

October 1, 1959

Dr. Richard Klein
Botanical Garden
Bronx Park
New York 58, N. Y.

Dear Dr. Klein:

In accordance with our discussion of ten days ago, I am enclosing a synopsis of my results of bean vines along with an explanation. Copies of the three graphs showing ratio of beans to shucks are included.

While in New York, I searched through the Agricultural Index from its start in 1916 down to May 1959. Also I examined the first twelve volumes of Bibliography of Agriculture from 1942 through 1948. There are hundreds of articles about vines. Nearly all tell how to beautify ones garden. Perhaps a dozen are of descriptive nature giving details on the plant structure. Only three described any kind of physical experiment on vines. These were all by H.V. Hendricks during the years 1919-1923 and all were quite different from my efforts.

I will be pleased to have you examine my enclosures and send me any comments and suggestions.

Sincerely yours,

Grote Reber

GR/j
Encl.

REVERSED BEAN VINES

by
Grote Reber

Eight different kinds of pole beans were planted in rows of about fifty hills each. All eight kinds twined about the poles in the same direction, namely a right-hand screw thread. The vines on even numbered poles of three rows were carefully unwound and twined backward. The runner was loosely tied about two inches below tip. This process was repeated whenever the runner had grown eight to ten inches. The period between ties was only a couple of days at first and gradually increased to about ten days as vines reached full growth. All vines and beans were allowed to ripen, wither and dry on the poles. Then the plants were harvested. The field data on each hill consists of: number and weight of pods, number and weight of beans, weight of shucks, number and weight of vines. Since the vines still appeared to be a bit green in places, the vines and shucks were saved and sun dried for about ten days. They were then reweighed. The vines of row #8 turned out to be rather more green than expected.

The data may be analysed on a group basis or a hill basis. Both results are shown in the table. In all cases there is an appreciably better ratio of oz beans/oz shucks and to a lesser extent oz beans/oz vines for the reversed vines compared to normal vines. This experiment was also done in a qualitative way both on Maui, Hawaii and Tasmania, Australia with similar results. The reversed vines gave somewhat better production of green beans in these cases. The unknown bean of row #8 was used. The vine turns the same way in both northern and southern hemispheres.

The unknown bean of row #8, I started using in Hawaii, but it is probably not a native of these islands. It is tan with fine irregular black streaks. Occasionally a bean turns up which is black with fine tan streaks. If one of these black beans is in a pod, all the rest in that pod are the same. Thus they are similar to identical twins. These black beans are more prevalent on the reversed vines.

I can supply a small quantity of seed from both normal and reversed vines to anyone interested in continuing these experiments.

Grote Reber
30 Sept 59

(continuation of Page 1)

<u>Oz of Beans</u>									
<u>Oz of Dry Shucks & Vines</u>			1.34			1.54			15
Percent Black Beans	1.5	.5	1.7	3.3	.8	3.2	1.4	120	88

Synopsis of Results 19

3 copies

Kentucky Wonder

Row #6

25 Normal Hills
29 Reversed Hills

	Normal Vines			Reversed Vines			Average of Hills Reversed from Normal Sum of 5 Hill Groups	Reversed Vines	
	Average of Hills	Standard Error	Group	Average of Hills	Standard Error	Group		Percent Increase	
								Hills	Group
Beans per Pod	7.16	.12	7.21	7.18	.09	7.05	0.1	0.4	-2
Beans per Oz	67.5	1.19	67.5	63.7	.98	64.0	-1.8	-6	-5
Oz of Beans Oz of Shucks	2.22	.08	2.19	2.68	.07	2.65	3.1	21	21
Oz of Beans Oz of Vines	2.90	.27	1.83	2.35	.18	2.08	-0.1	-2	14
Oz of Beans Oz Shucks + Vines	1.10	.07	1.00	1.22	.05	1.17	1.0	11	17
Oz Beans Oz Dry Shucks + Vines									

Corn Bean

Row #7

20 Normal Hills
16 Reversed Hills

Beans per Pod	6.93	.14	7.08	6.60	.17	6.62	-1.1	-5	-6
Beans per Oz	60.1	1.94	59.6	63.3	.31	60.6	.7	5	2
Oz of Beans Oz of Shucks	2.12	.09	2.11	2.90	.24	2.57	2.2	37	22
Oz of Beans Oz of Vines	2.77	.28	2.91	3.55	.37	2.73	1.2	28	13
Oz of Beans Oz of Shuck + Vines	1.18	.07	1.12	1.56	.13	1.32	1.3	32	18
Oz Beans Oz of Dry Shuck + Vines			1.35			1.55			15

Unknown Bean

Row #8

22 Normal Hills
22 Reversed Hills

Beans per Pod	3.46	.15	3.57	3.63	.09	4.93	.7	5	24
Beans per Oz	53.3	1.5	52.1	50.3	.98	48.9	-1.2	-6	-6
Oz of Beans Oz of Shucks	2.20	.21	1.96	3.90	.25	3.01	2.6	54	54
Oz of Beans Oz of Vines	.73	.06	.68	.99	.16	.74	1.2	36	9
Oz of Beans Oz of Shuck + Vines	.52	.05	.50	.73	.09	.60	1.5	40	20
Oz Beans Oz of Dry Shuck + Vines			1.34			1.54			15
Percent Black Beans	1.5	.5	1.7	3.3	.8	3.2	1.4	120	88

Row #4, Bush Beans

5 Oct 59

Hill	Condition of Vines	Number of Vines	Ounces Vines	Number Pods	Ounces Pods	Number Beans	Ounces Beans	Ounces Shucks	Beans Ory (Vines+Shucks) Ory	Beans Pod	Beans per oz.	Oz. Beans Ory. Shucks	Oz. Beans Ory Vines	Beans in Pods
Control Hills														
1	Very Dry	1	.1	2	.15	7	.1	.05						61
10	"	1	.1	2	.25	15	.15	.1						96
5000 R Hills														
3	"	1	.2	6	.6	31	.4	.2						755
10	"	2	.2	15	1.2	64	.9	.3						617
7500 R Hills														
2	"	1	.2	11	1.1	55	.9	.2						3445
2	"	1	.2	7	.8	34	.6	.2						5567
10000 R Hills														
3	"	1	.1	10	.8	50	.65	.15						24955
10	"	1	.4	8	1.1	49	.9	.2						56667
	Sums		1.5		6.0		4.6	1.4						

Weighed total beans = 4.9 oz

Weighed total vines plus stubs 3.1 oz.

6 Sept 59

Bush Beans.

5000 r.	Hills	# 3 + # 10
7500 r	"	# 2, 4
10000 r	"	# 3, 6
Control		1, 10

Wild game seeds still not ready to harvest.
 Harvested all beans from row # 1. Secured 4 lbs 0.3 oz
 dried pods, also about 3 lbs of green + partly mature beans.
 (over)

7 Sept 59

dried pods

These were shucked with following results
15.5 oz shucks, 2 lbs 15.9 oz beans. No black beans

Examined six bush bean vines. The beans are maturing faster than normal twining vines. Should be ready to harvest in a week or ten days.

On 4th Oct 59

Harvested a half coffee can
of triple winged seeds from
wild game, all along road
between Hovatum + dip down
to Deer Creek.

SEQ 01 Enter data
Miss CP

SEQ 19 Mean

SEQ 03

$$RMS = \sqrt{\frac{\sum (x_i - \bar{x})^2}{n-1}}$$
$$SE = \sqrt{\frac{\sum (x_i - \bar{x})^2}{n(n-1)}}$$

13 Sept 1959 Weighed dry vines ^{plus stubs} Row #8

Group	Hills #1-20	Hills #21-48
Normal	14.8 oz	23.8 oz
Reversed	13.0 oz	26.9 oz

30th Aug 1959 Bush Beans
5000 on hills #3 & #10

Twined row #5 on 22nd & 30th
cleared row #4 on 23rd to
eliminate runners, etc. Must
count number of vines of pole &
bush beans in each category
on row #4 as well as
weigh beans.

23 Aug - 2nd Sept it rained every day
at sometime during the 24 hours. This
caused rapid growth of secondary vine
and new purple flowers on row 8

Harvested row #8

Hills #1-20 on 3 Sept
#21-48 on 4 Sept.

#1 at east end, #48 at west end

6 Sept, cut all vines in #7 row
at ground level to make dry rapidly

11 Sept Harvested hills #1-#18

of row #7

Temp 44° at 1030pm

12 Sept 34° at 530am

Harvested hills #19-32 of row #7

Cut all vines in row #6 at ground level,

Rejected 18 very small dried beans from

Normal Vines, Hills #1-#18, row #7

These in total weigh less than 0.1 oz
in dried form.

13 Sept 34° at 6am

Harvested all but hills #47+49 row #7

14 Sept

Finished harvest of row #7

cut the eight bush beans at ground
level in row #4.

1959

18 June Tied beans reversed

24 June Tied beans reversed

27 " " " "

29 " " " "

Continued to tie beans at irregular periods of a few days up to 17 July. On trip until the 25, so nothing done.

25, 26 July. Tied beans on rows 7+8. Row 8 has about stopped growing. Row 7 still growing moderately. Rows 7+8 do not put out significant ^{extra} runners but confine themselves to climbing the poles.

Rows 5+6 throw out a lot of secondary runners especially when vines are small. These cause the vines to be a tangled mass at bottom of pole. Decided to clean up vines. Cut off all extraneous runners at bottom so vines are clean up to 6" or 8" above ground. Took off all except 3 or 4 strongest vines climbing poles. This makes rows 5+6 look more like rows 7+8. On row 5 there were no beans. On row 6 a considerable number of beans were found on material cut off, both on runners and at base of vines. All were saved but without sorting, according to normal and reversed vines. The total was $1\frac{3}{4}$ lbs which is a small amount. By observation, rather more than half, say 1 lb, came from reversed vines or runners there from.

Decided to confine my efforts to rows 5, 6, 7, 8.

The irradiated beans are beginning to twine. All go normal direction. Three or four plants are beginning to flower but are not sending up runners. Perhaps these are converted to bush beans. The effect of the irradiation seems to be to stunt the plants as those at end of row having 10,000r are only about half as high as unirradiated plants at other end of row. This is not due to soil as other rows of bean vines show rather better development at same end of row as 10,000r beans were planted.

31 July Sprayed to get rid yellow maggots under leaves. Row #8 doesn't need twining as has finished growth. Twined row #7 a bit but these growing slowly.

1st August, Twined rows #5 & #6 which are still growing fast. Hoed weeds.

6th August, Twined row #5 which is growing fast.

7th " " " #6

8th " " " #7

10th " " " #5 again as still growing fast.

12th " " " #6, #7, these have about stopped growing

17th " " " #5 still growing fast,

Decided to cut all the vines at top of pole. This makes all uniform upper limit. Most of vines cut were the normal ones which grow fastest. 11oz of beans were taken from cuttings of normal vines on row #7. None of the other rows had any beans on parts cut off.

16 May 59

Bright & Sunny. Ground damp from several days rain. Good south west wind, 2:00 to 5:30 pm planted beans in eight east-west rows. Hills spaced $2\frac{1}{2}$ ft and rows 4 ft apart, 6 to 8 beans in each hill all beans prepared with Legume-aid which is a black powder before planting. Beans placed about 3" to 4" deep. Varieties as follows starting at south row.

South	White Half runner
	Logan Giant
	Burpee Golden
	Burpee Big 6 Lima
	Cardinal or Sierra Lima
	Kentucky wonder
	Corn bean from Nellie (Probably same as Burpee Golden)
North	Hawaii bean from Goodspeed.

Then put one scarlet runner bean on each side of east pole on rows # 2 thru # 7

Replanted rows 5 & 6 on 6 June 59; Beans $\frac{1}{2}$ " to 1" deep
Replanted rows 1 & 2 on 8 June 59 " " " "
Replanted row # 3 on 10 June 59
Dusted beans on 11 June 59 + 20th June.

22nd June, Irradiated beans returned from Brookhaven.
Came in four packets as follows: Control, 5000r, 7500r,
10,000r. I planted these in row 4, a total of 48
hills were made. The east end 12 hills were control
with 7 or 8 beans per hill (all available). Next 12 hills
each 9 beans of 5000r. Next 12 hills each nine beans
of 7500r. West 12 hills each nine beans of 10,000r.
These are Kentucky Wonder beans like row #6.
Beans planted an inch deep. One cup of water placed
in hole with beans. Then filled and two more
cups of water poured on top.

The two existing hills of Bumper Big 6 Lima
were allowed to stand.

Row # 4

Rained 12th - 15th Oct.

Cleared on 16th

Remained clear to 21st.

Picked beans on row # 4 on 20 + 21st

Rained night of 21-22 st and continued thru the 24th.

Cleared night of 24th - 25th.

Clear on 25th + night 25-26th up to 3pm 26th.

26th from 4 to 6 pm. Brought in hulls

{ # 45 - # 48, # 5 - # 3 quite dry yet

Also # 24 - # 13 a bit damp as began to drizzle again after 5:30pm

Set all down to dry in Hill house.

27th rained. Analyzed hulls # 45 - # 48 + # 5 - # 3 + # 23 + # 24

28th cleared. Analyzed hulls # 13 - # 22

30th harvested hulls # 25 - # 36 and two of lines

2nd Nov. analyzed hulls # 25 - # 36 + two of lines

Harvested Hill # 37-48 on 20th
Harvested Hill # 12-16 on 21st

The vines on row #4 did not mature properly. The frost killed vines too soon. These vines dried in later warm weather. The leaves all fell off leaving bare vines with hard dry pods. Since the pods not mature the beans are small. Also they did not dry properly, but were killed by freezing. There a lot of water was in bean. It gradually dried and shrunk making a withered look with wrinkles, also a kind of white mould set in and stuck the beans to pod. They are very difficult to shuck. The outside of pods is all black with a different kind of mould. In spite of these difficulties all parts of row seemed to be killed at same relative maturity because the beans all show about 100 to the ounce. In all categories there are a few hard smooth shiny mature beans. These might be worth experimenting with next year. Probably less than 3% of beans appear mature and most of these are under size compared to beans in row #6.

Row # 4

21st Oct 59

Hz	Condition of Vines	Number of Vines	Ounces Vines	Number of Pods	Ounces Pods	Number of Beans	Ounces Beans	Ounces Shucks	Oz Beans <u>Oz Vines + Shucks</u>	Beans <u>Pods</u>	Beans per oz.	Oz Beans <u>Oz Shucks</u>	Oz Beans <u>Oz Vines</u>
1	Missing												
2	Missing												
3		7	1.4	39	2.9	213	2.1	0.8					
4	Missing												
5		6	1.4	45	3.6	285	2.5	1.1					
6		4	1.1	39	4.3	277	2.9	1.4					
7		8	1.1	30	2.9	157	1.5	0.9					
8		6	1.7	46	3.9	263	2.5	1.3					
9		5	1.6	65	5.8	406	3.9	1.9					
10		4	1.5	32	2.6	178	1.8	0.9					
11		7	1.5	47	3.5	237	2.4	1.1					
12		6	1.8	58	5.2	356	3.6	1.6					
13		4	1.1	45	2.6	214	1.6	1.0					
14		6	1.5	79	5.6	449	4.0	1.7					
15		4	1.5	53	3.0	217	1.7	1.4					
16		3	1.1	65	5.1	389	3.8	1.6					
17		4	1.5	57	4.5	320	2.5	1.9					
18		2	2.1	45	3.5	234	1.9	1.6					
19		2	2.0	22	1.4	104	0.6	0.8					
20		6	1.5	45	3.0	218	1.7	1.4					
21		7	2.3	65	4.1	313	2.6	1.5					
22		4	1.6	45	4.0	301	3.0	1.0					
23		4	1.4	68	5.4	407	4.0	1.6					
24		5	1.6	67	5.5	451	4.0	1.6					

Row # 4

20 Oct 1959

Plant	Condition of Vines	Number of Vines	Ounces Vines	Number of Pods	Ounces Pods	Number of Beans	Ounces Beans	Ounces Shucks	Oz Beans Oz Vines + Shucks	Beans Pods	Beans per oz	Oz Beans Oz Shucks	Oz Beans Oz Vines
25		8	1.9	59	4.6	371	3.5	1.1					
26		7	1.8	49	2.9	209	1.9	1.0					
27		6	1.9	66	4.7	379	3.4	1.4					
28		6	1.5	52	4.0	303	2.8	1.2					
29		8	2.4	79	5.4	412	3.8	1.7					
30		6	1.8	83	4.0	301	2.6	1.4					
31		3	1.9	67	4.6	386	3.2	1.5					
32		5	1.0	26	1.4	88	0.7	0.6					
33		2	1.1	16	1.0	62	0.5	0.5					
34		5	2.0	65	4.5	310	2.7	1.9					
35		5	2.2	37	2.9	211	1.9	1.0					
36		4	1.1	44	3.1	206	2.0	1.1					
37		3	1.3	79	4.8	271	2.5	2.3					
38		3	1.1	36	3.0	172	1.5	1.5					
39	Missing												
40		5	1.1	24	2.3	110	1.0	1.2					
41		5	1.6	31	2.2	134	1.1	1.2					
42		5	1.5	45	3.5	209	2.1	1.4					
43	Missing												
44		7	2.8	99	7.5	589	5.0	2.7					
45		5	2.1	72	5.9	392	3.9	2.0					
46		5	1.0	56	4.3	256	2.5	1.9					
47		2	0.8	13	0.5	26	.15	.35					
48		3	0.9	38	3.2	169	1.9	1.3					

2nd November 1959

Row # 4 Lima Beans

Vine	Rotation	Normal 2 plants split to 8 vines	Reversed 1 plant split to 5 vines
Number of Vines			
Ounces Vines		6.5	4.8
Number Pods		2	10
Ounces Pods		0.4	2.5
Number Beans		3+3 = 6	5+6+6+3+4+4 +6+5+4+5 = 49
Ounces Beans		0.2	1.5
Ounces Shucks		0.2	1.0

Normal pole in position # 49 at west end of row
 Reversed pole between hills # 30 & # 31 of X-rayed beans.

3rd November 59

Weighted Beans + Vines Row # 4 in Gross.

Hills		Beans	Vines plus stubble
1-12		20.1	22.0
13-24		30.1	33.1
25-30	17.0	27.1	33.0
31-36	10.1		
37-48		20.5	26.8

These have been drying since being analysed.

Two Hills of Linas

Normal	6.7
Reversed	5.8