The Effects of Wide Variations in Soil and Weather on the Growth and Nutritive Value of Turnip Greens

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by

J. A. Rigney
H. L. Lucas
Mary J. Harris

Institute of Statistics
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Description of the Soils-Weather Project Data

I. Data on IBM Cards.

At the Southern Cooperative meetings in March 1952, it was suggested that before making overall analysis of the data of the soils-weather project; the data should be checked by each station. The objective was to make the data as complete, consistent and correct as possible.

The data on IBM cards were tabulated and checked in Raleigh and all errors corrected. The new cards were then tabulated and sent to the various stations for checking and corrections.

The 1948, 1949, 1950 and 1951 corrected data are now on IBM cards in the following form:

A. NUTRIENT DATA CARDS (No. 1, 2, 5, 6)

Column	Item
1	Card Code (1, 2, 5 or 6)
2	Station No.
3,4	Year
5	Season
6,7	Month
8,9	Date
10	Planting (1, 2 or 3)
11-14	% Dry Matter
15-17	% Nitrogen - Dry Basis
18-21	Ascorbic Acid - Dry Basis (mg per 100 gm)
22-25	Thiamine - Dry Basis (mcg per 100 gm)
26-29	Riboflavin- Dry Basis (mcg per 100 gm)
30-33	Carotene - Dry Basis (mg per 100 gm)
34-37	Calcium - Dry Basis (m.e. per 100 gm)
38-40	Magnesium - Dry Basis (m.e. per 100 gm)
41-43	% Phosphorus - Dry Basis
44-47	Iron - Dry Basis (mg per 100 gm)
48-50	% Fat - Dry Basis
51-54	% Ash
55-57	% Fiber - Dry Basis

Column	Item
58-61	Potassium - Dry Basis (m.e. per 100 gm)
62-64	Sodium - Dry Basis (m.e. per 100 gm)
65-66	Days from Planting
79	Site No.

Cards 1 and 2 are the data for the duplicate samples taken from the field, and cards 5 and 6 are the data for the duplicate samples taken from the Sand Cultures.

B. AIR CLIMATE DATA CARD (No. 3)

Column	Item
1	Card Code - 3
2	Station No.
3,4	Year
5	Season
6,7	Month
8,9	Date
10-12	Maximum Daily Air Temperature (°F)
13-14	Minimum Daily Air Temperature (°F)
15-16	Range (Max. - Min. Air Temperature) (°F)
17-19	Daily Precipitation (hundredth of an inch)
20-22	Daily Light Intensity (Relative gm cal/cm^2/day)
23-25	Daily Wind Flow (mi/day)
26-28	Daily Evaporation (inches/day)
29-30	Mean Air Temperature (0800-1400) (°F)
31-32	" " " (1400-2000) (°F)
33-34	" " " (2000-0800) (°F)
35-37	Mean Relative Humidity (0800-1400) %
38-40	" " " (1400-2000) %
41-43	" " " (2000-0800) %
44-46	Radiation (Before 0800) (gm cal/Sq. cm)
47-50	" (0800-1400) (" " " ")
51-54	" (1400-2000) (" " " ")
55-58	Total Radiation (0800-0800) (gm cal/Sq. cm)
79	Site No.

C. SOIL CLIMATE DATA CARD (No. 4)

Column	Item
1	Card Code -4
2	Station
3,4	Year
5	Season
6,7	Month
8,9	Date
10-12	Maximum Soil Temperature - 2" depth (°F)
13-14	Minimum Soil Temperature - 2" depth (°F)
15-16	Range (max. - min. Soil Temperature 2" depth)
17-19	Mean Soil Temp. - 2" depth (0800-2000)
20-21	" " " - 2" depth (2000-0800)
22-23	" " " - 8" depth (av. of max. and min. for 12 A.M. to 12 A.M. day) or (8 A.M. - 8 A.M. av. of 2-hourly readings for some cases)
24-26	Soil Moisture Tension (Coleman Blocks) Planting 1-4" depth (8 A.M. measurements for plant sampling days only)
27-29	Soil Moisture Tension (Coleman Blocks) Planting 1-8" depth (8 A.M. measurements for plant sampling days only.)
30-32	Soil Moisture Tension (Coleman Blocks) Planting 1-14" depth (8 A.M. measurements for plant sampling days only)
33-35	Soil Moisture Tension (Coleman Blocks) Planting 2-4" depth (8 A.M. measurements for plant sampling days only)
36-38	Soil Moisture Tension (Coleman Blocks) Planting 2-8" depth (8 A.M. measurements for plant sampling days only)
39-41	Soil Moisture Tension (Coleman Blocks) Planting 2-14" depth (8 A.M. measurements for plant sampling days only)

Column	Item
42-44	Soil Moisture Tension (Coleman Blocks) Planting 3-4" depth (8 A.M. measurements for plant sampling days only)
45-47	Soil Moisture Tension (Coleman Blocks) Planting 3-8" depth (8 A.M. measurements for plant sampling days only)
48-50	Soil Moisture Tension (Coleman Blocks) Planting 3-14" depth (8 A.M. measurements for plant sampling days only)
79	Site No.

In an effort to make IBM work simpler, the Air Climate and Soil Climate cards were dated not according to a 12:00 - 12:00 day but according to an 8 A.M. to 8 A.M. using the latest date.

Illustration

Calendar Date	Date on Cards	Actual Time	Time on Cards (Air Temp., Rel. Humid, Soil Temp.)		Time on Cards (Rad.)	
↑		2 A.M.				
		4				
		6	6		6	
	↑	8	8		8	
		10	10		10	
May 27		12 Noon	12	0800-1400	12	0800-1400
		2 P.M.	14		14	
		4	16		16	
		6	18	1400-2000	18	1400-2000
	May 27	8	20		20	
		10	22		22	
↓ ↑		12 Midnight	24		24	
		2 A.M.	2	2000-0800	2	
		4	4		4	Before 0800
		6	6		6	
	↓ ↑	8	8		8	
		10	10		10	
May 28		12 Noon	12		12	
		2 P.M.				
		4				
		6				
	May 28	8				
		10				
↓		12 Midnight				
		2 A.M.				
		4				
		6				
	↓	8				

The 2-hourly readings were dated as shown in the illustration. The persons recording the data for IBM cards dated the means, sums, maximum and minimum as indicated by the braces and arrows.

The original data gave 2-hourly readings of the following:

Air Temperature - actual temp. at time of reading.

Relative Humidity - actual rel. humid. at time of reading.

Soil Temperature - 2" depth - acutal temp. at time of reading.

Radiation - sum for preceding 2 hours.

All daily measurements (i.e.) Maximum and Minimum Air Temperature, Wind Flow, Evaporation, Precipitation and Light Intensity were read at 8 A.M. (when the samples of turnip greens were taken) for the 24 hours previous and were recorded and dated as the day of the sampling.

Soil Moisture measurements were taken at 8 A.M. the day of sampling only.

The Soil Temperature 8" depth data were either daily readings (midnight to midnight) or simply the mean of the maximum and minimum that occurred from midnight to midnight. Therefore, the data were lagged a day in order to obtain as near as possible all weather data prior to hour of sampling. In 1951, North Carolina made 2-hourly reading of Soil Temperature - 8" depth and it was recorded as indicated above in illustration.

There are some data that are not on cards, such as weight per plant, number of plants, weight of deribbed material, etc. Every station did not send in the same type of data making it impractical to establish a single code.

It was decided that the sum of the three days of weather prior to sampling would be used in the analysis of the data. Therefore, a new set of cards was punched of the 3-day sums. If the sampling date was May 28th, then weather cards dated May 28, May 27 and May 26 were summed and dated as the 28th.

In order to have as little missing data as possible, if there were only two of the three days the data were adjusted.

Soil Moisture is not a three-day sum since soil moisture data were taken only twice a week, at most stations.

The 3-day summary cards are set up as follows:

A. Card Set 7

Column	Item
1	Card Code No. 7
2	Station No.

Column	Item
3,4	Year
5	Season
6,7	Month
8,9	Date
10-12	Maximum Air Temperature
13-15	Minimum " "
16-18	Range - " "
19-22	Precipitation
23-25	Mean Air Temperature (0800-1400)
26-28	" " " (1400-2000)
29-31	" " " (2000-0800)
32-34	Radiation - Before 0800
35-38	" (0800-1400)
39-42	" (1400-2000)
43-46	Total Radiation (0800-0800)
47-49	Maximum Soil Temperature - 2" depth
50-52	Minimum " " - 2" depth
53-54	Range - " " - 2" depth
55-57	Mean Soil Temperature - 2" depth (0800-2000)
58-60	" " " - 2" depth (2000-0800)
61-63	" " " - 8" depth
64-66	Soil Moisture - 8" depth for Planting 1
67-69	" " - 8" depth " " 2
70-72	" " - 8" depth " " 3
73-75	Wind Flow
79	Site No.

B. Card Set 8

Column	Item
1	Card Code No. 8
2	Station
3,4	Year
5	Season
6,7	Month

Column	Item
8,9	Date
10-13	Evaporation
14-16	Mean Relative Humidity (0800-1400)
17-19	" " " (1400-2000)
20-22	" " " (2000-0800)
23-25	Soil Moisture - 4" depth for Planting 1
26-28	" " - 4" depth " " 2
29-31	" " - 4" depth " " 3
32-34	" " - 12" depth " " 1
35-37	" " - 12" depth " " 2
38-40	" " - 12" depth " " 3
79	Site No.

For the overall analysis, the sum of the duplicate samples are being used. Card sets 1 and 2 and Card sets 5 and 6 were summarised in the following manner and form:

A. Card Set X

Column	Item
1	Site No.
2	Station No.
3,4	Year
5	Season
6,7	Month
8,9	Date
10	Planting
11-12	Days from Planting
13-16	% Dry Matter
17-20	Ascorbic Acid - Dry Basis
21-24	Thiamine - Dry Basis
25-28	Riboflavin - Dry Basis
29-33	Carotene - Dry Basis
34-37	Nitrogen - Dry Basis

Column	Item
38-41	Fat - Dry Basis
42-45	Fiber - Dry Basis
46-49	Calcium - Dry Basis
50-53	Magnesium - Dry Basis
54-57	Phosphorus - Dry Basis
58-61	Iron - Dry Basis
62-65	Potassium - Dry Basis
66-69	Sodium - Dry Basis

Six complete tabulations of data on card sets X, 3, and 4 were made and a copy sent to each cooperating station.

II. Data Graphed

At the meetings in Birmingham in January 1953, the technical committee decided to make graphs of the data for each station - season - site - year. Statistics was asked to recommend a uniform procedure and they recommended that each item be plotted against date.

The graphs were to be made on 10 x 10 mm graph paper - Keuffel and Esser Co. (359-14L). The horizontal and vertical scales were to be consistent over all station in order that comparisons could be made and in order that graphs within a station - season - season - year could be superimposed on one another for study.

On the horizontal scale the vertical dashes represent 8 A.M. readings on the day of sampling. (See Figures I and II.) Each mm square on the graph paper represents 4 hours, therefore, every six mm squares represent an 8 A.M. - 8 A.M. day.

On graphs 1, 2, and 3, figure I, the duplicate sample sums as read from the IBM sheets were plotted on the line that represents 8 A.M. on the date of sampling. On graph 2, Fig. I, the average total weight per plant (grams), (data not on cards nor tabulated sheets), was also plotted.

Since, as has been indicated, the weather data were dated differently from usual procedure, some care had to be taken in plotting the air and soil climate data. Most of the data were plotted to the left of the date given on IBM sheets so that when the nutrient data are superimposed on the weather data, they will be in correct relationship. Therefore, the weather data were plotted as follows:

1. Precipitation was plotted at the midpoint of the 8 A.M. to 8 A.M. day. For example, if one read 2.05 inches rainfall on June 6, then this amount was plotted between June 5, 8 A.M. - June 6, 8 A.M. All continuous data were joined with straight lines and the isolated points circled.

2. Wind Flow and Evaporation were plotted at the midpoint of the 8 A.M. to 8 A.M. day in the same manner as precipitation.

3. Relative Humidity, Radiation and Air Temperature. In preliminary graphing the 2-hourly readings(not on IBM sheet) as well as the means as given on the IBM sheets were plotted. The IBM means give a very good picture of the weather trend and cuts the time of graphing by at least two-thirds. Therefore, it was beleived to be sufficient to plot the means for Rel. Humid. and Air Temp. and sums for Radiation as shown on the IBM sheets. The data were plotted at the midpoint of the period which they represent as follows:

a. Relative Humidity plotted at 12 P.M., 6 P.M. and between 2 and 4 A.M. on the day before the date on the IBM sheets.

b. Radiation plotted at 12 P.M. , 6 P.M. and before 8 A.M. When plotting from the IBM sheets, note that the before 8 A.M. reading occurs on the date on the IBM card and must be plotted as such, but the 0800-1400 and the 1600-2000 reading occurs on the day before and should be plotted as such.

c. Air Temperature is plotted in the same manner as relative humidity.

4. Soil Temperature - 2" depth - The two mean values as given on the IBM sheets were plotted at the midpoint of the period they represent, i.e. between 2 and 4 P.M. and 2 and 4 A.M. on the day before the date given on the IBM sheet.

5. Soil Temperature - 8" depth data were plotted in the same manner as Wind Flow and Evaporation.

6. Soil Moisture 4", 8" and 12" depths data were plotted on a log scale which was reversed in order that the high values would be low on the graph since the high values represent low soil moisture. The following code was used for plotting, letting each small square on the graph represent one (1), but plotted in reverse of the usual procedure.

Plot Soil Moisture at 8 A.M. on date as you find it on your IBM sheets.

S.M.	Code
.1	0
.2	1.5
.3	2.5
.4	3.0
.5	3.5
.6- .7	4.0
.8	4.5
.9- 1.1	5.0
1.2- 1.4	5.5
1.5- 1.7	6.0
1.8- 2.2	6.5
2.3- 2.8	7.0
2.9- 3.4	7.5
3.5- 4.4	8.0
4.5- 5.6	8.5
5.7- 7.0	9.0
7.1- 8.9	9.5
9.0-11.7	10.0
11.8-14.1	10.5
14.2-15.0	11.0

The ranges given in Table 1 are the maximum and minimum for field and sand culture data for 1948, 1949, 1950 and 1951 and were used to determine the scales used in the graphs.

Table 1 - Maximum and minimum values of duplicate sample sums, organic and inorganic data for 1948, 1949, 1950, and 1951 over all field and sand culture data - Soils Weather Data

	Maximum	Minimum	Range
Dry Matter	53.58	13.36	40.22
Ascorbic Acid	4194	751	3443
Thiamine	6909	1038	5871
Riboflavin	9937	203	9734
Carotene	191.87	23.08	168.79
Nitrogen	15.42	5.21	10.21
Fat	16.36	.31	16.05
Fiber	25.03	6.66	18.37
Calcium	643.1	106.3	536.8
Magnesium	199.8	25.5	174.3
Phosphorus	1.998	.457	1.541
Iron	325.3	21.9	303.4
Potassium	408.0	68.2	339.8
Sodium	174.0	.5	173.5

Figure I and II show vertical and horizontal scales and content - of the graphs as made of the soils weather data for a station - site - season - year.

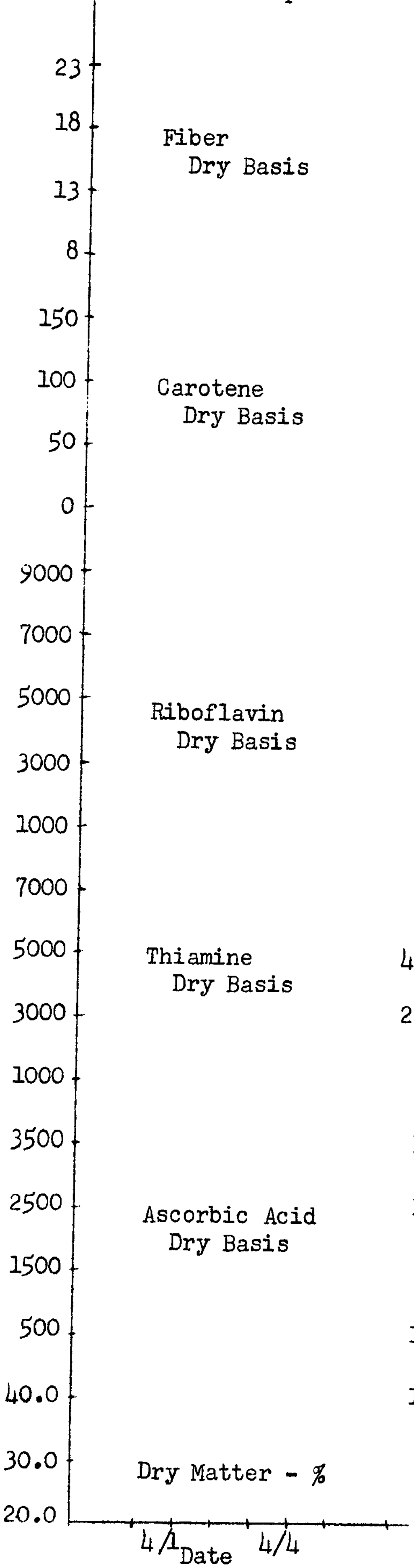
Figure I

Graph 1 - Field or Sand Culture Data
Graph 2 - Field and Sand Culture Data
Graph 3 - Field or Sand Culture Data

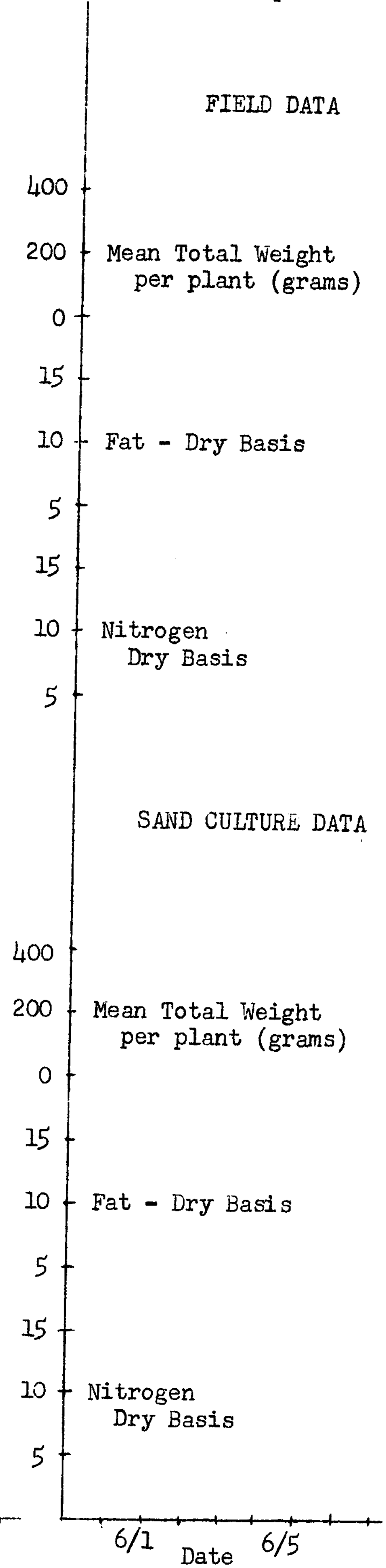
Figure II

Graph 4 - Air Climate Data
Graph 5 - Soil Climate Data

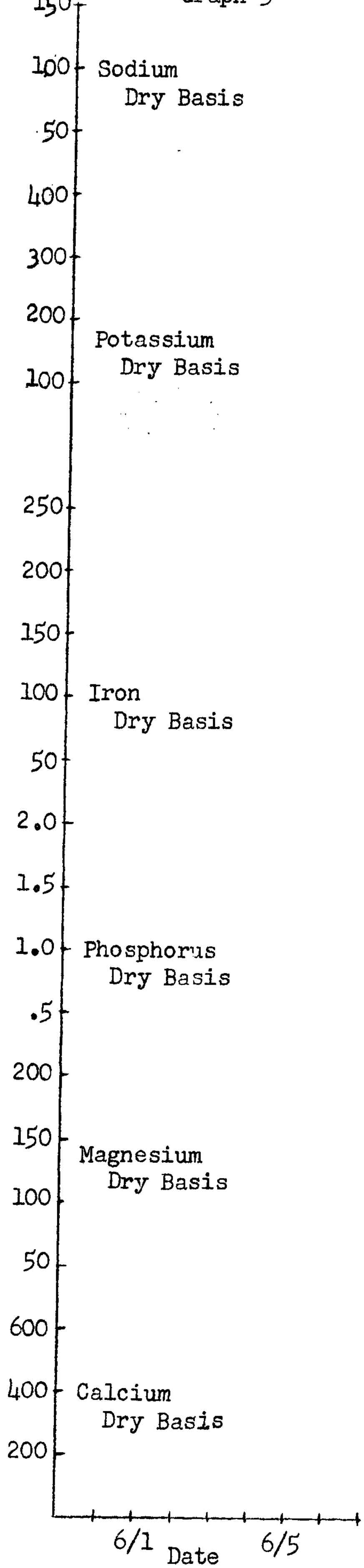
Graph 1



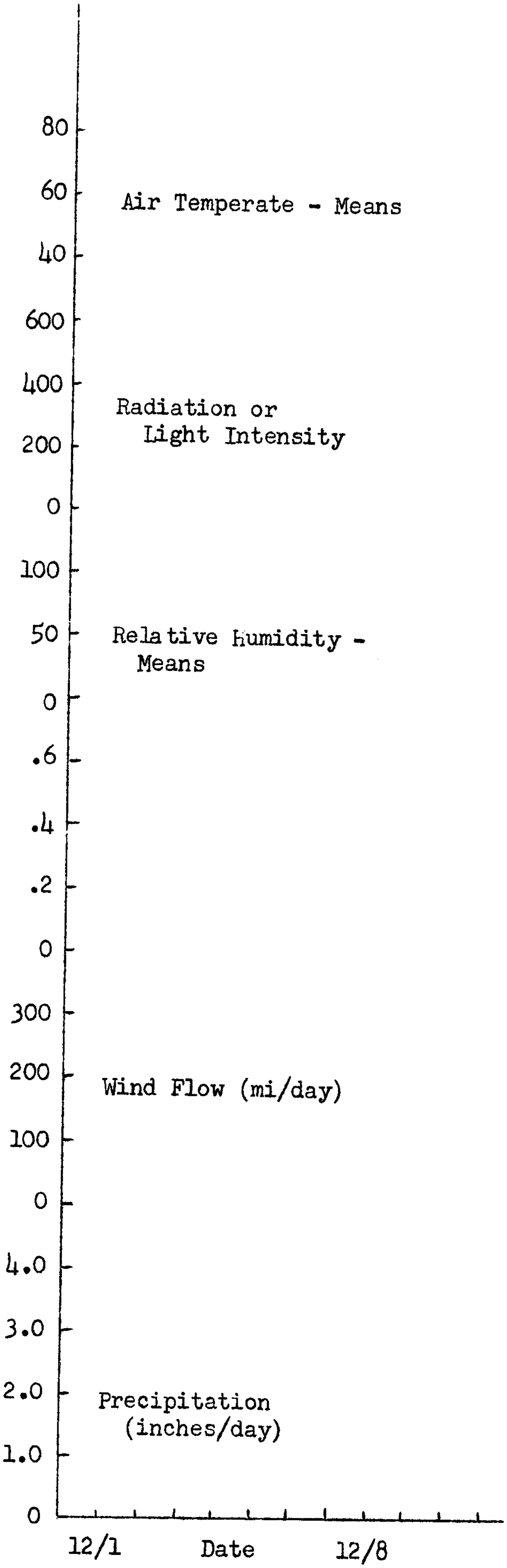
Graph 2



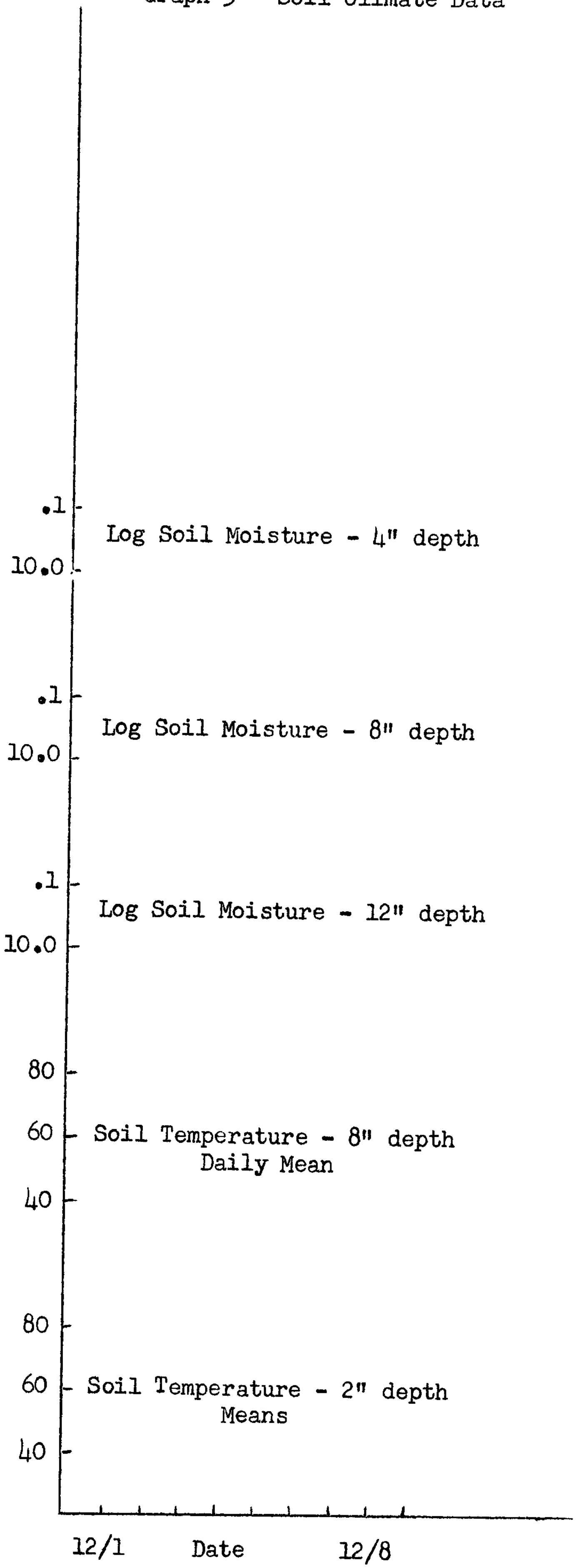
Graph 3



Graph 4 - Air Climate Data



Graph 5 - Soil Climate Data



Statistical Analyses

I. Frequency distributions of plant constituents:

In figures III through X are presented frequency distributions for the various plant constituents, along with the corresponding values for mode(mo), median (md), mean ($\bar{x}$), standard deviation (s.d.), coefficient of variation (C.V.), number of observations (N) and range. The means of the duplicate samples were considered to be the individual observations in forming the distributions. All constituents except dry matter are on the dry basis. These frequency distributions have been proposed as a possible way of presenting the grosser aspects of the data when publishing results.

In figures III through VI are presented overall distributions for each of the plant constituents which were studied. Separate distributions are given for field results and sand-culture results. All of the data from 1949 through 1951 were used in constructing these distributions.

The overall distributions can be separated into sub-distributions. Such breakdowns are illustrated with the field data for riboflavin and calcium in figures VII through X, with the overall distributions for field and sand-culture repeated for comparative purposes. Similar breakdowns for other constituents are almost complete. The data were subdivided by location, i.e. Puerto Rico and each site in each State. All data obtained at each location from 1949 through 1951 were included. The data were also subdivided by season, omitting the Puerto Rico data, but including the data from the three years at all other locations. If deemed worthwhile, finer subdivisions of the data can be made.

Certain interesting features of the data are seen from the distributions. From figures III through VI note that

(1) for all constituents except possibly nitrogen, the general shape of the distributions is essentially the same for field and sand-culture.

(2) the distributions for sodium, iron and magnesium are strongly skewed, for thiamine, nitrogen in the field, dry matter and potassium are moderately skewed, and for other constituents are fairly symmetrical.

(3) In general the means and coefficients of variation are similar for field and sand culture. The most notable exception is sodium which has a mean much lower for sand culture than for field. It is possible that significant differences for other constituents would be demonstrated by analysis of variance.

(4) By far the most variable constituent was sodium, and the least variable was fiber. Iron, magnesium, fat and potassium showed relatively high variability, and ascorbic acid, nitrogen, phosphorus and calcium relatively low variability. Dry matter, riboflavin, thiamin and carotene were intermediate.

From figures VII through X note that

(1) riboflavin averaged somewhat lower and was somewhat more variable in spring than in fall, but calcium showed about the same distributions in spring and fall.

(2) Although certain locations seem to stand out as having high or low means or variabilities, rough estimates show that location accounted for only about 10% of the total variation in riboflavin and about 20% in calcium.

Since the major differences in soil characteristics occur between locations, yet the major variations in riboflavin and calcium occur within locations, it appears that soil factors _per se_ will not explain much of the variation in riboflavin and calcium. It will be interesting to see if similar conclusions are reached for the other constituents. Tentatively it is proposed to submit the data to analysis of variance in order to assess more precisely the portions of variance attributable to location and season and possibly other gross factors.

Figure III Frequency Distribution of Field and Sand Culture Data for Ascorbic Acid, Thiamine, Riboflavin and Carotene, - Dry Basis for 1949, 1950, 1951 - Soils Weather Data

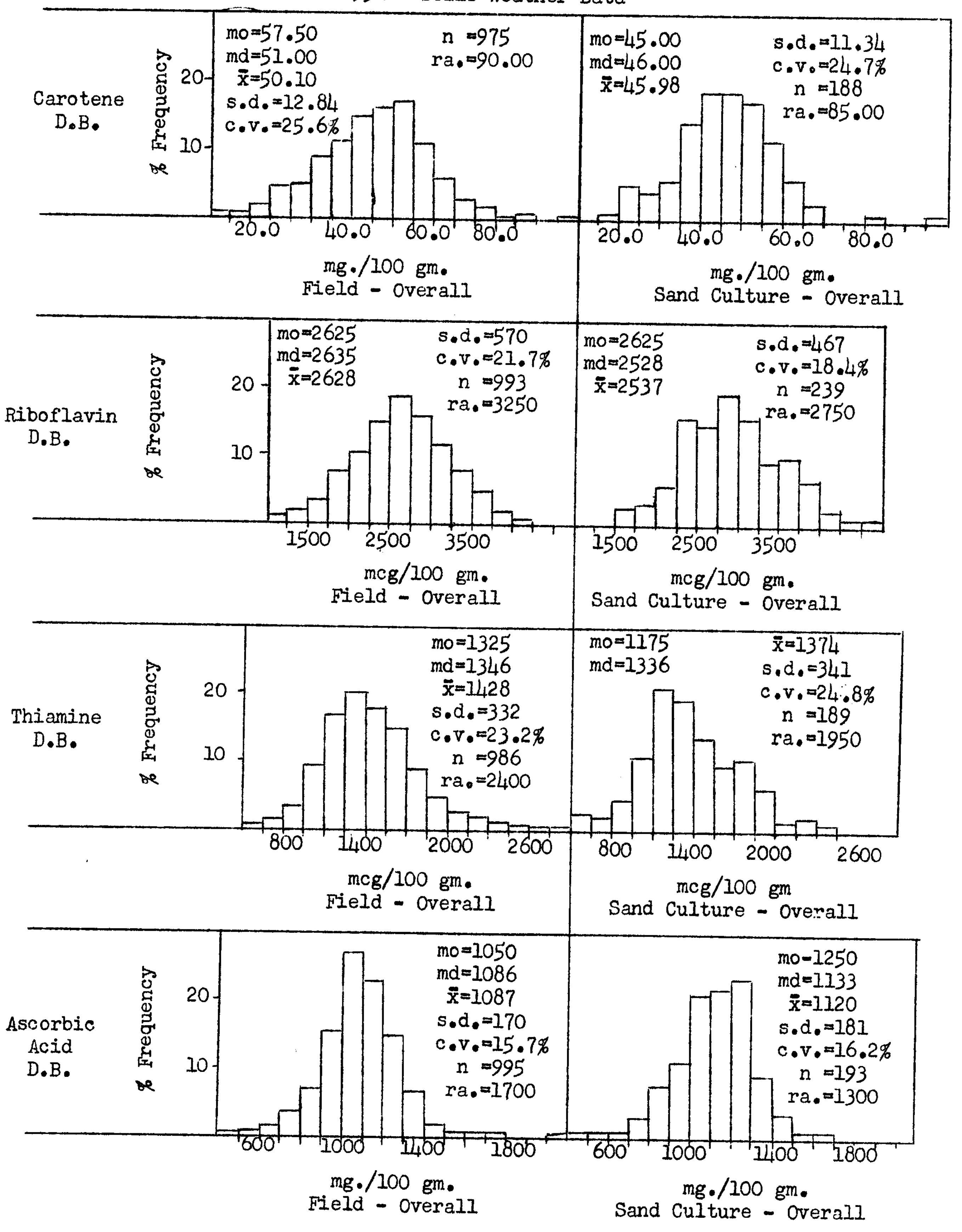


Figure IV

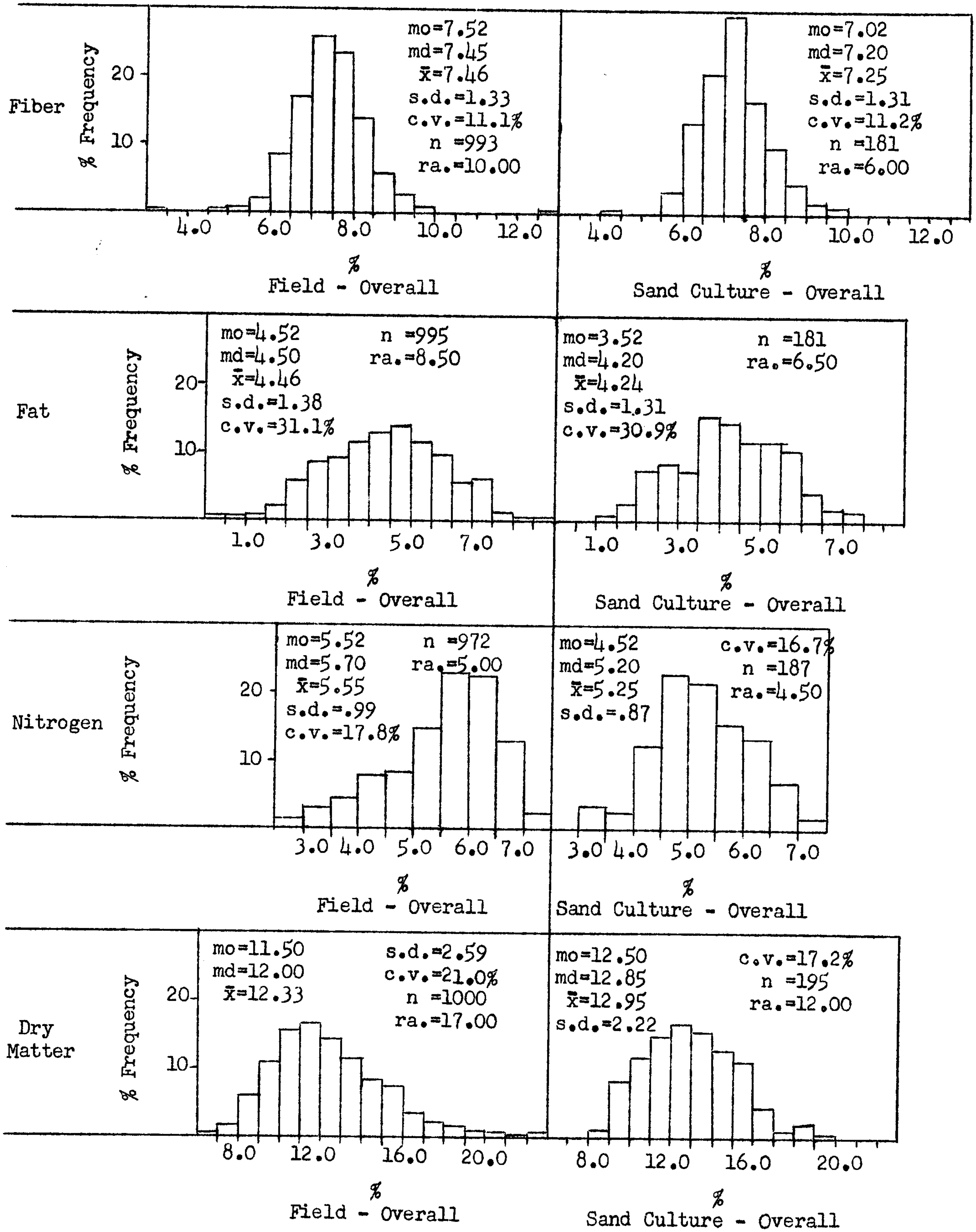


Figure IV Frequency Distribution of Field and Sand Culture Data for Fiber, Fat, Nitrogen, and Dry Matter, - Dry Basis for 1949, 1950, 1951 - Soils Weather Data

Figure V Frequency Distribution of Field and Sand Culture Data for Sodium, Potassium, and Iron, - Dry Basis for 1949, 1950, 1951 - Soils Weather Data

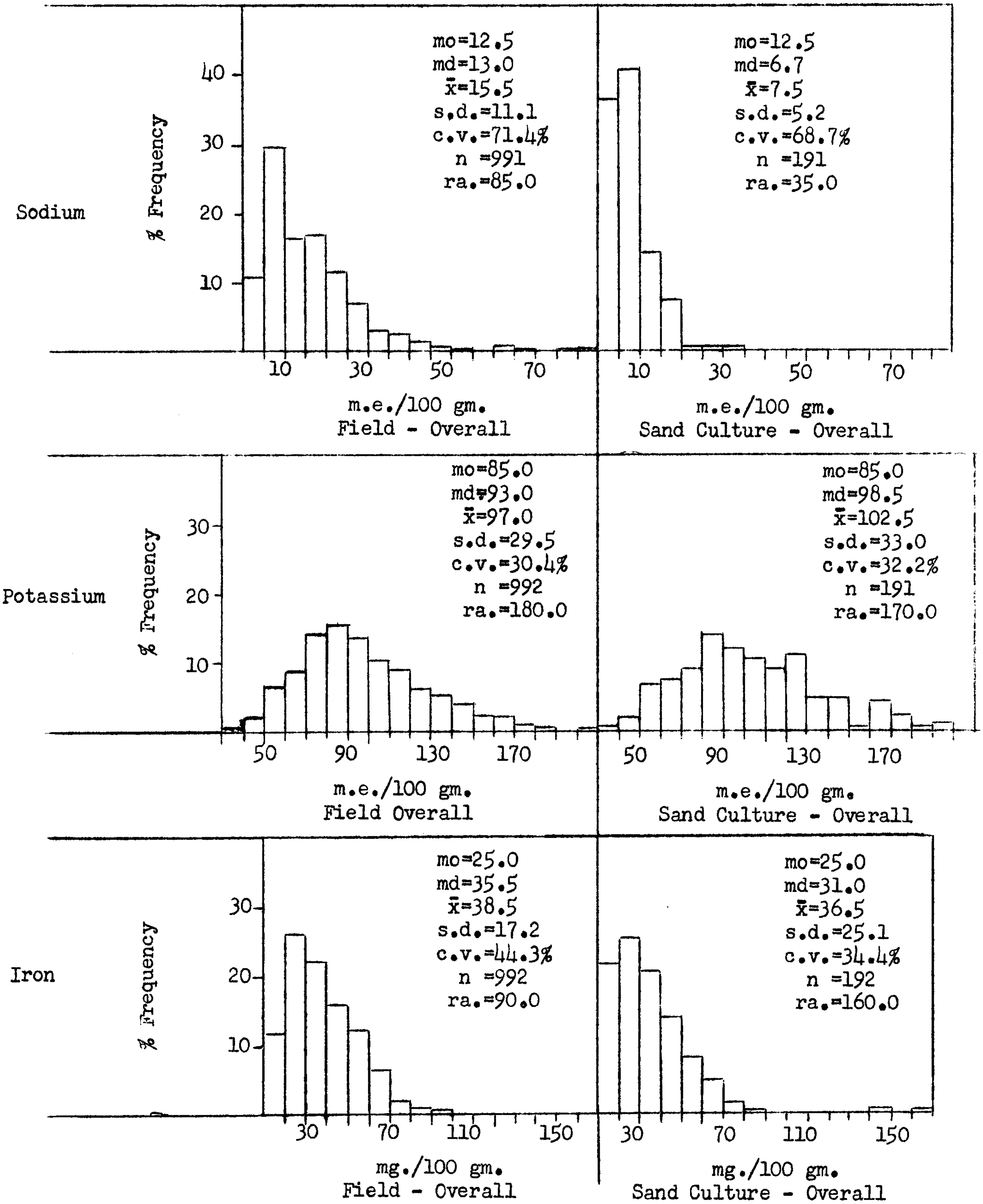


Figure VI Frequency Distribution of Field and Sand Culture Data for Phosphorus, Magnesium, and Calcium, - Dry Basis for 1949, 1950, 1951, - Soils Weather Data

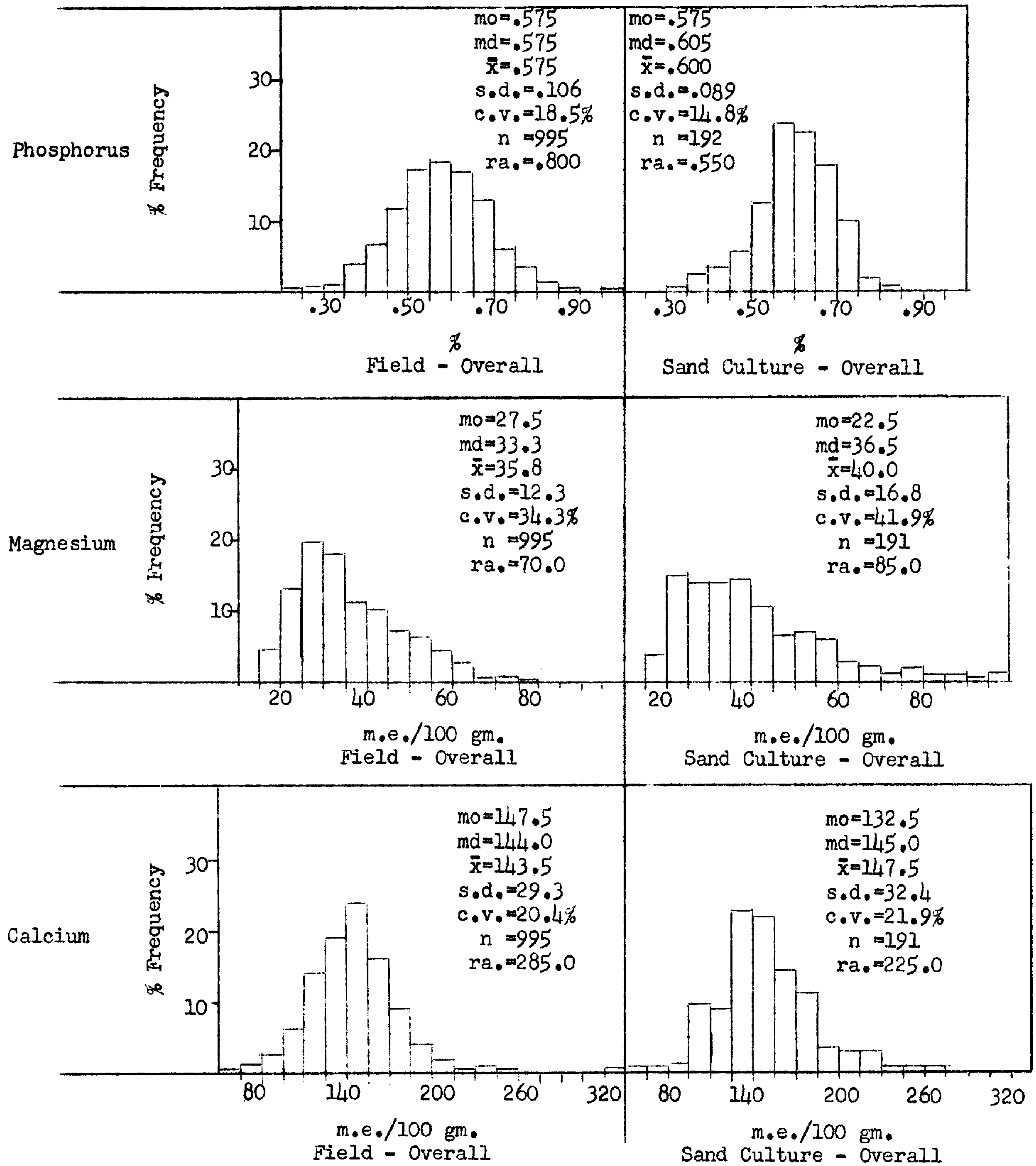


Figure VII Frequency Distributions of Riboflavin - Dry Basis for 1949, 1950, and 1951 - Soils Weather Data

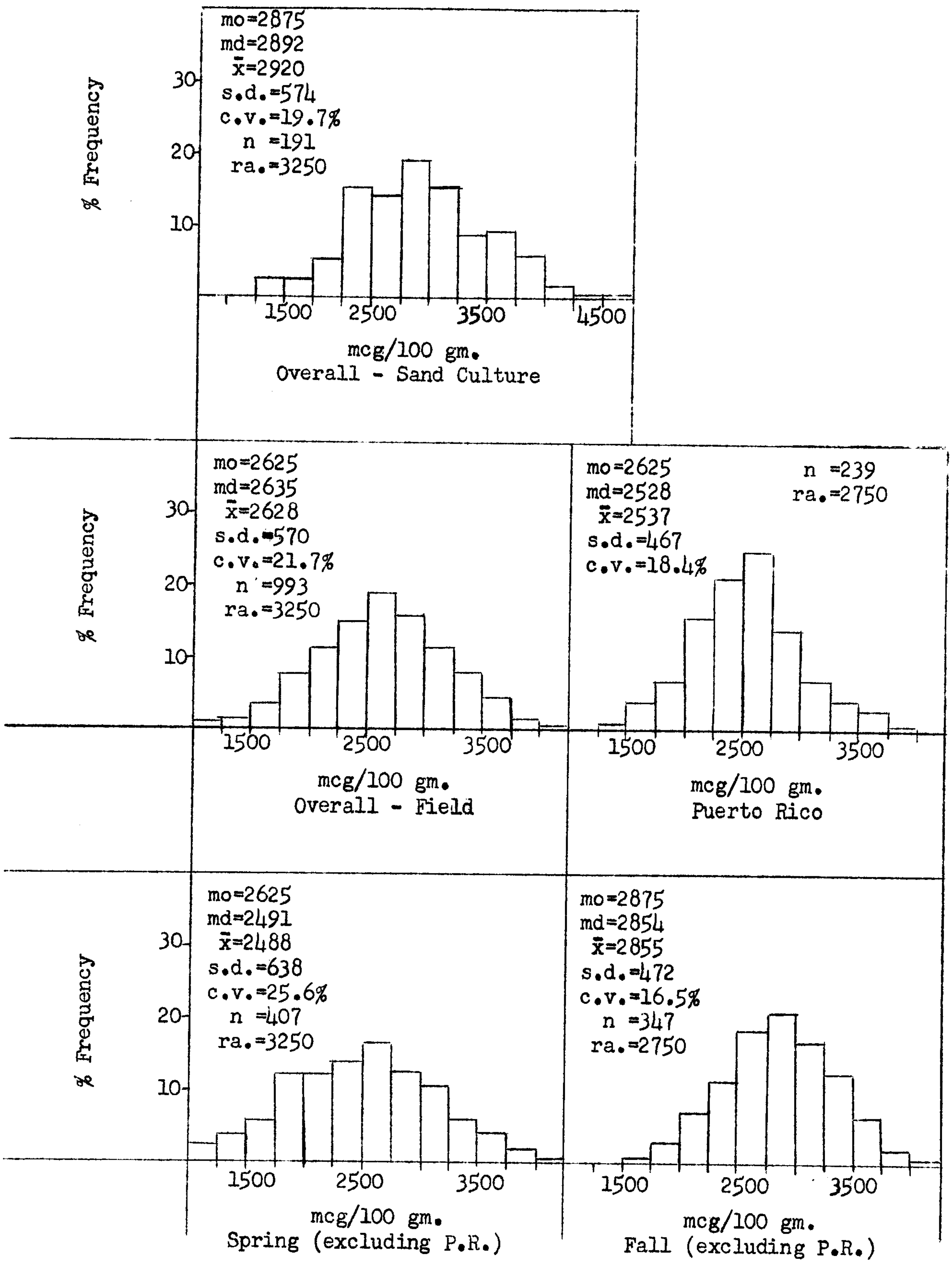


Figure VIII Frequency Distribution of Riboflavin - Dry Basis for Station - Sites for 1949, 1950, 1951 - Soils Weather Data

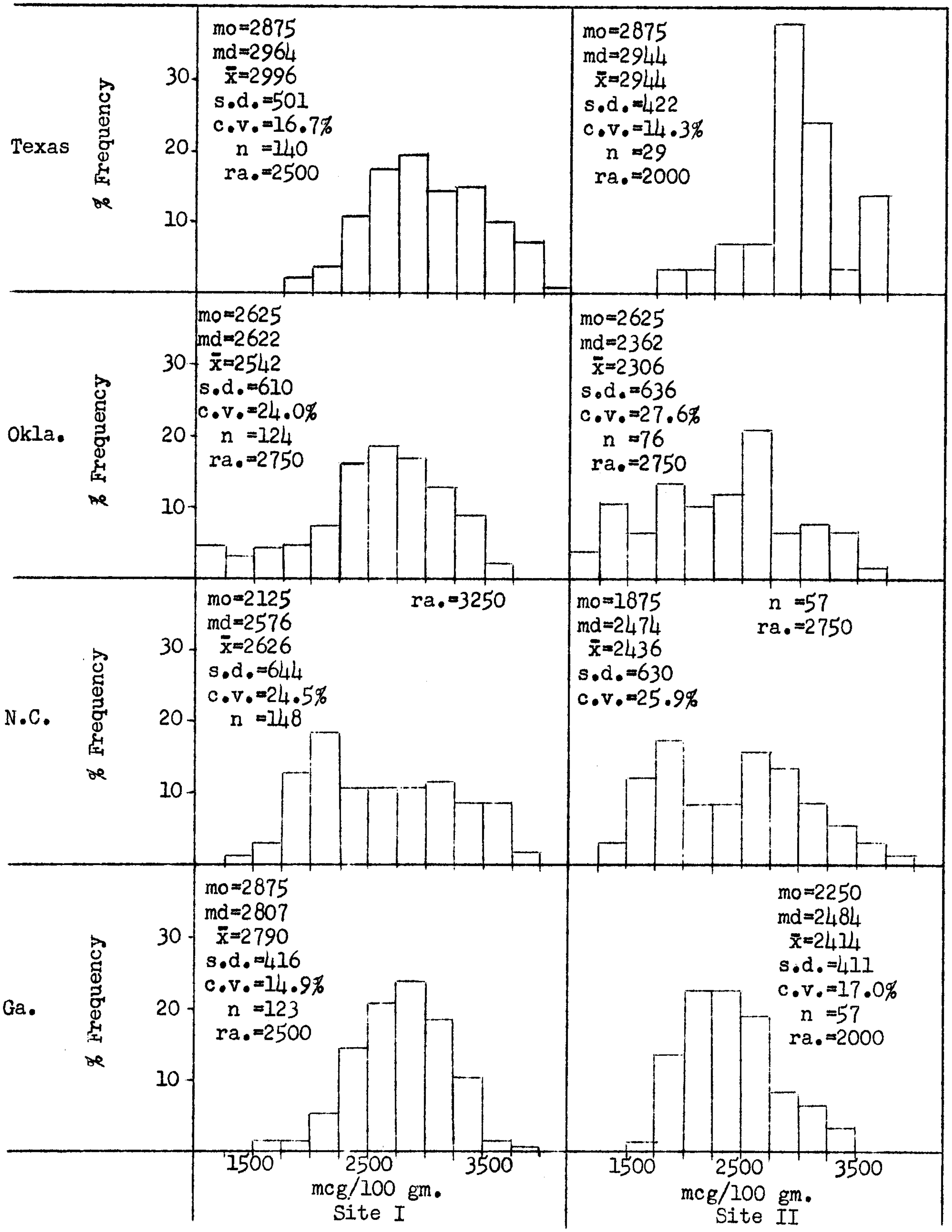


Figure IX. Frequency Distribution of Calcium-Dry Basis for 1949, 1950, 1951 - Soils Weather Data

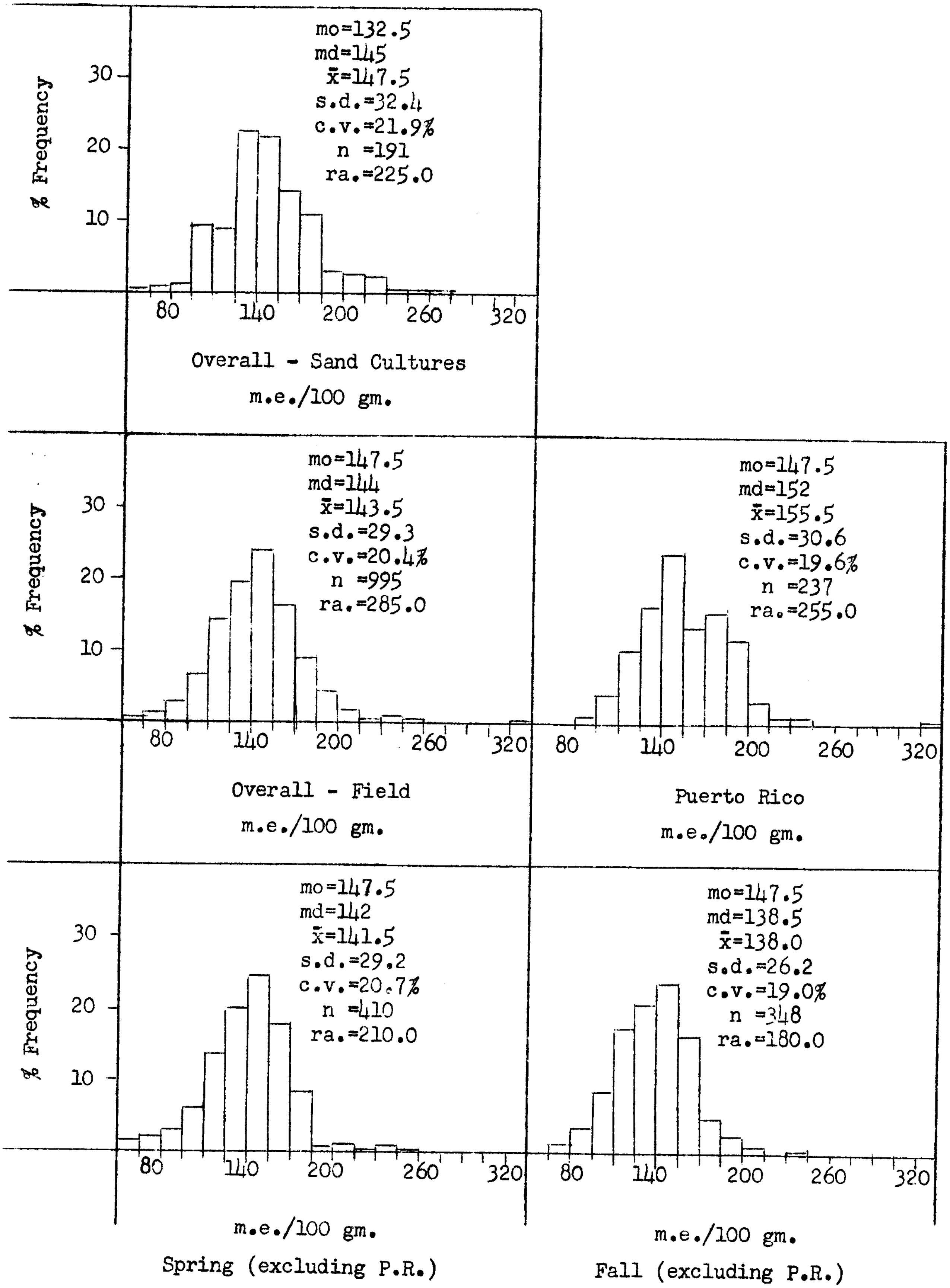
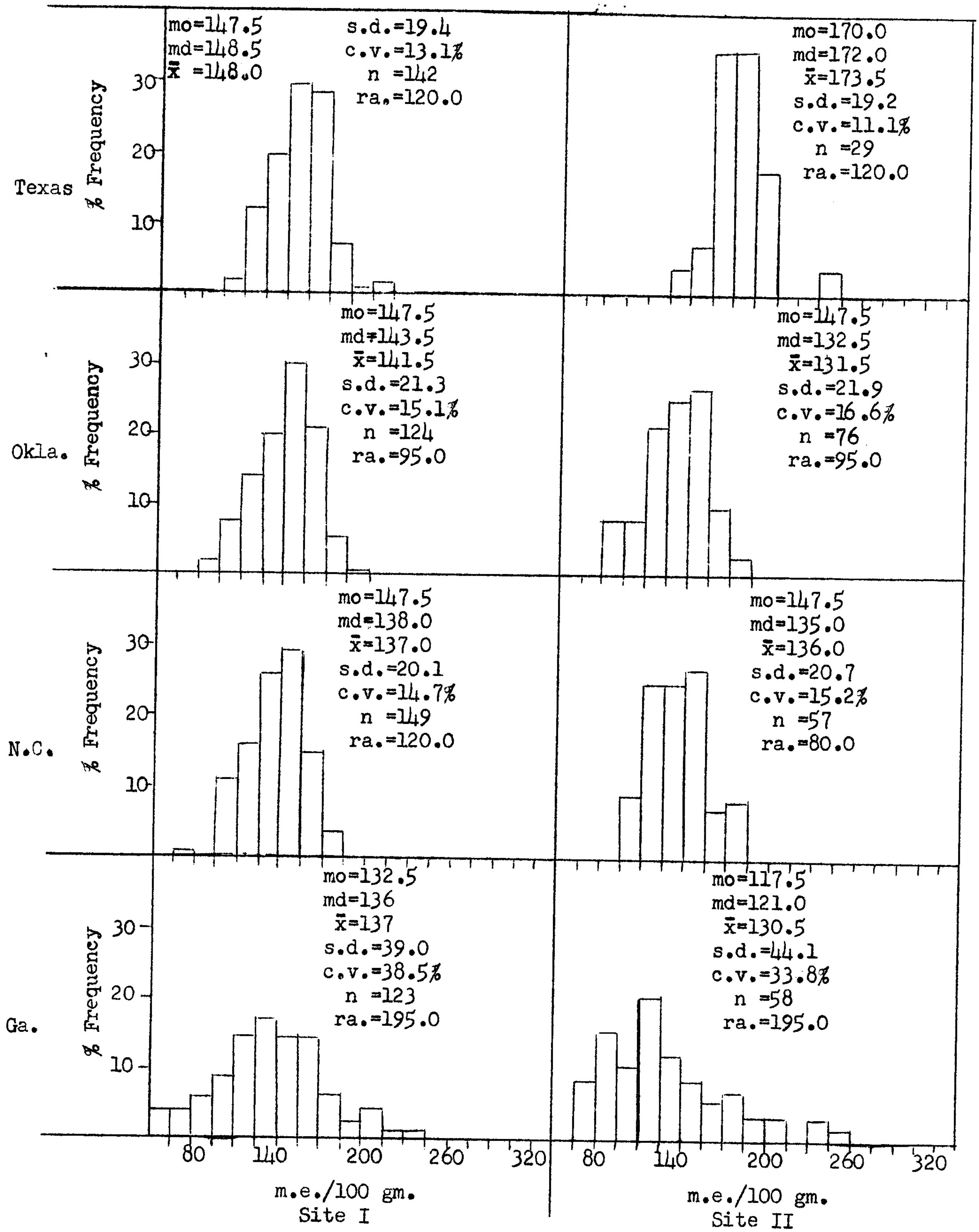


Figure X. Frequency Distribution of Calcium-Dry Basis for Station - Sites for 1949, 1950, 1951 - Soils Weather Data



II. Overall Analysis Relating Organic Plant Constituents to Weather.

In Table 2 are shown the results of an overall multiple regression study relating organic plant constituents on both the fresh and dry basis to soil temperature, soil moisture, radiation and dry matter content. Puerto Rico data were not included in this study because soil moisture data are not available. The principal difference in the fresh and dry analysis is in the relationship of the compounds to dry matter content. As expected, the partial regression coefficients for dry matter increases markedly in all cases when the fresh basis is used. Significant relations to weather were as follows:

(1) ascorbic acid to soil moisture.
(2) thiamine to soil temperature.
(3) riboflavin to soil temperature, soil moisture and interaction of radiation with soil moisture.
(4) carotene to soil temperature, soil moisture and radiation.
(5) nitrogen to soil temperature, soil moisture and interaction of radiation with soil moisture.
(6) fat to soil temperature, soil moisture and radiation.
(7) fiber to soil temperature, soil moisture radiation and interaction of soil moisture with radiation.

The above analyses would probably be more informative if date from planting were substituted for dry matter and dry matter were made a dependent variable in the fresh basis study. It is tentatively planned to make this change.

It is also planned to include the inorganic plant constituents as dependent variates in the above analysis.

Table 2. Results of overall analysis relating nutrient content (Dry Basis and Fresh Basis) to weather-Soils-Weather Data 1949-51.

$$\hat{y}_i = a + b_1x_1 + b_2x_2 + b_3x_3 + b_4x_4 + b_5x_5 + b_6x_6 + b_7x_7$$

x_1 = Dry Matter
x_2 = Soil Temperature-8" depth (3 day sums)
$x_3 = (x_2)^2$
x_4 = Soil Moisture-4" depth
$x_5 = (x_4)^2$
x_6 = Radiation (0800-0800) (3 day sums)
$x_7 = (x_6)^2$
$x_8 = (x_4)(x_6)$

$a_1 = (C.V.)^2$-Total
a_2=% Reduction due to Regression
$a_3 = (C.V.)^2$-Deviation

	Ascorbic Acid		Thiamine		Riboflavin		Carotene		Nitrogen		Fat		Fiber	
	D.B.	F.B.	D.B.	F.B.	D.B.	F.B.	D.B.	F.B.	D.B.	F.B.	D.B.	F.B.	D.B.	F.B.
a_1	270	645	467	784	360	334	513	552	227	282	1032	1663	125	442
a_2	4.2*	59.7*	8.0*	44.1*	38.0*	25.4*	29.3*	31.8*	34.3*	46.0*	25.3*	54.4*	20.8*	79.0*
a_3	263	264	438	446	227	253	369	384	152	155	784	773	101	95

"t" values (b_i/s_{b_i}) for x_i

x_1	1.6	22.3*	-1.2	15.3*	-13.2*	8.5*	-7.7*	8.8*	-12.4*	13.9*	2.9*	15.7*	.2	36.3*
x_2	- .5	- .5	3.0*	2.9*	- 2.2*	-3.5*	- .8	-1.1	- 5.1*	-5.9*	-1.9	-1.7	6.8*	7.5*
x_3	.7	.7	-2.5*	-2.4*	2.4*	3.6*	1.8	2.1*	5.0*	5.8*	2.7*	2.5*	-6.1*	-6.9*
x_4	-1.1	-1.5	.0	- .1	2.5*	2.3*	-2.3*	-2.3*	- 1.3*	- .8	2.4*	2.1*	-2.3*	-2.4*
x_5	2.1*	2.5*	.1	.2	.4	.3	3.6*	3.8*	3.3*	3.8*	-4.8*	-4.8*	- .4	- .4
x_6	1.8	1.2	.5	.1	- 1.5	-1.4	-3.0*	-3.4*	- 1.2	-1.8	-1.8	-2.0*	.8	1.1
x_7	-1.5	-1.1	- .6	- .5	1.6	1.5	2.2*	2.6*	1.0	1.6	1.3	1.6	-2.2*	-2.4*
x_8	-1.0	- .9	.6	.8	- 4.9*	-4.7*	- .6	- .8	- .9	-2.2*	.2	.6	4.5*	4.7*

*Signifies significance at 5% or 1% level.

III. Simple Correlations between Organic Plant Constituents.

Using the same data as was included in the overall regression analysis, the simple correlations between the several organic plant constituents were computed. These are shown for the dry basis in Table 3 and for the fresh basis in Table 4.

The most striking contrast between the two tables is that all correlations are positive, significant and for the most part of substantial size in Table 4. In Table 3 a good share of the correlations are close to zero and those which are significant and substantial size vary from negative to positive. Since moisture content is subject to considerable uncontrolled variation, this general difference in sign and magnitude of the correlations between the two tables is as expected and probably of little interest. Of definite interest, however, is the fact that certain correlations showed practically no change and some actually decreased slightly on converting from dry to fresh basis. Notable were the following:

carotene vs. riboflavin
nitrogen vs. riboflavin
nitrogen vs. carotene
fat vs. riboflavin
fat vs. nitrogen

Just what are the implications of these findings is not clear, but it is suggested that the compounds involved in the invariant correlations, or unmeasured compounds associated with them, play a role in governing the moisture content. It is planned to extend the correlations to include the inorganic plant constituents which were measured. Perhaps the implications of invariant correlation will become clearer at that time.

Table 3. Simple correlations between various Nutrients-Dry Basis

	Ascorbic Acid	Thiamine	Ribo-flavin	Carotene	Nitrogen	Fat	Fiber
Thiamine	.178*						
Riboflavin	.062	.118*					
Carotene	.400*	.215*	.323*				
Nitrogen	.036	.056	.585*	.430*			
Fat	.065	.112*	.235*	-.104	.325*		
Fiber	.015	.375*	-.043	.059	.162*	.193*	
Dry matter (Fresh basis)	.074	-.374*	-.569*	-.067	-.512*	.213*	-.094

Table 4. Simple correlations between Various Nutrients-Fresh Basis

	Ascorbic Acid	Thiamine	Ribo-flavin	Carotene	Nitrogen	Fat	Fiber
Thiamine	.609*						
Riboflavin	.420*	.310*					
Carotene	.590*	.429*	.335*				
Nitrogen	.564*	.448*	.585*	.562*			
Fat	.495*	.479*	.166*	.394*	.253*		
Fiber	.670*	.700*	.264*	.340*	.417*	.645*	
Dry Matter	.242*	.403*	.410*	.626*	.598*	.641*	.855*

* Signifies significance at 5% or 1% level.

IV. Simple Correlations between Plant Constituents and Weather Factors.

In Table 5 are presented simple correlations of all measured plant constituents with all air and soil weather factors. The data correlated were averages over the season for 1st planting, computed for each season in each year at each site in each State. The tabled results were obtained just as this report was being prepared, so they have not been studied. It is planned to extend the computations to include soil minerals and characteristics as independent variables.

Table 5. The simple correlations (r) and regression coefficients (b) of station-season-site-year first planting means of organic nutrient values (Dry Basis) with various weather factors.

		Dry Matter %	Ascorbic Acid mg/100 gm Dry Basis	Thiamine mcg/100gm Dry Basis	Riboflavin mcg/100gm Dry Basis	Carotene mg/100gm Dry Basis	Nitrogen % Dry Basis	Fat % Dry Basis	Fiber % Dry Basis
Precipitation (inches/day-hundreth)	b	-3.35	384	2469	-1351	45.1	.680	5.01	2.29
	r	- .083	.16	.40*	-.16	.20	.037	.18	.16
Wind Flow (mi/day)	b	- .020	-2.56	.736	4.72	- .236	-.0007	-.020	.0090
	r	- .21	- .43*	.050	.24	- .45*	-.015	-.31*	.26
Evaporation (inches/day)	b	23.7	-986	2082	-615	-70.5	-.578	2.33	-3.38
	r	.52*	- .40*	.41*	-.066	- .36	-.30	.079	- .25
Radiation gm cal/cm^2/day	b	.016	.030	.539	-2.24	- .055	-.0053	.0053	- .0014
	r	.53*	.017	.13	- .38*	- .36*	-.41*	.27	- .14
Light Intensity Rel.gm.cal./cm^2/day	b	.012	-.218	.120	-1.48	- .030	-.0068	.0025	.0010
	r	.47*	-.13	.049	- .25	- .20	-.57*	.15	.12
Mean Air Temp. (0800-1400) °F	b	.187	.189	23.3	-24.9	- .120	-.079	.096	.019
	r	.48*	.008	.42*	- .31*	- .06	-.46*	.38*	.14
Mean Air Temp. (1400-2000)°F	b	.167	.808	22.1	-22.5	- .018	-.064	.065	.017
	r	.45*	.036	.42*	- .29*	- .009	-.39*	.27*	.14
Mean Air Temp. (2000-0800)°F	b	.138	1.51	25.6	-23.7	.085	-.059	.068	.020
	r	.37*	.066	.48*	- .30*	.042	-.35*	.28*	.16
Mean Rel. Humid. (0800-1400) %	b	- .081	1.59	20.1	- 8.65	.751	.031	.029	.022
	r	- .23	.076	.37*	- .12	.37*	.19	.13	.19
Mean Rel. Humid. (1400-2000) %	b	- .049	1.04	10.6	- 6.09	.441	.0024	.048	.015
	r	- .18	.064	.25*	- .11	.28	.019	.27	.16
Mean Rel. Humid. (2000-0800) %	b	.0004	1.56	19.3	- 2.23	.553	-.036	.122	.0611
	r	.001	.065	.31*	- .028	.24	-.19	.47*	.44*

Table 5 (Continued)

		Dry Matter %	Ascorbic Acid mg/100 gm Dry Basis	Thiamine mcg/100gm Dry Basis	Riboflavin mcg/100gm Dry Basis	Carotene mg/100gm Dry Basis	Nitrogen % Dry Basis	Fat % Dry Basis	Fiber % Dry Basis
Mean Soil Temp. °F 2" depth(0800-2000)	b	.162	-.190	16.9	-16.0	-.149	-.041	.066	-.023
	r	.48*	-.009	.33*	- .23	-.083	-.27	.30*	-.19
Mean Soil Temp. °F 2" depth(2000-0800)	b	.171	-1.46	24.9	-18.9	-.245	-.047	.062	-.025
	r	.44*	- .061	.43*	- .24	-.12	-.27	.24	-.18
Mean Soil Temp. 8" depth - °F	b	.183	1.26	23.1	-27.3	.080	-.065	.084	.0015
	r	.47*	.054	.42*	- .34	.038	-.38*	.35*	.012
Soil Moisture Tension 4" depth	b	.620	-2.48	50.1	7.95	-1.28	-.110	-.192	.0099
	r	.47*	- .026	.26	.028	- .17	-.19	-.21	.020
Soil Moisture Tension 8" depth	b	.243	-14.5	27.3	-50.0	- .700	-.032	-.098	.0096
	r	.17	-.14	.13	- .16	- .088	-.05	-.10	.019

*Signifies significance at 5% or 1% level.

Table 5 (Continued)

Inorganic

		Calcium m.e./100gm	Magnesium m.e./100gm	Phosphorus %	Iron mg/100gm	Potassium m.e./100gm	Sodium m.e./100gm
Precip.	b	7.20	-53.7	.486	139	-119	-66.2
	r	.014	-.21	.22	.48*	-.20	-.25
W.F.	b	.321	.231	.0004	.036	-.0005	-.022
	r	.25	.354*	.080	.047	-.000	-.032
Evap.	b	36.6	198	-.581	13.1	-252	44.5
	r	.057	-.62*	-.27	.065	-.35	.13
Rad.	b	-.052	.064	-.0004	.014	-.091	.0065
	r	-.17	.34*	-.26	.061	-.23	.042
L. Int.	b	.109	.086	-.0008	-.029	-.221	.020
	r	.30	.63*	-.59*	-.21	-.058	.11
Mean A.T. 08-14	b	.346	.409	-.0065	.349	-2.28	.0036
	r	.072	.18	-.34*	.13	-.42*	.002
Mean A.T. 14-20	b	.537	.484	-.0063	.246	-2.39	-.165
	r	.12	.22	-.34*	.097	-.47*	-.075
Mean A.T. 20-08	b	.482	.197	-.0042	.637	-2.34	-.309
	r	.10	.090	-.22	.25	-.45*	-.14
Mean R.H. 08-14	b	-.061	-.847	.0063	1.27	.171	-.856
	r	-.015	-.39*	.38*	.52*	.035	-.39*
Mean R.H. 14-20	b	-.364	-.784	.0030	.840	.330	-.434
	r	-.11	-.47*	.23	.44*	.086	-.25
Mean R.H. 20-08	b	-.133	-.651	-.0017	.494	-.491	.193
	r	-.028	-.26	-.092	.18	-.087	.076
Mean S.T. 2" 08-20	b	.183	.477	-.0048	.391	-1.67	.036
	r	.042	.22	-.28	.15	-.34*	.016
Mean S.T. 2" 20-08	b	.437	.365	-.0030	.901	-2.26	-.345
	r	.087	.14	-.15	.30*	-.40*	-.13
Mean S.T. 8"	b	.214	.166	-.0050	.643	-2.52	-.240
	r	.044	.073	-.26	.24	-.46*	-.10
S.M. 4"	b	1.78	1.72	-.028	-1.44	-1.12	-1.65
	r	.095	.20	-.40*	-.16	-.052	-.18
S.M. 8"	b	-2.27	2.26	-.0098	.763	3.91	-1.46
	r	-.11	.25	-.13	.079	.17	-.15

* Signifies significance at 5% or 1% level.