WASHINGTON STATE UNIVERSITY EXTENSION

Economics of P and K Applications in Alfalfa

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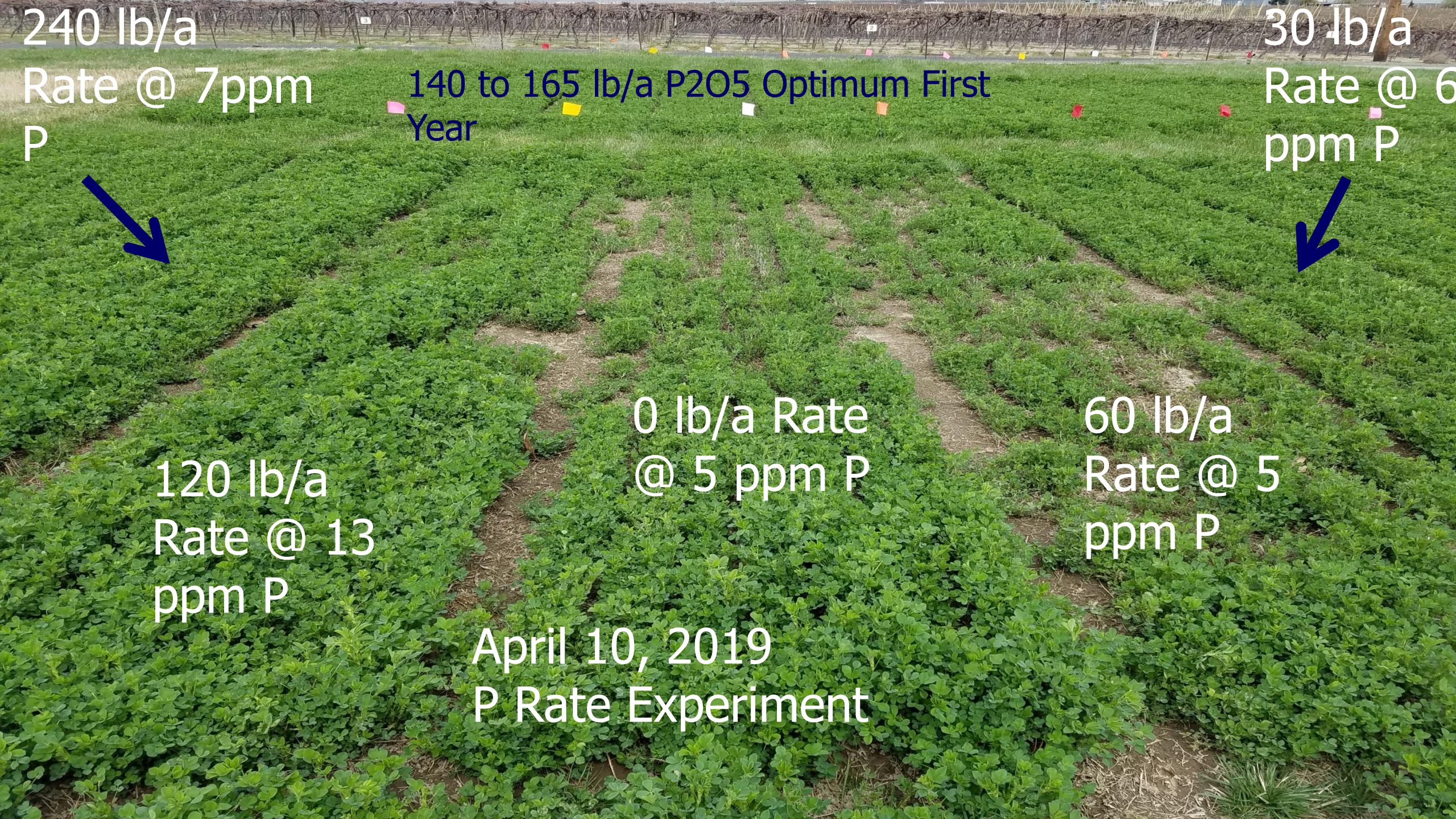
Alfalfa

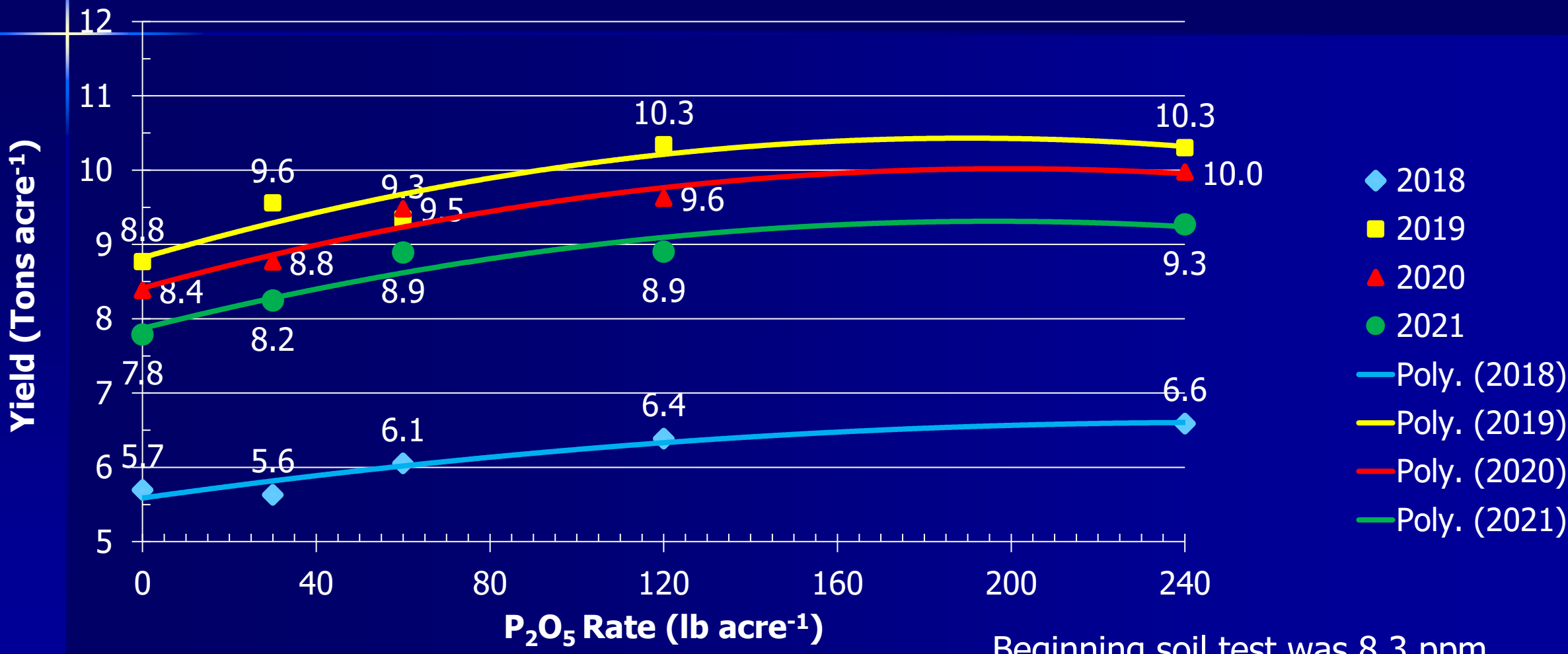
NAFA

U.S. Alfalfa Farmer Research Initiative

Phosphorus Study and Interpretation

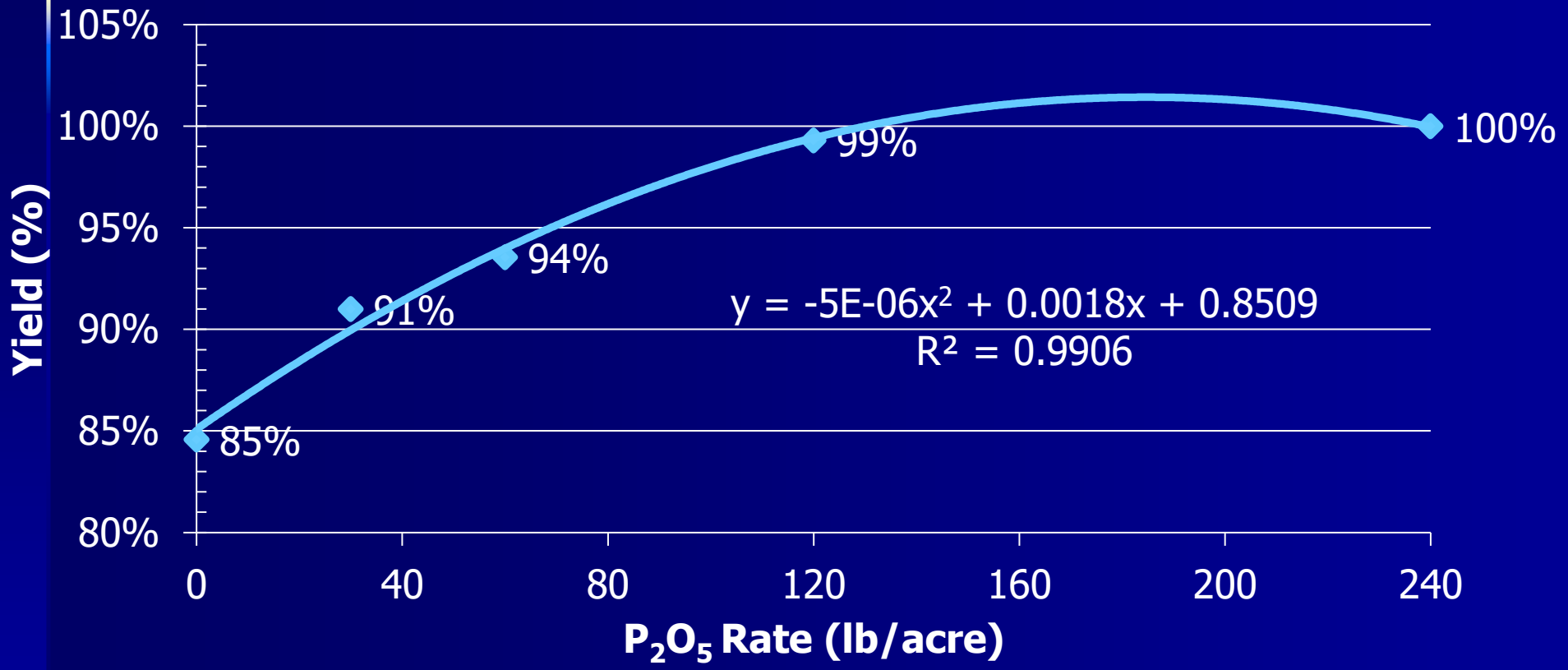

240 lb/a Rate @ 7ppm P
140 to 165 lb/a P2O5 Optimum First Year
30 lb/a Rate @ 6 ppm P
120 lb/a Rate @ 13 ppm P
0 lb/a Rate @ 5 ppm P
60 lb/a Rate @ 5 ppm P
April 10, 2019
P Rate Experiment

2018 – 2021 Yield of Alfalfa as Influenced by Phosphorus Rate



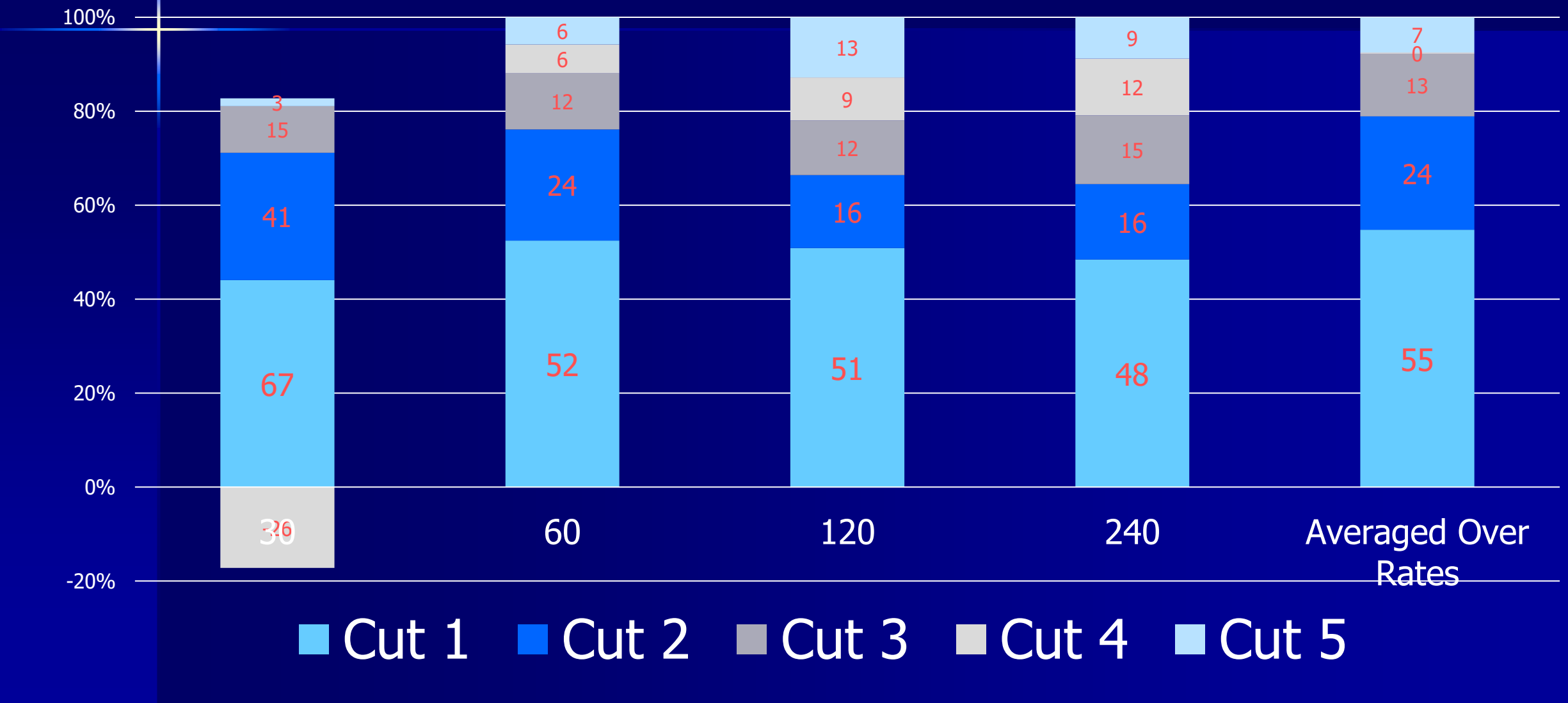
Beginning soil test was 8.3 ppm

2019 – 2020 Total Yield of Alfalfa as Influenced by Phosphorus Rate



Beginning P soil test level was 6.7 and 5.7 ppm in 2019 and 2020, respectively.

% of Increase In Yield Over the Control As Influenced by Cutting and Phosphorus Rate

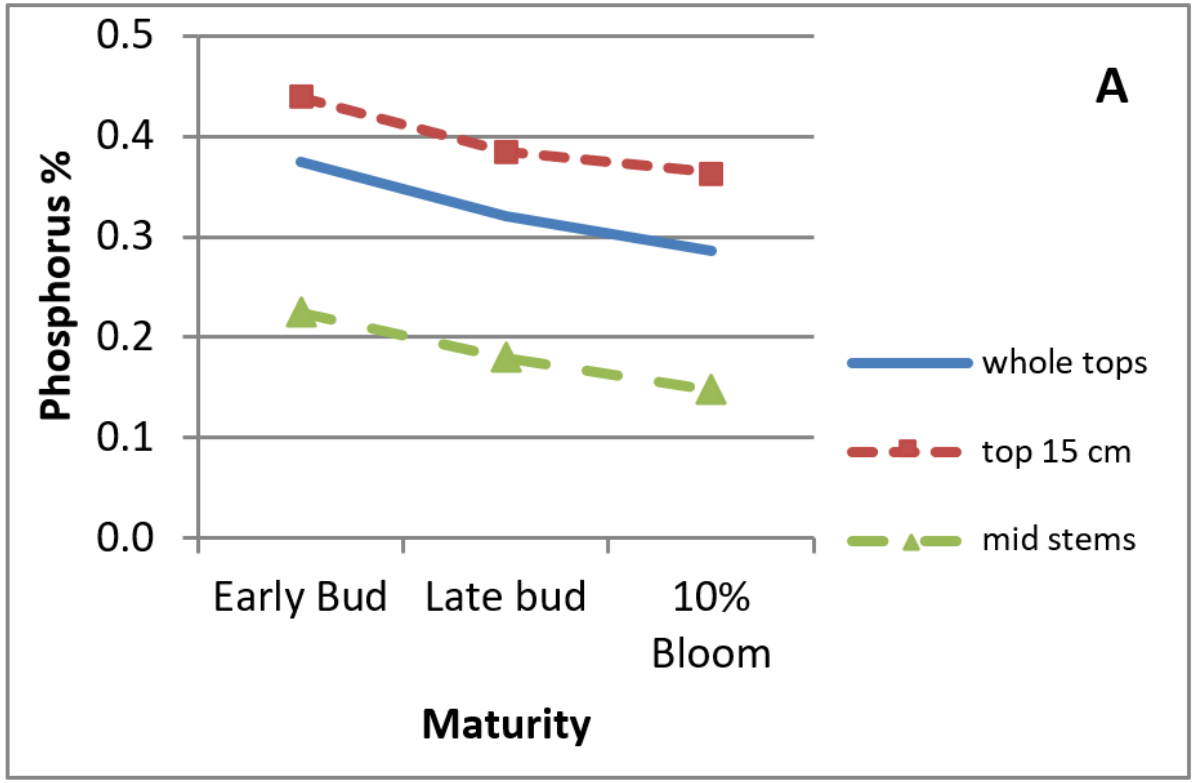


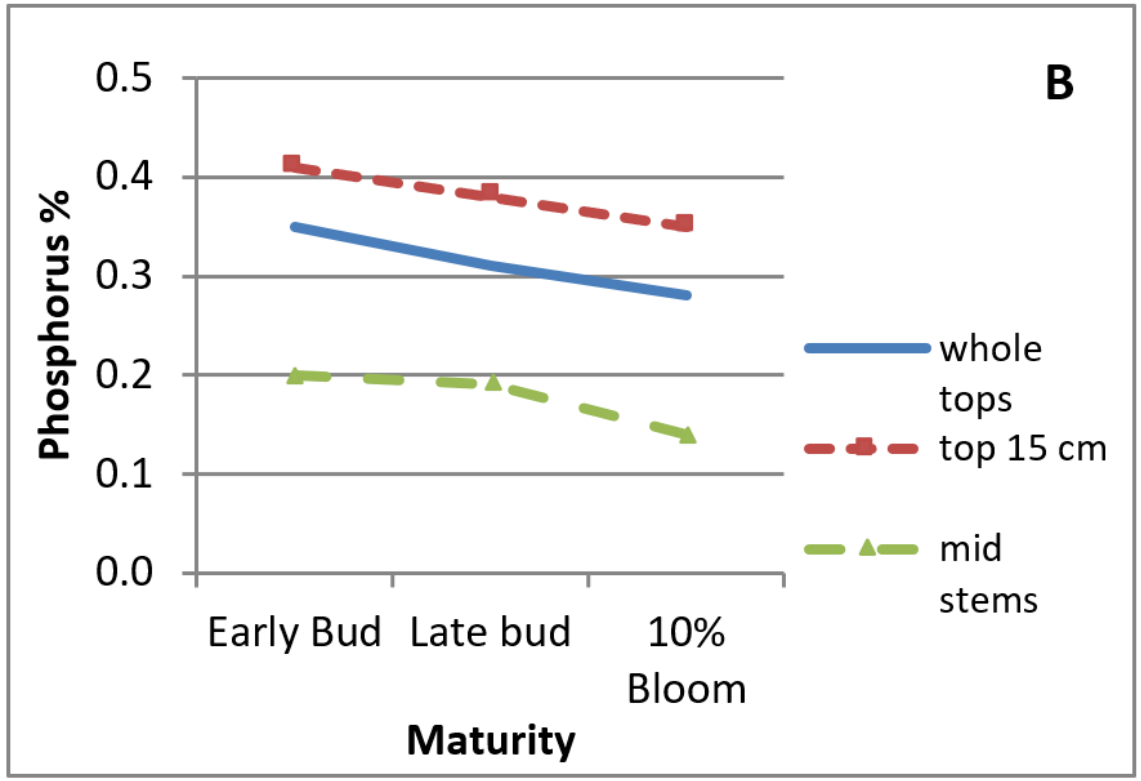
Whole Plant Critical Levels by University Guides

Source	Critical Phosphorus Tissue Content %
PNW Guide PNW0611 Nutrient Management Guide for Dryland and Irrigated Alfalfa	0.2-0.25 at first flower, whole plant
Publication 3512 Irrigated Alfalfa Management (Chapter 6)	0.28-0.26 whole plants from baled hay at early bud and bud stage, respectively. (Appendix Table A)

Maturity and sampling portion affect on phosphorus content

Orloff and Putnam Improved Methods for Nutrient Tissue Testing in Alfalfa in 2010 (A) and 2011 (B) average of 10 farms **and all cuttings**. Whole tops and top 15 cm are expressed as total P, whereas mid-stem phosphorus is expressed as PO_4-P.

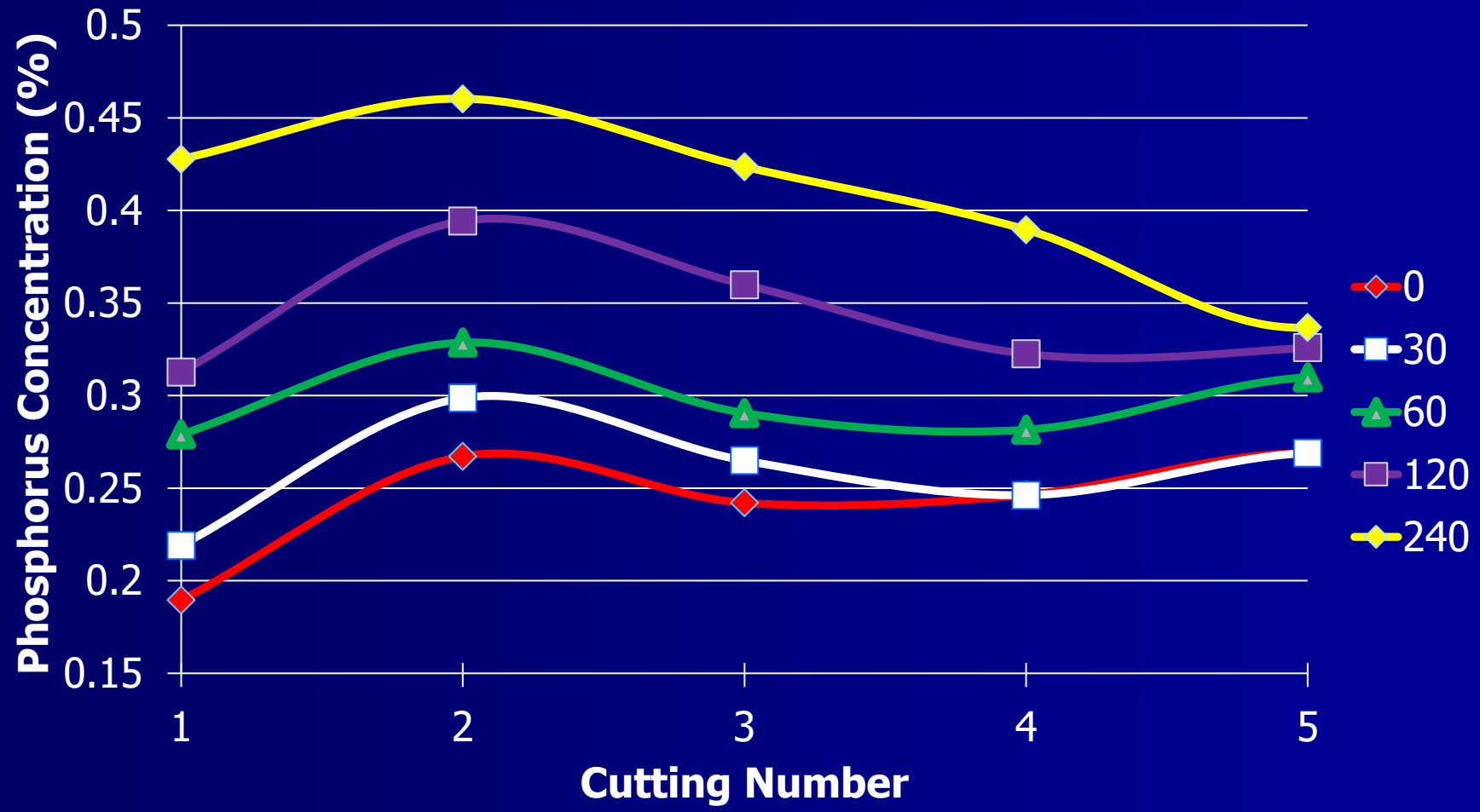




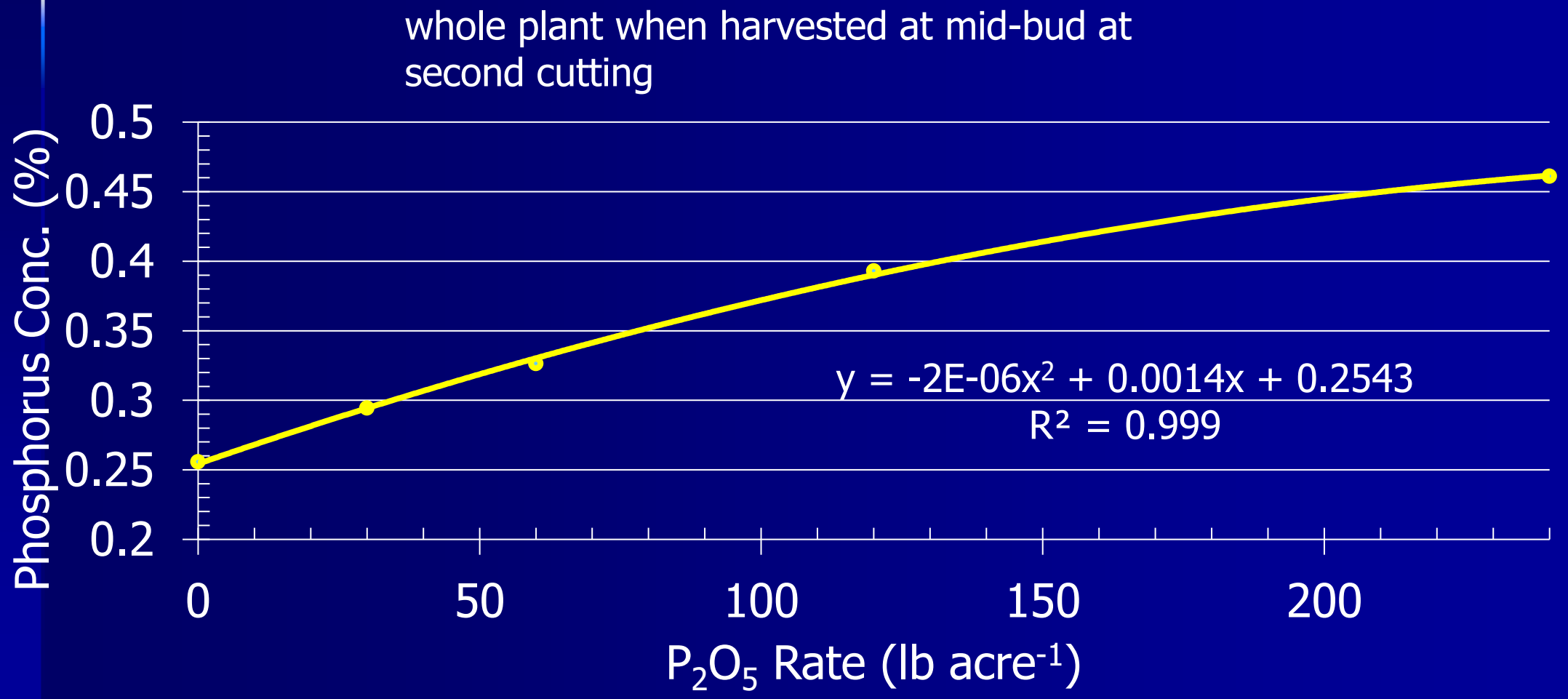
2019 Tissue P Concentration at Harvest by Cutting and Rate

(whole plant when harvested at mid-bud)

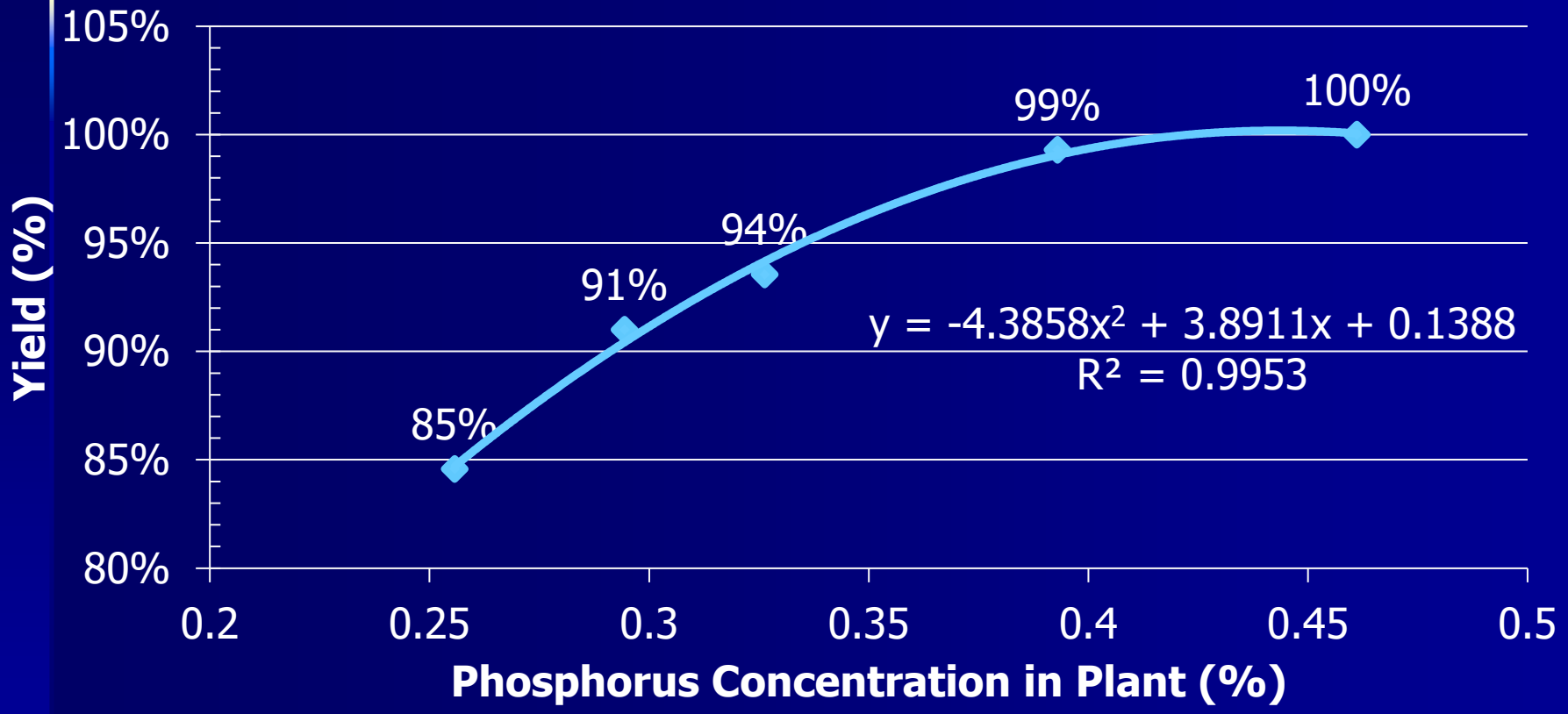
150 and 160 lb P_2O_5 acre maximized gross revenue minus fert. cost, at 150 and 200 $/ton of alfalfa hay, respectively. Assumes $560 per ton of MAP.



2nd & 3rd Year Alfalfa Tissue Conc. At 2nd Cut as Influenced by Phosphorus Rate



2019 – 2020 Total Yield of Alfalfa as Influenced by Phosphorus Rate



Beginning P soil test level was 6.7 and 5.7 ppm in 2019 and 2020, respectively.

Two types of tests

- ICP
  - Ideal test but may cost $53 / sample
  - Fertilizer is too expensive to have the wrong answer

2nd Cut Harvest P Conc. (%)	Lbs of P_2O_5 to reach this from previous 0.01 %	Amount of P_2O_5 required to reach Optimum %	Dollars lost acre^{-1} year^{-1} for misapplying P when P is \$0.54 lb of P_2O_5 and Alfalfa is \$150 ton^{-1}	Dollars lost acre^{-1} year^{-1} for misapplying P when P is \$1.04 lb of P_2O_5 and Alfalfa is \$300 ton^{-1}
0.27	8	133	119	251
0.31	8	102	71	149
0.35	9	67	31	66
0.41	13	0	0	0
0.45	20	-65	27	54

Inflation Correction Factor for P Fertilizer Rates Based on Hay and Fertilizer Price In Alfalfa

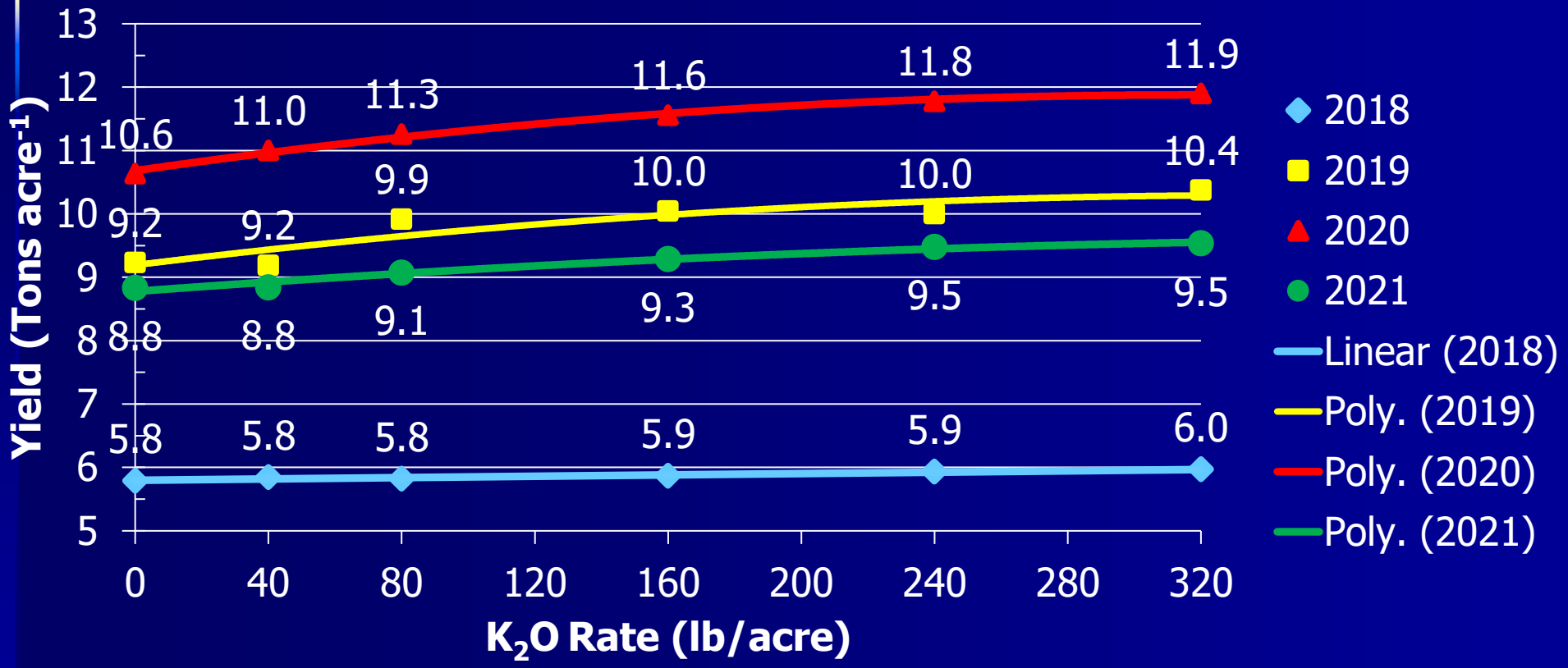
Fertilizer Price Of MAP (11-52-0)	Hay Price $150 per Ton	Hay Price $225 per Ton	Hay Price $300 per Ton
Base Price $ 560/Ton of MAP ($0.54 lb P_2O_5)	1.00 (146 lb $acre^{-1}$)	1.09	1.14
95% increase in Fert. Price $1090/Ton ($1.04 lb P_2O_5)	0.73	0.92	1.01
189% Increase in Fert. Price $1620/Ton ($1.56 lb P_2O_5)	0.47	0.75	0.88

Change is Soil Test P Levels (Olson P) and Total Removed from 2017 to 2021

P_2O_5 Rate Applied	Total # of P_2O_5 Removed	Fall Soil Test P 2017	Fall Soil Test P 2020	Fall Soil Test P 2021
lb P_2O_5 a^{-1}	lb P_2O_5 a^{-1}	ppm P	ppm P	ppm P
0	228	8.4	5.50	5.25
30	265	8.6	4.75	7.5
60	293	7.9	3.25	5.25
120	**382**	**7.6**	**6.00**	**8.5**
240	455	9.1	7.50	12.25

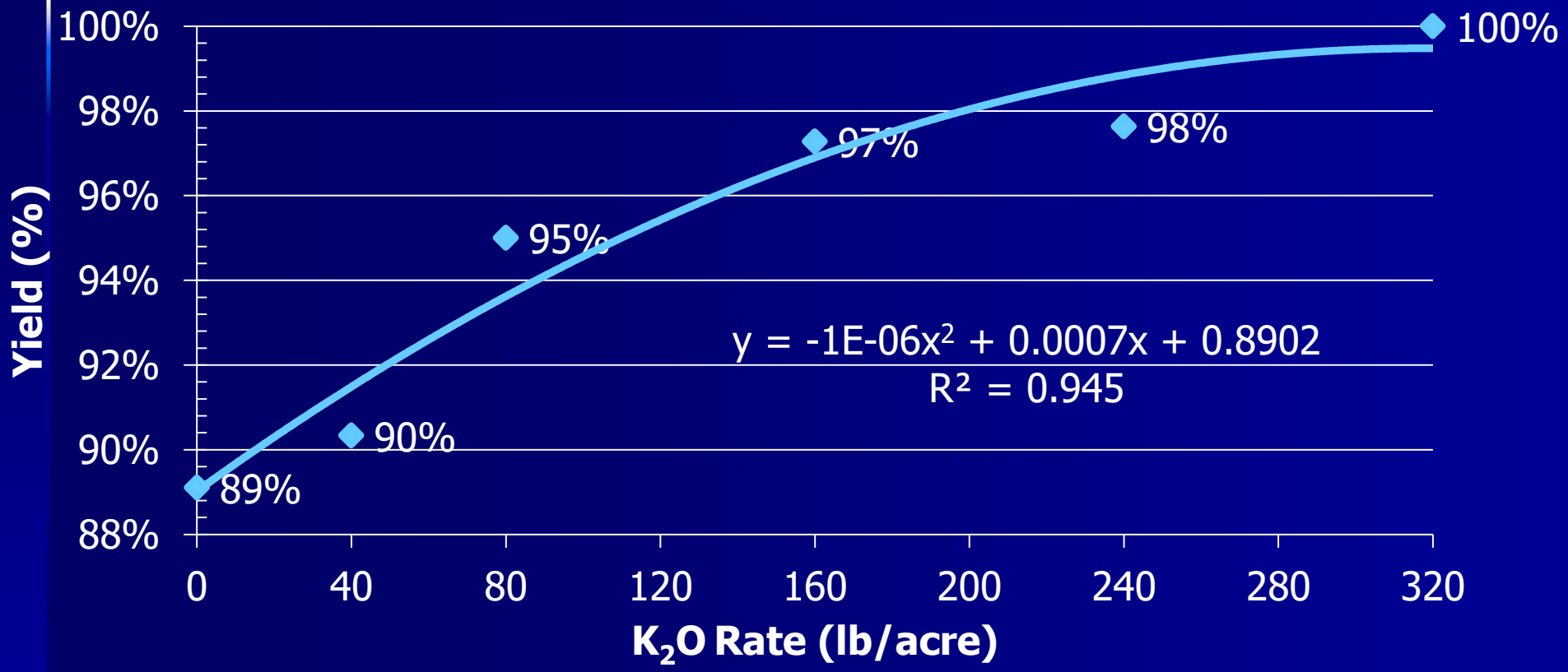
Potassium Study and Interpretation

2018 – 2021 Total Yield of Alfalfa as Influenced by Potassium Rate



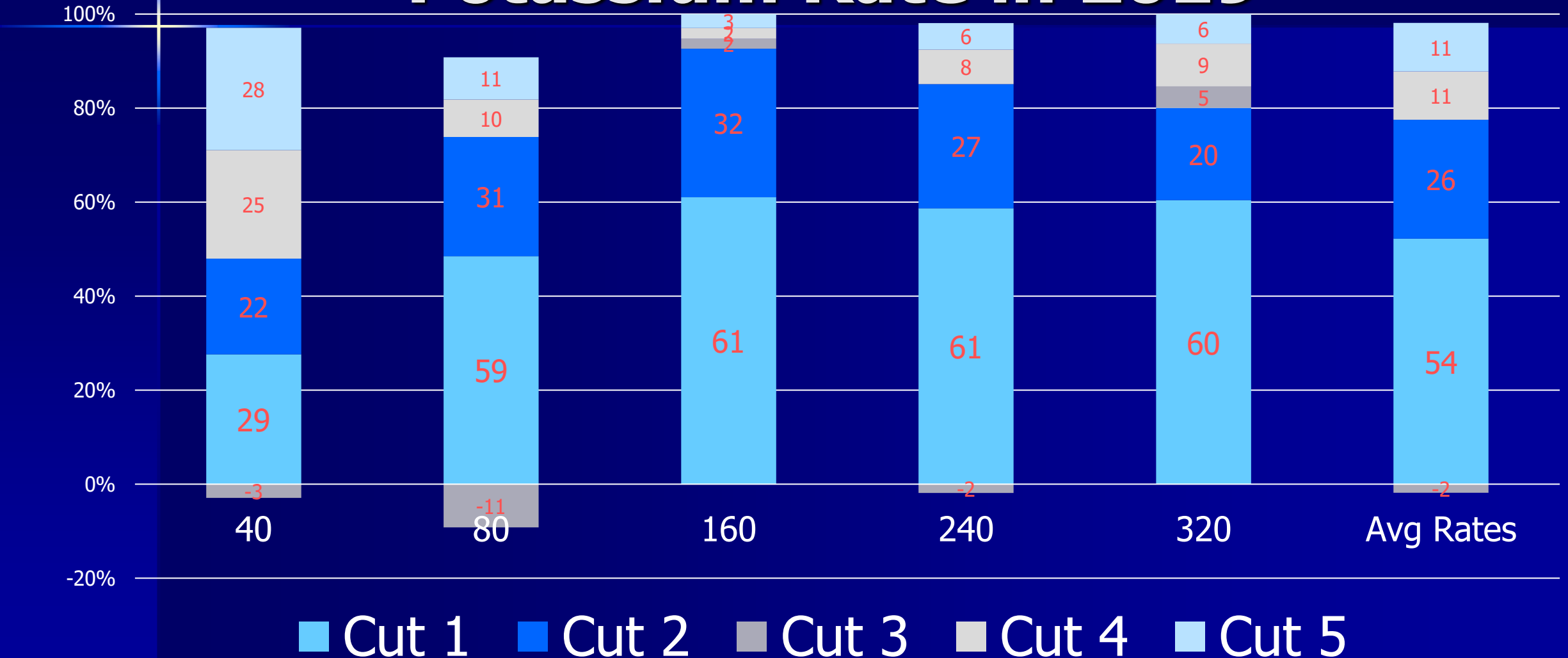
Beginning soil test level was 101 ppm K

2019 – 2020 Total Yield of Alfalfa as Influenced by Potassium Rate

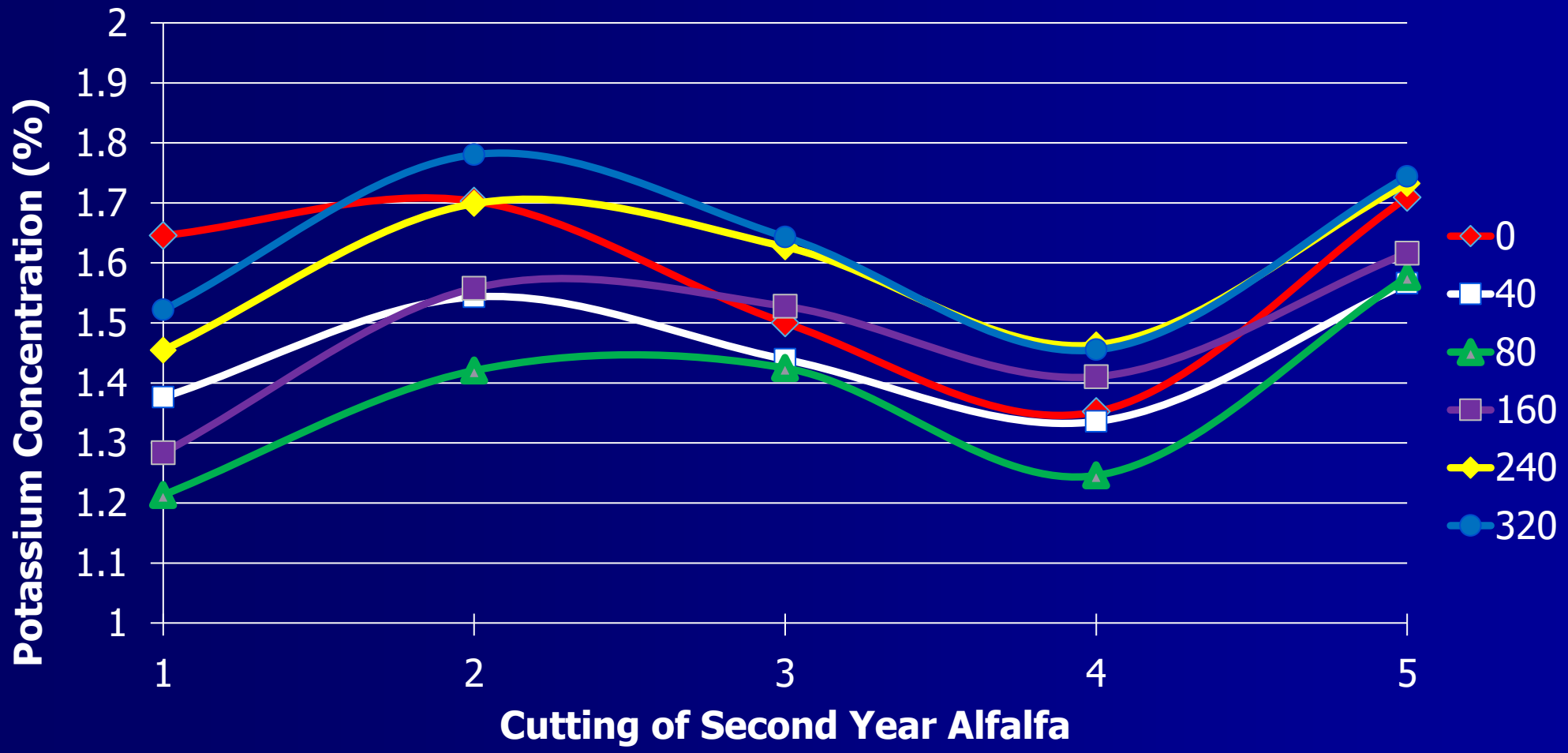


Beginning K soil test levels was 86 & 79 ppm in 2019 and 2020, respectively.

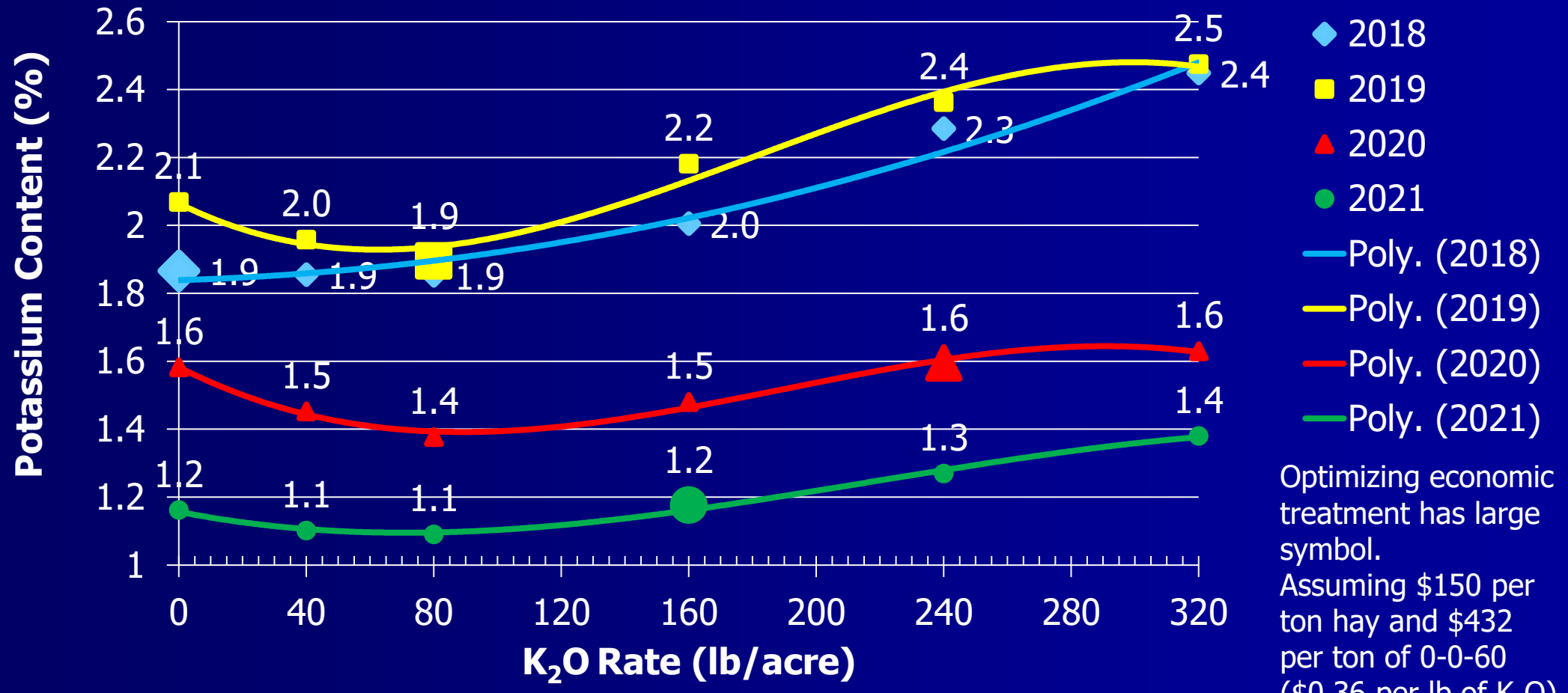
Percent of K Uptake by Cutting and Potassium Rate in 2019



2019 Tissue K Concentration at Harvest by Cutting and Rate After Spring Applications of K_2O (lb/acre)

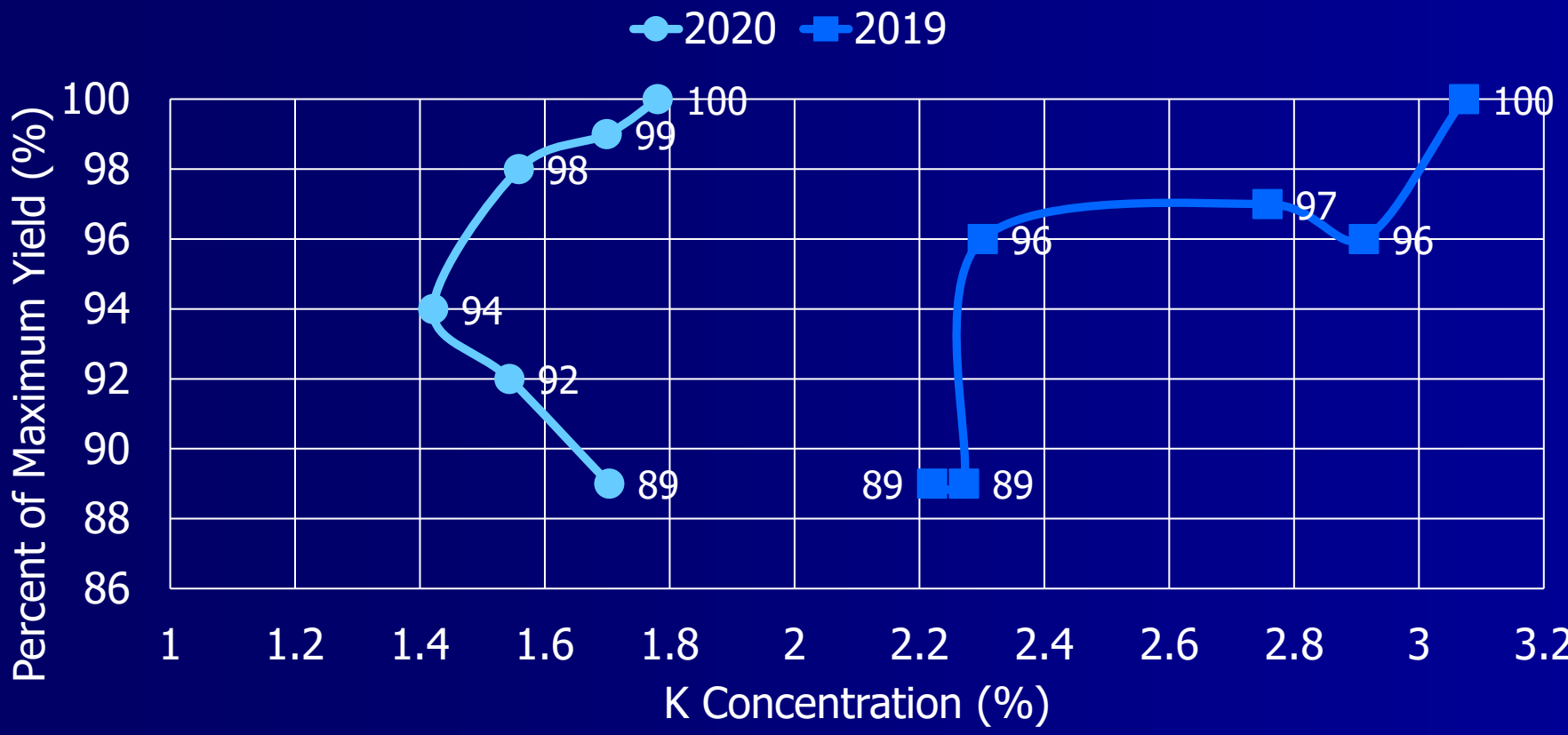


2018 – 2021 Potassium Content Averaged over Cuttings



Optimizing economic treatment has large symbol.
Assuming $150 per ton hay and $432 per ton of 0-0-60 ($0.36 per lb of K_2O)

2019 – 2020 Total Yield of Alfalfa as Influenced by Potassium Rate



CA Alfalfa Book Ch. 6
Whole Plant Tissue Conc. Early bud to bud stage Adequate
1.1 to 1.4%

PNW Guide 0611
Whole plant, First flower
2.0 to 2.5%

Inflation Correction Factor for K_2O Fertilizer Rates Based on Hay and Fertilizer Price In Alfalfa

Fertilizer Price Of KCl^- (0-0-60)	Hay Price $150 per Ton	Hay Price $225 per Ton	Hay Price $300 per Ton
Base Price $ 446/Ton of KCl^- (0-0-60), $0.37 lb K_2O	1.00	1.21	1.30
122% increase in Fert. Price $990/Ton, $0.83 lb K_2O	0.22	0.71	0.94
244% Increase in Fert. Price $1534/Ton, $1.28 lb K_2O	0.00	0.21	0.57

K_2O Rate	Spring Soil Test K 2018	Spring Soil Test K 2019	Spring Soil Test K 2020	Fall Soil Test K 2021	Spring Soil Test K 2022	Reduction from Start (ppm)
(lb/a)	----------ppm----------					Sp. 18-Sp. 21
0	106.8	90.5	79.0	51.5	71.6	**35**
40	104.3	85.8	69.0	58.5	76.3	**28**
80	87.0	82.3	82.8	47.8	74.6	**12**
160	106.0	88.0	83.0	52.3	73.25	**33**
240	106.3	85.0	83.5	64.0	73.5	**33**
320	92.8	84.8	78.3	62.3	89.75	**3**

How much K_2O are we hauling off our fields?

K_2O Rate (lb/a)	2018 K_2O Rem-oved (lb/a)	2019 K_2O Rem-oved (lb/a)	2020 K_2O Rem-oved (lb/a)	2021 K_2O Rem oved (lb/a)	0-1′ Drop in K Test (ppm)	1-2′ Drop in K Test (ppm)	2-3′ Drop in K Test (ppm)
0	196.1	458.3	216	201.5	35	18	14
40	212.1	431.5	197	189.8	28	15	8
80	213.5	450.8	189	191.2	12	11	5
160	239.3	525.6	215	212.7	33	17	-3
240	308.4	567.2	239	236.8	33	14	23
320	300.2	616.1	250	259.5	3	19	6

Goal to put back what we took off as potassium or maximize yield

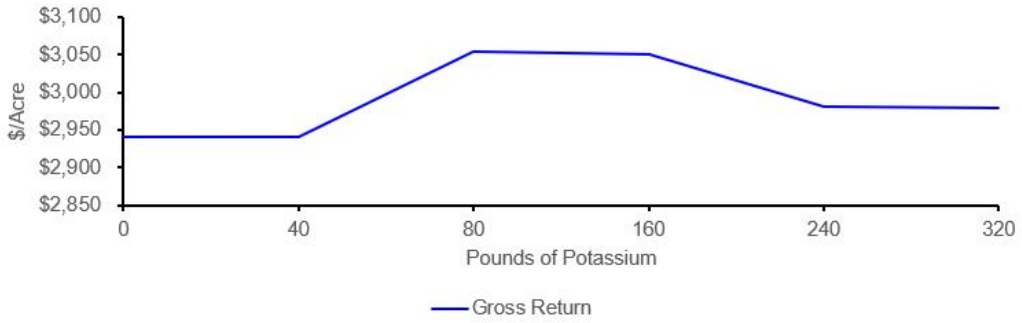
- Averaging over 4 years we pulled off 356 lbs/acre/year of K_2O
- Year two was the highest at 616 lb/acre of K_2O

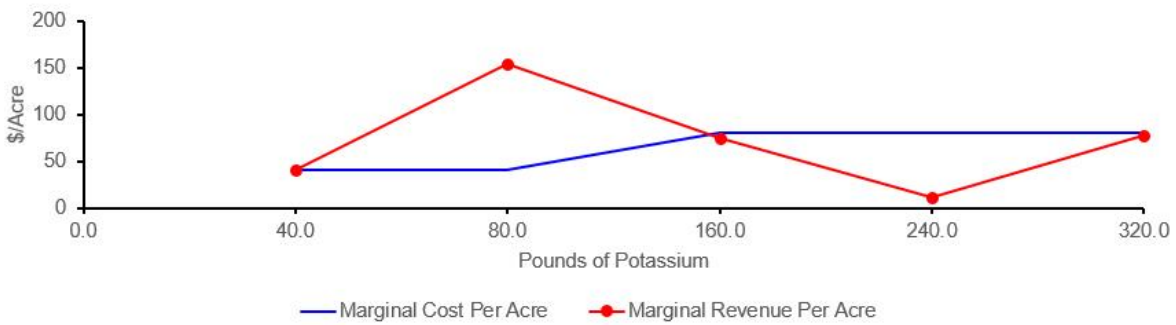
Goal	Fertilizer Price (0-0-60)		
	$ 446/ton of Fert. $0.37 lb K_2O	$990/ton of Fert. $0.83 lb K_2O	$1,534/ton of Fert. $1.28 lb K_2O
Optimizing Annual Profit K Rate	265 lbs/acre/yr	191 lbs/acre/yr	116 lbs/acre/yr
Total K Replacement Rate or Maximizing Yield	356 lbs/acre/yr	356 lbs/acre/yr	356 lbs/acre/yr
Increased Fert. Cost $/acre	$34/acre/yr	$137/acre/yr	$307/acre/yr

Sheet View | Workbook Views | Show | Zoom | Window | Macros

G3 =F3/100

			% of Max Yield	Yield Per Acre	Gross Return	Yield Change	Gross Revenue Per Ac	Marginal Revenue Per Acre		Marginal Cost Per Acre	Fertilizer Cost Per Acre	Fertilizer (Lbs. per Acre)
Yield Goal Per Ac	**11**		89%	9.80	$ 2,940.61		$ 2,940.61				$ -	0
Starting P (PPM)	**75-100 ppm K**		90%	9.94	$ 2,941.12	0.14	$ 2,981.12	$ 40.51	>	$ 40.00	$ 40.00	40
Hay Price	**300**		95%	10.45	$ 3,055.14	0.51	$ 3,135.14	$ 154.03	>	$ 40.00	$ 80.00	80
$/Lb. P	**1**		97%	10.70	$ 3,050.24	0.25	$ 3,210.24	$ 75.10	<	$ 80.00	$ 160.00	160
			98%	10.74	$ 2,981.92	0.04	$ 3,221.92	$ 11.68	<	$ 80.00	$ 240.00	240
			100%	11.00	$ 2,980.00	0.26	$ 3,300.00	$ 78.08	<	$ 80.00	$ 320.00	320





Intro | Phosphorus | Po | Plot Area

This research was funded by:


Questions?