August 15, 1938

To the Committee on Graduate Study:

I submit herewith a thesis written by Mr. Jefferson D. Carr and entitled "Variations in the Vegetative Characters of Balbo Rye", and recommend that it be accepted for nine quarter hours credit in partial fulfillment of the requirements for the degree of Master of Science, with a major in Agronomy.

O. W. Dykes
Major Professor

At the request of the
Committee on Graduate Study,
we have read this thesis,
and recommend its acceptance.

C. H. Burg

H. R. Duncan

Accepted for the Graduate Committee

W. C. Smith
Dean

VARIATIONS IN THE VEGETATIVE CHARACTERS OF BALBO RYE

- o -

A THESIS

Submitted to the Graduate Committee
of
The University of Tennessee
in
Partial Fulfillment of the Requirements
for the degree of
Master of Science



by

JEFFERSON D. CARR

August 1938

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CHAPTER I

HISTORY OF BALBO RYE

About 1919 the Experiment Station at Knoxville acquired from Italy a small package of rye, which it grew for observation. It was grown in rod rows for a number of years at the Central Experiment Station where it proved to be winter hardy, early, and an exceptionally high producer of grain. Later, two bushels of seed were sent to the Middle Tennessee Experiment Station where it proved to be a vigorous grower, especially well adapted to grazing, and an abundant producer of grain (Table I and II). The Experiment Station named this new introduction "Balbo" rye, in honor of the distinguished Italian aviator, Balbo.

TABLE I. PASTURE DAYS FOR ONE STEER PER ACRE FOR BALBO AND COMMERCIAL RYE.

Year	Balbo	Commercial
1931-32	136	156
1932-33	162	84
1933-34	208	80
Average	169	107

The average animal gain per acre for Balbo was more than 300 pounds, while the average animal gain per acre for commercial rye was about 200 pounds. (Neel 1937:1).

TABLE II. VARIETAL TRIALS OF BALBO, ROSEN AND TENNESSEE COMMON RYE AT KNOXVILLE

Variety	YIELD BY YEARS						3-Yr. Average	
	1931		1932		1933			
	Grain Bu.	Straw Tons	Grain Bu.	Straw Tons	Grain Bu.	Straw Tons	Grain Bu.	Straw Tons
Balbo	40.9	2.26	25.5	1.03	25.0	1.10	30.5	1.46
Rosen	24.6	2.63	10.8	1.23	13.9	.80	16.4	1.55
Tenn. Common	44.0	2.37	20.1	1.58	21.3	1.08	28.5	1.68

The results of these varietal trials may be summarized as follows:

1. Balbo was found to be high-yielding in all respects, comparing favorably with all varieties tried by the Experiment Station, and in these trials it was found slightly superior in yield of grain.

2. The Tennessee Common ranked second in yield of grain, being much superior to Rosen. Trials also showed it to be very winter hardy.

3. The Rosen proved very inferior to the other two in yield, and is not recommended by the Experiment Station to be grown anywhere in the State. (Mooers 1936:1-2).

Since Balbo rye has been proved by the Experiment Station to be superior in yield of grain and the amount of pasture it affords, to any other variety yet known, it has been recommended by the Experiment Station to the farmers of the State over other varieties, and has been given a great deal of publicity by the Extension Service.

This rye was released to the farmers by the Experiment Station in 1934, and having been endorsed by the Experiment Station and well advertised by the Extension Service, in farm magazines, and in the farm section of newspapers, a good demand was built up for Balbo seed in a short time. This was an opportunity for unscrupulous seed dealers to make a good profit by selling any kind of rye seed as Balbo, because the name Balbo attached to a lot of seed commanded a premium over other seed

not so named. As a result, farmers desiring to purchase Balbo seed and not knowing one variety from another, often bought Abruzzi, Rosen, Common, or some other variety not so well adapted to Tennessee conditions, and not recommended by the Experiment Station, yet they paid the Balbo price for it.

When Balbo was first obtained from the Experiment Station by the farmers it was not grown as well isolated from other varieties as it should have been, in many cases, and being a cross-pollinated plant it is quite probable that a large part of this original seed became contaminated, to a certain extent, with other varieties.

It is the purpose of this thesis to try to determine the vegetative characteristics of Balbo rye that will distinguish it from other varieties commonly grown in Tennessee, and to what extent these characters are variable. It is hoped that by this study the problem of certifying rye in Tennessee will be somewhat simplified.

CHAPTER II

METHOD OF PROCEDURE

In the beginning of this experiment, the Experiment Station and Tennessee Crop Improvement Association records were checked for all possible sources of Balbo seed in the State, and each farmer was asked to send in a small sample of his seed by mail for the experiment. In addition, a small sample was taken from each of the 46 samples that were shown at the State Fair in 1937. One sample of Abruzzi seed was obtained from the Alabama State Seed Laboratory, two samples of certified Abruzzi seed from North Carolina, one sample of Rosen seed from Michigan, and one sample of Dakold from North Dakota.

The plot was made up of 200 rows ten feet long and one foot apart. One hundred seventy-four of these rows contained 30 seeds taken at random from each sample and spaced 4 inches apart. Twenty-six rows were seeded from the Standard Balbo samples at the rate of 20 seeds to the row and spaced 6 inches apart. Each tenth row was planted from one of the two Standard Balbo samples obtained from the Tennessee Experiment Station at Knoxville. The plants from the 26 rows planted from the Standard Balbo seed were used in a statistical study as is shown in Chapter IV of this paper. A diagram of the plot drawn to scale and the system of numbering the rows used in this experiment is shown in Fig. 1. Following is a key to the plot, giving the corresponding row numbers, source of seed, and address from which each sample was obtained. A map of Tennessee (Fig. 2) shows the counties from which the seed were obtained.

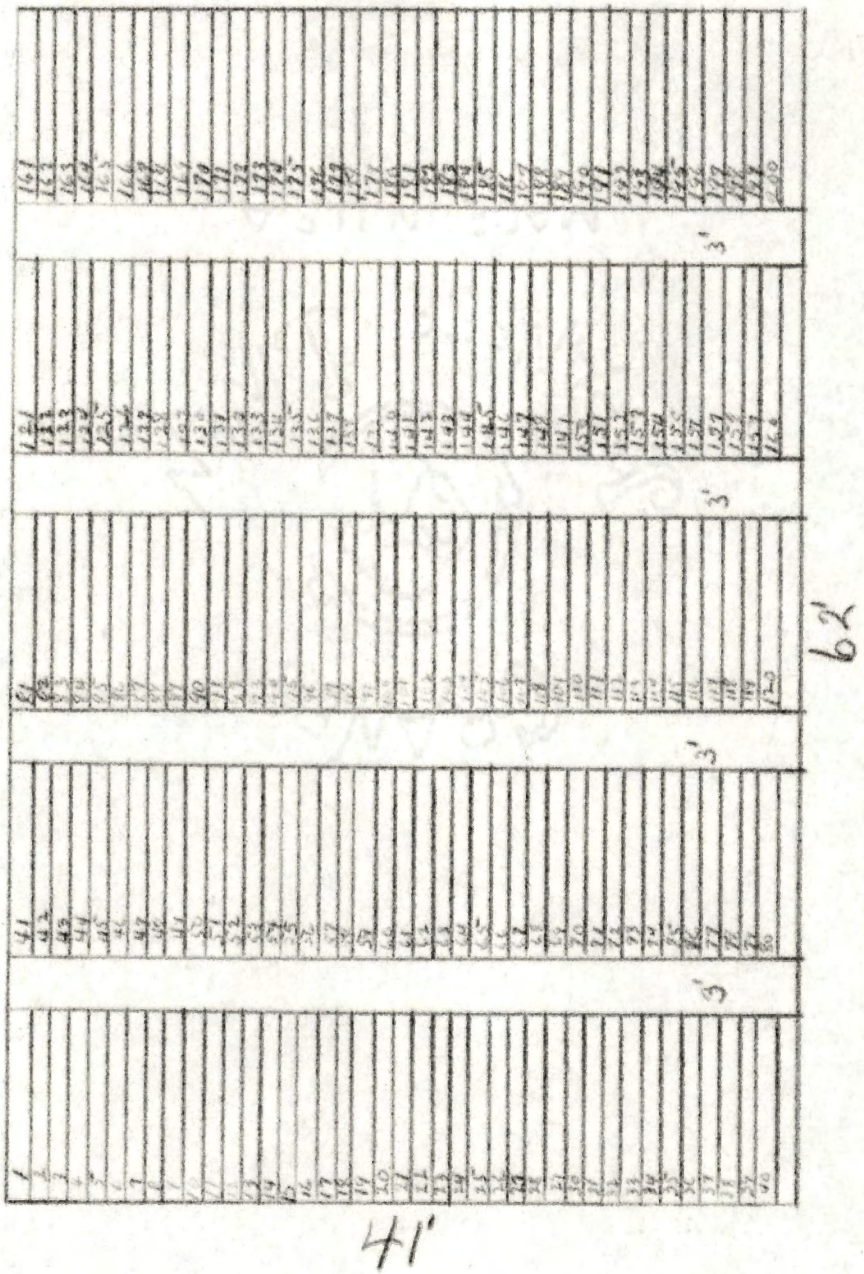


Fig. 1. Diagram of Plot, Showing Each Row Correctly Numbered

KEY TO THE PLOT

Balbo

Row No.	Source of Seed	Address
1.	Central Station	Knoxville
2.	C. E. Allred	Allred
3.	W. H. Arnold	Eagleville
4.	W. N. Butler & Co.	Columbia
5.	John Cecil	Columbia
6.	Roy Cecil	Gallatin
7.	J. P. Church	Columbia
8.	J. C. Couch	Murfreesboro
9.	J. P. Covington	College Grove
10.	Central Station	Knoxville
11.	O. D. Dalton	McEwen
12.	Dement Bros.	Cortner
13.	Douglass Bros.	Gallatin
14.	J. M. Erwin	Wartrace
15.	W. H. Evans	Lewisburg
16.	W. F. Garrison	Gallatin
17.	J. M. Haynes	Murfreesboro
18.	Alex Knox	Columbia
19.	T. A. Marsh	Spring City
20.	Central Station	Knoxville
21.	McAdams Bros	Belfast
22.	C. K. McLemore	Franklin
23.	P. A. Meriwether	Clarksville
24.	W. P. Ridley	Columbia
25.	W. A. Shaw	Lewisburg
26.	Dock Smith	Rhea Springs
27.	Central Station #37565 (Only large grain used in this sample.)	Knoxville
28.	Central Station #37565 (Only small grain used in this sample.)	Knoxville
29.	Central Station #37565 (Only black grain used in this sample.)	Knoxville
30.	Central Station	Knoxville
31.	Central Station	Knoxville
32.	Central Station #37566 (Only large grain used in this sample.)	Knoxville
33.	Central Station #37566 (Only small grain used in this sample.)	Knoxville
34.	Central Station #37566 (Only black grain used in this sample.)	Knoxville
35.	Central Station #37566	Knoxville

36. C. H. Austin	Ardmore
37. Ralph Christenberry	Oliver Springs
38. R. C. Elam	Santa Fe
39. E. B. Fly	Santa Fe
40. Central Station	Knoxville
41. J. D. Frierson	Columbia
42. Paul Goddard	Springfield
43. Noe Harlan	Morristown
44. Abijah Hatmaker	Oliver Springs
45. H. G. Hodges	Boyd's Creek
46. Tom J. Hord, Jr.	Murfreesboro
47. G. M. Jones	Bufort
48. J. W. Long & Son	Springfield
49. Geo. K. Lowe	Eagleville
50. Central Station	Knoxville
51. J. W. Massengill	Morristown
52. Wilbur Norton	Dayton
53. J. M. Owens	Eagleville
54. W. J. Porterfield	Milton
55. J. E. Praisly	Pulaski
56. E. C. Prellen	Hurrican Mills
57. Glen Purkey	Morristown
58. A. F. Sowell	Columbia
59. Frank W. Taylor	Morristown
60. Central Station	Knoxville
61. W. M. Trumbitt	Cleveland
62. W. B. Turner	Columbia
63. E. R. Walker	Dandridge
64. Miss Agnes Bennett	Franklin
65. Mrs. Geo. Burlein	Lawrenceburg
66. William J. Burlein	Lawrenceburg
67. Bratton Bros.	Williamsport
68. Mrs. J. Hugh Brown	Columbia
69. Campbell Clan Farm	Columbia
70. Central Station	Knoxville
71. J. H. Childress	Cookeville
72. V. H. Coley	LaFayette
73. Jipp Collier	Fayetteville
74. Collier & Stone	Fayetteville
75. M. Cook	Santa Fe
76. J. R. Copeland	Lawrenceburg
77. V. T. Denny	Silverpoint
78. N. R. Dodson	Columbia
79. C. H. Eblen	Shelbyville
80. Central Station	Knoxville
81. C. Gray Elkins	McMinnville
82. Joe Evans	Lawrenceburg
83. Farm Bureau Supply Assn.	Dunlap
84. Luther Farris	Hampshire
85. Emmett Gilbreath	Columbia
86. Gillette Grain Co.	Nashville
87. Haskel Green	Sparta

88.	W. J. Green	Sparta
89.	J. H. Grime, Jr.	Lebanon
90.	Central Station	Knoxville
91.	F. E. Gwaltney	Hickman
92.	Ralph Gwaltney	Hickman
93.	H. H. Hogan	Lebanon
94.	Wayne Hardison	Carter's Creek
95.	Carl Harris	Williamsport
96.	Thomas B. Haynes	Murfreesboro
97.	Fred L. Hill	Sparta
98.	O. R. Holley	Woodbury
99.	Stanton Hunter	Carthage
100.	Central Station	Knoxville
101.	Ira Johnson	Lebanon
102.	J. C. Jones	Alexanderia
103.	Geo. Kerr & Son	Mt. Pleasant
104.	Charlie Mahon	Spring Hill
105.	Ed. Malone	Alexandria
106.	K. Miller	Lebanon
107.	J. P. Nunnely	Nunnely
108.	Jim Odell	Spring Hill
109.	H. O. Pepper	Wartrace
110.	Central Station	Knoxville
111.	John Dinny Pigg	Santa Fe
112.	Mrs. Annie Powell	Watertown
113.	Ben T. Powell	Lebanon
114.	Neal Powell	Lebanon
115.	N. B. Rickman	Hartsville
116.	Robert Russell	Carter's Creek
117.	Gordon C. Shafner	Shelbyville
118.	Charlie Skillington	Santa Fe
119.	Comer Smith	Columbia
120.	Central Station	Knoxville
121.	P. A. Stiver	Manchester
122.	C. M. Stone	Cookeville
123.	E. H. Swingle	Pikeville
124.	W. M. Tolly	Waverly
125.	Chas. Vaughn	Celina
126.	R. S. Vaughn	Celina
127.	G. W. Venters	Portland
128.	Homer Vestal	Columbia
129.	Jas. E. Ward	Lynchburg
130.	Central Station	Knoxville

<u>Abruzzi</u>

131.	L. N. Allen	Montgomery, Ala.
132.	Mrs. Geo. Burlein	Lawrenceburg
133.	William J. Burlein	Lawrenceburg
134.	J. E. Bryan	Goldsboro, N. C.
135.	Jepp Collier	Fayetteville
136.	Collier & Stone	Fayetteville
137.	J. B. Cotner	Raleigh, N. C.

138. Joe Evans	Lawrenceburg
139. W. G. Gilchrist	Elizabethton, N. C.
140. (Balbo) Central Station	Knoxville
141. L. N. Hall	Raleigh, N. C.
142. Clyde Hazlett	Fayetteville
143. Tom Jarred	Sparta
144. E. F. Johnson, Jr.	Sparta
145. Gordon Shofner	Shelbyville
146. Leonard Wade	Fayetteville

Tennessee Common

147. Perry Graham	Sparta
148. J. E. Green	Sparta
149. W. J. Green	Sparta
150. (Balbo) Central Station	Knoxville
151. F. E. Gwaltney	Hickman
152. Ralph Gwaltney	Hickman
153. B. Pitman	Alexanderia
154. Eli Pitman	Alexanderia
155. (Balbo) Central Station	Knoxville
156. W. S. Roy	Sparta
157. Robbins	Sparta
158. Gordon C. Shafner	Shelbyville
159. F. M. White	Sparta
160. (Balbo) Central Station	Knoxville

Rosen

161. Earl Brown	Fayetteville
162. Jepp Collier	Fayetteville
163. Collier & Stone	Fayetteville
164. J. M. Donoho	Portland
165. Michigan Experiment Station	East Lansing, Mich.
166. F. E. Gwaltney	Hickman
167. Ralph Gwaltney	Hickman
168. Leonard Wade	Fayetteville

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169. Mr. Gibson (Common)	Paris
170. (Balbo) Central Station	Knoxville
171. N. D. Experiment Station (Dokald)	Fargo, N. Dak.
172. Ed. S. Ezell (Balbo)	Chapel Hill
173. Lester Gross (Balbo)	Pulaski
174. J. H. Holloway (Balbo)	Spring City
175-200. (Balbo) Central Station	Knoxville

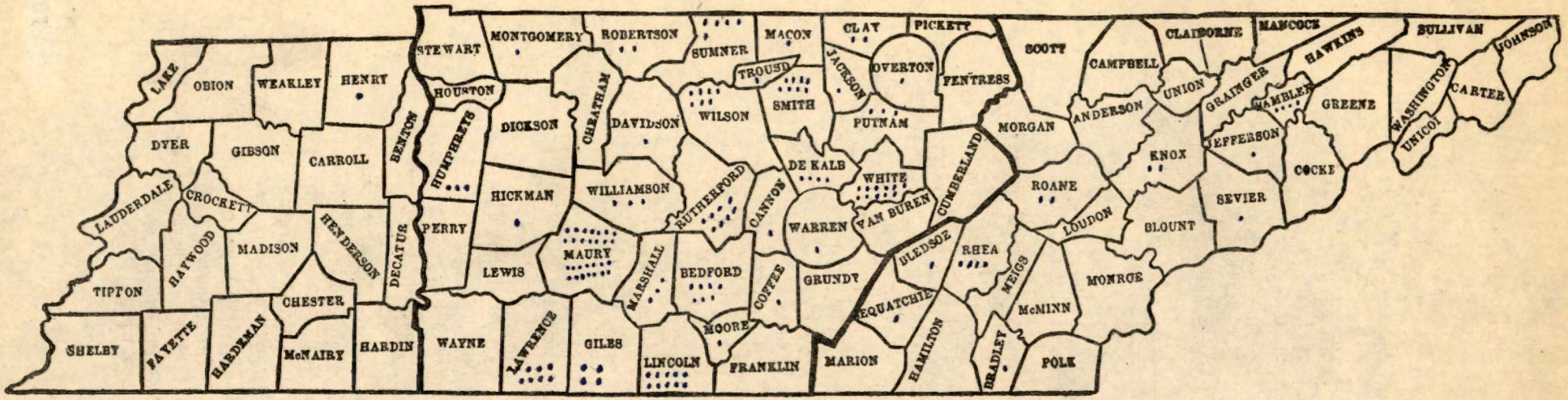


Fig. 2. Map of Tennessee Showing the Counties from Which Seed was Obtained. Each Dot Represents one Sample of Seed.

CHAPTER III

COMPARISON BETWEEN PLANT AND SEED CHARACTERISTICS OF BALBO, ABRUZZI, TENNESSEE COMMON AND ROSEN RYE

Differences in the Field Habits of the Four Varieties

Balbo and Abruzzi are characterized by a rapid, upright habit of growth, while Rosen and Tennessee Common have the true winter habit of a spreading or decumbent growth. The chief differences between Balbo and Abruzzi are that Balbo stools more than Abruzzi, grows taller, and has a longer head, as will be shown later, and it has been found by the Experiment Station to be more winter hardy. The Tennessee Common and Rosen varieties look very much alike in their early stages of growth, both being very decumbent in their habit, but as they approach maturity there is a marked distinction. Rosen does not grow as tall as Tennessee Common, does not stool as much, and does not mature seed as readily as does the Tennessee Common, under Tennessee conditions.

By using the above characters as the basis of field-studying the 145 samples of rye collected throughout the State by mail and at the State Fair, the writer obtained the following results:

Samples of Seed Obtained at State Fair

Row No.	Classification of Sample	Plant and Seed Type	Correct Incorrect or Mixed	Row No.	Classification of Sample	Plant and Seed Type	Correct Incorrect or Mixed
65	Balbo	Balbo	Correct	66	Balbo	Balbo	Correct
132	Abruzzi	Balbo	Incorrect	133	Abruzzi	Balbo	Incorrect

Row No.	Classification of Sample	Plant and Seed Type	Correct Incorrect or Mixed
73	Balbo	Balbo	Correct
135	Abruzzi	Balbo	Incorrect
162	Rosen	Rosen	Correct
82	Balbo	Balbo	Correct
87	Balbo	Balbo	Correct
148	Tennessee Common	Tennessee Common	Correct
91	Balbo	Balbo	Correct
151	Tennessee Common	Tennessee Common	Correct
166	Rosen	Rosen	Correct
117	Balbo	Balbo	Correct
158	Tennessee Common	Tennessee Common	Correct
168	Rosen	Balbo	Incorrect
155	Tennessee Common	Tennessee Common	Correct
93	Balbo	Balbo	Correct
99	Balbo	Tennessee Common	Incorrect
105	Balbo	Rosen	Incorrect
142	Abruzzi	Abruzzi	Correct
144	Abruzzi	Abruzzi	Correct
156	Tennessee Common	Abruzzi	Incorrect
159	Tennessee Common	Tennessee Common	Correct
164	Rosen	Rosen	Correct

Row No.	Classification of Sample	Plant and Seed Type	Correct Incorrect or Mixed
74	Balbo	Balbo	Correct
136	Abruzzi	Balbo	Incorrect
163	Rosen	Rosen	Correct
138	Abruzzi	Abruzzi	Correct
88	Balbo	Balbo	Correct
149	Tennessee Common	Tennessee Common	Correct
92	Balbo	Balbo	Correct
152	Tennessee Common	Tennessee Common	Correct
167	Rosen	Rosen	Correct
145	Abruzzi	Tennessee Common	Incorrect
146	Abruzzi	Balbo	Incorrect
76	Balbo	Balbo	Correct
154	Tennessee Common	Tennessee Common	Correct
97	Balbo	Balbo	Correct
102	Balbo	Rosen	Incorrect
122	Balbo	Mixed	Mixed
143	Abruzzi	Tennessee Common	Incorrect
147	Tennessee Common	Abruzzi	Incorrect
157	Tennessee Common	Tennessee Common	Correct
161	Rosen	Rosen	Correct
169	Tennessee Common	Tennessee Common	Correct

Samples of Seed Obtained From Farmers By Mail

Row No.	Classification of Sample	Plant and Seed Type	Correct Incorrect or Mixed
1	Balbo	Balbo	Correct
2	Balbo	Balbo	Correct
3	Balbo	Balbo	Correct
4	Balbo	Balbo	Correct
5	Balbo	Balbo	Correct
6	Balbo	Balbo	Correct
7	Balbo	Balbo	Correct
8	Balbo	Mixed	Mixed
9	Balbo	Balbo	Correct
11	Balbo	Balbo	Correct
12	Balbo	Balbo	Correct
13	Balbo	Balbo	Correct
14	Balbo	Balbo	Correct
15	Balbo	Balbo	Correct
16	Balbo	Mixed	Mixed
17	Balbo	Mixed	Mixed
18	Balbo	Mixed	Mixed
19	Balbo	Balbo	Correct
21	Balbo	Mixed	Mixed
22	Balbo	Balbo	Correct
23	Balbo	Mixed	Mixed
24	Balbo	Balbo	Correct
25	Balbo	Balbo	Correct
26	Balbo	Balbo	Correct

Row No.	Classification of Sample	Plant and Seed Type	Correct Incorrect or Mixed
27	Balbo	Balbo	Correct
28	Balbo	Balbo	Correct
29	Balbo	Balbo	Correct
36	Balbo	Balbo	Correct
37	Balbo	Balbo	Correct
38	Balbo	Balbo	Correct
39	Balbo	Balbo	Correct
41	Balbo	Balbo	Correct
42	Balbo	Balbo	Correct
43	Balbo	Tennessee Common	Incorrect
44	Balbo	Balbo	Correct
45	Balbo	Tennessee Common	Incorrect
46	Balbo	Mixed	Mixed
47	Balbo	Mixed	Mixed
48	Balbo	Mixed	Mixed
49	Balbo	Mixed	Mixed
51	Balbo	Tennessee Common	Incorrect
52	Balbo	Balbo	Correct
53	Balbo	Balbo	Correct
54	Balbo	Balbo	Correct
55	Balbo	Balbo	Correct
56	Balbo	Tennessee Common	Incorrect
57	Balbo	Mixed	Mixed
58	Balbo	Mixed	Mixed

Row No.	Classification of Sample	Plant and Seed Type	Correct Incorrect or Mixed
59	Balbo	Tennessee Common	Incorrect
61	Balbo	Balbo	Correct
62	Balbo	Balbo	Correct
63	Balbo	Balbo	Correct
64	Balbo	Balbo	Correct
67	Balbo	Balbo	Correct
68	Balbo	Balbo	Correct
69	Balbo	Balbo	Correct
71	Balbo	Tennessee Common	Incorrect
72	Balbo	Balbo	Correct
75	Balbo	Tennessee Common	Incorrect
77	Balbo	Balbo	Correct
78	Balbo	Balbo	Correct
79	Balbo	Balbo	Correct
81	Balbo	Balbo	Correct
83	Balbo	Mixed	Mixed
84	Balbo	Mixed	Mixed
85	Balbo	Balbo	Correct
86	Balbo	Balbo	Correct
89	Balbo	Balbo	Correct
94	Balbo	Balbo	Correct
95	Balbo	Balbo	Correct
96	Balbo	Balbo	Correct
98	Balbo	Balbo	Correct
101	Balbo	Mixed	Mixed
103	Balbo	Mixed	Mixed
104	Balbo	Balbo	Correct
106	Balbo	Balbo	Correct
107	Balbo	Mixed	Mixed
108	Balbo	Mixed	Mixed
109	Balbo	Balbo	Correct
111	Balbo	Balbo	Correct
112	Balbo	Mixed	Mixed
113	Balbo	Balbo	Correct
114	Balbo	Balbo	Correct
115	Balbo	Balbo	Correct
116	Balbo	Balbo	Correct
118	Balbo	Mixed	Mixed
119	Balbo	Balbo	Correct
121	Balbo	Mixed	Mixed
122	Balbo	Balbo	Correct
123	Balbo	Balbo	Correct
124	Balbo	Tennessee Common	Incorrect
125	Balbo	Balbo	Correct
126	Balbo	Balbo	Correct
127	Balbo	Mixed	Mixed
128	Balbo	Balbo	Correct
129	Balbo	Balbo	Correct
172	Balbo	Mixed	Mixed
173	Balbo	Balbo	Correct
174	Balbo	Balbo	Correct

The above data may be summarized as follows:

Of the 46 samples collected at the State Fair, 32 were entered in their proper class, 13 were entered in the wrong class (Balbo entered as Abruzzi or Tennessee Common entered as Balbo) and one sample showing more than one type of growth habit in the field, was termed mixed. Of the 99 samples collected by mail and classified as Balbo, 68 possessed field habits which resembled more closely the Balbo type than they did either of the other types, Abruzzi, Tennessee Common, or Rosen, while 8 did not resemble the Balbo type at all, and 23 showing more than one type of growth habit, were termed mixed. Summarizing the data on all 145 samples, 101 seem to be correctly named, while 20 were incorrectly named, and 24 showing more than one type of growth habit, were termed mixed (Table III).

Differences in the Seed Characters of the Four Varieties

Fifty grams of each of the Standard Balbo samples, the three Standard Abruzzi samples, the three Rosen samples, and the three Tennessee Common samples were weighed out, and separated into the three most prominent colors, which are black, wheat colored, and green or greenish, and the percentage of each determined. In addition, 100 seeds were taken at random from each sample, placed end to end, and measured for total length; the same 100 seeds were placed side by side, and measured for total width; and, the same 100 seeds were weighed in each case. These data are shown in Table IV.

TABLE III. THE SUMMARY OF THE DATA ON 145 SAMPLES OF RYE COLLECTED AT THE STATE FAIR AND FROM FARMERS BY MAIL

Class	Number of Samples	Number of Samples Correctly Classified	Number of Samples Incorrectly Classified	Number of Samples Mixed
Balbo (Samples from State Fair)	17	13	3	1
Abruzzi (Samples from State Fair)	10	3	7	0
Rosen (Samples from State Fair)	7	6	1	0
Tenn. Common (Samples from State Fair)	12	10	2	0
Balbo (Samples received by mail)	99	68	8	23
TOTAL	145	101	20	24

TABLE IV. THE PER CENT OF BLACK, WHEAT COLORED, AND GREEN OR GREENISH COLORED SEED IN 50-GRAM SAMPLES OF BALBO, ABRUZZI, ROSEN, AND TENNESSEE COMMON RYE AND THE LENGTH, WIDTH AND WEIGHT OF 100 SEEDS OF EACH VARIETY

Variety	Per Cent Black Seed	Per Cent Wheat Colored Seed	Per Cent Green or Greenish Colored Seed	Length of 100 Seed	Width of 100 Seed	Weight of 100 Seed
Balbo #37565	30.0	50.0	20.0	31.8"	9.1"	2.8
Balbo #37566 Abruzzi	18.8	47.6	33.6	32.1"	8.9"	2.7
W. G. Gilchrist Abruzzi	14.4	80.0	5.6	27.7"	9.4"	2.6
J. E. Bryan Abruzzi	22.8	67.0	10.2	27.6"	9.9"	2.8
Alabama Rosen	20.0	73.6	6.4	29.4"	10.1"	3.0
Michigan Rosen	6.8	21.4	71.8	30.4"	10.2"	3.2
Jepp Collier Rosen	12.0	58.0	30.0	31.0"	8.5"	2.5
Earl Brown Tenn. Common	12.0	58.0	30.0	31.0"	8.2"	2.5
F. E. Gwaltney Tenn. Common	28.0	61.0	11.0	26.2"	7.5"	1.7
Eli Pitman Tenn. Common	41.0	42.0	17.0	26.0"	7.9"	1.8
J. E. Green	36.0	48.8	15.2	25.6"	8.1"	1.7

These data may be summarized as follows:

The average of the two Balbo samples contained 24.8 per cent of black seed, 5.8 per cent more than the average of the three Abruzzi samples, 14.5 per cent more than the average of the three Rosen samples, and 10.2 per cent less than the average of the three Tennessee Common samples.

The average of the two Balbo samples contained 48.8 per cent of wheat colored seed, 24.7 per cent less than the average of the three Abruzzi samples, 3 per cent more than the average of the three Rosen samples, and 1.8 per cent less than the average of the three Tennessee Common samples.

The average of the two Balbo samples contained 26.8 per cent of green or greenish colored seed, 19.4 per cent more than the average of the three Abruzzi samples, 17.1 per cent less than the average of the three Rosen samples, and 12.4 per cent more than the average of the three Tennessee Common samples.

The average length of 100 seeds from each of the two Balbo samples was 31.9 inches, 3.7 inches longer than the average of 100 seeds from each of the three Abruzzi samples, 1.1 inches longer than the average of 100 seeds from each of the three Rosen samples, and 6 inches longer than the average of 100 seeds from each of the three Tennessee Common samples.

The average width of 100 seeds from each of the two Balbo samples was 9 inches, 0.8 inches less than the average width of 100 seeds from each of the three Abruzzi samples, 0.1 inch more than the average width of 100 seeds from each of the three Rosen samples, and 1.2 inches more than the average of 100 seeds from each of the three Tennessee Common samples.

The average weight of 100 seeds from each of the two Balbo samples was 2.8 grams, 0.1 gram more than the average weight of 100 seeds from each of the three Abruzzi and of the three Rosen samples, and 1.1 grams more than the average of 100 seeds from each of the three Tennessee Common samples. See Table V.

TABLE V. THE AVERAGE PER CENT OF BLACK, WHEAT COLORED, AND GREEN OR GREENISH COLORED SEED IN TWO 50-GRAM SAMPLES OF BALBO, THREE 50-GRAM SAMPLES OF ABRUZZI, ROSEN, AND TENNESSEE COMMON RYE, AND THE LENGTH, WIDTH AND WEIGHT OF 100 SEEDS OF EACH VARIETY

Variety	Per Cent Black Seed	Per Cent Wheat Colored Seed	Per Cent Green Seed	Length of 100 Seed	Width of 100 Seed	Weight of 100 Seed	Number of Seed in 1 Gram
Balbo	24.8	48.8	26.8	31.9"	9.0"	2.8	40.5
Abruzzi	19.0	73.5	7.4	28.2"	9.8"	2.7	38.7
Rosen	10.3	45.8	43.9	30.8"	8.9"	2.7	39.7
Tenn. Common	35.0	50.6	14.4	25.9"	7.8"	1.7	61.3

Difference Found By Laboratory Comparison of Twenty-Five Plants Of Abruzzi, Balbo and Tennessee Common

Twenty-five typical plants of each of the Abruzzi, Balbo and Tennessee Common varieties were selected and compared in the laboratory by Student's Method. There were not enough Rosen plants available to make the same study of this variety.

The following factors of each of the three varieties were compared (All measurements in this paper are in inches):

1. The number of culms per plant.
2. The total length of culms per plant.
3. The length of the longest culm per plant.

4. The total length of heads per plant.

5. The length of the longest head per plant.

6. The number of spikelets per plant.

7. The greatest number of spikelets per spike, per plant.

The data for each of these factors were grouped into a frequency distribution (Tables VI, IX, XII, XV, XVIII, XXI, and XXIV), and plotted (Figures 3, 4, 5, 6, 7, 8, and 9). The mean and standard deviation of each group of data were calculated (Love 1936:43, 76), and are shown in Tables VI, IX, XII, XV, XVIII, XXI, and XXIV.

The mean is the average for the population, and there may not be a single individual in the entire population with the exact number as the mean, for example, the mean number of culms per plant for Abruzzi, Balbo and Tennessee Common (Table VI) is 4.54 $\pm$ .515, 6.40 $\pm$ .358, and 7.66 $\pm$ .347 respectively, and no plant would contain 4.5, 6.4, or 6.6 culms, but instead, it would be some whole number. More than one distribution may be obtained with the same range, yet in one the majority of the population may be grouped closely about the mean, while in another the grouping may be spread out considerably from the mean. It is true, then, that the mean does not always have a great deal of significance and it is also true that the range is not a good measure of the variability of a group of individuals (Love 1936:66).

The standard deviation was used to measure the variability of all groups of data contained in this paper. As Yule defines it, the standard deviation is "the square root of the arithmetic mean of the squares of all deviations, deviations being measured from the arithmetic mean of the observations" (Love 1936:74).

"The reliability of constants, such as the mean and the standard deviation, is indicated by the probable error, and it is evident that the smaller the error the more reliable is the constant" (Love 1936:74). The probable error of the mean and the standard deviation were calculated (Love 1936:238) for each group of data used in this paper.

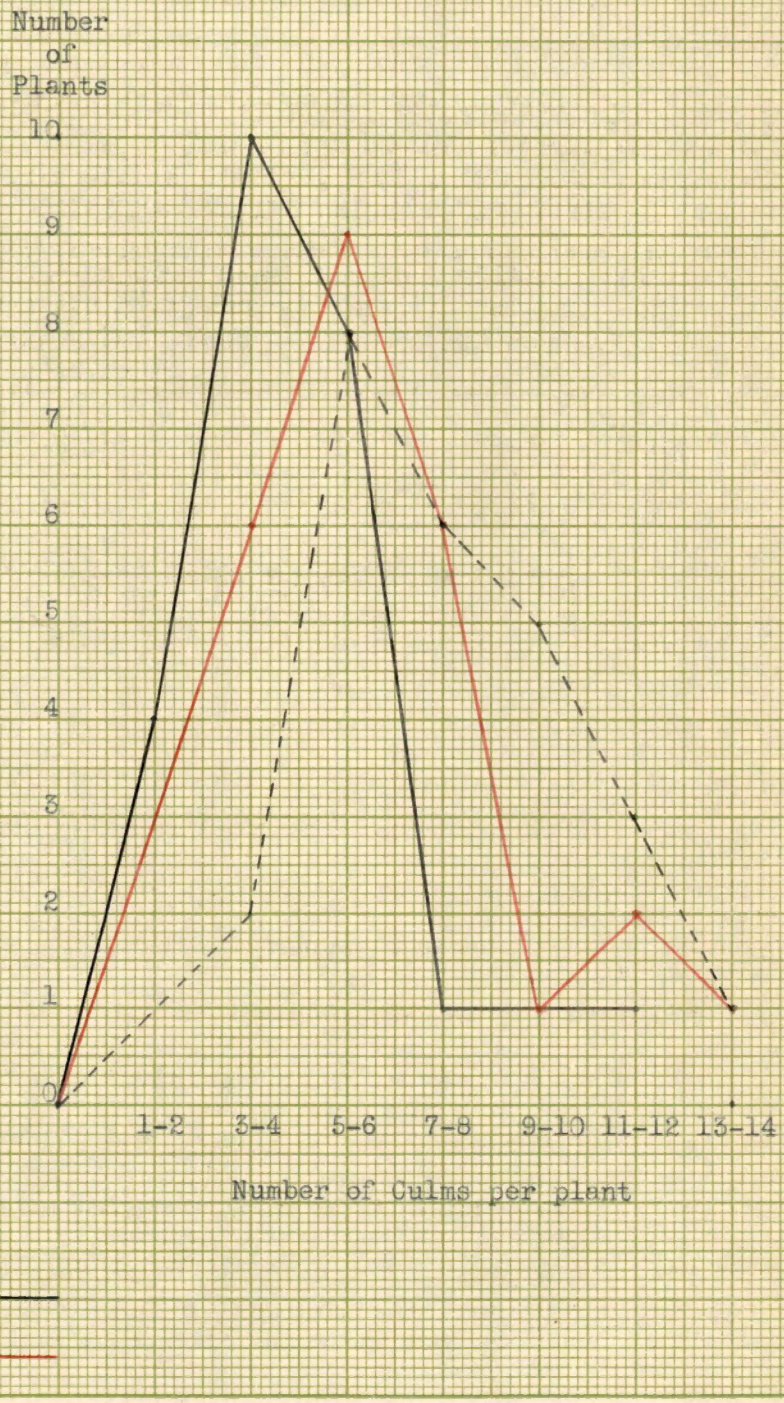
TABLE VI. FREQUENCY DISTRIBUTION, SHOWING NUMBER OF CULMS PER PLANT FOR 25 PLANTS OF ABRUZZI, BALBO AND TENNESSEE COMMON, ALSO MEAN AND STANDARD DEVIATION

Number of Culms Per Plant	Number of Plants		
Class Range	Abruzzi	Balbo	Tennessee Common
1-2	4	0	0
3-4	10	6	2
5-6	8	9	8
7-8	1	6	6
9-10	1	1	5
11-12	1	2	3
13-14	0	1	1
Total	25	25	25
Mean	4.54 ± .315	6.40 ± .358	7.66 ± .347
Standard Deviation	2.34 ± .223	2.66 ± .253	2.59 ± .246

Comparison of Abruzzi and Tennessee Common with Balbo shows a significant difference in the number of culms per plant in favor of Balbo as compared with Abruzzi (Table VII). When Z = .6 and the number of plants equal 25 the odds are 277 to 1 against a difference as great as this occuring due to chance alone (Love 1936:483).

No significant difference is apparent between Balbo and Tennessee Common (Table VIII). When Z = .3 and the number of plants equal 25 the odds are 12 to 1 against a difference as great as this occuring due to chance alone (Love 1936:483).

Fig. 3. Number of Culms per Plant for 25 Plants of Abruzzi, Balbo and Tennessee Common



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In all of the following comparisons, the results are considered significant if the odds are more than 20 to 1 and insignificant if less than 20 to 1.

TABLE VII. COMPARISON BETWEEN ABRUZZI AND BALBO IN THE NUMBER OF CULMS PER PLANT FOR 25 PLANTS BY STUDENT'S METHOD

A Abruzzi	B Balbo	A - B D	D - M	$(D - M)^2$
7	5	+2	+4	16
4	6	-2	0	0
3	4	-1	+1	1
6	8	-2	0	0
11	5	+6	+8	64
5	7	-2	0	0
9	4	+5	+7	49
5	5	0	0	0
6	6	0	0	0
3	7	-4	-2	4
3	7	-4	-2	4
3	12	-9	-7	49
2	9	-7	-5	25
2	4	-2	0	0
3	6	-3	-1	1
5	7	-2	0	0
1	7	-6	-4	16
2	5	-3	-1	1
3	11	-8	-6	36
4	3	+1	+3	9
4	4	0	0	0
5	13	-8	-6	36
3	6	-3	-1	1
6	6	0	0	0
5	4	+1	+3	9

-66

+15

25)-51

Mean = -2.04

25)321.00

12.84

$\sqrt{12.84}$ =

S. D. = 3.584

$$Z = \frac{M}{S.\ D.} = \frac{2.04}{3.584} = .569$$

When Z = .6 the odds are 277 to 1

TABLE VIII. COMPARISON BETWEEN BALBO AND TENNESSEE COMMON IN THE NUMBER OF CULMS PER PLANT FOR 25 PLANTS BY STUDENT'S METHOD

A Balbo	B Tenn. Common	A - B D	D - M	$(D - M)^2$
5	14	-9	-7.8	60.84
6	12	-6	-4.8	23.04
4	6	-2	- .8	.64
8	4	+4	+5.2	27.04
5	5	0	.0	.00
7	9	-2	- .8	.64
4	9	-5	-3.8	14.44
5	10	-5	-3.8	14.44
6	5	+1	+2.2	4.84
7	12	-5	-3.8	14.44
7	8	-1	+ .2	.04
12	6	+6	+7.2	51.84
9	9	0	.0	.00
4	11	-7	-5.8	33.64
6	5	+1	+2.2	4.84
7	7	0	.0	.00
7	6	+1	+2.2	4.84
5	8	-3	-1.8	3.24
11	8	+3	+4.2	17.64
3	5	-2	- .8	.64
4	7	-3	-1.8	3.24
13	7	+6	+7.2	51.84
6	9	-3	-1.8	3.24
6	3	+3	+4.2	17.64
4	6	-2	- .8	.64

$$-55$$

$$25\overline{)\begin{array}{r}+25\\-30\end{array}}$$

Mean = -1.2

$$25\overline{)353.68}$$

$$14.15$$

$$\sqrt{14.15} =$$

S. D. = 3.762

$$Z = \frac{M}{S.\ D.} = \frac{1.2}{3.762} = .32$$

When Z = .3 the odds are 12 to 1

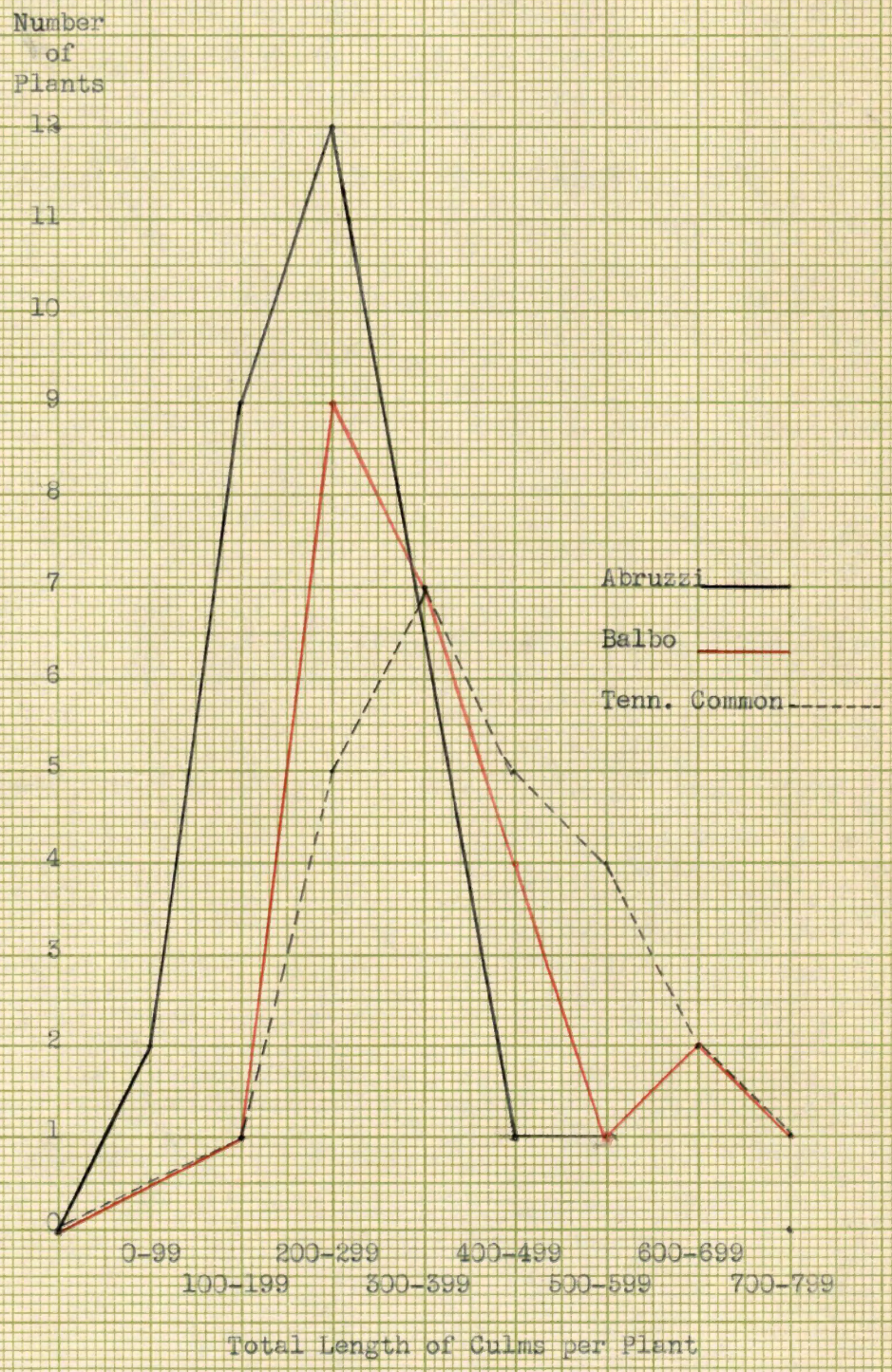
TABLE IX. FREQUENCY DISTRIBUTION, SHOWING THE TOTAL LENGTH OF CULMS PER PLANT IN INCHES FOR 25 PLANTS OF ABRUZZI, BALBO, AND TENNESSEE COMMON, ALSO MEAN AND STANDARD DEVIATION

Total Length of Culms per Plant	Number of Plants		
Class Range	Abruzzi	Balbo	Tennessee Common
0-99	2	0	0
100-199	9	1	1
200-299	12	9	5
300-399	0	7	7
400-499	1	4	5
500-599	1	1	4
600-699	0	2	2
700-799	0	1	1
Total	25	25	25
Mean	222 ± 14.143	370 ± 19.826	414 ± 19.782
Standard Deviation	104.84 ± 10.000	146.97 ± 14.019	146.64 ± 13.988

Comparison of Abruzzi and Tennessee Common with Balbo shows a significant difference in the total length of culms per plant in favor of Balbo as compared with Abruzzi (Table X). When Z = .8 and the number of plants equal 25 the odds are 3332 to 1 against a difference as great as this occuring due to chance alone (Love 1936:483).

No significant difference is apparent between Balbo and Tennessee Common (Table XI). When Z = .2 and the number of plants equal 25 the odds are 5 to 1 against a difference as great as this occuring due to chance alone (Love 1936:483).

Fig. 4. Total Length of Culms Per Plant in Inches For 25 Plants of Abruzzi, Balbo and Tennessee Common



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TABLE X. COMPARISON BETWEEN ABRUZZI AND BALBO IN THE TOTAL LENGTH OF CULMS PER PLANT IN INCHES FOR 25 PLANTS BY STUDENT'S METHOD

A Abruzzi	B Balbo	A - B D	D - M	$(D - M)^2$
388.5	283.0	+105.5	+265.7	70,596.49
215.5	386.0	-170.5	- 10.3	106.09
148.5	234.5	- 86.0	+ 74.2	5,505.64
263.0	494.5	-231.5	- 71.2	5,069.44
523.0	291.5	+231.5	+391.7	153,428.89
251.5	369.0	-117.5	+ 42.7	1,823.29
464.0	242.0	+222.0	+382.2	146,076.84
237.5	267.0	- 29.5	+130.7	17,082.49
273.0	335.5	- 62.5	+ 97.7	9,545.29
145.0	442.0	-297.0	-136.8	18,714.24
155.5	392.0	-236.5	- 76.3	5,821.69
153.5	640.0	-486.5	-326.2	106,406.44
105.0	526.5	-421.5	-261.3	42,147.69
106.5	254.0	-148.5	+ 11.7	136.89
124.5	373.0	-248.5	- 88.3	7,796.89
218.5	417.5	-199.0	- 38.8	1,505.44
55.0	457.0	-402.0	-241.8	58,467.24
98.0	281.0	-183.0	- 22.8	519.84
120.5	602.5	-482.0	-321.8	103,555.24
219.0	181.0	+ 38.0	+198.2	39,283.24
203.0	216.0	- 13.0	+147.2	21,667.84
206.0	732.0	-526.0	-365.8	133,809.64
149.5	316.0	-166.5	- 6.3	39.69
267.0	387.0	-120.0	+ 40.2	1,616.04
272.0	246.5	+ 25.5	+185.7	34,484.49

-4627.5

+ 622.5

25) 4005.0

Mean = -160.2

25) 985,207.00

39,408.28

$\sqrt{39,408.28}$ =

S. D. = 198.515

$$Z = \frac{M}{S.\ D.} = \frac{160.2}{198.515} = .807$$

When Z = .8 the odds are 3332 to 1

TABLE XI. COMPARISON BETWEEN BALBO AND TENNESSEE COMMON IN THE TOTAL LENGTH OF CULMS PER PLANT IN INCHES FOR 25 PLANTS BY STUDENT'S METHOD

A Balbo	B Tenn. Common	A - B D	D - M	$(D - M)^2$
285.0	691.5	-406.5	-364.5	132,860.25
386.0	606.0	-220.0	-176.0	30,976.00
234.5	320.5	- 86.0	- 42.0	1,764.00
494.5	245.0	+249.0	+293.0	85,849.00
291.5	277.5	+ 14.0	+ 58.0	3,364.00
369.0	467.5	- 98.5	- 54.5	2,970.25
242.0	519.0	-277.0	-233.0	54,289.00
267.0	578.0	-311.0	-267.0	71,289.00
335.5	321.0	+ 14.5	+ 58.5	3,422.25
442.0	735.0	-293.0	-249.0	62,001.00
392.0	393.0	- 1.0	+ 43.0	1,849.00
640.0	361.5	+278.5	+322.5	104,006.25
526.5	513.5	+ 13.0	+ 57.0	3,249.00
254.0	564.5	-310.5	-266.5	71,022.25
373.0	302.0	+ 71.0	+115.0	13,225.00
417.5	414.5	+ 3.0	+ 47.0	2,209.00
457.0	299.0	+158.0	+202.0	40,804.00
281.0	439.5	-158.5	-114.5	13,110.25
602.5	471.0	+131.5	+175.5	30,800.25
181.0	293.0	-112.0	- 68.0	4,624.00
216.0	361.0	-145.0	-101.0	10,201.00
732.0	354.0	+378.0	+422.0	178,084.00
316.0	482.5	-166.5	-122.5	15,006.25
387.0	160.0	+227.0	+271.0	73,441.00
246.5	297.5	- 51.0	- 7.0	49.00

-2638.5

+1537.5

25)-1101.0

Mean = - 44.04

25)1,010,465.00

40,418.60

$\sqrt{40,418.60}$ =

S. D. = 201.044

$$Z = \frac{M}{S.\ D.} = \frac{44.04}{201.044} = .219$$

When Z = .2 the odds are 5 to 1

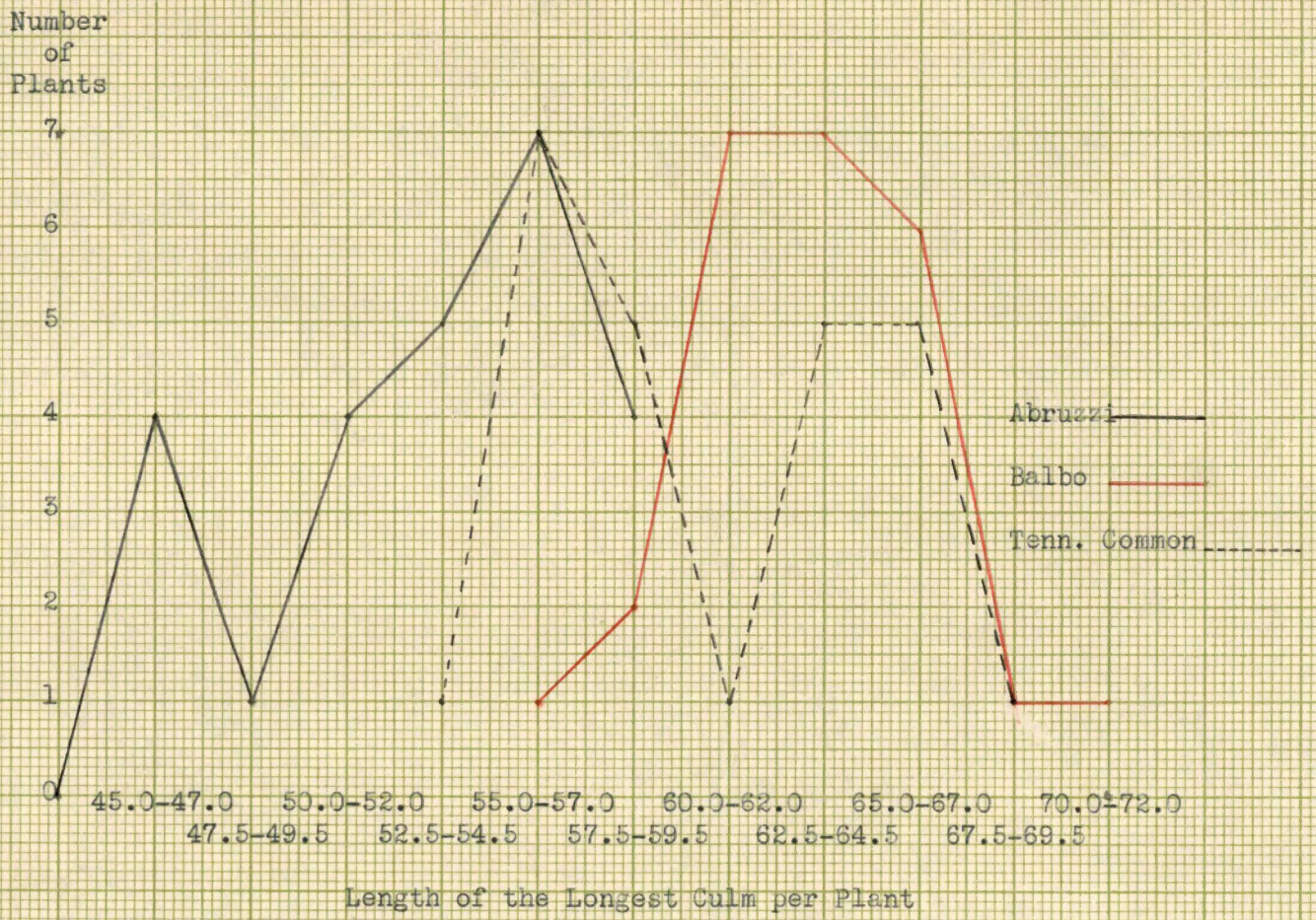
TABLE XII. FREQUENCY DISTRIBUTION, SHOWING THE LENGTH OF THE LONGEST CULM PER PLANT IN INCHES FOR 25 PLANTS OF ABRUZZI, BALBO AND TENNESSEE COMMON, ALSO MEAN AND STANDARD DEVIATION

Length of Longest Culm per Plant	Number of Plants		
Class Range	Abruzzi	Balbo	Tennessee Common
45.0-47.0	4	0	0
47.5-49.5	1	0	0
50.0-52.0	4	0	0
52.5-54.5	5	0	1
55.0-57.0	7	1	7
57.5-59.5	4	2	5
60.0-62.0	0	7	1
62.5-64.5	0	7	5
65.0-67.0	0	6	5
67.5-69.5	0	1	1
70.0-72.0	0	1	0
Total	25	25	25
Mean	53.2 $\pm$ .550	63.2 $\pm$ .440	60.6 $\pm$ .586
Standard Deviation	4.08 $\pm$ .389	3.27 $\pm$ .311	4.35 $\pm$ .414

Comparison of Abruzzi and Tennessee Common with Balbo shows a significant difference in the length of the longest culm per plant in favor of Balbo as compared with Abruzzi (Table XIII). When Z = .5 and the number of plants equal 25 the odds are 90 to 1 against a difference as great as this occuring due to chance alone (Love 1936:483).

A significant difference is also apparent between Balbo and Tennessee Common, in favor of Tennessee Common (Table XIV). When Z = .5 and the number of plants equal 25 the odds are 90 to 1 against a difference as great as this occuring due to chance alone (Love 1936:483).

Fig. 5. Length of the Longest Culm Per Plant in Inches for 25 Plants of Abruzzi, Balbo and Tennessee Common



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TABLE XIII. COMPARISON BETWEEN ABRUZZI AND BALBO IN THE LENGTH OF THE LONGEST CULM PER PLANT IN INCHES FOR 25 PLANTS BY STUDENT'S METHOD

A Abruzzi	B Balbo	A - B D	D - M	$(D - M)^2$
59.5	60.0	- .5	-10.6	112.36
57.0	66.5	- 9.5	-19.6	384.16
50.0	60.5	-10.5	-20.6	424.36
53.0	64.0	-11.0	-21.1	445.21
57.0	63.5	- 6.5	-16.6	275.56
58.0	63.5	- 5.5	-15.6	243.36
53.0	63.5	-10.5	-20.6	424.16
51.0	59.0	- 8.0	-18.1	327.61
53.0	60.0	- 7.0	-17.1	292.41
50.0	65.5	-15.5	-25.6	655.36
53.5	63.5	-10.0	-20.1	404.01
55.5	62.5	- 7.0	-17.1	292.41
53.0	62.0	- 9.0	-19.1	364.81
56.5	66.0	- 9.5	-19.6	384.16
46.5	65.0	-18.5	-28.6	817.96
49.5	70.0	-20.5	-30.6	936.36
55.0	67.0	-12.0	-22.1	488.41
50.5	59.5	- 9.0	-19.1	364.81
46.5	64.0	-17.5	-27.6	761.76
55.0	60.5	- 5.5	-15.6	243.36
57.5	56.0	+ 1.5	- 8.6	73.96
45.5	61.5	-16.0	-26.1	681.21
56.5	62.0	- 5.5	-15.6	243.36
46.5	66.0	-19.5	-29.6	876.16
58.0	69.0	-11.0	-21.1	445.21

-255.0

+ 1.5

25) -253.5

Mean = - 10.14

25) 10,962.50

438.50

$\sqrt{438.50}$ =

S. D. = 20.941

$$Z = \frac{M}{S.\ D.} = \frac{10.14}{20.941} = .484$$

When Z = .5 the odds are 90 to 1

TABLE XIV. COMPARISON BETWEEN BALBO AND TENNESSEE COMMON IN THE LENGTH OF THE LONGEST CULM PER PLANT IN INCHES FOR 25 PLANTS BY STUDENT'S METHOD

A Balbo	B Tenn. Common	A - B D	D - M	$(D - M)^2$
60.0	56.0	+ 4.0	+ 1.4	1.96
66.5	56.0	+10.5	+ 7.9	62.41
60.5	56.0	+ 4.5	+ 1.9	3.61
64.0	64.5	- .5	- 3.1	9.61
63.5	59.0	+ 4.5	+ 1.9	3.61
63.5	55.0	+ 8.5	+ 5.9	34.81
63.5	63.5	.0	.0	.00
59.0	65.0	- 6.0	- 8.6	73.96
60.0	65.0	- 5.0	- 7.6	57.76
65.5	69.5	- 4.0	- 6.6	43.56
63.5	57.5	+ 6.0	+ 3.4	11.56
62.5	65.5	- 3.0	- 5.6	31.36
62.0	65.0	- 3.0	- 5.6	31.36
66.0	57.0	+ 9.0	+ 6.4	40.96
65.0	64.0	+ 1.0	- 1.6	2.56
70.0	63.0	+ 7.0	+ 4.4	19.36
67.0	66.0	+ 1.0	- 1.6	2.56
59.0	59.0	.0	.0	.00
64.0	61.0	+ 3.0	- .4	.16
60.5	64.5	- 4.0	- 6.6	43.56
56.0	59.5	- 3.5	- 6.1	37.21
61.5	55.0	+ 6.5	+ 3.9	15.21
62.0	58.0	+ 4.0	+ 1.4	1.96
66.0	57.0	+ 9.0	+ 6.4	40.96
69.0	53.5	+15.5	+12.9	166.41
		+94.0		25) 736.48
		-29.0		29.46
		25) +65.0		$\sqrt{29.46}$ =
		Mean = + 2.6		S. D. = 5.428

$$Z = \frac{M}{S.\ D.} = \frac{2.6}{5.428} = .479$$

When Z = .5 the odds are 90 to 1

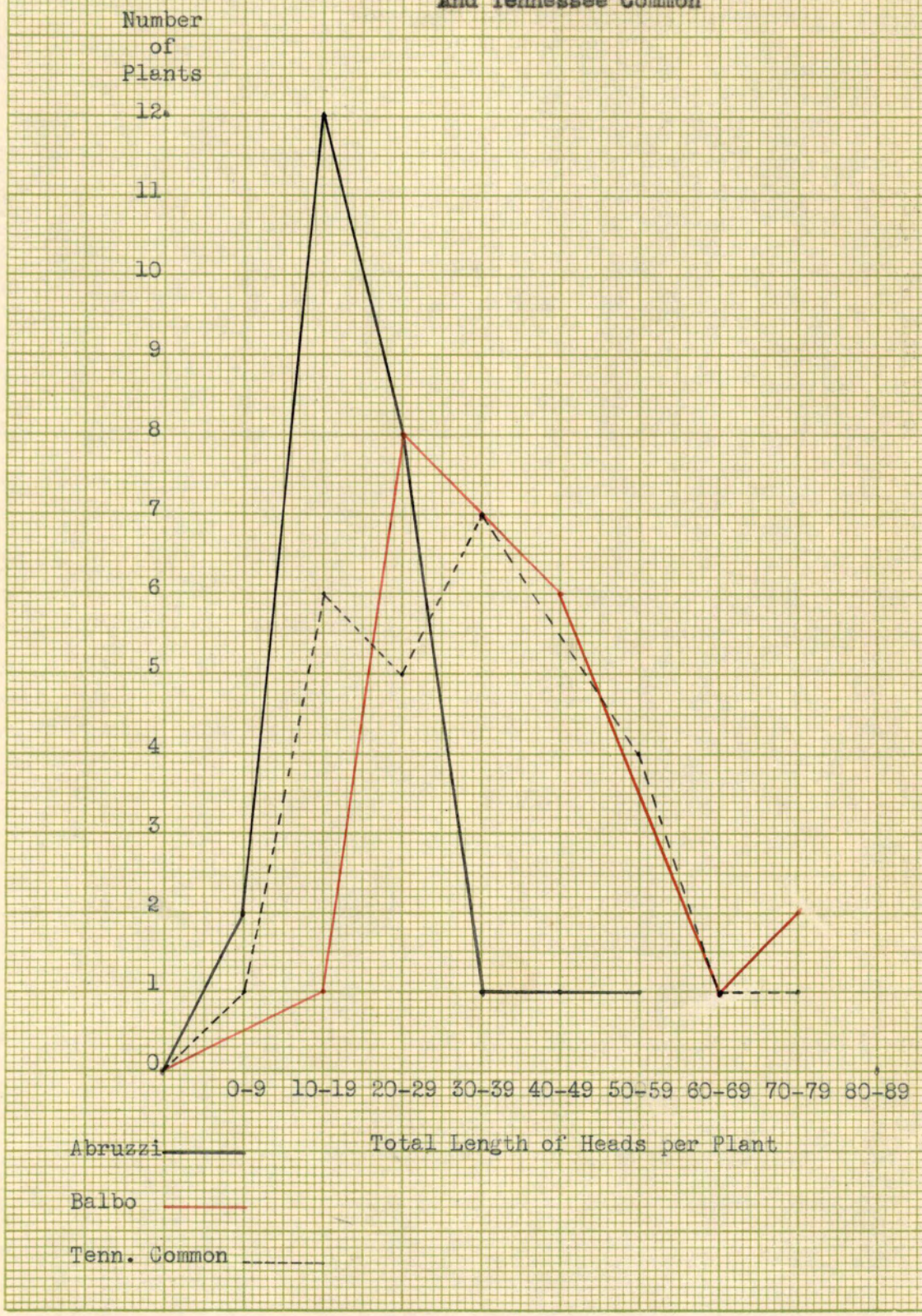
TABLE XV. FREQUENCY DISTRIBUTION, SHOWING TOTAL LENGTH OF HEADS PER PLANT IN INCHES FOR 25 PLANTS OF ABRUZZI, BALBO AND TENNESSEE COMMON, ALSO MEAN AND STANDARD DEVIATION

Total Length of Heads per Plant	Number of Plants		
Class Range	Abruzzi	Balbo	Tennessee Common
0-9	2	0	1
10-19	12	1	6
20-29	8	8	5
30-39	1	7	7
40-49	1	6	0
50-59	1	0	4
60-69	0	1	1
70-79	0	2	1
80-89	0	0	0
Total	25	25	25
Mean	21.0 $\pm$ 1.477	37.8 $\pm$ 2.165	43.0 $\pm$ 2.382
Standard Deviation	10.95 $\pm$ 1.044	15.11 $\pm$ 1.440	17.66 $\pm$ 1.684

Comparison of Abruzzi and Tennessee Common with Balbo shows a significant difference in the total length of heads per plant in favor of Balbo as compared with Abruzzi (Table XVI). When Z = .9 and the number of plants equal 25 the odds are 9999 to 1 against a difference as great as this occuring due to chance alone (Love 1936:483).

No significant difference is apparent between Balbo and Tennessee Common (Table XVII). When Z = .2 and the number of plants equal 25 the odds are 5 to 1 against a difference as great as this occuring due to chance alone (Love 1936:483).

Fig. 6. Total Length of Heads Per Plant in Inches For 25 Plants of Abruzzi, Balbo And Tennessee Common



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TABLE XVI. COMPARISON BETWEEN ABRUZZI AND BALBO IN THE TOTAL LENGTH OF HEADS PER PLANT IN INCHES FOR 25 PLANTS BY STUDENT'S METHOD

A Abruzzi	B Balbo	A - B D	D - M	$(D - M)^2$
34.5	31.0	+ 3.5	+21.5	462.25
19.0	37.0	-18.0	.0	.00
12.0	24.0	-12.0	+ 6.0	36.00
23.5	47.5	-24.0	- 6.0	36.00
50.5	28.0	+22.5	+40.5	1,640.25
24.5	37.0	-12.5	+ 5.5	30.25
47.0	24.0	+23.0	+41.0	1,681.00
19.5	32.0	-12.5	+ 5.5	30.25
28.5	33.0	- 4.5	+13.5	182.25
14.0	43.0	-29.0	-11.0	121.00
14.5	49.5	-35.0	-17.0	289.00
14.5	76.5	-62.0	-44.0	1,936.00
10.0	46.0	-36.0	-18.0	324.00
10.0	23.0	-13.0	+ 5.0	25.00
11.5	35.5	-24.0	- 6.0	36.00
20.5	44.5	-24.0	- 6.0	36.00
4.0	41.0	-37.0	-19.0	361.00
9.0	27.0	-18.0	.0	.00
13.0	70.5	-57.5	-39.5	1,560.25
21.5	17.0	+ 4.5	+22.5	506.25
15.0	24.0	- 9.0	+ 9.0	81.00
21.0	70.0	-49.0	-31.0	961.00
13.5	31.0	-17.5	+ .5	.25
26.0	29.5	- 3.5	+14.5	210.25
16.0	23.5	- 7.5	+10.5	110.25
		-505.5		25)10,655.50
		+ 53.5		426.22
		25) -452.0		
		Mean = - 18.08		S. D. = $\sqrt{426.22}$ = 20.645

$$Z = \frac{M}{S.\ D.} = \frac{18.08}{20.645} = .876$$

When Z = .9 the odds are 9999 to 1

TABLE XVII. COMPARISON BETWEEN BALBO AND TENNESSEE COMMON IN THE TOTAL LENGTH OF HEADS PER PLANT IN INCHES FOR 25 PLANTS BY STUDENT'S METHOD

A Balbo	B Tenn. Common	A - B D	D - M	$(D - M)^2$
31.0	73.0	-42.0	-38.7	1,497.69
37.0	59.0	-22.0	-18.7	349.69
24.0	28.5	- 4.5	- 1.2	1.44
47.5	27.0	+20.5	+23.8	566.44
28.0	23.5	+ 4.5	+ 7.8	60.84
37.0	47.5	-10.5	- 7.2	51.84
24.0	56.0	-32.0	-28.7	823.69
32.0	48.0	-16.0	-12.7	161.29
33.0	26.5	+ 6.5	+ 9.8	96.04
43.0	81.0	-38.0	-34.7	1,204.09
49.5	35.5	+14.0	+17.3	299.29
76.5	33.0	+43.5	+46.8	2,190.24
46.0	55.0	- 9.0	- 5.7	32.49
23.0	47.5	-24.5	-21.2	499.44
35.5	30.5	+ 5.0	+ 8.3	68.89
44.5	34.5	+10.0	+13.3	176.89
41.0	26.0	+15.0	+18.3	334.89
27.0	42.5	-15.5	-12.2	148.84
70.5	50.5	+20.0	+23.3	542.89
17.0	27.5	-10.5	- 7.2	51.84
24.0	39.5	-15.5	-12.2	148.84
70.0	43.5	+26.5	+29.8	888.04
31.0	47.0	-16.0	-12.7	161.29
29.5	14.0	+15.5	+12.2	148.84
23.5	31.0	- 7.5	- 4.2	17.64

-263.5

$+181.0$

$25)-82.5$

$\text{Mean} = -3.3$

$25)10,525.40$

420.94

$\sqrt{420.94} =$

S. D. = 20.517

$$Z = \frac{M}{\text{S. D.}} = \frac{3.3}{20.517} = .161$$

When Z = .2 the odds are 5 to 1

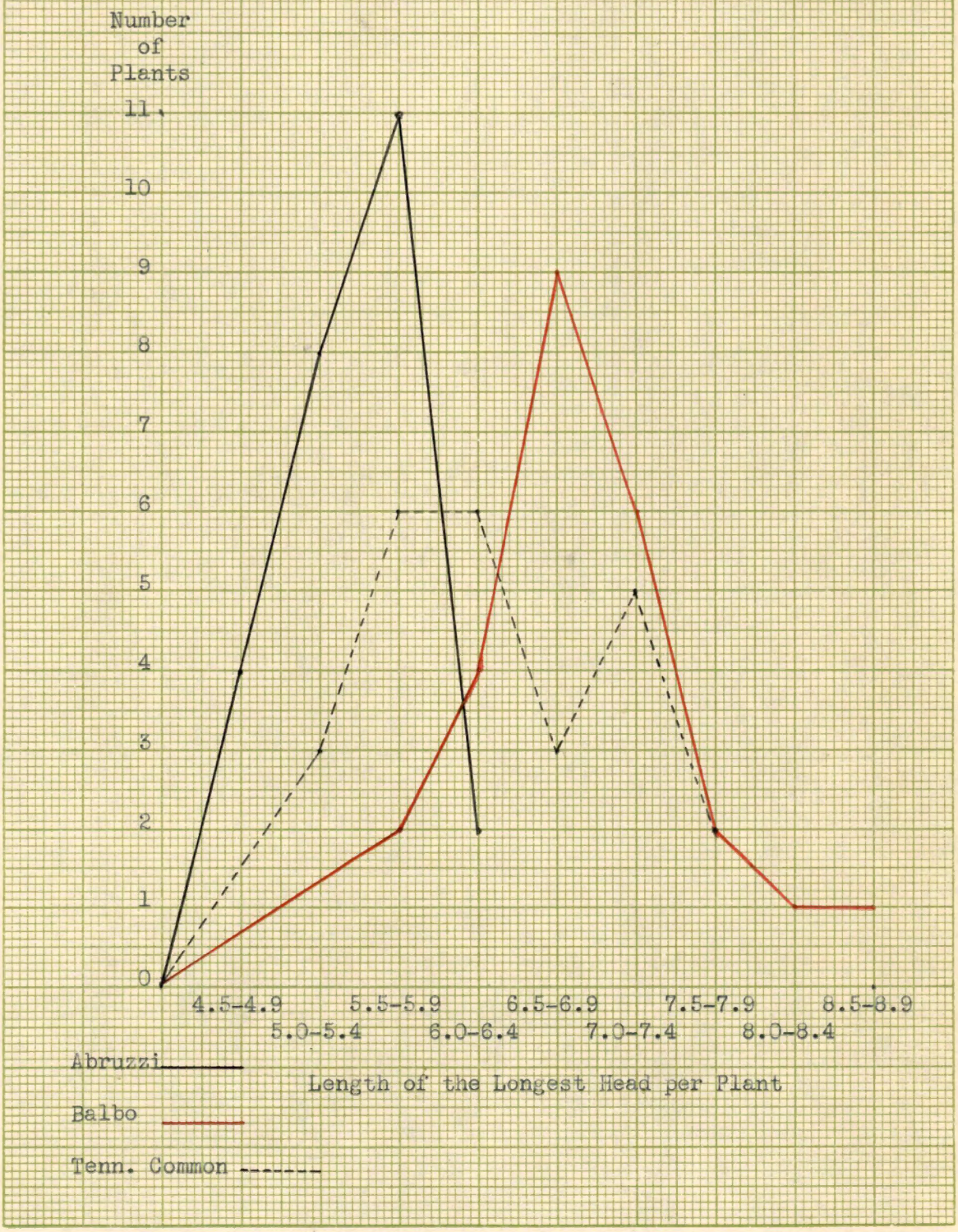
TABLE XVIII. FREQUENCY DISTRIBUTION, SHOWING THE LENGTH OF THE LONGEST HEAD PER PLANT IN INCHES FOR 25 PLANTS OF ABRUZZI, BALBO AND TENNESSEE COMMON, ALSO MEAN AND STANDARD DEVIATION

Length of Longest Head per Plant	Number of Plants		
Class Range	Abruzzi	Balbo	Tennessee Common
4.5-4.9	4	0	0
5.0-5.4	8	0	3
5.5-5.9	11	2	6
6.0-6.4	2	4	6
6.5-6.9	0	9	3
7.0-7.4	0	6	5
7.5-7.9	0	2	2
8.0-8.4	0	1	0
8.5-8.9	0	1	0
Total	25	25	25
Mean	5.42 $\pm$ .057	6.88 $\pm$ .089	6.34 $\pm$ .101
Standard Deviation	.426 $\pm$ .004	.664 $\pm$ .006	.755 $\pm$ .011

Comparison of Abruzzi and Tennessee Common with Balbo shows a significant difference in the length of the longest head per plant in favor of Balbo as compared with Abruzzi (Table XIX). When Z = 2 and the number of plants equal 25 the odds are more than 10,000 to 1 against a difference as great as this occuring due to chance alone (Love 1936:483).

No significant difference is apparent between Balbo and Tennessee Common (Table XX). When Z = .55 and the number of plants equal 25 the odds are 18 to 1 against a difference as great as this occuring due to chance alone (Love 1936:483).

Fig. 7. Length of the Longest Head Per Plant in Inches for 25 Plants of Abruzzi, Balbo and Tennessee Common



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TABLE XIX. COMPARISON BETWEEN ABRUZZI AND BALBO IN THE LENGTH OF THE LONGEST HEAD PER PLANT IN INCHES FOR 25 PLANTS BY STUDENT'S METHOD

A Abruzzi	B Balbo	A - B D	D - M	$(D - M)^2$
5.5	6.5	-1.0	+ .5	.25
5.0	6.5	-1.5	.0	.00
4.5	7.0	-2.5	-1.0	1.00
5.5	6.5	-1.0	+ .5	.25
5.5	6.5	-1.0	+ .5	.25
5.5	7.0	-1.5	.0	.00
5.5	6.5	-1.0	+ .5	.25
5.0	7.5	-2.5	-1.0	1.00
5.5	7.0	-1.5	.0	.00
5.0	6.5	-1.5	.0	.00
5.5	8.0	-2.5	-1.0	1.00
5.5	8.5	-3.0	-1.5	2.25
5.0	5.5	- .5	+1.0	1.00
5.0	6.0	-1.0	+ .5	.25
4.5	6.5	-2.0	- .5	.25
5.5	7.0	-1.5	.0	.00
4.5	6.5	-2.0	- .5	.25
5.0	5.5	- .5	+1.0	1.00
5.5	7.5	-2.0	- .5	.25
5.5	6.5	-1.0	+ .5	.25
4.5	6.5	-2.0	- .5	.25
5.0	6.0	-1.0	+ .5	.25
5.0	6.5	-1.5	.0	.00
5.0	5.5	- .5	+1.0	1.00
4.5	7.0	-2.5	-1.0	1.00

$25\overline{)-38.5}$ $\quad -38.5$

Mean = -1.54

$25\overline{)12.00}$ $\quad .48$

$\sqrt{.48} =$

S. D. = .693

$$Z = \frac{M}{S.\ D.} = \frac{1.54}{.693} = 2.222$$

When Z = 2 the odds are greater than 10,000 to 1

TABLE XX. COMPARISON BETWEEN BALBO AND TENNESSEE COMMON IN THE LENGTH OF THE LONGEST HEAD PER PLANT IN INCHES FOR 25 PLANTS BY STUDENT'S METHOD

A Balbo	B Tenn. Common	A - B D	D - M	$(D - M)^2$
6.5	6.0	+ .5	+1.0	1.00
6.5	5.5	+1.0	+1.5	2.25
7.0	6.0	+1.0	+1.5	2.25
6.5	7.0	- .5	.0	.00
6.5	5.0	+1.5	+2.0	4.00
7.0	6.0	+1.0	+1.5	2.25
6.5	6.5	.0	.0	.00
7.5	5.5	+2.0	+2.5	6.25
7.0	5.5	+1.5	+2.0	4.00
6.5	7.5	-1.0	- .5	.25
8.0	5.5	+2.5	+3.0	9.00
8.5	6.0	+2.5	+3.0	9.00
5.5	7.5	-2.0	-1.5	2.25
6.0	5.0	+1.0	+1.5	2.25
6.5	7.0	- .5	.0	.00
7.0	5.5	+1.5	+2.0	4.00
6.5	6.0	+ .5	+1.0	1.00
5.5	5.5	.0	.0	.00
7.5	7.0	+ .5	+1.0	1.00
6.5	6.0	+ .5	+1.0	1.00
6.5	7.0	- .5	.0	.00
6.0	7.5	-1.5	-1.0	1.00
6.5	6.5	.0	.0	.00
5.5	5.0	+ .5	+1.0	1.00
7.0	6.5	+ .5	+1.0	1.00

$+18.5$

-6.0

$25)\ +12.5$

Mean = + .5

$25)\ 54.75$

2.19

$\sqrt{2.19} =$

S. D. = 1.479

$$Z = \frac{M}{S.\ D.} = \frac{.5}{1.479} = .338$$

When Z = .35 the odds are 18 to 1

TABLE XXI. FREQUENCY DISTRIBUTION, SHOWING THE NUMBER OF SPIKELETS PER PLANT FOR 25 PLANTS OF ABRUZZI, BALBO AND TENNESSEE COMMON, ALSO MEAN AND STANDARD DEVIATION

Number of Spikelets per Plant	Number of Plants		
Class Range	Abruzzi	Balbo	Tennessee Common
0-49	1	0	0
50-99	3	0	0
100-149	10	2	1
150-199	6	6	2
200-249	2	6	5
250-299	1	3	5
300-349	1	5	3
350-399	1	0	3
400-449	0	0	3
450-499	0	3	1
500-549	0	0	1
550-599	0	0	1
Total	25	25	25
Mean	159 ± 10.400	261 ± 15.422	317 ± 14.987
Standard Deviation	77.1 ± 7.354	99.5 ± 9.491	111.1 ± 10.502

Comparison of Abruzzi and Tennessee Common with Balbo shows a significant difference in the number of spikelets per plant in favor of Balbo as compared with Abruzzi (Table XXII). When Z = .8 and the number of plants equal 25 the odds are 3332 to 1 against a difference as great as this occuring due to chance alone (Love 1936:483).

No significant difference is apparent between Balbo and Tennessee Common (Table XXIII). When Z = .3 and the number of plants equal 25 the odds are 12 to 1 against a difference as great as this occuring due to chance alone (Love 1936:483).

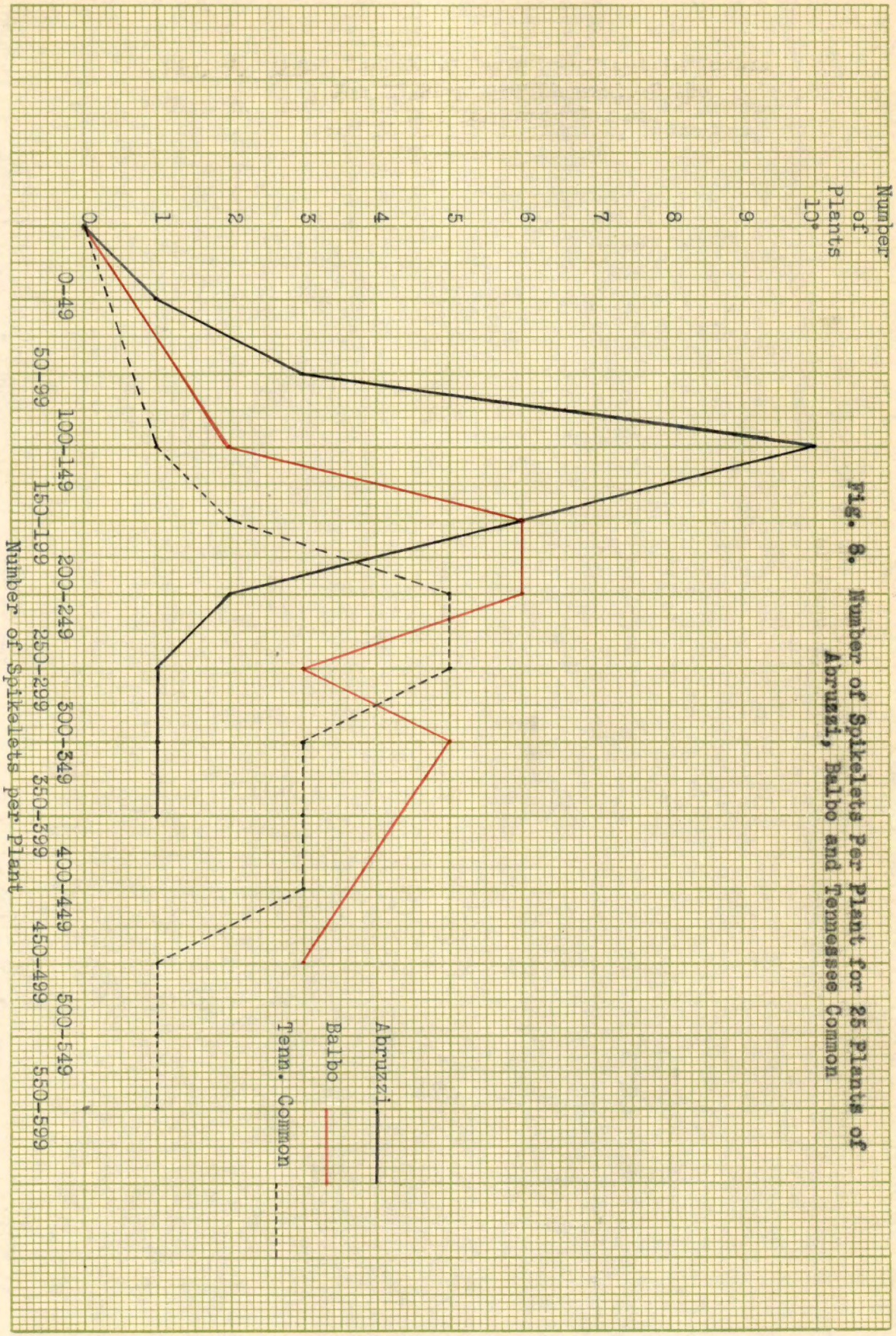


Fig. 8. Number of Spikelets Per Plant for 25 Plants of Abruzzi, Balbo and Tennessee Common

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TABLE XXII. COMPARISON BETWEEN ABRUZZI AND BALBO IN THE NUMBER OF SPIKELETS PER PLANT FOR 25 PLANTS BY STUDENT'S METHOD

A Abruzzi	B Balbo	A - B D	D - M	$(D - M)^2$
256	206	+ 50	+155.6	24,211.36
148	256	-108	- 2.4	5.76
104	166	- 62	+ 43.6	1,900.96
172	333	-161	- 55.4	3,069.16
382	181	+201	+306.6	94,003.56
183	258	- 75	+ 30.6	936.36
326	145	+181	+ 75.4	5,685.16
162	238	- 76	+ 29.6	876.16
217	213	+ 4	+109.6	12,012.16
110	305	-195	- 89.4	7,992.36
113	308	-195	- 89.4	7,992.36
112	470	-358	-252.4	63,705.76
82	338	-256	-150.4	22,620.16
76	164	- 88	+ 17.6	309.76
106	242	-136	- 30.4	924.16
183	325	-142	- 36.4	1,321.52
36	282	-246	-140.4	19,712.16
71	198	-127	- 21.4	457.96
109	496	-387	-281.4	79,185.96
153	112	+ 41	+146.6	21,491.56
117	173	- 56	+ 49.6	2,460.16
161	474	-313	-207.4	43,014.76
116	204	- 88	+ 17.6	309.76
206	223	- 17	+ 88.6	7,849.96
129	158	- 29	+ 76.6	5,867.56

-3115

+ 477

25) -2638

- 105.62

25) 427,916.56

17,116.6584

$\sqrt{17,116.66}$ =

Mean = - 105.62

S. D. = 130.831

$$Z = \frac{M}{S.\ D.} = \frac{105.62}{130.831} = .807$$

When Z = .8 the odds are 3332 to 1

TABLE XXIII. COMPARISON BETWEEN BALBO AND TENNESSEE COMMON IN THE NUMBER OF SPIKELETS PER PLANT FOR 25 PLANTS BY STUDENT'S METHOD

A Balbo	B Tenn. Common	A - B D	D - M	$(D - M)^2$
206	550	-344	-404.6	163,701.16
256	486	-230	-288.6	83,289.96
166	222	- 56	-114.6	13,133.16
333	188	+145	+ 86.4	7,464.96
181	189	- 8	- 66.6	4,435.56
258	363	-105	-163.6	26,764.96
145	417	-272	-230.6	53,176.36
238	433	-195	-253.6	64,312.96
213	209	+ 4	- 54.6	2,981.16
305	584	-279	-337.6	113,973.76
308	296	+ 12	- 46.6	2,171.56
470	258	+212	+153.4	23,531.56
338	407	- 69	-127.6	16,281.76
164	396	-232	-290.6	84,448.36
242	232	+ 10	- 48.6	2,361.96
325	304	+ 21	- 37.6	1,413.76
282	211	+ 71	+ 12.4	153.76
198	298	-100	-158.6	25,153.96
496	373	+123	+ 64.4	4,147.36
112	254	-142	-200.6	40,240.36
173	261	- 88	-146.6	21,491.56
474	302	+172	+113.4	12,859.56
204	347	-143	-201.6	40,642.56
223	110	+113	+ 54.4	2,959.36
158	244	- 86	-144.6	20,909.16

-2549

+ 883

25) -1466

Mean = - 58.64

25) 842,000.60

33,680.24

$\sqrt{33,680.24}$ =

S. D. = 183.522

$$Z = \frac{M}{S.\ D.} = \frac{58.64}{183.522} = .319$$

When Z = .3 the odds are 12 to 1

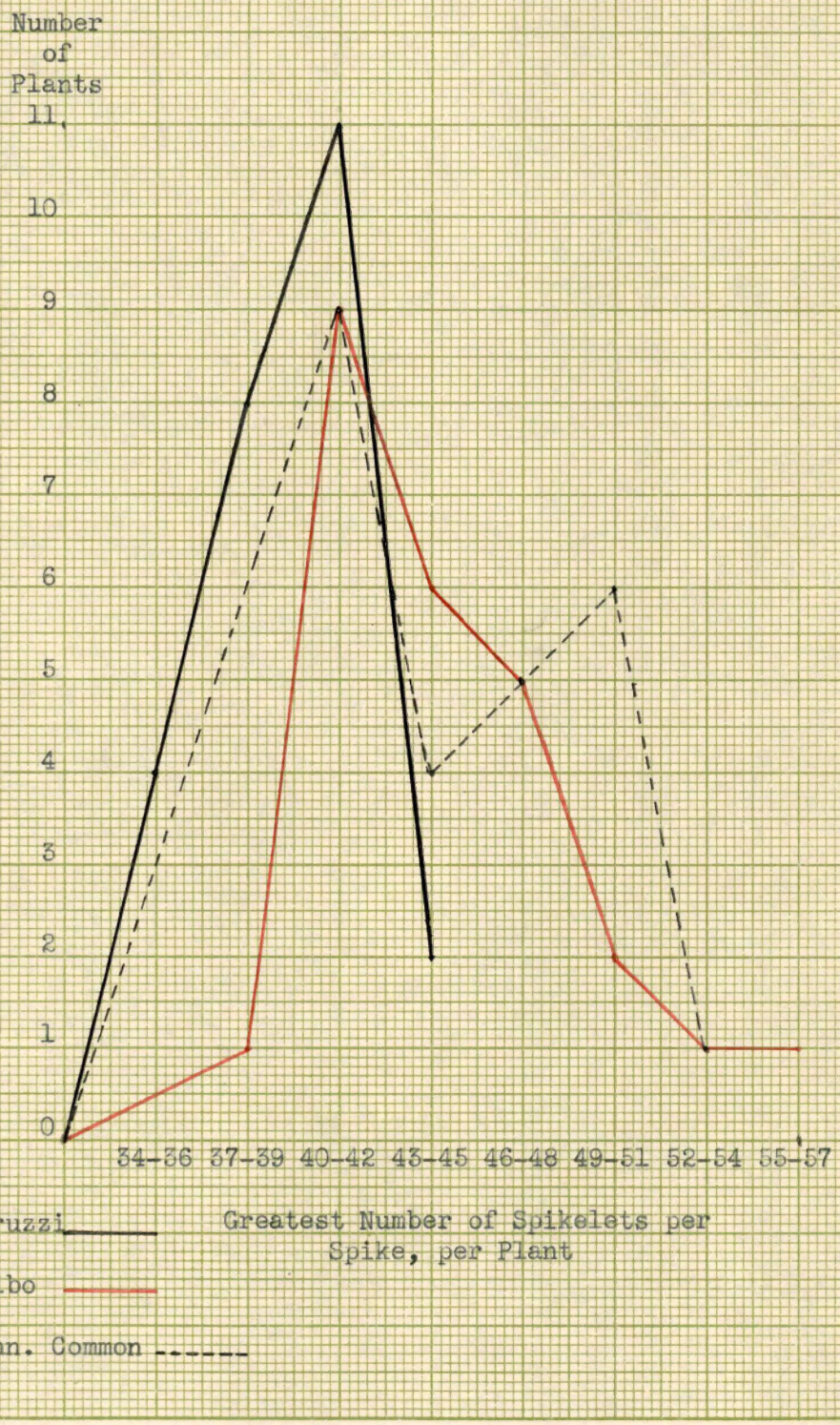
TABLE XXIV. FREQUENCY DISTRIBUTION, SHOWING THE GREATEST NUMBER OF SPIKELETS PER SPIKE, PER PLANT, FOR 25 PLANTS OF ABRUZZI, BALBO AND TENNESSEE COMMON, ALSO MEAN AND STANDARD DEVIATION

Greatest Number of Spikelets per Spike, per Plant	Number of Plants		
Class Range	Abruzzi	Balbo	Tennessee Common
34-36	4	0	0
37-39	8	1	0
40-42	11	9	9
43-45	2	6	4
46-48	0	5	5
49-51	0	2	6
52-54	0	1	1
55-57	0	1	0
Total	25	25	25
Mean	39.3 ± .344	44.6 ± .572	45.4 ± .525
Standard Deviation	2.56 ± .243	4.24 ± .404	3.90 ± .369

Comparison of Abruzzi and Tennessee Common with Balbo shows a significant difference in the greatest number of spikelets per spike, per plant, in favor of Balbo as compared with Abruzzi (Table XXV). When Z = 1 and the number of plants equal 25 the odds are more than 10,000 to 1 against a difference as great as this occuring due to chance alone (Love 1936:483).

No significant difference is apparent between Balbo and Tennessee Common (Table XXVI). When Z = .5 and the number of plants equal 25 the odds are 12 to 1 against a difference as great as this occuring due to chance alone (Love 1936:483).

Fig. 9. Greatest Number of Spikelets Per Spike, Per Plant, For 25 Plants of Abruzzi, Balbo and Tennessee Common



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TABLE XXV. COMPARISON BETWEEN ABRUZZI AND BALBO IN THE GREATEST NUMBER OF SPIKELETS PER SPIKE, PER PLANT, FOR 25 PLANTS BY STUDENT'S METHOD

A Abruzzi	B Balbo	A - B D	D - M	$(D - M)^2$
40	43	- 3	+ 1.8	3.24
40	43	- 3	+ 1.8	3.24
38	44	- 6	- 1.2	1.44
38	44	- 6	- 1.2	1.44
42	40	+ 2	+ 6.8	46.24
40	43	- 3	+ 1.8	3.24
40	39	+ 1	+ 5.8	33.64
38	55	-17	-12.2	148.84
40	40	0	.0	.00
40	48	- 8	- 3.2	10.24
38	49	-11	- 6.2	38.44
40	48	- 8	- 3.8	14.44
42	40	+ 2	+ 6.8	46.24
40	42	- 2	+ 2.8	7.84
38	48	0	.0	.00
44	50	- 6	- 1.2	1.44
36	42	- 6	- 1.2	1.44
39	42	- 3	+ 1.8	3.24
40	52	-12	- 7.2	51.84
39	40	- 1	+ 3.8	14.44
36	47	-11	- 6.2	38.44
34	40	- 6	- 1.2	1.44
43	44	- 1	+ 3.8	14.44
38	40	- 2	+ 2.8	7.84
36	41	-10	- 5.2	27.04

-125

$$25\overline{)-120}\quad +5$$

$$\text{Mean} = -4.8$$

$$25\overline{)520.12}\quad 20.804$$

$$\text{S. D.} = \sqrt{20.80} = 4.561$$

$$Z = \frac{M}{\text{S. D.}} = \frac{4.8}{4.561} = 1.053$$

When Z = 1 the odds are greater than 10,000 to 1

TABLE XXVI. COMPARISON BETWEEN BALBO AND TENNESSEE COMMON IN THE GREATEST NUMBER OF SPIKELETS PER SPIKE, PER PLANT, FOR 25 PLANTS BY STUDENT'S METHOD

A Balbo	B Tenn. Common	A - B D	D - M	$(D - M)^2$
43	42	+ 1	+ 2.3	5.29
45	46	- 5	- 1.7	2.89
44	40	+ 4	+ 5.3	28.09
44	48	- 4	- 2.7	7.29
40	42	- 2	- .7	.49
43	42	+ 1	+ 2.3	5.29
39	50	-11	- 9.7	94.09
55	48	+ 7	+ 8.3	68.89
40	44	- 4	- 2.7	7.29
48	50	- 2	- .7	.49
49	42	+ 7	+ 8.3	68.89
48	45	+ 3	+ 4.3	18.49
40	51	-11	- 9.7	94.09
42	42	0	.0	.00
48	54	- 6	- 4.7	22.09
50	48	+ 2	+ 3.3	10.89
42	41	+ 1	+ 2.3	5.29
42	40	+ 2	+ 3.3	10.89
52	50	+ 2	+ 3.3	10.89
40	48	- 8	- 6.7	44.89
47	44	+ 3	+ 4.3	18.49
40	50	-10	- 8.7	75.69
44	45	- 1	+ .3	.09
40	40	0	.0	.00
46	50	- 4	- 2.7	7.29

-66

+33

25) -33

Mean = -1.3

25) 608.04

24.322

$\sqrt{24.32}$ =

S. D. = 4.932

$$Z = \frac{M}{S.\ D.} = \frac{1.3}{4.932} = .264$$

When Z = .3 the odds are 12 to 1

CHAPTER IV

STATISTICAL ANALYSIS OF 196 BALBO PLANTS

The last 26 rows (176-200) of the plot were seeded from the Standard Balbo samples (Fig. 1) at the rate of 20 seeds to the row, spaced 6 inches apart. These plants were used in a statistical study. At this rate of seeding, if all the seeds had been viable and all the plants had survived the winter, there would have been 520 plants. However, only 388 were harvested and of this number only 196 were fit for use. Rainy weather made it impossible to get them out of the field before part of them were badly lodged, broken up and made unfit for taking the necessary measurements. The number of plants and the number of culms per row were counted, however, regardless of their condition, but only the 196 plants that were not so badly lodged and broken were used, the other 192 being discarded.

The following measurements were taken on each of the 196 plants:

1. Number of culms per plant.
2. Total length of culms per plant.
3. Length of the longest culm per plant.
4. Total length of heads per plant.
5. Length of the longest head per plant.

These data were grouped into 5 frequency distributions (Tables XXVII-XXXI), and plotted (Figures 10-14). The mode is designated by the

mid-point of the modal class, while the median, mean, and standard deviation were calculated (Love 1936:54, 45, 76) for each frequency distribution as well as the probable error of the mean and standard deviation in each case (Love 1936:238). The mode, median, mean and standard deviation are shown in Tables XXVII-XXXI.

"The mode is the score that occurs most often in a frequency distribution.

"The median is the mid-most score, or the one above and below which there are equal numbers of scores, regardless of how far above or below it they chance to go" (Crawford 1928:226-227).

TABLE XXVII. FREQUENCY DISTRIBUTION OF THE NUMBER OF CULMS PER PLANT FOR 196 BALBO PLANTS

Class Range	Number of Plants
1-2	6
3-4	35
5-6	58
7-8	44
9-10	33
11-12	15
13-14	1
15-16	2
17-18	1
19-20	1
Total	196

Mode = 6.0

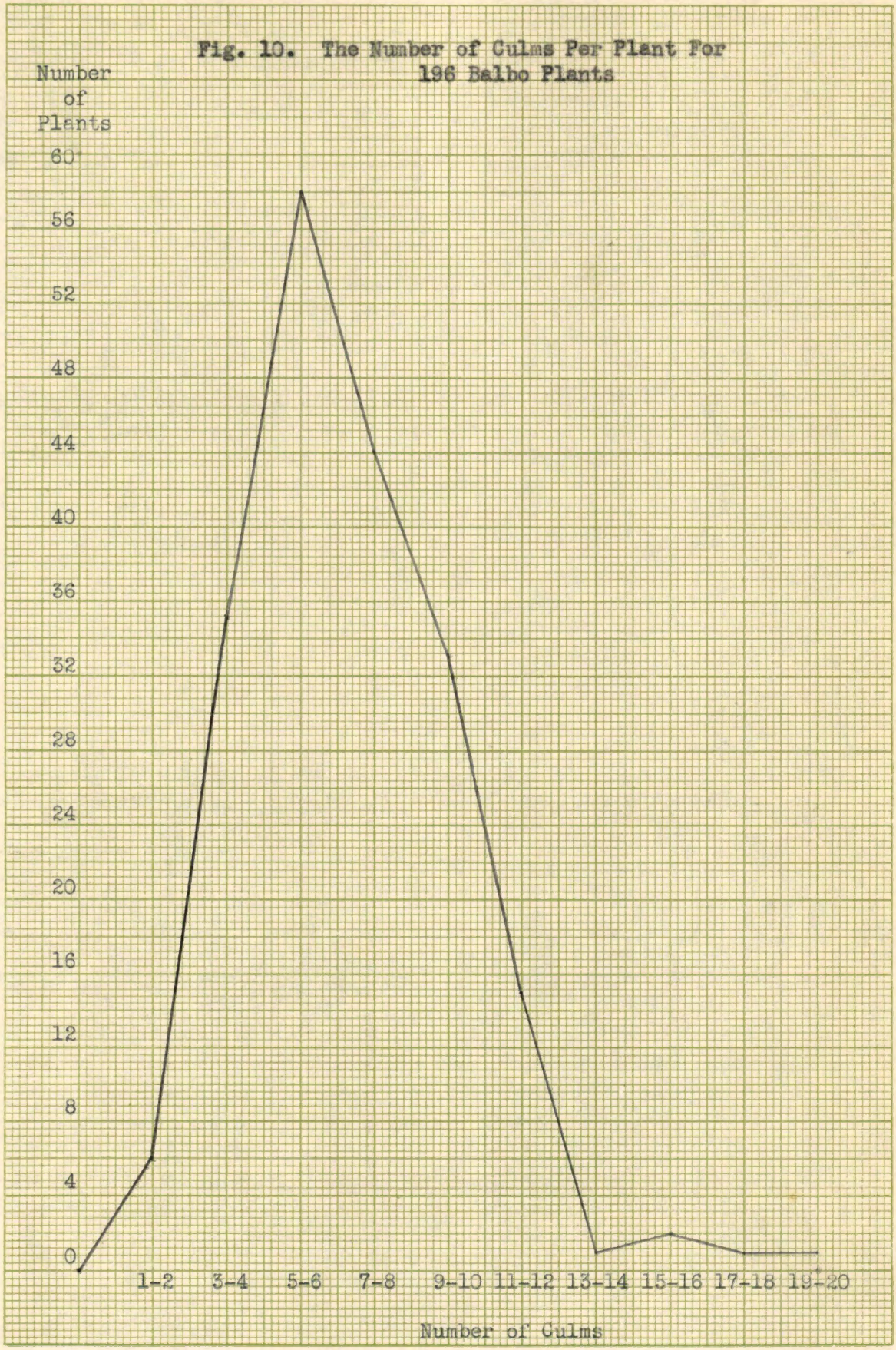
Median = 6.98

Mean = 6.88 $\pm$ .142

Standard deviation = 2.955 $\pm$ .101

The total number of culms for 388 plants was 2,569, giving a mean of 6.62 while the calculated mean for 196 plants was 6.88 $\pm$ .142. From this it would seem that the 196 plants used were a fairly representative sample of the 388.

Fig. 10. The Number of Culms Per Plant For 196 Balbo Plants



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TABLE XXVIII. FREQUENCY DISTRIBUTION OF THE TOTAL LENGTH OF CULMS PER PLANT IN INCHES FOR 196 BALBO PLANTS

Class Range	Number of Plants
0-99	5
100-199	29
200-299	36
300-399	55
400-499	38
500-599	20
600-699	9
700-799	2
800-899	1
900-999	1
Total	196

Mode	=	350.0
Median	=	351.8
Mean	=	357.66 $\pm$ 7.75
Standard Deviation	=	160.97 $\pm$ 5.48

Fig. 11. The Total Length of Culms Per Plant In Inches for 196 Balbo Plants



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TABLE XXIX. FREQUENCY DISTRIBUTION OF THE LENGTH OF THE LONGEST CULM PER PLANT IN INCHES FOR 196 BALBO PLANTS

Class Range	Number of Plants
40.0-41.9	1
42.0-43.9	2
44.0-45.9	3
46.0-47.9	5
48.0-49.9	8
50.0-51.9	9
52.0-53.9	22
54.0-55.9	28
56.0-57.9	30
58.0-59.9	34
60.0-61.9	27
62.0-63.9	16
64.0-65.9	6
66.0-67.9	4
68.0-69.9	1
Total	196

Mode	=	59.0
Median	=	57.36
Mean	=	$59.9 \pm .239$
Standard Deviation	=	$4.974 \pm .169$

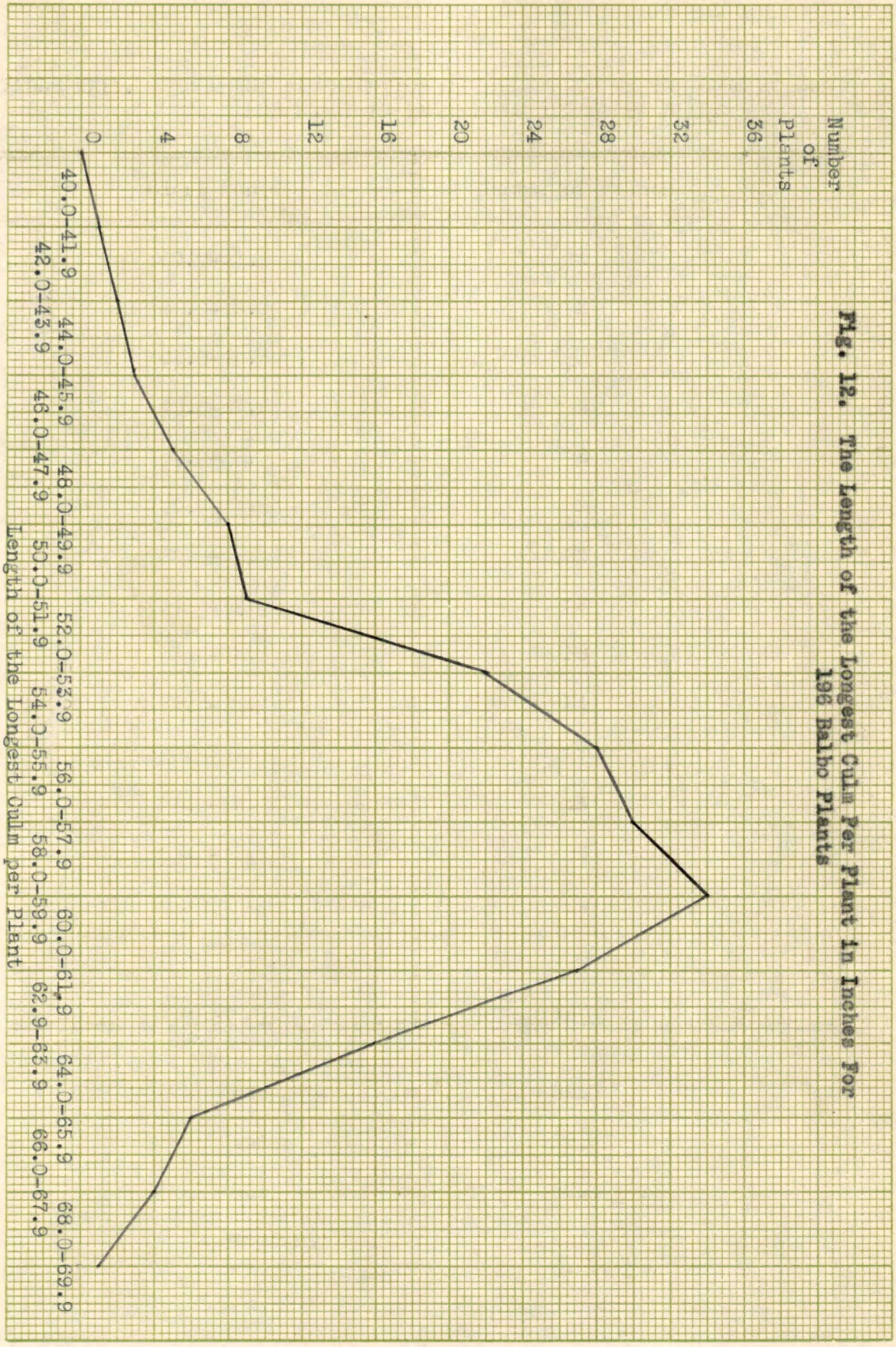


Fig. 12. The Length of the Longest Culm Per Plant in Inches For 196 Balbo Plants

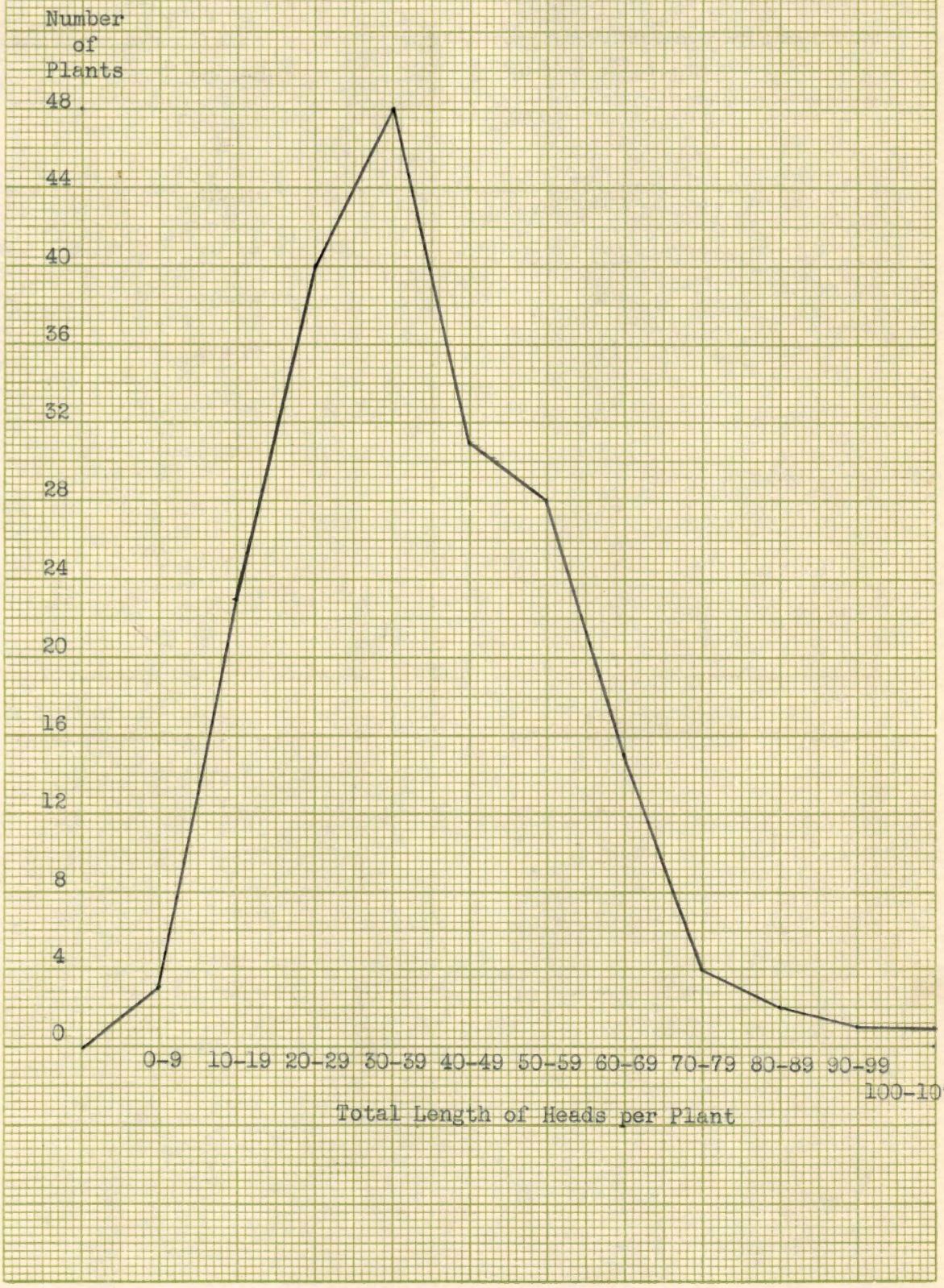
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TABLE XXX. FREQUENCY DISTRIBUTION OF THE TOTAL LENGTH OF HEADS PER PLANT IN INCHES FOR 196 BALBO PLANTS

Class Range	Number of Plants
0-9	3
10-19	23
20-29	40
30-39	48
40-49	31
50-59	28
60-69	15
70-79	4
80-89	2
90-99	1
100-109	1
Total	196

Mode	=	35.0
Median	=	36.76
Mean	=	38.88 $\pm$ .833
Standard Deviation	=	17.289 $\pm$ .588

Fig. 13. The Total Length of Heads Per Plant In Inches for 196 Balbo Plants



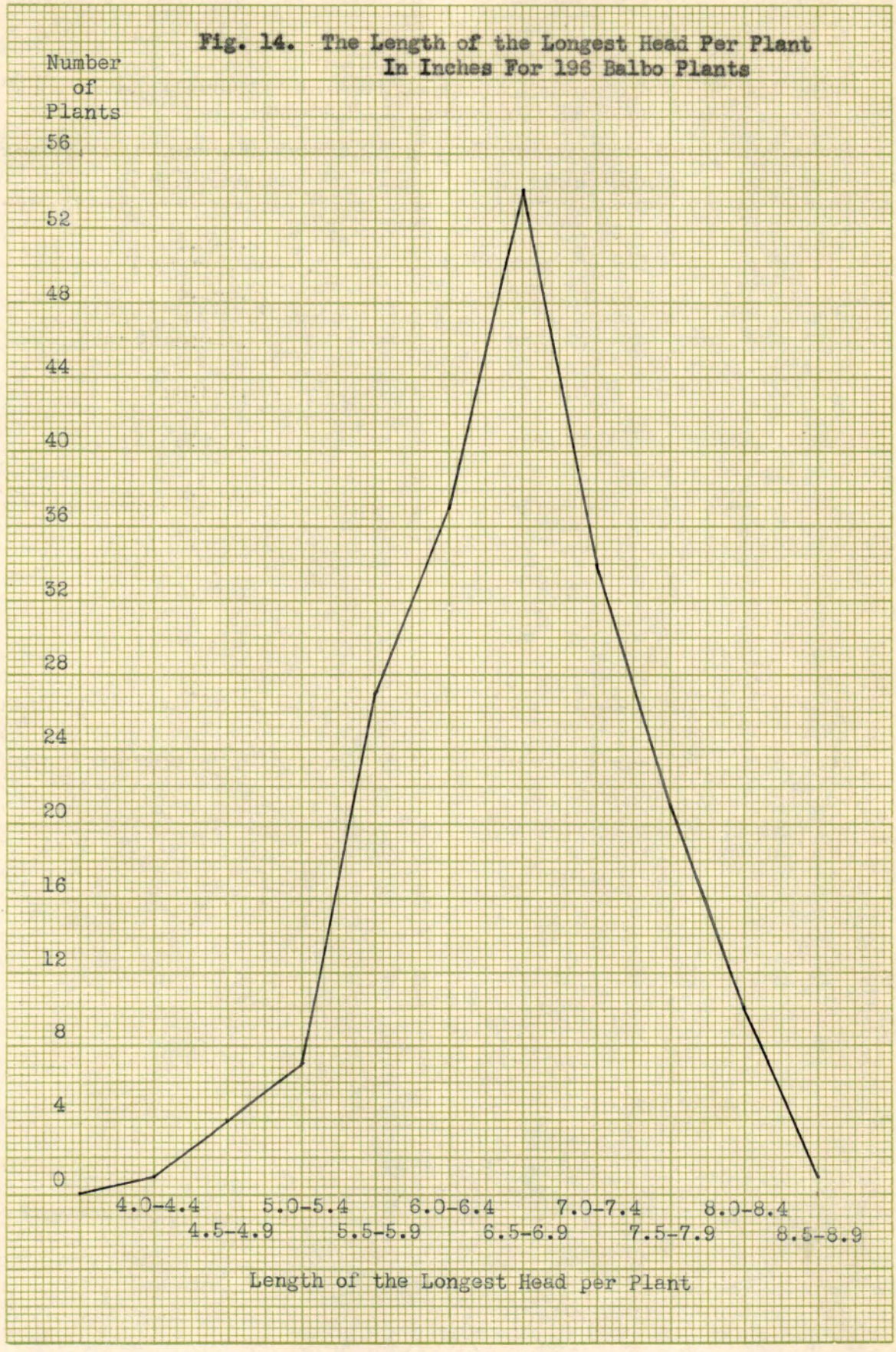
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TABLE XXXI. FREQUENCY DISTRIBUTION OF THE LENGTH OF THE LONGEST HEAD PER PLANT IN INCHES FOR 196 BALBO PLANTS

Class Range	Number of Plants
4.0-4.4	1
4.5-4.9	4
5.0-5.4	7
5.5-5.9	27
6.0-6.4	37
6.5-6.9	54
7.0-7.4	34
7.5-7.9	21
8.0-8.4	10
8.5-8.9	1
Total	196

Mode	=	6.7
Median	=	6.86
Mean	=	6.64 $\pm$ .391
Standard Deviation	=	.813 $\pm$ .276

Fig. 14. The Length of the Longest Head Per Plant In Inches For 196 Balbo Plants



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CHAPTER V

SUMMARY

The Experiment Station has found Balbo to be a high yielding variety in all respects and better adapted to Tennessee conditions than any other variety yet tried. The Tennessee Common variety was found to be very winter hardy, but inferior to Balbo in yield of grain and the amount of pasture it afforded. Rosen, being a northern variety, is not adapted to Tennessee conditions, and is not recommended by the Experiment Station to be grown in the State.

Abruzzi approaches more closely the Balbo type in field habits than either Tennessee Common or Rosen, therefore, it is more difficult to distinguish from Balbo. Balbo and Abruzzi have a rapid upright habit of growth, while Tennessee Common and Rosen have a spreading or decumbent habit. Balbo stools more, grows taller and has a longer head than Abruzzi.

Analysis of twelve 50-gram samples of seed shows Balbo to contain more black seed than Abruzzi and Rosen, but less than Tennessee Common; it contains about the same amount of wheat colored seed as Rosen and Tennessee Common, but less than Abruzzi; and it contains more green seed than Abruzzi and Tennessee Common, but less than Rosen. One hundred seeds from each sample showed Balbo to be longer than the other three varieties, wider than either of the other three except Abruzzi, and to weigh more

than either of the other three.

The mean number of culms per plant for 25 plants of Abruzzi, Balbo and Tennessee Common was 4.54 ± .315, 6.40 ± .358, and 7.66 ± .347 respectively. In comparing these by Student's Method, a significant difference in the stooling power of Balbo over Abruzzi was found, while no significant difference was found in the stooling power of Balbo and Tennessee Common.

The mean of the total length of culms per plant for 25 plants of Abruzzi, Balbo and Tennessee Common was 222 ± 14.14, 370 ± 19.82, and 414 ± 19.78 respectively. The difference between Abruzzi and Balbo was found to be significant, but the difference between Balbo and Tennessee Common was insignificant.

The mean length of the longest culm per plant for 25 plants of Abruzzi, Balbo and Tennessee Common was 53.2 ± .55, 63.2 ± .44, and 60.6 ± .58 respectively. These differences between Abruzzi and Balbo and between Balbo and Tennessee Common are significant.

The mean of the total length of heads per plant for 25 plants of Abruzzi, Balbo and Tennessee Common was 21.0 ± 1.47, 37.8 ± 2.16, and 43.0 ± 2.38 respectively. The difference between Abruzzi and Balbo is significant, but the difference between Balbo and Tennessee Common is insignificant.

The mean length of the longest head per plant for 25 plants of Abruzzi, Balbo and Tennessee Common was 5.42 ± .05, 6.88 ± .08, and 6.34 ± .10 respectively. The difference between Abruzzi and Balbo is significant, but the difference between Balbo and Tennessee Common is insignificant.

The number of spikelets per plant for 25 plants of Abruzzi, Balbo and

Tennessee Common was 159 ± 10.4, 261 ± 13.42, and 317 ± 14.98 respectively. The difference between Abruzzi and Balbo is significant, but the difference between Balbo and Tennessee Common is insignificant.

The mean of the greatest number of spikelets per spike, per plant, for 25 plants of Abruzzi, Balbo, and Tennessee Common was 39.3 ± .34, 44.6 ± .57, and 45.4 ± .52 respectively. The difference between Abruzzi and Balbo is significant, but the difference between Balbo and Tennessee Common is insignificant.

For 196 Balbo plants, the calculated mean number of culms per plant was 6.88 ± .14. This seems to be about correct because the true mean for 388 plants, 192 of which could not be used due to their condition, was 6.62. The mode and median were 6.0 and 6.98 respectively. The degree of variation was measured by the standard deviation which, in this case, was 2.955 ± .10.

The mean of the total length of culms per plant for 196 Balbo plants was 357.66 ± 7.75. The mode, median and standard deviation were 350.0, 351.8, and 160.97 ± 5.48 respectively.

The mean length of the longest culm per plant for 196 Balbo plants was 59.9 ± .23. The mode, median, and standard deviation were 59.0, 57.36, and 4.97 ± .16 respectively.

The mean of the total length of heads per plant for 196 Balbo plants was 38.88 ± .83. The mode, median and standard deviation were 35.0, 36.76, and 17.28 ± .58 respectively.

The mean length of the longest head per plant for 196 Balbo plants was 6.64 ± .39. The mode, median and standard deviation were 6.7, 6.88, and .813 ± .27 respectively.

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