

FACTORS WHICH INFLUENCE
THE PICK OF FIELD BEANS

THESIS FOR THE DEGREE OF M. S.

EDWARD J. GRAMBAU
1933

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Beans

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

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and Applied Science

Edward J. Granbau

1933

THESIS

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I INTRODUCTION

Tracy (25) The American Indians were growing beans at the time Columbus discovered America. Botanists are agreed in that the three varieties, Phaseolus vulgaris, P. coccineus and P. lunatus are native to our country. Since the discovery of America, bean production has gradually increased. The earliest plantings by white folks were made from foreign stock, namely, broad beans. These beans were not adaptable to our country.

As a vegetable our common bean (Phaseolus vulgaris) ranks next to the potato in importance in the United States. In Michigan the white pea bean is the specialty. As reported in the Michigan Annual Crop Report (5) for 1931 there were 543,000 acres of white pea beans with a total production of 5,030,000 bushels. Large whites, light red kidneys, dark red kidneys and other varieties together had an acreage of only 63,000 acres and a total production of 463,000 bushels. In the United States for 1931 (Year Book of Agriculture 1932), 6,913,000 bushels of white pea beans were produced. This credits Michigan with producing over 75% of the white pea bean crop of the United States. There are more than twice as many white pea beans produced as any other class. Other classes produced that have a regular market are given in order of importance:

Great Northern, Limas, Pinto, Red Kidney, Pinks, Red Mexican, Large White, Yellow Eye, Cranberry, and White Kidneys. Other states that produce a considerable quantity of white pea beans are California, New York, Idaho, and Wisconsin.

The average yearly value of the dry bean crop for Michigan from 1921 to 1930 inclusive was 17,036,000 dollars. The average price per bushel for the same period was 3.14 dollars.

1. The Meaning of Pick

Beans are easily damaged by various agencies causing what is called by the bean trade "pick." Often as beans are brought to the elevator they are not uniform in quality. The beans may contain discolored, shrunken, broken, frosted, wet or misshaped seeds together with little stones, bits of dirt, sticks, and other foreign material. No elevator man desires to pay for this waste so he picks or docks them according to condition. Beans that come to the elevator in such condition that no pick is necessary is said to be a quality crop. It is with the idea in mind of lessening this pick and producing a better quality crop and taking out some of the gamble in producing beans that the writer has undertaken a study of field damage in beans and its causes.

The pick may not be a total loss for cull beans

are utilized as food for stock. Oftimes a farmer is not equipped nor has he the time to pick his own beans. If this is the case the beans are taken to the elevator and processed. The farmer is docked for pick and does not even get his cull beans back. This represents quite a loss to the farmer. Not to have any pick is ideal but a goal one can hardly expect to reach as a general rule. For this reason it is desirable that the per cent of pick be kept to a minimum. Since there is such a great variation in the per cent of pick from year to year a study has been made by the writer to determine some of the causes that produce so much damage to the bean crop.

The method used by elevator men to determine pick is as follows: After the load has been screened to remove straw, sticks, stones, or weeds, a pound of beans is taken and the unmarketable beans and foreign material removed and weighed. The ratio of these cull beans to the pound sample is found and the per cent figured. If the pick of a pound sample is one ounce, the pick would be designated by the ratio 1:16 or $6\frac{1}{4}\%$ or $6\frac{1}{4}$ pounds pick meaning $6\frac{1}{4}$ pounds per hundred. The accompanying graph shows the variation in pick in this state for the years 1919 to 1932 inclusive. Dr. Hedrick (11) reports that there is a great range in pick in different purchases by elevators. In the season 1928-29 four

neighboring elevators reported:

31.5% of all purchases without pick
14.4% of all purchases with 1% pick
13.2% of all purchases with 2% pick
12.4% of all purchases with 3% pick
10.5% of all purchases with 4% pick
7.5% of all purchases with 5% pick
4.1% of all purchases with 6% pick
2.8% of all purchases with 7% pick
2.8% of all purchases with 8% pick
.25% of all purchases with over 40% pick

The farmer is charged for removing the culls and also looses the culls.

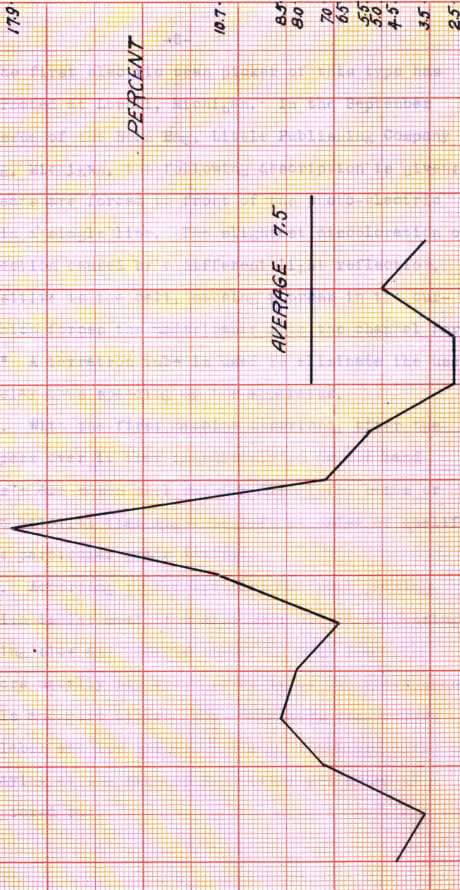
2. Partial Recovery Methods

a. As ordinary dry beans come into the elevator they are not ready for shipment until they are processed. They are first put through a cleaning mill. If there is very much dirt present they may be put through the mill several times. Many beans need no further treatment but others go directly to the machine pickers of which there are several types. Two of these types will be described briefly. Paired rubber rolls about two inches in diameter and two feet long are arranged so they slope to the outside from a common center much like the spokes from the hub of a wheel placed in a horizontal position. The unclean beans are fed to the

rolls at the center or hub. The clean smooth beans keep right on going until they drop off at the outer end of the roll. Dirt, many discolored beans, pebbles, and broken beans are caught between the moving rolls and pass through underneath the machine. This machine does not do an absolutely clean job, but helps considerably in lessening the labor of handpicking.

b. A machine known as the "Electric Eye" Bean Picker designed by Hammerslag and Tinkham in association with the General Electric Company is the latest in bean sorting machinery. Mr. Hugo B. Hammerslag, bean broker, reports that this new development will be of extreme value to the canning industry. He writes that the best possible grade of beans available for the canning industry today contain $1\frac{1}{2}\%$ discolored beans and foreign material. These beans are sorted by hand and it is impossible to secure a better pick by this method. Therefore, when these beans are purchased by the canners it is necessary for them to pick out this $1\frac{1}{2}\%$ of objectionable beans and foreign material and even then there is a definite opportunity for error. He says, "We are now in a position to offer the canning trade a grade of beans that is absolutely free from any objectionable beans or foreign material, eliminating the necessity of resorting at the cannery."

Fig. 1
GRAPH SHOWING PERCENT PICK
OF BEANS 1919 TO 1932



1919 20 21 22 23 24 25 26 27 28 29 30 31 32

Crop Report for Michigan (5)

20
 19
 18
 17
 16
 15
 14
 13
 12
 11
 10
 9
 8
 7
 6
 5
 4
 3
 2
 1

Figure 1

The first electric bean picker of this type has been erected at Lowell, Michigan. In the September 1931 issue of the Bean Bag, Little Publishing Company Lansing, Michigan, the following description is given: "The beans are forced in front of the photo-electric cells in a single line. The slightest discoloration or imperfection caused by a different light reflection, so sensitive is the cell, causing a break in the current which forces the undesirable into the channel for culls." A thyratron tube is used to eliminate the use of a relay thus speeding up the apparatus.

c. With the first machine described, after the beans pass over it they immediately go to the hand pickers where women pick out any discolored beans or foreign material that might be left in order to qualify for the particular grade desired.

d. According to Hedrick (11) the hand picking operation is the most expensive part of the processing requiring slow and tedious labor, if well done. Elevators usually pay women seven cents for every pound of culls and dirt picked out. Recently, due to much cheap labor and low prices of beans, elevators have been paying at the rate of five cents per pound of culls picked out.

II REVIEW OF LITERATURE

A. Disease

Spragg and Down (21) Disease in beans not only affects the yield but also the quality of the product. It is a crop very sensitive to its surroundings. A brief description of bacterial blight, anthracnose and mosaic and a few other diseases or molds as they affect the bean seed follow.

1. Bacterial blight. Phytophthora phaseoli.

Bacterial blight of beans as reported by Plant Disease Reporter (23) is universal wherever beans are grown. Michigan records losses from 10 to 15 per cent in the year 1925, 3 per cent in 1927, and 5 per cent in 1930.

According to Zaunmeyer (23) The disease affects the bean seed through discoloration and cessation of growth. Seed beans that are affected by the organism may appear brown or yellow in color or may even rot away. Bean blight affects the vascular system of the bean plant partially or wholly, causing many seeds to be uneven in size. Burkholder (2) Newly formed seeds may not grow at all or remain small and shriveled. Older seeds may become colored brown and somewhat shriveled. Muncie (13) In case of a blight attack on the seed, light yellow blotches without definite margins are produced. Zaunmeyer (23) In some cases the disease

cannot be detected at all in the seed, yet the disease be present within its tissues. If the infection is severe the discoloration may be deep and the germination injured. Muncie (16) Under normal conditions one half of the pick is made up of diseased beans. Thirty per cent of this half is caused by bacterial blight.

2. Bean anthracnose--Colletotrichum lindemuthianum.

This disease is caused by a parasitic fungus plant. During some years it is difficult even to secure specimens while in others 100 per cent of a field may be affected. From the Plant Disease Reporter very little damage by anthracnose was reported for the United States for the years 1929 and 1930. In the year 1928 Michigan's loss was 1.5% of the total crop (93,000 bu.) and for the United States 1.8% or 209,000 bushels. The damage that results from this disease varies considerably. It depends upon the conditions that influence the spread of the causal organism. In the years when the disease is severe the damage to the bean is due to the following factors:

1. Poor germination of seed
2. Destruction of affected seedlings
3. Injury to the seed.

Muncie (16) If infected seed is planted many vacant places appear in the row. Either the seed rots before germination or the young seedlings decay at the surface of the ground. This disease may also affect older growing plants and may spread from plant to plant by spores. After the mycelium has worked its way through the tissues of the bean pod, the seed beans themselves become affected. In case of young pods the seeds may not even form. Barrus (1) In older pods the seeds may become discolored. The discolored spots usually appear black with a brown or tan colored border or, if entirely diseased, it may be of the latter color. Muncie (16) In years when the disease is prevalent about 70% of the 50% due to pick in beans is caused by bean anthracnose.

3. Other Diseases

Mosaic, brown rot, dry root rot, Rhizoctonose cephalothecum roseum may affect the bean seed directly or indirectly. Nelson (17) says about mosaic: "Associated with excessive branching is the delayed maturity that results from over stimulation of vegetative activity. Diseased plants are still green in the fall after mosaic-free plants have ceased vegetative activity and ripened their seeds." This delayed ripening may cause further damage through adverse weather conditions. The damage that results from too

much moisture may be caused by several mold producing fungi. These may cause the seed to become discolored or rotten.

Little information concerning the causal organisms for ordinary field damage of beans due to adverse weather conditions has been found. Muncie (16) reports an increase in pick from anthracnose of beans for years when there is a greater precipitation, less sunshine, and more rainy days for the growing months of June, July, and August.

B. Insect Pests

There are a few insects that may attack the bean or bean plant; among these are the bean weevils, bean maggots, Mexican bean beetles, and a specie of a bug called Adelphocorus rapidus. All of these insects except the Mexican bean beetle and bean maggots attack the seed and may cause more or less damage.

1. The Bean Weevil

Pettit (19) The bean weevil, Mylabris obtectus is a beetle that may live over winter in stored beans. In the spring it flies to young bean plants and feeds off them until the new pods are formed. At this time the eggs are laid in the pod and the new grubs enter the young seeds. In time the grubs develop into adult beetles and are ready to start another generation immediately unless protective measures are taken. They

continue this until the beans are all used up or a mere shell left.

2. The Bean Maggot

Pettit (19) The bean maggot is the larva stage of a kind of fly called Hylemyia cilicrura. It passes the winter in the maggot stage in the roots of clover plants and in fresh manure. In the spring it goes directly to the newly sprouted beans. If the conditions are right for the maggot, severe damage may be done to the newly planted crop. Some of the sprouted beans are killed and others stunted in growth. This causes the crop to ripen unevenly and the new beans to vary much in size.

3. Dimple blemish of Beans

A "bug" called Adelphocorus rapidus was discovered by Dr. I. M. Hawley of Cornell University to cause the characteristic dimple beans. The insect injures the pods while they are green. The beans within the pod grow some after the injury, producing a sort of ragged depression.

4. The Mexican Bean Beetle.

The Mexican bean-beetle has been in this state only a comparatively short time. It is a beetle belonging to the ladybird group. The adult beetle has sixteen irregular black spots on its back. These are arranged in three rows across the back. The writer

discovered some at work on the Michigan State College experimental bean plots just south and east of the Veterinary Clinic. The larvae and adults both eat the under side of the leaves. The damage done to the bean plant is to stunt it in growth thereby producing many small uneven beans.

C. Varietal Variations

1. Disease Resistance

Pettigrove and Oviatt (13) There are a few varieties of beans that are more or less resistant to disease. The Robust bean, the most outstanding variety of the white navy bean, was developed by the late Professor Spragg at Michigan State College. It was selected from a commercial lot of pea beans. Besides being resistant to blight, anthracnose and mosaic, it withstands the summer heat well. It has proved its high yielding characteristics in competition with many varieties of white pea beans. Spragg and Down (21) Its leaf development remains profuse until a few days before harvest when most all leaves turn yellow and drop off. This allows for hurried ripening of the variety. Its freedom from mosaic aids in the setting of pods. More pods will be set at the same time and the plants will not take on that "green" appearance near harvest time. That is, only a short time will be necessary to dry the vines and shorten the period of risk during adverse

weather.

Gloyer (9) In New York, Wells Red Kidney, Geneva and York varieties of red kidney beans were developed. Reddick (20) found Wells Red Kidneys and White Imperial to be practically immune to alpha and beta races of anthracnose but Burkholder (2) found strain gamma would affect both varieties. Gloyer (9) developed the two varieties Geneva and York from a cross of white and red kidney beans. These varieties were not only selected for disease resistance, but also for yield, cooking quality, quality of seed coat, behavior under various weather and soil conditions, color, soak, and taste.

2. Pick to Weight of Vine

Thompson (24) in his thesis for the degree of Master of Science (1930), Michigan State College, states that in years with average rainfall during harvest, the varieties with large vines will have less pick. The smaller and weaker vines lie closer to the ground where they may be discolored by moisture and molds. Robust and Mexican Tree were large vined varieties and Pliter, Greiner, and Vermont, small vined with the highest pick.

D. Soil Conditions

1. Drainage

Pettigrove and Oviatt (13) Beans grown on well drained fields grow better, yield better, ripen better

and the plants and beans are less subject to water injury.

2. Fertility

Gloyer (9) at Geneva, New York, found that soils with higher fertility produced better beans, less subject to bean blight. As previously stated, Thompson (24) discovered that beans with larger vines produced less pick than smaller vined varieties. He obtained larger vines by the application of 500 pounds of 4-16-4 fertilizer per acre. Pettigrove and Oviatt (18) A balanced plant food made up of wisely chosen commercial fertilizer with green or barnyard manure will hasten maturity, promote uniformity of ripening and increase the yield per acre. Care must be exercised in applying commercial fertilizer as it may injure the germination of the seed if it gets in contact with it.

E. Climatic Conditions

Harter (10) Temperature may affect the beans directly or indirectly. Due to high temperature the ripening process may be started too soon, causing the bean pods to shrink and tighten about the seed causing difficulty at threshing; viz. splitting of the bean seed. Low temperature and plenty of moisture causes bean anthracnose to become more severe. Zaunmeyer (28) High temperature with rain, hail, dew, old bean straw, surface drainage, insects and irrigation all are con-

ducive to the spread and success of blight in a bean field.

F. Planting and Cultivating

Pettigrove and Oviatt (18) Under Michigan conditions beans should be planted between May 28th and June 8th. At this time moisture and temperature are usually right for best germination. If the beans grow and develop steadily the crop should mature uniformly and be ready for harvest early in September. To decrease the damage by disease, clean seed from disease-free stock should be used. Plant at the minimum depth in order to avoid damage by the bean maggot, yet have enough coverage to secure sufficient moisture for germination.

Muncie (16) Beans should not be cultivated while the field is wet with dew or rain, as this helps to spread blight and anthracnose.

G. Harvesting

There are several good bean harvesters made. The writer is indebted to the following manufacturers for description and best operation of bean harvesting machinery: Donaldson Brothers, Mount Clemens, Michigan; Lehr Company, Fremont, Ohio; Wiard Plow Company, Batavia, New York; Caledonia Bean Harvester Works, Caledonia, New York, and others.

There are two common types of bean harvesters, the

two row and the four row. The two row is for horse power and the four row for tractor attachment.

The bean harvester looks like a riding cultivator equipped with two large knives. These knives should be run as shallow as possible, throwing the two rows of beans together. The knives are easily adjusted with levers and should be set so that they go two, to two and one-half inches under the ground in front and just showing through the ground at the heel. The iron divider rods at the rear may be bent by hand to suit conditions. If they are set too close the beans will bunch under the machine and thresh out some. The rods should be placed so that when the beans are 23 inches between rows, they will pass over the knives at about two-thirds of the distance down. Almost every machine can be made to do good work with a little trying and adjusting.

The harvesting should be done when the beans are just ripe, but not so ripe that they shatter. Next they are forked into small piles or placed in a windrow by use of a side-delivery rake.

John Deere (13) If a side-delivery rake is used, the teeth should be set as high as possible and still pick up the beans. This adjustment leaves the windrow loose, permitting free circulation of air and thereby hurrying the curing process.

Cox and Pettigrove (4) After several hours of drying the beans are next placed in small narrow cocks. Then after a day or more of curing, depending upon weather conditions, they may be threshed, stacked or hauled to the barn.

In case of adverse weather conditions the "McNaughton System" of curing beans is recommended. It is described by H. R. Pettigrove of Michigan State College in a special circular. Tall, narrow stacks of beans are built on a straw base. This takes the beans away from soil and allows for better aeration. By using this system, the most high-quality beans are obtained.

H. Storing and Storage

Hedrick (11) Beans deteriorate slowly and not very expensive storage facilities are necessary. In the elevators they are sometimes placed in bins loose; or cleaned, sacked and stored in the warehouse ready for shipment.

In Farleman's (8) bean storage experiment, thirteen samples of picked and like number of unpicked samples of beans were stored in air-tight containers at room temperature that ranged from 70° to 85° F. for nearly five months. His results were as follows:

At the start	Av. % moisture unpicked Beans	12.36
	Av. % moisture picked Beans	<u>11.89</u>
	Difference in Av. % moisture	.47

After 5 months storage Av. % germination picked	87.31
After 5 months storage Av. % germination unpicked	<u>73.38</u>
Difference in Average % germination	13.93

This would go to show that picked beans have a little lower per cent of moisture at the beginning of the period but a higher per cent of germination after five months of storage.

I. Threshing.

Beans are threshed by a special bean separator. Two cylinders are used. The first cylinder is run at a low speed to thresh the riper and drier beans. The second cylinder is run at a higher speed to thresh out the unripe or tough podded beans. By this method fewer split beans are obtained. Good bean separators are also equipped with stone pickers and rubber rolls. The stone picker picks out stones from the tangled vines, and throws them into a box. The rubber rolls crush clods of dirt thereby helping to keep the beans clean. (The Huber Manufacturing Company, Marion, Ohio; American Grain Separator Company, Minneapolis, Minnesota; and others.)

III MATERIAL

The material for this problem was furnished by Alfred Whitehead and the Farm Crops Department of Michigan State College.

A. Source

The original sources of varieties used in this

problem were as follows:

1. The seed for 1928 was obtained from Alfred Whitehead, Mount Pleasant, Michigan, on whose farm the experiment was run.
 - a. 1200 to 1. It is not known where the seed was secured.
 - b. Robust. Certified seed obtained by Grace Pope in 1927 from the Coleman Elevator.
2. No experiment was run in 1929. The seed for 1930 was secured through the Farm Crops Department of Michigan State College. The growing season was so dry that the experiment was abandoned for the year.
3. In 1931--there were six varieties:
 - No. 1. Great Northern
 - No. 2. Red Kidneys

A variety of dark red kidneys that were grown at the Experiment station.
 - No. 3. Michigan Pea

A variety of white pea beans sent to the station by Rosenbrock Auburn.
 - No. 4. Early Wonder

A variety of white pea beans sent to the experiment station by Meinath Millington.
 - No. 5. White pea Beans

This variety was sent to the station by

by Huni Foster

No. 6. Robust

4. In 1932 Great Northern, Red Kidneys and Robust seed were used from 1931 experiment and eighteen different strains from the Experiment Station. In addition to the above the checks at the Experiment Station from the Experiment on the Methods of Planting and Dates of Harvest was used.

B. Soil

Kerr and Trull (14) report the soil types that were used as follows: Berrien sandy loam in 1928, Brookston sandy loam in 1931, and Brookston loam in 1932.

The Berrien sandy loam was tile drained and rich in organic matter. The Brookston sandy loam was rich in organic matter and had fair surface drainage. The Brookston loam was not so rich in organic matter and lacked drainage. A hard crust would form over it upon drying after rain.

IV METHOD OF PROCEDURE IN THE EXPERIMENT

A. In the Field

Different methods of procedure were used. This depended upon the size of the experiment and upon conditions that were uncontrollable, such as, weather, seed, and the land available.

1. Planting

In 1928 the two varieties of beans 1200 to 1 and Robust were planted side by side in two plots with a grain drill. Every fourth hole of the drill was left open and the drill wheel was allowed to follow its own track and return. This made the rows just 28 inches apart. The Robust plot contained one acre and the 1200 to 1, two acres. Both varieties were planted in June at the rate of 20 quarts to the acre. Weather conditions were favorable for the growth of the beans, and good results were obtained for the relationship of precipitation to pick and moisture content.

In 1930 the beans were planted with a bean planter. Due to adverse weather conditions during the growing season the yield and pick were so small that no results could be obtained.

In 1931 the six varieties, as mentioned under material, were planted June 11 with the use of an ordinary grain drill. The four varieties of the white pea beans were planted at the rate of twenty quarts

per acre. The Red Kidney and Great Northern were planted at the rate of five pecks per acre. To avoid mixing the bean varieties in the grain drill, only one variety was planted at a time. Where there wasn't enough seed for three rows, eighty rods long, the seed was shifted over to one side so that only two rows would be planted. The number of rows of each variety, eighty rods long, is as follows:

No. 1	Great Northern	2 rows
No. 2	Red Kidney	8 rows
No. 3	Michigan Pea	6 rows
No. 4	Early Wonder	6 rows
No. 5	White Pea Beans	8 rows
No. 6	Robust	12 rows

In 1932 the beans were planted with a grain drill at the rate of twenty quarts to the acre. The "Great Northern" and "Red Kidneys" were planted at five pecks per acre. The quantity of each variety varied so much that no measurement was taken. There were twenty-one varieties altogether. The Robust variety was planted at three different places in the plot.

2. Harvesting

In 1928, one square rod or one-hundred sixtieth of an acre of each of the varieties was measured out. The beans were harvested as they ripened. Pods were considered ripe when they turned yellow and felt

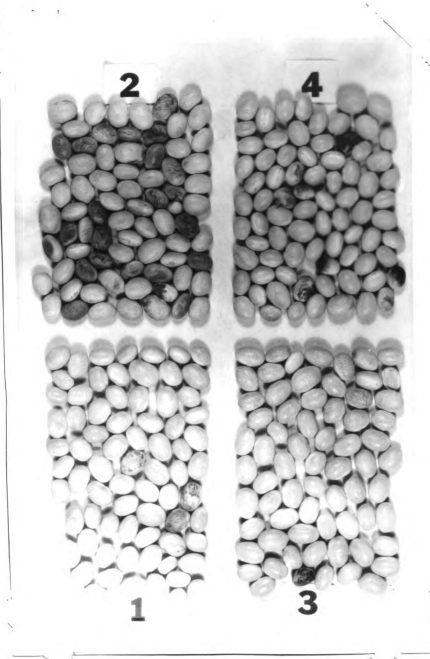
dry to the touch. The ripe pods of both varieties were picked by hand every third day, except when rain interfered. The pods up above the ground, and those touching the ground were kept separate and shelled by hand. The beans above the ground hereafter shall be designated as "uppers" and those touching the ground as "lowers". The weights of all of these were determined and recorded. All beans were saved until moisture and pick were determined.

In 1931 the same procedure was followed with six varieties, with the exception that no single square rod, block was used, but $116\frac{1}{4}$ feet of row of each variety was selected for the experiment. These $116\frac{1}{4}$ feet of row were not continuous but taken from various parts of the rows of each variety. This was done to get a good average sample of $1/160$ of an acre.

In 1932, instead of harvesting the pods every third day, only two harvests were made. The first harvest was made when the beans showed a number of ripe pods, and the second after some varieties were all ripe and others frozen. Also in 1932 an extra or complete harvest of Robust beans was made after all beans were ripe.

3. Pick

In 1933 the pick was determined by taking the entire weight of each harvest and sorting out all



-Fig. 2. Beans showing Condition of Seed. 1932

1. No. 379 Uppers second harvest, pick. 3.6%
2. No. 424 Uppers second harvest, pick 21.0%
3. Robust Uppers one harvest, pick 3.0%
4. No. 427 Uppers first harvest, pick 8.0%

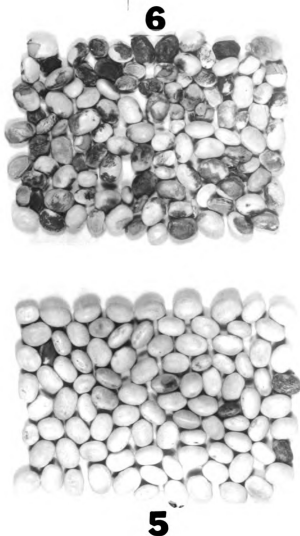


Fig. 3. Beans Showing Condition of Seed, 1931

- 5. Michigan Pea, Uppers and Lovers mixed, pick 8.55%
- 6. White Pea, pick Uppers and Lovers mixed

unmarketable beans and weighing them. The weights of the cull beans was then divided by the original weight of either "uppers" or "lowers" as the case may be. The total pick for each variety for the season was obtained by adding the weights of cull beans of all harvests, both "uppers" and "lowers" by dividing by the total weight of beans of that variety. In a similar way the total pick of either "uppers" or "lowers" for each variety was determined.

In 1931 and 1932 the pick for each harvest of "uppers" or "lowers" was determined by taking 100 gram samples and picking out the culls. In this case the weight of the cull beans in grams represented the per cent of culls or pick. To obtain the per cent pick of "uppers" or "lowers" or both, the total weight of beans was divided into the total weight of culls.

4. Moisture

In 1923 and 1931 moisture tests for both "uppers" and "lowers" of each picking and for each variety were determined by use of Brown Duvel Moisture Tester and by the usual method.

5. Yield

In 1923 all beans were weighed on a regular laboratory beam scale. These weights in grams were then changed to equivalent avoirdupois weight by dividing by 28.35, the number of grams in an ounce.

The weight for "uppers", "lowers", and total for each variety was then determined by dividing the number of ounces by 16 to get pounds and the number of pounds by 60 to get the number of bushels per square rod and the number of bushels was multiplied by 160 to get the yield per acre in bushels.

In 1931 and 1932 a regular grain beam-balance scale that gave the weights direct in pounds, ounces and one-tenth ounces was used. The yields per acre were determined in the regular way.

The yield per acre in each case was determined by correcting the moisture to 17% and subtracting the pick. If the moisture was above 17% as many pounds as would correct the sample to 17% moisture was subtracted. This was necessary as in 1928 some of the harvest tested as high as 36% moisture. In 1931 there were a few cases where a small addition had to be made to the weight of the sample to make the beans correct to 17% moisture.

6. Soak

In 1932 a "soak" test of twenty-one varieties of beans was included in the experiment in order to ascertain if a relationship existed between "soak" and "pick."

A one hundred gram sample of each one of the varieties of beans was taken and placed in small tin soil cans. A count of the beans in each sample was

made. A bean was considered soaked when the testa or seed coat became puckered. Counts of the beans soaked after being covered with water were made at stated intervals. A considerable difference in soak in some of the varieties was noticed. A few beans of some of the varieties did not even soak after being covered with water for 72 hours. The beans were kept at a temperature of 70° F. Previous to soaking the beans were stored in the basement of a hot-air furnace heated home.

V OBSTACLES ENCOUNTERED

A. Weather

As the pick and field damage of beans is largely due to weather conditions, such as rainfall and frost, the results obtained were variable. In 1928 there was a fair amount of precipitation during the harvest season. In 1930 there was no pick, thus the experiment was abandoned for that year. In 1931 the rainfall during the harvest season was less than during the harvest season of 1928. Similar results were obtained in 1932. The rainfall for the growing and harvest period of 1928, 1931, and 1932 (August 1st and October 1st) may be found in table one. In 1932 there was some frost damage to a few of the later varieties of beans.

B. Disease

Much of the pick of 1931 was due to bacterial blight of beans. Some varieties of beans are more susceptible to this disease than others, and the effect of this would increase the pick in those beans materially. Some varieties are also more susceptible to mosaic causing them to ripen unevenly, and to extend the ripening period. The "Robust" beans were freer from disease than any other variety and the pick of them was due to weather conditions and contact with the soil.

C. Soil Fertility

The plot used in 1928 was a very fertile soil. The Robust field was treated with an application of 250 pounds of 2-16-2 fertilizer. In 1931 the soil in the experimental plot was practically the same. It was a fertile loam reinforced with ten loads of barnyard manure per acre. No fertilizer or manure was added to the plot used in 1932. The soil lacked humus and its water-holding capacity was not so great. The greatest obstacle encountered was a condition brought about by a combination of some of the factors that cause pick in beans.

VI RESULTS

A. Factors that Influence Field Damage

Those conditions which affect beans in the

field are so variable from year to year that it is most difficult to interpret the results from the several experiments.

1. Variety and Pick

There are various reasons why some varieties of beans pick more than others. Table No. 2 shows the average pick of the 1200 to variety as 1.68% and the Robust as 1.196%. The Robust beans showed a higher per cent of upper pods than the 1200 to 1 variety. The per cent weight of pods to beans was also greater in the Robust variety. The ripening period of the 1200 to 1 variety was longer. The longer ripening period causes some of the beans to become spoiled. This shows up especially in the "lowers" of the first harvest of both varieties. Under normal weather conditions the earliest beans to mature have a longer period in which to become damaged before harvest time. Disease was not much of a factor in pick this year.

In 1931 the results were not so good as several varieties tested were badly diseased. (Table No. 3) The varieties quite free from disease were the Great Northern, Robust, and Michigan Pea. They picked 2.59%, 2.91%, and 3.11% respectively. The Red Kidney and White Pea varieties were diseased and picked 5.138% and 8.55% respectively. The early wonder showed a pick of 6.11%, but this was due largely to a higher

per cent of lower beans with a comparatively heavy pick.

The average pick for the beans tested in 1932 varies from 1.4% for the Great Northern to 19.3% for variety No. 424. No. 424 was badly diseased and late. (Tables 12, 13, and 14) The Robust variety was a close second to the Great Northern, with a pick of 1.91%. The average pick for all the varieties for 1932 was 6.350%. The Robust beans from another area in the field harvested only once on September 23, picked 3.1%.

2. Pick of "Uppers" and "Lowers".

Table 2 shows the pick of "uppers" and "lowers", 1932 for both 1200 to 1, and Robust for each harvest date. The highest pick for the "lowers" of 1200 to 1 variety was 4.4% and of the first harvest August 23. This was probably due to a few pods that ripened early and laid on the ground. The "uppers" for the same harvest picked only 0.93%. The lowest pick from the "lowers" was 1.6% on September 3, and the "uppers" picked 0.89% for the same harvest. The average for the seven harvest dates of 1200 to 1 beans was 1.63%. The average pick for the "lowers" was 2.93% and for the "uppers", 1.13%. The highest pick for the "lower" Robust was 3.5% on September 17. The yield for that harvest was 0.832 bushels per acre. The lowest pick was only 0.11% and

the yield the same as on September 17. The "uppers" for corresponding dates picked 0.85% and 0.047% respectively. The average pick of "lower" Robust was 3.15% and 0.737% for "uppers" for the six harvest dates. The average pick for all Robust in 1923 was 1.196%.

Six varieties were compared in 1931 as to the extent of damage to beans in upper and lower pods. (Table 3, page 40) Not such good results were obtained as in 1923 due to dry weather, low yield, and disease. Three varieties showed a greater per cent pick in the "lowers" than in the "uppers". The three varieties that showed results contrary to the above were the Red Kidney, Michigan Pea, and White Pea. The yield of the Red Kidney "lowers" was so small that accurate results were difficult to obtain. The pick of Michigan Pea was made up largely of diseased beans. This probably accounts for a slightly greater per cent pick in the "uppers" than in the "lowers" as disease affects both.

In 1932 data on pick of "uppers" and "lowers" of 21 varieties was obtained for two harvests. (Tables 12, 13, and 14) All mature beans were harvested for the first time on September 13 and 14. The average pick of all upper beans was 2.991% and for the lower beans it was 3.9535%. The "uppers" picked less by nearly one per cent. In a few cases results contrary to

the average were obtained. This was probably due to too small a sample to work with. The results for Robust beans compared well with the results of 1931. In 1932 at the first harvest the pick of Robust "uppers" was a trace and of the "lowers" only 3 per cent. The average pick of both "uppers" and "lowers" of Robust was 1.4%. As with the Robust, the Great Northern variety behaved about the same. The lower Great Northern picked 1.1% more than the upper in the first harvest. In 1931 the total lower Great Northern beans picked 0.98% more than the upper. In 1932 they picked 1.43% more than the upper. This higher per cent pick in 1932 may be due to fewer harvests and also to a later harvest, because more beans had time to become damaged.

In 1931 the total lower Robust picked 4.14% more than the upper. In 1932 two harvests of the upper Robust beans picked 1.62%, and the lower Robust 3.74%, making the lower pick 1.12% greater than the upper pick. In a different area harvested only once in 1932, the lower Robust picked 1% more than the upper Robust. Of the 21 varieties harvested in 1932, only four of them showed contrary results, and that is where the "uppers" showed a higher pick than the "lowers."

3. Soak and Pick of Varieties.

A test for soak or hardshell was conducted in 1932. (Table No. 5) As all the beans were planted

the same day, the soil conditions were similar, one would expect favorable results. The average pick of Great Northern was 1.4% and the per cent of hard shell after one hour of soaking was 83.7% and after 43 hours of soaking 21.7%. Robust picked 1.91% and the hardshell, after one hour of soaking, was 15.83%. At the end of 24 hours, all Robust beans were soaked. Bean sample 294 picked 4.54%, and all beans were soaked in 30 minutes. Bean sample 424 picked the highest (19.2%) and after one hour of soaking had 6.64% of hard shell. Sample No. 557 picked 3.89% and had 55.8% hardshell after one hour soaking. No. 379 picked 5.86% and had 85.9% hardshell after one hour soaking and 13.94% hardshell after soaking for 43 hours.

4. Moisture and Pick

Moisture for every harvest was determined in the years 1928 and 1931. In referring to Tables No. 9 and 10, no relationship seems to exist. As all pods were harvested as they ripened, there was little time for infection of the bean seed. In some cases bean samples with a high moisture content have a low pick and other cases the reverse is true. These conditions

were also shown in Table No. 11 This work was done on the Station Experimental Grounds in 1932.

5. Frost and Pick

No definite results were obtained from the relationship of frost and pick. All beans ripened before frost in 1928 and 1931. In 1932 a few late and low yielding varieties were frozen. The beans from the frozen plants showed a characteristic venation in the testa. The canner objects to this as it detracts from the appearance of the cooked product.

6. Weight of Pods and Pick

Table No. 7 shows the per cent weight of pods to beans. These results were obtained in 1928, but nothing further was done with them until 1933 when they were tabulated. The upper Robust picked 0.737% and the pods weighed 26.3% of the beans. The upper 1200 to 1 variety picked 1.18% and the pods weighed 25.1% of the beans. The lower 1200 to 1 beans picked 2.83% and the Robust, 3.15% respectively. The pods weighed 23.1% of the beans in each case. The average per cent weight of pods to beans in 1200 to 1 variety was 24.5, and for Robust 25.6. Some relationship seems to exist between weight of pods and pick. More experimental data is, however, necessary before any definite conclusion can be formed.

7. Time of Harvest and Pick

Tables 12, 13, and 14 show that there is a greater pick in beans if left too long in the field before harvesting. One lot of Robust beans were harvested September 14, and again September 23. The average pick for the first harvest was 1.4%, and for the second harvest 2.13%, and the average of both harvests, 1.91%. Another lot of Robust beans was harvested on September 23 only, and the average pick was 3.1%. This goes to show that a delayed harvest does affect the pick, depending more or less upon weather conditions.

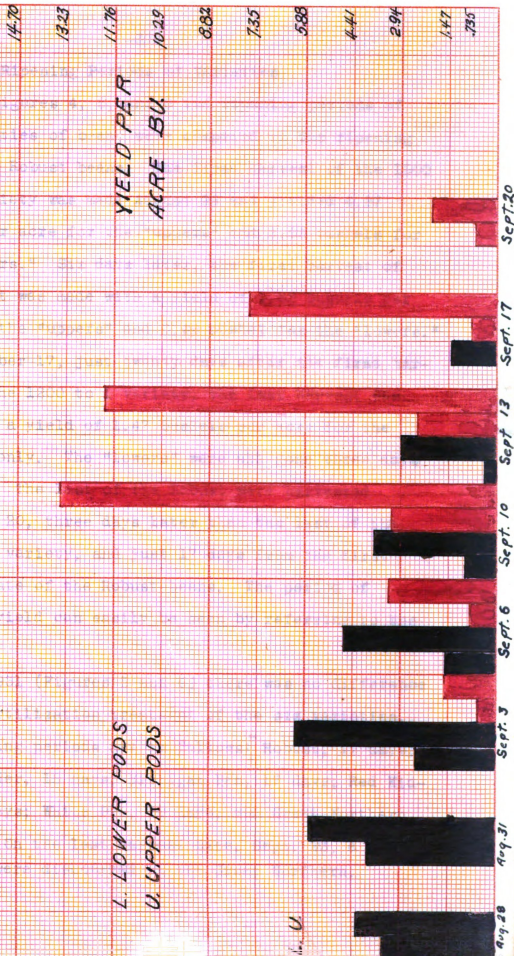
Table No. 11 shows the results of the experimental work conducted at Michigan State College. Four different checks were used in different methods of planting. The harvest dates were September 14, 23, 29, and October 8 respectively. Sample No. 1 picked 4.34%, 4.24%, 6.72%, and 3.03% at the different harvest dates, named in order. Sample No. 4 picked 3.75%, 3.02%, 6.72%, and 5.23% respectively. Only sample No. 13 showed contrary results between the first and last harvest. The first harvest picked 5.26% and the last one 4.77%. Sample No. 13 shows the greatest difference in pick, viz., 5.85% for the first harvest and 13.9% for the fourth harvest, making a difference of 7.05% in a twenty-five day delay in harvest.

Fig. 4 GRAPH SHOWING RIPENING PERIODS 1928

OF

1200 TO 1 BEANS

ROBUST BEANS



2001 ГОДОВЫЙ ПОКАЗАТЕЛЬ 1991 ГОДА

100

2001 ГОДОВЫЙ ПОКАЗАТЕЛЬ 1991 ГОДА

100

100

100

100

100

100

100

100

100

100

100

2001 ГОДОВЫЙ ПОКАЗАТЕЛЬ 1991 ГОДА

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2001 ГОДОВЫЙ ПОКАЗАТЕЛЬ 1991 ГОДА

8. Ripening Periods of Varieties

In figures 4, 5, and 6 the ripening periods of six varieties of beans were compared to the ripening period of Robust beans. The first harvest of the 1200 to 1 variety was made August 23 and yielded 4.27 bushel per acre for the "uppers" and 3.53 bushels for the "lowers." Six days later, the first harvest of the Robust was made with a yield of 1.62 bushels per acre for the "uppers" and 0.49 bushel for the "lowers." On September 17, just twenty days after the first harvest of the 1200 to 1 variety, the last harvest was made with a yield of 1.47 bushels per acre for the "uppers" only. The "lowers" were all gone three days previous. The last of the Robust were harvested September 20, three days later than the last of the 1200 to 1 variety, and just 17 days from the first harvest date of the Robust beans. The period of greatest yield can easily be seen by referring to the graph.

In 1931 (Figures 5 and 6) there was no difference in the fertilization treatment of the six varieties. The ripening periods are as follows: Robust, 11 days; Early Wonder, 15 days; Michigan Pea, 17 days; Red Kidney, 18 days; White Pea, 20 days; and Great Northern, 23 days. On the last harvest date, Sept. 23, a few blossoms were discovered on the Great Northern.

Fig. 5

GRAPH COMPARING RIPENING PERIODS

OF BEANS

1931/1931

NO. 6 ROBUST

NO. 4 EARLY WONDER

NO. 1 GREAT NORTHERN

NO 2 RED KIDNEY

972

YIELD PER ACRE BU. 8.91

018

728

879

267

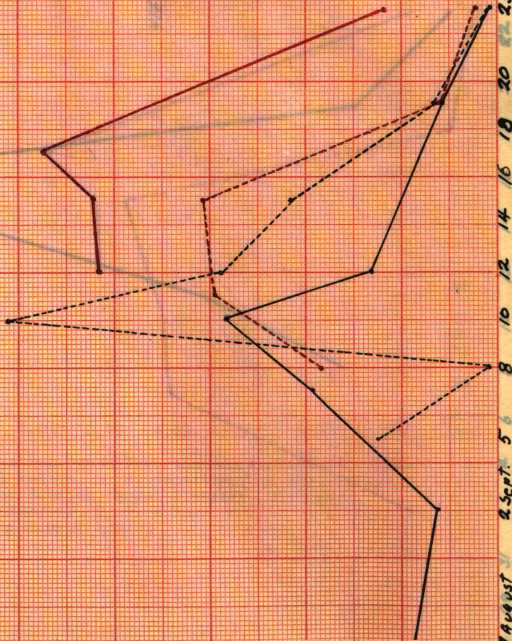
486

4.05

324

2.43

1.62 Bu.



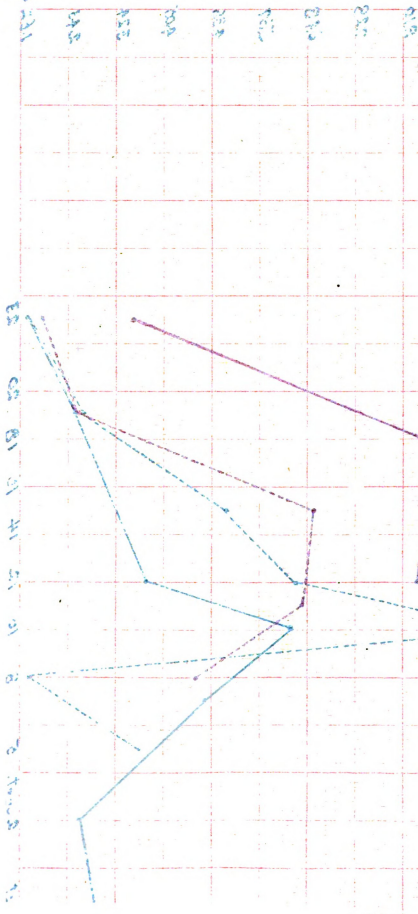
2001-2002 ANNUAL REPORT

2001-2002

1991 2002

REGIONAL BOARD
MEMBERSHIP LIST
YEAR 2001

MEMBER NAME



GRAPH COMPARING RIPENING PERIODS OF BEANS

Fig. 6

1931

NO. 6 ROBUST

NO. 3 MICHIGAN PEA

NO. 5 WHITE PEA

891

8.10

YIELD PER ACRE BU

7.29

648

567

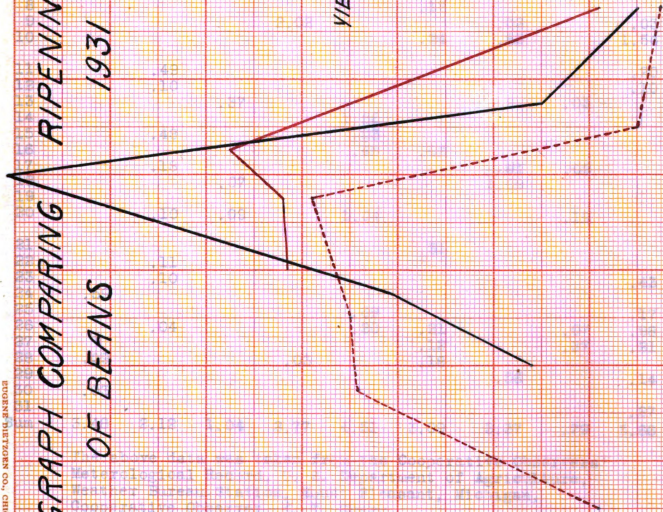
486

405

324

243

162



1983

200173 2111211111
1001

1001 1001

1001 1001 1001

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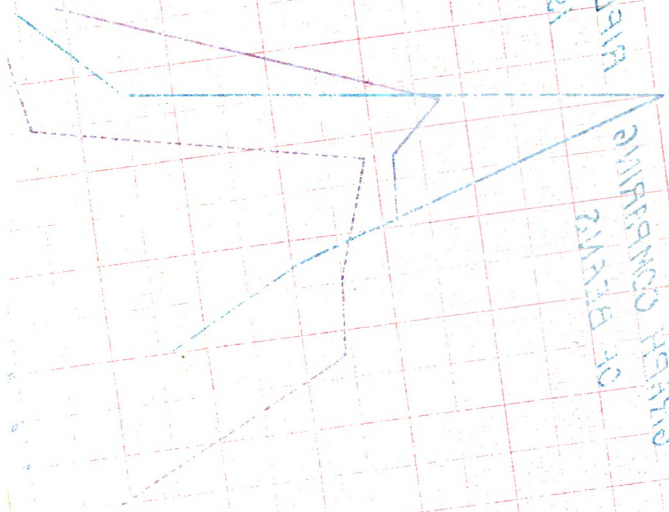


Table No. 1
PRECIPITATION

	1928			1931			1932		
	Aug.	Sept	July	Aug.	Sept.	July	Aug.	Sept.	Oct.
1					.12	.67			
2		.18	.04	.58			.03		
3	2.00	.34		.07		.11	.37	.11	.05
4	.05			.07	.38	1.00			1.16
5	.09		.47						.38
6									
7	.63				.01	.03	.62		
8						.17			
9				2.02			.03		.03
10						.24	.66		1.54
11		.49							.20
12		.10							.10
13			.37					.03	
14					1.56				
15		.48			.03				
16					.48	.02			
17		.18					.01	.02	
18			.07				1.09		
19									
20		.10	.09		1.04			.19	
21						.31			
22		.11							
23		.10							.43
24	.59								
25					.69				.17
26		.04			.20	.21		.07	.98
27						.12		.37	.21
28	.09			.03		.18			
29							.56		.14
30	.03								
31									.27
Sum	3.48	2.12	1.04	2.77	4.51	2.09	3.37	.79	5.66

The above data was taken from the Cooperative Observers' Meteorological Record, U. S. Department of Agriculture, Weather Bureau Station, Mount Pleasant, Michigan, Cooperative Observer, E. T. Oberg
Discussion on page 59 and 61

Table No. 2

PER CENT PICK IN 1928

Harvest Date	1200 to 1			Robust		
	Uppers	Lower	Average	Uppers	Lower	Average
Aug. 28	.93	4.4	2.6			
Aug. 31	.89	2.3	1.32			
Sept. 3	.55	1.6	.89	.51	3.0	1.23
Sept. 6	.05	2.58	.87	.047	.11	.62
Sept. 10	2.01	2.99	2.23	.08	2.9	1.23
Sept. 13	1.6	2.2	1.7	.64	2.0	.88
Sept. 17	1.93		1.93	.85	3.5	1.76
Sept. 20				.88	6.09	2.34
AVERAGE	1.18	2.83	1.68	.737	3.15	1.198

Discussion on pages 30 and 32

Table No. 3

PICK IN 1931

Harvesting Dates

	Aug. 27	Sept. 2	Sept. 5	Sept. 7	Sept. 8	Sept. 10	Sept. 11	Sept. 12	Sept. 15	Sept. 17	Sept. 18	Sept. 19	Sept. 23	Average
Great Northern														
Upper	3.89	4.30		.9		.6								2.04
Lower	4.64	5.22		.73		.625		3.24				11.5		3.02
Average	3.98	4.51		.81		.61		3.24				11.5		2.59
Red Kidney														
Upper		3.62			9.09	4.53		6.69	4.65		4.35		3.33	5.06
Lower		4.62			T	5.00		3.64	10.00					5.66
Average		3.79			8.33	4.57		6.37	5.66		4.35		3.33	5.136
Michigan Pea														
Upper					10.00	4.81			1.02			1.95	2.50	3.30
Lower					9.20	4.54			.74					2.72
Average					9.86	4.74			.92			1.95	2.50	3.11
Early Wonder														
Upper				1.02		8.89			2.0			2.50	1.43	5.61
Lower				11.11		6.09			5.16			7.69		7.00
Average				10.53		7.78			3.38			3.77	1.43	6.11
White Pea														
Upper		5.00	11.44	17.65		8.93			4.13		5.00		8.00	8.67
Lower		7.69	9.63	14.29		6.00			4.76		10.00			8.18
Average		5.69	10.92	16.66		8.34			4.32		6.00		8.00	8.55
Robust														
Upper								3.125	1.28	1.54			1.38	1.86
Lower								3.45	12.5	5.15				6.00
Average								3.23	3.19	3.50			1.38	2.91

Discussion on pages 31 and 33

Table 4

YIELD IN 1931

Harvesting Dates
(Weight in ounces)

	Aug.27	Sept.2	Sept.5	Sept.7	Sept.8	Sept.10	Sept.11	Sept.12	Sept.15	Sept.17	Sept.18	Sept.19	Sept.23	Total	Total %
Great Northern															
Upper	10.43	8.96		11.20		17.00								47.59	43.7
Lower	4.53	2.68		13.50		16.00		18.50					6.00	61.20	56.3
Total	14.95	11.64		24.70		33.00		18.50					6.00	108.79	
Red Kidney															
Upper			14.35		5.50	51.00		29.00	21.50		11.5		6.00	138.85	87.7
Lower			3.04		.50	5.20		5.50	5.00					19.24	12.3
Total			17.39		6.00	56.20		34.50	26.50		11.5		6.00	158.09	
Michigan Pea															
Upper					16.00		27.00		49.00			20.50	10.00	122.5	74.0
Lower					5.00		11.00		27.00					43.0	26.0
Total					21.00		38.00		76.00			20.50	10.00	165.5	
Early Wonder															
Upper					14.75		18.00		20.00			8.00	7.00	67.75	67.75
Lower					8.00		11.50		15.50			2.60		38.80	36.4
Total					23.75		29.50		35.50			10.60	7.00	106.55	
White Pea															
Upper		10.50	9.00	17.00		28.00			24.20		8.00		7.50	104.20	75.1
Lower		3.67	4.37	7.00		7.00			10.50		2.00			34.48	24.9
Total		14.17	13.37	24.00		35.00			34.70		10.00		7.50	138.68	
Robust															
Upper								32.00	39.00	33.50			14.50	118.00	74.7
Lower								14.50	8.00	17.50				40.00	25.3
Total								46.50	47.00	50.00			14.50	158.00	

Discussion on pages 58 and 59

No moisture or pick deducted
(120 ft. of row)

Total Average Upper	71.7
Total Average Lower	28.3

Table No. 5

COMPARISON OF SOAK AND PICK IN BEAN STRAINS 1932

Name or Number of Bean Sample	Pick %	Number in 100 gms.	% 15 Min.	% 30 Min.	% 45 Min.	% 1 Hr.	% 2 Hrs.	% 4 Hrs.	% 6 Hrs.	% 10 Hrs.	% 24 Hrs.	% 48 Hrs.	% Dry After 48 Hours Soak
Robust	1.91	436	58.25	68.57	80.2	84.17	89.0	97.0	97.94	99.09	100.00		
Blue Pod	7.6	368	74.4			82.3	86.1	94.0	96.5	99.45	99.45	99.45	.55
Red Kidney	5.2	182	13.7	13.7	25.8	31.3	43.4	63.2	84.0	99.4	100.00		
Great Northern	1.4	307	4.56		14.3	16.3	20.9	46.2	56.35	68.1	70.7	78.8	21.17
No. 442	9.87	431	95.8	98.3	99.2	99.2	99.2	100					
No. 294	4.54	423	99.5	100									
No. 427	8.23	410	88.5	99.5	99.5	99.5	99.5	100					
No. 558	5.0	419	89.2	95.2	96.1	96.9	97.3	99.2	99.5	99.8	100		
No. 576	11.63	4.61	94.3	97.6	98.0	98.2	98.0	99.7	99.7	100.0			
No. 435	9.9	428	94.6	98.8	98.8	99.0	99.3	99.5	100.0				
No. 557	8.89	362	24.0		36.7	44.2	55.2	72.9	82.0	87.3	91.4	93.6	6.53
No. 296	7.89	431		80.97	83.06	84.68	88.16	89.5	93.27	95.3	96.3	97.9	2.1
No. 307	8.46	438	86.07	93.37	94.97	96.8	96.8	99.08	99.77	99.77	100.00		
No. 305	7.88	432	97.45	98.6	98.84	99.0	99.76	99.76	99.76	99.76	100.00		
No. 461	8.30	451	88.91	92.0	92.0	93.12	95.5	98.0	98.2	98.67	98.67	98.67	1.33
No. 379	5.86	409	.97	10.78	11.76	14.91	28.85	54.76	68.7	75.3	81.41	86.06	13.94
No. 158	9.8	400	89.5		93.2	94.0	94.75	96.00	97.00	98.75	99.75	99.75	.25
No. 161	3.07	396	39.9	55.55	71.43	75.25	79.79	89.14	90.65	93.18	96.71	97.98	2.02
No. 458	4.44	479	9.18	18.78	25.05	28.39	43.63	68.47	75.78	83.3	89.97	91.88	6.12
No. 470	10.85	421	51.3	78.9	87.9	91.2	93.9	98.8	99.2	99.2	99.7	99.7	.3
No. 424	19.8	437	86.27	92.67	93.36	93.36	94.7	95.19	96.1	97.25	97.94	98.4	1.6

Discussion on pages 27 and 34

Table No. 6

WEIGHT OF BEAN PODS IN GRAMS IN DIFFERENT HARVESTS IN 1928

Harvest Date	1200 to 1		Robust	
	Upper	Lower	Upper	Lower
August 28	247.0	190.5		
August 31	317.0	167.0		
September 3	317.5	121.0	96.5	28.4
September 6	192.0	70.0	201.0	39.1
September 10	178.5	52.0	623.0	155.0
September 13				
September 17	123.5		282.0	32.0
September 20			79.0	27.0
Total	1375.5	600.5	1281.5	281.5

Table No. 7

PER CENT OF PODS TO BEANS 1928

Harvest Date	1200 to 1			Robust		
	Upper	Lower	Average	Upper	Lower	Average
August 28	28.8	23.9	26.5			
August 31	25.6	21.8	24.1			
September 3	22.1	22.3	22.11	29.3	21.1	27.0
September 6	22.5	24.1	22.9	31.9	22.4	30.0
September 10	26.7	26.3	26.5	25.3	24.4	25.2
September 13						
September 17	30.3			26.6	27.4	26.7
September 20				23.2	20.8	22.6
Average	25.1	23.1	24.5	26.3	23.1	25.6

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Table No. 8

WEIGHT OF BEANS IN GRAMS IN EACH HARVEST 1928

Harvest Date	1200 to 1		Robust	
	Upper	Lower	Upper	Lower
August 28	856.0	727.0		
August 31	1242.0	765.0		
September 3	1438.6	542.0	329	134.0
September 6	853.6	290.3	631	170.3
September 10	669.5	197.5	2455	634.0
September 13	613.0	89.0	2330	497.0
September 17	407.5		1060	149.0
September 20			340	129.5
Total	6080.2	2680.8	7205	1713.8
Per cent of Total	69.46	30.54	80.8	19.2

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Table No. 9

MOISTURE CONTENT HARVEST PERIOD 1928
(In per cent)

Picking Date	1200 to 1		Robust	
	Uppers	Lowers	Uppers	Lowers
August 28	30.3	36.0		
August 31	27.5	27.0		
September 3	31.0	36.0	33.0	34.0
September 6	21.8	21.3	25.4	25.7
September 10	20.0	19.0	23.0	24.0
September 13	24.5	26.0	28.0	30.0
September 17	23.7		19.5	19.5
September 20			19.0	19.0

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Table No. 10

TABLE OF MOISTURE 1931

Harvest Dates	Aug. 27	Sept. 2	Sept. 5	Sept. 7	Sept. 8	Sept. 10	Sept. 11	Sept. 12	Sept. 15	Sept. 17	Sept. 18	Sept. 19	Sept. 23	Average
Great Northern														
Upper	23.5	19.6		16.5		15.8								18.34
Lower	23.4	19.7		20.0		18.4		28.0				18.0		20.9
Average	23.47	19.62		18.37		18.09		28.0				18.0		19.78
Red Kidney														
Upper			31.0		30.0	30.0		28.0	37.0		35.0		27.0	31.5
Lower			31.0		30.0	35.0		27.0	40.0					33.25
Average			31.0		30.0	30.46		27.84	37.19		35.0		27.0	31.32
Michigan Pea														
Upper					25.0		16.0		30.0			30.0	19.0	25.36
Lower					29.0		16.0		32.0					27.56
Average					26.0		16.0		30.71			30.0	19.0	25.9
Early Wonder														
Upper					21.5		16.2		18.0			30.0	22.0	20.11
Lower					23.0		13.3		18.5			30.0		19.06
Average					22.07		16.23		18.22			30.0	22.0	19.72
White Pea														
Upper		18.0	22.0	19.0		16.0			26.0		21.0		20.0	20.20
Lower		18.1	27.0	19.0		16.5			30.0		21.0			22.98
Average		18.06	24.7	19.0		16.1			27.2		21.0		20.0	20.90
Robust														
Upper								18.0	28.0	30.0			21.0	24.23
Lower								18.0	27.0	32.0				25.90
Average								18.0	28.16	30.7			21.0	24.65

Precipitation (Table 1) Aug. 28, 0.03; Sept. 1, 0.12; Sept. 4, 0.35; Sept. 7, 0.10; Sept. 14, 1.56; Sept. 15, 0.03; Sept. 18, 0.48; Sept. 20, 1.04

Discussion on page 34

Table No. 11

SHOWING WEIGHT, MOISTURE AND PICK AT DIFFERENT HARVEST DATES 1932

First Harvest September 14, 1932

No. of Sample	1	4	7	10	13	16
Weight in gms.	535.0	475.0	1225.0	430.0	471.0	202.0
% moisture	15.9	16.4	17.2	16.3	18.0	25.8
% pick	4.35	3.75	7.34	5.37	5.26	5.85

Second Harvest September 23, 1932

Weight in gms.	797.0	510.0	1272.0	578.0	567.0	371.0
% moisture	31.7	27.9	24.9	40.3	33.2	60.9
% pick	4.24	3.02	7.67	2.7	3.18	10.82

Third Harvest September 29, 1932

Weight in gms.	664.0	567.0	1170.0	405.0	470.0	190.0
% moisture	38.2	18.8	23.1	44.1	22.9	29.1
% pick	6.72	6.72	5.96	4.1	5.34	12.75

Fourth Harvest October 8, 1932

Weight in gms.	595.0	496.0	1136.0	462.0	480.0	213.0
% moisture	36.3	22.1	20.3	40.3	22.7	27.3
% pick	8.08	5.28	10.09	5.38	4.77	13.9

Precipitation in Inches

September Total 3.04 Inches

Dates	3	13	16	17	18	20	21	22	26	27	30
Ppt.	2.0	.13	T	.01	T	.20	.02	T	.40	.28	T

October Total 15 days 2.85 Inches

Dates	1	3	4	5	9	10	11	12	13	14
Ppt.	T	.03	1.43	.02	.01	1.24	.04	.02	.05	.01

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Table No. 12

COMPARISON OF YIELD AND PICK 1932

First Harvest

	Weight of Beans Ounces	Weight clean Beans Ounces	Pick Per cent	Date of Harvest
No. 307				
Upper	21.0	19.95	4.0	Sept. 14
Lower	4.5	4.16	7.5	Sept. 14
Total	25.5	24.11	5.31	Sept. 14
Blue Pod				
Upper	15.0	13.8	8.0	Sept. 14
Lower	3.5	3.3	5.5	Sept. 14
Total	18.5	17.1	7.57	Sept. 14
No. 557				
Upper	21.0	20.58	2.0	Sept. 14
Lower	3.0	2.38	4.0	Sept. 14
Total	24.0	23.46	2.25	Sept. 14
Robust				
Upper	42.5	42.0	T	Sept. 14
Lower	5.5	5.33	3.0	Sept. 14
Total	48.0	47.33	1.4	Sept. 14
No. 461				
Upper	14.0	13.72	2.0	Sept. 14
Lower	3.0	2.91	3.0	Sept. 14
Total	17.0	16.63	2.17	Sept. 14
No. 442				
Upper	7.5	7.24	3.5	Sept. 14
Lower	.5	.47	5.0	Sept. 14
Total	8.0	7.71	3.6	Sept. 14
Red Kidney				
Upper	12.0	11.16	7.0	Sept. 14
Lower	1.0	.90	10.0	Sept. 14
Total	13.0	12.06	7.20	Sept. 14

YIELD AND PICK (continued) 1932
First Harvest

	Weight of Beans Ounces	Weight clean Beans Ounces	Pick Per cent	Date of Harvest
No. 296				
Upper	16.0	15.2	5.0	Sept. 14
Lower	4.0	3.88	3.0	Sept. 14
Total	20.0	19.08	4.6	Sept. 14
No. 424				
Upper	11.0	9.9	10.0	Sept. 14
Lower	2.0	1.74	13.2	Sept. 14
Total	13.0	11.64	10.4	
No. 470				
Upper	3.5	3.3	6.0	Sept. 14
Lower	.67	.38	42.0	Sept. 14
Total	4.17	3.68	11.7	
Great Northern				
Upper	64.0	63.42	.9	Sept. 14
Lower	10.0	9.8	2.0	Sept. 14
Total	74.0	73.22	1.05	
No. 305				
Upper	27.0	25.65	5.0	Sept. 14
Lower	5.5	5.28	4.0	Sept. 14
Total	32.5	30.93	4.8	
No. 576				
Upper	9.0	8.32	7.5	Sept. 14
Lower	2.0	2.0	T	Sept. 14
Total	11.0	10.32	7.1	
No. 379				
Upper	11.5	10.70	7.0	Sept. 14
Lower	4.0	3.68	8.0	Sept. 14
Total	15.5	14.38	7.2	
No. 558				
Upper	26.5	25.97	2.0	Sept. 14
Lower	3.0	3.00	T	Sept. 14
Total	29.5	28.97	1.8	

YIELD AND PICK (continued) 1932

First Harvest

	Weight of Beans Ounces	Weight clean Beans Ounces	Pick in Per cent	Date of Harvest
No. 427				
Upper	46.0	43.24	8.0	Sept. 14
Lower	8.0	7.56	5.5	Sept. 14
Total	54.0	50.80	5.9	
No. 161				
Upper	17.0	16.92	.5	Sept. 13
Lower	7.5	7.42	1.0	Sept. 13
Total	24.5	24.34	.65	
No. 294				
Upper	35.5	35.15	1.0	Sept. 13
Lower	7.0	6.82	2.5	Sept. 13
Total	42.5	41.97	1.24	
No. 458				
Upper	58.0	57.97	1.00	Sept. 14
Lower	6.5	6.37	2.00	Sept. 14
Total	64.5	64.34	1.40	
No. 158				
Upper	4.0	3.84	4.0	Sept. 13
Lower	2.0	2.0	T	Sept. 13
Total	6.0	5.84	2.66	
No. 435				
Upper	15.0	14.7	2.0	Sept. 14
Lower	2.6	2.5	4.0	Sept. 14
Total	17.6	17.2	2.27	
All Uppers	477.00	448.93	2.9916	
All Loweres	85.77	82.38	3.9535	
Total	562.77	531.31	3.1025	

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Table No. 13
COMPARISON OF YIELD AND PICK 1932
Second Harvest

	Weight of Beans Ounces	Weight clean Beans Ounces	Pick Per Cent	Date of Harvest
No. 307				
Upper	21.5	19.35	10.0	Oct. 8
Lower	15.5	13.79	11.0	Oct. 8
Total	37.0	33.14	10.4	
Blue Pod				
Upper	36.0	33.84	6.0	Oct. 14
Lower	24.0	21.60	10.0	Oct. 14
Total	60.0	55.44	7.6	
No. 557				
Upper	24.0	20.52	14.5	Oct. 13
Lower	25.2	22.81	9.5	Oct. 13
Total	49.2	43.33	11.9	
Robust				
Upper	77.0	75.56	2.0	Sept. 28
Lower	13.5	12.96	4.0	Sept. 28
Total	90.5	88.52	2.18	
Robust All One Harvest				
Upper	135.0	130.95	3.0	Sept. 28
Lower	16.0	15.25	4.0	Sept. 28
Total	151.0	146.20	3.6	
No. 461				
Upper	15.6	14.66	6.0	Oct. 13
Lower	17.5	15.75	10.0	Oct. 13
Total	33.1	30.41	8.0	
No. 442				
Upper	10.0	8.7	13.0	Oct. 13
Lower	5.5	4.77	13.2	Oct. 13
Total	15.5	13.47	13.0	

YIELD AND PICK (Continued) 1932
Second Harvest

	Weight of Beans Ounces	Weight clean Beans Ounces	Pick Per Cent	Date of Harvest
Red Kidney				
Upper	19.6	18.95	3.3	Sept. 28
Lower	4.5	4.16	7.5	Sept. 23
Total	24.1	23.11	4.08	
No. 296				
Upper	42.0	36.96	12.0	Oct. 7
Lower	23.0	22.25	11.0	Oct. 7
Total	65.0	59.21	11.6	
No. 424				
Upper	37.5	29.62	21.0	Oct. 13
Lower	20.6	15.76	23.5	Oct. 13
Total	58.1	45.38	21.88	
No. 470				
Upper	28.5	25.65	10.00	Oct. 13
Lower	18.0	15.84	12.00	Oct. 13
Total	46.5	41.49	10.7	
Great Northern				
Upper	23.5	22.05	2.0	Sept. 28
Lower	4.5	4.32	4.0	Sept. 28
Total	27.10	26.37	2.3	
No. 305				
Upper	35.0	31.85	9.0	Oct. 8
Lower	19.2	17.08	11.0	Oct. 8
Total	54.2	48.93	9.7	
No. 576				
Upper	9.5	8.33	11.8	Oct. 13
Lower	12.0	10.02	16.5	Oct. 13
Total	21.5	19.40	14.4	
No. 379				
Upper	85.6	82.50	3.6	Oct. 13
Lower	49.0	44.39	9.4	Oct. 13
Total	134.6	126.89	5.73	

YIELD AND PICK (continued) 1952
Second Harvest

	Weight of Beans Ounces	Weight clean Beans Ounces	Pick Per cent	Date of Harvest
No. 558				
Upper	35.3	33.19	6.00	Oct. 14
Lower	20.0	18.40	8.00	Oct. 14
Total	55.3	51.59	6.9	
No. 427				
Upper	61.5	56.58	8.0	Oct. 13
Lower	22.0	18.81	14.5	Oct. 13
Total	83.5	75.39	9.7	
No. 161				
Upper	51.2	49.01	4.3	Oct. 7
Lower	36.0	34.92	3.0	Oct. 7
Total	87.2	83.93	3.75	
No. 294				
Upper	35.0	32.37	7.5	Oct. 7
Lower	19.5	18.26	6.5	Oct. 7
Total	54.5	50.63	7.1	
No. 458				
Upper	34.0	32.47	4.5	Oct. 13
Lower	18.5	17.11	7.5	Oct. 13
Total	52.5	49.58	5.8	
No. 158				
Upper	17.2	14.91	13.3	Oct. 7
Lower	12.5	11.44	8.5	Oct. 7
Total	29.7	26.35	11.28	
No. 435				
Upper	46.5	40.45	13.0	Oct. 13
Lower	25.5	23.08	9.5	Oct. 13
Total	72.0	63.53	11.7	
All Upper	880.0	818.52	6.986	
All Lower	422.0	382.77	9.296	
Total	1302.0	1201.29	7.735	

Table No. 14

COMPARISON OF YIELD AND PICK 1932

All Upper and Lower Pods

	Weight of Beans in Ounces	Per cent of Total	Wt. Clean Beans Ounces	Pick Average Per cent	Dates of Harvest
No. 161					
Upper	68.2	61.1	65.93	3.33	Sept. 13
Lower	43.5	38.9	42.34	2.66	and
Total	111.7		108.27	3.07	Oct. 7
No. 158					
Upper	21.2	59.4	18.75	11.56	Sept. 13
Lower	14.5	40.6	13.44	7.34	and
Total	35.7		32.19	9.80	Oct. 7
No. 294					
Upper	70.5	72.7	67.52	4.23	Sept. 13
Lower	26.5	27.3	24.03	5.36	and
Total	97.0		91.60	4.54	Oct. 7
No. 296					
Upper	58.0	68.2	52.16	11.79	Sept. 14
Lower	27.0	31.8	26.13	3.22	and
Total	85.0		78.29	7.39	Oct. 7
No. 305					
Upper	62.0	71.5	57.50	7.26	Sept. 14
Lower	24.7	28.5	22.36	9.47	and
Total	86.7		79.86	7.88	Oct. 8
Red Kidney					
Upper	31.6	82.5	30.11	4.71	Sept. 14
Lower	5.5	17.5	5.06	8.00	and
Total	37.1		35.17	5.20	Sept. 23

COMPARISON OF YIELD AND PICK 1932

All Upper and Lower Pods

	Weight of Beans in Ounces	Per Cent of Total	Wt. Clean Beans Ounces	Pick Average Per Cent	Dates of Harvest
Robust					
Upper	119.5	86.3	117.56	1.62	Sept. 14
Lower	19.0	13.7	18.29	3.74	and
Total	138.5		135.85	1.91	Sept. 28
Robust (CK) One Harvest					
Upper	135.0	89.4	130.95	3.0	Sept. 28
Lower	16.0	10.6	15.25	4.0	only
Total	151.0		146.20	3.1	
Great Northern					
Upper	88.5	85.6	85.47	1.19	Sept. 14
Lower	14.5	14.4	14.12	2.62	and
Total	103.0	.	99.59	1.40	Sept. 28
No. 307					
Upper	42.5	68.0	39.25	7.65	Sept. 14
Lower	20.0	32.0	17.95	10.25	and
Total	62.5		57.20	8.48	Oct. 8
Blue Pod					
Upper	51.0	65.0	47.64	6.60	Sept. 14
Lower	27.5	35.0	24.90	9.45	and
Total	78.5		72.54	7.59	Oct. 14
No. 557					
Upper	45.0	61.5	41.10	3.67	Sept. 14
Lower	23.2	33.5	25.69	8.90	and
Total	73.2		66.79	8.89	Oct. 13
No. 442					
Upper	17.5	74.5	15.94	8.91	Sept. 14
Lower	6.0	25.5	5.24	12.66	and
Total	23.5		21.18	9.87	Oct. 13

COMPARISON OF YIELD AND PICK 1932

All Upper and Lower Pods

	Weight of Beans in Ounces	Per Cent of Total	Wt. Clean Beans Ounces	Pick Average Per Cent	Dates of Harvest
No. 461					
Upper	29.6	59.1	23.33	4.12	Sept. 14
Lower	20.5	40.9	18.66	9.00	and
Total	50.1		47.04	8.30	Oct. 13
No. 424					
Upper	43.5	63.2	39.52	18.51	Sept. 14
Lower	22.6	31.8	17.50	22.57	and
Total	71.1		57.02	19.80	Oct. 13
No. 470					
Upper	32.00	63.2	28.95	9.53	Sept. 14
Lower	18.67	36.8	16.22	13.12	and
Total	50.67		45.17	10.85	Oct. 13
No. 576					
Upper	18.5	57.0	16.70	9.73	Sept. 14
Lower	14.0	43.0	12.02	14.14	and
Total	32.5		28.72	11.63	Oct. 13
No. 379					
Upper	97.1	64.7	93.20	4.02	Sept. 14
Lower	53.0	35.3	43.07	8.36	and
Total	150.1	.	141.27	5.86	Oct. 13
No. 558					
Upper	61.3	72.9	59.16	4.27	Sept. 14
Lower	23.0	27.1	21.40	6.96	and
Total	84.8		80.56	5.00	Oct. 13
No. 427					
Upper	107.5	78.2	99.82	7.14	Sept. 14
Lower	30.0	21.8	26.37	12.10	and
Total	137.5		126.19	8.23	Oct. 13

COMPARISON OF YIELD AND PICK 1932

All Upper and Lower Pods

	Weight of Beans in Ounces	Per Cent of Total	Wt. Clean Beans Ounces	Pick Average Per Cent	Dates of Harvest
No. 458					
Upper	92.0	78.6	90.44	1.59	Sept. 14
Lower	25.0	21.4	23.43	6.08	and
Total	117.0		113.92	4.44	Oct. 13
No. 435					
Upper	61.5	68.6	55.15	10.32	Sept. 14
Lower	23.1	31.4	25.58	8.98	and
Total	89.6		80.73	9.90	Oct. 13
All Upper	1357.0	72.8	1231.20	5.585	
All Lower	507.77	27.2	464.15	8.590	
Total	1864.77		1745.35	6.350	

Discussion on page 58

VIII DISCUSSION AND SUMMARY

1. Since "pick" is such an important factor in the production of field beans in Michigan, any of the factors which influence field damage is important.
2. This investigation was outlined to determine the extent of damage and some of the factors which influence the "pick" of beans.
3. The factors dealt with in this investigation were: varieties, upper pods, lower pods, disease, soil, precipitation, soak, weight of pods, time of harvest, ripening period, and pick.
4. Robust beans were used throughout the investigation. They were compared with several other varieties in their ability to withstand damage.
5. Robust beans had a greater per cent of upper pods in 1928 than the 1200 to 1 variety. In 1931 the Red Kidney beans had the highest per cent of "uppers" and the White Pea beans a slightly greater per cent of "uppers" than the Robust. Due to blight in 1932, the yield of Red Kidney beans was very low, but the per cent of "uppers" compared well to that of 1931. In 1932 Robust beans led all other varieties in per cent of "uppers" as well as in total yield. Two different areas of Robust beans were harvested. The area harvested at two different times had 86.3% "uppers" while the area harvested only once after all beans had matured had

89.4% "uppers." Of all beans harvested in 1923, 75.2% were "uppers"; in 1931, 71.7%; and in 1932, 72.8%.

Other varieties tested in 1932 (table 14) that have a high per cent of "uppers" are: Great Northern (85.6%), Red Kidney (82.5%), No. 453 (79.6%), and No. 427 (78.2%). The varieties with a low per cent of "uppers" are No. 576 (57%), No. 161 (61.1%), and No. 461 (59.1%).

The yield of No. 379 is slightly greater than the Robust where two harvests were made and lesser than the Robust where one harvest of another area was made. The pick of No. 379 is greater in both cases and lesser in per cent of "uppers." Robust beans loose their leaves at harvest time more than other varieties. This aids greatly in drying the pods, and thus prevents an increase pick.

6. During a harvest period when there is very little precipitation and the ground remains dry, the difference in pick between "uppers" and "lowers" remains about the same. This was shown in the Great Northern variety (1931). There were more "lowers" than "uppers" and the bulk of the crop was harvested during a comparatively dry period. The difference in per cent pick between "uppers" and "lowers" was small. In other varieties, both for 1931 and 1932, similar results were obtained.

In a few cases that appear contrary to the above much of the damage done was due to disease. Beans whose pods touch the ground during a rainy period may become discolored by stains from the soil, and the pod itself. A few soil organisms may also help to increase the pick.

7. The above is a good reason for using the McNaughton system for harvesting beans. If weather is threatening and beans are mature they could be pulled and stacked the same day. This gets them off the wet ground so that they may dry quickly and be ready for threshing during fair weather. By using this system of harvesting further pick in beans will be prevented.

8. The experiment of 1932 seems to show no definite relationship between soak and pick. Robust beans picked 1.91% and 100% of them were soaked in 24 hours. Of the twenty-one varieties tested, fourteen had a greater per cent pick than Robust. Four of these showed the same soak in 24 hours as Robust, and the remaining ten showed from 0.25% to 13.94% hardshell after 48 hours of soaking.

9. The results of 1923 show that the heavier pods seem to offer greater protection to the beans within. Tables 2 and 7 show that Robust upper pods weigh 26.3% and lower pods 23.1% of the total weight

and the beans pick 0.737 and 3.15 per cent respectively. The upper pods of 1200 to 1 variety weigh 25.1% and the lower pods 23.1% of the total weight, and the beans pick 1.13 and 2.83 per cent respectively. The average weight of Robust pods is 25.6% of the total weight, and the pick of beans is 1.193%, while the average weight of 1200 to 1 variety is 24.5% of the total weight and the pick of beans is 1.68%. The beans with the greatest per cent weight of pods have the least pick.

10. A definite relationship exists between time of harvest and pick, but not as much as one would expect. Early maturing pods show a considerable amount of pick even though the pods were gathered before the plants would normally be harvested. If the harvest is delayed, as was the case in 1932, the pick is increased materially.

11. The time of the ripening period is important. Of the six varieties tested in 1931, the Robust had the shortest, and the Great Northern the longest ripening period. The bulk of the Great Northern variety was harvested during fair weather and the Robust, during a period of frequent rains.

In 1932 Robust and Great Northern were harvested first on Sept. 14 and then on Sept. 28. During ten days previous to the first harvest, there was 0.03 inch precipitation and for a like period before the

second harvest the precipitation was 0.63 inch. The average pick of the Great Northern was 1.05 per cent in the first harvest, and 2.3 per cent in the second harvest. For the same harvest dates Robust beans picked 1.4 and 2.18 percent respectively.

CONCLUSIONS

1. Any variety of beans that is least susceptible to the factors which cause pick, and yet produces an excellent yield of beans, should become a favorite among bean growers.

2. Varieties of beans with a larger per cent of upper pods suffer less damage during adverse weather conditions.

3. Varieties whose leaves drop off during the ripening period tend to dry easier and prevent further damage.

4. The most advantageous time for harvesting is more evident when the ripening period is short. Excluding all factors except moisture, beans with a short ripening period have less pick.

5. Varieties with a higher per cent weight of pods to beans, pick less.

6. Damage to beans by disease depends upon the kind of disease, how severe it is, and the susceptibility of the variety.

7. No definite relationship exists between soak and pick.

8. Robust beans have fulfilled the foregoing factors better than any other variety. They should continue to be a favorite among bean growers.

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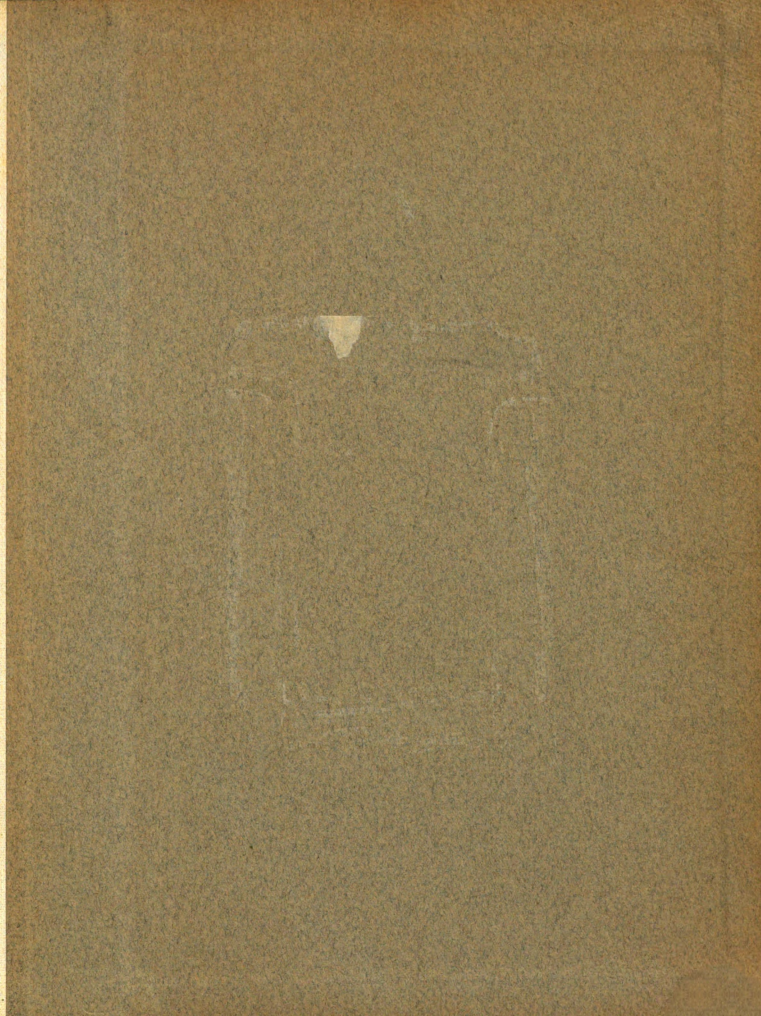
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