11S 13E	3	100%	100%
11S 14E	29	100%	100%
12S 12E	42	100%	100%
12S 13E	27	100%	100%
12S 14E	16	100%	100%
12S 15E	31	100%	100%
13S 12E	38	96%	86%
13S 14E	39	100%	100%
13S 15E	12	100%	100%
14S 15E	32	100%	100%

There were ten (10) townships below 90% completion. Of those townships, two (2) were ranked in the top twenty. The average completion for all townships is 95% which corresponds closely with the information presented in Table 1 (97% received, 3% missing). The quality assessment is not intended to establish 2018 participation percentages and/or identify delinquent parcels. It is meant to assess data gaps in the FE/MWE survey data on a township level.

There was one township where data was less than 90% valid. The quality of data coalition-wide has improved consistently from year to year. This is due in large part to outreach efforts by District and Coalition staff. Also, Coalition members are informed of ILRP requirements and the data needs of the Coalition at annual meetings and outreach activities. Additionally, repeat web portal users had the prior year's data as a starting point, which provided greater overall continuity, especially with Part C of the survey.

DATA DEFICIENCIES AND CORRECTIVE ACTIONS

The Coalition has identified several data deficiencies since 2014 and has implemented corrective actions to address these deficiencies. Following is a summary of these deficiencies and the actions taken on a yearly basis to address them.

- **2014 Deficiency:** The data requested by the surveys was not clear to the member. Since APN was prepopulated on the forms, the member thought that it was necessary to group his/her management practices, fields and crops by APN. This resulted in management practices that were not differentiated by a single crop. The Coalition rectified this by assigning a primary crop using the criteria previously discussed. However, assigning primary crop, especially for large parcels, would result in over-reporting some crop acreages and under-reporting others since the coalition has no ability to determine how many acres of a given parcel correspond to a given field/crop combination.

  Corrective Action (suggested in 2014): In effort to avoid this issue in the future, FE surveys will not be prepopulated with APN. Each member will be provided with an APN list and corresponding map. Efforts will be made to clarify that FE surveys should be filled out according to crop. The coalition intends to provide examples of completed survey to coalition members in the next FE/MWE packet.

  2015 Progress: The Westside Coalition prepopulated forms to the field level in cases where the data was available. The forms that were prepopulated to the field level yielded excellent results provided the prepopulated information was correct. Where data was not available, the Coalition provided lists of enrolled APNs to each member and made an effort to prepopulate survey forms as accurately as possible. Based on grower feedback, the APN lists and farm maps are a valuable tool and assist them greatly with filling out the form. For the upcoming survey, the Coalition intends to prepopulate the forms using the data collected in the previous survey where applicable. For permanent crops, all site level information, including acreage and crop will be prepopulated. For non-permanent crops, the Coalition intends to prepopulate to the field level but leave the crop and acreage unpopulated. There were still cases where multiple crops were reported per APN. However, this occurred much less than it did in 2014.

  2016 Progress: Data quality continues to improve. The Westside Coalition is developing an online web portal that will give growers the ability submit their Coalition documents online.

This will further improve accuracy of the data because the portal will provide a more standardized completion process. For example, crop will be selected from a "drop-down" menu and multiple crop designations will not be present on this menu. If two crops were grown, the portal will require them to be reported as separate management units.

2017 Progress: Data validity according to the criteria of the quality assessment was very good with only a few records considered unclear. The web portal and outreach activities have successfully remedied this issue.

2018 Progress: Very few records were considered unclear based on the criteria outlined in Table 14. The corrective actions discussed above have been effective.

- **2014 Deficiency:** There were instances where portions of a survey were missing upon receipt by the Coalition. In most cases, the irrigation efficiency and nitrogen management methods were missing. This likely occurred because those two questions were listed on separate pages of the FE survey.

  Corrective Action (suggested in 2014): Consolidate the number of pages in the FE survey, as well as revise and clarify instructions. For the 2015 FE Survey, the number of surveyed APNs will decrease because it will only focus on high-vulnerability areas. The Coalition anticipates that a higher level of quality control will be possible since there will be a lesser amount of forms to process.

  2015 Progress: Unnecessary page breaks were eliminated from the surveys in effort to address this problem. In cases where incomplete forms were received, District and Coalition staff made an effort to procure the missing page. Levels of quality control exceeding that discussed above were not possible due to the rollout of the Nitrogen Management Plan Summary Report surveys and associated data collection. The Coalition will continue to bolster follow-up efforts in for the 2016 surveys, specifically targeting multiple crop designations per APN.

  2016 Progress: The efforts implemented in 2015 were carried over to 2016. The quantity of incomplete forms received were minimal and the Coalition was able to follow-up and retrieve the missing information. The Coalition anticipates a large number of percentage of growers will utilize the web portal which will further decrease instances of incomplete forms since the portal will not allow the grower to submit a form until it is complete.

  2017 Progress: There were very few instances of incomplete surveys for 2017. The Coalition made efforts to procure missing portions of the survey when needed. This issue has been remedied by implementation of the web portal and Coalition outreach efforts.

  2018 Progress: Incomplete surveys occurred rarely in 2018. The Coalition was able to procure all missing information when needed.

- **2014 Deficiency:** In some cases, APNs lie in multiple townships. In the case of the FE survey results, duplicating records is not a viable option because parcel acreage cannot be easily subdivided between two townships. For the MWE surveys, it was not requested that management practices be differentiated by APN. Rather, the MWE survey was structures as a "whole wetland" evaluation, much like Part A of the FE was a "whole farm" evaluation.

  Corrective Action (suggested in 2014): To address this issue for the FE surveys, the township in which the parcel centroid resided was assigned. While this method is acceptable for the FE surveys since management practices are assigned by APN, it was not applicable for some of the MWE surveys because of the MWE survey structure. In cases where a MWE survey applied to a small number of parcels with the same habitat type, the parcel centroid method was applicable. For a large block of parcels that span multiple townships, it was

necessary to include a group of townships for each data record. Further delineation is not possible since it is not known which parcel(s) apply to the reported habitat types and corresponding management practices.

2015 Progress: Only one township per APN was assigned. The township in which a given parcel's centroid is located was assigned to the parcel.

2016 Progress: The remedy used to address this issue in 2015 has adequately addressed the concern.

2017 Progress: The remedy used to address this issue in 2015 has adequately addressed the concern.

2018 Progress: The Coalition continues to assign township based on the location of the parcel centroids.

Appendix II

NMP SR EVALUATIONS OF NITROGEN APPLIED AND NITROGEN REMOVED DATA BY CROP (2018 CROP YEAR)

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INTRODUCTION

This appendix comprises the Coalition's evaluation of AR metrics by crop. Each section contains summary statistics and plots for a unique crop type, though a single crop can contain multiple specific crops (e.g., alfalfa, hay and alfalfa, silage). Some unique crops did not have sufficient data to calculate statistics and/or generate images. These crops are listed in the "Other Crops" section. Crops without an available nitrogen removed (C_N) coefficient are also listed in the "Other Crops" section.

The focus of this appendix is to report summary statistics representing the relationship between nitrogen applied and nitrogen removed. Therefore, the analysis does not include management units with crops that were not harvested in 2018 (e.g., no yield reported). As such, the total acreage and number of parcels reported for each crop here may or may not match the acreage for all the received summary reports.

I. ALFALFA

Important analysis considerations:

The calculation of nitrogen removed for Alfalfa, Hay assumes that 0.03115 lbs N/lbs at 12% moisture are removed at harvest. This estimate is obtained from Geisseler (2016). The author considers that the dataset used for this report can be considered a very good estimate for alfalfa hay produced in California. However, the range probably includes sites outside the Central Valley.

Table I-1. Summary statistics for Alfalfa, Hay.

Specific Crop	Parameter	N Parcels	Acreage	Mean	Standard Deviation	Min	Max
ALFALFA, HAY	A/R	281	15,102	0.12	0.32	0	4.31
	A-R	220	12,717	-334.3	107.89	-541.98	248.08

Figure I-1. Histogram plot of A/R values for Alfalfa, Hay for the 2018 Crop Year.

The dotted blue line represents the mean. The number of parcels (n) and Standard deviation (SD) are provided.

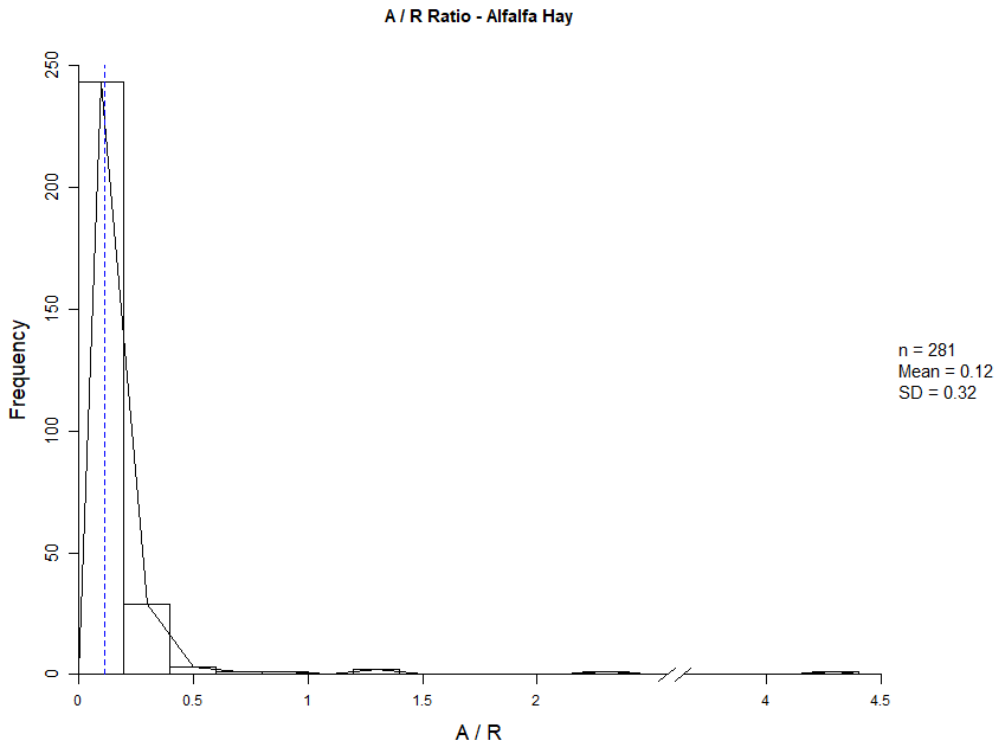
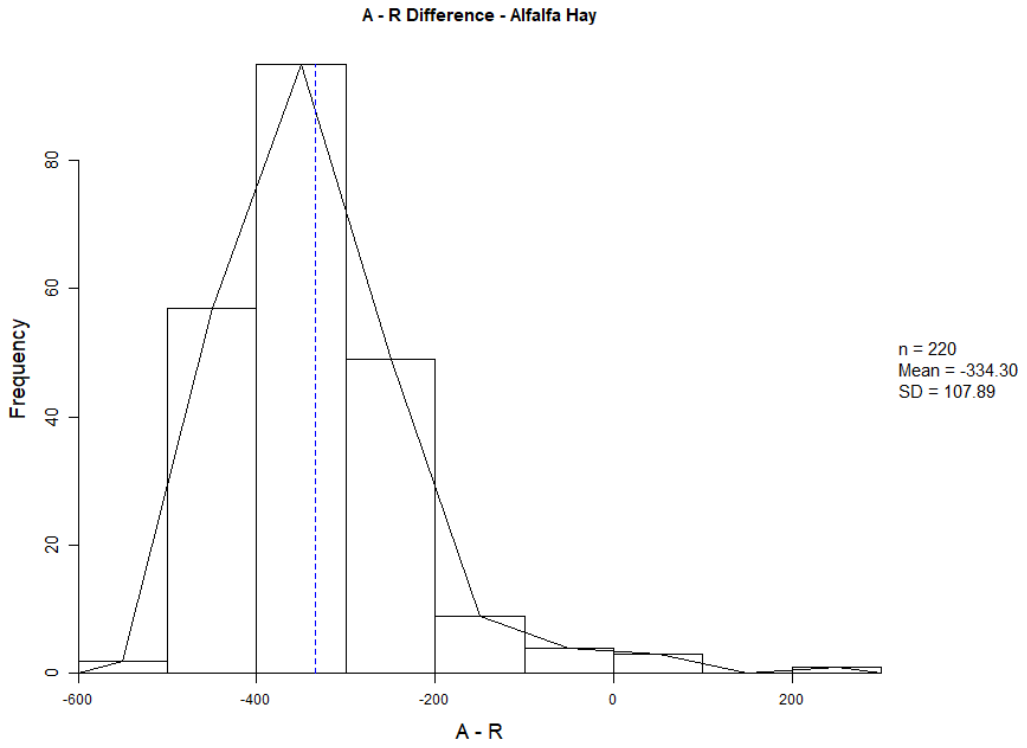


Figure I-2. Histogram plot of A-R values for Alfalfa, Hay for the 2018 Crop Year.

The dotted blue line represents the mean. The number of parcels (n) and Standard deviation (SD) are provided.



II. ALMONDS

Important analysis considerations:

The calculation of nitrogen removed for Almonds assumes that 0.068 lbs N/lbs of marketable kernels are removed at harvest. This estimate is obtained from Geisseler (2016). The author considers that the C_N coefficient is a good estimate for nitrogen removed from almond orchards in the Central Valley.

Table II-1. Summary statistics for Almond.

Specific Crop	Parameter	N Parcels	Acreage	Mean	Standard Deviation	Min	Max
ALMONDS	A/R	646	59,628	1.52	1.19	0	20.29
	A-R	644	59,491	48.2	63.34	-268.95	343.78

Figure II-1. Histogram plot of A/R values for Almonds for the 2018 Crop Year.

The dotted blue line represents the mean. The number of parcels (n) and Standard deviation (SD) are provided.

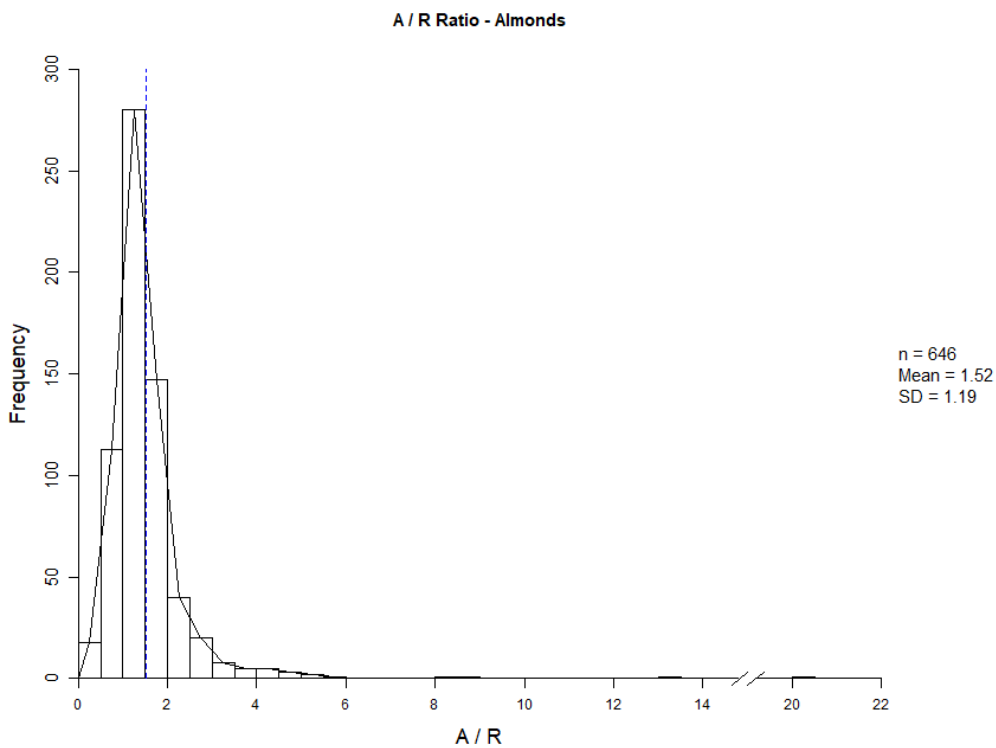
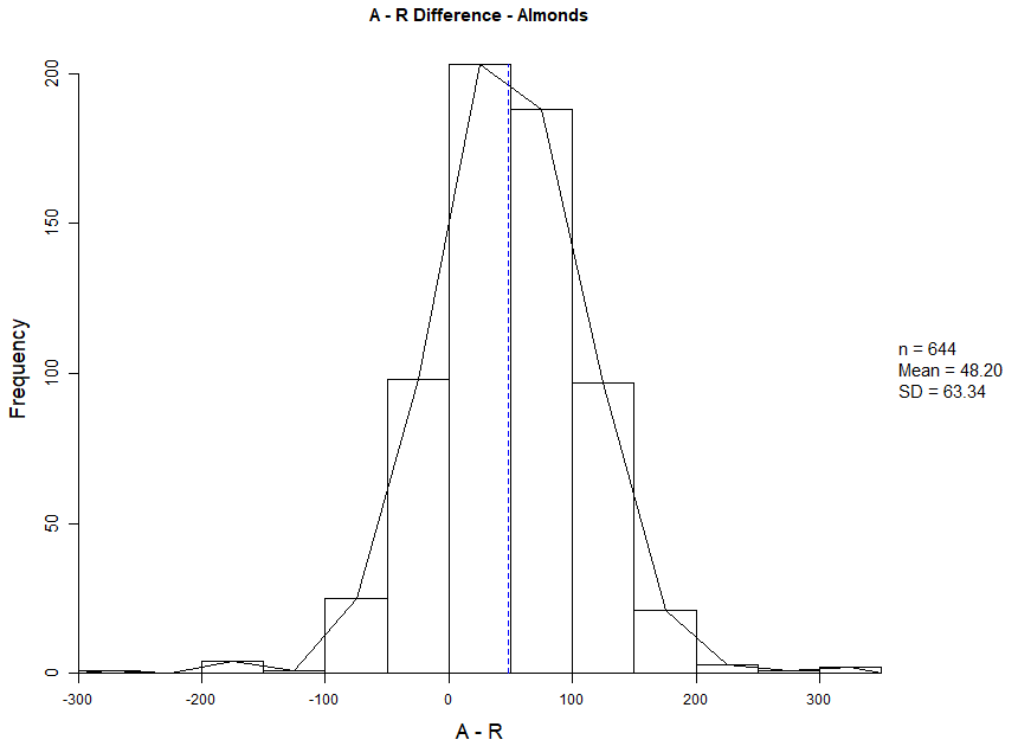


Figure II-2. Histogram plot of A-R values for Almonds for the 2018 Crop Year.

The dotted blue line represents the mean. The number of parcels (n) and Standard deviation (SD) are provided.



III. APRICOTS

Important analysis considerations:

The calculation of nitrogen removed for Apricots assumes that 0.00278 lbs N/lbs of fruits are removed at harvest. This estimate is obtained from Geisseler (2016). The author considers that the C_N coefficient is only a rough estimate.

Table III-1. Summary statistics for Apricots.

Specific Crop	Parameter	N Parcels	Acreage	Mean	Standard Deviation	Min	Max
APRICOTS	A/R	64	2,866	3.30	4.19	0	22.48
	A-R	59	2,681	68.53	146.55	-60.89	944.4

Figure III-1. Histogram plot of A/R values for Apricots for the 2018 Crop Year.

The dotted blue line represents the mean. The number of parcels (n) and Standard deviation (SD) are provided.

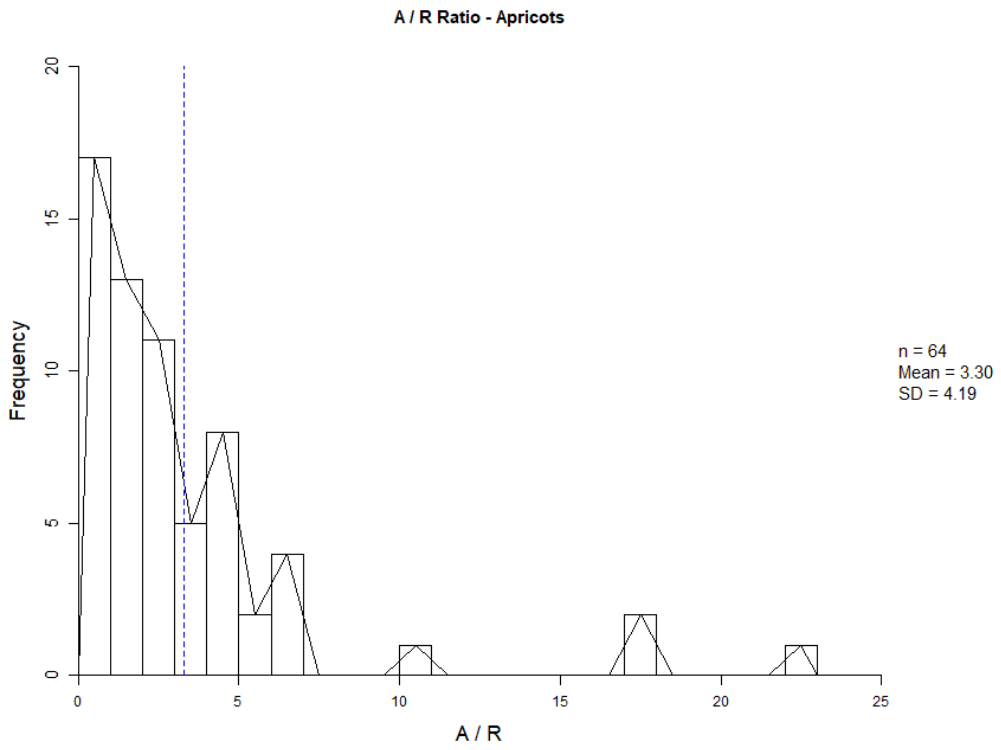
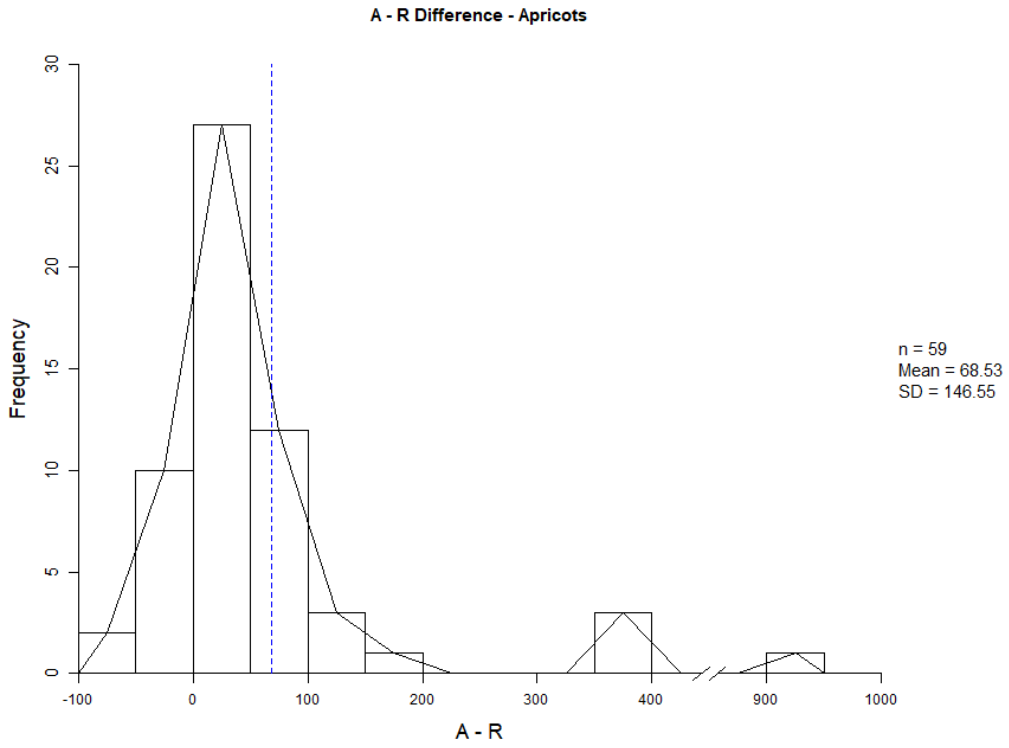


Figure III-2. Histogram plot of A-R values for Apricots for the 2018 Crop Year.

The dotted blue line represents the mean. The number of parcels (n) and Standard deviation (SD) are provided.



IV. BEANS

Important analysis considerations:

The calculation of nitrogen removed for Beans, Dry assumes that 0.0354 lbs N/lbs of mature dry beans at 12% moisture are removed at harvest. This estimate is obtained from an average of the nitrogen removed at harvest for black-eyed, garbanzo and lima beans from Geisseler (2016). The Coalition considers this is likely a reasonable estimate for the Central Valley as the means and ranges overlap substantially for the different beans, and some C_N coefficient were determined in California.

The calculation of nitrogen removed for Beans, Lima assumes that 0.03615 lbs N/lbs of mature dry beans at 12% moisture is removed at harvest. This estimate is obtained from Geisseler (2016). The author considers the C_N coefficient to be a reasonable estimate of nitrogen in lima beans harvested in California.

Table IV-1. Summary statistics for Beans.

Specific Crop	Parameter	N Parcels	Acreage	Mean	Standard Deviation	Min	Max
BEANS	A/R	60	6,266	0.16	0.29	0	1.52
	A-R	29	2,101	-54.31	41.79	-152.29	37.17
BEANS, LIMA	A/R	37	3,083	0.19	0.36	0	1.45
	A-R	36	2,775	-87.17	43.42	-195.82	27.93

Figure IV-1. Histogram plot of A/R values for Beans for the 2018 Crop Year.

The dotted blue line represents the mean. The number of parcels (n) and Standard deviation (SD) are provided.

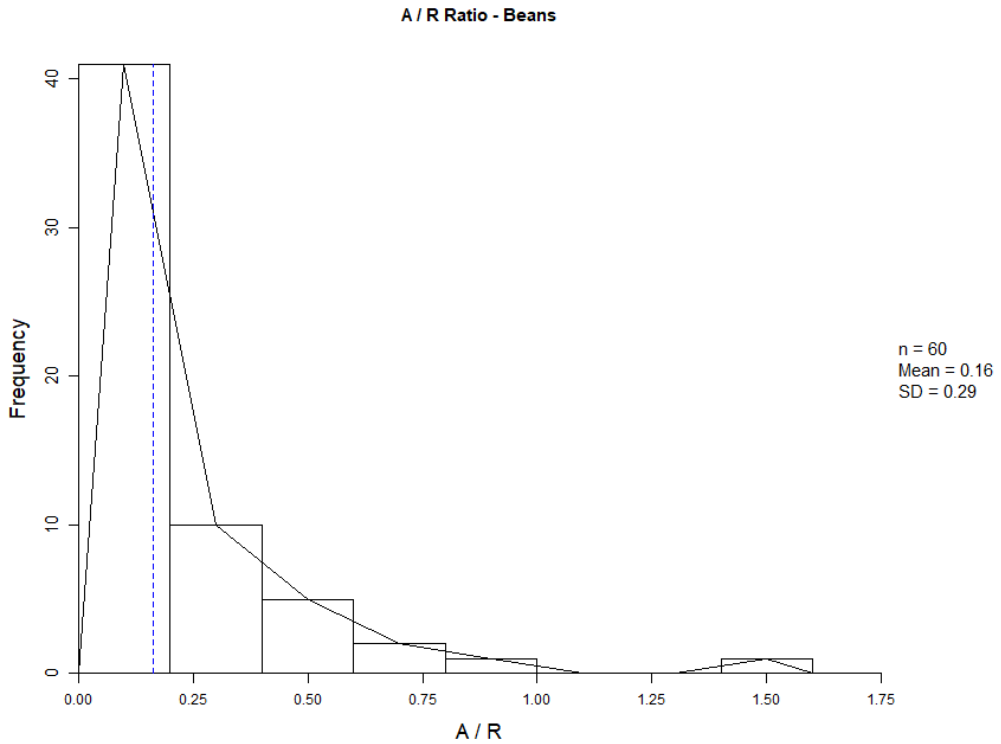


Figure IV-2. Histogram plot of A-R values for Beans for the 2018 Crop Year.

The dotted blue line represents the mean. The number of parcels (n) and Standard deviation (SD) are provided.

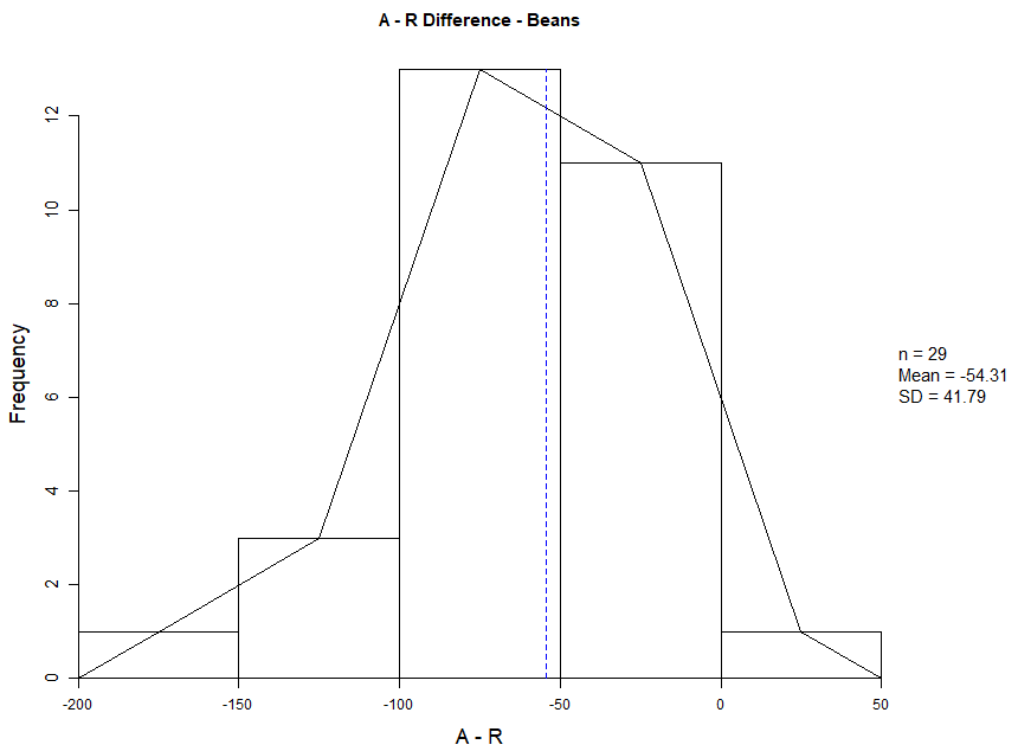


Figure IV-3. Histogram plot of A/R values for Beans, Lima for the 2018 Crop Year.

The dotted blue line represents the mean. The number of parcels (n) and Standard deviation (SD) are provided.

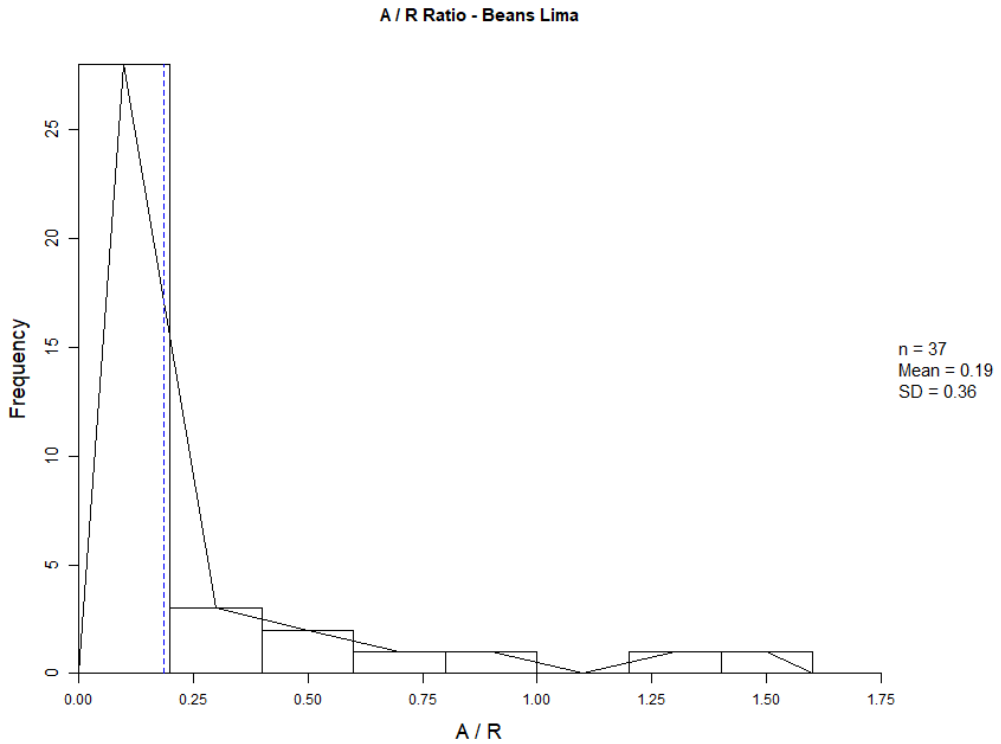
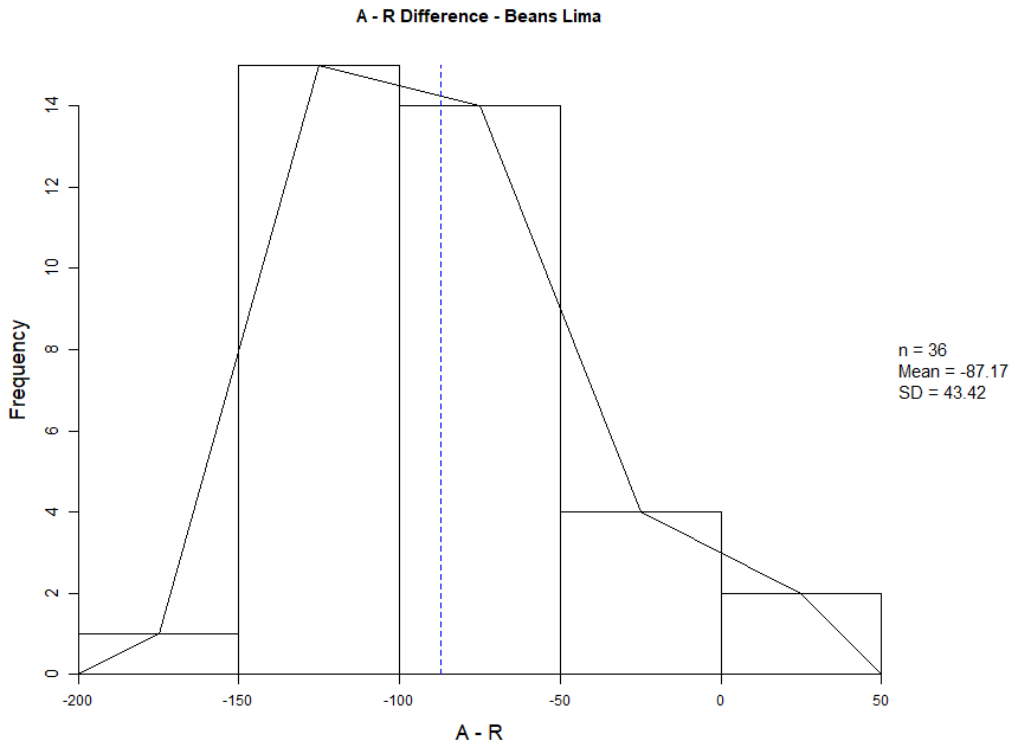


Figure IV-4. Histogram plot of A-R values for Beans, Lima for the 2018 Crop Year.

The dotted blue line represents the mean. The number of parcels (n) and Standard deviation (SD) are provided.



V. BROCCOLI

Important analysis considerations:

The calculation of nitrogen removed for Broccoli assumes that 0.0056 lbs N/lbs of fresh weight is removed at harvest. This estimate is obtained from Geisseler (2016). The author considers the average C_N coefficient may not be a good estimate of the nitrogen concentration in broccoli in the Central Valley. Samples need to be collected from the Central Valley.

Table V-1. Summary statistics for Broccoli.

Specific Crop	Parameter	N Parcels	Acreage	Mean	Standard Deviation	Min	Max
BROCCOLI	A/R	26	2,536	4.76	11.03	1.09	53.57
	A-R	26	2,536	55.04	32.66	10.34	147.2

Figure V-1. Histogram plot of A/R values for Broccoli for the 2018 Crop Year.

The dotted blue line represents the mean. The number of parcels (n) and Standard deviation (SD) are provided.

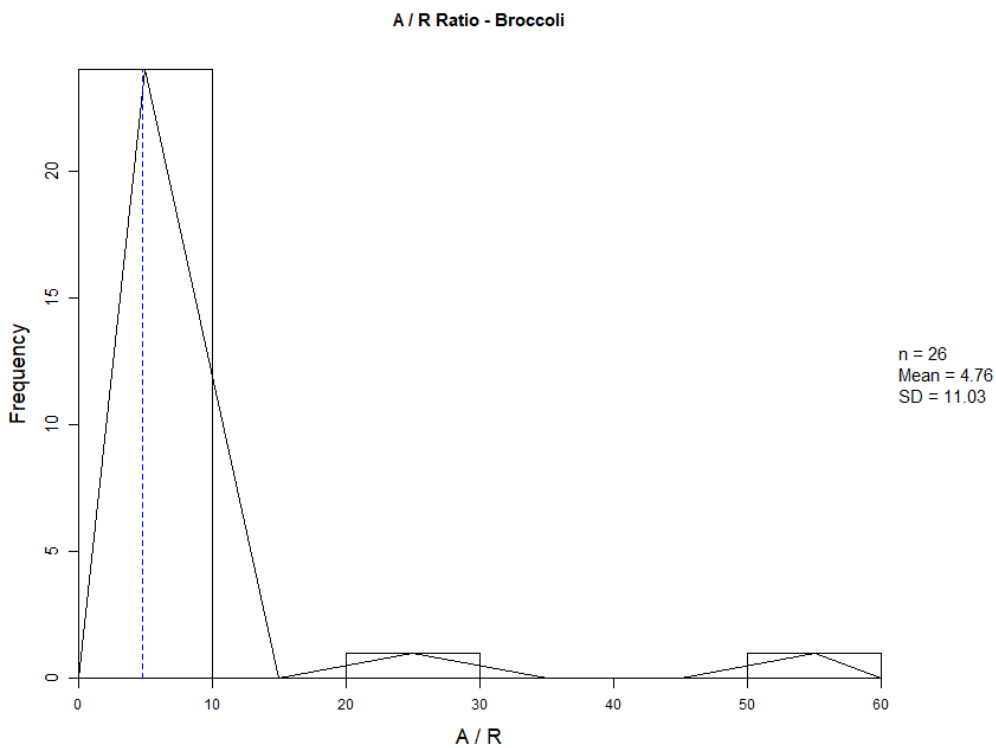
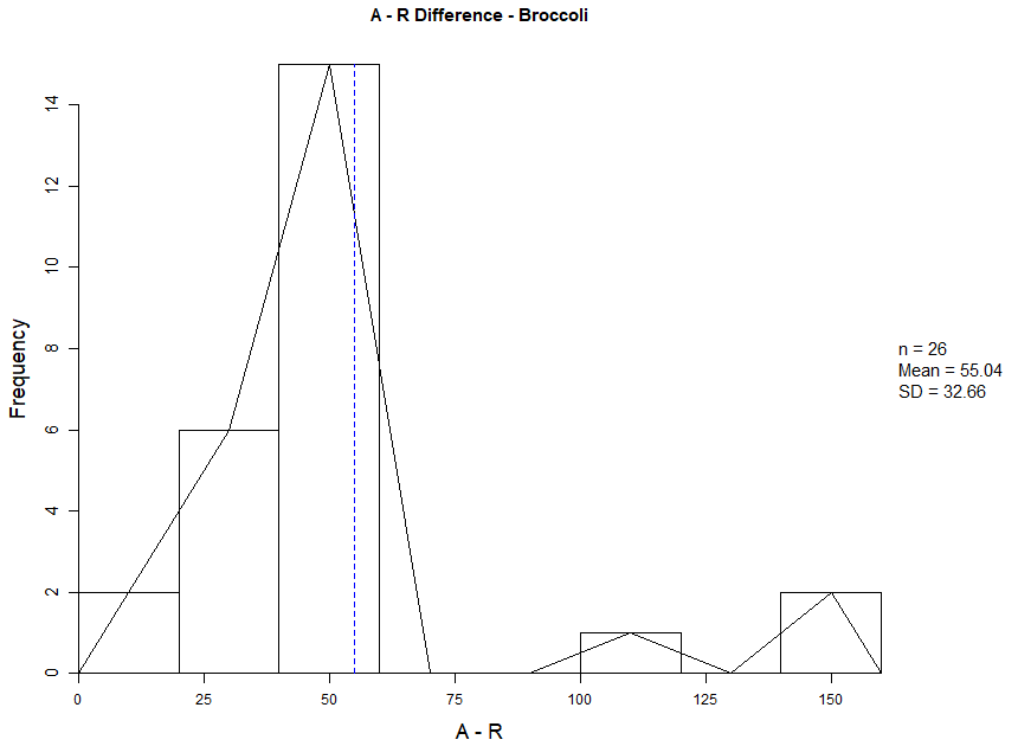


Figure V-2. Histogram plot of A-R values for Broccoli for the 2018 Crop Year.

The dotted blue line represents the mean. The number of parcels (n) and Standard deviation (SD) are provided.



VI. CHERRIES

Important analysis considerations:

The calculation of nitrogen removed for Cherries assumes that 0.00221 lbs N/lbs of fruits are removed at harvest. This estimate is obtained from Geisseler (2016). The author considers that the C_N coefficient is only a rough estimate.

Table VI-1. Summary statistics for Cherries.

Specific Crop	Parameter	N Parcels	Acreage	Mean	Standard Deviation	Min	Max
CHERRIES	A/R	65	1,730	6.80	7.97	0	37.71
	A-R	60	1,603	38.6	31.31	-21.15	111.21

Figure VI-1. Histogram plot of A/R values for Cherries for the 2018 Crop Year.

The dotted blue line represents the mean. The number of parcels (n) and Standard deviation (SD) are provided.

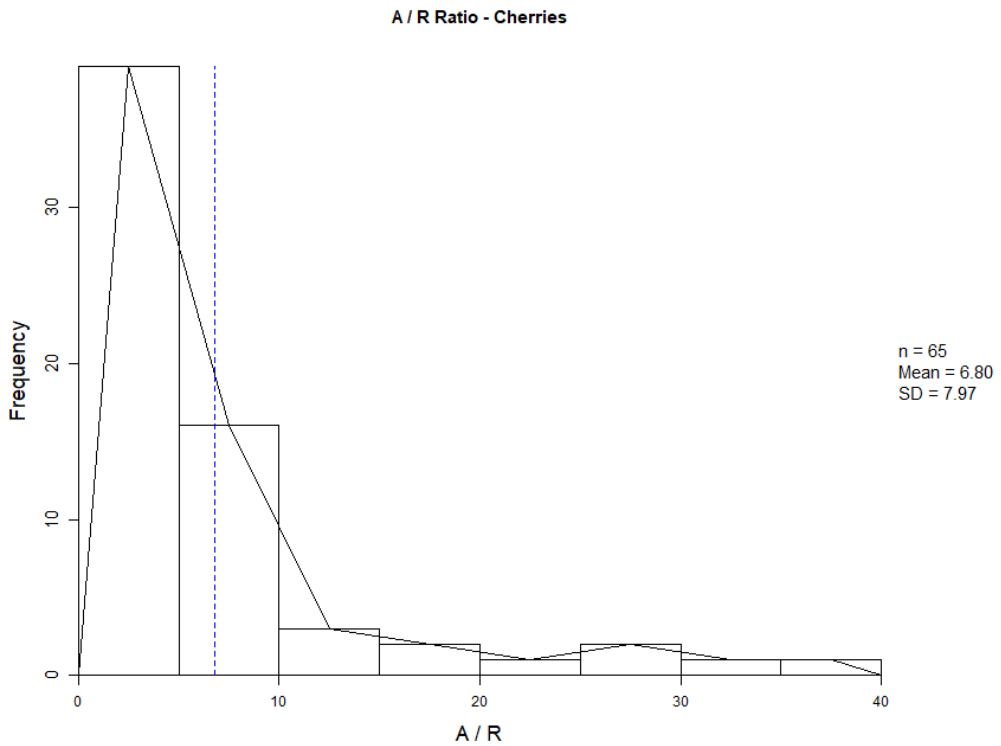
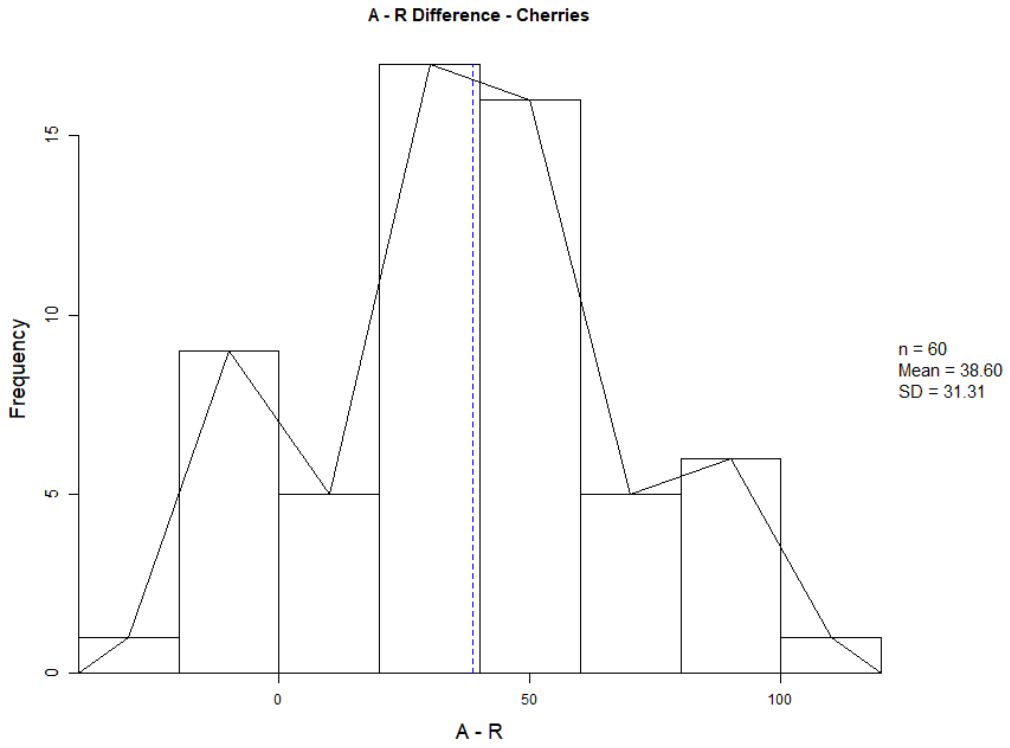


Figure VI-2. Histogram plot of A-R values for Cherries for the 2018 Crop Year.

The dotted blue line represents the mean. The number of parcels (n) and Standard deviation (SD) are provided.



VII. CORN

Important analysis considerations:

The calculation of nitrogen removed for Corn, Grain assumes that 0.012 lbs N/lbs of grain at 15.5% moisture are removed at harvest. This estimate is obtained from Geisseler (2016). The author considers that more corn grain samples from Central Valley fields are necessary to determine whether the C_N coefficient is a good estimate for the region.

The calculation of nitrogen removed at harvest for Corn, Silage assumes that 0.00378 lbs N/lbs at 70% moisture are removed at harvest. This estimate is obtained from Geisseler (2016). The author considers this C_N coefficient to be a very good estimate of Central Valley corn silage.

Table VII-1. Summary statistics for Corn.

Specific Crop	Parameter	N Parcels	Acreage	Mean	Standard Deviation	Min	Max
CORN, GRAIN	A/R	13	521	1.70	0.77	0.16	3.58
	A-R	13	521	64.01	61.66	-78.14	133.06
CORN, SILAGE	A/R	108	5,450	1.05	0.46	0	3.86
	A-R	108	5,450	2.10	68.65	-189	129.04

Figure VII-1. Histogram plot of A/R values for Corn, Grain for the 2018 Crop Year.

The dotted blue line represents the mean. The number of parcels (n) and Standard deviation (SD) are provided.

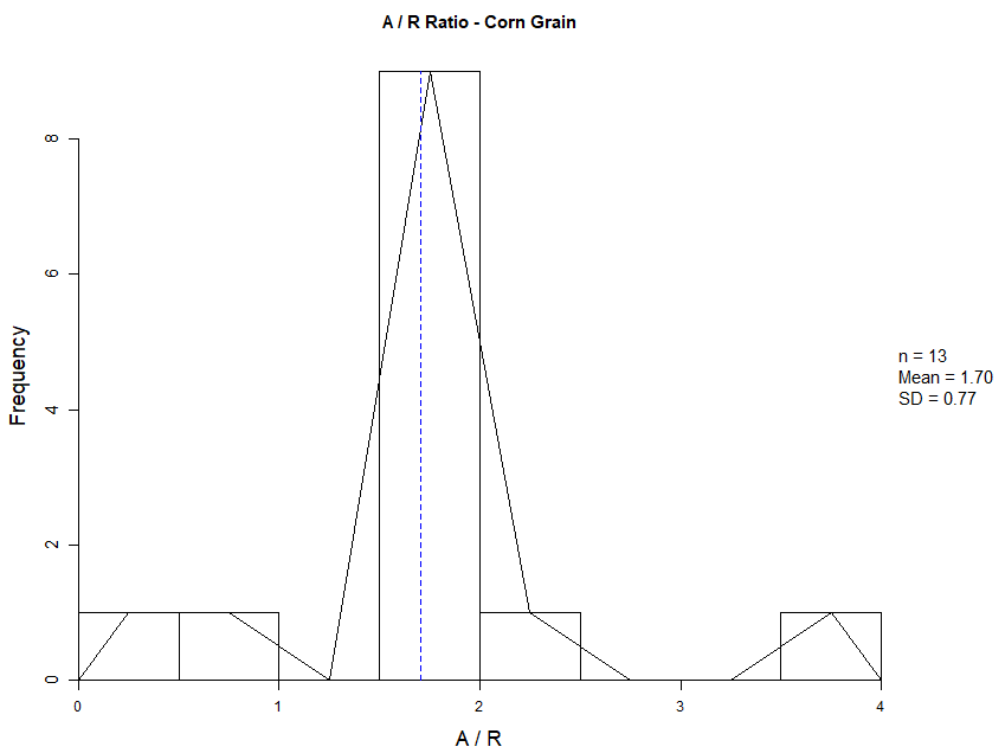


Figure VII-2. Histogram plot of A-R values for Corn, Grain for the 2018 Crop Year.

The dotted blue line represents the mean. The number of parcels (n) and Standard deviation (SD) are provided.

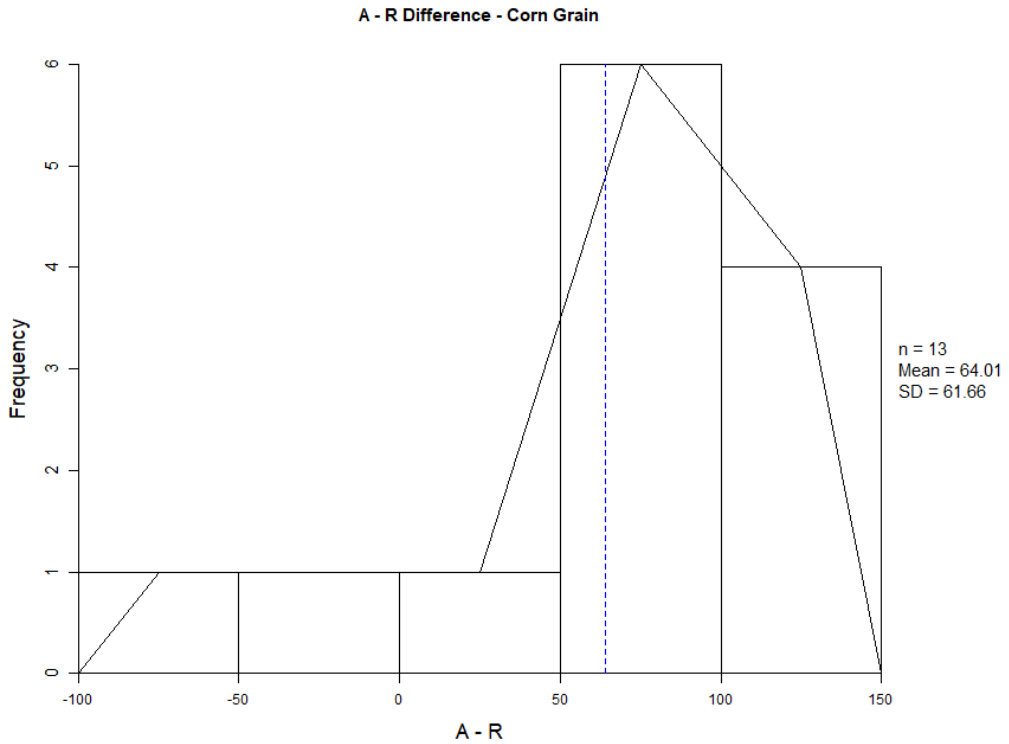


Figure VII-3. Histogram plot of A/R values for Corn, Silage for the 2018 Crop Year.

The dotted blue line represents the mean. The number of parcels (n) and Standard deviation (SD) are provided.

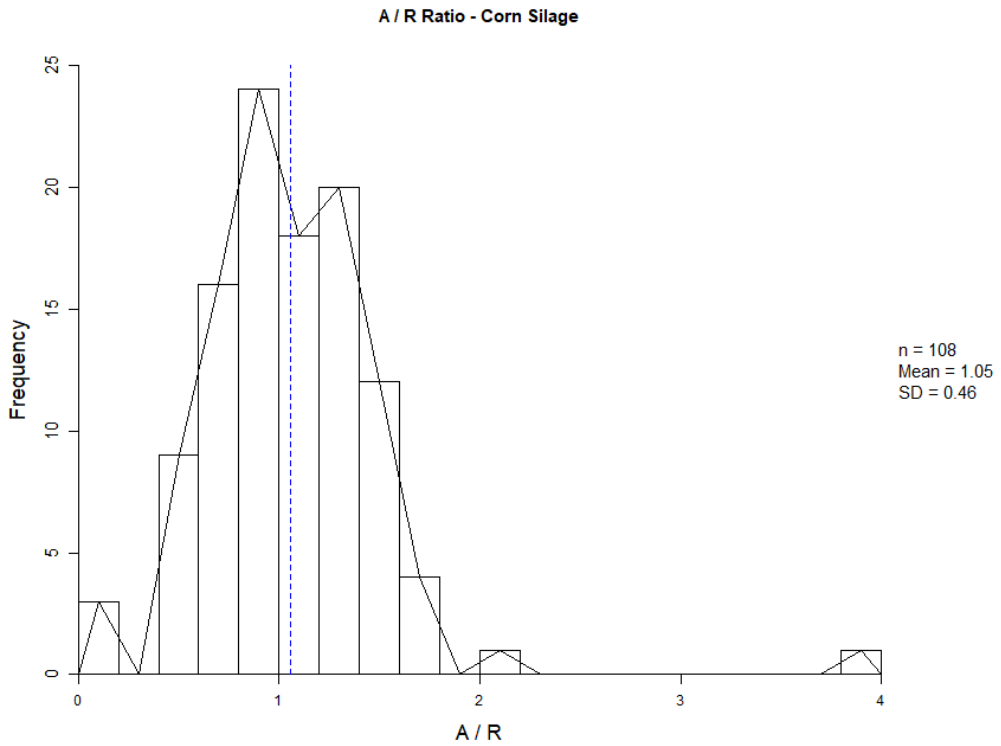
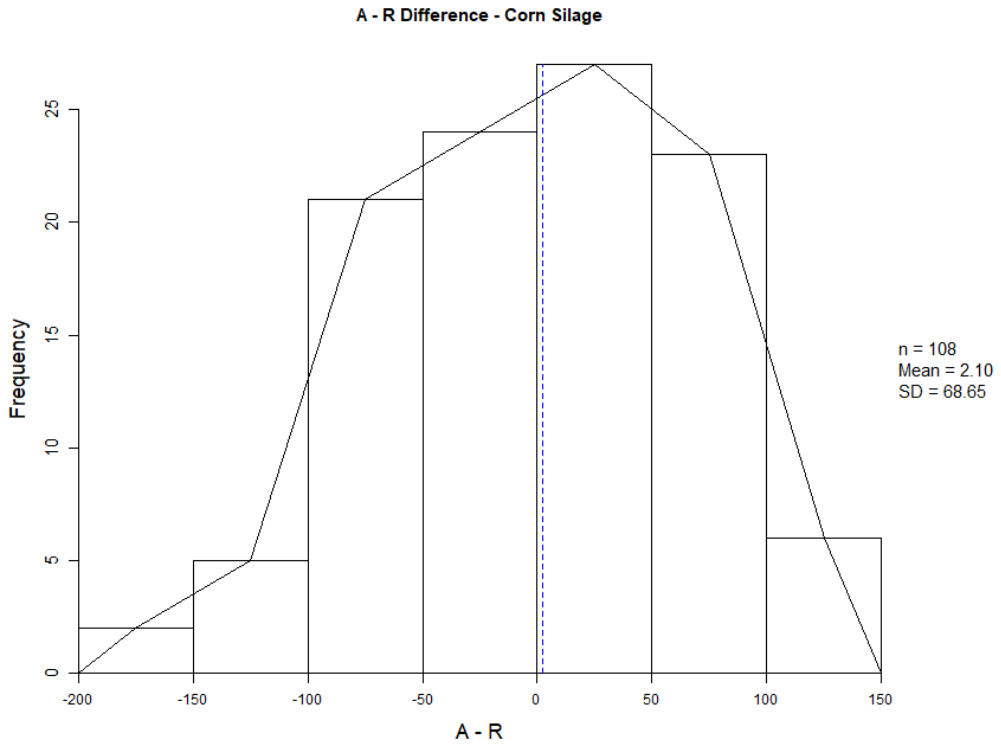


Figure VII-4. Histogram plot of A-R values for Corn, Silage for the 2018 Crop Year.

The dotted blue line represents the mean. The number of parcels (n) and Standard deviation (SD) are provided.



VIII. COTTON

Important analysis considerations:

The calculation of nitrogen removed for Cotton (Cotton, Acala Cotton, Pima Cotton, and Upland Cotton) assumes that 0.02185 lbs N/lbs of lint and seed are removed at harvest. This estimate is obtained from Geisseler (2016). The author considers this C_N coefficient a very good estimate of the nitrogen concentration in cotton from the Central Valley. The Coalition used this Cotton average C_N coefficient in cases when the grower reported other Cotton varieties not included in that list.

Table VIII-1. Summary statistics for Cotton.

Specific Crop	Parameter	N Parcels	Acreage	Mean	Standard Deviation	Min	Max
COTTON	A/R	97	5,100	4.04	1.90	0	11.44
	A-R	97	5,100	106.12	62.14	-38.24	313.93
COTTON, ACALA	A/R	43	1,698	6.23	3.7	1.66	19.07
	A-R	43	1,698	171.44	103.26	15.96	473.78
COTTON, PIMA	A/R	131	9,831	5.71	2.58	0	16.11
	A-R	131	9,831	156.44	82.08	-89.59	514.38
COTTON, UPLAND	A/R	7	962	4.52	1.72	1.17	6.29
	A-R	7	962	124.64	63.13	8.59	185.04

Figure VIII-1. Histogram plot of A/R values for Cotton for the 2018 Crop Year.

The dotted blue line represents the mean. The number of parcels (n) and Standard deviation (SD) are provided.

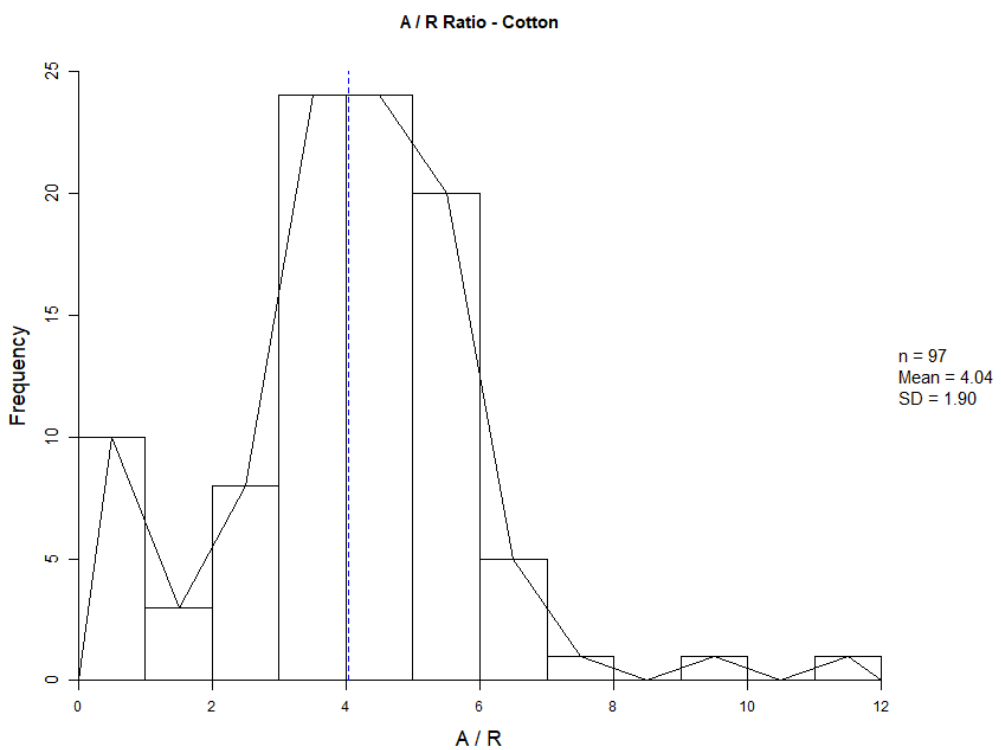


Figure VIII-2. Histogram plot of A-R values for Cotton for the 2018 Crop Year.

The dotted blue line represents the mean. The number of parcels (n) and Standard deviation (SD) are provided.

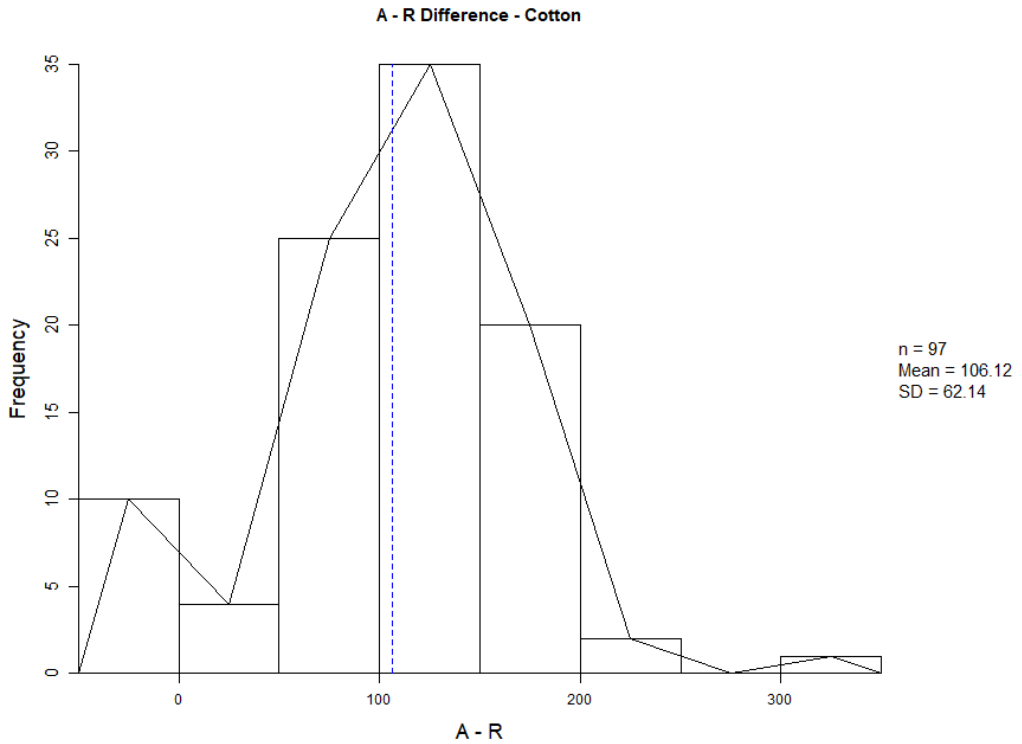


Figure VIII-3. Histogram plot of A/R values for Cotton, Acala for the 2018 Crop Year.

The dotted blue line represents the mean. The number of parcels (n) and Standard deviation (SD) are provided.

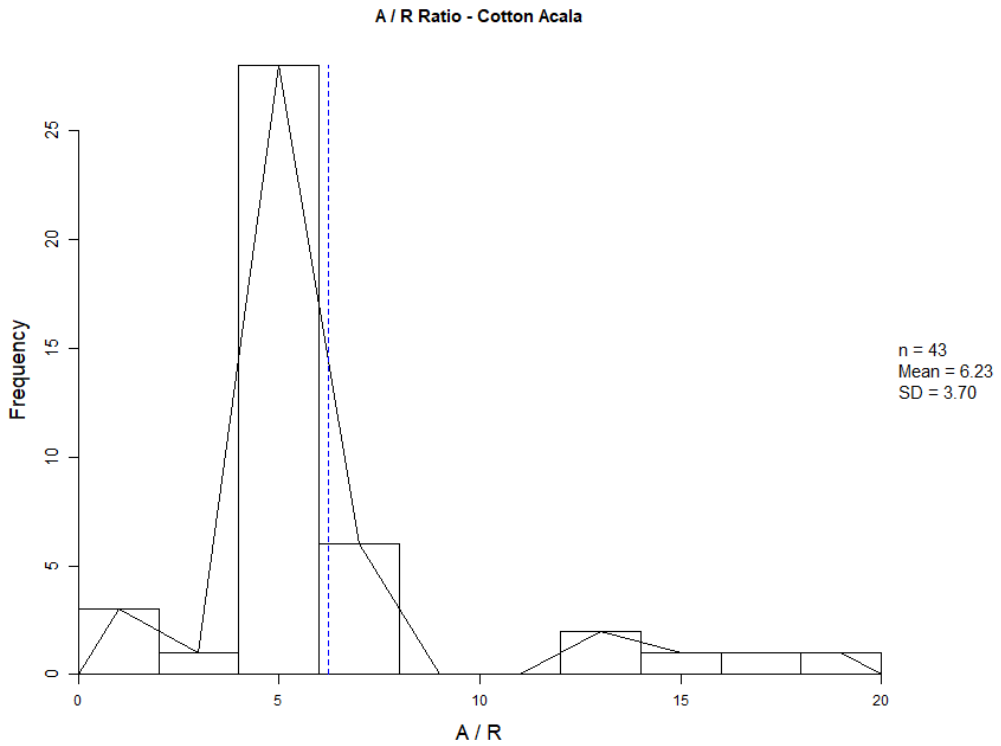


Figure VIII-4. Histogram plot of A-R values for Cotton, Acala for the 2018 Crop Year.

The dotted blue line represents the mean. The number of parcels (n) and Standard deviation (SD) are provided.

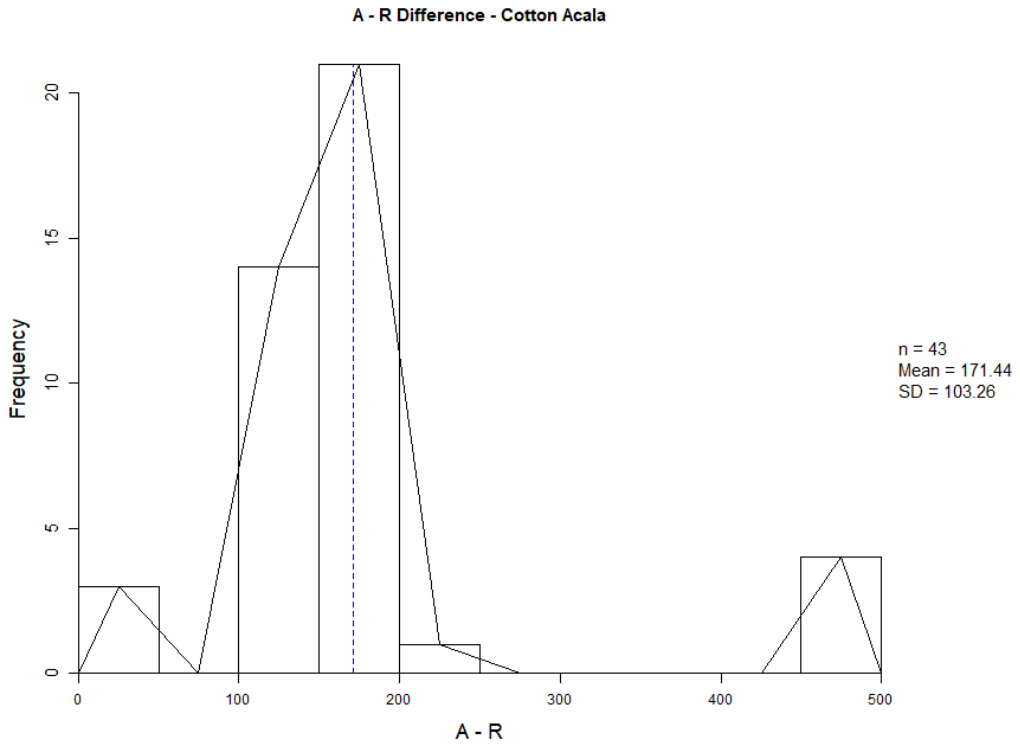


Figure VIII-5. Histogram plot of A/R values for Cotton, Pima for the 2018 Crop Year.

The dotted blue line represents the mean. The number of parcels (n) and Standard deviation (SD) are provided.

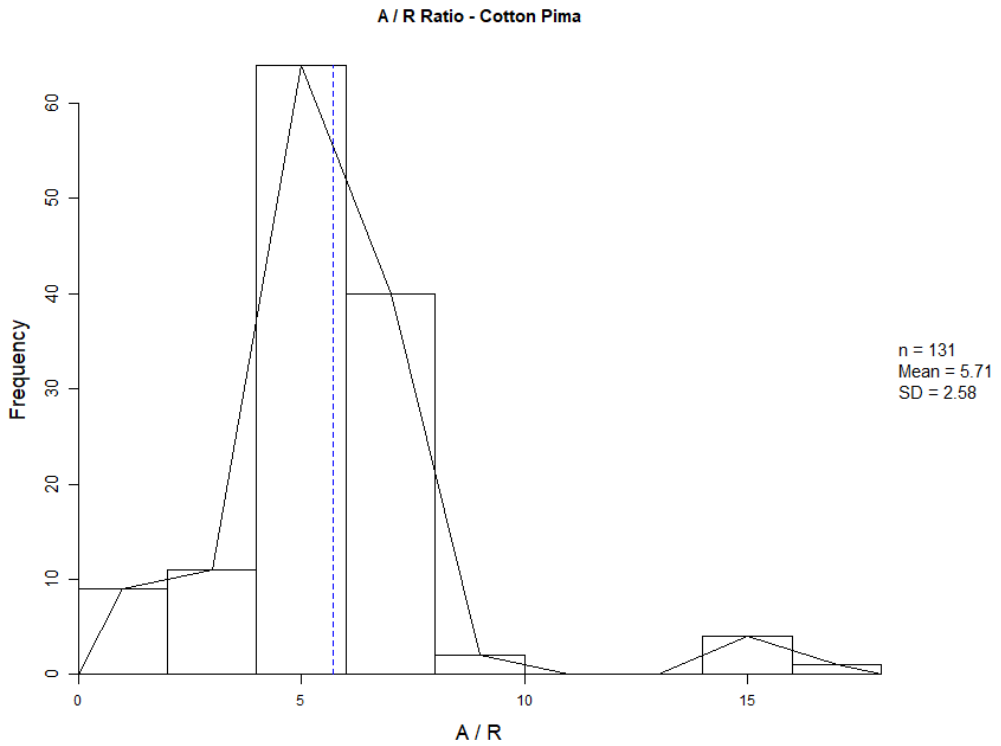


Figure VIII-6. Histogram plot of A-R values for Cotton, Pima for the 2018 Crop Year.

The dotted blue line represents the mean. The number of parcels (n) and Standard deviation (SD) are provided.

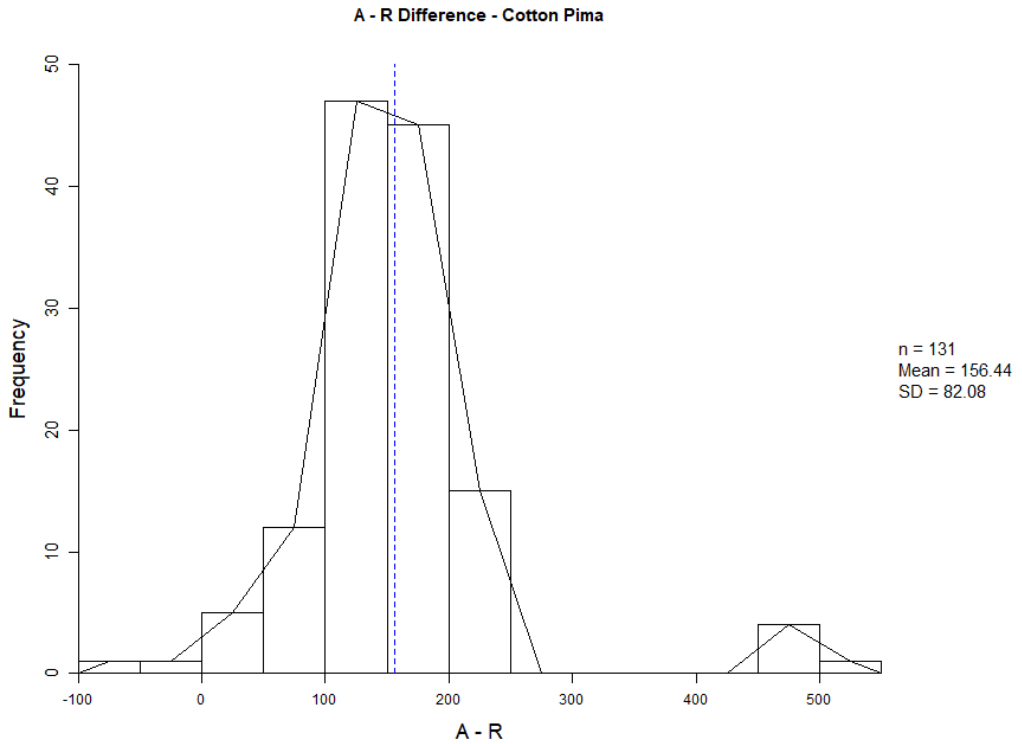


Figure VIII-7. Histogram plot of A/R values for Cotton, Upland for the 2018 Crop Year.

The dotted blue line represents the mean. The number of parcels (n) and Standard deviation (SD) are provided.

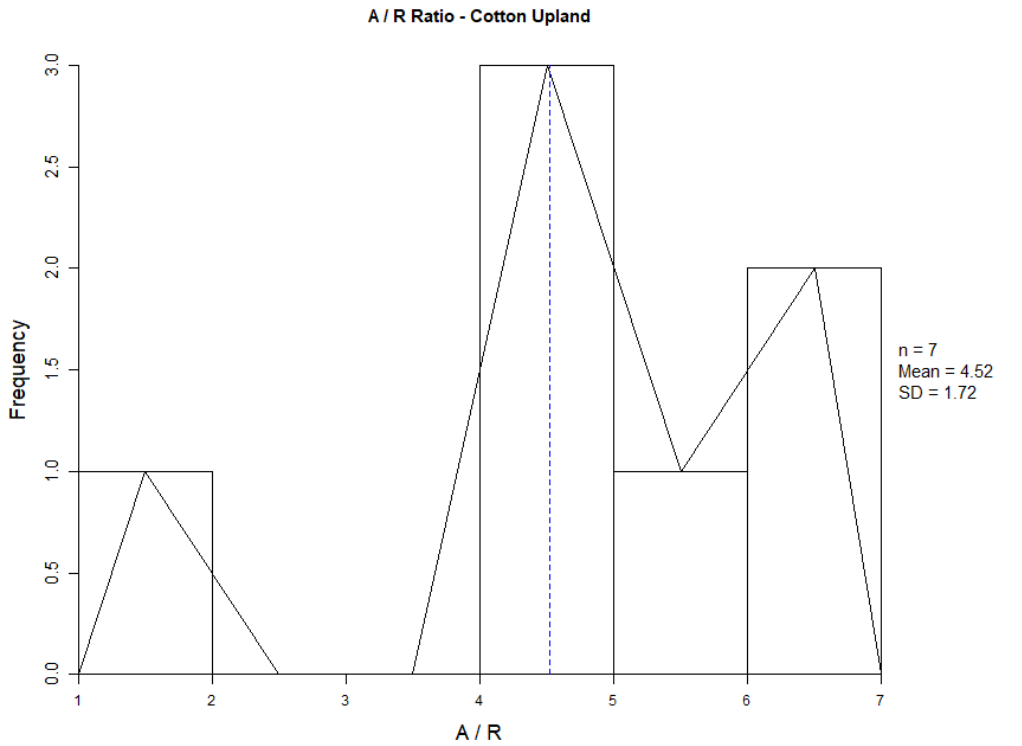
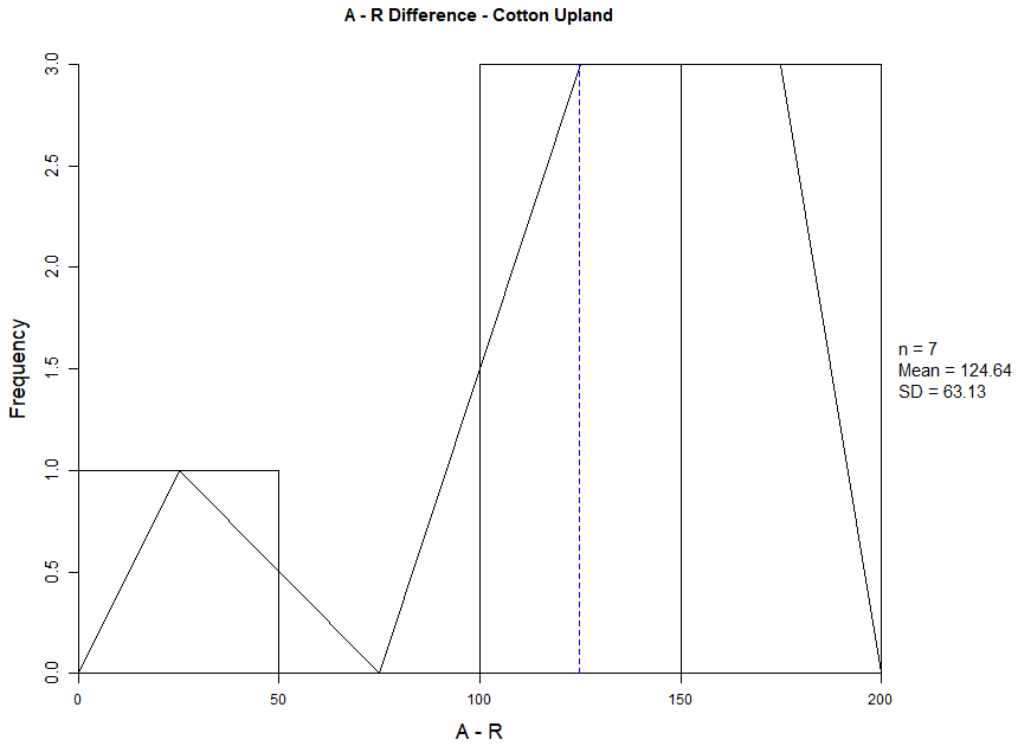


Figure VIII-8. Histogram plot of A-R values for Cotton, Upland for the 2018 Crop Year.

The dotted blue line represents the mean. The number of parcels (n) and Standard deviation (SD) are provided.



IX. GARLIC

Important analysis considerations:

The calculation of nitrogen removed for Garlic assumes that 0.00755 lbs N/lbs of bulb weight is removed at harvest. This estimate is obtained from Geisseler (2016). The author considers the variability within and among studies is high. With no recent C_N coefficient from California, it is not possible to determine how well the C_N coefficient in the table represent nitrogen concentrations in garlic harvested in California.

Table IX-1. Summary statistics for Garlic.

Specific Crop	Parameter	N Parcels	Acreage	Mean	Standard Deviation	Min	Max
GARLIC	A/R	9	1,288	1.72	0.44	1.18	2.41
	A-R	9	1,288	65.11	32.85	19.3	116.95

Figure IX-1. Histogram plot of A/R values for Garlic for the 2018 Crop Year.

The dotted blue line represents the mean. The number of parcels (n) and Standard deviation (SD) are provided.

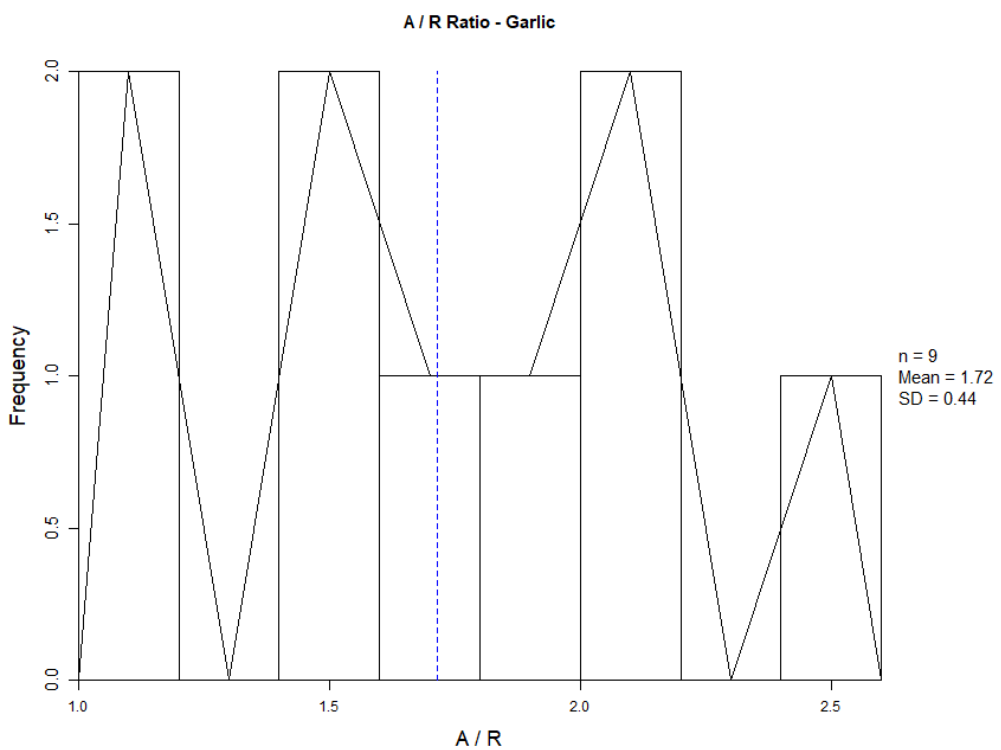
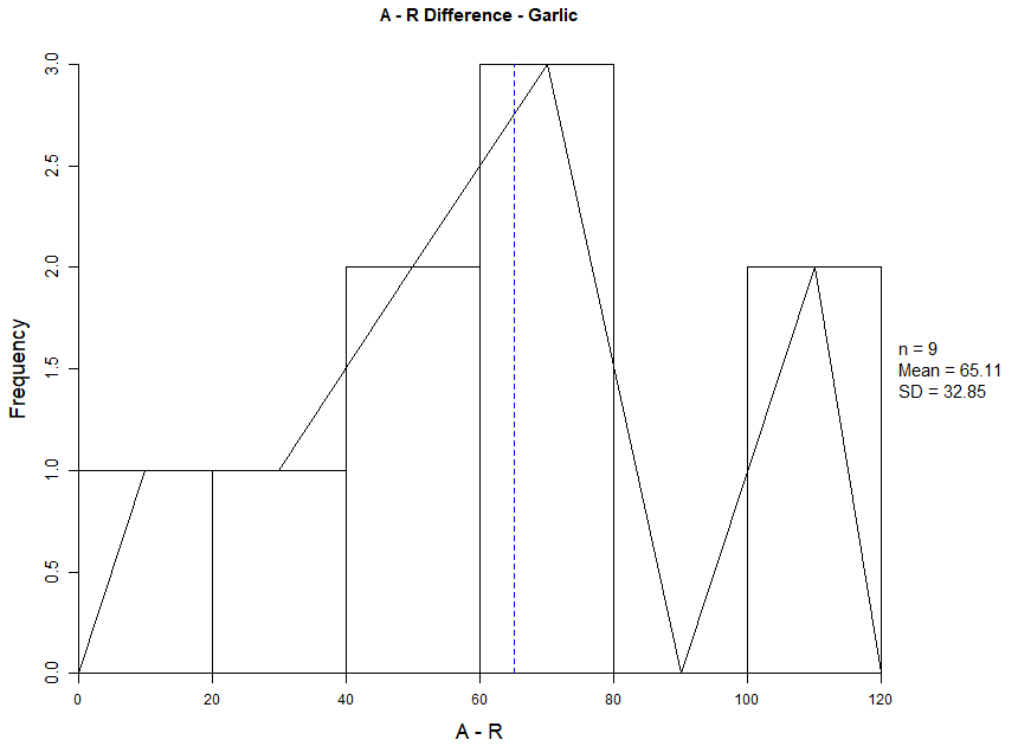


Figure IX-2. Histogram plot of A-R values for Garlic for the 2018 Crop Year.

The dotted blue line represents the mean. The number of parcels (n) and Standard deviation (SD) are provided.



X. GRAPES

Important analysis considerations:

The calculation of nitrogen removed for Grapes, Wine assumes that 0.0018 lbs N/lbs of grapes are removed at harvest. This estimate is obtained from Geisseler (2016). The author concedes that it cannot be determined if this C_N coefficient is representative for wine grapes from California.

Table X-1. Summary statistics for Grapes, Wine.

Specific Crop	Parameter	N Parcels	Acreage	Mean	Standard Deviation	Min	Max
GRAPES, WINE	A/R	16	1,480	2.25	1.60	0.65	5.56
	A-R	16	1,480	34.26	41.49	-19	156.8

Figure X-1. Histogram plot of A/R values for Grapes, Wine for the 2018 Crop Year.

The dotted blue line represents the mean. The number of parcels (n) and Standard deviation (SD) are provided.

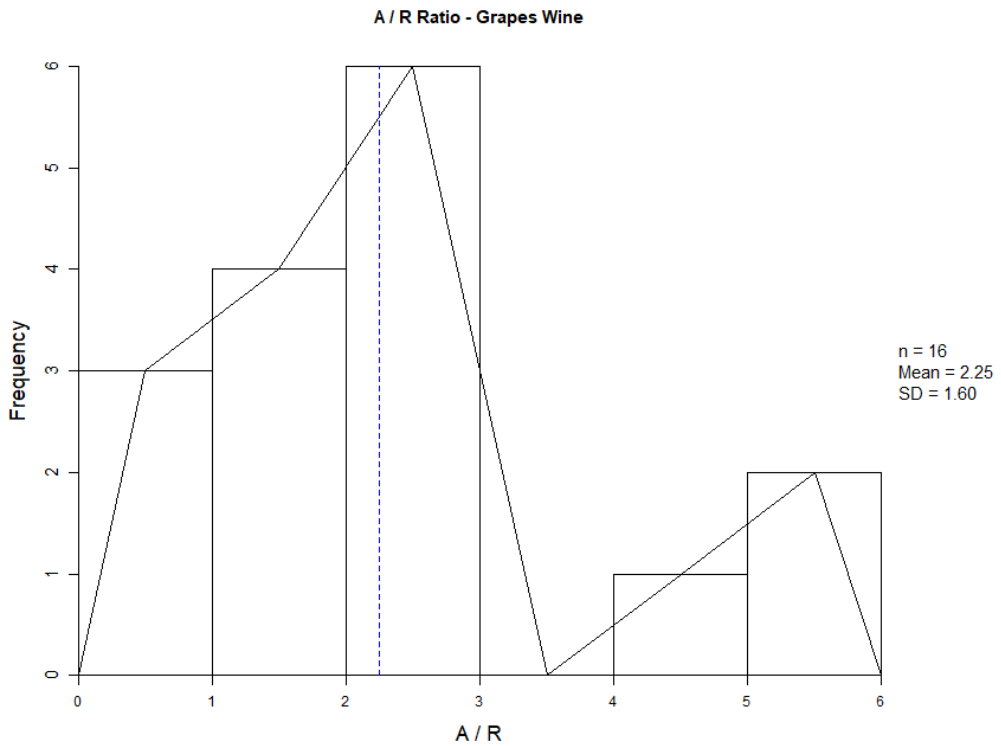
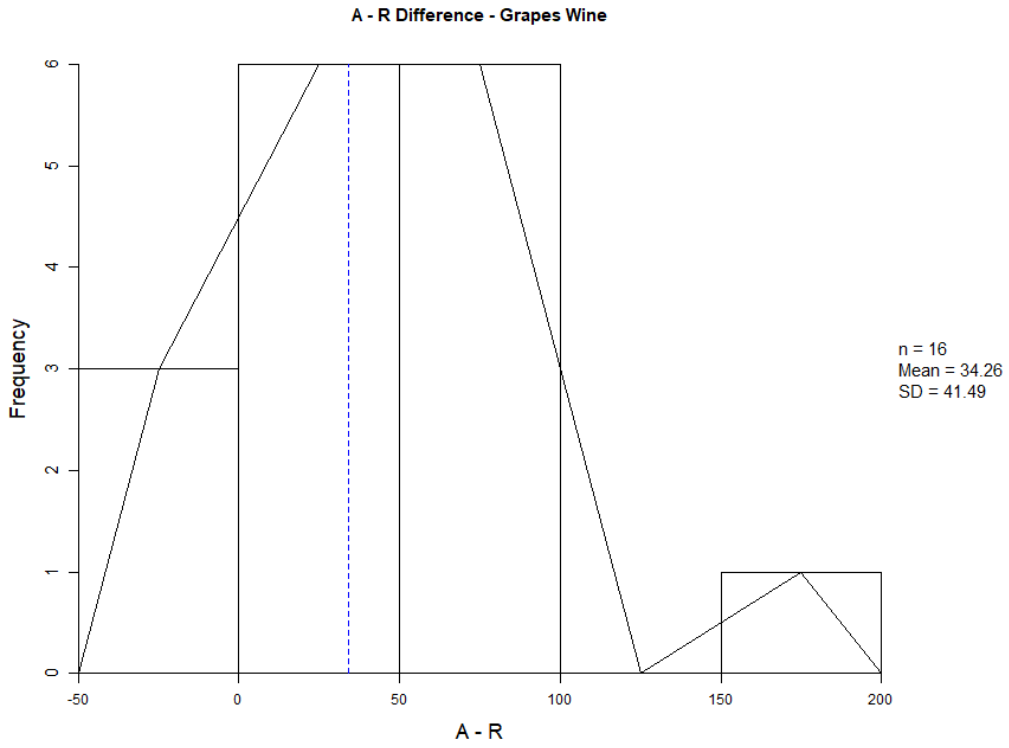


Figure X-2. Histogram plot of A-R values for Grapes, Wine for the 2018 Crop Year.

The dotted blue line represents the mean. The number of parcels (n) and Standard deviation (SD) are provided.



XI. MELONS

Important analysis considerations:

The calculation of nitrogen removed for Cantaloupe assumes that 0.002435 lbs N/lbs of melons is removed at harvest. This estimate is obtained from Geisseler (2016). The author considers the variability within and among the studies to be high, indicating samples need to be collected from fields in California to generate a more robust estimate.

The calculation of nitrogen removed for Melon, NR (Not Recorded) assumes that 0.001955 lbs N/lbs of melons is removed at harvest. This estimate is obtained from an average of the nitrogen removed at harvest for cantaloupe and honeydew melons from Geisseler (2016). Ranges for the two C_N Coefficients overlap partly, but the means are different, and the individual datasets are variable and lacking in data collected from California. The Coalition applied the melon average C_N Coefficient to cases when the grower did not specify the variety of melon grown. The coefficient is likely a poor representation of unspecified melons in the Central Valley.

The calculation of nitrogen removed for Watermelon assumes that 0.000695 lbs N/lbs of melons is removed at harvest. This estimate is obtained from Geisseler (2016). With no recent data from California, the author considers it not possible to determine if the C_N coefficient is a good estimate of watermelon harvested from the Central Valley.

Table XI-1. Summary statistics for Melons.

Specific Crop	Parameter	N Parcels	Acreage	Mean	Standard Deviation	Min	Max
CANTALOUPE	A/R	29	1,751	1.91	1.24	0	5.99
	A-R	29	1,751	50.96	60.84	-58.77	291.56
MELONS, NR	A/R	8	708	1.93	0.57	1.19	2.74
	A-R	8	708	51.79	30.16	12.97	95.26
WATERMELON	A/R	8	544	7.6	10.45	1.88	33.01
	A-R	8	544	105.63	41.87	51.62	161.98

Figure XI-1. Histogram plot of A/R values for Cantaloupe for the 2018 Crop Year.

The dotted blue line represents the mean. The number of parcels (n) and Standard deviation (SD) are provided.

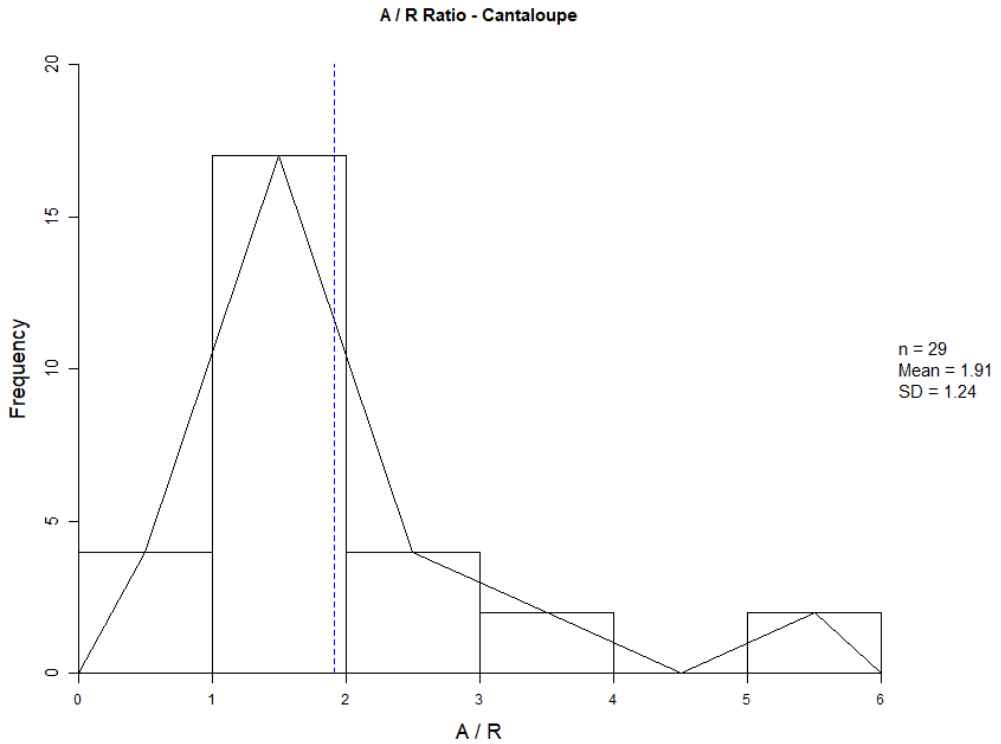


Figure XI-2. Histogram plot of A-R values for Cantaloupe for the 2018 Crop Year.

The dotted blue line represents the mean. The number of parcels (n) and Standard deviation (SD) are provided.

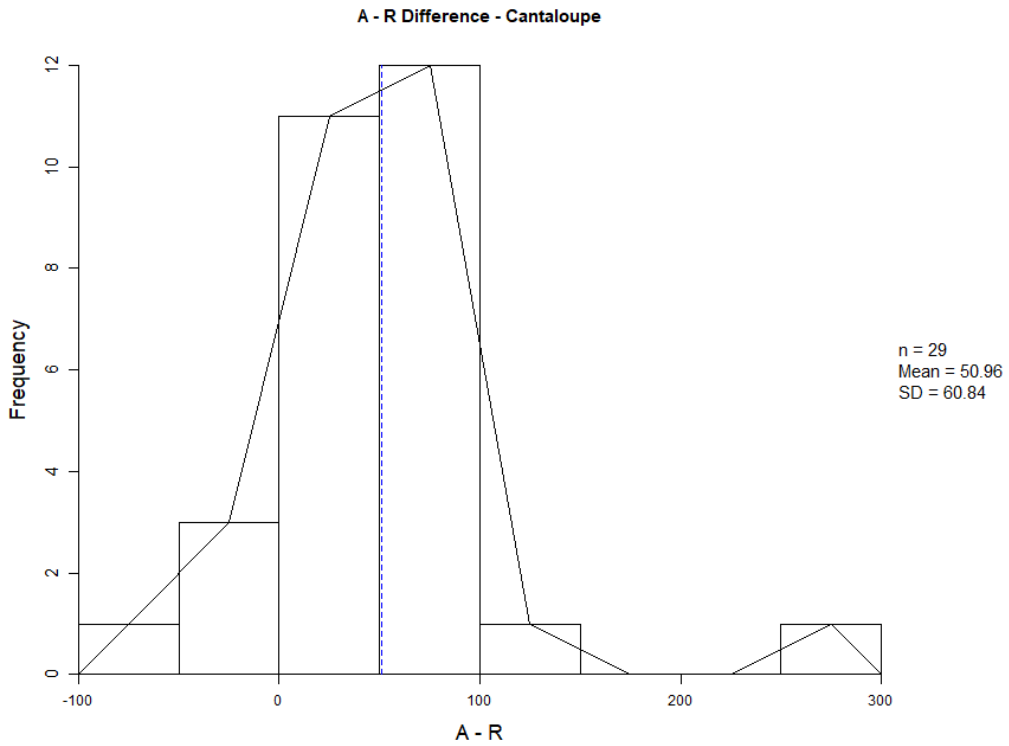


Figure XI-3. Histogram plot of A/R values for Melons, NR for the 2018 Crop Year.

The dotted blue line represents the mean. The number of parcels (n) and Standard deviation (SD) are provided.

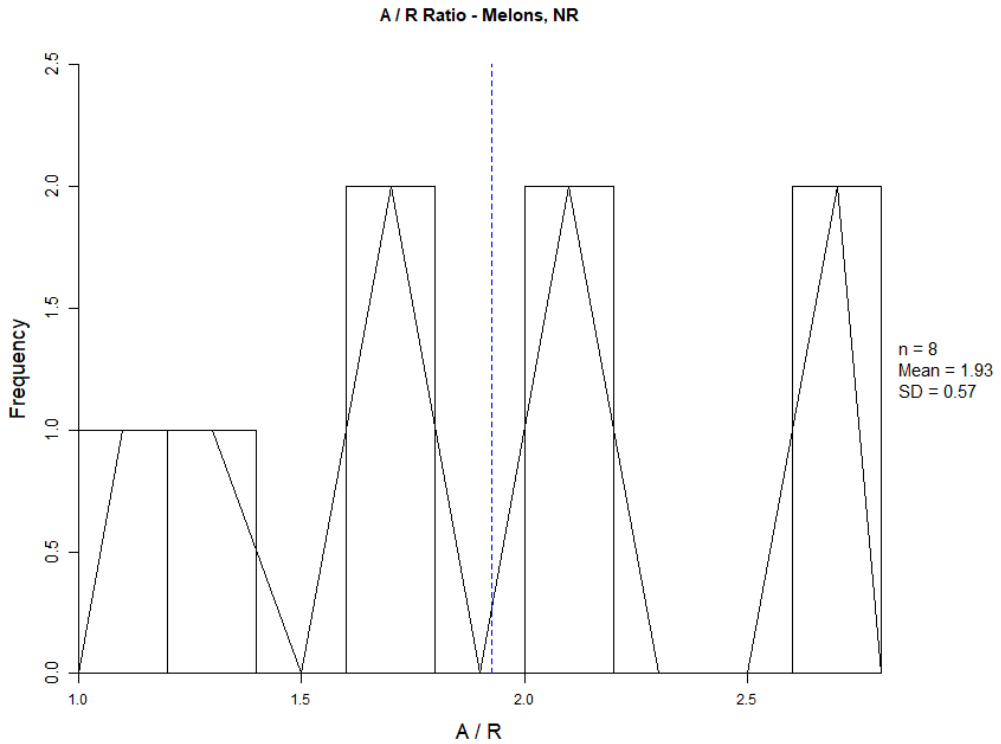


Figure XI-4. Histogram plot of A-R values for Melons, NR for the 2018 Crop Year.

The dotted blue line represents the mean. The number of parcels (n) and Standard deviation (SD) are provided.

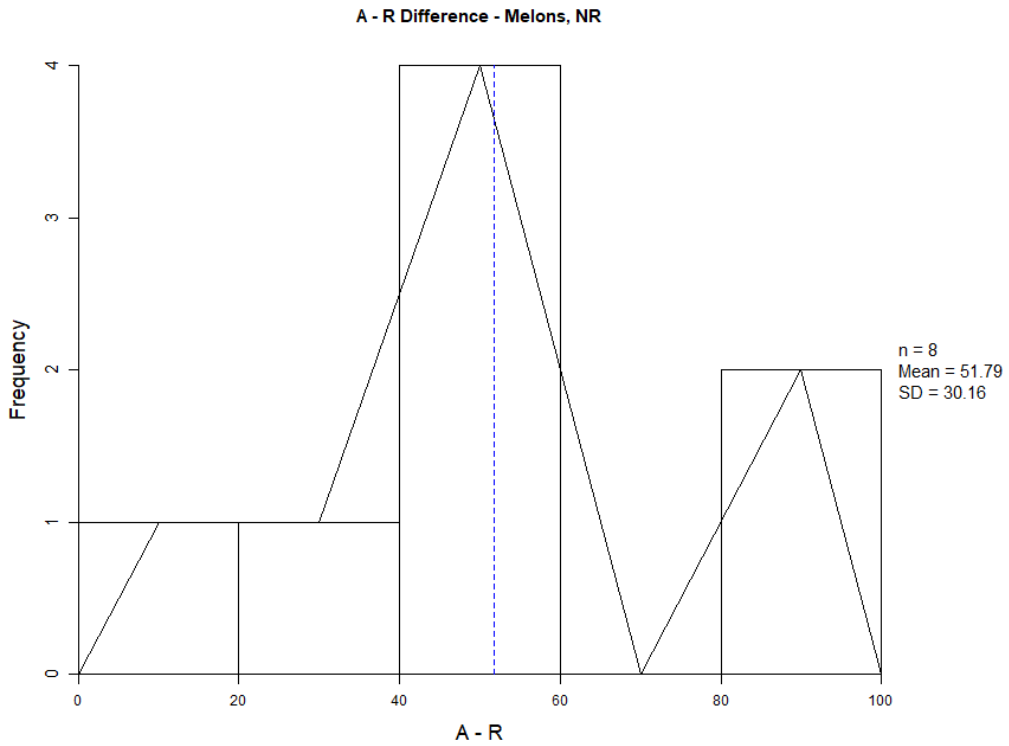


Figure XI-5. Histogram plot of A/R values for Watermelon for the 2018 Crop Year.

The dotted blue line represents the mean. The number of parcels (n) and Standard deviation (SD) are provided.

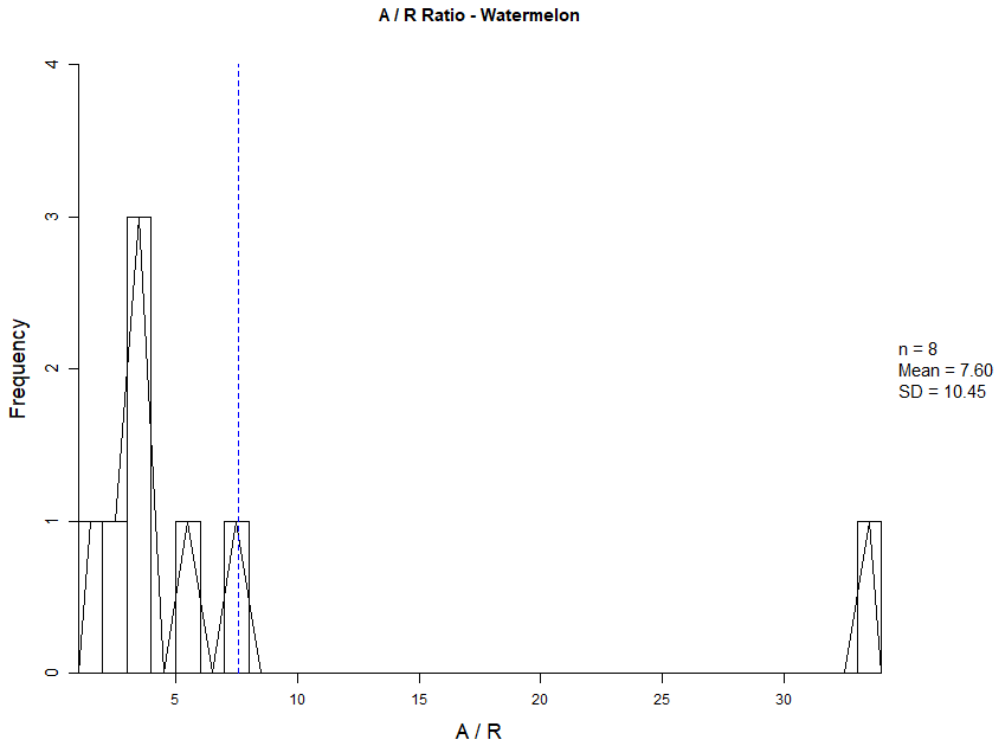
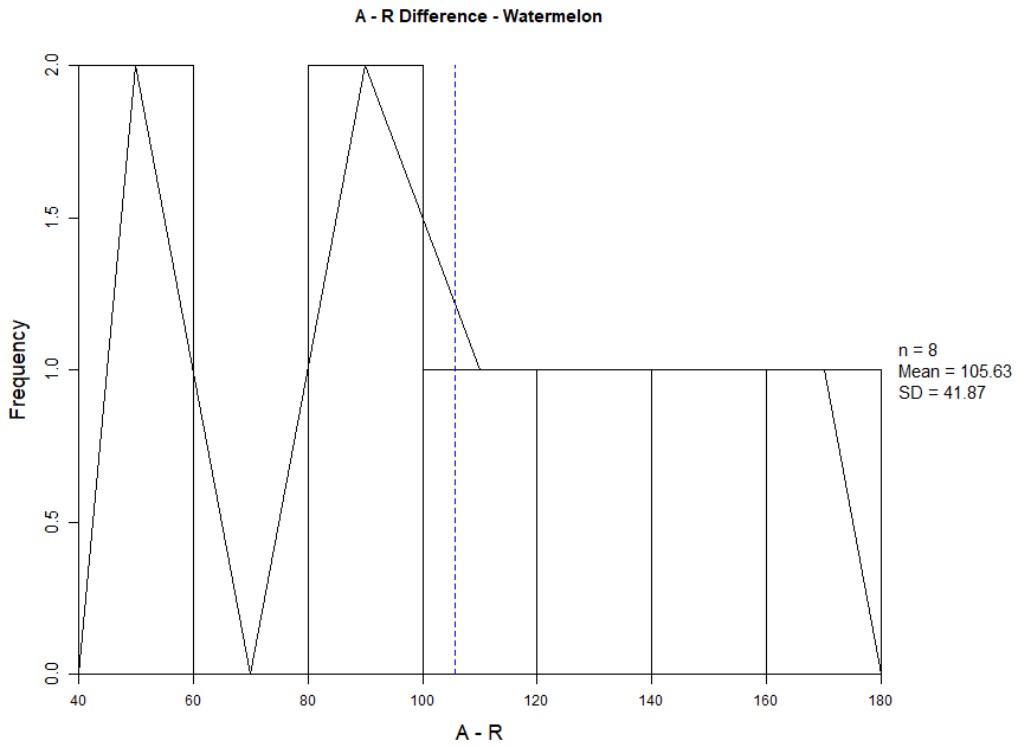


Figure XI-6. Histogram plot of A-R values for Watermelon for the 2018 Crop Year.

The dotted blue line represents the mean. The number of parcels (n) and Standard deviation (SD) are provided.



XII. OATS

Important analysis considerations:

The calculation of nitrogen removed for Oats, Hay assumes that 0.01085 lbs N/lbs of grain at 12% moisture are removed at harvest. This estimate is obtained from Geisseler (2016). The author considers that the C_N coefficient is a good estimate of the average nitrogen concentration in oat hay produced in the Central Valley.

The calculation of nitrogen removed for Oats, Silage, assumes that 0.0048825 lbs N/lbs at 70% moisture are removed at harvest. This estimate is an average of triticale and wheat coefficients obtained from Geisseler (2016). As means and ranges overlap substantially among the two small grains, this is likely a reasonable estimate of nitrogen removal with small grains silage in the Central Valley. The Coalition applied this C_N coefficient to all other small grains without coefficients available.

Table XII-1. Summary statistics for Oats.

Specific Crop	Parameter	N Parcels	Acreage	Mean	Standard Deviation	Min	Max
OATS, HAY	A/R	16	538	0.38	0.65	0	2.35
	A-R	10	430	-45.2	70.71	-147.94	87.9
OATS, SILAGE	A/R	12	663	0.65	0.57	0	1.81
	A-R	11	629	-40.16	72.07	-164.42	78.02

Figure XII-1. Histogram plot of A/R values for Oats, Hay for the 2018 Crop Year.

The dotted blue line represents the mean. The number of parcels (n) and Standard deviation (SD) are provided.

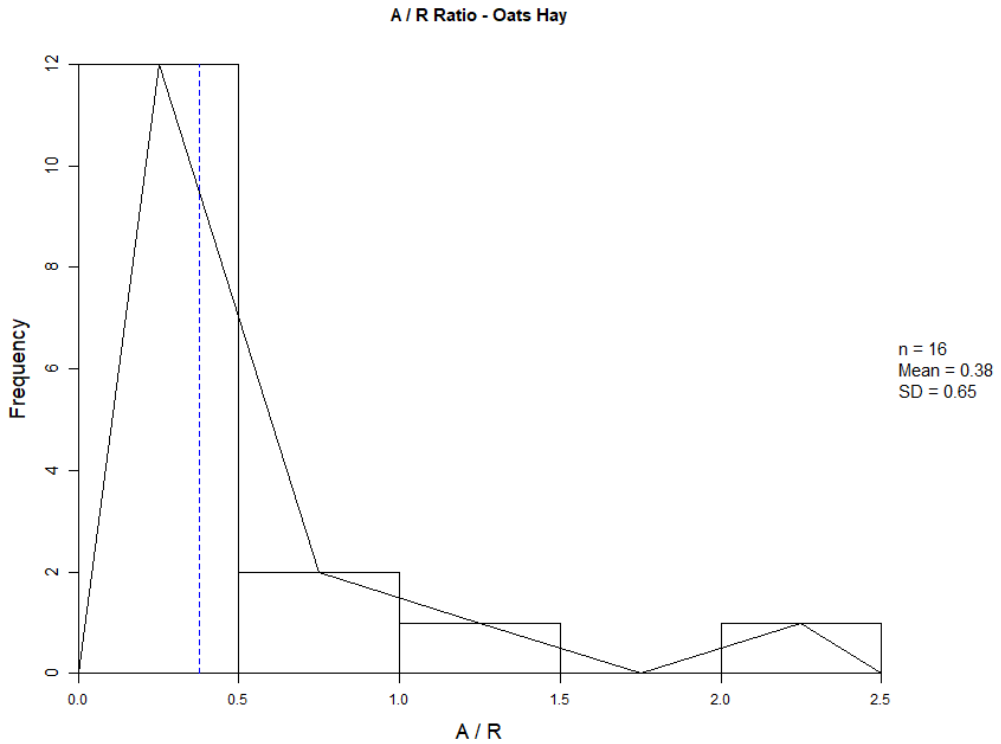


Figure XII-2. Histogram plot of A-R values for Oats, Hay for the 2018 Crop Year.

The dotted blue line represents the mean. The number of parcels (n) and Standard deviation (SD) are provided.

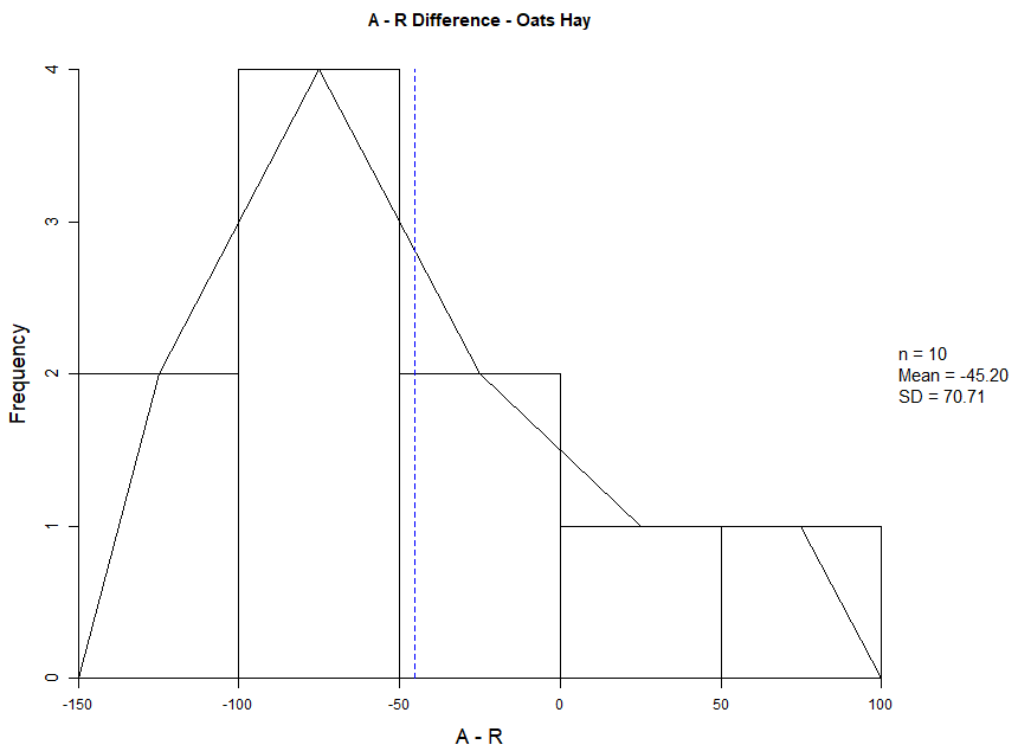


Figure XII-3. Histogram plot of A/R values for Oats, Silage for the 2018 Crop Year.

The dotted blue line represents the mean. The number of parcels (n) and Standard deviation (SD) are provided.

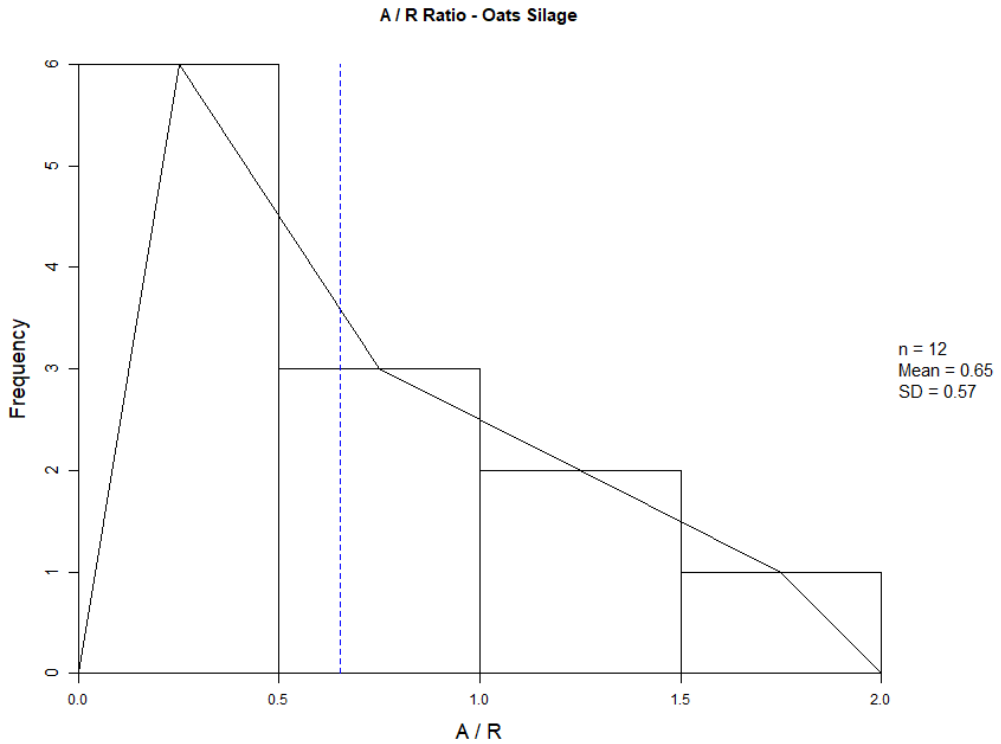
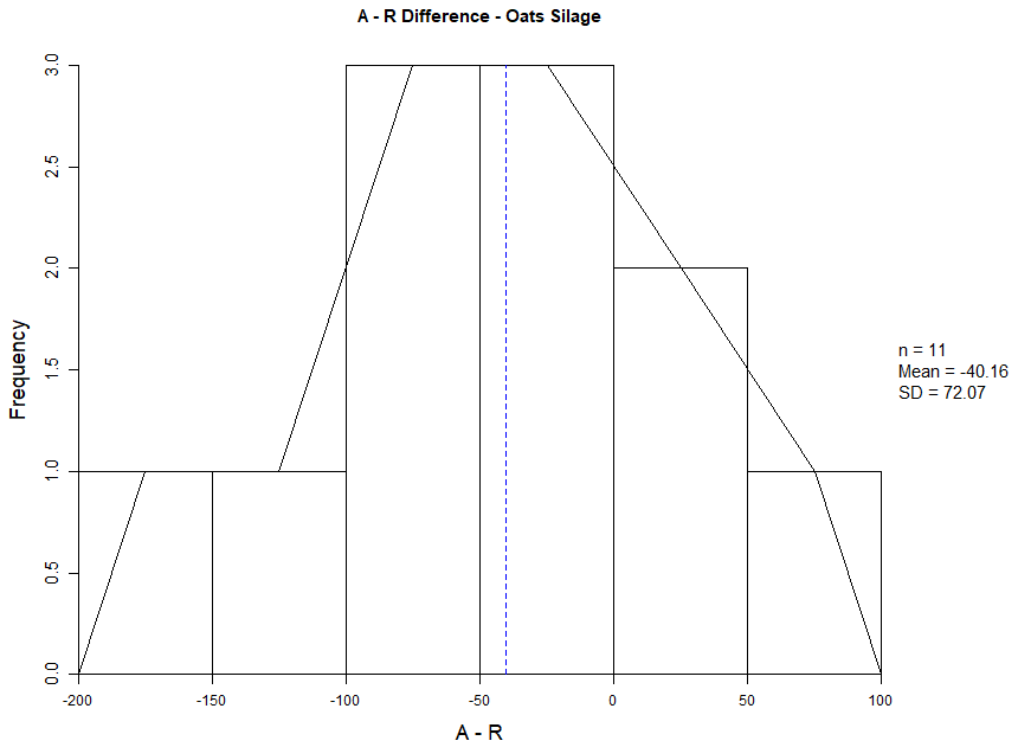


Figure XII-4. Histogram plot of A-R values for Oats, Silage for the 2018 Crop Year.

The dotted blue line represents the mean. The number of parcels (n) and Standard deviation (SD) are provided.



XIII. PISTACHIOS

Important analysis considerations:

The calculation of nitrogen removed for Pistachios assumes that 0.02805 lbs N/lbs of dry yield are removed at harvest. This estimate is obtained from Geisseler (2016). The author considers that this C_N coefficient is a good estimate for nitrogen removed from pistachio orchards in the Central Valley.

Table XIII-1. Summary statistics for Pistachios.

Specific Crop	Parameter	N Parcels	Acreage	Mean	Standard Deviation	Min	Max
PISTACHIOS	A/R	22	3,364	4.54	4.51	1.01	17.31
	A-R	22	3,364	94.11	57.25	1.6	197.33

Figure XIII-1. Histogram plot of A/R values for Pistachios for the 2018 Crop Year.

The dotted blue line represents the mean. The number of parcels (n) and Standard deviation (SD) are provided.

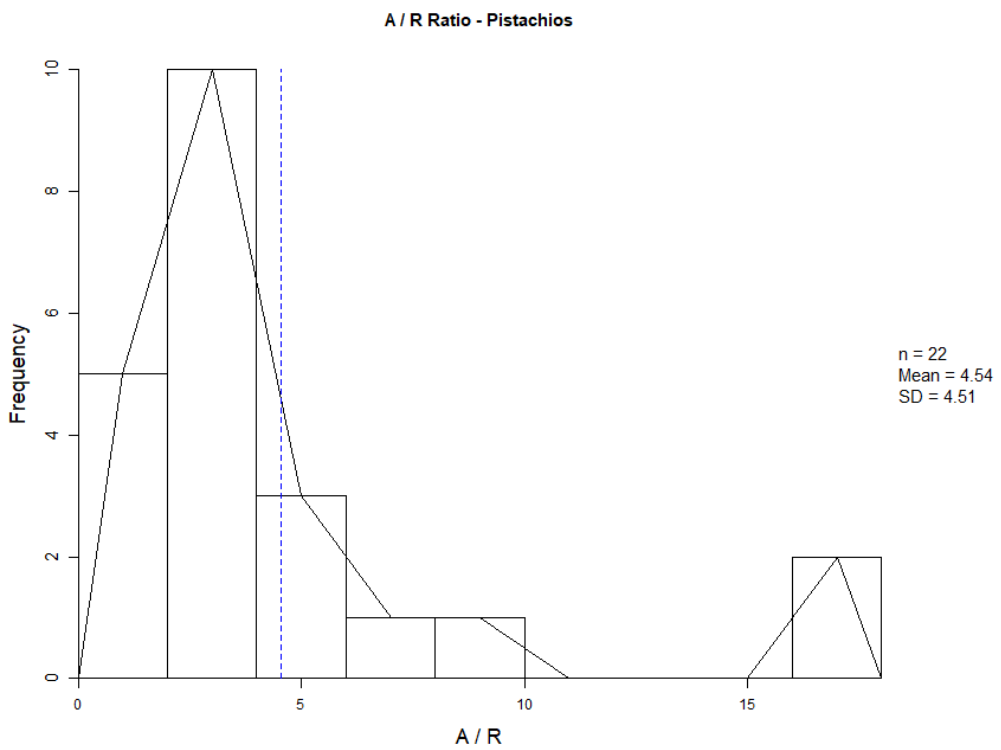
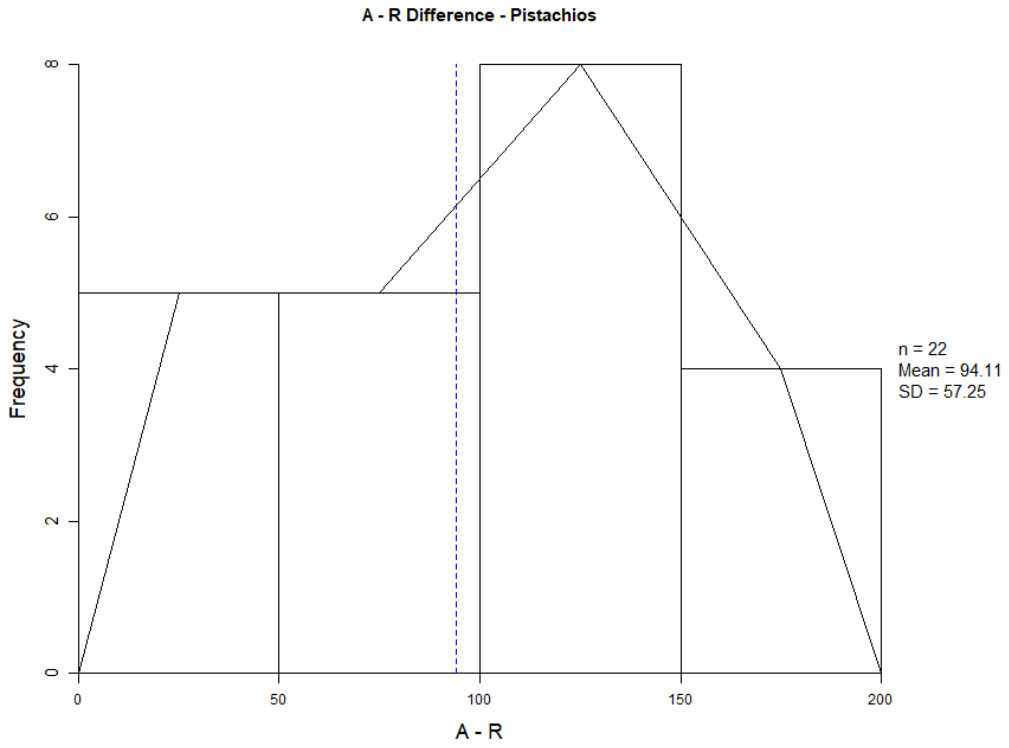


Figure XIII-2. Histogram plot of A-R values for Pistachios for the 2018 Crop Year.

The dotted blue line represents the mean. The number of parcels (n) and Standard deviation (SD) are provided.



XIV. TOMATOES

Important analysis considerations:

The calculation of nitrogen removed for Tomatoes, Fresh Market assumes that 0.001305 lbs N/lbs of fresh weight are removed at harvest. This estimate is obtained from Geisseler (2016). The author considers that it is not possible to determine the degree to which the dataset is representative of tomatoes harvested in the Central Valley. However, means and ranges overlap substantially, with processing tomatoes from the Central Valley.

The calculation of nitrogen removed for Tomatoes, NR assumes that 0.001335 lbs N/lbs of fresh weight are removed at harvest. This estimate is obtained from Geisseler (2016). The author evaluated market and processing tomatoes separately. Means and ranges for the two C_N coefficients overlap substantially. The Coalition created a tomato average C_N coefficient and applied that to cases when the grower did not specify the kind of tomato reported. As C_N coefficients overlap substantially, and there is good representation for processing tomatoes in the Central Valley, this is likely a reasonable estimate for tomato nitrogen removal in the region.

The calculation of nitrogen removed for Tomatoes, Processing assumes that 0.001365 lbs N/lbs of fresh weight are removed at harvest. This estimate is obtained from Geisseler (2016). The author considers that the average C_N coefficient can be considered a very good estimate for the Central Valley.

Table XIV-1. Summary statistics for Tomatoes.

Specific Crop	Parameter	N Parcels	Acreage	Mean	Standard Deviation	Min	Max
TOMATOES, MARKET	A/R	19	1,967	4.45	2.50	1.02	9.58
	A-R	19	1,967	178.33	95	3.4	427.93
TOMATOES, NR	A/R	37	2,986	1.7	1.36	0	8.63
	A-R	37	2,986	63.86	57.48	-5.78	204.04
TOMATOES, PROCESSING	A/R	99	11,907	2.48	4.31	0.73	28.18
	A-R	99	11,907	84.65	70.84	-44.81	382.61

Figure XIV-1. Histogram plot of A/R values for Tomatoes, Market for the 2018 Crop Year.

The dotted blue line represents the mean. The number of parcels (n) and Standard deviation (SD) are provided.

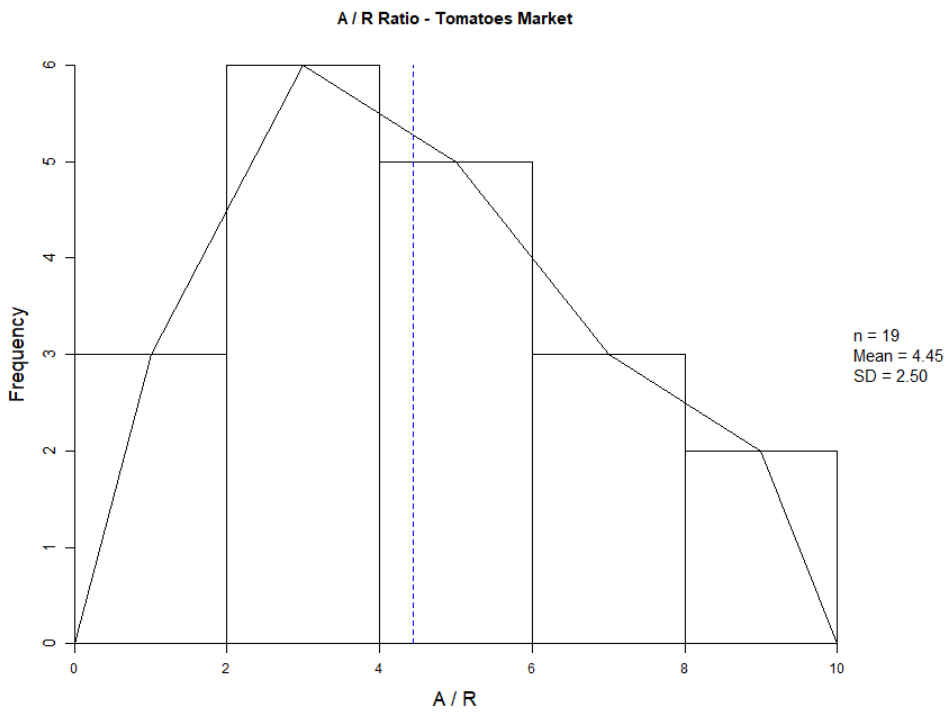


Figure XIV-2. Histogram plot of A-R values for Tomatoes, Market for the 2018 Crop Year.

The dotted blue line represents the mean. The number of parcels (n) and Standard deviation (SD) are provided.

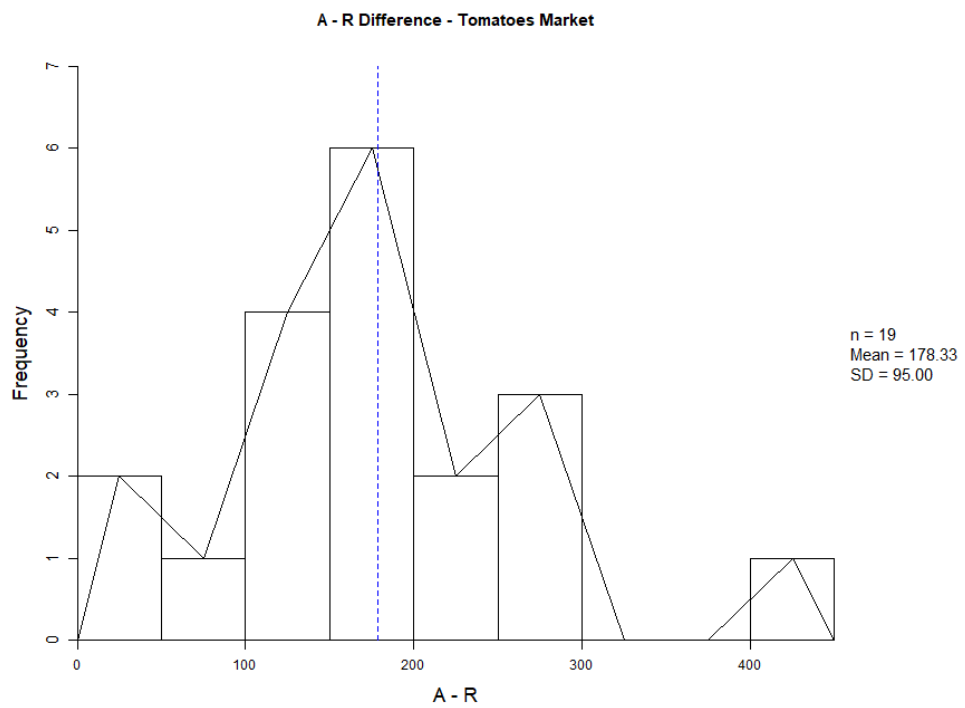


Figure XIV-3. Histogram plot of A/R values for Tomatoes, NR for the 2018 Crop Year.

The dotted blue line represents the mean. The number of parcels (n) and Standard deviation (SD) are provided.

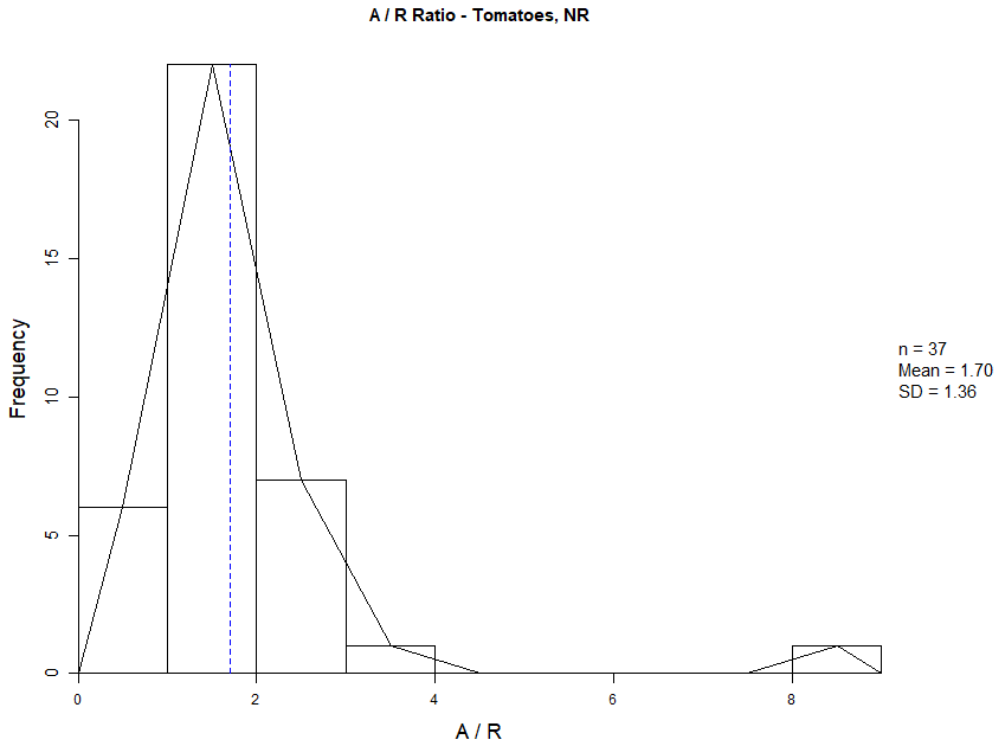


Figure XIV-4. Histogram plot of A-R values for Tomatoes, NR for the 2018 Crop Year.

The dotted blue line represents the mean. The number of parcels (n) and Standard deviation (SD) are provided.

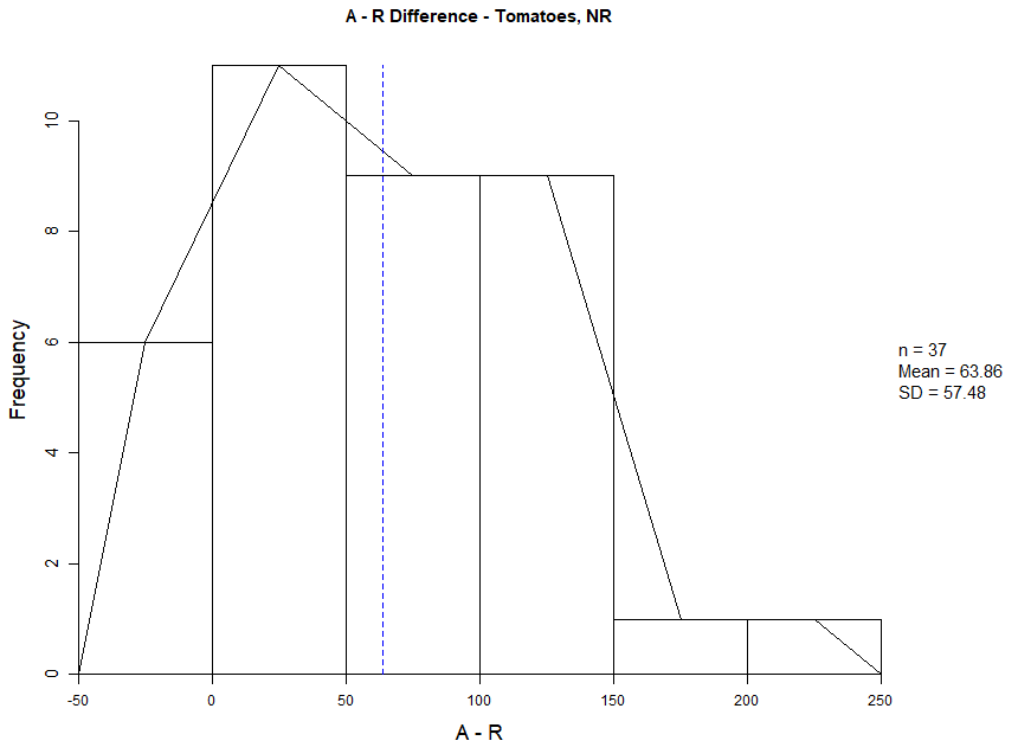


Figure XIV-5. Histogram plot of A/R values for Tomatoes, Processing for the 2018 Crop Year.

The dotted blue line represents the mean. The number of parcels (n) and Standard deviation (SD) are provided.

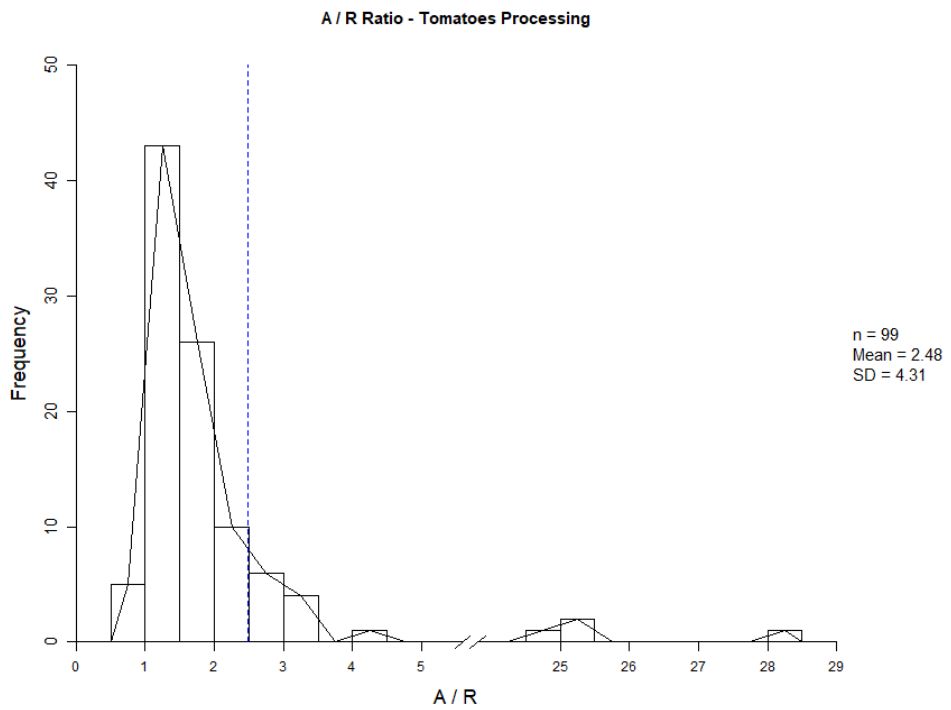
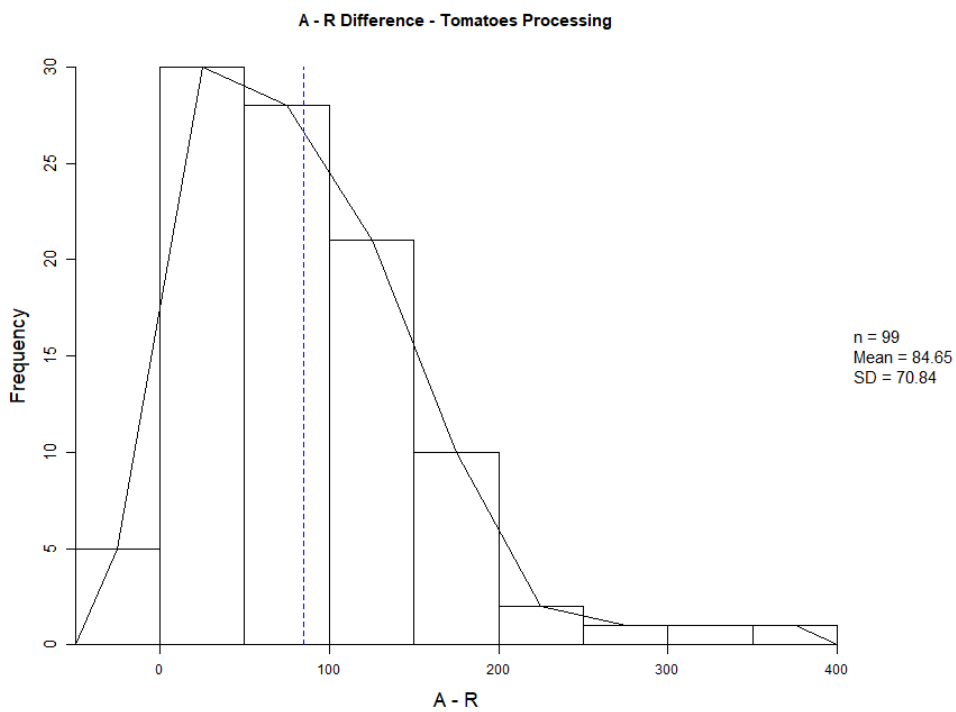


Figure XIV-6. Histogram plot of A-R values for Tomatoes, Processing for the 2018 Crop Year.

The dotted blue line represents the mean. The number of parcels (n) and Standard deviation (SD) are provided.



XV. WALNUTS

Important analysis considerations:

The calculation of nitrogen removed for Walnuts assumes that 0.01595 lbs N/lbs with shells are removed at harvest. This estimate is obtained from Geisseler (2016). The author considers that the C_N coefficient can be considered a good estimate of nitrogen removed with walnuts in the Central Valley. However, the data range may not fully capture the variability.

Table XV-1. Summary statistics for Walnuts.

Specific Crop	Parameter	N Parcels	Acreage	Mean	Standard Deviation	Min	Max
WALNUTS	A/R	181	9,678	3.10	3.18	0	26.98
	A-R	178	9,543	70.7	43.22	-27.14	240.73

Figure XV-1. Histogram plot of A/R values for Walnuts for the 2018 Crop Year.

The dotted blue line represents the mean. The number of parcels (n) and Standard deviation (SD) are provided.

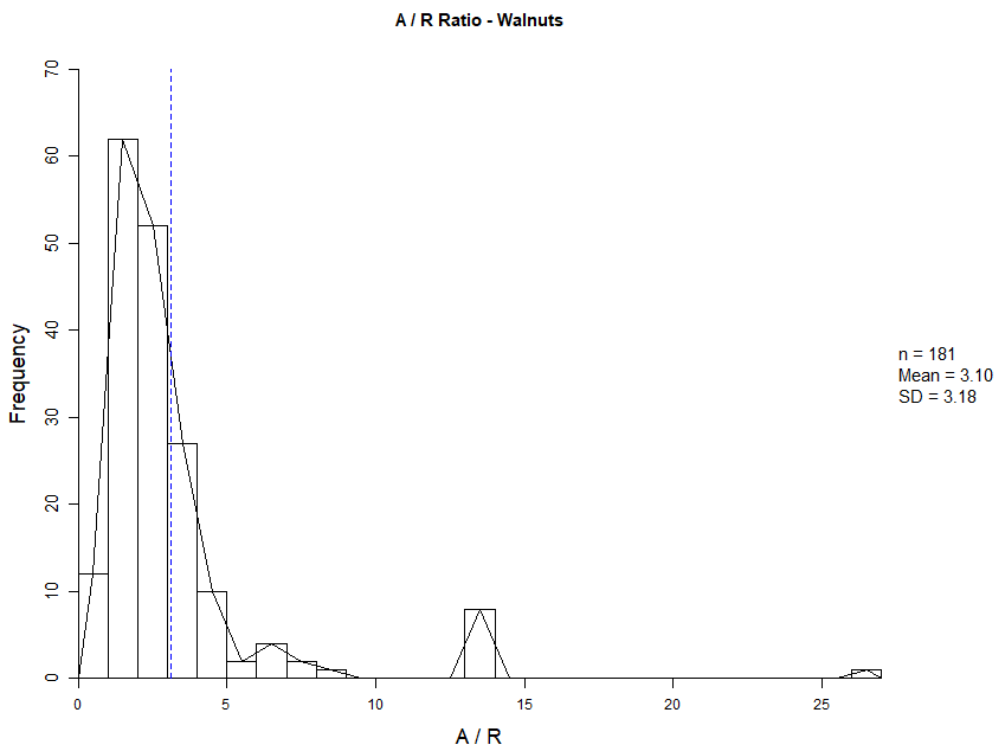
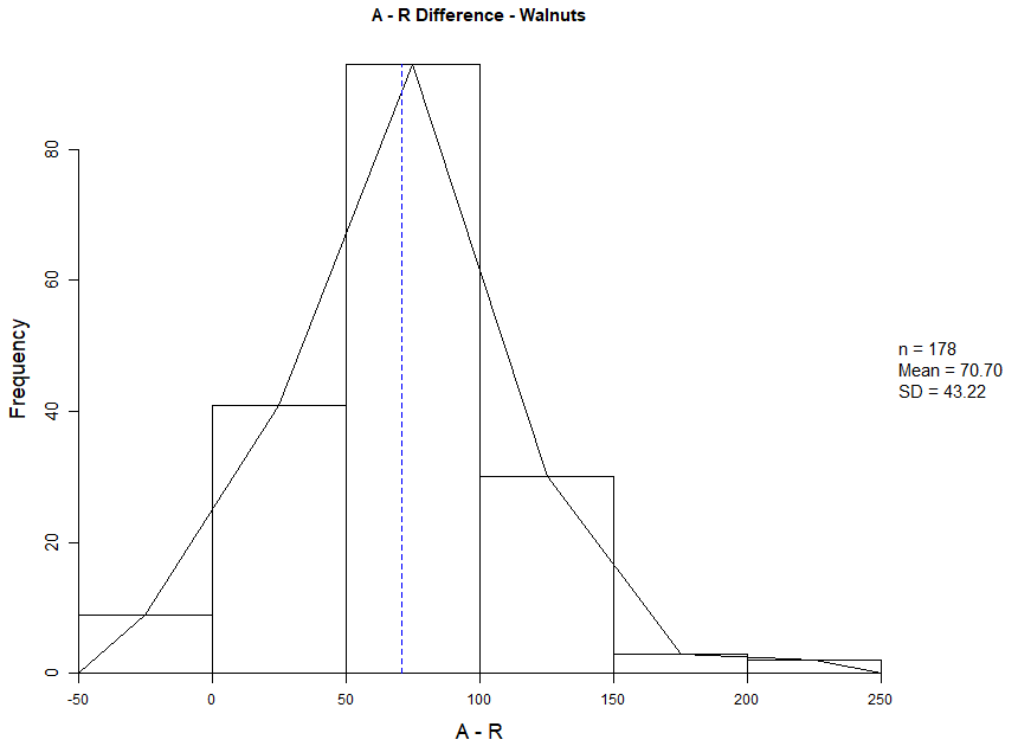


Figure XV-2. Histogram plot of A-R values for Walnuts for the 2018 Crop Year.

The dotted blue line represents the mean. The number of parcels (n) and Standard deviation (SD) are provided.



XVI. WHEAT

Important analysis considerations:

The calculation of nitrogen removed for Wheat, Grain assumes that 0.021275 lbs N/lbs of grain at 12% moisture are removed at harvest. This estimate is obtained from Geisseler (2016). The author evaluated grains from common wheat and durum wheat separately. Coalition growers did not differentiate between the two types of wheat. The Coalition applied this average to all wheat reported by the growers. Both C_N coefficients overlap substantially, and results are highly representative of wheat grown in Central Valley.

The calculation of nitrogen removed for Wheat, Silage assumes that 0.00525 lbs N/lbs of grain at 70% moisture are removed at harvest. This estimate is obtained from Geisseler (2016). The author considers that the dataset likely provides a good estimate of the average nitrogen concentration in wheat silage produced in the Central Valley. However, the data may not fully capture the variability.

Table XVI-1. Summary statistics for Wheat.

Specific Crop	Parameter	N Parcels	Acreage	Mean	Standard Deviation	Min	Max
WHEAT, GRAIN	A/R	9	977	1.41	0.71	0	2.29
	A-R	8	966	71.06	69.6	-38.29	169.27
WHEAT, SILAGE	A/R	6	867	0.96	1.34	0.06	3.65
	A-R	6	867	-64.88	95.48	-177	100.2

Figure XVI-1. Histogram plot of A/R values for Wheat, Grain for the 2018 Crop Year.

The dotted blue line represents the mean. The number of parcels (n) and Standard deviation (SD) are provided.

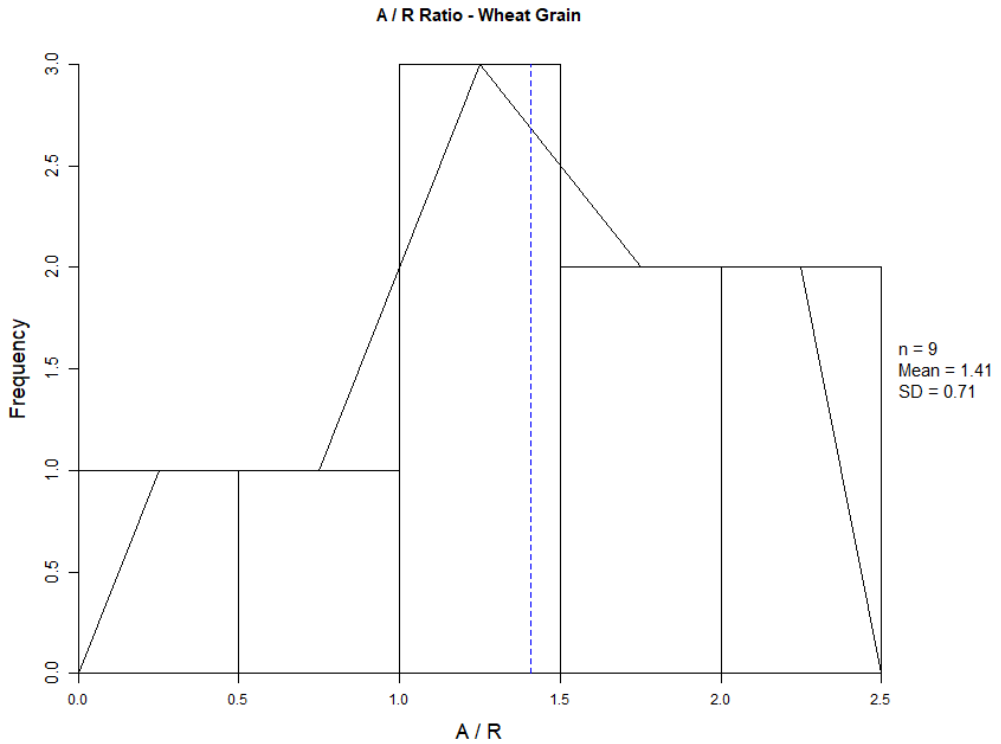


Figure XVI-2. Histogram plot of A-R values for Wheat, Grain for the 2018 Crop Year.

The dotted blue line represents the mean. The number of parcels (n) and Standard deviation (SD) are provided.

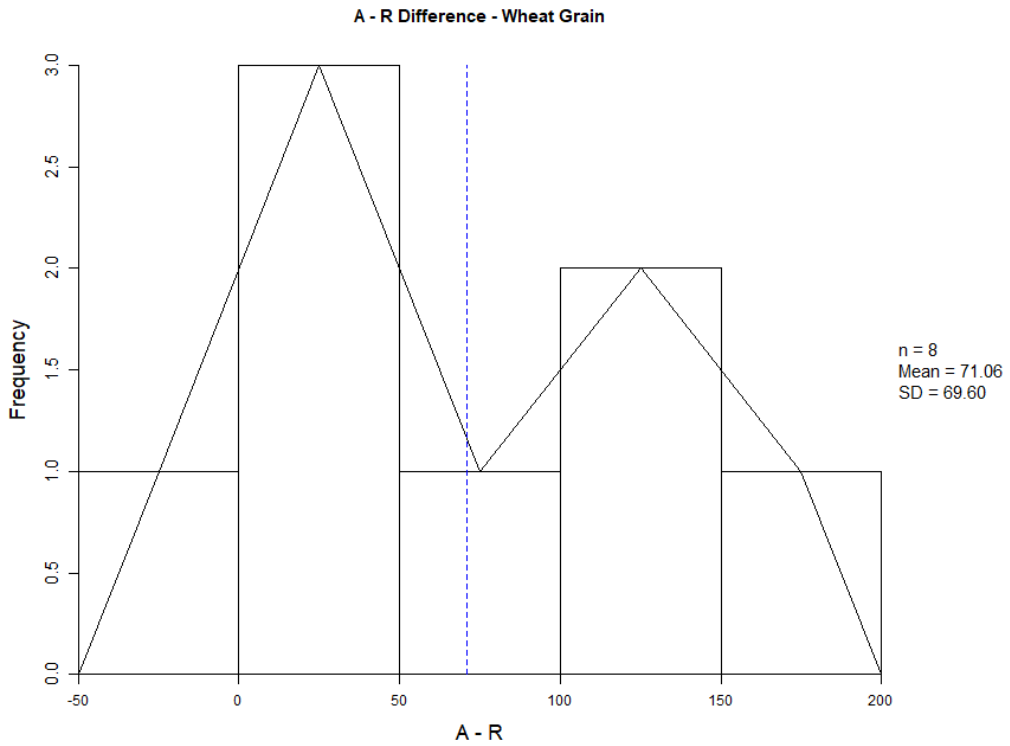


Figure XVI-3. Histogram plot of A/R values for Wheat, Silage for the 2018 Crop Year.

The dotted blue line represents the mean. The number of parcels (n) and Standard deviation (SD) are provided.

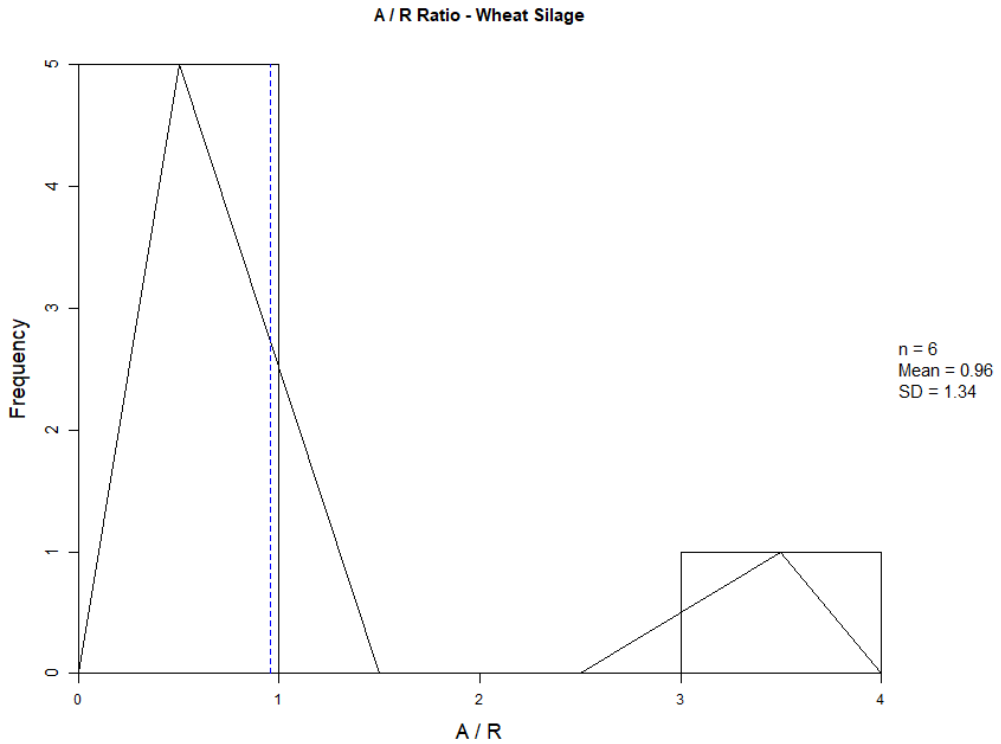
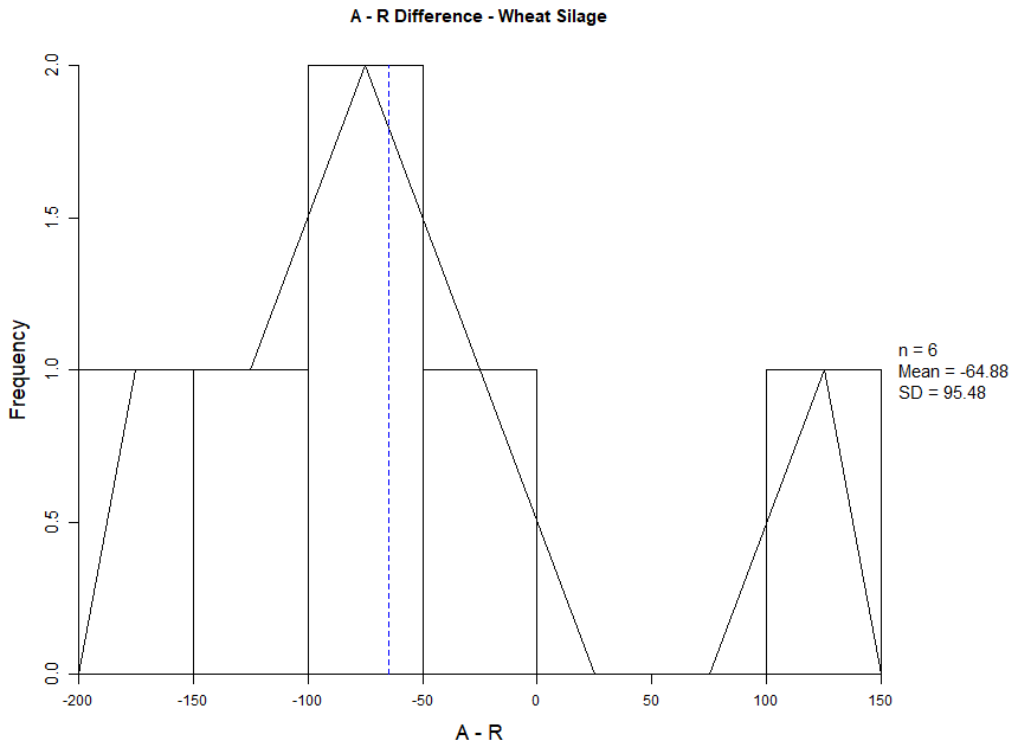


Figure XVI-4. Histogram plot of A-R values for Wheat, Silage for the 2018 Crop Year.

The dotted blue line represents the mean. The number of parcels (n) and Standard deviation (SD) are provided.



XVII. OTHER CROPS

Table XVII-I Summary statistics for crops with limited representation in the WSJRWC region.

Crops with only one management unit with complete data (Count = 1) or more than one management units with identical values, have no summary statistics because a range of values is necessary to estimate percentiles.

Specific Crop	Parameter	N MUs	Acreage	Mean	Standard Deviation	Min	Max
Apple	A/R	1	12	6.19	--	6.19	6.19
	A-R	1	12	44.43	--	44.43	44.43
Apriums	A/R	3	34	7.06	9.14	1.55	17.61
	A-R	3	34	40.46	28.44	16.82	72.01
Barley Grain	A/R	1	9	0	--	0	0
Beans Garbanzo	A/R	2	177	0	0	0	0
	A-R	2	177	-90.72	9.5	-97.44	-84
Beets	A/Y	1	22	0.14	--	0.14	0.14
Corn Sweet	A/R	2	105	40.43	56.43	0.53	80.33
	A-R	2	105	47.09	84.24	-12.47	106.66
Forage	A/R	1	169	0.28	--	0.28	0.28
	A-R	1	169	-153.6	--	-153.6	-153.6
Forage Mix	A-R	4	140	-378.88	230.73	-610.47	-177.3
Forage Mix, NR	A/Y	11	487	0.01	0.01	0	0.02
Grapes Raisin	A/R	2	114	2.48	0	2.48	2.48
	A-R	2	114	29.8	0	29.8	29.8
Grapes Table	A/R	1	53	1.84	--	1.84	1.84
	A-R	1	53	22.88	--	22.88	22.88
Grass Teff, NR	A/Y	1	23	0.01	--	0.01	0.01
Jalapenos	A/R	1	16	3.43	--	3.43	3.43
	A-R	1	16	152.81	--	152.81	152.81
Lemons	A/R	2	51	2.32	1.28	1.42	3.23
	A-R	2	51	36.52	2.84	34.51	38.53
Mandarins	A/R	2	273	1.39	0.09	1.33	1.45
	A-R	2	273	25.08	3.99	22.25	27.9
Nectarines	A/R	1	5	10.73	--	10.73	10.73
	A-R	1	5	68.01	--	68.01	68.01
Oats Grain	A/R	2	25	0.33	0.47	0	0.66
	A-R	1	21	-76.2	--	-76.2	-76.2
Olives	A/R	8	656	2.34	2.69	0	5.97
Onions	A/R	1	78	2.98	--	2.98	2.98
	A-R	1	78	132.99	--	132.99	132.99
Oranges	A-R	4	67	3.5	10.47	-9.9	14.42
	A/R	6	69	0.74	0.6	0	1.41
Peaches	A/R	2	59	17.75	5.55	13.83	21.68
	A-R	2	59	128.27	83	69.58	186.96
Peppers, Bell	A/R	1	36	4.05	--	4.05	4.05
	A-R	1	36	155.12	--	155.12	155.12
Persimmons	A/Y	2	30	0	0	0	0.01
Pomegranates	A/R	2	1,771	0.64	0.49	0.29	0.98
	A-R	2	1,771	-71.22	96.06	-139.14	-3.29
Pomelo	A/R	1	4	1.81	--	1.81	1.81
	A-R	1	4	22.4	--	22.4	22.4
Prunes	A/R	3	109	3.91	3.12	0.3	5.71
	A-R	3	109	25.93	76.66	-62.47	74.25

Specific Crop	Parameter	N MUs	Acreage	Mean	Standard Deviation	Min	Max
Pumpkins	A/R	3	57	1.33	1.2	0.6	2.72
	A-R	3	57	-8.16	66.64	-68.79	63.2
Squash	A/R	1	3	1.25	--	1.25	1.25
	A-R	1	3	26.28	--	26.28	26.28
Strawberries	A/R	1	1	4.81	--	4.81	4.81
	A-R	1	1	277.2	--	277.2	277.2
Sudan Hay	A/Y	4	58	0	0.01	0	0.01
Sudan, Silage	A/R	1	18	0	--	0	0
	A-R	1	18	-80.74	--	-80.74	-80.74
Tangerine	A/R	1	1	2.46	--	2.46	2.46
	A-R	1	1	29.68	--	29.68	29.68
Wheat Hay	A/Y	37	1,723	0.01	0.03	0	0.17
Zucchini	A/R	1	95	0.9	--	0.9	0.9
	A-R	1	95	-13.96	--	-13.96	-13.96

Appendix III

NITROGEN EVALUATION REPORT EXAMPLE

Section 1

Your 2017 NMP Summary Report

Member ID # XXXXXX

Member

Below is information you reported to the Westside Coalition in your Nitrogen Management Plan (NMP) Summary Report. The information is provided by parcel. In cases where several parcels belong to a single management unit, the values for A, A/Y and Y are repeated.

Some of your reported parcels may not be included in this table if they contained No-Yield or Non-Bearing crops, were not farmed or contained Non Crops (like pastures, or dairy), or if there was not adequate information to do the comparison. If any of this information does not match your records, or you believe some of your parcels were excluded by mistake, please contact the Coalition to update your records.

Assessor Parcel Number	Management Unit		Applied-N (pounds/acre)	Applied-N/ Yield	Yield per acre	
APN	Name	Crop	**A**	**A/Y**	**Y**	**Units**
00000001	MU 01	Almonds	166	0.1200	1383	Pounds

Notes:
Your Yield (Y) was calculated from the A/Y value.
In Section 2 you can compare your NMP data for common crops to other members of the Westside Coalition. Crops that are less common or that do not have harvest type will not appear in Section 2.

Section 2

Nitrogen Use Evaluation: Almonds (Page 1 of 1)

Member/Tenant ID # XXXXXX

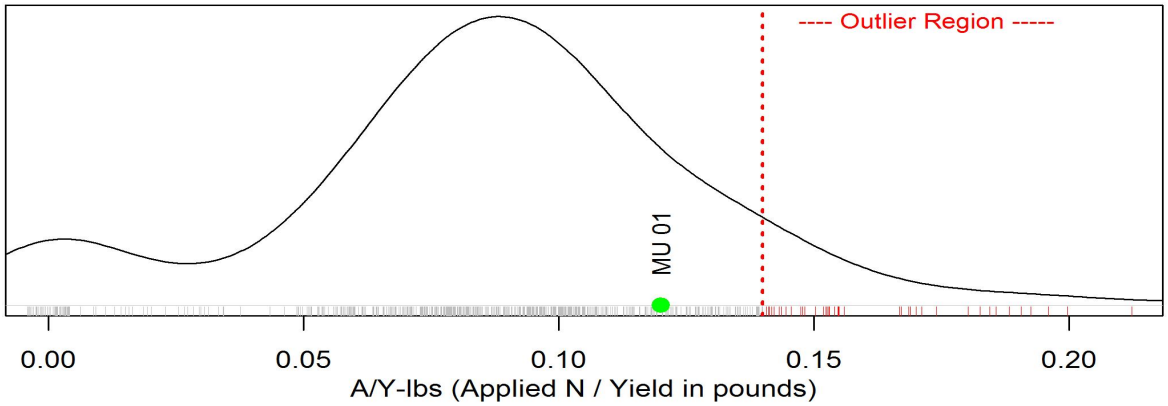
Management Unit		Applied-N/ Yield-pounds	Applied-N (pounds/acre)	Removed-N (pounds/acre)
Name	**Total Acres**	**A/Y-lbs***	**A**	**R****
MU 01	20	0.1200	166	94

* All Yields were converted to pounds. **A/Y-lbs** may differ from your reported A/Y if you reported yield in units other than pounds.
** R estimates are based on the assumption that nitrogen removed at harvest for Almonds is 0.068lbs N/lbs of marketable kernels.

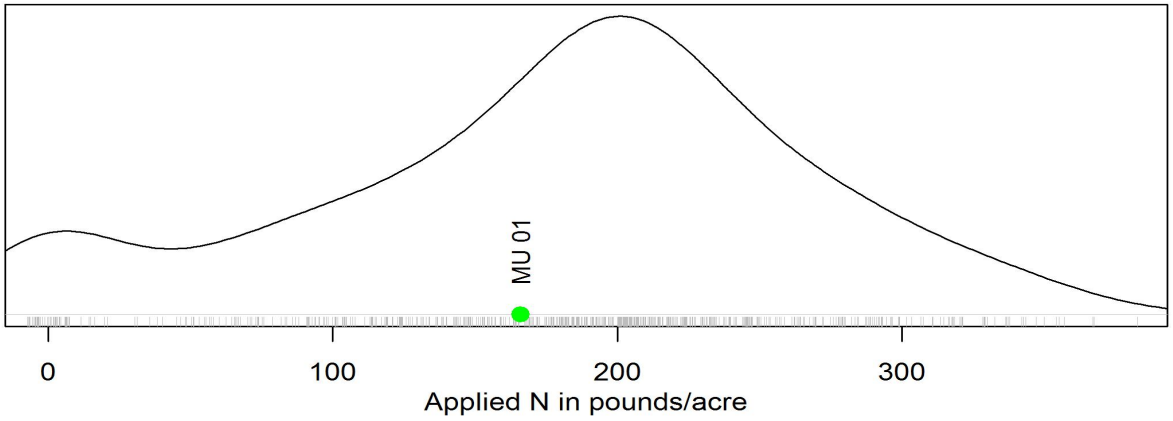
How Do Your Management Units Compare To All Other Almonds Growers?

401 Coalition members reported on **603** Almonds Management Units.
Median A/Y-lbs = **0.0915**
Median A = **200** pounds/acre
A/Y-lbs values larger than **0.1429** are considered outliers.

Your A/Y-lbs Compared To All Other Almonds Growers



Your Applied N Compared To All Other Almonds Growers



If you have two or more Management Units with the same A/Y-lbs or A, the points will overlap in the figures. Management Units considered Outliers will be colored in red.

Section 3

How to Interpret Your Nitrogen Use Evaluation

The A/Y ratio is your reported A/Y standardized to the following; this allows for a comparison of management units across the Coalition region:

$$\frac{A}{Y} = \frac{A}{Y(in\ lbs)}$$

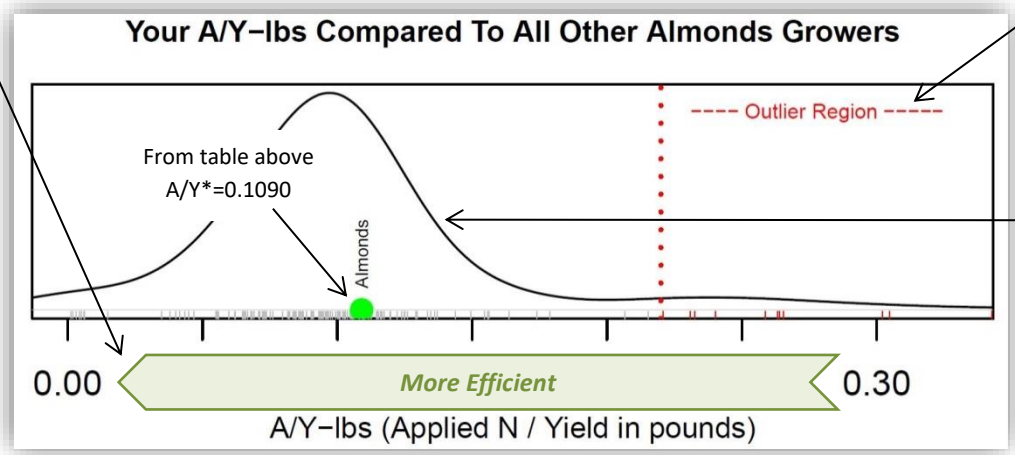
Removed-N (R) is an estimate of how much nitrogen your crop used. It is based on the Yield in pounds (Y), and the Crop Nitrogen Uptake values from the CDFA FREP site (http://apps.cdfa.ca.gov/frep/docs/N_Uptake.html).

$$R = Y \times N\ removed\ coefficeint$$

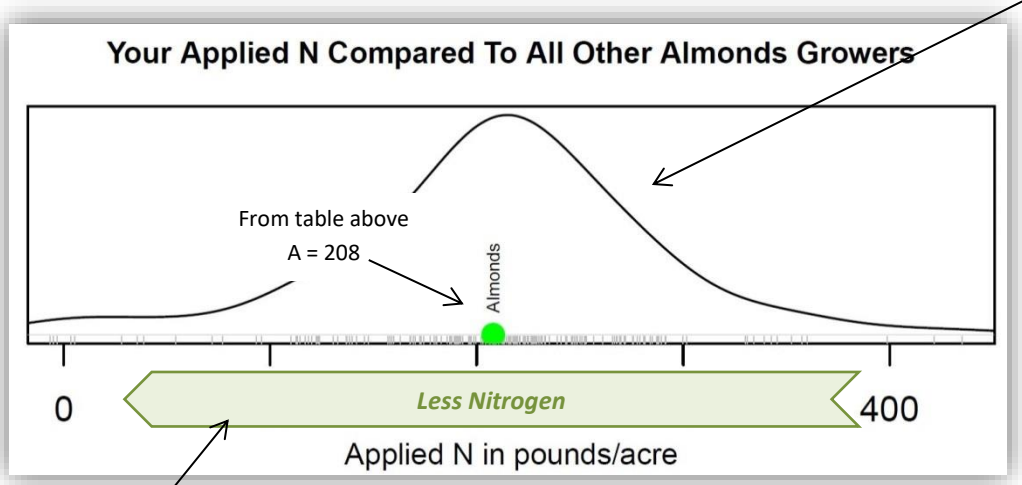
Management Unit		Applied-N/ Yield-pounds	Applied-N (pounds/acre)	Removed-N (pounds/acre)
Name	**Total Acres**	**A/Y-lbs***	**A**	**R****
Almonds	61	0.1090	208	130

The further to the **left** on this curve a Management Unit falls, the more efficient the nitrogen usage—fields to the left are getting more yield per unit of nitrogen applied.

Outlier Region: A Management Unit falling in this region indicates inefficient nitrogen usage, and could mean that nitrogen is leaching below the root zone, and into the groundwater.



The **"bell" curves** represent all Coalition growers with the same crop who reported A/Y values. The peak of the "bell" is where most Management Units fall.



The further to the **left** on this curve a Management Unit falls, the less nitrogen was applied.

Section 3

How to Interpret Your Nitrogen Use Evaluation

Are Growers Applying Too Much Nitrogen to Their Crops?

This is a key question being asked by water quality regulators and the public. If more nitrogen is applied than the crop can use, any excess nitrogen has the potential to leach into groundwater aquifers. Groundwater aquifers in a high vulnerability area either have nitrates above state standards or are vulnerable to nitrate contamination due to geological characteristics.

Determining If "Excess Nitrogen" Is Applied to a Crop

Two factors must be known to determine if excess nitrogen is being applied to a crop.

1) **N Applied** - this is the pounds of nitrogen applied per acre to your crop throughout the year.
2) **Crop Yield** - this is calculated from the A/Y ratio (Applied divided by Yield) and converted to pounds per acre.

Comparing how much nitrogen is applied to how much nitrogen is removed gives an indication of the nitrogen that could potentially leach into groundwater. The amount of nitrogen removed is estimated from Crop Yield multiplied by a nitrogen removed coefficient to determine an estimate of nitrogen removed (R).

It is acknowledged that the amount of nitrogen applied and the amount of crop yield are not the only factors that affect the potential for nitrogen to leach into groundwater. Other important variables not considered in the NMP Summary Reports are: timing of nitrogen applications, amounts of nitrogen in each application, and the timing and amounts of irrigation water. However, a field's A/Y is a key indicator of the potential of excessive nitrogen applications.

Determining an "Outlier"

Using a statistical analysis, the Coalition compares the A/Y (standardized for yield in pounds) for each management unit to the A/Y of all other management units of the same crop grown in the Coalition region. Management units in the top 10% (higher A/Y than 90% of the coalition growers) are considered "outliers".

There can be many reasons a Management Unit (or field) is an "outlier" other than excess nitrogen application; such as lower than expected crop yield, pest damage, or other factors.

In Section 2, there is a "Nitrogen Removed" value which is calculated using the nitrogen removed coefficient multiplied by the Crop Yield. The nitrogen removed coefficient is a number developed through scientific studies evaluated by CDFA. Some crops have more information needed for calculating nitrogen removed than others; for some crops there is no nitrogen removed coefficient available. In coming years, additional effort will be put into further refining the nitrogen removed numbers to reflect the variables of crop production in the Central Valley.

Section 3

How to Interpret Your Nitrogen Use Evaluation

What Action Is the Regional Water Board Taking Against "Outliers?"

It is not anticipated that a single season A/Y number that is considered an "outlier" will mean that the management unit or field is "out of compliance" and subject to enforcement actions. It may take more than one year for each field to compensate for normal seasonal variability of production and weather. However, if a field is consistently determined to be an outlier as a result of excessive nitrogen applications, it is expected that the Regional Water Board will contact that grower and request information to justify why nitrogen applications are made above apparent crop need.

If you have a field or management unit labeled as an outlier, a first step would be to talk to a Certified Crop Advisor (CCA), an agronomist or local University of California farm advisor who specializes in your crop. You should also double check the nitrogen applied information you reported to us to make sure it is correct.

At this time there is not enough information to know which A/Y indicates an optimal or acceptable nitrogen use that results in a minimal amount of nitrogen leaching to the groundwater. The "Management Practices Evaluation Program" (MPEP) is a program being implemented by the Central Valley water quality coalitions and is focusing on better understanding which crop management practices are more effective in minimizing the amount of nitrogen leached to groundwater. Information acquired in the MPEP will be used to help growers adapt to management practices to be protective of groundwater in their specific circumstance. Over the next few years, this information will be provided as it becomes available. In the meantime, growers are encouraged to use their best efforts to reduce discharges to groundwater.

For information on crop fertilization guidelines, go to the website developed by the California Department of Food and Agriculture (CDFA) and the University of California (UC):

www.cdfa.ca.gov/go/FREPguide