Beans

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Scientific Name and Introduction: Snap beans and long beans are commodities of the Fabaceae (Leguminosae) family in which both the fleshy pod and seeds are consumed. They include fresh snap or common beans (string beans, yellow wax beans, green beans) (*Phaseolus vulgaris* L.), runner or flat beans (*P. coccineus* L.), and long beans (*Vigna sesquipedalis*). Fresh pod beans are available from many production areas in the U.S., but in the Winter months they are produced mainly in Florida and Mexico.

Quality Characteristics and Criteria: Beans should be well formed and straight, bright in color with a fresh appearance free of defects, and tender (not tough or stringy) but firm. The diameter of the pod, rather than length, is a good indicator of quality. Buyers prefer pods with no or only slight bulges, indicating tender, young seeds. As the name implies, snap beans should break easily when the pod is bent, giving off a distinct audible snap. Poor quality is most often associated with over-maturity, broken beans, water loss, chilling damage and decay.

Horticultural Maturity Indices: Snap beans (yellow, green and purple types) are harvested when they are rapidly growing; about 8 to 10 days after flowering for typical mature snap beans. All pod beans should be harvested when the pod is bright green and fleshy, and the seeds are small and green. After that period, excessive seed development reduces quality and the pod becomes pithy and tough, and loses its bright color.

Grades, Sizes and Packaging: U.S. Grades for snap beans are U.S. Fancy, U.S. No. 1 and U.S. No. 2 based primarily on external appearance. Although not sized for market, a reasonable size is expected according to the characteristics of each variety. Beans are packed in 25- to 30-lb (11.4 to 13.6 kg) crates, and 15- or 20-lb (6.8 or 9.1 kg) cartons; pre-snipped beans for foodservice are available in 10-lb bags (4.5 kg).

Cooling: Snaps beans can be hydro-cooled, and this is especially beneficial in dry climates where dehydration is a concern, and in situations where evaporation of surface moisture occurs rapidly after cooling, ie., beans packed in wire-bound crates. Although hydro-cooling is very rapid, significant postharvest decay can occur if the product remains wet after cooling. Forced-air cooling is the method of choice if beans have been packed. Although efficient cooling is achieved without leaving free moisture on beans, water loss does occur (Boyette et al., 1994; Sargent, 1995).

Optimum Storage Conditions: The recommended conditions for commercial storage of snap beans are 5 to 7.5 °C (41 to 46 °F) with 95 to 100% RH. At 5 to 7.5 °C (41 to 46 °F) a storage-life of 8 to 12 days is expected. Good quality can be maintained for a few days at temperatures below 5 °C (41 °F) but chilling injury will be induced (see chilling sensitivity). Some chilling may occur even at the recommended storage temperature of 5 °C (41 °F) after 7 to 8 days depending on cultivar. At storage temperatures above 7.5 °C (46 °F), quality rapidly decreases due to yellowing, seed development and water loss. Waxed cartons and plastic film liners are helpful to reduce water loss. The perishability and rates of water loss of immature beans are higher than for mature beans. Long beans have postharvest requirements similar to those of snap beans with similar responses to chilling temperatures (Zong et al., 1992).

Controlled Atmosphere (CA) Considerations: At recommended storage temperatures, O_2 of 2 to 5%

reduces respiration (Saltveit, 1997). Snap beans tolerate and are benefited by CO_2 between 3 to 10%. The main benefit is retention of color and reduced discoloration and decay on damaged beans (Cano et al., 1997; Hardenburg et al., 1986; Trail et al., 1992). Higher CO_2 (20 to 30%) levels are used for short periods, like 24 h, but can cause off-flavors (Costa et al., 1992).

Retail Outlet Display Considerations: Snap beans should not come in contact with ice or water, both of which can leave spots (translucent, water soaked areas) on the pods. For the same reason, misting is not generally recommended unless the beans are seriously dehydrated.

Chilling Sensitivity. Snap and Pod beans are chilling sensitive, and visual symptoms will depend on the storage temperature. At temperatures below 5 °C (41 °F), the typical symptom of chilling injury is a general opaque discoloration of the entire bean. A less common symptom is pitting on the surface and increased water loss. At temperatures of 5 to 7.5 °C (41 to 46 °F), the most common symptom of chilling injury is the appearance of discrete rusty brown spots. These lesions are very susceptible to attack by common fungal pathogens. Beans can be held about 2 days at 1 °C (34 °F), 4 days at 2.5 °C (37 °F), and 6 to 10 days at 5 °C (41 °F) before chilling symptoms appear (Cantwell, unpublished). No discoloration occurs on beans stored at 10 °C (50 °F), but undesirable seed development, water loss, and yellowing will occur at this storage temperature. Different varieties differ substantially in their susceptibility to chilling injury (Cantwell, unpublished; Watada and Morris, 1966b).

Freezing injury. Freeze damage appears as water-soaked areas which subsequently deteriorate and decay. Freezing injury occurs at temperatures of -0.7 °C (30.7 °F) or below.

Ethylene Production and Sensitivity: Beans produce only very low amounts of ethylene (< 0.05 µL kg^{-1} h^{-1} at 5 °C (41 °F). Ethylene exposure > 0.1 µL L^{-1} promotes chlorophyll loss, increases browning, and reduces green bean storage-life by 30 to 50% at 5 °C (41 °F) (Wills and Kim, 1996).

Respiration Rates: Beans are rapidly growing when harvested and have high respiration rates.

Temperature	Snap Beans (mg CO_2 kg^{-1} h^{-1})	Long Beans
0 °C	40	80
5 °C	66	90
10 °C	110	175
15 °C	170	374
20 °C	234	396

To get mL kg^{-1} h^{-1}, divide the mg kg^{-1} h^{-1} rate by 2.0 at 0 °C (32 °F), 1.9 at 10 °C (50 °F), and 1.8 at 20 °C (68 °F). To calculate heat production, multiply mg kg^{-1} h^{-1} by 220 to get BTU per ton per day or by 61 to get kcal per metric ton per day. Snap bean data are from Watada and Morris (1966a), and Long bean data are from Zong et al. (1992).

Physiological Disorders: See section on "Chilling Sensitivity."

Postharvest Pathology: Various decay organisms may attack fresh pod beans as a result of chilling injury, surface moisture, or mechanical damage. Common decay causing fungi are those causing "nesting decays" (cottony leak caused by *Pythium* spp., *Rhizopus* spp), gray mold (*Botrytis cinerea*), and watery soft rot (*Sclerotinia* species). Watersoaked spots may be due to lesions caused by bacterial infections (*Pseudomonas* spp., *Xanthomonas* spp.) (Snowdon, 1992).

Quarantine Issues: None.

Suitability as Fresh-cut Product: For foodservice, beans are snipped to remove stem and tails. Browning of the cut ends can be a problem, and high CO_2 atmospheres help retard discoloration.

Special Considerations: Extra careful and expedited postharvest handling are required for highly perishable very fine French beans or Haricot Verts to avoid physical damage and dehydration.

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