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/Soil test recommendation studies

## Quick Facts



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A large selection of soil test laboratory services are available to Colorado farmers.

In a controlled experiment laboratory recommendations were compared to determine if university fertilizer recommendations are adequate to produce optimum economic yields, and whether the variability in recommendations results in different yields and to determine each recommendation's cost and its relationship to yield.

The results indicated that suggested fertilizer recommendations made by laboratories on a given field can vary considerably.

Farmers must be aware of this variability and evaluate suggested fertilizer recommendations in relation to fertilizer research results and their individual experience for the area.

Field experiments were conducted in 1981 at five locations and in 1982 at four locations to determine variations among fertilizer recommendations of several soil testing laboratories operating within Colorado. A bulk composite soil sample was collected from each location prior to initiation of the study. This bulk soil sample was thoroughly mixed and subdivided into enough subsamples to send one to each laboratory in the study along with the same production information for each location.

Significant variation existed among fertilizer recommendations. The cost of recommended fertilizer varied by as much as 100 percent, yet yields from all recommendations did not differ significantly at any location.

## Introduction

A large selection of soil test laboratory services are available to Colorado farmers. These services are provided by independent commercial laboratories and by the Colorado State University Soil Testing Laboratory. It is estimated that independent commercial laboratories test 80 percent

## Soil test recommendation studies

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of the soil samples in Colorado each year.

The objective of these experiments was to compare, under controlled conditions, university recommendations with other laboratories to determine if university fertilizer recommendations are adequate to produce optimum economic yields. A second objective was to determine if the variability in recommendations results in different yields and to determine each recommendation's cost and its relationship to yield.

## Methods

Soil samples were taken to plow depth from each experimental area. These samples were thoroughly mixed, dried and divided into four to six subsamples. Each subsample was sent to four to six preselected laboratories operating within the test area. The samples were not identified as CSU research material. Each laboratory was asked to make fertilizer recommendations for the yield goal and crop specified. Corn was the test crop at all locations.

The experimental design was a randomized complete block with four replications. The fertilizer recommendation from each laboratory served as a treatment with fertilizer being weighed out for each plot. All nutrients suggested by the laboratory were assumed to be needed and were applied. All fertilizers were broadcast and incorporated prior to planting. Seedbed preparation, planting, weed control and other cultural practices are those used by the cooperator on the rest of the field. Harvesting was accomplished by a small plot combine, and plot weights and grain moisture were taken at harvest. The yield results are reported in bushels per acre.

Fertilizer cost was based upon local fertilizer prices for spring, 1981 and 1982. Colorado State University is the only soil testing laboratory identified specifically in this report. All others are identified by letters only.

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To simplify technical terminology, trade names of products and equipment occasionally will be used. No endorsement of products named is intended nor is criticism implied of products not mentioned.

## Results and Discussion

Comparative soil test recommendations were conducted at five different locations in 1981 and are presented in Tables 1 to 5. The actual fertilizer recommendation, fertilizer costs and resulting yields are given in the tables for each location. Statistical analysis of the yield results indicated no significant difference in yield for any of the locations.

The comparative soil test recommendations for 1982 are presented in Tables 6, 8, 9 and 10. For two locations (Fort Collins and Greeley), the soil test results are presented in Table 7. In comparing soil test results, it is important to keep in mind that chemical procedure differences may exist that would make comparisons of some tests not possible with the given information. However, the soil test interpretations as reflected in fertilizer recommendations can be compared.

The results indicated that suggested fertilizer recommendations made by laboratories on a given field can vary considerably. Farmers must be aware of this variability and evaluate suggested fertilizer recommendations in relation to fertilizer research results and their experience for the

area. If the recommendations appear unusual for the area, it would be wise to evaluate their use on a limited area before investing heavily in fertilizer for the entire field.

Yields were not statistically significantly different at any location. The recommendation given by each laboratory produced the same yield, regardless of fertilizer cost. These results indicated that the recommendations from the CSU Soil Testing Laboratory resulted in the lowest fertilizer costs at the nine locations in this report.

Reliable fertilizer recommendations are the result of soil test calibrations developed from extensive field and greenhouse research. In order to interpret a soil test value, it is necessary to correlate the test value with known field response for various crops. In all soil testing programs, tables are prepared or computer programs written, showing soil test results and suggested fertilizer use for various crops. Soil testing laboratories must have access to both local and regional soil test-crop response correlation research in order to develop economical fertilizer recommendations.

**Table 1: Comparative soil test recommendations on irrigated corn at the Fort Collins location—1981.**

Nutrient	Laboratory recommendations—lbs/A <sup>1</sup>				
	CSU	B	C	D	Check
Nitrogen, N	30	200	150	180	—
Phosphorus, P <sub>2</sub> O <sub>5</sub>	50	120	90	40	—
Potassium, K <sub>2</sub> O	—	55	30	—	—
Sulfur, S	—	8	30	—	—
Magnesium, Mg	—	10	—	—	—
Zinc, Zn	10	8	14.5	8	—
Manganese, Mn	—	2	—	—	—
Boron, B	—	0.5	—	1	—
Fertilizer cost, \$	29.93	106.51	80.98	64.83	0
Yield <sup>2</sup> bu/A	164	172	177	175	177

<sup>1</sup>Recommendations were made for a yield goal of 175 bu/A

<sup>2</sup>Yield difference not significant, LSD (0.5) = N.S.

**Table 2: Comparative soil test recommendations on irrigated corn at the Greeley location—1981.**

Nutrient	Laboratory recommendation—lbs/A <sup>1</sup>				
	CSU	B	C	D	E
Nitrogen, N	70	200	174	170	150
Potassium, K <sub>2</sub> O	—	80	30	40	—
Sulfur, S	—	3.3	—	10	—
Boron, B	—	0.5	—	—	—
Fertilizer cost, \$	16.97	58.10	46.18	52.86	36.37
Yield <sup>2</sup> bu/A	184	175	171	162	173

<sup>1</sup>Recommendations were for a yield goal of 175 bu/A

<sup>2</sup>Yield difference not significant, LSD (0.5) = N.S.

**Table 3: Comparative soil test recommendations on irrigated corn at the Delta location—1981.**

Nutrient	Laboratory recommendation—lbs/A <sup>1</sup>					
	CSU	C	I	J	K	L
Nitrogen, N	175	175	140	150	210	220
Phosphorus, P <sub>2</sub> O <sub>5</sub>	—	60	30	50	20	40
Potassium, K <sub>2</sub> O	—	30	40	—	130	120
Zinc, Zn	—	—	2.5	—	—	—
Iron, Fe	—	—	5	—	—	—
Fertilizer cost, \$	43.42	61.73	52.64	48.93	73.93	79.11
Yield <sup>2</sup> bu/A	194	188	181	175	184	192

<sup>1</sup>Recommendations were for a yield goal of 175 bu/A<sup>2</sup>Yield difference not significant, LSD (.05) = N.S.**Table 4: Comparative soil test recommendations on irrigated corn at the Fruita location—1981.**

Nutrient	Laboratory recommendations—lbs/A <sup>1</sup>					
	CSU	C	I	J	K	L
Nitrogen, N	135	220	100	160	260	240
Phosphorus, P <sub>2</sub> O <sub>5</sub>	30	100	60	90	120	210
Potassium, K <sub>2</sub> O	—	55	—	—	225	140
Sulfur, S	—	—	50	—	—	—
Zinc, Zn	—	—	2.5	—	—	—
Iron, Fe	—	—	0.5	—	—	—
Boron, B	—	1	—	—	—	1
Fertilizer cost, \$	36.02	86.97	63.10	61.64	123.33	138.14
Yield <sup>2</sup> bu/A	157	176	169	169	176	166

<sup>1</sup>Recommendations were for a yield goal of 150 bu/A<sup>2</sup>Yield difference not significant, LSD (.05) = N.S.**Table 5: Comparative soil test recommendations on irrigated corn at the Prowers County location—1981.**

Nutrient	Laboratory recommendations—lbs/A <sup>1</sup>					
	CSU	B	C	D	F	H
Nitrogen, N	—	125	120	110	—	160
Phosphorus, P <sub>2</sub> O <sub>5</sub>	—	25	30	—	—	—
Potassium, K <sub>2</sub> O	—	20	30	—	—	—
Zinc, Zn	—	—	—	3	—	—
Fertilizer cost, \$	0	39.24	40.62	29.67	0	38.80
Yield <sup>2</sup> bu/A	209	207	203	198	193	184

<sup>1</sup>Recommendations were for a yield goal of 175 bu/A<sup>2</sup>Yield difference not significant, LSD (.05) = N.S.**Table 6: Comparative soil test recommendations on irrigated corn at the Fort Collins location—1982.**

Nutrient	Laboratory recommendation—lbs/A <sup>1</sup>						
	CSU	B	C	D	E	F	Check
Nitrogen, N	170	220	225	180	150	255	—
Phosphorus, P <sub>2</sub> O <sub>5</sub>	50	105	100	110	90	145	—
Potassium, K <sub>2</sub> O	—	65	40	60	50	35	—
Sulfur, S	—	3.3	—	20	100	16	—
Zinc, Zn	10	9	—	8	5	3	—
Manganese, Mn	—	2	—	3	—	4	—
Copper, Cu	—	—	—	0.5	—	—	—
Iron, Fe	—	—	—	—	—	3	—
Boron, B	—	—	—	1	—	1	—
Fertilizer cost, \$	63.60	104.21	86.26	102.79	92.60	123.71	0
Yield <sup>2</sup> bu/A	150	138	135	143	140	138	143

<sup>1</sup>Recommendations were made for a yield goal of 175 bu/A<sup>2</sup>Yield difference not significant, LSD (.05) = N.S.

**Table 7: Soil test results from six laboratories on a split soil sample, Fort Collins—1982.**

Soil Test	Laboratory					
	CSU	B	C	D	E	F
Soil pH	7.7	7.8	8.1	7.7	8.3	8.1
Salts, mmho/cm	0.9-L	0.5	0.3	0.3	—	0.4-L
O.M., %	1.3	1.2	1.1	2.1	1.9	1.3-L
Nitrate, ppm N	18-L	5-VL	—	VL	25	13M
Avail. P, ppm	8-H	17-M	9-VL	62	10	2-VL
Avail. K, ppm	267-VH	370-H	232-L	410	210	275-VH
Exch. Ca, ppm	—	4280-VH	4841	18400	2500	3230-H
Exch. Mg, ppm	—	590-VH	449	1170	410	484-VH
Avail. Zn, ppm	0.6-L	0.4-VL	—	0.02	0.3	0.5-L
Avail. Fe, ppm	9.4-H	23-H	—	2.8	4.2	10-L
Avail. Mn, ppm	4.8-H	10.5-M	—	5.3	—	7-L
Avail. Cu, ppm	3.2-H	1.6-H	—	2.1	—	1.2-M
Avail. S, ppm	—	30-M	—	6	—	7-L
Hot H <sub>2</sub> O B, ppm	—	—	—	0.9	—	1-M
CEC, me/100g	—	27.7	28.8	—	37.8	21.6
Lime	H	H	VH	—	H	H
Texture	CL	—	—	—	—	—

VL—Very Low, M—Medium, H—High, VH—Very High  
 Sampled Spring of 1982

**Table 8: Comparative soil test recommendations on irrigated corn at the Greeley location—1982.**

Nutrient	Laboratory recommendation—lbs/A <sup>1</sup>					
	CSU	B	C	D	E	F
Nitrogen, N	205	210	235	180	250	255
Phosphorus, P <sub>2</sub> O <sub>5</sub>	—	—	—	—	30	—
Potassium, K <sub>2</sub> O	—	100	85	130	40	50
Sulfur, S	—	70	—	60	—	—
Magnesium, Mg	—	25	—	15	—	—
Manganese, Mn	—	3	—	5	—	—
Copper, Cu	—	—	—	0.5	—	—
Fertilizer cost, \$	60.30	92.11	81.17	88.92	85.13	82.06
Yield <sup>2</sup> bu/A	186	189	185	210	180	192

<sup>1</sup>Recommendations were for a yield goal of 175 bu/A

<sup>2</sup>Yield difference not significant, LSD (.05) = N.S.

**Table 9: Comparative soil test recommendations on irrigated corn at the Fruita location—1982.**

Nutrient	Laboratory recommendation—lbs/A <sup>1</sup>					
	CSU	B	C	D	E	Check
Nitrogen, N	180	262	260	140	200	—
Phosphorus, P <sub>2</sub> O <sub>5</sub>	30	180	95	20	50	—
Potassium, K <sub>2</sub> O	—	50	55	—	50	—
Sulfur, S	—	—	24	—	—	—
Boron, B	—	—	1.2	—	—	—
Fertilizer cost, \$	62.40	142.00	125.04	47.60	87.00	0
Yield <sup>2</sup> bu/A	79	97	97	77	80	25

<sup>1</sup>Recommendations were for a yield goal of 150 bu/A

<sup>2</sup>Average of four replications, LSD (.05) = 17.9

**Table 10: Comparative soil test recommendations on irrigated corn at the Delta County location—1982.**

Lab recommendation—lbs/A <sup>1</sup>					Lab recommendation—lbs/A <sup>1</sup>				
Nutrient	CSU	B	C	D	Nutrient	CSU	B	C	D
Nitrogen, N	—	135	140	40	Fertilizer cost, \$	0	100.10	71.90	12.00
Phosphorus, P <sub>2</sub> O <sub>5</sub>	—	120	65	—	Yield <sup>2</sup> bu/A	200	212	227	193
Potassium, K <sub>2</sub> O	—	100	45	—					

<sup>1</sup>Recommendations were for a yield goal of 150 bu/A

<sup>2</sup>Yield difference not significant, LSD (.05) = N.S.