CALIFORNIA LEAFY GREENS RESEARCH PROGRAM

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Assessment of N uptake and N removal of leafy greens under different production regimes

PROJECT INVESTIGATORS:

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ABSTRACT

Agricultural Discharge Order 4.0 was finalized on April 15, 2021. The order contains limits on the amount of nitrogen (N) loading that can occur in agricultural operations in the Central Coast Regional Water Quality Control Region 3. When targets/ limits take effect in two years, growers will be required to report the amount (A) of N applied to the fields as well as N removed (R) from the fields. The metric used to calculate loading is A-R in relation to the limits set by the board. Calculating the R removed in the harvested portion of the product ($R_{harvest}$) requires knowledge of the percent moisture and N content of the crop. Crop coefficients have been proposed as a tool to reduce the cost for estimating N removed at harvest. This project is evaluating the moisture content of leafy greens and the percent N in the tissue to develop N removal coefficients that growers can use to calculate $R_{harvest}$ over a range of growing conditions and production practices used by the industry. In 2020 we completed evaluations of 8-10 fields of the major lettuce types and various harvest products of the lettuces. This information has been entered into a searchable data base available to growers to access N removal coefficients.

OBJECTIVES

The main objective of this project is to compile existing crop N uptake and N removal data for leafy green vegetables and conduct field research for commodities and growing conditions where there is a lack of information. Summaries of the data will be extended to the leafy green industry through blog entries, industry meetings, and the annual Irrigation and Nutrient Management Meeting.

PROCEDURES

Commodities sampled are shown in Table 1. We worked with harvest crews to sample harvested product as it is leaving the field. Percent moisture of the products were determined by weighing the fresh product immediately in the field, drying at 149 F for 48 hours (or until completely dry) and weighing again. Samples were sent to the UC Davis Analytical Laboratory for total N content. Over the two years of this project we intend to sample 20 fields of each

commodity. Fields sampled were selected on different soil types, planting configurations and geographic locations in the Salinas and surrounding valleys to capture the variability of the the N content. The N removal coefficient is calculated by multiplying the percent solids by the N content of the tissue. The data developed in 2020 has been entered into the N removal coefficient database on Microsoft Access. The data is organized and searchable. Summaries of N uptake and N removal will be made to the leafy green industry. The database will be used to develop reports of N uptake and N removal that can be provided to the leafy green industry upon request.

RESULTS

Calculated N removal coefficients developed to date are shown in Table 1. The data developed thus far indicates that there is substantial variability in the N removal coefficient. The reason for the variability is indicated by the variability shown in the percent moisture and N content of the harvested tissue in Table 2. In 2020 our goal was to evaluated 10 fields of each of the lettuce types. In 2021, we hope to complete a total of 20 fields of each lettuce type which will encompass a stronger database from which to base the N removal coefficients for the various lettuce types.

As an example, a bulk romaine lettuce field that yields 30,000 lbs/A on average would remove 45 lbs N/A (30,000 x 0.00150), but N removal varies from 38 lbs N/A (30,000 x 0.00127) to 61 lbs N/A (30,000 x 0.00204). This information provides the $R_{harvest}$ number in the A-R equation.

Table 1. Nitrogen removal coefficient and minimum and maximum calculated coefficients

Commodity	Product	Pack type	No. fields sampled	mean coeff	min coeff	max coeff
Butter	Fresh Market	Carton	8	0.00190	0.00142	0.00255
Green Leaf	Fresh Market	Carton	8	0.00193	0.00134	0.00253
Head Lettuce	Bulk	Bulk (field cored)	10	0.00116	0.00088	0.00137
Head Lettuce	Fresh Market	Film Wrap	10	0.00130	0.00103	0.00181
Head Lettuce	Fresh Market	Naked (Liner)	10	0.00135	0.00113	0.00165
Red Leaf	Fresh Market	Carton	8	0.00222	0.00173	0.00266
Romaine	Bulk	Bulk	10	0.00150	0.00127	0.00204
Romaine	Fresh Market	Naked (Liner)	10	0.00178	0.00147	0.00243
Romaine	Hearts	Carton	11	0.00179	0.00148	0.00221

Table 2. Mean, minimum and maximum percent tissue solids and N content

Commodity	Product	Pack type	mean %solids	min % solids	max % solids	mean %N	min %N	max %N
Butter	Fresh Market	Carton	5.41	4.11	6.85	3.51	2.85	4.22
Green Leaf	Fresh Market	Carton	6.56	5.52	7.80	2.95	2.18	3.56
Head Lettuce	Bulk	Bulk (field cored)	3.93	3.19	5.25	2.98	2.55	3.43
Head Lettuce	Fresh Market	Film Wrap	4.32	3.60	6.32	3.01	2.48	3.52
Head Lettuce	Fresh Market	Naked (Liner)	4.30	3.55	5.04	3.15	2.61	3.49
Red Leaf	Fresh Market	Carton	5.84	4.61	7.82	3.81	3.26	4.78
Romaine	Bulk	Bulk	4.88	3.72	5.90	3.09	2.55	3.75
Romaine	Fresh Market	Naked (Liner)	5.69	4.65	7.51	3.15	2.33	3.97
Romaine	Hearts	Carton	5.28	3.98	6.60	3.40	2.81	3.90

SUMMARY

N removal coefficients were developed from evaluations of 8-10 fields of the range of lettuces and lettuce products in 2020. The data collected to date indicates that there is a great deal of variability in the harvested products. The data is entered into a searchable Microsoft Access database that can be provided to growers with N removal coefficients upon request.