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Okra (*Abelmoschus esculentus* (L.) Moench) as a Valuable Vegetable of the World

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Summary: Okra is a commercial vegetable crop with considerable area under cultivation in Africa and Asia. Okra belongs to the family Malvaceae. It probably originated in Ethiopia and is widely spread all over tropical, subtropical and warm temperate regions of the world. Okra plays an important role in the human diet by supplying fats, proteins, carbohydrates, minerals and vitamins. Moreover, its mucilage is suitable for certain medical and industrial applications. Therefore, young fruits of okra have reawakened beneficial interest in bringing this crop into commercial production. The optimum yield of okra is approximately 6.6 t ha^{-1}. Okra requires warm temperatures. The optimum temperatures are in the range of 20-30°C, with minimum temperatures of 18°C and maximum of 35°C. Okra needs rather high quantity of water despite having considerable drought resistance. The plant forms a deeply penetrating tap root with dense shallow feeder roots reaching out in all directions in the upper 45 cm of soil. Soil clamminess is essential during the continuation of growing period.
Key words: *Abelmoschus esculentus*, breeding, composition, cultivation practice, diseases, insects, okra, origin, production

Introduction

Latin binomial names for okra are *Abelmoschus esculentus* and *Hibiscus esculentus* (Kumar et al. 2010), and it is commonly known as bhindi in India, krajiab kheaw in Thailand, okra plant, ochro, okoro, quimgombo, quingumbo, gombo, kopi arab, kacang bendi and bhindi in South East Asia. However, in Middle East it is known as bamia, bamya or bamieh and gumbo in Southern USA, and lady's finger in England (Ndunguru & Rajabu 2004). On the other hand, in Portuguese and Angola, okra is known as quiabo, and as quimbombo in Cuba, gombo commun, gombo, gumbo in France, mbamia and mbinda in Sweden, and in Japan as okura (Chauhan 1972, Lamont 1999). Lastly, it is also found in Taiwan, where it is called qiu kui (Siemonsma & Kouame 2000).

Chemical composition

Okra contains proteins, carbohydrates and vitamin C (Lamont 1999, Owolarafe & Shotonde 2004, Gopalan et al. 2007, Arapitsas 2008, Dilruba et al. 2009), and plays a vital role in human diet (Kahlon et al. 2007, Saifullah & Rabbani 2009). Consumption of young immature okra pods is important as fresh fruits, and it can be consumed in different forms (Ndunguru & Rajabu 2004). Fruits can be boiled, fried or cooked (Akintoye et al. 2011). The composition of okra pods per 100 g edible portion (81% of the product as purchased, ends trimmed) is: water 88.6 g, energy 144.00 kJ (36 kcal), protein 2.10 g, carbohydrate 8.20 g, fat 0.20 g, fibre 1.70 g, Ca 84.00 mg, P 90.00 mg, Fe 1.20 mg, β-carotene 185.00 µg, riboflavin 0.08 mg, thiamin 0.04 mg, niacin 0.60 mg, ascorbic acid 47.00 mg.

The composition of okra leaves per 100 g edible portion is: water 81.50 g, energy 235.00 kJ (56.00 kcal), protein 4.40 g, fat 0.60 g, carbohydrate 11.30 g, fibre 2.10 g, Ca 532.00 mg, P 70.00 mg, Fe 0.70 mg, ascorbic acid 59.00 mg, β-carotene 385.00 µg, thiamin 0.25 mg, riboflavin 2.80 mg, niacin 0.20 mg (Gopalan et al. 2007, Varmudy 2011). Carbohydrates are mainly present in the form of mucilage (Liu et al. 2005, Kumar et al. 2009). That of young fruits consists of long chain molecules with a molecular weight of about 170,000 made up of sugar units and amino acids. The main components are galactose (25%),

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rhamnose (22%), galacturonic acid (27%) and amino acids (11%). The mucilage is highly soluble in water. Its solution in water has an intrinsic viscosity value of about 30%.

Okra seeds contain about 20% protein and 20% oil (Tindall 1983, Charrier 1984). The bark fibre is easy to extract. It is white to yellow in colour, strong but rather coarse. Tests conducted in China suggest that an alcohol extract of okra leaves can eliminate oxygen free radicals, alleviate renal tubular-interstitial diseases, reduce proteinuria, and improve renal function (Liu et al. 2005, Kumar et al. 2009). In Thailand, okra is usually boiled in water resulting in slimy soups and sauces, which are relished. The fruits also serve as soup thickeners. Okra seed can be dried, and the dried seeds are a nutritious material that can be used to prepare vegetable curds, or roasted and ground to be used as coffee additive or substitute (Moekchantuk & Kumar 2004). Okra leaves are considered good cattle feed, but this is seldom compatible with the primary use of the plant. The leaf buds and flowers are also edible (Doijode 2001).

Moreover, okra mucilage is suitable for industrial and medicinal applications (Akinyele & Temikotan 2007). Industrially, okra mucilage is usually used for glace paper production and also has a confectionery use. Okra has found medical application as a plasma replacement or blood volume expander (Savello et al. 1980, Markose & Peter 1990, Lengsfeld et al. 2004, Adetuyi et al. 2008, Kumar et al. 2010).

World Marketing

Okra production is estimated at 6 million t per year in the world (Burkil 1997). The total area of okra has increased over the years. In 1991-1992, the total area under okra cultivation was 0.22 million hectares and the production was 1.88 million t, while in 2006-2007 the area increased to 0.396 million hectares and the production was 4.07 million t. Finally, in 2009-2010 the area was 0.43 million hectares and the production stood at 4.54 million t. Table 1 gives data on area, production and productivity of okra in the world (2008-2009), the share of India being 67.1%, followed by Nigeria at 15.4% and Sudan at 9.3 % (Varmudy 2011).

Origin and Geographic Distribution

Okra plant or lady's finger was previously included in the genus *Hibiscus.* Later, it was designated to *Abelmoschus*, which is distinguished from the genus *Hibiscus* (Aladele et al. 2008). *Abelmoschus* was subsequently proposed to be raised to the rank of distinct genus by Medikus in 1787. Okra originated somewhere around the Ethiopia, and was cultivated by the ancient Egyptians by the 12th century BC. Its cultivation spread throughout Middle East and North Africa (Tindall 1983, Lamont 1999). Okra is grown in many parts of the world, especially in tropical and sub-tropical countries (Arapitsas 2007, Saifullah & Rabbani 2009). This crop can be grown on a large commercial farm or as a garden crop (Rubatzky & Yamaguchi 1997). Okra plants are grown commercially in many countries such as India, Japan, Turkey, Iran, Western Africa, Yugoslavia, Bangladesh, Afghanistan, Pakistan, Myanmar, Malaysia, Thailand, India, Brazil, Ethiopia, Cyprus and in the Southern United States (Purseglove 1987, Benjawan et al. 2007, Qhureshi 2007). Okra is found all around the

Table 1. Area production and productivity of okra in the world in 2008-2009

Countries	Area (ha)	Production (M t)	Productivity(M t ha^{-1})
India	432,000	4,528,000	10.50
Nigeria	387,000	1,039,000	2.70
Sudan	21,926	223,650	10.20
Iraq	22,250	141,000	6.30
Ivory Coast	46,000	115,867	2.50
Pakistan	15,081	114,657	7.60
Ghana	19,500	108,000	5.50
Egypt	6,800	107,000	15.70
Benin	13,658	48,060	3.50
Saudi Arabia	4,000	46,000	11.50
Others	58,365	276,206	4.50
Total	1,024,580	6,749,440	6.60

Source: Varmudy (2011)

world from equatorial areas to Mediterranean Sea as may be seen from the geographical distribution of cultivated and wild species. Cultivated and wild species of okra clearly showed overlapping in Southeast Asia, which is considered as the centre of diversity. The spread of the other species is the result of their introduction to Africa and America (Qhureshi 2007, Aladele et al. 2008).

There are two hypotheses concerning the geographical origin of *A. esculentus*. Some scientists argue that one putative ancestor (*A. tuberculatus*) is native from Northern India, suggesting that the species originated from this geographic area. On the basis of ancient cultivation in East Africa and the presence of the other putative ancestor (*A. ficulneus*), others suggest that the area of domestication is Ethiopia or North Egypt, but no definitive proof is available today (Department of Biotechnology 2009). *Abelmoschus* species occur in the world including as *A. moschatus, A. manihot, A. esculentus, A. tuberculatus, A. ficulneus, A. crinitus* and *A. angulosus* (Charrier 1984). The three cultivated species which are sometimes found in a semi-wild state in clearings, along roads and near villages, occur at low altitudes in all tropical, subtropical and warm temperate regions of the world.

The species *A. moschatus* has a wide geographical distribution in India, Southern China, Indonesia, Papua New Guinea, Australia, Central and West Africa. The species *A. manihot subsp. manihot* is cultivated mainly in the East Asia, but also in the Indian sub-continent and Northern Australia. It is less frequently found in America and tropical Africa (Chevalier 1940). The species *A. manihot subsp. tetraphyllus* comprises two wild forms differentiated on the basis of their ecological adaptation. First, *var. tetraphyllus*, grows at low altitudes between 0 and 400 m in the regions with a marked dry season of Indonesia, Philippines, Papua New Guinea and New Ireland. Second, *var. punens*, grows at altitudes between 400 and 1600 m in Philippine and Indonesia (Department of Biotechnology 2009). The species *A. esculentus* is cultivated as a vegetable in most tropical and subtropical regions of Africa such as Ghana, Guinea, Ivory Coast, Liberia and Nigeria.

The wild species *A. tuberculatus*, related to *A. esculentus*, is endemic to the medium altitude hilly areas in India (IBPGR 1991). The wild species *A. ficulneus* is found in a vast geographic area stretching from Africa to Asia and Australia. It flourishes in tropical areas of low altitude with a long dry season, i.e. desert regions of Sahelian

Table 2. Chromosome numbers in *Abelmoschus spp.*

Species	Chromosome numbers (2n)	References
A. esculentus	62	IBPGR (1991)
A. esculentus	66	Ford (1938)
A. esculentus	72	Ugale *et al* (1976), Datta & Naug (1968), kamalova (1977) and Qhureshi (2007)
A. esculentus	108	Datta & Naug (1968)
A. esculentus	118	Tischler (1931)
A. esculentus	120	Purewal & Randhawa (1947) and Datta & Naug (1968)
A. esculentus	122	Tischler (1931)
A. esculentus	124	Kuwada (1964, 1966)
A. esculentus	126-134	Chizaki (1934)
A. esculentus	130	Joshi & Hardas (1976), Singh & Bhatnagar (1975) and Kumar et al. (2010)
A. esculentus	131-143	Datta & Naug (1968) and Siemonsma (1982)
A. esculentus	132	Ford (1938) and Datta & Naug (1968)
A. esculentus	144	Datta & Naug (1968)
A. manihot ssp. Manihot	60	Chizaki (1934)
A. manihot ssp. Manihot	66	Kamalova (1977)
A. manihot ssp. Manihot	68	Kuwada (1974)
A. manihot ssp. tetraphyllus	130	Ugale et al. (1976)
A. manihot Var. tetraphyllus	138	Joshi & Hardas (1976)
A. manihot ssp. tetraphyllus	138	Joshi & Hardas (1976)
A. moschatus	72	Gadwal et al. (1968)
A. ficulneus	72	Kuwada (1966,1974) and Gadwal et al. (1968)
A. angulosus	56	Ford (1938)
A. tuberculatus	58	Joshi & Hardas (1953)
A. caillei	194	Singh & Bhatnagar (1975) and Kumar et al. (2010)
A. manihot var. caillei	185-199	Siemonsma (1982)

Source : Department of biotechnology (2009)

Africa (Niger), Madagascar, East Africa, India, Indonesia, Malaysia and Northern Australia (Lamont 1999).The two wild species *A. crinitus* and *A. angulosus* are exclusively of Asian origin. They are differentiated by their ecology. *A. crinitus* grows at low altitudes in regions with a marked dry season, being (China, India, Pakistan and Philippines). *A. angulosus* grows at altitudes between 750 and 2000 m in Pakistan, India, Sri Lanka and Indonesia (Charrier 1984, IBPGR 1991).

Cytogenetic Relationship

There is a significant variation in the chromosome numbers and ploidy levels in *Abelmoschus* (Tab. 2). The highest chromosome number reported are close to 200 for *A. manihot var. caillei*, whereas the lowest chromosome numbers reported is 2n=56 for *A. angulosus* (Ford 1938, Siemonsma 1982). The most frequently observed somatic chromosome number of okra is 2n=130. Although, Datta & Naug (1968) suggest that the numbers chromosome 2n=72, 108, 120, 132 and 144 are in regular series of polyploids with n=12. The existing taxonomical classifications at the species level in the genus *Abelmoschus* are unsatisfactory. Detailed cytogenetical observations on Asian material of okra and related species are likely to provide more examples of the existence of amphidiploids in the genus (Siemonsma 1982).

Ecology and Season Growth

Okra needs temperatures above 20°C for normal growth and development (Lamont 1999, Abd El-Kader et al. 2010). Germination percentage and speed of emergence are optimal at 30-35°C (Akande et al. 2003). Flower initiation and flowering are delayed with increasing temperatures (positive correlation between temperature and number of vegetative nodes) (Lamont 1999, Abd El-Kader et al. 2010). *Abelmoschus spp.* is a short-day plant, but its wide geographical distribution (up to latitudes of 35-40°) indicates that cultivars differ markedly in sensitivity. Flower initiation and flowering are hardly affected by day length in popular subtropical cultivars. Most tropical cultivars show quantitative short-day responses, but qualitative responses also occur. The shortest critical day length reported is 12.30 hours. This explains why flowering of local cultivars of common okra is only quantitatively affected by day length in the coastal areas of the Gulf of Guinea (5°N). However, more inland at higher latitudes (10°N) one can occasionally observe very tall non-flowering plants of common okra due to a qualitative response. Okra tolerates poor soils, but prefers well-drained sandy loams, with pH 6-7, and a high content of organic matter (Lamont 1999, Adilakshmi et al. 2008, Akanbi et al. 2010, Akande et al. 2010). Okra requires a moderate rainfall of 80-100 cm well distributed to produce its young edible fruits over a relatively long period. An average temperature of 20°C to 30°C is considered optimum for growing, flowering and fruiting (Akinyele & Temikotan 2007, Dada & Fayinminnu 2010).

Propagation and Planting

Most farmers harvest seed from their own local cultivar or rather heterogeneous landrace (Moekchantuk & Kumar 2004). The easiest way to keep the seed is to leave it in the pods. Seed weight varies from 30 to 80 g 1000^{-1} seeds. To soften the hard seed coat, the seed is often soaked in water or chemicals prior to sowing. The seed is usually dibbled directly in the field (2-3 seeds per hole). Optimum plant densities are in the range of 50,000 – 60,000 plants ha^{-1}(Olasotan 2001). Emergence is within one week. When the plants are about 10 cm tall, they are thinned to one plant per hole. Germination and initial growth are improved greatly by cultural practices that lower soil temperature, e.g. mulching, watering before the hottest part of the day, and sowing on ridge sides least exposed to direct sunlight (Splittstoesser 1984, Doijode 2001).

Integrated Management

Commercial okra growers usually practice sole cropping, and prefer the early, homogeneous, introduced cultivars. In traditional agriculture, farmers grow their okra landraces in home gardens or in fields with other food crops (Rashid et al. 2002). In West and Central Africa the landraces often consist of a mixture of *Abelmoschus esculentus* and *Abelmoschus caillei*, the former being predominant in dry climates, the latter in humid climates (Dabire-Binso et al. 2009). The uptake of minerals is rather high. Indicative figures for total nutrient uptake per hectares of a crop with a fruit yield of about 10 t ha^{-1} are 100 kg N, 10 kg P, 60 kg K, 80 kg Ca and 40 kg Mg (Kumar et al. 2010). Under humid tropical conditions a full grown crop consumes about 8 mm of water per day. A ration crop flowers soon after cutting, but usually results in poor quality fruit with a high percentage of bent fruits (Purseglove 1987, Anant & Manohar 2001).

Irrigation and Watering Systems

Thailand has an abundance of water, but growing demand, regional deficiencies and problems with contamination have placed pressure on the resource. Large-scale deforestation also has increased watershed degradation (DoAE 2002). 5.76 million ha are irrigated (mostly for rice), with 46% in central, 26% in the northern, 17% in the northeast and 12% in the southern regions with increasing pressures on supply, cost-effective strategies are needed to ensure sustainability. Improved technologies are available but costs (and also access in some areas) are a constraint. Strategic use of on-farm storage can lift productivity in dry areas (DoAE 2007, Tipraqsa et al. 2007).

Plant Protection Issues in Export Okra Production

In general, misuse and over-use of pesticides were not a major issue for the export okra cultivation in Thailand, but export data clearly indicate a major dip in export during 2000, when several consignments of the fresh okra from Thailand were rejected from the Japanese market because of high levels of pesticide residues (Moekchantuk & Kumar 2004). A collaborative effort by okra export companies and the Department of Agricultural Extension created considerable awareness among farmers and also introduced methods under the "Safe Vegetables" campaign to reduce the use of pesticides. Under this same campaign, home-made pesticide brews were promoted to further replace the dependency of the okra farmers on chemical pesticides. However, following visits to the okra fields and discussions with several farmers, it was found that the brews were largely ineffective in reducing pest populations. Currently, chemical insecticides along with *Bacillus thuringiensis* (BT) and locally-fermented herbal pesticides are extensively used by farmers to manage pest problems (Rashid et al. 2002). The export companies select the type and doses of agro-chemical inputs, generally to an extent necessary to keep residues below the Maximum Residue Levels (MRLs) set by the major importing companies (Odeleye et al. 2005).

Insect Pests and Diseases in Okra Production

Okra is susceptible to a large range of insect pests and diseases (N'Guessan et al. 1992, Ghanem 2003). Various growth stages of the crops are susceptible to the different insect pests and diseases (Ek-amnuay 2007, Fasunwon & Banjo 2010). Insect pests like crickets can be a problem during germination/seedling stage of the crop while the thrips, whitefly and other phloem feeders are common during vegetative stage (Fajinmi & Fajinmi 2010) (Tab. 3). The incidence pattern of insect pests and diseases are more or less common to all growing areas. Yellow Vein Mosaic (YVM) is the most pressing plant protection problem universally faced by all okra growers

Table 3. List of commonly occurring insect pests on okra

Common names	Scientific names	Susceptible crop stage	References
Cricket	*Metioche vittaticollis*; *Anaxipha longipennis*	Early vegetative-harvest	Charrier (1984)
Cotton leaf hopper	*Amarasca biguttula* Ishida	Early vegetative-harvest	Adilakshmi et al. (2008)
Mealy bug	*Maconellicoccus hirsutus*	Vegetative	Department of Biotechnology (2009)
Cotton aphids	*Aphis gossypii*	Vegetative	Charrier (1984)
Cotton leaf worm	*Spodoptera litura* E.	Vegetative – Fruiting	Charrier (1984)
Whitefly	*Bemisia tabaci*	Vegetative	Adilakshmi et al. (2008), Ghanem (2003) and Ali et al.(2005)
Cotton thrips	*Thrips palmi* karny	Vegetative	Ek-amnuay (2007) and Moekchantuk & Kumar (2004)
Army worm	*Spodoptera exigua*	Early Vegetative	Kumar et al. (2010)
Castor leaf hopper	*Empoasca formosana* Paoli	Vegetative	Ek-amnuay (2007)
Okra red mite	*Tetranychus macfarlanei* Baker	Seedling	Lamont (1999)
Cotton stainer	*Dysdercus cingulatus* F.	Fruiting	Ek-amnuay (2007)
Transverse moth	*Xanthodes transversa* Guenee	Vegetative	Ek-amnuay (2007)
Cotton bollworn	*Helicoverpa armigera* Hubner	Vegetative	Moekchantuk & Kumar (2004)
Cotton leaf roller	*Haritalodes derogate* F.	Harvest	Ek-amnuay (2007)
Citrus leaf roller	*Archips micaceana* Walker	Vegetative- harvest	Ek-amnuay (2007)
Jassids	*Amrasca biguttula* biguttula	Vegetative- harvest	Ek-amnuay (2007)
Cotton seed bug	*Oxycarenus hyalinipennis*	Seedling	Kumar et al. (2010)
Tomato fruit worm	*Helicoverpa armigera*	Vegetative- harvest	Kumar et al. (2010)
Beetles	*Podagrica spp*	Vegetative- harvest	Alegbejo et al. (2008),Fasunwon & Banjo (2010) and Dabire-Binso et al. (2009)

Table 4. List of commonly occurring diseases on okra

Common diseases	Scientific names	Susceptible crop stage	References
Pod spot	*Alternaria* sp.	Fruit setting	Kumar et al. (2010)
Anthracnose	*Colletotrichum* spp.	Flowering/Fruiting	Charrier (1984) and Lamont (1999)
Powdery mildew	*Erysiphe cichoracearum*	Vegetative	Kumar et al. (2010)
Virus (Yellow Vein Mosaic)	*Geminivirus* group	Early vegetative-harvest	Sastry & Singh (1975), Givord & Denboer (1980) and Rashid et al. (2002)
Leaf Spot	*Pseudocercospora abelmoschi* (Ell. & Ev.) Deighton	Vegetative stage	Charrier (1984) and Moekchantuk & Kumar (2004)
Damping-off	*Pythium vexans* de Bary	Seedling– early vegetative	Ek-amnuay (2007)
Root knot nematodes	*Meloidogyne* spp.	Seedling	Kumar et al. (2010)
Okra Leaf Curl Virus	Genus *Begomovirus*	Vegetative- harvest	Ghanem (2003)

Table 5. Pesticides used against okra insect pests

Trade names	Active Ingredient	Insect against
Dinitrofuran	Carbofuran	Cotton leaf hopper
Parathion-methyl	Organophosphates	Cotton leaf hopper
Parathion-methyl	Permethrin	Cotton leaf hopper
Parathion-methyl	Abamectin	Thrips/whiteflies
Home-made herbal	Fermented herbal (home-made)	All insect-pests
Proclaim (Syngenta)	Bt (*Bacillus thuringiensis*)	All defoliator
Proclaim (Syngenta)	Emamectin benzoate)	Thrips/whiteflies
Paraquat	Paraquat-dichloride	Weeds

Source: Moekchantuk & Kumar (2004)

(Ndunguru & Rajabu 2004, Alegbejo et al. 2008, Benchasri 2012) (Tab. 4). This jassid transmitted virus disease seriously stunts plant growth, reduces available leaf area for photosynthesis resulting into serious yield and quality loss (Sastry & Singh 1974, Ali et al. 2005). The vein and veinlets of affected plants turn yellow and even the fruit produced by such plants turn yellow in colour (Rashid et al. 2002). The viruleferous population of vectors has potential to turn a large tract of healthy okra crop into an unproductive one in a short span of time. Virus resistant and tolerant commercial varieties (F_1 hybrid and Open Pollination) are available for management of this disease in countries like India and Japan (Weerasekar 2006). Moreover, chemicals and insecticides were also used to control in many countries (Dabire-Binso et al. 2009) (Tab. 5).

Harvesting

Normally, okra pods are harvested every second day from the time the first pod is formed. It takes 5 to 10 days from flowering to picking fruits ready for the markets (Adetuyi et al. 2008). Harvesting is usually done early in the morning, after which it enters the market (Moekchantuk & Kumar 2004). Thailand market prefers small, tender fruits on every alternate day of okra. It is important to harvest this plant frequently to increase the yield and to spur the growth (Varmudy 2011). Fresh okra can be transported quite easily in bulk and kept for a few days without much loss of quality (Lamont 1999).

Breeding Goals

In some parts of the world, breeding of common okra has only been carried out to a limited scale by the commercial sector. A seed company in Senegal distributes improved African cultivars, suitable for the hot and cool season, and the F_1 hybrid with high tolerance to virus diseases and suitable for export. African farmers have selected an enormous diversity of forms which fit within a great variety of cropping systems. Some of these are available from local seed houses. International breeding efforts have been oriented towards intensive cultivation with high production in a short period (early maturity) and wide adaptation (photoperiod insensitivity, resistance to insects and diseases). Crossing between promising parents combined with pedigree selection or backcrossing remains the most common breeding procedure. Several attractive American and Indian cultivars have found their way to commercial growers throughout the tropics and subtropics, but there is still plenty of scope for cultivar improvement in Africa for the commercial sector (where good alternatives for the introduced cultivars are needed with better adaptation to local conditions) as well as for the traditional sector (where hardy, robust, long-lived types are required). Nevertheless, molecular markers analyses have shown a rather low level of genetic diversity in cultivated okra in spite of large phenotypic variability. There is little information on improvement using biotechnology apart from *in vitro* DNA extraction and plant regeneration from various explants and callus tissue. The characteristics of okra species open up new opportunities for recombination. They cross readily in both directions and crosses result in vigorous hybrids for sustainable okra product in the future.

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Bamija (*Abelmoschus esculentus* (L.) Moench) kao važna povrtarska vrsta u svetu

Sorapong Benchasri

Izvod: Bamija je komercijalna povrtarska vrsta koja se gaji na značajnim površinama u Africi i Aziji. Pripada porodici Malvaceae i verovatno vodi poreklo iz Etiopije. Ima važnu ulogu u ljudskoj ishrani kao izvor masti, belančevina, ugljenih hidrata, mineral i vitamina. U radu je dat pregled hemijskog sastava, porekla, proizvodnje i rasprostranjenosti, agrotehničkih mera, zaštite bilja i ciljeva u oplemenjivanju bamije sa posebnim osvrtom na tržište Tajlanda.

Ključne reči: *Abelmoschus esculentus*, agrotehničke mere, bamija, bolesti, oplemenjivanje, poreklo, proizvodnja, sastav, štetočine