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REFRIGERATION AND HANDLING OF TWO VEGETABLES AT RETAIL

- *Green Snap Beans and*
- *Southern Yellow Summer Squashes*

Marketing Research Report No. 276

Agricultural Marketing Service
Marketing Research Division
UNITED STATES DEPARTMENT OF AGRICULTURE

PREFACE

Snap beans are one of our more important vegetable crops, with an average annual production of nearly 20,000,000 bushels and with an annual farm value of over \$40,000,000. "Russeting" is frequently a serious problem with snap beans, and special attention has been given to determining its nature and methods of control, as even slight russeting affects the market value of beans, and severe russeting sometimes makes them worthless.

Figures for summer squash production and value are not available, but these squashes are a fairly important fresh vegetable item in retail stores. Previous studies have shown that summer squashes are very perishable, remaining in good condition on a nonrefrigerated dry display rack for only 1 day.

This study of deterioration of the two vegetables and of ways of minimizing it is part of a national program of research to improve the marketing of farm products.

September 1958

Washington, D. C.

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REFRIGERATION AND HANDLING OF TWO VEGETABLES AT RETAIL

Green Snap Beans and Southern Yellow Summer Squashes

By William E. Lewis, senior horticulturist¹

SUMMARY AND CONCLUSIONS

Studies of the effects of different storage and display practices on green snap beans and Southern yellow summer squashes, in a laboratory simulating retail-store conditions, showed the following:

Russeting or discoloration of green snap beans is influenced by certain interrelationships of temperature, length of storage, and sprinkling. No russeting or other discoloration was apparent when beans were removed from refrigerated storage of several days, but it developed during a 1-day period at a higher temperature (75° to 80° F.) after removal from low-temperature storage.

Beans held at temperatures of 32° or 40° F. for 10 days became severely russeted and otherwise discolored during the succeeding 1-day period at room temperature. After 5 days' storage at these temperatures, also, a considerable amount of russeting developed during 1 day at room temperature. The russeting and discoloration occurred in both sprinkled and nonsprinkled beans, but was much more pronounced in those sprinkled, particularly after 10 days' storage. The nonsprinkled beans, however, became flabby or dry, lost weight, and were unattractive after 1 day at room temperature. Beans held at 32° or 40° for 4 days or less remained relatively free of discoloration after 1 day at room temperature, whether they had been sprinkled or not.

A small amount of discoloration following scarring or rubbing developed in beans held at 45° and 50° F. in the lots that had been sprinkled and had been in storage 5 days or longer.

The development of russeting following relatively long storage at low temperatures might be an explanation for the presence of serious russeting found in carloads of beans after long transit periods. Green beans should be moved quickly into consumer channels to avoid rapid deterioration by aging, drying, flabbiness, and discoloration. A temperature of 45° F. is recommended for storing beans. Lower temperatures predispose them to russeting and other discoloration, and higher temperatures favor flabbiness and decay. Sprinkling aids in keeping beans fresh and crisp.

Straightneck squashes are benefited by refrigeration, although for 1 or 2 days' display, refrigeration is not essential. Crookneck squashes are more perishable and require refrigeration and sprinkling to maintain quality.

Either an ice-bed rack or mechanical refrigeration with sprinkling gave the best results when squashes of either type were displayed for 3 days.

Squashes displayed without refrigeration during the day should be refrigerated at night.

RUSSETING AND OTHER DISCOLORATION OF GREEN BEANS

Many retail-store operators object to sprinkling green beans with water, fearing that this practice will cause russeting and other discoloration. Russeting is described

¹Now retired.

as a surface discoloration of the pods which develops primarily after harvest.² It is considered to be a physiological disease, as fungi or bacteria are not involved.

Preliminary studies conducted on one lot of beans³ indicated that russetting was influenced by the length and temperature of storage. It did not develop at 50° F. and developed at 36° and 40° only after storage 8 days or more. It developed in 1 day at room temperature only in beans previously subjected to 3 or more days' storage at 36° or 40°.

Studies were made at Beltsville, Md., in 1956 to determine the interrelationship of temperature, moisture, and length of storage.

Equipment and Methods

Three different lots of green beans were used in the tests during September and October. The beans were grown in Delaware, Maryland, and Virginia, and were obtained on the Washington, D. C., wholesale produce market.

At the start of each test, discolored or otherwise damaged beans were discarded and the remainder sorted into representative samples of 500 grams each (slightly more than 1 pound). Each sample was placed in an uncovered 4-quart basket. Ten samples of beans were stored in each of 4 different refrigerated storage rooms (32°, 40°, 45°, and 50° F.). Five of each 10 samples were sprinkled with water 4 times daily, and the other 5 were not sprinkled.

The relative humidity in the storage rooms was kept at approximately 85 to 90 percent. Small fans were used to provide circulation of air. Produce other than that used in the tests also was stored in the rooms.

At the end of each storage period of 2, 3, 4, 5, and 10 days, 1 sprinkled and 1 non-sprinkled sample were removed from each of the refrigerated rooms and held for 1 day at temperatures of 75°-80° F. The beans were then weighed and scored for discoloration. Some of the discoloration observed in these beans was not typical of the russetting described by Ramsey and Wiant (see footnote 2), but since it all adversely affected the appearance of the beans, it is included in this report. Most of the discoloration observed in beans which had been stored at 32° and 40° F. was typical russetting, but the discoloration following storage at 45° and 50° appeared only after injury of the beans by scarring and rubbing.

The numbers of days shown in figure 1 and reported elsewhere in this report indicate the time the beans were in the refrigerated rooms and do not include the 1-day period at 75°-80° that followed. The discoloration percentages discussed apply only to the appearance of the beans after the 1-day period at 75° to 80° F.

Results

No discoloration was apparent upon removal of the beans from the refrigerated rooms, but it developed in certain lots during the 1-day period when they were held without refrigeration.

Beans from the 32° F. room after 10 days' refrigeration and 1 day at room temperature had 63 percent discoloration in the sprinkled lots and 13 percent in the non-sprinkled (fig. 1). Those from the 40° room had 60 percent discoloration in the sprinkled lots and 11 percent in the nonsprinkled. The sprinkled and nonsprinkled beans that were refrigerated for not more than 4 days at 32° and 40° averaged less than 2 percent discoloration.

²Ramsey, G. B. and Wiant, J. S. Market Diseases of Fruits and Vegetables: Asparagus, Onions, Beans, Peas, Carrots, Celery, and Related Vegetables, U. S. Dept. Agr. Misc. Pub. No. 440, 1941.

³Hansen, John C. Test on Russetting of Beans, 1948. Unpublished.

Effect of Temperature and Sprinkling

DISCOLORATION OF GREEN BEANS

Held 1 Day at 75-80 Degrees F. After Storage

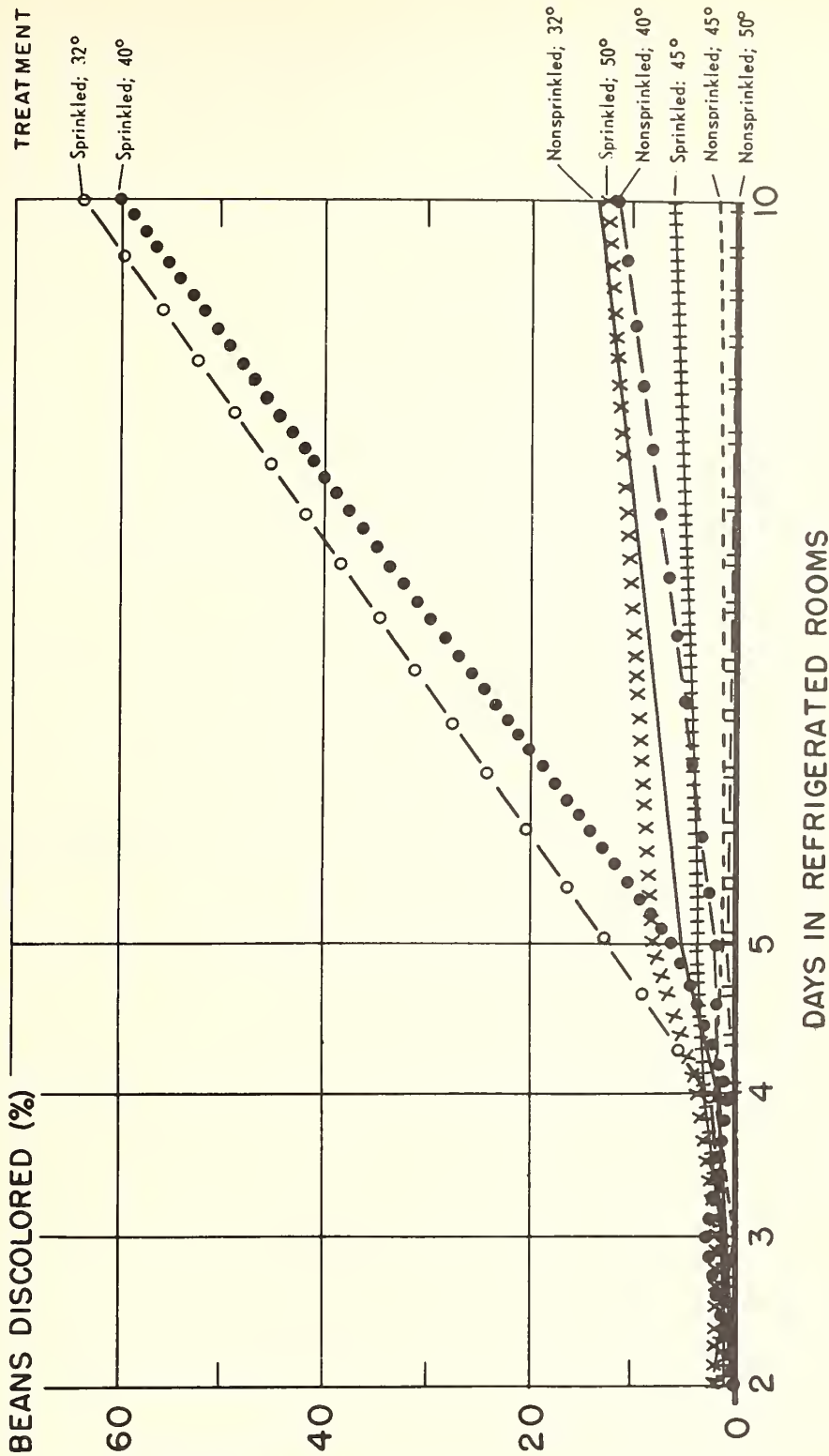
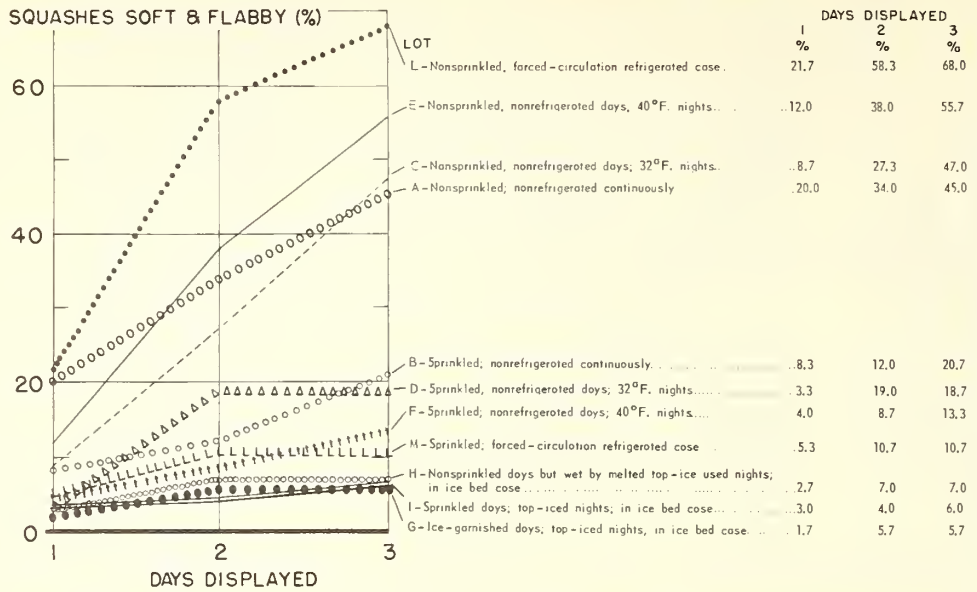


Figure 1

Effect of Refrigeration and Sprinkling

CROOKNECK YELLOW SUMMER SQUASHES



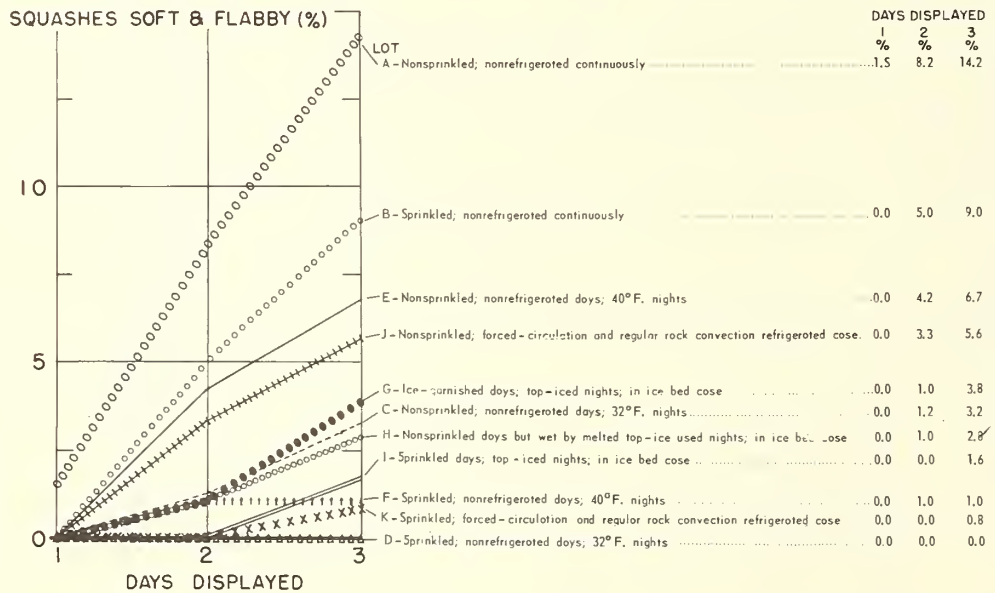
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Figure 2

Effect of Refrigeration and Sprinkling

STRAIGHTNECK YELLOW SUMMER SQUASHES



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Figure 3

Sprinkled beans from the 45° and 50° F. rooms after 10 days' storage developed 6 and 12 percent discoloration, respectively, during a day at room temperature, while the nonsprinkled beans had less than 2 percent. After 5 days' storage, sprinkled beans from the 45° and 50° rooms developed 3 and 8 percent discoloration, respectively, while the nonsprinkled beans had less than 1 percent. Sprinkled beans held at 45° and 50° for 4 days had less than 3 percent discoloration while those held at these temperatures for 3 days or less had 1 percent or less discoloration.

Nonsprinkled beans became unattractive much sooner than the sprinkled ones, because of a flabby and dried appearance caused by excessive loss of weight. Beans that were not sprinkled during storage had 4 to 9 times as much weight loss as those that were sprinkled.

A small percentage of decay was found in beans stored 2 days or longer at all refrigeration temperatures and then held for 1 day without refrigeration.

RETAIL-STORE HANDLING OF SOUTHERN YELLOW SUMMER SQUASHES

Summer squashes are highly perishable, as has been shown in previous studies.⁴ In this study, the effects of various retail-store display and handling practices on the quality of southern-grown yellow summer squashes were studied in a laboratory equipped and operated to simulate different retail-store handling methods. Straightneck, or "banana," and crookneck types of squashes, grown in Florida and South Carolina, were obtained from the Washington, D. C., wholesale produce market, for use in the tests.

Operation of the Display Room

The squashes were displayed for 3 days as follows:

1. Continuously in a nonrefrigerated case.
2. During the daytime in a nonrefrigerated case, and stored at night in 32° and 40° F. "walk-in coolers."
3. Continuously in commercial convection and forced-circulation types of mechanically refrigerated cases.
4. Continuously in a commercial ice-bed case.

In both mechanically refrigerated and nonrefrigerated cases, 1 lot of squashes was sprinkled with tap water 4 times daily and a duplicate lot was not sprinkled. The non-sprinkled squashes that were held overnight in the refrigerated storage rooms became wet from condensed moisture when returned to the nonrefrigerated rack each morning. In the ice-bed case, 1 lot was garnished with crushed ice, another was sprinkled 4 times daily, and a third lot was not garnished or sprinkled during the daytime. At night, all lots in the ice-bed case were covered with a heavy layer of ice and kraft paper. The display periods began between 8 and 9 a.m. and ended between 6 and 7 p.m.

Decayed and defective squashes were discarded at the beginning of the tests. The squashes were displayed about 7 inches deep, extending from the front to the back of each rack. Four tests were conducted with straightneck squashes, and 3 tests with crookneck. The number in each display method averaged about 25 for the straightneck and 50 for the crookneck for each test.

⁴Hansen, J. C. and McColloch, L. P. Effect of Temperature and Moisture on the Shelf Life of Fresh Produce, U. S. Dept. Agr., Bur. Plant Ind., Soils, and Agr. Eng., H. T. and S. Off. Rpt. No. 213. 1949 (mimeographed).

Results

Decay was of minor importance in all lots. Softness, flabbiness, and discoloration were the most serious causes of unattractiveness. The soft, flabby condition of the affected squashes was usually followed by unsightly discoloration. Losses due to softness, flabbiness, and weight loss were greater in the crookneck than in the straightneck type (figs. 2 and 3). Some soft, flabby squashes appeared in all lots in the crookneck type at the end of the first day, the percentages increasing rapidly during the second and third days in lots that were not sprinkled, garnished, or wet by melted ice.

In the straightneck-type squashes, softness and flabbiness were of little importance until the third day, when lots that were displayed continuously without refrigeration showed a slight increase in this condition.

In the ice-bed case, the sprinkled and the ice-garnished squashes gained in weight; squashes that were not garnished or sprinkled during the day showed little change in weight.

Sprinkling was beneficial to crookneck squashes in all types of display cases or overnight storage, but was of slight value to the straightneck.

SOME RELATED PUBLICATIONS

The following related publications also may be of interest to readers of this report:

Lewis, William E., Effect of Various Retail-Store Display and Handling Practices on the Quality of Elberta Peaches. AMS-40, U. S. Dept. Agr., Agr. Mktg. Serv., May 1955.

Lewis, William E., Maintaining Produce Quality in Retail Stores. Agr. Handbook 117, U. S. Dept. Agr., Agr. Mktg. Serv., March 1957.

Lewis, William E., Temperatures of Produce in Retail-Store Type Display Cases. AMS-69, U. S. Dept. Agr., Agr. Mktg. Serv., September 1955.

Lewis, William E., Effects of Various Retail-Store Display and Handling Practices on the Quality and Condition of Green Peppers. AMS-44, U. S. Dept. Agr., Agr. Mktg. Serv., May 1955.

Whiteman, T. M., Freezing Points of Fruits, Vegetables, and Florist Stocks. Mktg. Res. Rept. 196, U. S. Dept. Agr., Agr. Mktg. Serv., December 1957.

