Okra—A Versatile Vegetable Crop

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ADDITIONAL INDEX WORDS. *Abelmoschus esculentus*

Ookra [*Abelmoschus esculentus* (L.) Moench] belongs to the Malvaceae or mallow family and is a relative of cotton (*Gossypium hirsutum* L.). Okra is one of the world's oldest cultivated crops. The first recorded reference to okra was made by the Egyptians in 1216 A.D., although the plant explorer Vavilov indicated that there was strong evidence that the crop flourished even before that date in the tropical climate of Ethiopia, while others have identified its origin as India. It eventually spread completely around the Mediterranean and westward to the new world. Its arrival in the American colonies during the early 1700s is attributed to either slaves brought from Africa or early French colonists in Louisiana. Thomas Jefferson recorded the presence of okra in his garden log in 1748. It continued its march northward and was found in Philadelphia in 1781, and from 1800 onward it was mentioned by many garden writers.

Genetic studies indicate that the crop may be composed of multiple species, origins of which might have been southeastern Asia, India, western Africa, or Ethiopia. The chromosome number of okra varies greatly, with the diploid ranging from $2n = 66$ to 144. Okra actually may be of amphidiploid origin, exhibiting genomic contributions from hybridization of species of different ploidy levels. Cultivated species of *Abelmoschus* in addition to *A. esculentus* are semiwild species *A. manihot* (L.) Medikus and *A. moschatus* Medic. Wild species *A. crinitus* Wall., *A. tetraphyllus* (Roxb. ex Hornem) R. Graham, *A. angulosus* Wall. ex

W.&A., and *A. tuberculatus* Pal&Singh are found in Asia; *A. ficulneus* (L.) W. & A. ex Wight is present in western Africa (Duzyaman, 1997). A perennial treelike okra grown in west-African villages is believed to be an intermediate between *A. esculentus* and *A. manihot* (Rubatzky and Yamaguchi, 1997).

The discovery of *A. caillei* (A. Chev.) Stev in western Africa (Chevalier, 1940) and later evaluations (Hamon and Yapo, 1986) have received much attention in the last decade. It is distinguished from *A. esculentus* by plant shape, number of epicalyx segments, and fruit shape and orientation (Siemonsma, 1982). *Abelmoschus caillei* is prized for its potentially prolific yield, vigorous growth, and tolerance to some negative environments, serving as a source of many desirable characteristics (Ariyo, 1993). However, it is a short-day plant, and will require selection for photoperiod insensitivity to make it more adaptable.

Okra is sometimes called gumbo, although that name is more commonly associated with soups and other dishes containing okra. It is also known as gombo in French, bhendi in Hindu, bamiah in Arabic, and by other names such as quingumbo, quaio, and lady's finger.

Anatomy

The okra plant somewhat resembles its close relative cotton, although okra has much larger, rougher leaves and a thicker stem. It is a semiwoody, fibrous, herbaceous annual with an indeterminate growth habit; it grows to a height of 3 to 6 ft (0.9 to 1.8 m). The plant forms a deeply penetrating taproot with dense, shallow feeder roots in the upper 18 inches (46 cm) of the soil. It has large, alternate, palmate leaves with small stipules. Leaf margins vary from slightly wavy to very deeply lobed. Flower buds appear in the axil of each leaf beginning above the six- to eight-leaf stage and develop into five large showy, yellow petals with a large dark maroon or royal purple colored area at the base. As the okra plant develops, the lowest flower bud on each stem opens soon after sunrise and closes in the middle to late afternoon. The anthers dehisce between 0730 and 0900 HR (McGregor, 1976). Although okra is considered to be a self-pollinated crop,

insects such as honey bees [*Apis mellifera* (L.)] and bumblebees [*Bombus auricomus* (L.)] can effect cross-pollination. In India, Tanda (1984) found that intensive bee pollination resulted in a 19% increase in yield and improvement in the protein and carbohydrate content of the okra seed pods.

The edible immature seed pods must be harvested while they are still soft and the seeds are only partially developed. The color of immature pods varies from pale to dark green, red, or purple. Red pigmentation can also occur in stems, petioles, leaf veins, pedicel, and petal bases, which gives the plant ornamental value (Martin et al., 1981; More and Vibhute, 1983). Okra pods may be ridged or smooth. Okra carries unicellular trichomes on almost all parts of the plant, providing protection from pests such as leafhoppers (*Empoasca fabae* Harris) (Rao, 1991). In the 1880s, a spineless mutant appeared in a garden in Lancaster County, S.C. This spineless characteristic was incorporated into commercial okra varieties in the 1930s. Mature pods dehisce, releasing round, very hard, dark-green or brown seed. Seed sizes can vary from 5,670 to 15,120 seeds/lb (12,500 to 33,300 seeds/kg).

Composition and uses

Okra has been used in a variety of ways (Table 1) throughout history (Martin, 1982).

LEAVES. The tender leaves of okra are often consumed as a vegetable in areas where a wide variety of leafy greens are used in the diet (e.g., western Africa, southeastern Asia). The leaves of some varieties are somewhat hispid (hairy), an objectionable quality reduced by cooking. Leaves of other varieties are smooth. The tender shoots, flower buds, and calyxes are often eaten along with the leaves (Irvine, 1952).

FRUIT. Whether boiled, added to soups, or sliced and fried, the pods have a unique flavor and mucilaginous texture, the latter objectionable to many people. Edible seeds can be extracted from pods that are too mature to be eaten. In Turkey, the young pods are strung together and allowed to dry for use in winter. In western Africa the fruit are sliced, sun-dried, ground to a powder, and stored until needed. Dried pods or okra powder can easily be rendered edible by boiling.

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Table 1. The nutritional composition of the edible portion of fresh okra.^z

Nutrient	Value
Water (%)	90
Energy (kcal)	38
Protein	2.0
Fat (g)	0.1
Carbohydrate (g)	7.6
Fiber (g)	0.9
Ca (mg)	81
P (mg)	63
Fe (mg)	0.8
Na (mg)	8
K (mg)	303
Vitamin A (IU)	660
Thiamine (mg)	0.20
Riboflavin (mg)	0.06
Niacin (mg)	1.00
Ascorbic acid (mg)	21.1
Vitamin B ₆ (mg)	0.22

^zSource: Haytowitz and Matthews (1984).

COFFEE SUBSTITUTE. Mature dried seeds of okra can be roasted and ground as a coffee substitute or added to coffee as an adulterant. Using ground okra seeds to make a coffee is widespread in El Salvador and other parts of Central America, Africa, and Malaysia (Burkill, 1935). Coffee brewed from okra has a good aroma, but it lacks the stimulating effect of caffeine.

OIL AND PROTEIN SOURCE. The content of unsaturated fatty acids, especially linoleic and oleic acids, is high (70%) in okra seeds. The keeping quality of the oil is poor, but it is readily hydrogenated into a solid shortening and can be used as margarine. Okra has a high protein content that ranges from 18% to 27%.

CURD. Curds made from okra seeds have a creamy or light yellow color, a background flavor similar to that of tofu (vegetable curd made from soybeans [*Glycine max* (L.) Merr.], and a musky, distinctive flavor. Okra vegetable curd has one possible drawback: seeds reportedly contain the toxic pigment gossypol (or a gossypol-like compound), which is soluble in oil and, thus, is included in the curd at concentrations several times higher than that of the original seed. To avoid possible long-term toxicity, it would be desirable to remove the gossypol, as is the practice in producing cottonseed oil (Canella and Sodini, 1977).

PAPER PULP. The fiber of the okra plant, like that found in other plants of the Malvaceae family, is a suitable

material for making paper. Okra stems contain longer fibers in their woody cores than most other dicotyledonous plants (Nelson et al., 1961).

FUEL. Thoroughly dried okra stems can be burned as an inexpensive fuel. It burns rapidly, producing considerable heat, but it is not long lasting.

MUCILAGE. When the pod is boiled, it becomes highly mucilaginous. This mucilage has been used as a spreading agent in the manufacture of paper in Malaysia.

In the United States, okra is used primarily as a food in the fresh and processed state (canned, in prepared soups, frozen, and dehydrated as a powder). The young, tender pods of okra, popular in creole cookery, are excellent in soup and stews; they may be boiled, baked, or fried. Many cooks in the southern United States dip the sliced pods in cornmeal and fry them. Okra combines well with other vegetables, especially tomatoes. Pods that are boiled and then chilled are used in combination salads. Regardless of the method used, rapid cooking is preferred, as it preserves flavor and prevents the mucilaginous consistency from developing.

Production

There are ≈15,000 acres (6,000 ha) of okra grown annually in the United States. Most commercial okra production is in Georgia, South Carolina, Tennessee, Alabama, Texas, California, and Florida. It is difficult to obtain exact figures on production acreage, because much of it is produced and marketed locally and therefore is not reported. Most southern states grow enough okra to provide for local demand. Mexico is the leading exporter of okra to the United States.

Okra can be grown anywhere in the United States where other vegetables are grown, except in the coolest northernmost parts or at high altitudes. Okra varieties are short-day responsive, although some are day-neutral. Temperature and photoperiod interact to influence flowering. Flower initiation and flowering are delayed at high temperatures, and high night temperatures can increase plant height in most currently grown varieties (Tenga and Ormrod, 1985). Temperatures >68 °F (20 °C) are needed for normal development. It is considered a southern crop plant that is categorized as

very tender and unable to tolerate temperatures of <59 °F (15 °C) for very long. At temperatures >108 °F (42 °C), flower abortion can occur. The plant develops rapidly in areas to which it is adapted and requires only 2 months from planting to harvest of the first pods. If properly maintained, plants continue to bear until frost, especially if the young pods are harvested promptly and not allowed to mature.

Soils

Okra can be grown on a wide range of soil types, although rich, sandy loam soils are optimum. It is most important that the soil be well drained and not prone to waterlogging. It is difficult to achieve good stands when directly seeding into heavy clay soils. The soil should be well supplied with organic matter. This can be accomplished by applying animal manures or incorporating green manure crops (Colditz and Barber, 1975).

Okra is slightly sensitive to excess soil acidity; thus, proper liming is essential. The optimum soil pH range for okra is 6.0 to 7.0. If lime is needed, the use of dolomitic lime is recommended to supply calcium and magnesium. Okra is very susceptible to damage by root-knot nematode (*Meloidogynesp.*) and sting nematode (*Belonolaimussp.*). Using a rotation with corn, grasses, and small grains helps prevent a buildup of nematode populations. Okra should not follow crops such as squash (*Cucurbita pepo* L.), cucumber (*Cucumis sativus* L.), muskmelon (*Cucumis melo* L.), watermelon [*Citrullus lanatus* (Thunb.) Mansf.], or sweet potatoes [*Ipomoea batatas* (L.) Poir.], which tend to increase nematode populations. It is important before planting, preferably in the late summer of the previous season, to take a soil sample and check for the presence of nematodes. If nematodes are found, the use of a soil fumigant is recommended.

Fertilization should be based on a soil test to prevent excessive plant vigor and poor yields. If a soil test is not available, a general recommendation is to apply N at 30 lb/acre (34 kg·ha⁻¹), P at 26 to 34 lb/acre (29 to 38 kg·ha⁻¹), and K at 49 to 66 lb/acre (55 to 74 kg·ha⁻¹). All of this can be incorporated under the row or applied in a band to the side. Nitrogen should be sidedressed at 25 lb/acre (28 kg·ha⁻¹) when the plants are 6 to 8 inches (15

to 20 cm) tall and again 2 to 3 weeks later. Additional N may be required if there is excessive amounts of rainfall that could leach out previously applied fertilizer.

Research on okra for 5 years in Georgia indicated that an 8N-3.4P-6.6K analysis fertilizer or 1 N : 1 P : 1 K ratio was most satisfactory. The additional 2% of N is of more value in increasing okra yields than an additional 1.8% of P or 3.3% K found in a 6N-5.2P-6.6K or 6N-3.4P-9.9K material (Spivey et al., 1957). Since okra produces over a long period compared to many vegetables, proper use of fertilizers including sidedressed N applications is particularly important. The okra plant has a sensitive balance between the vegetative (foliage production) and reproductive (pod production) growth that needs to be considered in developing any fertilization program. Using additional N should be avoided on vigorous plantings until fruiting begins to check growth.

Varieties

Recent genetic improvement has emphasized plant characteristics such as semidwarf plant stature, reduced branching, moderately lobed leaves for increasing fruit visibility to improve harvest, red ornamental pigmentation, early maturity, and smooth, dark-green pods with slow fiber development (Corley, 1985; Scott et al., 1990). Using hybrid, dwarf varieties of okra such as 'Annie Oakley I' for the fresh market has allowed closer plant spacing and increased yields than older, open-pollinated varieties. Some of the more important varieties are listed below: 'Clemson Spineless'—a uniform spineless variety with medium dark-green ridged pods requiring 55 to 58 d to reach maturity (Fig. 1).

'Clemson Spineless 80'—slightly taller than 'Clemson Spineless' with a more open growth habit and medium-green ridged pods requiring 52 d to reach maturity.

'Cajun Delight'—the hybrid version of 'Clemson Spineless', requiring 53 d to reach maturity.

'North & South'—a hybrid spineless variety with darker pods than 'Annie Oakley', requiring 46 d to reach maturity.

'Emerald'—a spineless variety with dark-green, smooth, round pods, requiring 58 to 60 d to reach maturity (Fig. 2).

'Lee'—a spineless, semidwarf variety with deep, bright-green angular pods, requiring 53 to 55 d to reach maturity. 'Annie Oakley I'—a hybrid, spineless, dwarf variety with bright-green angular pods, requiring 53 to 55 d to reach maturity (Fig. 3).

'Annie Oakley II'—a hybrid, spineless, dwarf variety, with medium-green angular pods, requiring 48 d to reach maturity; it out yields 'Annie Oakley' by 10% to 15%.

'Prelude'—a new open-pollinated, spineless variety with very-dark-green, glossy, ridged pods. It can be harvested when pods are longer than other varieties and still be tender. It requires 50 to 53 d to reach maturity.

'UGA Red'—a new red pigmented plant that can be used as an edible ornamental.

In addition to the above list, there are other varieties of okra that should be mentioned such as 'Green Best F₁', 'Perkins Dwarf Spineless', 'Burgundy (Red)', 'Red Velvet', 'Red Wonder', 'White Velvet' (Fig. 4), 'Blondy', 'Perkins Mammoth Long Pod', 'Louisiana', and 'Jefferson'.

Planting

Both the Cole planter, used for planting corn seed, and the Planet Jr., used on a wide variety of vegetable seeds, are suitable for planting okra.

SEED TREATMENT. Thiram (a.i.) at 2.25 to 3.0 oz/100 lb of seed (1.4 to 1.9 g·kg⁻¹) and metalaxyl (a.i.) at 0.5 oz/100 lb of seed (0.3 g·kg⁻¹) are recommended for improved germination and stand (Orzolek et al., 1997). Okra has a hard seedcoat. A 24-h soaking in water will enhance germination and emergence, especially for planting in warm soils. The seeds should be allowed to surface-dry before sowing. Research in Egypt has shown that soaking okra seeds for 12 h in distilled water and then soaking them for 12 h in growth regulator solutions (gibberellic acid, indole-3-acetic acid, and naphthalene acetic acid) increased yields due to the increase in germination percentage and subsequent plant stand, increased the number and dry matter content of branches and leaves (i.e., photosynthetic surfaces), and increased the number and weight of pods (Omran et al., 1980).

SPACING. Rows are commonly spaced 28 to 39 inches (71 to 99 cm) apart. Seeds are planted 1.5 to 2 inches (4 to 5 cm) deep at a rate of 4 to 6

Fig. 1. 'Clemson Spineless' okra.

Fig. 2. 'Emerald' okra.

Fig. 3. 'Lee' okra.

Fig. 4. 'White Velvet' okra.

seeds/ft of row (13 to 20 seeds/m). Plants are thinned to 8 to 12 inches (20 to 30 cm) between plants. This spacing requires 10 to 20 lb of seed/acre (11 to 22 kg·ha⁻¹).

Research has shown that decreasing the in-row spacing of 'Clemson Spineless' and 'Lee' from 16 to 4 inches (40 to 10 cm) increased yields from 5,538 to 10,064 lb/acre (6202 to 11271 kg·ha⁻¹), while increasing the between-row spacing from 12 to 24 inches (30 to 60 cm) did not significantly affect yield (Patterson and Morelock, 1979). Decreasing in-row spacing from 16 to 4 inches (40 to 10 cm) decreased the number of laterals formed per plant from 5.7 to 1.6.

TIMING. Okra for the fresh market can be planted as soon as soil temperatures rise above the base temperature of 60 °F (15 °C). The optimum soil temperature for germination is 75 to 90 °F (24 to 32 °C) (Maynard and Hochmuth, 1997). Earlier planting for fresh-market okra is desired, since the intention is to market okra early when the price is normally the highest. For processed okra, maximum yield rather than earlier production is the prime consideration, and later planting dates are the rule.

Plastic mulches

Black plastic mulch increases soil temperatures, controls weeds, and conserves soil moisture, thus increasing yield and earliness. Plastic mulch, used in conjunction with drip irrigation and container-grown okra transplants, can advance earliness by as much as 21 d (Khan et al., 1990; Lamont, 1989). Okra transplants should be 3 to 4 weeks old and have about three to four leaves. Okra is transplanted on the plastic mulch in double rows 15 to 18 inches (37 to 45 cm) apart and spaced 12 inches (30 cm) apart in the row. The drip irrigation tape would be positioned in the center of the mulched bed and buried 2 to 3 inches (5 to 8 cm) deep. The use of plastic mulch, drip irrigation, and transplants can increase marketable yields of okra by >3,000 lb/acre (3,360 kg·ha⁻¹) compared to bare ground (Khan et al., 1991).

Irrigation

Okra is considered by many to be tolerant of dry weather, but it is actually sensitive to moisture stress. Some of the older, tall-growing varieties are

more drought tolerant than some of the newer dwarf varieties. In general, as is the case with other crops, the effect of moisture stress depends on the phenological stage of the plant. The flowering and pod filling stages are critical, and water stress at this time can reduce yield >70% (Mbagwu and Adesipe, 1987).

When the okra plant begins to suffer from lack of moisture, it begins to drop its leaves. If drought continues, it will drop both pods and leaves and finally die. It takes less dry weather to substantially lower yields than is generally suspected. In irrigation studies on okra (Singh, 1987), the leaf dry weight, stem dry weight, and leaf area were significantly increased as the amount of water applied increased, based on a higher percentage of pan evaporation. Similar increases were observed in fruit yield. A general recommendation is to apply 1 to 1.5 inches (25 to 38 mm) of water per week. Drip irrigation has been used quite successfully with okra and is an excellent way to supply moisture and nutrients while reducing disease pressure.

Pest management

INSECTS. Compared to other vegetable crops, okra has few insect pests. Insect pests of okra can be grouped into two categories: foliage feeders and pod feeders. Foliage-feeding insects such as melon and cotton aphid (*Aphis gossypii* Glover), corn earworm (*Helicoverpa zea* Boddie), Japanese beetle (*Popillia japonica* Newman), leafhopper (*Empoasca fabae* Harris), pink bollworm (*Pectinophora gossypiella* Saunders), spider mites (*Tetranychus* sp.), whitefly (*Bemisia tabaci* Gennadius), and vegetable leafminer (*Liriomyza sativae* Blanchard) will cause serious reduction in yields only when their numbers are high or when plants are young or under stress. Well-established or healthy okra plants can tolerate considerable loss of foliage before their yields are reduced. Insect pests that attack the pods can be a greater problem. Insects in this category include corn earworm (*Helicoverpa zea* Boddie), southern green stink bug (*Nezara viridula* L.), and leaffooted bug (*Leptoglossus phyllopus* L.). If control measures become necessary and the plants are bearing pods, chemicals should be applied immediately after all

Pods (marketable and immature) have been removed.

DISEASES. Some important diseases affecting okra include the following: anthracnose (*Colletotrichum* sp.), cercospora blight (*Cercospora abelmoschi* Ellis and Everhart), fusarium wilt (*Fusarium oxysporum* f. *vasinfectum* (Atkinson) Snyder and Hansen), leaf spot (*Ascochyta abelmoschi* Saccardo), powdery mildew (*Erysiphe cichoracearum* DeCandolle), and verticillium wilt (*Verticillium albo-atrum* Reinke & Berthold). A general control measure for all these diseases is to practice good crop rotation and deep plow to cover old crop residues. Chemical control recommendations are specific to individual states.

NEMATODES. As mentioned, root-knot nematode and sting nematode are by far the most serious nematodes affecting okra. Their damage often causes irregular growth and reduced or delayed production. Okra plants damaged by root-knot nematodes are usually stunted and appear unhealthy with elongated, round swellings on both large and small roots. The use of a soil fumigant or nematicide is required to ensure production of okra in nematode-infested fields.

Nonchemical management of nematodes can be accomplished through the use of soil solarization, crop rotation, or using nematode-suppressive crops. Nematode-suppressive crops include bahiagrass (*Paspalum notatum* Flugge) or common vetch (*Vicia sativa* L.) and release toxic compounds that inhibit nematodes.

WEEDS. Shallow cultivation should be practiced to conserve soil moisture and destroy weeds. Chemical control measures for weeds are limited, but glyphosate and trifluralin are registered for okra.

Harvest and handling

Except in unusually hot weather, an okra pod reaches marketable stage [$\approx$ 3 to 4 inches (8 to 10 cm) in length] in 4 to 6 d. At this stage of development, the pods are tender and free of fiber. Almost all okra is hand harvested, and okra should be harvested at least every second day, preferably everyday, to ensure that the pods are of optimum size and quality.

HARVESTING FOR PROCESSING. The ideal pod type for freezing is short, dark green, and round or multifaceted

Fig. 5. Harvested okra.

(Sistrunk et al., 1960). Okra for canning requires more color retention (chlorophyll content), low mucilage content, and low fiber content (Woodroof and Shelor, 1958). Okra varieties like 'Emerald', 'Louisiana Green Velvet', and 'White Velvet' are grown for processing and produce pods on a brittle stem that allows the pods to be broken or snapped off so that the stem remains on the plant and not with the pod. Okra grown for processing should be allowed to grow as long as possible without becoming fibrous or hard. The pod is usually tender as long as the pod top will snap off evenly. Processing-type okra usually requires three harvests a week. The proper training of picking crews to grade okra as it is being harvested and discard tough and damaged pods is extremely important for an efficient operation. Pods <4 inches (10 cm) long should be left to reach maximum length of ≈ 5.5 to 6 inches (14 to 15 cm), at which time these pods will return a much greater weight per acre.

HARVESTING FOR FRESH MARKET.

Okra for fresh market must be cut with a knife to remove the stem and graded into three sizes: Fancy = pods ≤ 3.5 inches (9 cm) long; Choice = pods 3.5 to 4.5 inches (9 to 11 cm) long; Jumbo = pods ≥ 4.5 inches (11 cm) long but still tender. It is often necessary to harvest every day during periods of rapid growth to ensure that there will be pods small enough to grade Fancy or Choice. Allowing fruit to mature on the plant, as is the case in seed production, results in alternate bearing or fruiting waves, reducing fruit yields per plant by 60% to 70% (Perkins et al., 1952). The practice of cutting off (cropping) the older leaves of the okra plant during harvest does not negatively influence future yields as long as the leaves being removed are not higher than the undeveloped pods.

Okra pods must be handled carefully to prevent bruising, which turns pods black within a few hours. Picking crews should wear soft cotton gloves to minimize damage to the tender pods. In addition, most people are sensitive to the small spines on okra and often get a rash or itch. To avoid this problem, pickers should wear long-sleeved shirts and long pants.

Under favorable conditions, yields of fresh-market okra are ≈ 300 bushels/acre or 9,000 lb/acre (10,000 kg·ha⁻¹) compared to a processed okra yield of 10,000 lb/acre (11,200 kg·ha⁻¹). A bushel basket of okra weighs 30 to 35 lb (14 to 16 kg). The price range for fresh market okra is \$0.20 to \$0.70/lb and \$0.08 to \$0.12/lb for processing okra. The average costs of okra production are preharvest, \$156/acre (\$385/ha), and harvest and handling, \$1,064/acre (\$2628/ha), for a total of \$1,220/acre (\$3,013/ha).

Storage and marketing

Okra harvested in good condition has a satisfactory shelf life of 7 to 10 d when stored at 54.5 °F (12.5 °C) and 90% to 95% relative humidity (Hardenburg et al., 1986). The high relative humidity of 90% to 95% is desirable to prevent sweating or shriveling of the okra pods. When stored at <50 °F (10 °C), okra is subject to chilling injury, which is manifested by surface discoloration, pitting, and decay. Contact or top icing is not used to cool okra because it causes water spotting in 3 d.

If okra is stored in hampers for >24 h without refrigeration, the pods

may develop a bleaching injury. As for any vegetable crop, it is imperative that any storage container used permit adequate ventilation.

Okra may be spray washed or placed in a large water tank for cleaning. It is recommended that the wash water be chlorinated to 75 to 100 ppm (mg·L⁻¹) of free chlorine to prevent disease problems. Excess water should be removed after packing.

Using postharvest dips, various packaging technologies, and controlled-atmosphere storage have been somewhat successful in extending the shelf life of okra (Fontenot et al., 1987; Ilker and Morris, 1975; Perkins-Veazie and Collins, 1996; Singh et al., 1980). Preshipment packaging in perforated film prevents wilting and physical injury during handling. Results of a packaging study suggest that 5% to 10% carbon dioxide in the atmosphere lengthens the shelf life of okra by ≈ 1 week. Higher concentrations of carbon dioxide caused off-flavors (Anandaswamy, 1963).

In general, okra has the same storage requirements as green beans, cucumber, eggplant, peppers, and squash. These products may be stored together without deleterious effect. Okra should not be stored with melons (*Cucumis* sp.), bananas (*Musa* sp.), apples (*Malus* sp.), or other produce that gives off ethylene gas.

Okra is supplied to the markets in the United States by the southern tier of states during June, July, and August, while California ships okra from June through October. Mexico exports okra year-round to the United States.

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