QUALITY EVALUATION OF CANNED BUSH SNAP BEANS GROWN IN OREGON

by

MEHMET ARIF ARAT

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APPROVED:

Professor of Food Technology

In Charge of Major

Head of Department of Food Technology

Chairman of School Graduate Committee

Dean of Graduate School

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CHAPTER I

INTRODUCTION

Snap (string, green) Beans (Phaseolus vulgaris L.), the garden varieties developed for edible pods, are of two common groups: green-podded and yellow-podded or wax. Through breeding, the "strings" have been so reduced as to warrant the name "stringless", (36, p. 347).

Oregon ranked second among all states in the total tonnage of beans produced in 1946. It ranked first in yield obtained per acre, with an average yield 3 times larger than the national average. In Oregon beans are quite widely grown for canning and freezing. In 1934, only 900 acres of beans were grown for processing. In 1949, approximately 6,600 acres of land were planted to this crop for canning and freezing, (3, p. 3).

The cost of picking Pole Beans is very high. Labor accounted for about 80 percent of their total cost of farm production, (10, p. 4). A mechanical bean harvester has already been developed, but the ideal snap bean adapted for the mechanical harvester has not yet been developed, (38, p. 40).

This study is an attempt to evaluate the canning quality of 40 varieties of snap beans grown in Oregon by noting and comparing the factors: 1. Percent of seeds by weight (wet and dry seeds), 2. Percent of fibrous material, and 3. Turbidity number of the canned bean liquor.

CHAPTER II

REVIEW OF LITERATURE

"Wittmack, in his investigations of seeds of Peruvian tombs, found a number which he identified as varieties of Phaseolus vulgaris and obtained evidence conclusive enough to convince De Candolle that the species is of South American origin," (36, p. 347).

The snap bean is an important and widely grown vegetable crop with many factors contributing to its wide distribution. These factors are adaptability for growth on a wide range of soil types; the short period from planting to usable maturity which allows the crop to fit easily into cropping systems; and breeding selection which has adapted the plant to each great agricultural region in the United States, (4, pp. 309-311).

Kramer (24, pp. 38-46) tells us that the three important factors of quality for green beans are maturity, size, and lack of fibrousness. He states that maturity may be measured by the proportion of the weight of seeds to the pods; size by determining the mean diameter from suture to suture; and fibrousness by alkali digestion. Maturity is apparently judged in various ways, such as ratio of hull to seed, size of

pod, and length of seed.

The United States standards for grades of canned green beans (30, p. 1) are concerned with the following factors: clearness of liquor, color, absence of defects, and maturity. The relative importance of each factor is expressed numerically on the scale of 100. The maximum number of points that may be given each factor is:

	Points
1. Clearness of liquor	10
2. Color	15
3. Absence of defects	35
4. Maturity	40
Total Score	100

The factor of maturity refers to the degree of development of pods and seeds and the tenderness of the pods. Stark and Mahoney (34, pp. 353-359) have shown that the parchment or fibrous sheath of the side walls, as they call it, is actually in the inner mesocarp. The tissue starts as a one-celled layer of parenchyma and later develops into a region several cells in thickness. These workers have shown that the variety Bountiful differentiates these small close-fitting parenchmatous cells into fibers three days sooner than the variety Giant Stringless Green Pod, but at twenty days after anthesis, both varieties show equal development and

thickness of the cells of the fibrillar layer. They further show that cool temperatures and abundant rainfall produce less thickening of these cells and that high temperatures accelerate cell wall thickening. Harris (20, pp. 44-47) has shown that the seed weight is correlated with the relative position in the pod as well as with the number of seeds per pod.

Culpepper (9, pp. 357-377) states, "The value of any vegetable as a food product depends primarily upon its composition and palatability. Both are generally greatly influenced by the stage of maturity at which the material is prepared for use." Flynn, et al, (12, p. 419) mention that with increasing maturity at the time of harvest the yield progressively decreased from 2698 kg. per acre for immature beans to 734 kg. for beans harvested when markedly overmature.

Kramer (25, pp. 55-63) states that quality may be measured by one of two methods: either the organoleptic or the objective. The organoleptic method refers to evaluation by the senses, such as seeing with the unaided eye, feeling with the fingers, chewing or smelling. The objective method is one that is based on the use of an impersonal instrument or by chemical procedure. The advantage of the organoleptic method is that the determination is made by employing the very same senses

that are used by the consumer. The organoleptic grader does not possess a fixed point of reference, and for that reason he may vary considerably from day to day and certainly between seasons. In some cases where the quality evaluations are not based on objective measures, the definition of the factor of quality is not satisfactory. The objective method, on the other hand, eliminates to a large extent this possibility of disagreement because it automatically eliminates the human element. No matter how precise and accurate a method may be, it is not worth very much if the determination is made on an unrepresentative sample, if the procedure is not followed exactly, or if the particular instrument used is not properly adjusted.

Gould (17, p. 54) states that all of the measures of quality evaluated on canned snap beans (seed length, tenderness, lack of fiber and clearness of liquor) were found to correlate with maturity. The value found to have the highest positive correlation was seed length. This would seem to be an excellent objective measurement of maturity in contrast to deseeding of the pericarps and weighing the seeds. The length of the seeds could be measured directly in the field, since weighing equipment would not be needed and a very reliable indication of maturity would result. The values proposed as maximums

to correspond with the immature, optimum, and mature stages of maturity are 9, 13, and 17 millimeters, respectively, fresh basis. Clearness of liquor on the canned product gave a negative correlation of -0.63 with percent by weight of seeds. It is possible that cloudy liquors can be produced by using pieces of snap beans, extra long cook, excessive agitation, or cloudy water.

Gould's laboratory has constructed an instrument called the Textureometer, (14, pp. 26-27), by which the tenderness of canned beans can be determined. It is easy to use and to clean. Maturity in Gould's work was based on percent of seeds by weight; that is, the pods were de-seeded and the seeds weighed. Samples with 8 percent or less seeds were considered grade A or immature, 8 to 16 percent were graded B or optimum, and those with seed content from 16 to 25 percent were graded C or mature.

One of the major problems confronting the snap bean processors today is the maximum tolerances set by the Food and Drug Administration for fiber in the canned product. This value was originally (1947) set at 0.12 percent. However, in June 1948 the tolerance was raised to 0.15 percent, since few processors could meet this lower level, (16, pp. 42-44). The rapid procedure set up by Rowe and Bonney was the method used in determining the fiber content.

The Food and Drug Administration (13, p. 3726) announced that the details of the chemical method for determining fibrous material have not been sufficiently clear, and suggested that a few changes in its wording would make it easier to apply. The following expanded description should be used:

> "Transfer to the metal cup of a malted-milk stirrer and mash with a pestle. Wash material adhering to the pestle back into cup with 200 cc. of boiling water. Bring mixture nearly to a boil, add 25 cc. of 50 percent (by weight) sodium hydroxide solution and bring to a boil. (If foaming is excessive, 1 cc. of capryl alcohol may be added.) Boil for 5 minutes, then stir for 5 minutes with a malted-milk stirrer capable of a no-load speed of at least 7200 r.p.m. Use a roter with two scalloped buttons. Transfer the material from the cup to a previously weighed 30-mesh monel metal screen having a diameter of about 3½ to 4 inches and side walls about 1 inch high, and wash fiber on the screen with a stream of water, using a pressure not exceeding a head (vertical distance between upper level of water and outlet of glass tube) of 60 inches, delivered through a glass tube 3 inches long and 1/8 inch inside diameter, inserted into a rubber tube of ¼ inch inside diameter. Wash the pulpy portion of the material through the screen and continue washing until the remaining fibrous material, moistened with phenolphthalein solution, does not show any red color after standing 5 minutes. Again wash to remove phenolphthalein. Dry the screen containing the fibrous material for 2 hours at 100° C., cool, and deduct weight of screen. Divide the weight of fibrous material by the weight of combined deseeded pods, trimmings, and strings and multiply by 100 to obtain the percentage of fibrous material."

Percent by weight fiber (15, pp. 26-70): According to Gould, the maximum for grade A should be 0.05 percent, for grade B 0.10 percent, and for grade C 0.15 percent. In the canned product, varieties that he found to meet the fiber standards of 0.15 percent and percent by weight of seeds under 16 percent or in the grade A and B range were: Idaho Refugee, Giant Stringless, Green Pod, Asgrow Stringless Green Pod, and Landreths' Stringless Green Pod. Varieties that were definitely unsuitable for canning were Bountiful, Tennessee Green Pod, Hopkins Earliest Red Valentine, Sure Crop Wax, Stringless Black Valentine, Florida Belle, Stringless Refugee, U. S. Refugee No. 5, Improved Commodore, Pencil Pod Black Wax, and Keystonian (19, p. 28).

Siegel (32, p. 16) analyzed round-pod Asgrow Stringless green beans which were packed in Western Maryland. Seed percentage was 3.7 to 14.6. Fibrous material percentage ranged from 0.003 to 0.069. Gould concludes that:

> "Fiber is an index of quality for each variety at the different stages of maturity, and thus it should be evaluated accordingly, (16, pp. 42-44). This fact suggests that processors must have varieties evaluated within their own production areas, if climatic conditions do effect fiber development; or processors cannot rely wholly on seedmen's statements as to the amount of fiber in the particular varieties at the different stages of maturity."

CHAPTER III

EXPERIMENTAL PROCEDURE

A. Materials

Data were obtained on forty varieties of bush snap beans (Table VI) grown in Oregon by the Horticulture Department of Oregon State College and canned by the Food Technology Department in July, 1950, using a regular bean canning process (8, pp. 220-223). There were a few replicated lots and a few second pickings. Those which have numbers only were from the United States Department of Agriculture trials. After four months storage at the warehouse of the Food Technology Department we opened each variety of beans and tested them for three quality factors by the objective methods described below. These tests were run for every variety until the deviation of the two results appeared reasonably irreducible.

B. Methods of Analysis

Each variety of canned bush snap beans was analyzed for the following:

1. Percent of seeds by weight (wet and dry seeds)
2. Fibrous material
3. Turbidity number

The methods of analysis were:

1. Percent of seeds by weight (wet and dry seeds)

a. Wet seeds. The general standard method for determining the percent of seeds by weight was followed with little change, (31, pp. 620-628).

The contents of the can were transferred to a container. Two cans of water were added, mixed, and spread on an 8-mesh screen. The screen was tilted as much as possible without shifting the beans, and they were drained for 2 minutes exactly by using an interval timer.

One hundred fifty grams of drained beans were weighed out. The seeds were separated from the pods by using a knife, and separated into aluminum weighing boxes. The seeds (S) and pods (B) were weighed separately.

From these two weighings, the percent of seed by weight was calculated in this formula:

$$\frac{S}{(B + S)} \times 100 = \% \text{ seed}$$

The pods were weighed accurately on a triple-beam balance to the nearest 0.1 gm. and estimated to 0.05 gm. The seeds were weighed on an analytical balance to greater accuracy.

b. Dry seeds. The method for determination of the percent by weight of dry seeds was not in the literature. It was thought that it would be better to make determinations on the dry seeds, because water collected on the seeds when they were being picked from the pods. To get the true weight of seeds, the aluminum box of wet seeds was dried in a 100° C. oven for 2 hours, cooled in a desiccator, and weighed on an analytical balance. Percent by weight of dry seeds was calculated in the same way as of wet seeds.

2. Fibrous material. The method adopted for the fibrous material determination was essentially that of Rowe and Bonney (31, pp. 620-628). One hundred grams of the pods, which had been separated from the seeds, were weighed. These pods were cut into pieces approximately ½ inch in length. This cutting was done as the seeds were picked from the pods. The samples were pulped in a large mortar for five minutes exactly, without stopping, and in the same manner each time. The pulp samples were transferred to the metal cup of a malted milk mixer with 200 cc. of boiling water to which was added ½ gram of paraffin. The mixtures were brought to a temperature of 99° C., and 25 cc. of 50 percent sodium hydroxide solution were added. (The 50 percent sodium hydroxide solution was prepared by dissolving 50 grams

sodium hydroxide in the 100 ml. distilled water.)

Afterwards sodium hydroxide solution was added to the mixtures. They were boiled exactly 5 minutes; then they were stirred for exactly 5 minutes with a malted milk stirrer (capable of a no-lead speed of at least 7200 r.p.m.). The mixtures were filtered with suction through a tared 30-mesh monel metal screen fitted into a Buchner funnel.

The pulp was washed through the screen with a ½-inch stream of boiling distilled water.

After washing the fiber on the screen free of alkalinity (1-1.5 liters of water), it was further washed with a stream of boiling water until the pulp was removed and the washings were clear. Two and one-half liters of boiling distilled water were used for every test. The Food and Drug Administration method (13, p. 3726) has the disadvantage that a standard volume of wash water is not called for.

The screen and fiber were dried at 100° C. oven for 2 hours, cooled in a desiccator, and weighed on an analytical balance.

The difference in weighings was reported as fibrous material.

It was noticed that the original Rowe and Bonney methods (31, pp. 620-628) gave such directions as:

a. "Pulp the sample in a large morter." We ourselves saw that a time length is necessary for this pulping. The longer we pulped, the less fiber we got. So we pulped every sample for 5 minutes and exercised care to pulp the sample uniformly.

b. "Bring the mixture to a boil and add sodium hydroxide." Since it is difficult to determine the right time to add sodium hydroxide (NaOH), because the container is metal and deep, we added NaOH when each sample was at 99° C., and we continued heating it for exactly 5 minutes; for if any were boiled for more than 5 minutes, it would yield low fiber.

c. "Wash the fiber until the pulp is removed and washings are clear." It is hard to tell whether or not the washings are clear because small pieces of pulp are always present. We used exactly 2.5 liters of water for washing each test. The more water we used, the less fiber we got.

These three improvements of Rowe and Bonney methods were made by the Food and Drug Administration also, but in different ways, (13, p. 3726):

3. Turbidity Number. The turbidity tester of Kertesz (23, pp. 15-16) was used for determining the turbidity number of bean liquor. The can was shaken

five times up and down as in bacteriology laboratory technique, and then it was opened. The liquid was poured into the tester, and the number was read as rapidly as possible.

The Turbidity Tester consists of a pair of wedge-shaped containers obtained by diagonal separation of a box-like structure constructed from Plexiglas or any other transparent material. It has two side walls of 9.5 x 12.8 cm. dimensions, held together by two narrow plates, 2.5 x 12.8 cm. in size. The structure thus formed is open on the bottom and the top but is diagonally divided by a plate on which a scale is engraved.

For the determination, the top section of the instrument is filled with the test liquid, and then the observer's vision is directed horizontally from the direction of the narrow side of the instrument through the liquid and toward the dividing plate with the scale. The last line which is still visible through the liquid column is established, and then this point is read to the nearest 0.25 or 0.50 unit on the scale. Since the scale indicates the thickness of the liquid column in centimeters at any of the different levels, the reading, called the "Turbidity Number" or TN, will indicate the maximum distance in centimeters through which the scale is visible.

It is recommended that the observer hold the device away from the light, with the major light source behind his back. Within reasonable limits, the intensity of the light and the coloring of the test liquid do not affect the TN values obtained. Good light makes the reading easier. When a reading is completed, the test liquid is poured out and the container is rinsed. Thereupon the device is turned upside down and the top wedge is used for the next test while the other drains and dries.

CHAPTER IV

RESULTS

A. Presentation

The complete list of snap beans (*Phaseolus vulgaris* L.) and the results of the analyses are presented in the Appendix Table VI. This table shows for every variety of beans percent of wet seeds by weight, percent of dry seeds by weight, percent of fibrous material, and turbidity number of liquor, including also their averages and deviations.

Table VII includes identification of the beans, date they were canned, and date opened.

The raw data from the Appendix Table VI were re-arranged in Tables I, II, and III to list the varieties and pickings in order of merit for each objective quality factor investigated.

B. Discussion of Results

1. Percent of wet seeds by weight: In the Appendix appears Table VI which summarizes the results of percent of wet seeds and percent of deviation. Table I re-arranges the varieties from Table VI in order of percent of seeds by weight. The range of percent of seeds is between 2.02 and 7.14 percent as shown in

Table I. All samples having less than 8 percent seeds are classified as grade A by Gould's standards, (15, pp. 26-70).

The 14 best varieties of beans (Table IV) have 2.02-3.65 percent wet seeds. In this list Rival is on top with 2.02 percent. We agree with other workers (19, p. 39) that Rival is the best variety for percent wet seed, because it gives a very low percentage of seeds. (Table IV.)

Next to Rival ranks the new United States Department of Agriculture variety B 2334-1-1 with 2.05 percent wet seeds. This variety is also present in the list of varieties which was compiled from the 22 best varieties in all three quality factors (Table IV) for percent fiber and clearness of liquor of canned beans.

When picking the seeds from the pods and putting them into the aluminum box, much care was exercised in order not to collect water with the seeds. This special care is needed when the seeds are small in size because in such cases it is difficult to pick the seeds without collecting water, and some inaccuracy in the data may result.

2. Percent of dry seeds by weight: From Appendix Table VI we can see that the figure of percent of dry

seeds for these forty varieties of snap beans lies between 0.22 and 1.16 percent. The deviation of the results is very high compared with the wet seeds data. Perhaps the varying sizes of the seeds cause them to contain different amounts of water, and in addition to instrumental error, give these large percentage deviations in the results. Also this method is more expensive because it requires more power, more equipment, and more time. Therefore, it is not satisfactory, and no separate table listing the varieties according to this factor was compiled.

3. Fibrous material (crude fiber, or percent of fiber): The figures for the fibrous material of forty varieties bush snap beans show a range of 0.008-0.207 percent (Table II). Different varieties of even approximately the same percent wet seed give different percentages of fiber.

From these varieties we picked the 22 best varieties with a fiber content of 0.008-0.031 percent. Twenty-two varieties were chosen in order to have Topcrop, an important new variety, appear on all three lists. Rival variety was in this list with 0.011 percent fiber. From these lists of 22 best varieties, including Topcrop, which were selected for wet seeds, fiber and turbidity number, we found only 14 varieties present on

all three lists. Some varieties are near the top on one of the lists, but rank as inferior on another. For example, the new United States Department of Agriculture variety, B 1229-1-2-6, is 5th on the wet seeds list (Table I), but 29th on the fiber list (Table II).

Topcrop is the 11th best variety (Table IV). This result for Topcrop does not quite agree with Wegener (35, pp. 54-56) and Zaumeyer (38, p. 40), but our varieties were not the same as theirs in every instance. For example, they compared Topcrop with Tendergreen, Stringless Green Pod, Stringless Black Valentine, etc.; we did not test these varieties.

In general, we found a low fiber content in bean varieties. Perhaps the climatic condition caused this result in 1950. Stark and Mahoney (34, pp. 353-359) state, "It appears that conditions of high temperature and low rainfall have an accelerating effect on cell wall thickening."

4. Turbidity Number: In Appendix Table VI, we have recorded the result of this work. (Table III) In general, we found that the higher the fiber, the lower the turbidity number. A low turbidity number indicates cloudy canned bean liquor.

We did not find any other results cited in the

literature, because the use of a turbidity tester of Kertesz (23, p. 15) is so new in this field that results of tests have not yet been reported. Rapid and dependable results can be obtained with this tester.

Of Pole Beans we ran 4 varieties. They yielded very high turbidity numbers, higher than that of all bush beans except United States Department of Agriculture 1515 1-7-1-2 (replicate). Naturally, it is not possible to make a final conclusion based on any one factor. (Table III).

TABLE I

Bean Varieties Listed in Order of Percent of Seeds by Weight (Wet)

	Variety U.S.D.A. Number	Food Technology Code		Percent of Wet Seed
1	Rival	(FT. 7)		2.02
2	B 2334-1-1	(FT. 16)		2.05
3	B 2869	(FT. 28)		2.18
4	B 2884-4-1	(FT. 31)		2.26
5	B 1229-1-2-6	(FT. 19)		2.27
6	B 1482-5-3-2	(FT. 52)		2.30
	Pole beans PM 65	(FT. 64)		2.30
7	1515-1-7-1-2	(FT. 58)	(replicate)	2.41
8	B 2095-1-2	(FT. 60)	(replicate)	2.53
9	Puregold	(FT. 61)	(replicate)	2.54
10	B 2669	(FT. 38)		2.94
11	Tenderlong	(FT. 21)		3.06
12	B 1661-7	(FT. 41)		3.09
	Pole beans 2066			3.13
13	B 2248-1	(FT. 39)		3.14
14	Topcrop	(FT. 18)		3.25
15	MGCA-5002	(FT. 26)		3.43
16	Tendergreen	(FT. 62)	(replicate)	3.44
17	B 1801-4	(FT. 29)		3.56
18	B 1763	(FT. 17)	(2nd picking)	3.65
19	B 1468-1-17-12	(FT. 27)		3.70
20	B 1468-1-17-12	(FT. 53)	(2nd picking)	3.73
21	B 1515-1-7-1-2	(FT. 30)		3.95
22	MGCA	(FT. 20)		3.97
23	Rival	(FT. 63)	(replicate)	4.02
24	B 2096-4-1	(FT. 15)		4.15
25	B 1763	(FT. 49)		4.16
26	2095-1-2	(FT. 45)		4.31
27	B 1762	(FT. 14)	(2nd picking)	4.41
28	B 1733	(FT. 24)		4.41
29	Topcrop	(FT. 59)	(replicate)	4.47
	Pole beans 2006			4.57
30	L. Schreiber, Helva wax	(FT. 12)		4.59
	Pole Beans Associated 231			4.68

TABLE I - Continued

Variety U.S.D.A. Number	Food Technology Code		Percent of Wet Seed
31 Puregold	(FT. 11)		4.95
32 B 9126	(FT. 25)		5.01
33 B 2637	(FT. 6)		5.07
34 B 1762	(FT. 56)		5.10
35 Idagreen	(FT. 36)		5.23
36 B 1755-1-1	(FT. 4)		5.57
37 B 2095-1-2	(FT. 10)	(2nd picking)	6.06
38 Logan	(FT. 43)		6.50
39 Contender	(FT. 9)		6.90
*40 B 2568-1	(FT. 3)		7.14

* All varieties are grade A by Gould's standards.

TABLE II

Bean Varieties Listed in Order of Percent of Fibrous Material

	Variety		Percent of Fibrous Material
1	Puregold	(FT. 61)(Replicate)	0.008
2	Rival	(FT. 7)	0.011
3	B 2095-1-2	(FT. 60)(Replicate)	0.011
4	Puregold	(FT. 11)	0.012
5	1515-1-7-1-2	(FT. 58)(Replicate)	0.014
6	B 2248-1	(FT. 39)	0.016
7	Tendergreen	(FT. 62)(Replicate)	0.016
	Pole beans 2066		0.016
8	B 1762	(FT. 14)(2nd picking)	0.017
9	B 1661-7	(FT. 41)	0.017
10	Rival	(FT. 63)(Replicate)	0.017
11	B 2884-4-1	(FT. 31)	0.018
	Pole Beans Associated 231		0.018
12	Topcrop	(FT. 59)(Replicate)	0.019
13	B 2096-4-1	(FT. 15)	0.020
14	B 2869	(FT. 28)	0.020
15	B 2637	(FT. 6)	0.022
16	B 2334-1-1	(FT. 16)	0.022
17	B 1763	(FT. 17)(2nd picking)	0.022
18	Tenderlong	(FT. 21)	0.022
	Pole Beans FM 65		0.022
19	B 2669	(FT. 38)	0.023
20	B 1801-4	(FT. 29)	0.024
21	B 1468-1-17-12	(FT. 53)(2nd picking)	0.024
22	Topcrop	(FT. 18)	0.031
	Pole beans 2006		0.031
23	Idagreen	(FT. 36)	0.032
24	B 1515-1-7-1-2	(FT. 30)	0.035
25	B 1763	(FT. 49)	0.035
26	B 1468-1-17-12	(FT. 27)	0.036
27	2095-1-2	(FT. 45)	0.037
28	B 9126	(FT. 25)	0.039
29	Logan	(FT. 43)	0.040
30	B 1482-5-32	(FT. 52)	0.040

TABLE II - Continued

	Variety		Percent of Fibrous Material
31	B 1229-1-2-6	(FT. 19)	0.042
32	MGCA-5002	(FT. 26)	0.044
33	B 1755-1-1	(FT. 4)	0.045
34	B 2095-1-2	(FT. 10)(2nd picking)	0.048
35	MGCA	(FT. 20)	0.048
36	B 1762	(FT. 56)	0.048
*37	B 1733	(FT. 24)	0.049
**38	Contender	(FT. 9)	0.067
***39	L. Schreiber Helva wax	(FT. 12)	0.114
****40	B 2568-1	(FT. 3)	0.207

* All preceding are Grade A by Gould's standards
** Grade B by Gould's standards
*** Grade C by Gould's standards
**** Grade substandard by Gould's standards

TABLE III

Bean Varieties Listed in Order of Clarity of Liquor

	Variety			Turbidity Number (TN)
1	1515-1-7-1-2	(FT. 58)	(replicate)	8.50
	Pole bean FM 65	(FT. 64)		8.50
	Pole bean 2066			8.50
	Pole Bean Associated 231			8.50
	Pole bean 2006			8.00
2	B 2334-1-1	(FT. 16)		7.75
3	Tendergreen	(FT. 62)	(replicate)	7.50
4	B 9126	(FT. 25)		7.25
5	Puregold	(FT. 11)		7.00
6	B 2248-1	(FT. 39)		7.00
7	B 2669	(FT. 38)		6.75
8	Puregold	(FT. 61)	(replicate)	6.75
9	Rival	(FT. 7)		6.50
10	B 1229-1-2-6	(FT. 19)		6.50
11	Tenderlong	(FT. 21)		6.50
12	2095-1-2	(FT. 45)		6.50
13	B 1763	(FT. 49)		6.50
14	B 1482-5-32	(FT. 52)		6.50
15	B 2095-1-2	(FT. 60)	(replicate)	6.50
16	L. Schreiber (Helva wax)	(FT. 12)		6.25
17	B 2869	(FT. 28)		6.00
18	B 2096-4-1	(FT. 15)		5.75
19	B 1762	(FT. 14)	(2nd picking)	5.50
20	B 1763	(FT. 17)	(2nd picking)	5.50
21	Topcrop	(FT. 18)		5.50
22	B 1801-4	(FT. 29)		5.50
23	B 2884-4-1	(FT. 31)		5.50
24	B 1515-1-7-1-2	(FT. 30)		5.00
25	Idagreen	(FT. 36)		5.00
26	B 1762	(FT. 56)		5.00
27	B 1661-7	(FT. 41)		4.75
28	Topcrop	(FT. 59)	(replicate)	4.75
29	B 2637	(FT. 6)		4.50
30	B 2095-1-2	(FT. 10)	(2nd picking)	4.00
31	B 1733	(FT. 24)		4.00
32	Rival	(FT. 63)	(replicate)	4.00

TABLE III - Continued

	Variety			Turbidity Number (TN)
33	Logan	(FT. 43)	(replicate)	4.00
34	B 1468-1-17-12	(FT. 53)	(2nd picking)	3.75
35	B 1755-1-1	(FT. 4)		3.50
36	Contender	(FT. 9)		3.50
37	MGCA	(FT. 20)		3.50
38	B 1468-1-17-12	(FT. 27)		3.50
39	B 2568-1	(FT. 3)		3.25
40	MGCA-5002	(FT. 26)		----

TABLE IV

Combined List From 22 Varieties
Best in All Three Quality Factors

	Variety			Percent of Wet Seeds	Percent of Fiber	TN(cm)
1	Rival	(FT. 7)		2.02	0.011	6.50
2	B 2334-1-1	(FT.16)		2.05	0.022	7.75
3	B 2869	(FT.28)		2.18	0.020	6.00
4	B 2884-4-1	(FT.31)		2.26	0.018	5.50
5	1515-1-7-1-2	(FT.58)	(replicate)	2.41	0.014	8.50
6	B 2095-1-2	(FT.60)	(replicate)	2.53	0.011	6.50
7	Puregold	(FT.61)	(replicate)	2.54	0.008	6.75
8	B 2669	(FT.38)		2.94	0.023	6.75
9	Tenderlong	(FT.21)		3.06	0.022	6.50
10	B 2248-1	(FT.39)		3.14	0.016	7.00
11	Topcrop	(FT.18)		3.25	0.031	5.50
12	Tendergreen	(FT.62)	(replicate)	3.44	0.016	7.50
13	B 1801-4	(FT.29)		3.56	0.024	5.50
14	B 1763	(FT.17)		3.65	0.022	5.50

TABLE V

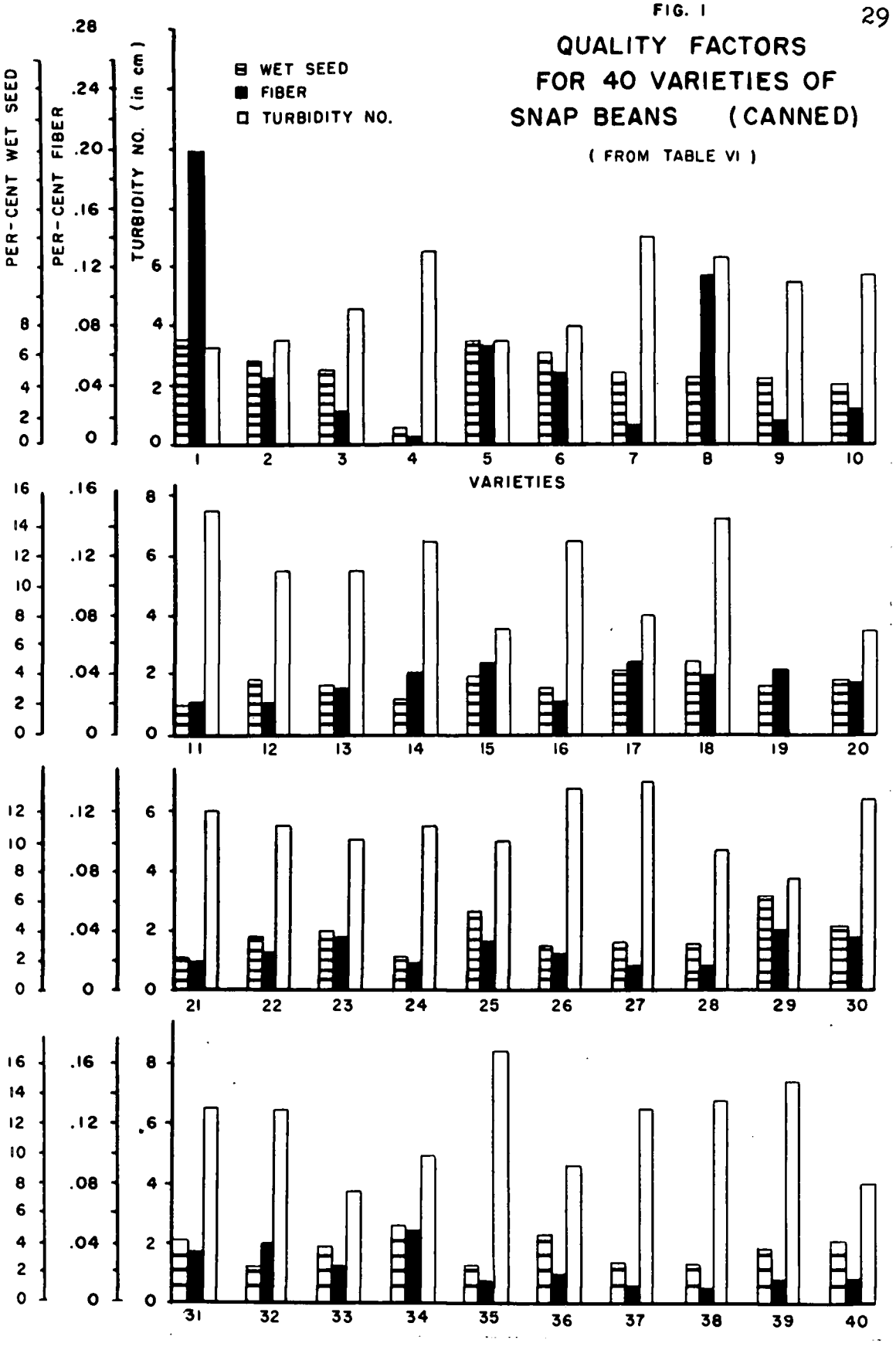
List of Varieties Poorest in Three Quality Factors

	Variety		Percent of Wet Seeds	Percent of Fiber	TN(cm)
1	B 2568-1	(FT. 3)	7.14	0.207	3.25
2	Contender	(FT. 9)	6.90	0.067	3.50
3	Logan	(FT.43)	6.50	0.040	3.75
4	B 1755-1-1	(FT. 4)	5.57	0.045	3.50
5	Idagreen	(FT.36)	5.23	0.032	5.00
6	B 1762	(FT.56)	5.10	0.048	5.00

FIG. 1

QUALITY FACTORS FOR 40 VARIETIES OF SNAP BEANS (CANNED)

(FROM TABLE VI)



CHAPTER V

SUMMARY AND CONCLUSIONS

This investigation was an attempt to evaluate the quality of 40 varieties (including a few replicates) of bush snap beans (Phaseolus vulgaris L.) grown in Oregon. Pole varieties were included for comparison. The work this year was preliminary and of the nature of screening tests to select the most promising varieties for further comparisons.

The following factors were used as quality indices:

1. Percent of wet seeds by weight: Rowe and Bonney method
2. Percent of dry seeds by weight: a new method
3. Percent of fibrous material: modified Rowe and Bonney method
4. Turbidity number: Kertesz' device

Additional data on these beans have been obtained by other workers.

Drying the seeds in the oven before weighing increased the deviations of the results and was thus proved to be an unsuitable method.

For percent of fibrous material determination, improvements in techniques over Rowe and Bonney methods were made on pulping time, on the temperature of

the solution when adding sodium hydroxyde, and on the use of a standard volume of wash water.

Kertesz' device (2, p. 15) for determining turbidity of liquor was found valuable and convenient. There are no data yet in the literature on its use for canned snap beans; therefore, the results here cannot be compared with the work of other investigators. The data here reported can help in the future drawing up of grade standards for clarity of liquor of canned snap beans.

The raw data from the Appendix Table VI were rearranged in Tables I, II, and III to list the varieties and pickings in order of merit for each objective quality factor investigated.

Of the 22 best varieties, including Toperop, which were tested for wet seeds, fiber and turbidity number, we found only 14 varieties present on all three lists of best varieties, as follows:

1. Rival
2. B 2334-1-1
3. B 2869
4. B 2884-4-1
5. 1515-1-7-1-2 (replicate)
6. B 2095-1-2 (replicate)
7. Puregold (replicate)
8. B 2669

9. Tenderlong
10. B 2248-1
11. Topcrop
12. Tendergreen (replicate)
13. B 1801-4
14. B 1763

A review of the literature on varieties of snap beans (*Phaseolus vulgaris* L.) for processing has been presented.

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A P P E N D I X

TABLE VI

Quality Factors for 40 Varieties of Snap Beans (Canned)
(Two Pickings of a Few Varieties)

Sample No.	VARIETIES & U.S.D.A. No.	WET SEED %	WET SEED Ave. %	WET SEED Dev. %	DRY SEED %	DRY SEED Ave. %	DRY SEED Dev. %	FIBER %	FIBER Ave. %	FIBER Dev. %	TURBIDITY (TN)
1	B 2568-1	6.83 7.45	7.14	9.08	1.12 1.20	1.16	7.14	0.168 0.246	0.207	46.43	3.25
2	B 1755-1-1	6.47 4.67	5.57	38.54	0.99 0.67	0.83	47.76	0.051 0.038	0.045	34.21	3.50
3	B 2637	5.03 5.11	5.07	1.59	0.69 0.75	0.72	8.70	0.023 0.021	0.022	9.52	4.50
4	Rival	1.79 2.25	2.02	25.70	0.21 0.23	0.22	9.52	0.012 0.009	0.011	33.33	6.50
5	Contender	6.41 7.39	6.90	15.29	0.92 1.02	0.98	9.68	0.073 0.061	0.067	19.67	3.50
6	B 2095-1-2	6.29 5.82	6.06	8.08	0.96 0.82	0.89	17.07	0.052 0.043	0.048	20.93	4.00
7	Puregold	4.81 5.09	4.95	5.82	0.62 0.64	0.63	3.23	0.012 0.011	0.012	9.09	7.00
8	L Schreiber, Helva wax	4.42 4.76	4.59	7.69	0.60 0.66	0.63	10.0	0.123 0.105	0.114	17.14	6.25

TABLE VI - Continued

Sample No.	VARIETIES & U.S.D.A. No.	WET SEED %	WET SEED Ave. %	WET SEED Dev. %	DRY SEED %	DRY SEED Ave. %	DRY SEED Dev. %	FIBER %	FIBER Ave. %	FIBER Dev. %	TURBIDITY (TN)
9	B 1762	4.61 4.21	4.41	9.50	0.60 0.53	0.57	13.21	0.018 0.016	0.017	12.50	5.50
10	B 2096-4-1	4.65 3.64	4.15	27.75	0.59 0.41	0.50	43.90	0.016 0.023	0.020	43.75	5.75
11	B 2334-1-1	1.83 2.27	2.05	24.04	0.24 0.24	0.24	0.00	0.028 0.016	0.022	75.00	7.75
12	B 1763	3.66 3.63	3.65	0.83	0.46 0.47	0.47	2.13	0.019 0.024	0.022	26.32	5.50
13	Topcrop	3.49 3.00	3.25	16.33	0.41 0.32	0.37	28.13	0.032 0.029	0.031	10.34	5.50
14	B 1229-1-2-6	2.38 2.15	2.27	10.70	0.30 0.23	0.27	30.43	0.054 0.029	0.042	86.21	6.50
15	MGCA	3.74 4.19	3.97	12.03	0.47 0.52	0.50	10.64	0.049 0.046	0.048	6.52	3.50
16	Tenderlong	3.22 2.90	3.06	11.03	0.39 0.31	0.35	25.81	0.026 0.017	0.022	52.94	6.50
17	B 1733	4.52 4.29	4.41	5.36	0.65 0.56	0.61	16.07	0.052 0.045	0.049	15.56	4.00

TABLE VI - Continued

Sample No.	VARIETIES & U.S.D.A. No.	WET SEED %	WET SEED Ave. %	WET SEED Dev. %	DRY SEED %	DRY SEED Ave. %	DRY SEED Dev. %	FIBER %	FIBER Ave. %	FIBER Dev. %	TURBIDITY (TN)
18	B 9126	4.94			0.62			0.042			7.25
		5.07	5.01	2.63	0.62	0.62	0.00	0.035	0.039	20.00	
19	MGCA-5002	3.78			0.51			0.045			
		3.07	3.43	23.13	0.27	0.39	88.89	0.043	0.044	4.65	
20	B 1468-1-17-12	3.62			0.50			0.046			3.50
		3.78	3.70	4.42	0.48	0.49	4.17	0.025	0.036	84.00	
21	B 2869	2.08			0.25			0.017			6.00
		2.27	2.18	9.13	0.24	0.25	4.17	0.022	0.020	29.41	
22	B 1801-4	4.01			0.56			0.030			5.50
		3.10	3.56	29.35	0.37	0.47	51.35	0.017	0.024	76.47	
23	B 1515-1-7-1-2	4.57			0.62			0.026			5.00
		3.32	3.95	37.65	0.39	0.51	58.97	0.043	0.035	65.38	
24	B 2884-4-1	2.17			0.27			0.021			5.50
		2.34	2.26	7.83	0.25	0.26	8.00	0.015	0.018	40.00	
25	Idagreen	5.25			0.66			0.036			5.00
		5.21	5.23	0.77	0.62	0.64	6.45	0.028	0.032	28.57	
26	B 2669	3.05			0.38			0.023			6.75
		2.83	2.94	7.77	0.30	0.34	26.67	0.023	0.023	0.00	

TABLE VI - Continued

Sample No.	VARIETIES & U.S.D.A. NO.	WET SEED %	WET SEED Ave. %	WET SEED Dev. %	DRY SEED %	DRY SEED Ave. %	DRY SEED Dev. %	FIBER %	FIBER Ave. %	FIBER Dev. %	TURBIDITY (TN)
27	B 2248-1	3.25 3.03	3.14	7.26	0.43 0.39	0.41	10.26	0.017 0.014	0.016	21.43	7.00
28	B 1661-7	3.23 2.94	3.09	9.86	0.46 0.35	0.41	31.43	0.019 0.015	0.017	26.67	4.75
29	Logan	7.06 5.93	6.50	19.06	1.33 0.91	1.12	46.15	0.043 0.036	0.040	19.44	3.75
30	2095-1-2	4.18 4.44	4.31	6.22	0.56 0.55	0.56	1.82	0.038 0.036	0.037	5.56	6.50
31	B 1763	3.67 4.65	4.16	26.70	0.47 0.61	0.54	29.79	0.036 0.033	0.035	9.09	6.50
32	B 1482-5-32	2.15 2.45	2.30	13.95	0.26 0.32	0.29	23.08	0.039 0.041	0.040	5.13	6.50
33	B 1468-1-17-12	3.94 3.52	3.73	11.93	0.55 0.45	0.50	22.22	0.028 0.019	0.024	47.37	3.75
34	B 1762	5.44 4.75	5.10	14.53	0.75 0.64	0.70	17.19	0.055 0.040	0.048	37.50	5.00
35	1515-1-7-1-2	2.42 2.39	2.41	1.26	0.28 0.24	0.26	16.67	0.015 0.012	0.014	25.00	8.50

TABLE VI - Continued

Sample No.	VARIETIES & U.S.D.A. No.	WET SEED %	Ave. %	Dev. %	DRY SEED %	Ave. %	Dev. %	FIBER %	Ave. %	Dev. %	TURBIDITY (TN)
36	Topcrop	4.64			0.63			0.020			4.75
		4.29	4.47	8.16	0.52	0.58	21.15	0.018	0.019	11.11	
37	B 2095-1-2	2.48			0.29			0.010			6.50
		2.57	2.53	3.63	0.26	0.28	11.54	0.011	0.011	10.00	
38	Puregold	2.54			0.29			0.009			6.75
		2.53	2.54	0.40	0.26	0.28	11.54	0.007	0.008	28.57	
39	Tendergreen	3.16			0.39			0.017			7.50
		3.71	3.44	17.41	0.46	0.43	17.95	0.014	0.016	21.43	
40	Rival	4.71			0.66			0.019			4.00
		3.33	4.02	41.44	0.41	0.54	60.98	0.014	0.017	35.71	
POLE SNAP BEANS											
1	FM 65	2.36			0.24			0.019			8.50
		2.24	2.30	5.36	0.21	0.23	14.29	0.024	0.022	26.32	
2	Beans 2066	3.23						0.015			8.50
		3.02	3.13	6.95				0.016	0.016	6.67	
3	Beans 2006	4.78						0.033			8.00
		4.36	4.57	9.63				0.029	0.031	13.79	
4	Beans, Associated 231	4.77						0.019			8.50
		4.59	4.68	3.92				0.016	0.018	18.75	

TABLE VII

List of Varieties, Date Canned and Date Analyzed

No.	Variety or U.S.D.A. No.	Food Tech.	Hort. Dept. No.		Date Canned	Date Analyzed	
1	B 2568-1	3	Acc 572		July 27, 1950	Feb. 1, 1951	
2	B 1755-1-1	4	Acc 583		July 19, 1950	Feb. 4, 1951	
3	B 2637	6	Acc 581		July 27, 1950	Feb. 5, 1951	
4	Rival	7	Acc 543		July 22, 1950	Feb. 11, 1951	
5	Contender	9	Acc 465		July 19, 1950	Feb. 12, 1951	
6	B 2095-1-2	10	Acc 586	2nd picking of FT. 45)	July 27, 1950	Feb. 13, 1951	
7	Puregold	11	Acc 402		July 27, 1950	Feb. 15, 1951	
8	L. Schreiber (Helva wax)	12	Acc 666		July 19, 1950	Feb. 26, 1951	(3rd Repeat)
9	B 1762	14	Acc 570	2nd picking of FT. 56)	July 27, 1950	Dec. 7, 1950	
10	B 2096-4-1	15	Acc 566		July 19, 1950	Dec. 8, 1950	
11	B 2334-1-1	16	Acc 584		July 19, 1950	Dec. 9, 1950	
12	B 1763	17	Acc 580	2nd picking of FT. 49)	July 27, 1950	Dec. 18, 1950	
13	Toperop	18	Acc 114		July 19, 1950	Dec. 19, 1950	
14	B 1229-1-2-6	19	Acc 582		July 19, 1950	Dec. 20, 1950	
15	MGCA	20	Acc 824		July 19, 1950	Dec. 21, 1950	
16	Tenderlong	21	Acc 836		July 19, 1950	Dec. 22, 1950	
17	B 1733	24	Acc 563		July 19, 1950	Dec. 23, 1950	
18	B 9126	25	Acc 569		July 27, 1950	Dec. 26, 1950	
19	MGCA-5002	26	Not Available		Not Available	Dec. 27, 1950	
20	B 1468-1-17-12	27	Not Available		Not Available	Feb. 20, 1951	(Repeat)
21	B 2869	28	Acc 575		Not Available	Dec. 29, 1950	
22	B 1801-4	29	Acc 578		July 21, 1950	Feb. 22, 1951	(Repeat)

TABLE VII - Continued

No.	Variety or U.S.D.A. NO.	Food Tech.	Hort. Dept. No.	Date Canned	Date Analyzed
23	B 1515-1-7-1-2	30	Acc 585	July 21, 1950	Jan. 3, 1951
24	B 2884-4-1	31	Acc 576	July 21, 1950	Jan. 4, 1951
25	Idagreen	36	Acc 209	July 22, 1950	Jan. 6, 1951
26	B 2669	38	Acc 574	July 22, 1950	Jan. 8, 1951
27	B 2248	39	Acc 577	July 22, 1950	Jan. 9, 1951
28	B 1661-7	41	Acc 562	July 27, 1950	Jan. 10, 1951
29	Logan	43	Acc 595	July 27, 1950	Jan. 11, 1951
30	2095-1-2	45	Acc 586	July 19, 1950	Jan. 15, 1951
31	B 1763	49	Acc 580	July 19, 1950	Jan. 16, 1951
32	B 1482-5-32	52	Acc 561	July 19, 1950	Jan. 18, 1951
33	B 1468-1-17-12	53	Acc 560 (2nd picking of FT. 27)	July 21, 1950	Jan. 19, 1951
34	B 1762	56	Acc 570	July 19, 1950	Jan. 22, 1951
35	1515-1-7-1-2	58	No. 1 (Replicate of FT. 30)	July 29, 1950	Jan. 23, 1951
36	Topcrop	59	No. 2 (Replicate of FT. 18)	July 29, 1950	Jan. 24, 1951
37	B 2095-1-2	60	No. 4 (Replicate of FT. 45)	July 29, 1950	Jan. 25, 1951
38	Puregold	61	No. 5 (Replicate of FT. 11)	July 29, 1950	Jan. 26, 1951
39	Tendergreen	62	No. 6 (Replicate of FT.)	July 29, 1950	Feb. 24, 1951 (Repeat)
40	Rival	63	No. 7 (Replicate of FT. 7)	July 29, 1950	Jan. 30, 1951

TABLE VII - Continued

	Variety or U.S.D.A. NO.	Food Tech.	Hort. Dept. No.	Date Canned	Date Analyzed
POLE BEANS					
1	FM 65	64	No. 8	August 2, 1950	March 7, 1951
2	Pole Beans 2066			August 23, 1950	March 9, 1951
3	Pole Beans 2006			August 22, 1950	March 10, 1951
4	Associated 231			August 22, 1950	March 11, 1951