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SOME OF THE FACTORS INFLUENCING  
THE YIELD OF FOURTEEN VARIETIES  
OF WHITE PEA BEANS IN MICHIGAN

THESIS FOR THE DEGREE OF M. S.

Robert B. Carr

1931

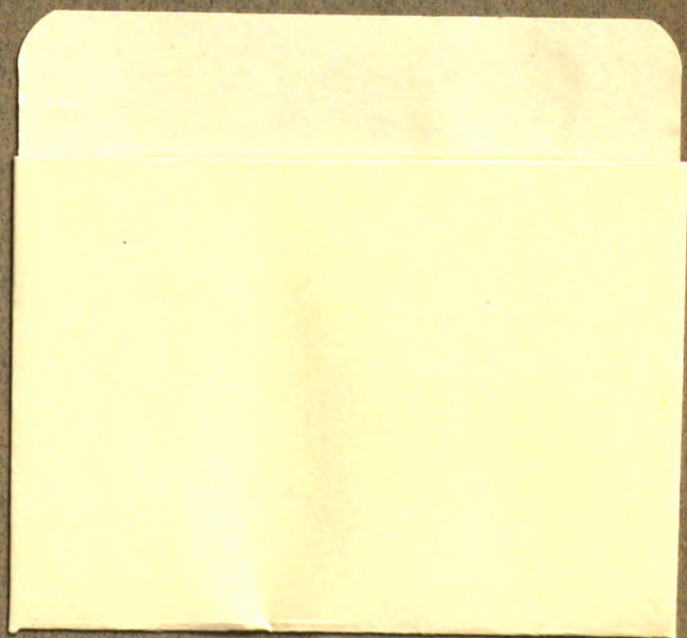


THESIS

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SOME OF THE FACTORS INFLUENCING THE YIELD OF  
FOURTEEN VARIETIES OF WHITE PEA BEANS  
IN MICHIGAN



SOIL OF THE MOUNTAINS INFLUENCING THE YIELD OF  
FOURTEEN VARIETIES OF WHITE TEA PLANTS  
IN MICHIGAN

Thesis

Respectfully submitted  
in partial fulfillment for the  
Degree of Master of Science

at

Michigan State College of Agriculture  
and Applied Science

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Robert B. Carr

1931

THESIS



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## I - INTRODUCTION

### A. Importance of Bean Production in Michigan.

The growing of white pea beans has become one of Michigan's leading industries. Over the five year period, 1925-1929, this crop has been worth 17 million dollars annually to the growers.<sup>(2)</sup>

Many factors have contributed to the development of this industry. Pea beans are adapted to Michigan's climate and fit well into its diversified agricultural program. The improvement in farm machinery has made it possible to greatly increase the acreage and also reduce the cost of production. The introduction of the Robust variety, by the Michigan Experiment Station, offered a greater profit on beans than that obtained from lower yielding varieties. However, because of personal preferences, some farmers continue to grow their old varieties because they believe that their variety gives a better stand, matures earlier, has a chancier seed coat, a larger vine, picks less, shells less during harvest, or, in some cases, gives a greater yield than Robust.

### B. Problem.

The harvest of 1925 brought to the attention of certain members of the Farm Crops Department the necessity for a study of varietal factors influencing yield of white pea beans. "Frequent rains required the repeated turning of all plots before they could



be threshed. It soon became apparent that some of the strains were shelling much more under this treatment than others. A few warm days caused the beans to sprout. Counts of the beans germinating in ten-foot sections of the rows, were taken at regular intervals along the plot. The loss varied from a trace to 11.6 per cent." (4) Also over-state reports during the winter of 1925-1926 were to the effect that Robust was picking materially less than other varieties under the same conditions.

No data could be cited to prove the influence of any varietal factor on yield, so to supply this need the present experiment was outlined in 1926 by members of the Farm Crops Department of the Michigan Experiment Station, and aimed to study the question of yield, as influenced by size of vine, stand, quality (per cent of good beans), and shelling, from a varietal standpoint.

## II - MATERIAL

The material used was furnished by the Farm Crops Department of Michigan State College. Fourteen varieties were chosen as representative of those grown in the state.

### A. Source.

The sources of the varieties used in this experiment were as follows:

1000-1. Sel. No. 825805, Ac. 197.

Received and entered the variety series in 1918. Final selection made in 1925. The original source is unknown.

Mexican Tree. Sel. No. 850205, Ac. 210.

Received from George Wise of Hart, Michigan, in 1918, and plant selected the same year.

Mexican Tree. Sel. No. 850206, Ac. 210.

Received from George Wise of Hart, Michigan, in 1918, and plant selected the same year.

Robust Selection. Sel. No. 850506, Ac. 213.

Received as Early Wonder (reclassified and called Robust Selection) from Sebastian Green of Hart, Michigan, in 1918 and plant selected the same year.

Greiner. Sel. No. 850604, Ac. 214.

Received, as a commercial navy bean, in 1918 from Sebastian Green of Hart, Michigan, and plant selected the same year.

Canter. Sel. No. 851502, Ac. 221.

Received as a commercial navy bean in 1918 from O. E. Canter of Shelby, Michigan, and plant selected the same year.

Early Wonder. Sel. No. 851503, Ac. 225.

Received in 1918 from Watson Billings of Davidson, Michigan, and plant selected the same year.

Pliter. Ac. 254.

Received as a commercial navy bean from W. C. Pliter, of Olio, Michigan, and planted in the variety series of 1921.

1300-1. Sel. No. 816001, Ac. 265.

Received from J. C. Walcott of St. Johns, Michigan, and planted in the 1922 nursery.

Alasin Parish. Ac. 373.

Received in 1926 as Alasin Giant from Frank Parish of East Lansing, Michigan, and planted in variety series that year. Mr. Parish secured his seed in 1924 from William Stock of Standish, Michigan.

Early Wonder. Ac. 383.

Received in 1926 from John Sims, County Agent in Tuscola County, Michigan, and planted in the variety series that same year.

Early Prolific. Ac. 506.

Received in 1932 from John C. Miller of Alma, Michigan, and planted in the variety series that same year. He had secured his seed from a 1931 Station show sample.

Vermont. Ac. 535.

Received in 1928 from H. R. Pettigrove of the Farm Crops Department of Michigan State College, and first included in the present experiment.

Robust. Sel. No. 40520, Ac. 15.

This strain is a selection made in 1914 by the late Professor Frank A. Spragg from one which he made in 1908. It is known throughout the state as "Improved Robust" and was used as a check in this problem.

In order to simplify references to these varieties, in the tables, the following abbreviations were given them:

| <u>Variety</u>   | <u>Sel. or Ac.</u> | <u>Ab.</u> |
|------------------|--------------------|------------|
| 1000-1           | 528303             | 10         |
| Mexican Tree     | 850205             | 15         |
| Mexican Tree     | 850206             | 16         |
| Robust Selection | 850506             | 13         |
| Greiner          | 850604             | Cr         |
| Canter           | 851302             | Cr         |
| Early Wonder     | 851503             | E2         |
| Fliter           | Ac.254             | P1         |
| 1200-1           | 518001             | 12         |
| Alaska Parish    | Ac.573             | AP         |
| Early Wonder     | Ac.583             | E3         |
| Early Prolific   | Ac.506             | EP         |
| Vermont          | Ac.535             | Vt         |
| Robust (Check)   | 40520              | Cr         |
| Total Population |                    | TP         |

### III - METHODS

To obtain data upon the problem previously stated, every effort was made to reduce the number of variables involved.

#### A. Methods Used in the Field.

##### 1. Planting.

The beans for planting were made practically uniform in size by using only those which would go through a  $5/16 \times 15/64$  inch mesh screen and would not go through a  $3/16 \times 15/64$  inch mesh screen. This did away with all oversized and undersized beans and gave approximately the same number in each plot, regardless of variety or replication.

The field was prepared in the usual manner. The varieties, other than check, were replicated three times, with one exception, in rows 30 inches apart and 266 feet in length, with the standard variety or check appearing every fourth row. The exception to this planting was that in 1926, on account of insufficient seed, the two west replications of Early Wonder (EW) had to be planted to Early Prolific (EP). Such was not the case in 1927 for there was sufficient seed of Early Wonder (EW) to plant its full number of replications. The area was then divided transversely into nine series, A to I inclusive, each 30 feet in length, with a two foot alley intervening.

The planting of the beans in this test was made June 5, 1926 and June 6 and 7, 1927.



## 2. Stand.

In 1926 and 1927 the count, (number of plants per plot,) was made just prior to blooming.

## 3. Harvesting.

For the purpose of studying the varietal response to weathering the series were grouped as shown:

| <u>Group</u> | <u>Series</u> |
|--------------|---------------|
| I            | A             |
| II           | BC            |
| III          | DE            |
| IV           | FG            |
| V            | HI            |

It was planned to have the groups treated in the following manner:

When the beans were ready for harvest, Groups I--IV inclusive, were to be pulled while Group V was to be left standing.

In order to have a comparison between all of the varieties, wherein the pick and shelling would be uninfluenced by delayed harvest, Group I was to be sacked and taken into storage immediately after being pulled.

Group II was to remain in the field one week before being taken to storage. To prevent accidental mixing a systematic method of piling, as shown in Plate I was used. All group piles were turned after each rain or at least every third day.



The diagonal method of piling the  
vines and beans from each lot to pre-  
vent accidental mixing.

Group III was to be left in the field one week longer than Group II before being stored.

Group IV was to be left in the field a week longer than Group III and then stored.

Group V, which had been standing throughout the harvesting of the other groups, was to be pulled and stored the same day that Group IV was removed from the field. Group V was treated in this manner so that a comparison might be made between the varietal response of delayed harvest upon standing vines and that upon vines which had been piled upon the ground from one to three weeks.

#### 4. Shelling.

A shelling count was made on every plot of beans immediately after they were taken out of the field. Some whole pods were broken off in the process of pulling or turning. The beans from these were shelled out and counted together with the loose beans found upon the plot. Care was exercised in turning the piles so that shelling would be a varietal response to weathering and not a result of rough handling.

#### 5. Weight of Vine.

The plants were removed from the sacks and weighed before threshing. Later, the threshed beans were fanned and weighed and this weight subtracted from the total weight of beans and vines, thus giving the weight of vine.

### 6. Threshing and Cleaning.

The beans were allowed to dry thoroughly in the field barn before threshing. The hand-made thresher used was not equipped with a fan for cleaning, but attached to the chute or outlet was a 1/2 inch mesh screen tray which permitted the beans to go through into a box, and retained the larger bits of broken vines and pods. The latter were removed by hand. It was necessary to drive the cylinder at 900 R. P. M. in order to make a thorough job of threshing, even though the speed was such that a high percentage of the beans were split.

In cleaning the beans, a screen was used on top which would permit only the beans and small bits of trash and dirt to pass through. The bottom screen permitted only the dirt to sift through. The fan was driven at a speed great enough to blow away the immature or light beans and chaff. The cleaned beans were put back into their respective sacks.

### 7. Yield.

The weight of the cleaned beans, or yield of each plot, was taken on a Toledo no-spring grain balance.

### 8. Per Cent of Good Beans.

Unfortunately, white pea-beans, when mature, will discolor very easily, if subjected to slightly adverse weather. In 1925, unfavorable weather caused a state average pick of 10.7 per cent. The average yield was 13.5 bushels per acre and the price December

first was 12.95 per bushel. These figures represent a loss of \$4.30 per acre, and suggest the value of data on varietal pick.

The percentage of good beans was obtained by discarding all unmarketable beans, that is the molded, diseased and discolored ones, in each of two representative one-hundred-bean samples taken from the cleaned beans, and averaging the count. The split ones were not discarded, because it was assumed that they resulted from the type of thresher used. Two halves were considered as a whole in the percentage count.

### B. Methods Used in Handling Data.

#### 1. Mean.

The arithmetic average or mean, was employed throughout the thesis.

In the different field treatments the varietal mean was obtained from four plots in group I and from eight plots in groups II, III, IV, and V. The check mean was computed, 17 plots in group I and 34 plots in the other groups.

When a mean was computed from all of the replications in the field it was taken from the correlation surface, rather than being obtained by actual summation.

#### 2. Probable Errors.

All probable errors were computed in the usual manner.<sup>(1)</sup>  
In the group treatments where  $N$  was less than 30,  $N-1$  was used



in obtaining the standard deviations from which the errors were computed.

The probable error of the difference was used to determine whether or not the difference between any two means was significant. It was considered that there was no correlation between varietal means and in such computations the formula,  $P. E. dif = (a^2 + b^2)^{\frac{1}{2}}$  was used. A difference was considered significant only when it was at least 3.2 times the probable error. (This limit is used frequently as the odds are over thirty to one that the difference is not due to chance.)

### 3. Correlations.

When dealing with those characters which are not perfectly correlated, it is necessary to know the degree of correlation actually shown. A statistical calculation is the only accurate way by which we can definitely determine the amount of relationship.

The diagonal method of computing correlation coefficients, as outlined by Crum and Patton<sup>(3)</sup> and modified by the plant breeding staff of the Farm Crops Department of Michigan State College, was used for the correlations.

### 4. Coefficient of Yield.

This is known as the "P over C" method of comparing yields. P is the actual yield of the plot and C is the calculated yield of the plot as interpolated between the two nearest checks.

"The coefficient of yield is the quotient obtained by dividing the yield of a variety by the calculated yield of the standard or check variety growing on the same plot the same year. This is a ratio that becomes unity when the yield of the variety it represents equals that of the standard. It is greater or less than unity when the yield of the variety it represents is greater or less than the yield of the standard."<sup>(5)</sup>

#### IV - OBSTACLES ENCOUNTERED

##### A. Weather.

The precipitation in June and July of 1926 was 2.25 inches below normal, Table 1, but in August and the first half of September it was about normal. This rainfall, together with a lack of killing frosts resulted in an extended growing season and contributed to a very late harvest.

Groups I--IV, inclusive, were pulled October 5th. It was intended that group I be taken to the barn immediately but the high humidity, a little precipitation and the low mean temperature delayed the storing until October 11th.

Because of a 0.5 inch precipitation more than group I received, group II was stored a few days later than planned, Table 2. Group III, which was subjected to 0.73 inch more precipitation than group II, or a total of 1.23 inches, was turned four times and stored nine days later. Three days later group IV was stored.

It had received 0.2 inch more precipitation and an additional turning but no sunshine. This brought the total precipitation on group IV up to 1.56 inches.

Group V should have been pulled and stored at the same time that group IV was taken in, but the character of the weather made it seem wise to wait a few days. It received an additional 0.30 inch of precipitation and little sunshine before being taken from the field November 2nd.

Table 1.

Daily Precipitation During the Growing and Harvest Months  
of 1926 and 1927.

Data from the local Weather Bureau Office, U. S. D. A.

|        | <u>1926</u> |             |             |              |             |             | <u>1927</u> |             |             |              |             |  |
|--------|-------------|-------------|-------------|--------------|-------------|-------------|-------------|-------------|-------------|--------------|-------------|--|
|        | <u>June</u> | <u>July</u> | <u>Aug.</u> | <u>Sept.</u> | <u>Oct.</u> | <u>Nov.</u> | <u>June</u> | <u>July</u> | <u>Aug.</u> | <u>Sept.</u> | <u>Oct.</u> |  |
| 1.     | .26         | T           | 1.69        | .16          | .42         | .26         | --          | .22         | .02         | --           | .62         |  |
| 2.     | T           | T           | .03         | --           | T           | --          | --          | .05         | --          | --           | --          |  |
| 3.     | --          | T           | --          | .51          | .03         | --          | T           | --          | --          | T            | .03         |  |
| 4.     | --          | --          | T           | .03          | .16         | --          | .33         | --          | T           | --           | .03         |  |
| 5.     | --          | --          | .14         | .33          | T           | --          | --          | T           | --          | --           | T           |  |
| 6.     | .72         | --          | --          | .01          | .07         | --          | --          | .43         | .01         | --           | .10         |  |
| 7.     | T           | --          | --          | --           | --          | --          | --          | .01         | .02         | .16          | .23         |  |
| 8.     | T           | .20         | --          | .27          | --          | --          | .20         | --          | T           | T            | --          |  |
| 9.     | --          | .51         | T           | .07          | --          | --          | --          | --          | --          | --           | --          |  |
| 10.    | --          | --          | T           | --           | .07         | --          | .07         | --          | --          | .44          | --          |  |
| 11.    | .02         | --          | T           | .22          | --          | --          | --          | T           | --          | --           | --          |  |
| 12.    | .02         | .01         | .23         | T            | .49         | --          | --          | .25         | --          | .37          | --          |  |
| 13.    | .57         | --          | T           | --           | --          | --          | --          | .04         | --          | .01          | --          |  |
| 14.    | 1.12        | T           | .03         | .30          | --          | --          | .17         | .05         | --          | --           | --          |  |
| 15.    | --          | --          | --          | .05          | --          | --          | --          | .21         | --          | --           | --          |  |
| 16.    | --          | --          | --          | --           | .20         | --          | --          | T           | --          | T            | --          |  |
| 17.    | T           | T           | .02         | --           | .17         | --          | --          | .02         | --          | .02          | --          |  |
| 18.    | --          | T           | --          | --           | .13         | --          | .09         | --          | .02         | .47          | --          |  |
| 19.    | --          | --          | --          | --           | .02         | --          | --          | --          | T           | T            | --          |  |
| 20.    | --          | --          | .51         | --           | .03         | --          | --          | --          | --          | .16          | --          |  |
| 21.    | T           | --          | --          | --           | .02         | --          | .36         | .07         | --          | .16          | --          |  |
| 22.    | --          | .91         | T           | .13          | .12         | --          | .14         | .12         | --          | .07          | --          |  |
| 23.    | --          | --          | T           | 1.06         | .04         | --          | .51         | --          | --          | --           | --          |  |
| 24.    | T           | --          | --          | .62          | .20         | --          | --          | --          | .14         | --           | --          |  |
| 25.    | .19         | --          | --          | .07          | T           | --          | .07         | --          | --          | .02          | --          |  |
| 26.    | --          | --          | --          | --           | --          | --          | --          | --          | --          | T            | --          |  |
| 27.    | --          | .06         | --          | --           | --          | --          | --          | --          | --          | .50          | --          |  |
| 28.    | --          | --          | --          | --           | .02         | --          | --          | T           | T           | 1.07         | --          |  |
| 29.    | T           | --          | --          | --           | --          | --          | --          | .04         | T           | 1.23         | --          |  |
| 30.    | --          | --          | --          | --           | T           | --          | --          | --          | --          | --           | --          |  |
| 31.    | --          | --          | --          | --           | T           | --          | --          | --          | --          | --           | --          |  |
| Total  | 2.90        | 1.49        | 2.61        | 3.71         | 2.24        | .26         | 1.49        | 2.11        | .21         | 4.63         | .46         |  |
| Normal | 3.40        | 3.22        | 2.63        | 2.62         | 2.23        |             | 3.40        | 3.72        | 2.63        | 2.62         |             |  |

-Total for season-

13.23

3.90

Table 2.

Weather Conditions During Harvest, 1936, Together with Storage

Dates and Number of Turnings for Each Group.

| <u>-Date-</u> |            | Character | Per cent possible sunshine | Group stored | <u>-Precipitation-</u>    |                       |                        | No. of Turnings |
|---------------|------------|-----------|----------------------------|--------------|---------------------------|-----------------------|------------------------|-----------------|
| <u>Month</u>  | <u>Day</u> |           |                            |              | Daily                     | Between storage dates | Oct. 5 to dates stored |                 |
| Oct.          | 1          | Pt. Cldy  | 8                          |              | .42                       |                       |                        |                 |
|               | 2          | Pt. Cldy  | 43                         |              | T                         |                       |                        |                 |
|               | 3          | Pt. Cldy  | 17                         |              | .03                       |                       |                        |                 |
|               | 4          | Pt. Cldy  | 62                         |              | .16                       |                       |                        |                 |
|               | 5          | Pt. Cldy  | 65                         |              | T                         |                       |                        |                 |
|               | 6          | Cloudy    | 17                         |              | .07                       |                       |                        |                 |
|               | 7          | Pt. Cldy  | 16                         |              |                           |                       |                        |                 |
|               | 8          | Clear     | 100                        |              |                           |                       |                        |                 |
|               | 9          | Pt. Cldy  | 49                         |              |                           |                       |                        |                 |
|               | 10         | Cloudy    | 0                          |              | .07                       |                       |                        |                 |
|               | 11         | Pt. Cldy  | 44                         | I*           |                           |                       | .14                    | 1               |
|               | 12         | Cloudy    | 0                          |              | .49                       |                       |                        |                 |
|               | 13         | Clear     | 100                        |              |                           |                       |                        |                 |
|               | 14         | Pt. Cldy  | 58                         | II           |                           | .49                   | .85                    | 2               |
|               | 15         | Pt. Cldy  | 64                         |              |                           |                       |                        |                 |
|               | 16         | Cloudy    | 2                          |              | .20                       |                       |                        |                 |
|               | 17         | Pt. Cldy  | 58                         |              | .17                       |                       |                        |                 |
|               | 18         | Pt. Cldy  | 29                         |              | .13                       |                       |                        |                 |
|               | 19         | Pt. Cldy  | 35                         |              | .02                       |                       |                        |                 |
|               | 20         | Cloudy    | 1                          |              | .03                       |                       |                        |                 |
|               | 21         | Cloudy    | 13                         |              | .02                       |                       |                        |                 |
|               | 22         | Pt. Cldy  | 21                         |              | .12                       |                       |                        |                 |
|               | 23         | Pt. Cldy  | 21                         | III          | .04                       | .75                   | 1.56                   | 4               |
|               | 24         | Cloudy    | 0                          |              | .20                       |                       |                        |                 |
|               | 25         | Cloudy    | 0                          |              | T                         |                       |                        |                 |
|               | 26         | Pt. Cldy  | 62                         | IV           |                           | .20                   | 1.56                   | 5               |
|               | 27         | Pt. Cldy  | 58                         |              |                           |                       |                        |                 |
|               | 28         | Cloudy    | 19                         |              | .02                       |                       |                        |                 |
|               | 29         | Pt. Cldy  | 42                         |              |                           |                       |                        |                 |
|               | 30         | Cloudy    | 0                          |              | T                         |                       |                        |                 |
|               | 31         | Cloudy    | 4                          |              | T                         |                       |                        |                 |
| Nov.          | 1          | Cloudy    | 0                          |              | .28                       |                       |                        |                 |
|               | 2          | Cloudy    | 0                          | V            |                           | .50                   | 1.86                   |                 |
|               |            |           |                            |              | <u>-Days-</u>             |                       |                        |                 |
|               |            |           |                            |              | Clear                     |                       |                        |                 |
|               |            |           |                            |              | 2                         |                       |                        |                 |
|               |            |           |                            |              | Pt. Cldy                  |                       |                        |                 |
|               |            |           |                            |              | 13                        |                       |                        |                 |
|               |            |           |                            |              | Cloudy                    |                       |                        |                 |
|               |            |           |                            |              | 15                        |                       |                        |                 |
|               |            |           |                            |              | Percent possible sunshine |                       |                        |                 |
|               |            |           |                            |              | 52                        |                       |                        |                 |

\*Groups I - IV was pulled Oct. 5 and group V was pulled Nov. 2.

A study of Table 2 shows that in 1926 the beans were subjected to 0.7 inch of precipitation in the four days prior to the beginning of, and 1.36 inches during the harvest. There were only two clear days during the entire harvest period of four weeks and an average percentage of possible sunshine of 29.6 per cent.

The harvest in 1927 began September 2. August had been a dry month, Table 1, and the beans were mature and dry. Group I was stored immediately.

September 9 was approximately the date for group II to be put into the barn, but, because of weather unsuited to drying, Table 3, this group had to be turned five times and could not be taken from the field until September 26. Group III received three inches more precipitation and was turned three times more than group II, before being stored October 4. Four days later group IV was stored. Because of 0.55 inch of precipitation more than group III another turning was necessary.

Group V, which had been standing, was pulled and stored on the same date that group IV was stored.

Summing up, it is found that, even though there were 16 clear days and an average percentage of possible sunshine of 53 during the 56 days of harvest, there were more than five inches of precipitation. Certainly this harvest was subjected to as adverse weather as is commonly experienced in Michigan.

Table 3.

Weather Conditions During Harvest, 1927, Together with Storage  
Dates and Number of Turnings for Each Group.

| <u>-Date-</u><br><u>Month Day</u> | Character                  | Per cent<br>possible<br>sunshine | Group<br>stored | <u>-Precipitation-</u> |                             |                                 | No.<br>of<br>Turn-<br>ings |
|-----------------------------------|----------------------------|----------------------------------|-----------------|------------------------|-----------------------------|---------------------------------|----------------------------|
|                                   |                            |                                  |                 | Daily                  | Between<br>storage<br>dates | Oct. 5<br>to<br>dates<br>stored |                            |
| Sept. 1                           | Clear                      | 83                               |                 |                        |                             |                                 |                            |
| 2                                 | Clear                      | 97                               | I*              | T                      |                             |                                 |                            |
| 3                                 | Pt. Cldy                   | 79                               |                 |                        |                             |                                 |                            |
| 4                                 | Clear                      | 100                              |                 |                        |                             |                                 |                            |
| 5                                 | Clear                      | 85                               |                 |                        |                             |                                 |                            |
| 6                                 | Clear                      | 92                               |                 |                        |                             |                                 |                            |
| 7                                 | Cloudy                     | 40                               |                 | .16                    |                             |                                 |                            |
| 8                                 | Pt. Cldy                   | 58                               |                 | T                      |                             |                                 |                            |
| 9                                 | Pt. Cldy                   | 78                               |                 |                        |                             |                                 |                            |
| 10                                | Cloudy                     | 22                               |                 | .44                    |                             |                                 |                            |
| 11                                | Clear                      | 95                               |                 |                        |                             |                                 |                            |
| 12                                | Clear                      | 90                               |                 | .57                    |                             |                                 |                            |
| 13                                | Pt. Cldy                   | 83                               |                 | .61                    |                             |                                 |                            |
| 14                                | Clear                      | 79                               |                 |                        |                             |                                 |                            |
| 15                                | Clear                      | 96                               |                 |                        |                             |                                 |                            |
| 16                                | Pt. Cldy                   | 67                               |                 | T                      |                             |                                 |                            |
| 17                                | Clear                      | 90                               |                 | .02                    |                             |                                 |                            |
| 18                                | Pt. Cldy                   | 59                               |                 | .47                    |                             |                                 |                            |
| 19                                | Pt. Cldy                   | 65                               |                 | T                      |                             |                                 |                            |
| 20                                | Pt. Cldy                   | 40                               |                 | .16                    |                             |                                 |                            |
| 21                                | Pt. Cldy                   | 56                               |                 | .06                    |                             |                                 |                            |
| 22                                | Cloudy                     | 19                               |                 | .07                    |                             |                                 |                            |
| 23                                | Clear                      | 96                               | II              |                        | 1.76                        |                                 | 5                          |
| 24                                | Clear                      | 61                               |                 |                        |                             |                                 |                            |
| 25                                | Cloudy                     | 23                               |                 | .02                    |                             |                                 |                            |
| 26                                | Cloudy                     | 4                                |                 | T                      |                             |                                 |                            |
| 27                                | Cloudy                     | 1                                |                 | .50                    |                             |                                 |                            |
| 28                                | Cloudy                     | 3                                |                 | 1.07                   |                             |                                 |                            |
| 29                                | Cloudy                     | 4                                |                 | 1.28                   |                             |                                 |                            |
| 30                                | Clear                      | 97                               |                 |                        |                             |                                 |                            |
| Oct. 1                            | Cloudy                     | 51                               |                 | .02                    |                             |                                 |                            |
| 2                                 | Clear                      | 97                               |                 |                        |                             |                                 |                            |
| 3                                 | Pt. Cldy                   | 54                               |                 | .03                    |                             |                                 |                            |
| 4                                 | Clear                      | 74                               | III             | .08                    | 3.00                        | 4.76                            | 8                          |
| 5                                 | Pt. Cldy                   | 65                               |                 | T                      |                             |                                 |                            |
| 6                                 | Pt. Cldy                   | 32                               |                 | .10                    |                             |                                 |                            |
| 7                                 | Cloudy                     | 12                               |                 | .25                    |                             |                                 |                            |
| 8                                 | Clear                      | 98                               | IV - V          |                        | .33                         | 5.09                            | 9                          |
|                                   |                            |                                  |                 | <u>-Days-</u>          |                             |                                 |                            |
|                                   | Clear                      |                                  |                 | 16                     |                             |                                 |                            |
|                                   | Pt. Cldy                   |                                  |                 | 12                     |                             |                                 |                            |
|                                   | Cloudy                     |                                  |                 | 10                     |                             |                                 |                            |
|                                   | Per cent possible sunshine |                                  |                 | 58                     |                             |                                 |                            |

\*Groups I - IV were pulled September 2 and group V was pulled October 6.



### B. Soil Fertility and Available Moisture.

This experiment was allotted to different fields in 1926 and 1927, however both soils were classified as fine sandy loam. The 1926 area was planted in 1925 to small grains and 500 pounds per acre of 5-12-1 fertilizer were applied just prior to the planting of the beans. Corn was planted in 1926 on the area that was assigned to the 1927 beans. In the spring of 1927, 500 pounds per acre of a 2-12-2 were applied. Seemingly this would have rendered approximately equal fertility for the two bean crops. However there were striking differences in the yields and weights of vines for 1926 and 1927.

|                          | <u>1926</u>     | <u>1927</u>     |
|--------------------------|-----------------|-----------------|
| Yield of beans in grams  | 928.3 $\pm$ 6.2 | 421.3 $\pm$ 5.4 |
| Weight of vines in grams | 568.0 $\pm$ 5.7 | 436.3 $\pm$ 4.1 |

A similar result was observed in 1928 and 1929 as reported by J. H. Thompson in his thesis on the same problem.<sup>(5)</sup>

The precipitation in 1926 through the growing season was only slightly below normal, whereas in 1927 it was about six inches short. The yield and weight of vine in 1926 were about normal. In 1927 the weight of vine was better than 4/5 that of 1926, but the yield of beans was less than half that of 1926. In fact, the yield was less than the weight of vine. Apparently the vines' need for moisture was first satisfied and then the surplus, if any, was utilized by the fruit.

7 - 1921113

A. Factors Influencing Yield.

1. Variety Fields.

Variety yields were calculated by two methods. Table 4 gives the P over C averages for 1926 and 1927. No variety exceeded or equalled the yield of the check, but Robust Selection (15) and Early Wonder 225 (22) were the closest to the check in yield.

The yields, as given in Table 5, are averages of actual yields for all the plots of a variety. Here again it is seen that check gave the highest yield, followed closely by Early Wonder 225 (22) and Carter (3r) in 1926, and by Robust Selection (15) and the same Early Wonder in 1927. On account of the very dry August and a growing season which ended the first week in September, the yields in 1927 were about half of those in 1926. However, it may be noticed that even with these adverse conditions Early Wonder 225 yielded close to the highest in both years.

The degree of significance of the varietal differences for each of the two years is shown in Table 6. This table emphasizes the fact that there was less intervarietal variability in 1926 than in 1927. There are two outstanding varieties in the 1926 data. 1000-1 (10) is significantly inferior to all and the check is significantly better than four other varieties. In 1927, only four of the varieties are significantly superior to 1000-1, and six of the others are greater, but not by significant differences. The check is superior to all but one and that one, Robust

Selection (245), is superior to nine others. Early Wonder 228 (22) is significantly superior to eight of the thirteen varieties.

Table 7 shows the yields as the field was grouped for the harvest treatments. A glance at the 1926 data leads one to conclude that these treatments were reflected in the yields. Only through the shelling could such be the case, and the shelling, as shown in Table 15, will not account for these differences.

Table 8 gives the yields as obtained under the various treatments in 1927. It is seen both from the clear and total population results that the yields of groups II and III were higher than those of the other groups.

The most plausible explanation for these conditions is that the variation in soil fertility tended to parallel the harvesting treatments both years.

Table 4.

Average coefficients of yield.

| -Variety-     | -1936- | -1937- |
|---------------|--------|--------|
| 10            | .7490  | .7033  |
| 15            | .4586  | .6490  |
| 18            | .9371  | .8486  |
| 18            | .4580  | .6332  |
| Gr            | .9305  | .7740  |
| Gr            | .9762  | .7804  |
| E2            | .9797  | .9219  |
| F1            | .9017  | .7745  |
| 12            | .9239  | .8623  |
| AP            | .9030  | .7594  |
| E5            | .8812  | .7101  |
| EP            | .9082  |        |
| Vt            | .8472  | .7103  |
| Gr            | 1.0000 | 1.0000 |
| TF(1)         | .9095  | .8215  |
| P. M. of ave. | .8400  | .6532  |

(1) All varieties other than clack are included in these averages.

Table 5.

The means and probable errors of the yields, in grams,  
for all treatments combined.

| -Variety- | -1936- |      | -1937- |      |
|-----------|--------|------|--------|------|
|           | Mean   | P.E. | Mean   | P.E. |
| 10        | 880.0  | 18.0 | 499.0  | 9.0  |
| 105       | 1017.3 | 24.2 | 448.8  | 12.0 |
| 110       | 979.4  | 26.6 | 448.0  | 9.7  |
| 125       | 970.5  | 17.1 | 490.0  | 10.4 |
| Or        | 981.8  | 22.9 | 402.8  | 10.5 |
| Or        | 1020.6 | 19.6 | 406.4  | 8.6  |
| E2        | 1020.6 | 13.6 | 479.2  | 9.0  |
| 11        | 944.1  | 17.0 | 404.2  | 10.7 |
| 12        | 921.1  | 20.0 | 400.6  | 11.3 |
| AP        | 930.2  | 17.0 | 509.5  | 12.0 |
| E3        | 950.0  | 20.4 | 387.2  | 10.5 |
| EP        | 972.2  | 21.1 |        |      |
| Vt        | 929.4  | 21.5 | 402.8  | 11.2 |
| Or        | 1032.5 | 10.5 | 525.8  | 8.0  |

Table 6.

The significance of differences between varieties on the basis of actual yields, with 1936 results above diagonal and 1937 below.

|     | Cr | Vt | EP* | ES | AP | 12 | P1 | E2 | Cr | Cr | RS | M6 | M5 | 10 |
|-----|----|----|-----|----|----|----|----|----|----|----|----|----|----|----|
| 10  | -S | -s | -S  | -S | -S | -S | -S | -S | -S | -S | -S | -S | -S |    |
| M5  |    |    |     |    |    |    |    |    |    |    |    |    |    |    |
| M6  |    |    |     |    |    |    |    |    |    |    |    |    | S  | S  |
| RS  |    |    |     |    |    |    |    |    |    |    |    |    | S  | S  |
| Cr  |    |    |     |    |    |    |    |    |    |    | -S |    |    |    |
| Cr  |    | S  |     |    |    |    | S  |    |    |    | -S |    |    |    |
| E2  |    | S  |     |    |    |    | S  |    | S  | S  |    |    |    | S  |
| P1  | -S |    |     |    |    |    |    | -S |    |    | -S |    |    |    |
| 12  |    |    |     |    |    |    |    | -S |    |    | -S |    |    |    |
| AP  |    |    |     |    |    | -S |    | -S |    |    | -S | -S | -S |    |
| ES  | -S |    |     |    |    |    |    | -S |    |    | -S | -S | -S |    |
| EP* | -S |    |     |    |    |    |    |    |    |    |    |    |    |    |
| Vt  | -S |    |     |    |    |    |    | -S |    |    | -S |    |    |    |
| Cr  |    | S  |     | S  | S  | S  | S  | S  | S  | S  |    | S  | S  | S  |

Key to tables of significance.

S or s indicates that the variety in left margin is greater than corresponding one above. If a dash (-) precedes the S or s, then the variety above is greater than the corresponding one in left margin. A large S indicates that this difference is significant by more than five times the probable error. A small s signifies a difference of between 3.2 and five times the probable error. No letter indicates a lack of significance.

\*Early Prolific (EP) was not included in 1937.

Table 7.

The means and probable errors of the actual yields in grams, of each variety under the different field treatments in 1933.

| Variety | I    |     | II   |    | III  |    | IV   |    | V    |    |
|---------|------|-----|------|----|------|----|------|----|------|----|
|         | Mean | PE  | Mean | PE | Mean | PE | Mean | PE | Mean | PE |
| 10      | 813  | 53  | 821  | 53 | 745  | 33 | 753  | 32 | 807  | 35 |
| M5      | 1134 | 76  | 1015 | 44 | 871  | 36 | 992  | 45 | 1055 | 46 |
| M8      | 1090 | 73  | 1027 | 45 | 943  | 44 | 936  | 42 | 888  | 39 |
| R8      | 1125 | 75  | 1115 | 49 | 939  | 41 | 854  | 39 | 949  | 41 |
| Gr      | 1013 | 68  | 933  | 41 | 902  | 40 | 900  | 44 | 730  | 52 |
| Gr      | 1134 | 76  | 1073 | 47 | 945  | 41 | 857  | 38 | 935  | 42 |
| E2      | 1053 | 71  | 1000 | 44 | 952  | 42 | 923  | 41 | 891  | 44 |
| F1      | 949  | 64  | 859  | 29 | 853  | 38 | 824  | 36 | 961  | 42 |
| 12      | 1020 | 63  | 1013 | 45 | 899  | 39 | 922  | 40 | 879  | 39 |
| AP      | 961  | 64  | 873  | 36 | 833  | 33 | 1036 | 45 | 973  | 43 |
| E3      | 1055 | 120 | 733  | 59 | 794  | 55 | 892  | 60 | 1074 | 72 |
| EP      | 1013 | 117 | 1035 | 71 | 945  | 65 | 737  | 49 | 854  | 57 |
| Vt      | 1000 | 67  | 943  | 41 | 835  | 37 | 829  | 36 | 917  | 40 |
| Gr      | 1125 | 63  | 1073 | 31 | 1000 | 30 | 942  | 19 | 1021 | 20 |
| TP(1)   | 1023 | 17  | 943  | 12 | 835  | 10 | 835  | 10 | 923  | 11 |

(1) In this and all subsequent tables, 12 is an average of all varieties, including check.

Table 8.

The means and probable errors of the actual yields, in bushels, of  
each variety under the different field treatments in 1937.

| Variety | I    |    | II   |    | III  |    | IV   |    | V    |    |
|---------|------|----|------|----|------|----|------|----|------|----|
|         | Mean | PE | Mean | PE | Mean | PE | Mean | PE | Mean | PE |
| 10      | 535  | 34 | 486  | 30 | 463  | 25 | 533  | 22 | 574  | 25 |
| 115     | 595  | 37 | 578  | 35 | 577  | 25 | 566  | 23 | 457  | 36 |
| 116     | 414  | 36 | 445  | 27 | 499  | 36 | 569  | 24 | 450  | 27 |
| RS      | 450  | 41 | 469  | 30 | 511  | 31 | 424  | 26 | 537  | 36 |
| Gr      | 547  | 32 | 432  | 26 | 461  | 26 | 559  | 32 | 537  | 25 |
| Gr      | 560  | 33 | 445  | 27 | 414  | 25 | 565  | 22 | 427  | 26 |
| E2      | 479  | 44 | 529  | 32 | 430  | 29 | 411  | 25 | 476  | 29 |
| F1      | 417  | 39 | 476  | 29 | 533  | 23 | 555  | 21 | 570  | 24 |
| 12      | 409  | 36 | 531  | 32 | 462  | 24 | 579  | 26 | 464  | 25 |
| AP      | 545  | 32 | 464  | 26 | 520  | 19 | 520  | 19 | 536  | 25 |
| E3      | 569  | 34 | 439  | 27 | 405  | 25 | 564  | 22 | 598  | 24 |
| Vt      | 572  | 35 | 505  | 31 | 376  | 23 | 546  | 21 | 571  | 23 |
| Gr      | 500  | 29 | 537  | 16 | 551  | 15 | 466  | 15 | 522  | 14 |
| TP      | 394  | 9  | 464  | 8  | 419  | 7  | 571  | 6  | 421  | 7  |



## 2. Weight of Vine.

The average weights of vine, per plot, are given in Table 9, and the significance of the differences between varieties is shown in Table 10. Mexican Tree '05 (15) has the largest vine in 1926 and is followed by 1200-1 (12) and Early Wonder 305 (25). In 1927 the two Mexican Tree strains have the largest vine and are followed by 1200-1 and Carter (Cr). Attention is called to the fact that the same variety, Mexican Tree '05, is highest both years and that the seven varieties with the heaviest vines in 1926 are the seven highest ranking ones in 1927, though the individual varieties do not hold the same positions both years. Table 10 shows that in 1926, 1000-1 (10) is inferior to 11 of the varieties, and in 1927 Alaska Parish (41) is inferior to all of the varieties.

The effect of the long dry spell during the growing season of 1927 is reflected in the general smallness of the vine when compared with that of 1926. However, there is not as great a difference in vine size as there is in the yields of the beans. This is probably due to the fact that the vines had more nearly attained their growth before dry weather hit them.

Table 9.

The means and probable errors of weight of nine, in grams.

| -Variety- | -1926- |      | -1927- |      |
|-----------|--------|------|--------|------|
|           | Mean   | P.E. | Mean   | P.E. |
| 10        | 517.7  | 13.1 | 472.2  | 13.7 |
| M5        | 733.2  | 27.9 | 531.1  | 16.2 |
| M6        | 661.8  | 21.4 | 533.3  | 13.3 |
| R3        | 550.0  | 16.0 | 439.4  | 12.7 |
| Gr        | 635.5  | 16.1 | 460.6  | 19.6 |
| Gr        | 647.1  | 14.1 | 513.9  | 11.6 |
| E2        | 617.7  | 24.5 | 450.0  | 10.3 |
| F1        | 611.6  | 15.6 | 475.0  | 14.6 |
| 12        | 632.4  | 22.4 | 516.7  | 12.6 |
| AP        | 600.6  | 13.6 | 533.1  | 11.3 |
| E5        | 631.3  | 20.1 | 477.3  | 12.7 |
| EP        | 555.6  | 15.5 |        |      |
| Vt        | 591.2  | 14.7 | 452.6  | 11.7 |
| Or        | 625.0  | 6.7  | 466.3  | 6.7  |

Table 10.

The significance of differences between varieties on the basis  
of the weight of vine, with 1926 results above diagonal,  
and 1927 below. See Table 6 for key to symbols.

| Cr  | Vt | EP* | ES | AP | 12 | F1 | E2 | Cr | Cr | RS | 15 | 16 | 10 |
|-----|----|-----|----|----|----|----|----|----|----|----|----|----|----|
| 10  | -S | -s  |    | -S | -s | -S | -s | -S | -S |    | -S | -S |    |
| 15  | s  | s   | S  |    | s  |    | s  |    | s  | S  |    |    | s  |
| 16  | s  | s   | S  |    | s  |    | s  |    |    | S  |    |    | s  |
| RS  | -s |     |    |    | -S |    |    | -S | -S |    | -S | -S |    |
| Cr  |    |     | s  |    |    |    |    |    |    |    |    |    |    |
| Cr  |    |     | s  |    |    |    |    |    |    |    |    |    |    |
| E2  |    |     |    |    |    |    |    | -S |    |    | -S | -S |    |
| F1  |    |     |    |    |    |    |    |    |    |    |    | -S |    |
| 12  |    | s   | s  |    |    |    | s  |    |    |    |    |    |    |
| AP  |    |     |    |    | -S | -s | -S | -S | -s | -S | -S | -S | -s |
| ES  |    |     | s  |    | S  |    |    |    |    |    |    | -S |    |
| EP* |    |     |    |    |    |    |    |    |    |    |    |    |    |
| Vt  |    |     |    |    | s  | -S |    | -S |    |    | -S | -S |    |
| Cr  |    |     |    |    | S  |    |    |    |    |    |    |    | s  |

\*Early Prolific (EP) was not included in 1927.

### 3. Stand.

The data on stand are given in Table 11 and the significance of the differences in Table 12. In 1926 the check had a significantly greater stand than any of the other varieties. Robust Selection (RS), Pliter (Pl) and Early Wonder 225 (E2) were each better than seven of the remaining varieties. 1200-1 (12), Early Prolific (EP) and 1000-1 (10) have the smallest stands.

In 1927 the stand of Mexican Tree '06 (M6) is significantly greater than all of the varieties except the check and the latter is superior to all others. 1000-1 (10) and Mexican Tree '05 (M5) are superior to seven and 1200-1 follows with a superiority over five of the varieties. Attention is called to the comparative ranking of 1000-1 the two years, it was third from lowest in 1926 and third from highest in 1927. Alaska Parish had the poorest stand of all in 1927.

It is difficult to understand just why there is such a variation in stand between varieties. Care was taken in preparing the seed for planting so that approximately the same number of beans would be planted per plot regardless of variety or replication. It can not be said that it is altogether a varietal response to moisture, because in 1927 there was less moisture during June than in 1926 and nine of the varieties had greater stands in 1927 than in 1926.

Table 11.

The means and probable errors of stand counts.

| -Variety- | -1936-      |             | -1937-      |             |
|-----------|-------------|-------------|-------------|-------------|
|           | <u>Mean</u> | <u>P.E.</u> | <u>Mean</u> | <u>P.E.</u> |
| 10        | 64.7        | 1.1         | 67.6        | 1.4         |
| 15        | 72.1        | 1.4         | 63.3        | 1.0         |
| 16        | 70.6        | 1.7         | 65.0        | 1.4         |
| 18        | 65.7        | 2.2         | 66.7        | 1.5         |
| Gr        | 76.0        | 1.3         | 77.5        | 1.5         |
| Gr        | 73.7        | 1.5         | 62.7        | 1.2         |
| EE        | 66.7        | 1.4         | 74.6        | 1.3         |
| Pl        | 70.9        | 1.0         | 73.2        | 1.0         |
| 12        | 62.1        | 1.5         | 64.3        | 1.3         |
| AP        | 70.5        | 1.2         | 64.7        | 1.6         |
| ES        | 70.6        | 2.0         | 72.1        | 1.7         |
| EP        | 63.3        | 1.5         |             |             |
| Vt        | 71.5        | 2.1         | 73.5        | 1.3         |
| OK        | 93.1        | 0.6         | 93.1        | 0.6         |

Table 12.

The significance of differences between varieties on the basis of  
stand with 1926 results above diagonal and 1927 below.

See Table 6 for key to symbols.

|     | Cr | Vt | EP* | ES | AP | 12 | P1 | ES | Cr | Cr | RS | M6 | M5 | 10 |
|-----|----|----|-----|----|----|----|----|----|----|----|----|----|----|----|
| 10  | -S |    |     |    |    |    | -S | -S | -S | -S | -S | -S | -S |    |
| M5  | -S |    | S   |    |    | S  | -S | -S |    |    | -S |    |    |    |
| M6  | -S |    | S   | s  | s  | S  |    |    |    |    |    |    | S  | s  |
| RS  | -s | s  | S   | S  | S  | S  |    |    |    |    | -S |    |    |    |
| Cr  | -S |    | S   |    | s  | S  |    |    |    |    | -S | -S | -S | -S |
| Cr  | -S |    | S   |    | S  | S  |    |    |    |    | -S | -S | -S | -S |
| E2  | -S | s  | S   | s  | S  | s  |    | -S |    |    | -S | -S | -S | -S |
| P1  | -S | s  | S   | s  | S  | S  |    | -S |    |    | -S | -S | -S | -S |
| 12  | -S | -s |     | -s | -s |    | S  | s  |    |    |    | -S |    |    |
| AP  | -S |    | s   |    |    | -S | -s | -s | -S | -S | -S | -S | -S | -S |
| ES  | -S |    | s   |    |    | -s |    |    | -S |    | -S | -S | -S | -S |
| EP* | -S | -s |     |    |    |    |    |    |    |    |    |    |    |    |
| Vt  | -S |    |     |    | S  | -s |    |    | -s |    | -S | -S | -S | -S |
| Cr  |    | S  |     | S  | S  | s  | S  | S  | S  | S  | s  |    | S  | s  |

\*Early Prolific (EP) was not included in 1927.

#### 4. Shelling.

The data on shelling are found in Table 15 and the significance of the differences in Table 14. In 1926 Mexican Tree '06 (16), 1200-1 (12) and Carter (Cr) each shelled significantly less than five of the other varieties. Table 9 shows that the first two of these three varieties had heavy vines which leads one to conclude that there may be a varietal relationship between size of vine and shelling. This is discussed under Relationships.

Tables 13 and 14 show very readily that Mexican Tree '05 (15) shelled more in 1927 than any other variety. This shelling count was boosted a great deal by the variety's response to the weathering in treatments II, III, IV and V as shown in Table 16. The sister strain, Mexican Tree '06, was one of the four lowest shelling varieties.

Table 15 shows that, in 1926, in the groups as a whole, there was greater shelling under treatment I than under any of the other treatments. This was unexpected because the beans were exposed to very little weathering between pulling and storing, whereas the other groups were exposed to considerably more weathering. Of course the yields of group I were greater and one would expect a slightly larger shelling but its ratio of shelling to yield was far out of line with that of the other groups. It is the writer's opinion that the first four groups shelled heavily due to proper weather conditions at time of pulling and first turning, but the 0.5 inch precipitation on groups II, III and IV before the counts were made

probably covered up a large percentage of the shelled beans. They of course did not germinate because of the advanced season and thus they could not be included in the count. This discrepancy could have been prevented only by picking up and counting all beans on each plot after the vines were pulled up and immediately after each turning. This would have been an endless task and would have necessitated the neglecting of other more important data. A further examination of this table shows that group V, which stood throughout the harvest treatments, shelled less in general than any of the other groups.

The 1926 data in Table 17 shows that the different treatments had no significant effect on three varieties: Robust Selection (RS), Early Wonder 505 (ES) and Early Prolific (EP), while treatment V caused less shelling than the other four treatments in Mexican Tree '06 (MS), Fliter (FL), 1200-1 (LS) and check. The total population shelled more in group I than in groups II and III and more in groups II, III and IV than in group V.

Table 18 shows that in 1927 all of the varieties, when taken individually and as a whole, were directly influenced in their shelling by the harvest treatments. That is, treatment I, as was expected, caused a relatively smaller amount of shelling than did treatments II, III and IV. The shelling in these groups increased in proportion to the time that they were piled upon the ground and exposed to the weather. Group V which stood throughout the harvest period shelled more than did groups I and II but considerably less



than groups III and IV.

The significant varietal differences are shown in Table 17. All but one of the varieties, Early Wonder 225 (E2), shelled significantly less in group I than in group IV and nine of the varieties shelled significantly less in group I than in group III. Group II does not show as many significant differences over groups III and IV as does group I. In no case were groups III, IV or V significantly superior (shell less beans) to groups I and II.

The shelling count may be interpreted in pounds per acre by considering that ten beans per plot is approximately three and one-fourth pounds per acre. The following is the shelling, in pounds per acre, of the various treatments:

|    | -1926-   |           |            |           |          | -1927-   |           |            |           |          |
|----|----------|-----------|------------|-----------|----------|----------|-----------|------------|-----------|----------|
|    | <u>I</u> | <u>II</u> | <u>III</u> | <u>IV</u> | <u>V</u> | <u>I</u> | <u>II</u> | <u>III</u> | <u>IV</u> | <u>V</u> |
| TP | 12       | 7         | 9          | 9         | 5        | 4        | 6         | 17         | 25        | 12       |

Table 18.

The means and probable errors of the shellin counts  
for all treatments combined.

| Variety | -1926-      |              | -1927-      |              |
|---------|-------------|--------------|-------------|--------------|
|         | <u>Mean</u> | <u>P. E.</u> | <u>Mean</u> | <u>P. E.</u> |
| 10      | 22.9        | 2.1          | 41.7        | 4.5          |
| 13      | 20.6        | 1.9          | 33.1        | 3.1          |
| 16      | 16.2        | 1.7          | 35.3        | 3.3          |
| 18      | 20.6        | 2.1          | 33.0        | 3.4          |
| Gr      | 26.5        | 1.9          | 32.3        | 4.2          |
| Gr      | 17.9        | 1.3          | 42.3        | 3.6          |
| ES      | 33.5        | 2.3          | 33.6        | 2.5          |
| Pl      | 27.6        | 2.2          | 37.2        | 2.9          |
| 12      | 17.4        | 1.3          | 36.9        | 2.3          |
| AP      | 25.9        | 2.3          | 36.1        | 3.1          |
| ES      | 23.1        | 3.3          | 37.2        | 4.1          |
| EP      | 21.1        | 2.3          |             |              |
| Vt      | 21.4        | 1.3          | 37.5        | 3.3          |
| Cr      | 32.5        | 1.1          | 32.2        | 1.4          |

Table 14.

The significance of differences between varieties on the basis of shelling<sup>(1)</sup> with 1926 results above diagonal and 1927 below.

See Table 6 for key to symbols.

|     | Cr | Vt | EP* | ES | AP | 12 | P1 | E2 | Gr | Gr | RS | RS | MS | 10 |
|-----|----|----|-----|----|----|----|----|----|----|----|----|----|----|----|
| 10  | -s |    |     |    |    |    |    | -s |    |    |    |    |    |    |
| MS  | -s |    |     |    |    |    |    | -s |    |    |    |    |    | s  |
| MS  | -s |    |     |    |    |    | -s | -s |    | -s | -s |    | -s |    |
| RS  |    |    |     |    |    | s  |    |    | s  |    |    |    | -s |    |
| Gr  |    |    |     |    |    | s  |    |    | s  |    | s  | s  | -s |    |
| Gr  | -s |    |     |    |    |    | -s | -s |    |    |    |    | -s |    |
| E2  |    |    | s   |    |    | s  |    |    |    | -s |    |    | -s |    |
| P1  |    |    |     |    |    | s  |    |    |    |    |    |    | -s |    |
| 12  | -s |    |     |    |    |    |    |    |    |    |    |    | -s |    |
| AP  |    |    |     |    |    |    |    |    |    |    |    |    | -s |    |
| ES  |    |    |     |    |    |    |    |    |    |    |    |    | -s |    |
| *EP | -s |    |     |    |    |    |    |    |    |    |    |    |    |    |
| Vt  | -s |    |     |    |    |    |    |    |    |    |    |    | -s |    |
| Cr  |    |    |     |    |    |    |    |    |    | -s |    |    | -s |    |

(1) Care must be taken in interpreting this table. The symbols are used the same as in all of the previous tables but they have a different meaning. For example: 1000-1 (10) has a shelling count that is significantly less than the check. This means that 1000-1 is to be preferred to the check and is not less desirable as is the case in Table 6 with regard to the yield, as it is most desirable to have a variety with the least shelling.

\*Early Prolific (EP) was not used in 1927.

Table 15.

The mean shellin of each variety under the different  
field treatments in 1936.

| Variety | I    |      | II   |      | III  |      | IV   |      | V    |      |
|---------|------|------|------|------|------|------|------|------|------|------|
|         | Mean | P.E. | Mean | P.E. | Mean | P.E. | Mean | P.E. | Mean | P.E. |
| 10      | 45   | 11   | 32   | 4    | 16   | 5    | 30   | 5    | 9    | 1    |
| M5      | 32   | 8    | 34   | 6    | 19   | 5    | 29   | 5    | 11   | 2    |
| M6      | 33   | 8    | 14   | 2    | 22   | 4    | 26   | 4    | 5    | 1    |
| RS      | 49   | 12   | 30   | 5    | 23   | 5    | 27   | 4    | 20   | 5    |
| Gr      | 31   | 8    | 19   | 5    | 36   | 6    | 32   | 5    | 12   | 2    |
| Gr      | 37   | 9    | 16   | 5    | 15   | 2    | 32   | 4    | 6    | 1    |
| E2      | 37   | 9    | 35   | 5    | 45   | 7    | 40   | 6    | 15   | 2    |
| F1      | 45   | 11   | 22   | 4    | 33   | 5    | 34   | 6    | 9    | 2    |
| 12      | 33   | 8    | 19   | 5    | 16   | 5    | 24   | 4    | 6    | 1    |
| AP      | 39   | 10   | 11   | 2    | 32   | 5    | 36   | 6    | 11   | 2    |
| E3      | 33   | 22   | 15   | 4    | 26   | 6    | 25   | 6    | 7    | 2    |
| EP      | 23   | 12   | 30   | 7    | 32   | 6    | 11   | 5    | 6    | 2    |
| Vt      | 30   | 7    | 17   | 5    | 29   | 5    | 34   | 5    | 7    | 1    |
| Gr      | 32   | 6    | 32   | 2    | 34   | 5    | 39   | 5    | 16   | 1    |
| TP      | 36   | 2    | 32   | 1    | 27   | 1    | 26   | 1    | 10   | 1    |

Table 16.

The mean shelling of each variety under the different  
field treatments in 1927.

| Variety | I    |      | II   |      | III  |      | IV   |      | V    |      |
|---------|------|------|------|------|------|------|------|------|------|------|
|         | Mean | P.E. | Mean | P.E. | Mean | P.E. | Mean | P.E. | Mean | P.E. |
| 10      | 7    | 2    | 11   | 2    | 61   | 12   | 66   | 17   | 40   | 8    |
| M5      | 29   | 9    | 50   | 10   | 94   | 19   | 127  | 25   | 62   | 16   |
| M6      | 8    | 3    | 15   | 3    | 45   | 9    | 70   | 14   | 50   | 6    |
| RS      | 15   | 4    | 12   | 2    | 39   | 8    | 61   | 16   | 28   | 6    |
| Gr      | 19   | 6    | 28   | 6    | 45   | 9    | 103  | 20   | 52   | 10   |
| Gr      | 7    | 2    | 16   | 3    | 42   | 8    | 64   | 17   | 50   | 10   |
| E2      | 14   | 4    | 17   | 3    | 53   | 11   | 46   | 9    | 32   | 6    |
| F1      | 11   | 3    | 21   | 4    | 57   | 11   | 63   | 13   | 35   | 5    |
| 12      | 17   | 5    | 17   | 3    | 51   | 10   | 57   | 11   | 37   | 7    |
| AP      | 15   | 4    | 14   | 3    | 46   | 9    | 76   | 16   | 33   | 7    |
| E3      | 8    | 3    | 9    | 2    | 59   | 12   | 69   | 14   | 27   | 5    |
| Vt      | 12   | 4    | 20   | 4    | 50   | 10   | 70   | 14   | 34   | 5    |
| Gr      | 17   | 2    | 15   | 1    | 39   | 4    | 62   | 6    | 27   | 2    |
| TP      | 12   | 1    | 16   | 1    | 54   | 4    | 76   | 6    | 36   | 3    |

Table 17.

The significance of differences in shelling counts.

| Variety | -1936- |     |     |         |     | -1937-  |       |     |    |   |
|---------|--------|-----|-----|---------|-----|---------|-------|-----|----|---|
|         | I      | II  | III | IV      | V   | I       | II    | III | IV | V |
| 10      |        |     |     |         | 4   | 2,3,4,5 | 3,4,5 |     |    |   |
| 11      |        |     |     |         | 2   | 4       |       |     |    |   |
| 13      |        |     |     | 1,2,3,4 |     | 3,4,5   |       |     |    |   |
| 18      |        |     |     |         |     | 4       | 3,4   |     |    |   |
| Gr      |        |     |     |         | 3,4 | 4       | 4     |     |    |   |
| Gr      |        |     |     | 1,2,4   |     | 3,4,5   | 4,5   |     |    |   |
| E2      |        |     |     |         | 3,4 | 3       | 3     |     |    |   |
| P1      |        |     |     | 1,2,3,4 |     | 3,4     | 4     |     |    |   |
| 12      |        |     |     | 1,2,3,4 |     | 4       | 4     |     |    |   |
| AP      |        | 3,4 |     |         | 3,4 | 3,4     | 3,4   |     |    |   |
| ES      |        |     |     |         |     | 3,4     | 3,4   |     |    |   |
| EP*     |        |     |     |         |     |         |       |     |    |   |
| Vt      |        |     |     |         | 3,4 | 3,4     | 4     |     |    |   |
| Cr      | 1,2,4  | 1   | 1   | 1,2,3,4 |     | 3,4     | 3,4,5 | 4   |    | 4 |
| TP      | 1      | 1   |     | 2,3,4   |     | 3,4     | 3,4,5 | 4   |    |   |

The treatments represented by the Roman numerals at the head of the column are considered to shell significantly less than those appearing in the column below. (The Arabic numerals are used in the columns for simplicity.)

For example in 1936: Anasim Parish (AP) shelled significantly less under treatments II and V than it did under III and IV. The treatments of 1936--were significantly different in only one case, group V shelled less than group IV.

Significant differences were computed from probable errors carried to one decimal place. For sake of brevity, no decimals are shown in Tables 15 and 16.

\*Early Prolific (EP) not planted in 1937.

#### 5. Per Cent of Good Beans.

The per cent of good beans, or that portion of the total yield which is classed as marketable, is given in Table 10, and the significant varietal differences are shown in Table 13. Jack was superior to seven varieties in 1926, and to six in 1927. Robust Selection (143) and Early Wonder 225 (22) are each superior to six varieties in 1926 and to three in 1927. Note that the Robust strains are substantiating the general opinion that they have a low pick. Both of the Mexican Tree strains are better than six other varieties in 1926 and better than one in 1927. Carter (3r) and 1200-1 (12) are superior to seven and six varieties, respectively, in 1926 but the difference between them and the other varieties is insignificant in 1927. The remaining varieties register inferiority in both years. 1000-1 (11) is the poorest in the test.

Tables 20 and 21 give the per cent of good beans under the harvest treatments of 1926 and 1927, respectively. In 1926, it was expected that the varieties taken as a whole would have a slightly smaller percentage of good beans in group II than in group I, but it was not thought that groups III, IV and V would be equal or superior, in percentage of good beans, to groups I and II. In general, the varieties responded individually in this manner. No explanation is offered.

In 1927 the varieties responded, individually and as a whole, as was expected. That is group I, which was stored immediately

after being pulled, had the highest percentage of good beans. Group II, which was piled on the ground in the field and thus exposed to some weathering, had a slightly lowered percentage of good beans. Groups III and IV were exposed to a great deal of weathering while piled on the ground, and had a very low percentage of good beans. Group V had been standing throughout the harvest period and picked more than groups I and II but not quite as much as groups III and IV.

Table 22 shows the significant varietal differences resulting from the varying field treatments. Note that in 1926 group IV, which was expected to be lowest in percentage of good beans, is significantly superior to group II in a majority of cases. In four varieties, groups III and V are also superior to group II. In contrast to 1926, the results of 1927 accord with expectations.



Table 10.

The means and probable errors for per cent of seed borne.

| Variety | -1926- |       | -1927- |       |
|---------|--------|-------|--------|-------|
|         | Mean   | P. E. | Mean   | P. E. |
| 10      | 72.1   | 0.7   | 64.2   | 0.6   |
| 15      | 80.5   | 0.6   | 74.4   | 2.0   |
| 16      | 81.5   | 0.7   | 73.3   | 2.4   |
| 23      | 80.5   | 0.6   | 77.2   | 2.0   |
| Gr      | 76.2   | 0.7   | 66.4   | 2.5   |
| Gr      | 66.2   | 0.6   | 69.4   | 2.4   |
| E2      | 79.7   | 0.6   | 76.1   | 1.6   |
| E1      | 75.8   | 0.6   | 65.0   | 2.7   |
| 12      | 80.0   | 0.6   | 70.6   | 2.5   |
| AP      | 75.9   | 0.7   | 68.5   | 2.5   |
| MS      | 77.5   | 0.5   | 68.5   | 2.4   |
| EP      | 78.6   | 0.6   |        |       |
| Vt      | 76.2   | 0.7   | 67.0   | 2.5   |
| Gr      | 66.6   | 0.7   | 77.3   | 0.7   |

Table 11.

The significance of the differences between variation on the basis  
of per cent mod bands with 1955 results above diagonal,  
and 1957 results below.

See Table 3 for key to symbols.

|    | Cr | Vt | EP* | ES | AP | 12 | Pl | EP | Cr | Cr | RS | HC | HS | 10 |
|----|----|----|-----|----|----|----|----|----|----|----|----|----|----|----|
| 10 | -S |    |     | -S |    | -S |    | -S | -S |    | -S | -S | -S |    |
| HS |    | S  | S   |    | S  |    | S  |    |    | S  |    |    |    |    |
| HS |    | S  | S   |    | S  |    | S  |    |    | S  |    |    |    |    |
| RS |    | S  | S   |    | S  |    | S  |    |    | S  |    |    |    | S  |
| Cr | -S |    |     |    |    | -S |    | -S | -S |    | -S |    |    |    |
| Cr |    | S  | S   | S  | S  |    | S  |    |    |    |    |    |    |    |
| EP |    | S  | S   |    | S  |    | S  |    |    | S  |    |    |    | S  |
| Pl | -S |    |     | -S |    | -S |    | -S |    |    | -S | -S | -S |    |
| 12 |    | S  | S   |    | S  |    |    |    |    |    |    |    |    |    |
| AP | -S |    |     |    |    |    |    |    |    |    |    |    |    |    |
| ES | -S |    |     |    |    |    |    |    |    |    |    |    |    |    |
| EP | -S |    |     |    |    |    |    |    |    |    |    |    |    |    |
| Vt | -S |    |     |    |    |    |    |    |    |    |    |    |    |    |
| Cr |    | S  |     | S  | S  |    | S  |    |    | S  |    |    |    | S  |

\*Early Prolific (EP) was not included in 1957.

Table 20.

The per cent of good berries under the different  
harvest treatments in 1933.

| Variety | I    |      | II   |      | III  |      | IV   |      | V    |      |
|---------|------|------|------|------|------|------|------|------|------|------|
|         | Mean | P.E. | Mean | P.E. | Mean | P.E. | Mean | P.E. | Mean | P.E. |
| 10      | 75   | 2    | 59   | 1    | 75   | 2    | 76   | 2    | 76   | 2    |
| 15      | 77   | 2    | 76   | 2    | 76   | 2    | 85   | 2    | 84   | 2    |
| 16      | 61   | 3    | 76   | 2    | 61   | 2    | 86   | 2    | 85   | 2    |
| 18      | 79   | 2    | 75   | 2    | 61   | 2    | 84   | 2    | 82   | 2    |
| Gr      | 76   | 2    | 76   | 2    | 75   | 2    | 76   | 2    | 76   | 2    |
| Gr      | 65   | 3    | 65   | 2    | 62   | 2    | 65   | 2    | 64   | 2    |
| 22      | 60   | 2    | 74   | 2    | 79   | 2    | 65   | 2    | 62   | 2    |
| 21      | 76   | 2    | 72   | 2    | 75   | 2    | 60   | 2    | 60   | 2    |
| 12      | 65   | 3    | 72   | 2    | 61   | 2    | 64   | 2    | 62   | 2    |
| AP      | 77   | 2    | 74   | 2    | 75   | 2    | 61   | 2    | 76   | 2    |
| ES      | 71   | 4    | 75   | 2    | 75   | 2    | 61   | 2    | 75   | 2    |
| MP      | 62   | 4    | 74   | 2    | 72   | 2    | 79   | 2    | 61   | 3    |
| Vt      | 69   | 2    | 70   | 1    | 77   | 2    | 79   | 2    | 60   | 2    |
| Gr      | 76   | 1    | 76   | 1    | 66   | 1    | 64   | 1    | 85   | 1    |
| TP      | 76   | 1    | 74   | 0    | 77   | 0    | 62   | 0    | 61   | 0    |

Probable errors were computed to one decimal place, but only the nearest whole numbers are indicated in the table.

Table 21.

The per cent of pod beans under the different  
harvest treatments in 1937.

| Variety | I    |      | II   |      | III  |      | IV   |      | V         |      |
|---------|------|------|------|------|------|------|------|------|-----------|------|
|         | Mean | P.E. | Mean | P.E. | Mean | P.E. | Mean | P.E. | Mean      | P.E. |
| Bo      | 91   | 3    | 91   | 3    | 53   | 3    | 80   | 2    | 59        | 3    |
| MS      | 93   | 3    | 94   | 5    | 63   | 4    | 81   | 3    | 76        | 4    |
| MS      | 93   | 3    | 93   | 5    | 65   | 4    | 46   | 3    | 73        | 4    |
| RS      | 94   | 3    | 94   | 5    | 72   | 4    | 52   | 3    | 79        | 4    |
| Gr      | 97   | 3    | 95   | 5    | 61   | 3    | 81   | 2    | 65        | 3    |
| Gr      | 93   | 3    | 93   | 5    | 61   | 3    | 86   | 2    | <b>73</b> | 4    |
| EB      | 93   | 3    | 93   | 5    | 70   | 4    | 55   | 3    | 73        | 4    |
| Fl      | 96   | 3    | 95   | 5    | 59   | 3    | 89   | 2    | 63        | 4    |
| LB      | 95   | 3    | 94   | 5    | 61   | 3    | 44   | 2    | 73        | 4    |
| AP      | 96   | 3    | 93   | 5    | 59   | 3    | 89   | 2    | 63        | 4    |
| ES      | 93   | 3    | 92   | 5    | 59   | 3    | 46   | 2    | 63        | 4    |
| Vt      | 95   | 3    | 93   | 5    | 55   | 3    | 42   | 2    | 63        | 4    |
| Gr      | 97   | 4    | 96   | 2    | 65   | 2    | 59   | 2    | 63        | 2    |
| TP      | 93   | 2    | 93   | 1    | 61   | 1    | 43   | 1    | 70        | 1    |

Probable errors were computed to one decimal place, but only the nearest whole numbers are indicated in the table.

Table 22.

Significant varietal differences between the field treatments,  
as reflected in the per cent of good beans.

| Variety | -1933- |    |     |       |       | -1937- |       |     |    |     |
|---------|--------|----|-----|-------|-------|--------|-------|-----|----|-----|
|         | I      | II | III | IV    | V     | I      | II    | III | IV | V   |
| 10      | 2      |    | 2   | 2     | 2     | 3,4,5  | 3,4,5 | 4   |    | 4   |
| M5      |        |    |     |       |       | 3,4    | 3,4   |     |    | 4   |
| M6      |        |    |     | 2     |       | 3,4    | 3,4   | 4   |    | 4   |
| R3      |        |    |     | 2     |       | 4      | 3,4   | 4   |    | 4   |
| Gr      |        |    |     |       |       | 3,4,5  | 3,4,5 | 4   |    | 4   |
| Gr      |        |    |     |       |       | 3,4    | 3,4   | 4   |    | 4   |
| E2      |        |    |     | 2     |       | 4      | 3,4   |     |    | 4   |
| F1      |        |    |     | 2     |       | 3,4,5  | 3,4,5 | 4   |    | 4   |
| 12      | 2      |    | 2   | 2     | 2     | 3,4    | 3,4,5 | 4   |    | 4   |
| AP      |        |    |     |       |       | 3,4,5  | 3,4,5 | 4   |    | 4   |
| E3      |        |    |     |       |       | 3,4    | 3,4,5 | 4   |    | 4   |
| MP      |        |    |     |       |       |        |       |     |    |     |
| Vt      |        |    | 2   | 2     | 2     | 3,4    | 3,4,5 | 4   |    | 4   |
| Gr      |        |    | 2   | 2,3   | 2     | 3,4    | 3,4,5 |     |    | 3,4 |
| TP      | 2      |    |     | 1,2,3 | 1,2,3 | 3,4,5  | 3,4,5 | 4   |    | 3,4 |

The significance of differences was computed from probable errors carried to one decimal place. For the sake of brevity, no decimals are given in Tables 20 and 21.

### B. Relationships.

In the introduction it was stated that the purpose of this experiment was to study the influence that stand, weight of vine, shelling and pick have upon the yield of white pea beans. The yields of 1926 reflect that as a whole the season was about normal but unfortunately in 1927 the lack of moisture during the growing season and an excessive amount during the harvest period affected to a great degree all of the factors influencing the yields of that year.

It is generally acknowledged that, if  $r^2$  is less than 0.35, the correlation is insignificant. The formula  $10Cr^2_{xy}$  is used as a measure of the degree that the dependent variable  $y$  is influenced by the independent variable  $x$ .

#### 1. Stand to Yield.

The correlation coefficients between stand and yield are given in Table 23. Considered individually the coefficients are not of high value, indicating that some of the varieties are capable of balancing a thin stand by producing more vine growth, which of course makes possible a greater average yield per vine. When the coefficients are considered as a whole they indicate a slight positive correlation.

The coefficients of Early Prolific (EP) and Vermont (Vt), in 1926, are such that, when they are squared, it shows that the

yield of these two varieties are influenced by stand to the extent of 20 and 27 per cent, respectively. In Early Wonder 300 (25) and 1800-1 (18) the yield is influenced by stand only slightly more than ten per cent.

In 1927, only 12 per cent of the variability of yield in 1800-1 is accounted for by the stand. In none of the other varieties is the influence of stand on yield quite so great. However, in general, those varieties whose yields are influenced the most by stand in 1926 are the varieties which have the higher coefficients in 1927.

Gunter (3r) and Early Wonder 300 (25) have a negative correlation coefficient in 1927. This would tend to show that the fewer the plants the greater the yield or the higher the average yield per plant. Only two of the varieties averaged less per plant and some averaged almost one-third more than did Gunter. The negative coefficient may be due to the fact that on the correlation surface of stand to yield for Gunter a few scattered individuals are so located as to make a negative correlation out of what might have been a low positive one.

Table 25.

Correlation coefficients between stam and yield.

| Variety | -1926-   |             | -1927-   |             |
|---------|----------|-------------|----------|-------------|
|         | <u>r</u> | <u>P.E.</u> | <u>r</u> | <u>P.E.</u> |
| 10      | .113     | .179        | .031     | .112        |
| 15      | .210     | .019        | .148     | .110        |
| 16      | .239     | .110        | .213     | .103        |
| 18      | .105     | .113        | .177     | .113        |
| Gr      | .020     | .104        | .197     | .102        |
| Gr      | .139     | .110        | -.013    | .108        |
| E2      | .009     | .120        | .000     | .111        |
| 11      | .043     | .130        | .051     | .135        |
| 12      | .055     | .130        | .017     | .099        |
| AP      | .205     | .115        | .173     | .109        |
| 13      | .097     | .113        | -.137    | .103        |
| EP      | .504     | .114        |          |             |
| Vt      | .521     | .004        | .035     | .135        |
| Gr      | .171     | .055        | .131     | .034        |
| 12      | .080     | .041        | .167     | .002        |



## 2. Stand to Weight of Vine.

Taken as a whole the correlations on stand to weight of vine do not indicate a very strong relationship, Table 21. Two of the varieties, Mexican Tree '05 (M5) and Greiner (Gr) have fairly strong positive coefficients in both 1926 and 1927. In 1926 alone, Mexican Tree '06 (M6), Early Wonder 803 (E8), Early Prolific (EP) and Vermont (Vt) have stronger correlations between stand and weight of vine than do the two varieties mentioned above but this group of four have very weak positive coefficients in 1927. In general, all of the other varieties of this test have exceptionally low coefficients. In 1927, Fliter (Fl) has a negative correlation which is so low as to be insignificant. The coefficients in Table 21 indicate that the varieties are able to compensate, within limits, for smaller stands by producing larger average vines.

Table 24.

Correlation coefficients between stalk and weight of vine.

| Variety | -1926-   |             | -1927-   |             |
|---------|----------|-------------|----------|-------------|
|         | <u>r</u> | <u>L.M.</u> | <u>r</u> | <u>P.M.</u> |
| 10      | .230     | .110        | .036     | .079        |
| M5      | .340     | .102        | .410     | .093        |
| 103     | .379     | .099        | .017     | .133        |
| RS      | .096     | .105        | .157     | .110        |
| Gr      | .206     | .038        | .334     | .120        |
| Gr      | .019     | .107        | .103     | .106        |
| M2      | .011     | .116        | .039     | .133        |
| H1      | .154     | .113        | -.035    | .133        |
| 12      | .200     | .111        | .240     | .102        |
| AP      | .033     | .116        | .331     | .102        |
| ES      | .200     | .142        | .076     | .133        |
| MP      | .032     | .099        |          |             |
| Vt      | .265     | .031        | .041     | .133        |
| Gr      | .130     | .035        | .207     | .032        |
| TP      | .102     | .033        | .327     | .033        |

### C. Stand to Shelling.

The correlation coefficients for stand with shelling are shown in Table 23. These are all positive with two exceptions which appear in 1936. The highest correlation for either year is for Greiner (Gr) in 1937 and an examination of the scatter diagram shows that the greater value was due to a few entries with large deviations. The average of the 1936 varietal coefficients is .136 and compares with the varietal average for 1937 of .160. The discrepancies between these averages and the total population (Tt) values are in large part due to placement effect of a few varieties on the combined surface. Practically all of the correlations are quite small; yet the fact that they are nearly all positive indicates a tendency for the plots with heavier stands to give higher shelling counts.

Table 25.

Correlation coefficients of seed to seedling.

| Variety | -1926-   |             | -1927-   |             |
|---------|----------|-------------|----------|-------------|
|         | <u>r</u> | <u>P.D.</u> | <u>r</u> | <u>P.D.</u> |
| 10      | .227     | .122        | .273     | .112        |
| 15      | .129     | .114        | .081     | .112        |
| 18      | .270     | .107        | .236     | .112        |
| 23      | .133     | .112        | .130     | .110        |
| Gr      | -.008    | .135        | .302     | .001        |
| Gr      | .213     | .110        | .081     | .112        |
| 22      | .206     | .108        | .019     | .112        |
| 11      | .041     | .135        | .137     | .110        |
| 12      | .277     | .107        | .313     | .039        |
| AP      | .035     | .135        | .203     | .103        |
| 25      | .210     | .119        | .211     | .107        |
| MP      | -.031    | .133        |          |             |
| Vt      | .113     | .114        | .134     | .103        |
| Gr      | .077     | .135        | .103     | .051        |
| MP      | .215     | .037        | .093     | .023        |

#### 4. Weight of Vine to Yield.

The correlations between weight of vine and yield, as shown in Table 26, are strong, positive ones. There is a greater average degree of relationship in 1926 than in 1927. The total population of 1926 shows a correlation of 0.61 which means that the yield is influenced by the weight of vine to the extent of 37 per cent. The same year Vermont (Vt) reaches a high point of 71 per cent, and there are three others, Center (Cr), Mexican Tree '05 (LS) and Early Prolific (LP) whose yield is influenced by stem to as high a degree as 50 per cent.

In 1927 the weight of vine influences the yield of the total population by 25 per cent. The yield of Early Wonder 240 (ES) is influenced by weight of vine by more than 50 per cent. Most of the other varieties are influenced in degrees ranging from 25 to 50 per cent.

In general there is a tendency for the varieties with high coefficients in 1926 to be the high ones in 1927. The same trend is true with regard to the varieties with low coefficients.

Table 26.

Correlation coefficients of weight of vines to yield.

| Variety | -1926-   |             | -1927-   |             |
|---------|----------|-------------|----------|-------------|
|         | <u>r</u> | <u>P.E.</u> | <u>r</u> | <u>P.E.</u> |
| 10      | .355     | .031        | .351     | .073        |
| 15      | .735     | .015        | .359     | .037        |
| 16      | .355     | .101        | .527     | .031        |
| 18      | .392     | .030        | .377     | .073        |
| Cr      | .297     | .035        | .225     | .010        |
| Cr      | .397     | .032        | .232     | .035        |
| 12      | .320     | .011        | .715     | .035        |
| 11      | .527     | .035        | .290     | .037        |
| 13      | .335     | .030        | .339     | .030        |
| AP      | .377     | .077        | .313     | .070        |
| 14      | .701     | .035        | .373     | .017        |
| MP      | .725     | .035        |          |             |
| 7t      | .331     | .030        | .302     | .031        |
| 3t      | .301     | .042        | .321     | .031        |
| TT      | .309     | .013        | .293     | .021        |

### 5. Weight of Vine to Shelling.

Table 27 shows that there are varietal coefficients which indicate a relationship between large vines and a small amount of shelling. In 1926 the strongest negative relationship is exhibited in Alaska Parish (AP) and lesser degrees of similar relationship are found in Fliter (Fl), 1000-1 (10) and Vermont (Vt). Early Wonder 583 (ES) and 1300-1 (12) had positive coefficients, signifying that a large vine permitted more shelling, but these same varieties had small negative coefficients in 1927. The latter is a trend in the expected and desired direction.

Every variety with the exception of Greiner (Gr) which had a small negative coefficient in 1926 had a much larger negative one in 1927, and five of the six varieties which had positive correlations in 1926 had negative coefficients in 1927.

Table 27.

Correlation coefficients of weight of vine to shelling.

| Variety | -1926-   |             | -1927-   |             |
|---------|----------|-------------|----------|-------------|
|         | <u>r</u> | <u>P.E.</u> | <u>r</u> | <u>P.E.</u> |
| 10      | -.141    | .118        | -.307    | .096        |
| 15      | .216     | .110        | .081     | .112        |
| 16      | -.019    | .125        | -.204    | .100        |
| 18      | .046     | .125        | -.103    | .094        |
| Gr      | -.071    | .115        | .150     | .111        |
| Gr      | .239     | .109        | -.016    | .112        |
| 12      | -.085    | .116        | -.085    | .096        |
| Fl      | -.207    | .111        | -.336    | .101        |
| 12      | .315     | .104        | -.112    | .111        |
| AP      | -.330    | .107        | -.404    | .094        |
| 13      | .097     | .142        | -.089    | .112        |
| 17      | .014     | .136        |          |             |
| Vt      | -.116    | .114        | -.334    | .096        |
| CK      | .027     | .056        | -.121    | .094        |
| TP      | .019     | .029        | .016     | .026        |



### C. Weight of Vine to Per Cent of Good Beans.

Table 26 shows the varietal relationships between the weight of vine and the per cent of good beans. Attention is called to the fact that in 1926 all but one of the varieties have a negative coefficient. This one exception, Early Prolific (EP) has a coefficient too small to be of significance. The writer will not attempt to explain the reason for this pronounced negative trend.

The 1927 coefficients, which are quite strong positive ones, indicate that there is an association between a large vine and a high per cent of marketable beans. Early Wonder 225 (E2) and Vermont (Vt) have the highest coefficients. Neither the weight of vine nor the yield of these two varieties were very high but the ratio of weight of vine to yield was such as to maintain a high percentage of marketable beans.

Table 20.

Correlation coefficients of weight of vine to  
per cent of wood barks.

| Variety | -1926-   |             | -1927-   |             |
|---------|----------|-------------|----------|-------------|
|         | <u>r</u> | <u>P.C.</u> | <u>r</u> | <u>P.C.</u> |
| 10      | -.202    | .100        | .202     | .104        |
| 15      | -.276    | .099        | .311     | .093        |
| 16      | -.276    | .099        | .207     | .155        |
| 18      | -.525    | .072        | .216     | .090        |
| Gr      | -.300    | .094        | -.002    | .135        |
| Cr      | -.254    | .100        | .114     | .111        |
| 12      | -.523    | .093        | .303     | .072        |
| 11      | -.400    | .096        | .252     | .105        |
| 12      | -.576    | .077        | .302     | .096        |
| AP      | -.502    | .105        | .354     | .100        |
| 13      | -.126    | .166        | .166     | .100        |
| EP      | .093     | .153        |          |             |
| Vt      | -.156    | .114        | .514     | .079        |
| CR      | -.300    | .092        | .341     | .043        |
| 1P      | -.267    | .047        | .276     | .093        |

## 7. Shelling to Yield.

The correlation coefficients for shelling with yield, as shown in Table 29, are quite small with two exceptions which appear in 1926. All but one of the varieties have positive correlations in 1926 and all but three are negative in 1927. The size of the correlations of Mexican Tree '05 (10) and 1000-1 (12) in 1926 indicates that the plots of these varieties having the greatest number of beans available shelled the most. However, the small size of the coefficients for the total population (TF) indicates but slight relationship between yield and shelling percentages.

It will be remembered that Mexican Tree '05 (10), 1000-1 (10) and Center (Cr) had excessive shelling in 1927. It is here seen that this excessive shelling is practically unrelated to yield. A possible explanation for the negative correlations may be that the plots with the higher yields also tended to have larger vines than the average but, as the vines were not overloaded with pods, the stems tended to protect the pods from ground moisture and from handling when turned.

Table 39.

Correlation coefficients of shelling to yield.

| Variety | -1926-   |             | -1927-   |             |
|---------|----------|-------------|----------|-------------|
|         | <u>r</u> | <u>P.M.</u> | <u>r</u> | <u>P.M.</u> |
| 10      | .210     | .107        | .102     | .104        |
| 15      | .185     | .089        | -.073    | .112        |
| 16      | .223     | .079        | .007     | .011        |
| 18      | .220     | .105        | -.001    | .112        |
| Gr      | .110     | .111        | -.003    | .112        |
| Gr      | .005     | .000        | -.135    | .100        |
| E2      | .003     | .112        | -.101    | .101        |
| F1      | -.001    | .110        | -.100    | .111        |
| 12      | .100     | .000        | -.005    | .112        |
| AP      | .209     | .105        | -.200    | .103        |
| EU      | .102     | .101        | .100     | .100        |
| EP      | .001     | .100        |          |             |
| Vt      | .009     | .111        | -.107    | .100        |
| Gr      | .111     | .000        | -.001    | .001        |
| TP      | .209     | .027        | -.104    | .027        |

### 8. Per Cent of Good Beans to Yield.

The correlations on per cent of good beans to yield, as shown in Table 50, are nearly all negative in 1926 and all positive in 1927. The negative relationships in 1926 are possibly due to the facts that the yields were high and so more pods could be in contact with the ground during the growing season and that the weather conditions were such that harvesting was delayed until after the middle of October, whereas the normal harvesting period is around the first week in September.

Although the total population coefficient for 1927 is larger in magnitude than that of the year before, it is seen that only in six varieties were per cent of good beans and yield more strongly related in 1927, than in 1926. Also, the magnitude of relationship was quite different in only three varieties: Mexican Tree '65 (MC), Grainer (Gr) and Vermont (Vt). The positive relationships in the second year might be due to the fact that the harvest season was about the normal time and that there was a larger ratio of vine to beans in 1927 than in 1926 and, so, the beans were kept up off the ground better the second year even though the rainfall during harvest was much heavier and the beans in groups II, III, and IV were turned more times.

Table 66.

Correlation coefficients of per cent of seed borne to yield.

| Variety | -1933-   |             | -1937-   |             |
|---------|----------|-------------|----------|-------------|
|         | <u>r</u> | <u>P.E.</u> | <u>r</u> | <u>P.E.</u> |
| 10      | -.533    | .100        | .500     | .084        |
| 15      | -.172    | .113        | .531     | .088        |
| 18      | -.235    | .103        | .101     | .108        |
| 23      | -.431    | .092        | .327     | .102        |
| Gr      | -.371    | .097        | .078     | .117        |
| Gr      | -.294    | .105        | .147     | .110        |
| 22      | -.371    | .078        | .367     | .047        |
| 11      | -.434    | .093        | .442     | .060        |
| 12      | -.503    | .081        | .353     | .070        |
| AP      | -.204    | .100        | .532     | .013        |
| 25      | .030     | .139        | .295     | .103        |
| 2P      | -.103    | .157        |          |             |
| Vt      | -.103    | .111        | .536     | .073        |
| Ch      | -.507    | .046        | .233     | .051        |
| 4P      | -.171    | .037        | .346     | .024        |

## VI. SUMMARY

This experiment was designed to study the influence of stand, weight of vine, shelling and pick on variety yields. In addition to these, four other relationships were studied: stand with weight of vine and shelling, and weight of vine with shelling and percent of good beans.

Fourteen representative varieties were used in 1926 and thirteen in 1927.

Robust was the highest yielding of the varieties in this experiment and was followed closely by Robust Selection and Early Wonder 225.

Mexican Tree '05 had the largest vines for the two-year period.

Robust and Robust Selection had the highest stands for the two-year period.

The weather was more favorable for the expression of the character of high shelling in 1927 than in 1926. Mexican Tree '05 shelled about one-third more than any of the other varieties in 1927. Its sister strain, Mexican Tree '06, was among the four varieties having the lowest percentage of shelling in both years.

The Robust strains stand above all of the varieties in percentage of good beans, emphasizing the general belief that Robust is able to stand bad weather during harvest better than most varieties.

The yields were observed to be higher on one end of the field than on the other each year, indicating that soil variations tended to parallel harvesting treatments.

The coefficients of correlation between stand and yield and also between stand and weight of vine are small thus indicating that the varieties are able to compensate, within limits, for smaller stands by producing larger vines, and larger yields per vine.

There is but slight relationship between stand and shelling.

The varieties, individually and as a whole, have a strong positive correlation between weight of vine and yield.

The coefficients of correlation between weight of vine and shelling are not strong.

The coefficients of correlation between weight of vine and percent of good beans are negative in 1926 and positive in 1927. This discrepancy is hard to explain when such varieties as Mexican Tree '05 and '06, two large vined beans, stood among the five varieties having the largest percentage of good beans for the two years.

There was practically no relationship between shelling and yield, even in the high shelling varieties such as Mexican Tree '05, 1000-1 and Cantor. The generally positive correlations in 1926 indicate that when vines are well podded shelling increases with yield. The generally negative correlations in 1927 indicate that when the vines are large and not well podded they inhibit shelling.

The relationship of per cent of good beans with yield was



found to be, on the average, slightly larger than that of shelling with yield but, even so, not very great.

## VII - CONCLUSIONS

It was found that soil and climatic variations affected the yields so greatly that it is hard to draw definite conclusions from just two years data.

If weather conditions are such that the beans can not be pulled and stored when first mature, less shelling and weathering will result, if the beans are left standing until good weather permits their being stored immediately after pulling, then if they are pulled, left on the ground, and turned several times.

It was found that the differences in stand had practically no effect on weight of vine, shelling, or percent of good beans.

Of the four factors studied in their relation to yield it is found that, within limits, stand had but little effect on yield and this effect was about the same both years; that shelling and percent of good beans had even less influence than stand and the manner of the association, whether positive or negative, was not due alone to yield differences; and that the size of vine, as determined by its weight, has the most effect, but this effect may be overshadowed by soil and weather.

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