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REVIEW ARTICLE

ORIGIN, DISTRIBUTION, TAXONOMY, BOTANICAL DESCRIPTION, GENETIC DIVERSITY AND BREEDING OF BRINJAL (*Solanum melongena* L.)

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ABSTRACT

Brinjal or eggplant (*Solanum melongena* L.) is an important Solanaceous crop of sub tropics and tropics. The name brinjal is popular in Indian subcontinents and is derived from Arabic and Sanskrit whereas the name eggplant has been derived from the shape of the fruit of some varieties, which are white and resemble in shape to chicken eggs. There are several names by which the crop is known in India, but brinjal is the most familiar. Brinjal is also called **'eggplant'** or **'aubergine'.** The name eggplant is believed to derive from Gerard's description of early forms with small, white fruit resembling eggs. In early years, eggplant was also termed 'Male insana' and the 'Italian Melazana', both of which translate to **"**made apple**".** The brinjal is of much importance in the warm areas of Far East, being grown extensively in India, Bangladesh, Pakistan, China and the Philippines. Names in Indian languages are Baingan (Hindi), Begun (Bengali), Ringna (Gujarathi), Badane (Kannada), Waangum (Kashmiri), Vange (Marathi), Bengena (Assamese), Baigan (Oriya), Vashuthana (Malayalam), Kathiri (Tamil), Vankaya (Telugu) and Peethabhala (Sanskrit). It was originally domesticated from the wild nightshade species *thorn* or *bitter apple*, *S. incanum*, probably with two independent domestications: one in South Asia, and one in East Asia. It was suggested that the brinjal originatd in Africa. But there is no evidence that *S. melongena* is native there though there are spiny African brinjal plants. Eggplant is widely used in its native India, for example in *sambar* (a tamarind lentil stew), *dalma* (a *dal* preparation with vegetables, native to Odisha), chutney, curry, and *achaar* (a pickled dish). Owing to its versatile nature and wide use in both everyday and festive Indian food, it is often described as the "king of vegetables". Roasted, skinned, mashed, mixed with onions, tomatoes, and spices, and then slow cooked gives the South Asian dish *baingan bharta* or *gojju*, similar to *salată de vinete* in Romania. Another version of the dish, *begun-pora* (eggplant charred or burnt), is very popular in Bangladesh and the east Indian states of Odisha and West Bengal where the pulp of the vegetable is mixed with raw chopped shallot, green chilies, salt, fresh coriander, and mustard oil. Sometimes fried tomatoes and deep-fried potatoes are also added, creating a dish called *begun bhorta*. In a dish from Maharashtra called *bharli vangi*, small brinjals are stuffed with ground coconut, peanuts, onions, tamarind, jaggery and masala spices, and then cooked in oil. Maharashtra and the adjacent state of Karnataka also have an eggplant-based vegetarian pilaf called 'vangi bhat'. Brinjal fruits are commonly considered as vegetables. They are cooked in various ways such as baking, barbecuing, frying or pickling. They can also be pureed, flavoured, and used as a dip or chutney as in Mediterranean and Indian cuisines. In Indian cuisine, they are used in curries and even made into soufflés. The cut fruits are typically soaked in cold salted water before cooking to avoid discoloration and to remove its mild bitterness. Brinjal is widely consumed as vegetable for its various health benefits. It is highly fibrous, contains antioxidants, potassium, Vitamin B-6 and phyto-nutrients like flavonoids which help in preventing cancer and heart disease. It also helps in weight loss with its low calories. It is good booster for brain and also helps in maintaining good health by lowering cholesterol in our body. The major brinjal producing states in India are Orissa, Bihar, West Bengal, Andhra Pradesh, Uttar Pradesh and Maharashtra. In the states of Tamil Nadu, Uttar Pradesh, Karnataka, Andhra Pradesh, Chhattisgarh and West Bengal, it is harvested all year round. Out of all states, in 2013-14, West Bengal stands to be the highest brinjal producing state with 23% of total production. In this review article origin, distribution, taxonomy, botanical description, genetic diversity and breeding, uses, nutritional value, health benefits of brinjal are discussed.

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INTRODUCTION

Brinjal or eggplant (*Solanum melongena* L.) is an important solanaceous crop of sub tropics and tropics. The name brinjal is popular in Indian subcontinents and is derived from Arabic and Sanskrit whereas the name eggplant has been derived from the shape of the fruit of some varieties, which are white and resemble in shape to chicken eggs. It is also called aubergine (French word) in Europe. The brinjal is of much importance in the warm areas of Far East, being grown extensively in India, Bangladesh, Pakistan, China and the Philippines. It is also popular in Egypt, France, Italy and United States (Bighaat, 2023). Eggplant (US, Canada), aubergine (UK, Ireland) or brinjal (Indian subcontinent, Singapore, Malaysia, South Africa) is a plant species in the nightshade family Solanaceae. *Solanum melongena* is grown worldwide for its edible fruit (WIKI, 2023; LFS, 2023). It is also calle as Aubergine, Brinjal, Eggplant, Mad Apple and Raging Apple (NCEG, 2023). It also known as Eggplant, aubergine, brinjal (English). Aubergine, bringelle, mélongène (French). Beringela (Poland). Mbiringanya, mbilingani (Sw). (Daunay and Chadha, 2004). Names in Indian languages are Baingan (Hindi), Begun (Bengali), Ringna (Gujarathi), Badane (Kannada), Waangum (Kashmiri), Vange (Marathi), Bengena (Assamese), Baigan (Oriya), Vashuthana (Malayalam), Kathiri (Tamil), Vankaya (Telugu) and Peethabhala (Sanskrit) (Farmnest, 2022).

The name *eggplant* is usual in North American English and Australian English. First recorded in 1763, the word "eggplant" was originally applied to white cultivars, which look very much like hen's eggs. Similar names are widespread in other languages, such as the Icelandic term *eggaldin* or the Welsh *planhigyn ŵy*. In English usage, modern names deriving from Arabic *bāḏinjān* include: 1) Aubergine, usual in British English (as well as German, French and Dutch). 2) Brinjal or brinjaul, usual in South Asia and South African English. 3) *Solanum melongena*, the Linnaean name. The modern Hindustani words descending directly from the Sanskrit name are *baingan* and *began*. Thus although Indian English brinjal ultimately originates in languages of the Indian Subcontinent, it actually came into Indian English via Portuguese (WIKI, 2023). Brinjal or eggplant (*Solanum melongena* L.) is an important Solanaceous crop of sub tropics and tropics. The name brinjal is popular in Indian subcontinents and is derived from Arabic and Sanskrit whereas the name eggplant has been derived from the shape of the fruit of some varieties, which are white and resemble in shape to chicken eggs. It is also called aubergine (French word) in Europe (Rajeshbhu, 2023). The eggplant (*Solanum melongena* L.), also known as aubergine or brinjal, has been cultivated for centuries in the Old World and is currently a crop species of global importance. Despite this, hypotheses of eggplant evolution have been fraught with controversy. Previous conclusions have relied solely on morphological characters or have been based on insufficient taxonomic sampling, leading to conflicting opinions of the number of species, phylogenetic relationships, and patterns of domestication in a group of related taxa termed the *S. melongena* complex (Weese and Bohs, 2010). Even with sampling across the full diversity of the Eggplant clade and a robust phylogenomic framework, our understanding of the biogeographic history of the Eggplant clade can still be improved; in particular the dispersal of *Solanum insanum* lineages to tropical Asia and emergence and domestication of the brinjal eggplant. Combining sampling for *S. insanum* through its whole geographical range with the use of recently developed targeted high-throughput sequencing (Kadlec *et al*., 2017) will provide a promising approach for reconstructing reliable scenarios of evolution of brinjal eggplant from its wild progenitor, *S. insanum* (Aubriot *et al.,* 2018). It was originally domesticated from the wild nightshade species *thorn* or *bitter apple*, *S. incanum*, probably with two independent domestications: one in South Asia, and one in East Asia (WIKI, 2023). Sampson (1936) suggested the African origin of this crop, but there is no evidence that *S. melongena* is native there though there are spiny African brinjal plants Eggplant is widely used in its native India, for example in *sambar* (a tamarind lentil stew), *dalma* (a *dal* preparation with vegetables, native to Odisha), chutney, curry, and *achaar* (a pickled dish). Owing to its versatile nature and wide use in both everyday and festive Indian food, it is often described as the "king of vegetables". Roasted, skinned, mashed, mixed with onions, tomatoes, and spices, and then slow cooked gives the South Asian dish *baingan bharta* or *gojju*, similar to *salată de vinete* in Romania. Another version of the dish, *begun-pora* (eggplant charred or burnt), is very popular in Bangladesh and the east Indian states of Odisha and West Bengal where the pulp of the vegetable is mixed with raw chopped shallot, green chilies, salt, fresh coriander, and mustard oil. Sometimes fried tomatoes and deep-fried potatoes are also added, creating a dish called *begun bhorta*. In a dish from Maharashtra called *bharli vangi*, small brinjals are stuffed with ground coconut, peanuts, onions, tamarind, jaggery and masala spices, and then cooked in oil. Maharashtra and the adjacent state of Karnataka also have an eggplant-based vegetarian pilaf called 'vangi bhat' (WIKI, 2023). Eggplant genetic resources consist of three genepools. The primary genepool consists of traditional and modern cultivars of *Solanum melongena*; the diversity is important in terms of fruit size (from some tens of g to over one kg), fruit shape (from globose to snake-shaped, furrowed or smooth) and fruit colour (white, green, pink to violet or purple or even black, uniform, striped, mottled or netted) (Daunay and Chadha, 2004). Eggplant is an autogamous species, with a strong tendency to cross pollination whenever there are pollinating insects (mostly *Hymenoptera*). Therefore controlled pollination is necessary for the maintenance of pure lines. The wide genetic diversity in *Solanum melongena* germplasm (e.g. fruit traits, earliness, resistance to diseases and agro-climatic adaptation) is more widely used by breeders from tropical countries than by those from temperate countries, where the production and marketing are highly standardized (Daunay and Chadha, 2004).

The creation of transgenic eggplants for resistance to insects and abiotic stress factors is actively pursued in many countries. The emergence of transgenic cultivars can be expected in a short time, though their superiority over conventionally bred cultivars remains to be demonstrated (Daunay and Chadha, 2004). Several promising cultivars of brinjal, viz., Pusa Purple Long, Pusa Purple Cluster, Pusa Kranti, Pusa Purple Round, PH 4, Pant Samrat, Pant Rituraj, KT 4, Punjab Barsati, Azad Kranti, K 202-9, Arka Navneet (Hybrid), T 3, Jamuni Gola, Pant Brinjal Hybrid 1, Pusa Anmol (hybrid), Arka Kusumakar, H7, Hisar Shyamal (H 8), H 16, Pusa Hybrid 5, Pusa Hybrid 6, NDB 25, Sel 4, DBSR 31, KS 224, DBR 8, DBSR 44, NDBH 6, ABH 2, BB 26, PLR 1, BB 7, BWR 12, Arka Nidhi, Swarna Mani, Punjab Sadabahar, Utkal Tarini, etc., have been identified/ released (Vidhi, 2023). A large number of eggplant hybrids by private sector seed companies are in the market to the tune of about 25 tons of seed (Vidhi, 2023). Bt brinjal is a transgenic eggplant that contains a gene from the soil bacterium *Bacillus thuringiensis*. This variety was designed to give the plant resistance to lepidopteran insects such as the brinjal fruit and shoot borer (*Leucinodes orbonalis*) and fruit borer (*Helicoverpa armigera*). Bt brinjal was approved for commercial cultivation in Bangladesh in 2013 (WIKI, 2023). Brinjal fruits are commonly considered as vegetables. They are cooked in various ways such as baking, barbecuing, frying or pickling. They can also be pureed, flavoured, and used as a dip or chutney as in Mediterranean and Indian cuisines. In Indian cuisine, they are used in curries and even made into soufflés. The cut fruits are typically soaked in cold salted water before cooking to avoid discoloration and to remove its mild bitterness (Ratnala, 2004). In traditional Chinese medicine, all parts of the plant are used to stop intestinal bleeding. The fruit of the plant is also used as an antidote for mushroom poisoning. In Indochina, parts of the plant are used as a purgative. In traditional Malay medicine, the ashes of the fruit are used in dry, hot poultices to treat haemorrhoids. To treat ulcers, the root is pounded and applied inside the nostrils. The Amboinese take the juice of the root of a wild variety of the plant to ease a difficult labour. Arabs believe that the fruit has high "heating" properties that in turn cause melancholia and madness. For this reason, Malay and Indian women do not consume brinjal for the first 40 days after giving birth (Ratnala, 2004).

Brinjal is widely consumed as vegetable for its various health benefits. It is highly fibrous, contains antioxidants, potassium, Vitamin B-6 and phyto-nutrients like flavonoids which help in preventing cancer and heart disease. It also helps in weight loss with its low calories. It is good booster for brain and also helps in maintaining good health by lowering cholesterol in our body (Farmnest, 2022). Raw eggplant is 92% water, 6% carbohydrates, 1% protein, and has negligible fat. It provides low amounts of essential nutrients, with only manganese having a moderate percentage (11%) of the Daily Value. Minor changes in nutrient composition occur with season, environment of cultivation (open field or greenhouse), and genotype (WIKI, 2023). The major brinjal producing states in India are Orissa, Bihar, West Bengal, Andhra Pradesh, Uttar Pradesh and Maharashtra. In the states of Tamil Nadu, Uttar Pradesh, Karnataka, Andhra Pradesh, Chhattisgarh and West Bengal, it is harvested all year round (Farmnest, 2022). Brinjal is produced comparatively by few countries, located in the warm areas of the Far East and is grown extensively in India, China, France, Italy, Spain, USA, Korea and Japan (Ikisan, 2023).

ORIGIN AND DISTRIBUTION

Sampson (1936) suggested the African origin of brinjal, but there is no evidence that *S. melongena* is native there though there are spiny African brinjal plants. According to Zeven and Zhukovsky (1975), it originated in India but spread eastward and by the 5th century B.C. was in China, which became a secondary centre of variation. Thus, it has been known for the last 1500 years in China. Arabic traders were responsible for subsequent movement to Africa and Spain. Brinjal cultivation in the Mediterranean region is relatively recent. Portuguese colonies took it to Brazil. It is now widely cultivated for its fruits in the tropical, subtropical and warm temperate zones, especially in Southern Europe and the Southern United States. Vavilov (1928) was of the opinion that its centre of origin was in the Indo-Burma region. Various forms, colours and shapes of brinjal are found throughout Southeast Asia, suggesting that this area is an important centre of variation. A centre of diversity is believed to be in the region of Bangladesh and Myanmar (Former India-Burma border). Evidence to this was given by Isshiki *et al* (1994) based on the is enzyme and morphological variation noticed in large germplasm collection from India. According to Zeven and Zhukovsky (1975), it originated in India but spread eastward and by the 5th century B.C. was in China, which became a secondary centre of variation. Thus, it has been known for the last 1500 years in China. Arabic traders were responsible for subsequent movement to Africa and Spain. Brinjal cultivation in the Mediterranean region is relatively recent. Portuguese colonies took it to Brazil. It is now widely cultivated for its fruits in the tropical, subtropical and warm temperate zones, especially in Southern Europe and the Southern United States.

Wild brinjal can be found growing in Malaysia and India. Solanum insanum, a prickly variety of the plant, is mostly found in the dry hills of West Bengal, India. Similarly, some yellow-fruit varieties of the plant can be found growing wild in Malaya. Brinjal was first domesticated in India. The Persians then introduced it to Africa from India while the Arabs introduced it to Spain. It presumably spread from Spain to the rest of Europe (Ratnala, 2004). Wild *Solanum melongena* is found in the area of Myanmar–Yunnan where it developed from the *Solanum incanum* complex, which had previously migrated into Asia from the Middle East and East Africa. Domestication took place in the area between India, Myanmar and China, where many primitive or weedy eggplant types are still found. The first reports of the use of *Solanum melongena* as a cultivated species in Sanskrit and Chinese agro-botanical literature date back about 2000 years. Eggplant was known in Iran as early as the 6–7th century AD. Following the great Muslim expansion westwards (8–9th century AD), eggplant moved towards the Maghreb and probably further South to the Oases of the Sahara and tropical Africa, as well as to Southern Europe. It was described in Ethiopia in the 14th century. Nowadays eggplant is cultivated worldwide, but its two main production regions are Asia and the Mediterranean. (Daunay and Chadha, 2004).

According to Daunay (2008) there are reports that *S. incannum*, a wild form of *S. melongena* is found in Southern India. *S. incannum* differentiated progressively, in South East Asia into a closely related species, the wild *S. melongena* which is still found growing in natural conditions in large areas from Southern and Eastern India to Southern China, Philippines and Indonesia and this has been described by former botanists as *S. cumingii*. Under domestication process, this wild form gave rise to *S. ovigerum* (small round/oblong fruits with white, green or violet colour) which evolved progressively into advanced cultivars with large fruits. *S. insanum*, widespread in India is probably a form of *S. ovigerum* which reversed to the wild state with strong prickliness. Later on all these taxa were brought under the umbrella of *S. melongena*. Decandolle has mentioned India as the place where eggplant was known since ancient times and regarded it as a native of Asia. According to Vavilov, the eggplant originated in the Indo-Burma region. The eggplant (*Solanum melongena* L.), also known as aubergine or brinjal, has been cultivated for centuries in the Old World and is currently a crop species of global importance. Despite this, hypotheses of eggplant evolution have been fraught with controversy. Previous condusions have relied solely on morphological characters or have been based on insufficient taxonomic sampling, leading to conflicting opinions of the number of species, phylogenetic relationships, and patterns of domestication in a group of related taxa termed the *S. melongena* complex (Weese and Bohs, 2010). Hanur (2011) opined that opponents of the commercialization of Bt brinjal have argued that its introduction into Indian agriculture might threaten the genetic diversity of wild and cultivated forms of brinjal by extensive adoption of Bt brinjal and cause 'genetic erosion' by horizontal spread of Bt transgenes into wild and weedy relatives of brinjal. They have also argued that Bt brinjal should not be released in India, which is the centre of origin of brinjal. Most of the Indian literature considers India as the centre of origin of brinjal. Several arguments have been put forth in favour of the possibility that brinjal is native to India: (a) Large genetic diversity exists in brinjal germplasm for many morphological and agronomically important traits in India, pointing to the possibility that the country is the centre of origin of brinjal. (b) Documented historical records, including Ayurveda and other systems of medicine refer to brinjal. (c) Several candidate areas for brinjal domestication have been proposed: India and South East China; China, India and Thailand; Indo-Burma region; Burma to Indo-China, and South East Asia. Unfortunately, there are no strong points of argument about India being the centre of origin of brinjal. Comprehensive and critical analysis of the literature suggests varying indications about the origin, domestication, speciation and evolution of brinjal.

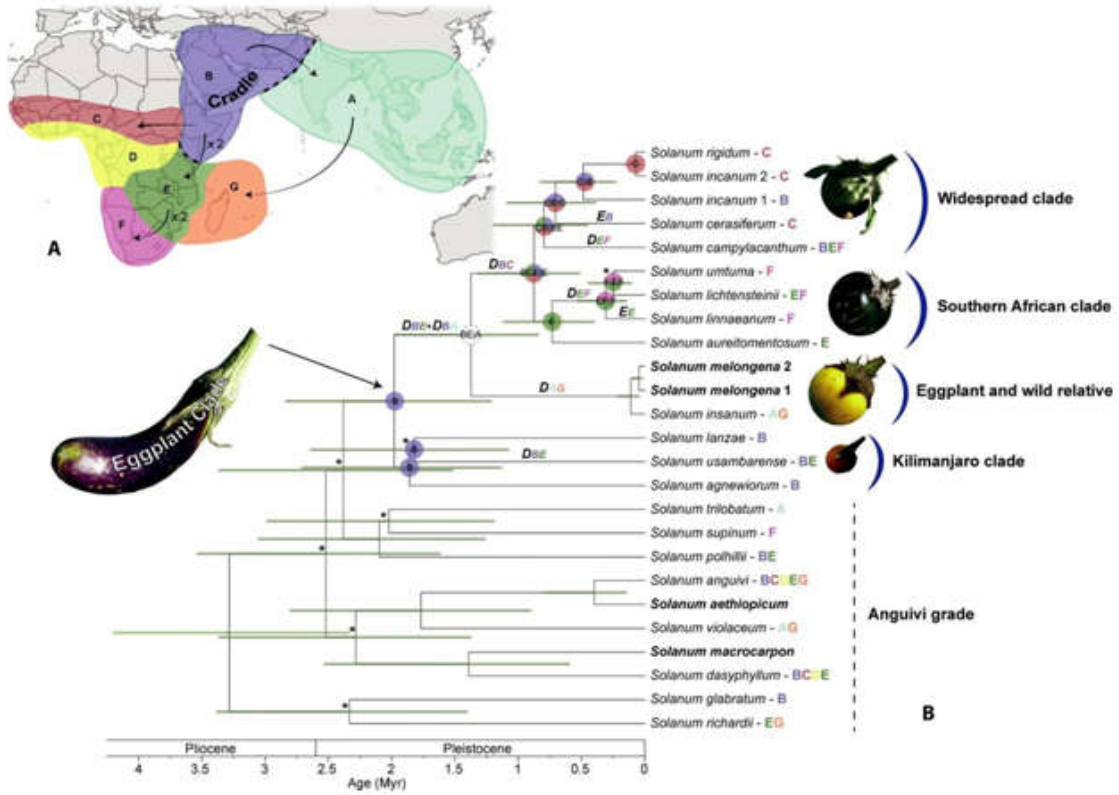
The following are some of the pointers that counter the veracity of the belief that India is the centre of origin of brinjal (Hanur, 2011): (1) Even though diversity exists in the morphological traits of brinjal, there is hardly any proof indicating that most of the accessions of the brinjal germplasm are genetically divergent enough to account for the documented diversity. The size of the germplasm is not substantially large to account for its origin being India. Claims on the number of brinjal germplasm accessions available in India to the tune of 2000 or more are unsubstantiated. Most of the germplasm accessions include duplicate entries, morphological variants (without substantial genetic diversity), breeding (segregating) stocks (arising from common parental populations or sibs, crosses and based on simple selections), and other uncharacterized replicates. Besides, mere presence of a large morphological diversity need not support the centre of origin. A crop can be introduced into a region and diversity may later be generated due to many forces of adaptation. Vavilov's proposal that the centres of diversity are indeed the centres of origin is not tenable in its entirety. Vavilov's concept in a nutshell is: the place of origin of a species of a cultivated plant is to be found in the area which contains the largest number of genetic varieties of this plant. As pointed out by Stebbins, Vavilov's interpretation of diversity patterns is an elaboration on Willis' age-and-area hypothesis, based on oversimplified hypotheses, and therefore Vavilov's concept of centre of origin should be greatly revised. (2) Vavilov was of the implicit opinion that crop species had each been domesticated only once when

he proposed his centres of domestication, and this assumption has been borne out for a number of species, including maize, bread wheat and sunflower. Interestingly, no clear information is available on the numbers of domestication for many crops, including tomato, brinjal and rapeseed. Vavilov's centres of origin and domestication are only a valuable first hypothesis as to where crops originated and where our sessile, agrarian cultures began. Since then, great strides have been made scientifically in pinpointing the origins of our domesticated crops and the associated wild species from which the respective cultivated crops have arisen. Our understanding of the details of the centres of origin has substantially metamorphosed over the last eight decades of intensive research. Interestingly and bewilderingly, there is still no clear consensus on the subject. (3) Hooker in The Flora of British India concedes as follows: 'De Candolle says it is a native of Asia and not America, and Sendtner fixes its origin in Arabia; all these appear uncertain.' (4) Brinjal is a member of Solanaceae, to which closely related crops like potato, tomato and chillies also belong. Genus *Solanum* is predominantly Central and South American, whereas the question of the centre of origin of *S. melongena* is yet to be resolved. Evidence for each of these is based on the presence of weedy forms (putative progenitors for many authors) and literature references. However, there is a possibility of multiple domestication events, which needs to be studied. Evolutionary evidences suggest that the progenitor of present-day brinjal, *S. melongena*, is the wild *S. incanum*. The centre of *S. incanum* is not India, but Africa. A logical approach to the problem of centre of origin would be to find out, utilizing the tools of molecular systematics, the wild progenitors of cultivated plants and their geographical distribution. By doing so, *S. incanum*, the progenitor of *S. melongena*, can be traced to African centre of origin and not Indo-Burma region. (5) Karihaloo and Gottlieb, through their studies on allozyme and RAPD variation in *S. melongena* and similar wild and weedy forms, suggested that *S.melongena* originated from an African species, *S. incanum*, as supported by AFLP and DNA sequence datasets and also established that even though *S.melongena* and *S. insanum* (another wild relative) are highly morphologically diverse, it is no longer appropriate to distinguish them taxonomically. (6) Mere mention in Ayurveda and other systems of medicine does not qualify the argument that brinjal is an ancient crop that was historically known in India. Evidence for an Indian domestication has been drawn from examination of the Sanskrit literature. Khan cited common names for the eggplant from various works, with the oldest dated between the 3rd century BC and the 3rd century AD.

His citation of the oldest Sanskrit work from 300 BC, however, was based on a secondary source, and the time range he estimated cannot be substantiated, due to the many revisions of the work in question over the centuries. (7) The true wild progenitor of brinjal has even been hypothesized to be an undiscovered species in the Savanna ecosystems of the region. Much of the uncertainty regarding the centre of origin of brinjal and its relationship with other species, including Asian prickly *Solanums* arise from the fact that most of the researchers have used a small number of collections only from the South Asian region. Besides, *S. melongena* can be crossed not only to putative progenitors but also to more distantly related species, within the section Melongena, with the species of Oliganthes and those of other sections. Moreover, due to high morphological variability, morphological data can lead to ambiguous interpretations. (8) Further, there is also a suggestion that the wild progenitor developed as a garden weed, and through human selection in South East Asia, progressively more advanced cultivars were selected. Consequently, *S. melongena* was divided into a series of morphological types or gene pools, complicating the patterns of character change associated with the movements of cultivars. (9) Molecular evidences suggest that brinjal may have originated in South America, Africa and Asia. Molecular data, including AFLP support the broad relationships between *S. incanum* and its African relatives and the eggplants, but the datasets did not include Chinese samples. None of the *S. incanum* subspecies group as currently understood is present in China or adjacent South East Asia.

Therefore, Hanur (2011) clearly inferred that: (i) India is not the only primary centre of origin of brinjal. There is a possibility of multiple origin and domestication events, which needs to be studied further. It may be considered that India is either a centre of diffuse origin or even only a centre of diversity. Origins are diffuse in both time and space, and consequently the problem of a 'centre of origin' can never quite be solved. Lack of archaeological evidence should not attract conclusions based on hypothetical premises. (ii) Citations from Ayurveda cannot be taken to infer that India is the centre of origin of brinjal. Sanskrit names have been regarded as evidence that the brinjal was first domesticated in India, although no further detailed and continuous evidence about the domestication process can be gleaned from the ancient Indian literature. It is essential that the primary sources of exact dates be re-examined in order to explore this further. (iii) Even though careful measures are needed when cultivating genetically engineered crops near the centres of origin, two things are obvious; first, India is not the centre of origin of brinjal and therefore we need not be conservative; secondly, this situation is not unique to GM crops alone and can happen with non GM too. Key to judging the impact of transgene movement is the nature of the trait and the frequency of its introduction into the ecosystem. Environmental risk assessment and statement is a long-term policy requirement to be judiciously implemented by all GM-growing countries with defined regulatory framework. In India, for any GM crop, including Bt brinjal, such an exercise is required and will be in place. (iv) Changes in key morphological and biochemical traits that occur during the process of crop domestication are mostly inferred by reference to wild relatives or to primitive land races, and have long been the subject of debate. Only in the case of genetic analysis of the availability of extensive plant fossil remains can specific sets of changes be documented. Historical details of the plant domestication processes are rare and other evidences of morphological changes can be equally difficult to arrive at, especially for vegetables like brinjal where substantial body of archaeological data is lacking. An attempt has been made for the first time, to scientifically question the veracity of the commonly held belief that India is the centre of origin of brinjal and surprisingly, this belief seems to be untenable.

Aubriot *et al.* (2018) reported that brinjal is said to have originated in India and has been cultivated for over 4,000 years (Sood, 2012). The eggplant clade has Pleistocene/geological origins in Northern Africa. Dispersals to tropical Asia gave rise to *Solanum insanum*, the wild progenitor of the eggplant, and to African distinct lineages of widespread and Southern African species. Results suggest that spread of the species to Southern Africa has been recent and likely facilitated by large mammalian herbivores, such as the African elephant and impala feeding on *Solanum* fruit. Rather than a linear 'Out of Africa' sequence, our results are more consistent with an initial dispersal event into Asia, and subsequent wide dispersal and differentiation across Africa driven by large mammalian herbivores. Aubriot *et al*. (2018) stated that even with sampling across the full diversity of the eggplant clade and a robust phylogenomic framework, our understanding of the biogeographic history of the eggplant clade can still be improved; in particular the dispersal of *Solanum insanum* lineages to tropical Asia and emergence and domestication of the brinjal/eggplant. Combining sampling for *S. insanum* through its whole geographical range with the use of recently developed targeted high-throughput sequencing will provide a promising approach for reconstructing reliable scenarios of evolution of brinjal /eggplant from its wild progenitor, *S. insanum* (Fig. 1). Eggplant is "is indigenous to a vast area stretching from Northeast India and Burma, to Northern Thailand, Laos, Viet Nam and Southwest China and wild plants can still be found in these locations." Generally speaking, most sources will tell you that these are solely from India and spread quickly to all of these other nations. However, other sources speculate about North African and Middle Eastern origins (Faden, 2020). The history of brinjal dates decades back and made its written presence in an ancient Chinese agricultural treatise completed in 544. It also has its mention in Sanskrit literature from 3rd century AD. It is believed to be a domestic crop of India, China, Thailand, Burma or some other South East Asian country. Till 18th century, it was not utilised as a vegetable due to its unfavourable taste and fear of causing diseases like ulcers,



A) Tropical Asian region; (B) Somalian and Middle East region; (C) Sudanian region; (D) Congolian region; (E) Zambesian region; (F) Southern African region; and (G) Malagasy region. This biogeographicframework is well suited for these solanums, because 10 of the 23 taxa included in our analysis are restricted to one region, and several clades are characteristic of a set of connected biogeographic regions (Southern African clade)

Fig. 1. Phylogeny and biogeography of the Eggplant clade based on whole chloroplast genome sequences

leprosy, elephantiasis, intestinal constriction etc., but now it is widely used in various parts of the world as vegetable. It has been cultivated through ages to have rid away with the earlier bitter taste. In the beginning of 6th century AD, it was popularised in Middle East, Turkey and Africa by Arabs through Mediterranean route. It was introduced in 7th or 8th century to Greeks and Romans by Arabs (Farmnest, 2022). It was originally domesticated from the wild nightshade species thorn apple or bitter apple, *S. incanum*, probably with two independent domestications: one in South Asia, and one in East Asia **(**WIKI, 2023**).**

There is no consensus about the place of origin of eggplant; the plant species has been described as native to India, where it continues to grow wild, Africa, or South Asia. It has been cultivated in Southern and Eastern Asia since prehistory. The first known written record of the plant is found in *Qimin Yaoshu*, an ancient Chinese agricultural treatise completed in 544 CE. The numerous Arabic and North African names for it, along with the lack of the ancient Greek and Roman names, indicate it was grown throughout the Mediterranean area by the Arabs in the early Middle Ages, who introduced it to Spain in the 8th century. A book on agriculture by Ibn Al-Awwam in 12th-century Arabic Spain described how to grow aubergines. Records exist from later medieval Catalan and Spanish. The aubergine is unrecorded in England until the 16th century **(**WIKI, 2023**).** Brinjal is native to South Central China, Laos, Myanmar, Thailand, and Vietnam. The plant is grown as a perennial in South Asia. It is now cultivated worldwide. In North Carolina, eggplant is considered an annual **(**NCEG, 2023**).** The brinjal is believed to be domesticated in north-eastern India where wild forms still grown. The seeds were carried to China more than 1500 years ago where small fruited types were developed later. It was introduced to India by early traders from Arabia and Persia and to the countries of the Eastern and Southern shores of the Mediterranean early in the Middle ages. In 1806, it was introduced to American gardens primarily as an ornamental plant and was probably introduced into Europe during the Moorish invasion of Spain. It gained popularity in 1890s, as minor vegetable.

It has been cultivated for many centuries in India, Bangladesh, Pakistan, China, Arabia and Philippines (Agropedia, 2023). Brinjal is considered a native to India where the major domestication of large fruited cultivars occurred. In "Origin of cultivated plants" published in 1886 De Candolle, stated that the species *S. melongena* has been known in India from ancient times and regarded it as a native of Asia. Its centre of origin was in the Indo-Burma region. Various forms, colours and shapes of brinjal are found throughout South-East Asia, suggesting that this area is an important centre of variation. A centre of diversity is believed to be in the region of Bangladesh and Myanmar (Former India-Burma border) (Rajeshbhu, 2023). Brinjal is native to South Central China, Laos, Myanmar, Thailand, and Vietnam. The plant is grown as a perennial in South Asia. It is now cultivated worldwide. In North Carolina, eggplant is considered an annual (NCEG,2023). Eeggplants are thought to have originated from Africa where they are referred to as S. incanum (LFS, 2023).

The brinjal is believed to have been domesticated in Northeast India where wild forms still grow. The seeds were carried to China more than 1500 years ago where small fruited types were later developed. It was introduced from India by early traders from Arabia and Persia to the countries of the eastern and southern shores of the Mediterranean early in the Middle ages. Portuguese colonies took it to Brazil. It is now widely cultivated for its fruits in the tropical, subtropical and warm temperate zones, especially in Southern Europe and the Southern United States. In 1806, it was introduced to American gardens primarily as an ornamental curiosity and was probably introduced into Europe during the Moorish invasion of Spain. It gained popularity in 1890s, as minor vegetable. The ancestral form was very likely a spiny plant with small, bitter fruit, but selection for improved palatability and for relative spinelessness resulted in gradual emergence of an acceptable type. Brinjal has been cultivated for many centuries in India, Bangladesh, Pakistan, China, Arabia and Philippines (Ikisan, 2023).

Brinjal is considered a native to India where the major domestication of large fruited cultivars occurred. In "Origin of cultivated plants"

published in 1886 De Candolle, stated that the species *S. Melongena* has been known in India from ancient times and regarded it as a native of Asia (Bighaat, 2023).

TAXONMY

Genus *Solanum: Solanum* comprises over 1000 species and includes major food species. *Solanum melongena* belongs to subgenus *Leptostemonum* section *Melongena* to which *Solanum macrocarpon* also belongs, and which have bisexual as well as male flowers. *Solanum melongena* is partially interfertile with the African cultigens *Solanum aethiopicum* and *Solanum macrocarpon*, as well as wild species in various sections of subgenus *Leptostemonum* (Daunay and Chadha, 2004). Over the past 30 years, the genus *Solanum* has received considerable attention in chemical and biological studies. *Solanum* is the largest genus in the family Solanaceae, comprising of about 2000 species distributed in the subtropical and tropical regions of Africa, Australia, and parts of Asia, e.g., China, India and Japan. Many of them are economically significant species (Kaunda and Zhang, 2019). Solanum is a large and diverse genus of flowering plants, which include two food crops of the highest economic importance, the potato and the tomato. It also contains the nightshades and horse nettles, as well as numerous plants cultivated for their ornamental flowers and fruit. *Solanum* species show a wide range of growing habits, such as annual and perennials, vines, subshrubs, shrubs, and small trees. Many formerly independent genera like *Lycopersicon* (the tomatoes) and *Cyphomandra* are now included in Solanum as subgenera or sections. Thus, the genus today contains about 1,500-2,000 species with 1,328 accepted species distributed across the whole world **(**Long An, 2015**).** The Genus *Solanum* there may be up to approximately 1500 species worldwide. With some 800 accepted specific and infra-specific taxa of the more than 4,000 described, the genus Solanum contains more species than any other genus in the Solanaceae family and it is one of the largest among the angiosperms. The following alphabetical list of important common Solanum species (Table 1) provides the binomial name followed by the name of the species authority, abbreviated according to the appropriate conventions and uses **(**Long An, 2015**).**

The *S. melongena* complex shows a series of morphological intermediates from small-fruited spiny plants to large-fruited non-spiny plants. We use DNA sequence data to show that eggplants arose in Africa and were dispersed throughout the Middle East to Asia. *Solanum linnaeanum*, a wild species not previously associated with eggplant evolution, is a member of the *S. melongena* complex. These data provide the most comprehensive evidence to date for the evolution of the cultivated eggplant. However, wild and semi- domesticated eggplant relatives usually have small, round, yellow fruits and the plants are abundantly prickly (Weese and Bohs, 2010) (Fig.2). The plants are highly variable morphologically and are mainly distinguished by stature and leaf width.The fruits are small, round, and yellow and the plants are variably prickly **(Fig. 2**). Plants of groups A and B were thought tohave expanded their original ranges to the north and into the Middle East, evolving into group C, and adapting to extremexerophytic conditions to the south to give rise to group D (Weese and Bohs, 2010). A new andromonoecious species related to the eggplant and belonging to *Solanum* subgenus *Leptostemonum* from southern Africa is described. *Solanum umtuma* Voronts. & S.Knapp, sp. nov**.** is found in the eastern part of South Africa, and is sympatric with its close relative *Solanum linnaeanum* Hepper & P.M-L.Jaeger. It is morphologically very similar to *Solanum cerasiferum* Dunal of northern tropical Africa (Vorontsova and Knapp, 2012). Eggplants are berry-producing vegetables belonging to the large Solanaceae family (nightshade family), which contains ~3,000 species distributed in some 90 genera. Out of these *Solanum* L. is the largest one, with around 1,500 species including globally important crops such as potato (*Solanum tuberosum* L.) and tomato (*Solanum lycopersicum* L.), as well as many other minor crops. Most taxa of *Solanum* genus have a basic chromosome number of $n = 12$ (Taher *et al.,* 2017). The *Solanum* genus is mega-diverse and can be divided into 13 clades, where eggplant is the member of the large and taxonomically challenging *Leptostemonum* clade, which is commonly known as the "spiny *Solanum*" group due to the presence of sharp epidermal prickles on stems and leaves. The subgenus *Leptostemonum* contains around 450 currently recognized species distributed worldwide, many of which originated in the New World. All three cultivated eggplant species have the OldWorld in origin. The Old World (Africa and Eurasia) and Australia, are home to more than 300 *Solanum* species. *Solanum melongena* and *S. macrocarpon* are usually included in section *Melongena* Dunal, whereas *S. aethiopicum* is assigned to section *Oliganthes* (Dunal) Bitter (Taher *et al*., 2017) **(Fig. 3).** Treated as part of the *S. incanum* group of the subg. *Leptostemonum,* together with *S. linnaeanum* and *S. marginatum*. Molecular studies confirm the close relationships with *S. incanum* and *S. linnaeanum.* African eggplants are referred to *S. incanum* while Asian eggplants are referred to *S. melongena* (LFS, 2023)

Species of *Solanum melongena:* Binjal belngs to the family Cucurbitaceae, sub family Solanoideae, tribe Solaneae, genus *Solanum* L. and the species *Solanum* melongena (Long An, 2015; WIKI, 2023). The genus name, Solanum, is from the Latin word solamen, which means "comforting or soothing." The species name, melongena, references the fruits melon shape. Another source states that the species name, melongena**,** has origins from the Italian name "melanzane," which is derived from "mela insane" or "mad apple" (NCEG, 2023). Accordig to WIKI (2023) synonyms of *Solanum melongena* are *Solanum ovigerum* Dunal and *Solanum trongum* Poir. According to Daunay and Chadha (2004) the synonyms of *Solanum melongena* are *Solanum insanum* L. (1767), *Solanum esculentum* Dunal (1813), and *Solanum incanum* auct. non L. According to Plantlist (2023) the synonyms of *Solanum melongena* are *Solanum esculentum* Dunal, *Solanum insanum* L.. *Solanum melongena* var. *depressum* L., *Solanum melongena* var. *esculentum* (Dunal) Nees, and *Solanum melongena* var. *serpentinum* L. Brinjal belongs to the family Solanaceae and is known under the botanical name *Solanum melongena* L. The family contains 75 genera and over 2000 species, out of which, about 150-200 are tuber bearing and belong to section Tuberarium. The majority of species (about 1800) are non tuber bearing. Cytological studies have indicated that basic chromosomal number 2n = 24 is same in almost all the varieties and species (GEAC, 2023). There are 3 main botanical varieties under the species *Solanum melongena*. The common brinjal, to which large, round or eggshaped fruited forms belong, are grouped under var. *esculentum*. The long, slender types are included under var. *serpentinum* and the dwarf brinjal plants are put under var. *depressum* (GEAC, 2023; WIKI, 2023). Large variation in yield parameters and in fruit quality parameters have been documented in the *Solanum melongena* accessions. Different fruit shapes, colors, and sizes of *Solanum melongena* accessions in the World Vegetable Center germplasm collection (Fig. 4).

BATONICAL DESCRIPTION

Annual herb to perennial shrub up to 150(–200) cm tall, often much-branched, with long taproot; stems and leaves with or without prickles and densely covered with stellate hairs having 8–10 arms. Leaves alternate, simple; stipules absent; petiole 6–10 cm long; blade ovate to ovate-oblong, 3–25 cm × 2–15 cm, base rounded or cordate, often unequal, apex acute or obtuse, margin sinuately lobed, densely hairy. Inflorescence a 1–5-flowered cyme (flowers often solitary). Flowers bisexual or functionally male, regular, 5–8(–10)-merous; pedicel 1–3 cm long, up to 8 cm in fruit; calyx campanulate, lobes c. 1.5 cm long, enlarging greatly and splitting in fruit; corolla campanulate with broadly triangular lobes, 3–4 cm in diameter, violet, rarely white; stamens inserted near the base of the corolla tube and alternate with corolla lobes, filaments short and thick, anthers connivent, yellow, opening by terminal pores; ovary superior, 2–many-celled, style as long as or longer than stamens, stigma green, capitate, lobed. Fruit a depressed globose to ellipsoid, ovoid, obovoid or even serpentine berry, 2–35 cm long (sometimes longer), 2–20 cm broad, smoothness and shininess variable, colour at commercial stage white, green or

Table 1. List of Solanum **species**

Note! The tuberous species within the genus (those related to Solanum tuberosum, the potato, and therefore often called wild potatoes) have been indicated with the letter T

1- *Solanum abutiloides* (Griseb.) Bitter & Lillo
2- *Solanum aculeastrum* Dunal
3- *Solanum aculeatissimum* Jacq...
4- *Solanum aculeatissimum* Jacq.
5- *Solanum adscendens* Sendtn. - Sonoita nightshade
6- *Solanum aethiopicum* L.
7- *Solanum albidum* Dunal
8- T *Solanum albornozii* Correll.
9- *Solanum americanum* Mill. - American nightshade, American black nightshade, glossy nightshade
10- *Solanum anguivi* Lam.
11- *Solanum arcanum* Peralta - "wild tomato"
12- *Solanum ashbyae* Symon
13- *Solanum asteropilodes* Bitter
14- *Solanum atropurpureum* Schrank
15- *Solanum aviculare* G.Forst. - poroporo (New Zealand), kangaroo apple (Australia)
16- *Solanum bahamense* L.
17- *Solanum bauerianum* Endl.
18- *Solanum bellum* S.Knapp
19- *Solanum betaceum* Cav. - tree tomato, tamarillo
20- T *Solanum brevicaule* Bitter.
21- T *Solanum bulbocastanum* Dunal - ornamental nightshade
22- *Solanum bullatum* Vell.
23- *Solanum cajanumense* Kunth
24- *Solanum campechiense* L.
25- T *Solanum candidum* Lindl.
26- T *Solanum capsicoides* All.
27- T *Solanum cardiophyllum* Lindl. - heart-leaved nightshade, heartleaf horsenettle
28- T *Solanum caripense* Dunal
29- T *Solanum carolinense* L. - horsenettle, Carolina horsenettle
30- *Solanum catilliflorum* G.J.Anderson, Martine, Prohens & Nuez
31- *Solanum centrale* J.M.Black - bush tomato (central Australia)
32- T *Solanum chacoense* Bitter.
33- *Solanum chenopodioides* Lam. - goosefoot nightshade, slender nightshade (including Solanum gracilius)
34- *Solanum chilense* (Dunal) Reiche
35- *Solanum chimborazense* Bitter & Sodiro
36- *Solanum chippendalei* Symon
37- *Solanum cinereum* R.Br.
38- *Solanum cinnamomeum* Sendtn.
39- T *Solanum citrullifolium* A.Braun
40- *Solanum citrullifolium* A.Braun.
41- *Solanum cleistogamum* Symon
42- *Solanum crispum* Ruiz & Pav. - Chilean potato vine, Chilean nightshade, Chilean potato tree
43- *Solanum densevestitum* Mueller ex Benth.
44- *Solanum dimidiatum* Raf. - western horsenettle
45- *Solanum diphyllum* L. - twin-leaved nightshade
46- *Solanum dolichorhachis* Bitter
47- *Solanum douglasii* Dunal - green-spotted nightshade
48- *Solanum dulcamara* L. - bittersweet
49- *Solanum elaeagnifolium* Cav. - silverleaf nightshade
50- *Solanum ellipticum* R.Br.
51- *Solanum ensifolium* Dunal
52- *Solanum erianthum* D.Don - potato tree, mullein nightshade
53- *Solanum exiguum* Bohs
54- *Solanum fallax* Bohs
55- *Solanum ferox* L. - hairy-fruited eggplant, Thai hairy-fruited eggplant
56- *Solanum fortunense* Bohs
57- *Solanum furcatum* Dunal - forked nightshade
58- *Solanum glaucophyllum* Desf.
59- *Solanum granuloso-leprosum* Dunal
60- Solanum grayi Rose vars. grandiflorum (basal) and grayi (smaller-flowered in sympatry with Solanum lumholtzianum)
61- *Solanum houstonii* Martyn
62- *Solanum huaylasense* Peralta
63- *Solanum hypocalycosarcum* Bitter
64- *Solanum hyporhodium* A.Braun & Bouché
65- *Solanum imbaburense* S.Knapp
66- *Solanum incanum* L.
67- *Solanum incompletum* Dunal
68- *Solanum interandinum* Bitter
69- T *Solanum jamesii* Torr. - wild potato
70- *Solanum lanceolatum* Cav.
71- *Solanum lasiocarpum* Dunal - Indian nightshade
72- *Solanum latiflorum* Bohs
73- *Solanum laxum* Spreng. - jasmine nightshade
74- *Solanum leiophyllum* Benth.
75- *Solanum leucodendron* Sendtn.

continue ……

76- *Solanum linnaeanum* Hepper & P.-M.L.Jaeger
77- *Solanum luteoalbum* Pers. (including S. semicoalitum)
78- *Solanum lycocarpum* St.-Hil. - wolf apple, fruta-de-lobo, lobeira (Brazil)
79- *Solanum lycopersicum* L. - tomato
80- *Solanum macrocarpon* L.
81- *Solanum mammosum* L.
82- *Solanum marginatum* L.f.
83- *Solanum mauritianum* Scop. - woolly nightshade, ear-leaved nightshade, flannel weed, bugweed, tobacco weed, kerosene plant, "wild tobacco" (Australia)
84- *Solanum melissarum* Bohs
85- *Solanum melongena* L. Eggplant
86- *Solanum muricatum* Aiton Hort. - pepino dulce, pepino melon, melon pear, "pepino", "tree melon"
87- *Solanum nelsonii* Dunal - Nelson's horsenettle
88- *Solanum nigrum* L. - European black nightshade, "black nightshade"
89- *Solanum opacum* A.Braun & Bouché .
90- *Solanum ovum-fringillae* (Dunal) Bohs
91- *Solanum paniculatum* L.
92- *Solanum paralum* Bohs
93- *Solanum parishii* Heller - Parish's nightshade
94- *Solanum perlongistylum* G.J.Anderson, Martine, Prohens & Nuez
95- Solanum peruvianum L. - Peruvian nightshade, "wild tomato"
96- *Solanum physalifolium* Rusby (Solanum sarrachoides auct.) - hairy nightshade
97- *Solanum pimpinellifolium* L. - currant tomato
98- *Solanum pinetorum* (L.B.Sm. & Downs) Bohs .
99- Solanum pinnatisectum Dunal - tansy-leaved nightshade
100- *Solanum prinophyllum* Dunal
101- *Solanum pseudocapsicum* L. - Jerusalem cherry, Madeira winter cherry, "winter cherry" (including Solanum capsicastrum)
102- Solanum pseudogracile Heiser - Glowing nightshade
103- *Solanum pseudolulo* Heiser
104- *Solanum pseudoquina* St.-Hil. (including S. inaequale Vell.)
105- *Solanum ptychanthum* Dunal - West Indian nightshade, eastern black nightshade
106- *Solanum pubescens* Willd.
107- *Solanum pungetium* R.Br.
108- *Solanum pyracanthon* Lam.
109- *Solanum quadriloculatum* Mueller
110- *Solanum quitoense* Lam.
111- *Solanum racemosum* Jacq.
112- *Solanum repandum* G.Forst.
113- *Solanum retroflexum* Dunal - wonderberry, sunberry
114- Solanum riedlei Dunal - Riedle's nightshade
115- *Solanum robustum* H.L.Wendl.
116- *Solanum roseum* Bohs
117- *Solanum rostratum* Dunal (seeds of which were ordered by Charles Darwin approx. 10 days prior to his death)
118- Solanum rugosum Dunal - tabacon aspero
119- *Solanum sandwicense* Hook. & Arn. - Hawaii horsenettle
120- *Solanum sarrachoides* Sendtn.
121- *Solanum scabrum* Mill. - garden huckleberry
122- *Solanum seaforthianum* Andrews - Brazilian nightshade
123- Solanum sejunctum Kym Brennan, Christopher T. Martine, & David E. Symon - Australian eggplant
124- *Solanum sessiliflorum* Dunal in Poir
125- *Solanum sibundoyense* (Bohs) Bohs
126- *Solanum sisymbriifolium* Lam. .
127- *Solanum sodiroi* Bitter (including S. carchiense)
128- *Solanum spirale* Roxb.
129- Solanum stoloniferum Schltdl. - tigna potato, Fendler's horsenettle
130- *Solanum sycocarpum* Mart. & Sendtn.
131- *Solanum tepuiense* S.Knapp
132- *Solanum ternatum* Ruiz & Pav. (including S. ternifolium)
133- *Solanum tobagense* (Sandwith) Bohs
134- *Solanum torvum* Sw. - Turkey Berry
135- *Solanum triflorum* Nutt. - cut-leaved nightshade
136- *Solanum trilobatum* L.
137- T *Solanum tuberosum* L. - potato
138- *Solanum umbelliferum* Eschsch. - bluewitch nightshade
139- *Solanum vescum* Mueller
140- *Solanum vestissimum* Dunal
141- *Solanum viarum* Dunal
142- *Solanum villosum* Mill. - yellow nightshade
143- *Solanum virginianum* L.
144- Solanum viride Spreng. - green nightshade
145- *Solanum wallacei* (A.Gray) Parish - Wallace's nightshade, Catalina nightshade, Clokey's nightshade, "wild tomato" (including Solnum clokeyi)
146- Solanum woodburyi Howard - Woodbury's nightshade
147- *Solanum xanti* A.Gray - purple nightshade, San Diego nightshade

Continue ….

2- Ornamental species

The species most widely seen in cultivation as ornamental plants are:

1- *Solanum aviculare* (kangaroo apple)
2- *Solanum capsicastrum* (false Jerusalem cherry, winter cherry)
3- *Solanum crispum* (Chilean potato tree)
4- Solanum laciniatum (kangaroo apple)
5- *Solanum laxum* (potato vine)
6- *Solanum pseudocapsicum* (Christmas cherry, winter cherry)
7- *Solanum rantonnetii* (blue potato bush)
8- *Solanum seaforthianum* (Italian jasmine, St. Vincent lilac)
9- Solanum wendlandii (paradise flower, potato vine)

3- Hybrid taxa (nothospecies/ A hybrid which is formed by direct hybridization of two species) The nothospecies belonging to the genera that are those taxa that have originated from a hybrid between two different species (for example, Solanum × viirsooi, which has been shown to be an interspecific hybrid resulting from the cross between Solanum acaule and Solanum infundibuliforme.)

1- T Solanum × ajanhuiri Juz. & Bukasov.
2- T Solanum × arahuayum Ochoa.
3- T Solanum × blanco-galdosii Ochoa.
4- T Solanum × brucheri Correll.
5- T Solanum × chaucha Juz. & Bukasov
6- T Solanum × curtilobum Juz. & Bukasov
7- T Solanum × edinense Berthault.
8- T Solanum × michoacanum (Bitter)
9- T Solanum × neoweberbaueri Wittm..
10- T Solanum × procurrens A.C.Leslie
11- T Solanum × ruiz-lealia Brücher
12- T Solanum × sambucinum Rydb.
13- T Solanum × sucrense Hawkes.
14- T Solanum × vallis-mexici Juz.
15- T Solanum × viirsooi K.A.Okada & A.M.Clausen

4- The most important species

1- T *Solanum capsicoides* All.
2- *Solanum lycopersicum* L. - tomato
3- *Solanum macrocarpon* L.
4- *Solanum mammosum* L.
5- *Solanum melongena* L. Eggplant
6- *Solanum nigrum* L. - European black nightshade, "black nightshade"
7- *Solanum pseudocapsicum* L. - Jerusalem cherry, Madeira winter cherry, "winter cherry" (including Solanum capsicastrum)
8- T *Solanum tuberosum* L. - potato

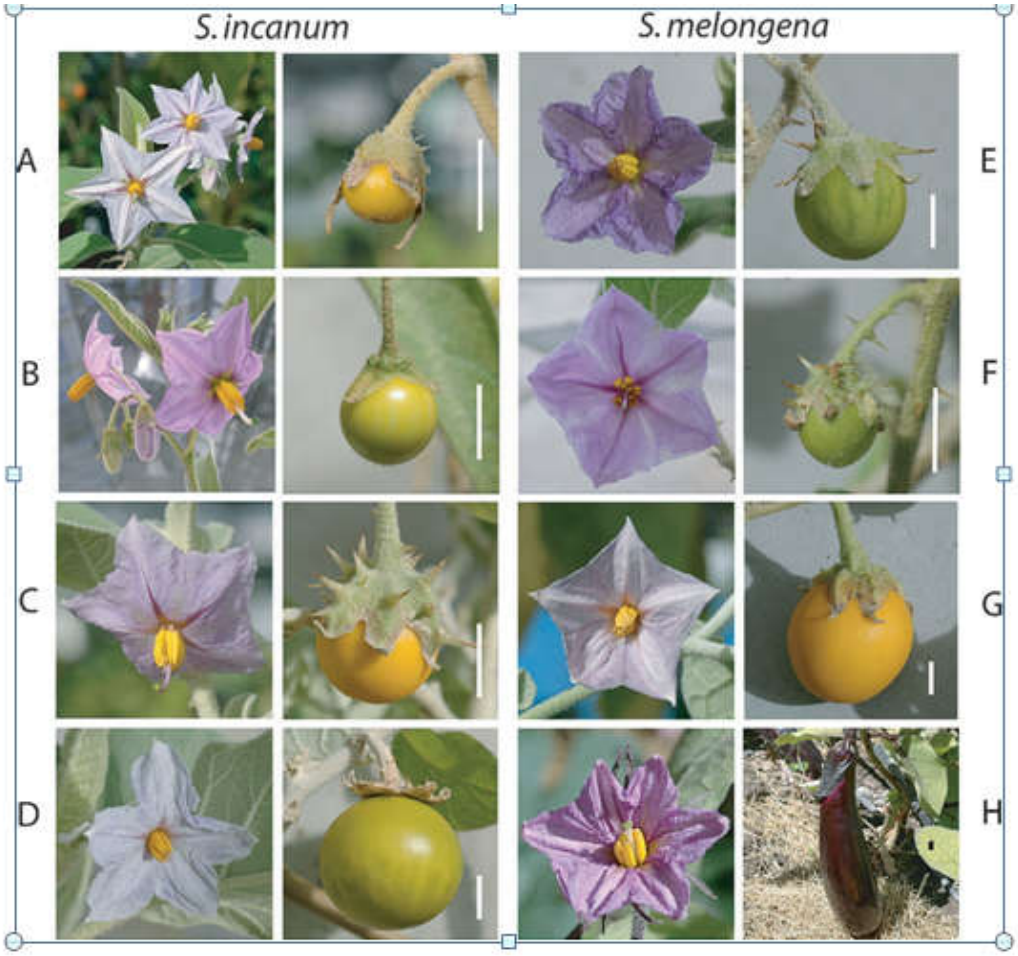


Fig. 2. However, wild (S.incanum; A-D) and semi- domesticated (S. melongena; E-H) eggplant relatives usually have small, round, yellow fruits and the plants are abundantly prickly

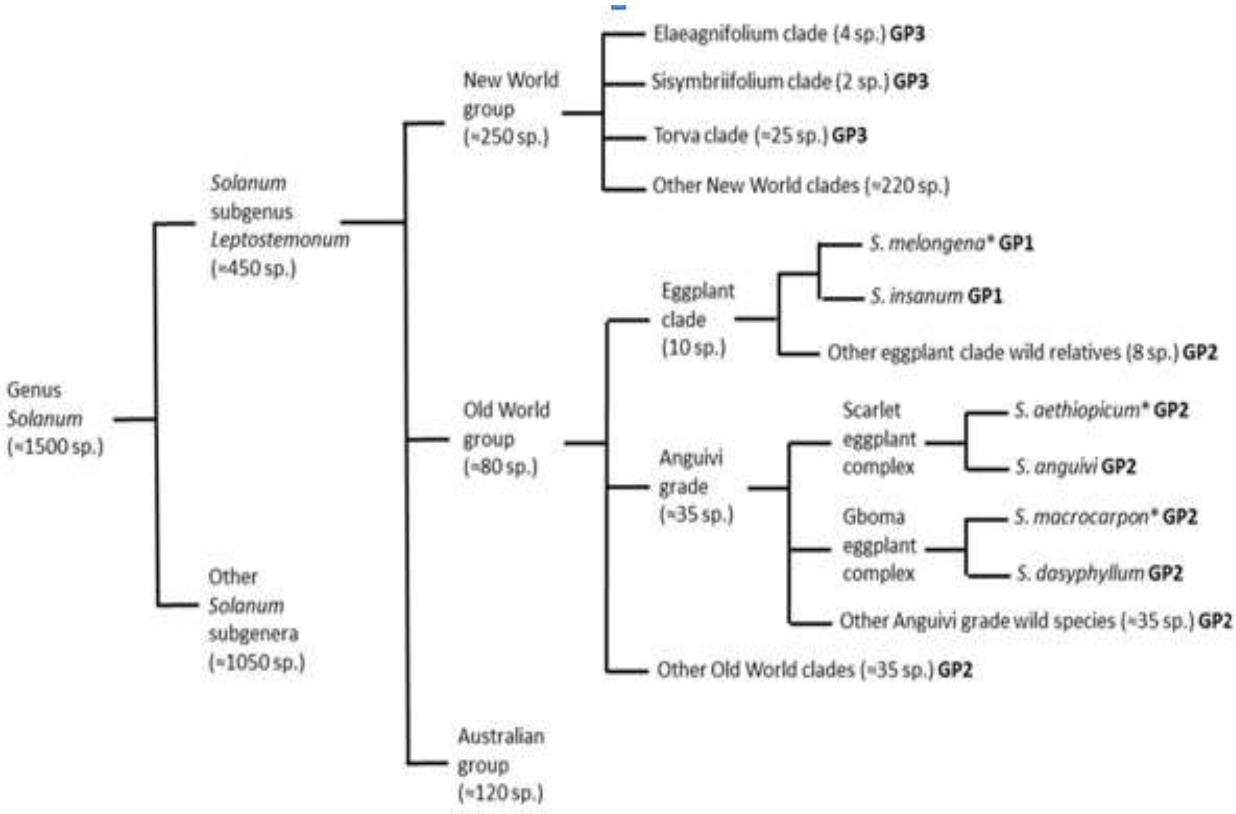


Fig. 3. Schematic representation of taxonomic relationships between the cultivated brinjal eggplant (Solanum melongena) and other cultivated (scarlet eggplant, S. aethiopicum; and gboma eggplant, S. macrocarpon) and wild relatives from the genus Solanum**. For each of the species and groups it is indicated if they are part of the primary (GP1), secondary (GP2), or tertiary (GP3) brinjal eggplant genepools. The three cultivated species are indicated with an asterisk**

Fig. 4. Different fruit shapes, colors, and sizes of *Solanum melongena* accessions in the World Vegetable Center germplasm collection (Taher *et al*., 2017).

from pale violet-purple hues to black, sometimes netted or striped, yellow to brown when ripe, many-seeded. Seeds lenticular to reniform, flattened, 3 mm × 4 mm, pale brown. Seedling with epigeal germination; cotyledons up to 2.5 cm × 1 cm (Daunay and Chadha, 2004). Brinjal is a rather small plant that grows up to 1.5 m. Brinjal is classified as a herb because of its non-woody stem. Its simple leaves are oblong to oval, slightly lobed, with its underside a paler green than the upper surface. Both leaves and stem are covered with fine hairs. Its flowers sprout singly or in small clusters from the leaf axils. Individual flowers are star-shaped, light purple in colour and have short stalks. There are five stamens attached to the corolla tube and a single superior ovary. Its fruits are berries with many seeds and are either long or round and vary in colour according to the variety: white, orange, green, purple or black. It is a perennial and fruits all year round (Ratnala, 2004; Lee *et al*., 2004)

Some eggplants will have spiny stems, some not. They have all 5 petals per flower, which can range in color from purple to white. They have that "classic" nightshade look to them with the vibrant yellow stamens and conical petal arrangement. Flowers are largely self-pollinating, but sometimes bees and such do like to get into the mix on the cross-pollination front. The leaves of the eggplant are lobed (have clefts) and alternate (they're staggered up the stem instead of opposite in pairs across the stem from one another), green to grey colored and typically with a coarse sort of fuzz on the leaves. The plants generally grow from 30-2.5 m tall. They can get quite big!. Eggplant leaves, in contrast, are not especially flavorful but can be eaten. You can view them as a sort of survival crop if you're not particularly curious about eating them otherwise. There's a kind of vegetable related to our eggplant called eggplant leaf, too, which is grown in many parts of Africa as a staple vegetable (Faden, 2020). Eggplant is an annual or short-lived perennial plant. The leaves and stems are covered with star-shaped hairs and sometimes prickles. The flowers are solitary, star-shaped, and usually violet in color. The fruit is a large fleshy smooth berry. The fruit color varies from white, green, or purple to black depending on the cultivar. The fruit has many pale brown kidney-shaped seeds. The fruits should not be consumed raw. Preferably, they should be baked, stewed, or fried. The flowers, leaves, and roots of the plant are toxic and should not be consumed. They contain alkaloids that include solanine. Ingestion may cause throat burning, nausea, vomiting, and irregular heart rhythms which may be fatal (NCEG, 2023).

The stem of eggplant is often spiny. The flowers are white to purple in color, with a five-lobed corolla and yellow stamens. Some common cultivars have fruit that is egg-shaped, glossy, and purple with white flesh and a spongy, "meaty" texture. Some other cultivars are white and longer in shape. The cut surface of the flesh rapidly turns brown when the fruit is cut open (oxidation). Eggplant grows 40 to 150 cm tall, with large, coarsely lobed leaves that are 10 to 20 cm long and 5 to 10 cm broad. Semiwild types can grow much larger, to 225 cm, with large leaves over 30 cm long and 15 cm broad. On wild plants, the fruit is less than 3 cm in diameter; in cultivated forms: 30 cm or more in length are possible for long, narrow types or the large fat purple ones common to the West. Botanically classified as a berry, the fruit contains numerous small, soft, edible seeds that taste bitter because they contain or are covered in nicotinoid alkaloids, like the related tobacco (WIKI, 2023). It is a perennial but grown commercially as an annual crop. A number of cultivars are grown in India, consumer preference being dependent upon fruit colour, size and shape. The varieties of *Solanum melongena* L. display a wide range of fruit shapes and colours, ranging from oval or egg-shaped to long club-shaped; and from white, yellow, green through degrees of purple pigmentation to almost black (Bighaat, 2023). Brinjal is an annual herb or short-lived soft-wooded shrub to 1 m tall, cultivated for its large edible fruit; cultivated forms lack prickles (except for a few soft ones on calyx), elsewhere forms with prickles occur; all parts sparsely or densely pubescent with stellate hairs (sessile or stalked porrect-stellate), glandular hairs not obvious, aspect grey or purplish-green. Leaves to 20cm long and 10 cm wide, ovate or ovate-oblong, entire or with 5–9 shallow sinuate lobes, lobes and sinuses rounded, base unequal, petiole 2–8 cm long. Inflorescence a single, large, hermaphrodite flower below a short raceme of few, smaller, male flowers; in domesticated plants male flowers may be lacking on some or all inflorescences; flowers frequently multi-partite with 5–7 lobes and anthers. Hermaphrodite flower: pedicel 1.5–3 cm long, relatively stout, soon deflexed. Calyx tube 5 mm long; lobes 1–1.5 cm long, oblong-lanceolate, tapering into acumens 3–5 mm long, with a few soft prickles. Corolla 3–4 cm diam., broadly stellate. Filaments 3–4 mm long; anthers 5–7 mm long, oblong, stout, erect. Ovary pubescent at summit with stellate hairs; style 1–1.5 cm long, erect, stout; stigma terminal. Male flower: peduncle 2–4 cm long with 1–5 flowers; pedicel 1–1.5 cm long, slender. Calyx tube to 5 mm long; lobes 5–8 mm long, triangular. Corolla 3–3.5 cm diam., broadly stellate. Filaments 2–3 mm long; anthers 5–6 mm long, oblong, erect. Ovary, style and stigma vestigial or absent. Fruiting pedicel massive, deflexed, berry 10–20 cm long, globose, obovate or oblong, glabrous, usually dark shining-purple, pale forms are known, flesh pale. Seeds 3–4 mm long, numerous, flattened, sub-reniform, pale yellow to light brown (LFS, 2023). Brinjal is an annual herbaceous plant. Inflorescence is often solitary but sometimes it constitutes a cluster of 2-5 flowers. Solitary or clustering nature of inflorescence is a varietal character. Flower is complete, actinomorphic and hermaphrodite. Calyx is five lobed, gamosepalous and persistent. It forms a cup-like structure at the base. Corolla is five lobed gamopetalous with margins of lobes incurved. There are five stamens which are free and inserted at the throat of corolla. Anthers are cone-shaped, free and with apical dehiscence. Ovary is hypogynous, bicarpellary, syncarpous and with basal placentation. Heterostyly is a common feature. Four types of flowers have been reported depending upon the length of style. These are: (i) Long styled with large ovary, (ii) Medium styled with medium size ovary, (iii) Pseudo-styled with rudimentary ovary and (iv) True short styled with very rudimentary ovary. Fruit setting flowers consist of long and medium styled flowers. Fruit setting in long styled flowers normally, varies from 70 to 85% and that in medium styled flowers from 12 to 55%. The non-fruit setting flowers consist of short styled flowers in which androecium is fertile but stigma is smaller with underdeveloped papillae (Vidhi, 2023).

Brinjal or eggplant is a herbaceous annual with erect or semi spreading habits. It is a perennial plant but cultivated as annual. It develops into bushy plants with large, fuzzy leaves that grow to a height of about 60 to 120 centimeters. The plant is erect, compact, and well branched. It has a rather fibrous or lignified root system. The leaves are large, simple, lobed and alternate on the stems. The stems, leaves, and calyx of some cultivars are spined. The botanical features of various plants parts of brinjal are as under.

Leaves: The leaf pattern is mostly opposite, large, single lobed and the underside of the most cultivars is covered with dense wool like hairs. The leaves may be with or without spines at the midrib portions. The leaf blade and tip angle is very acute to very obtuse. Inflorescence is often solitary but sometimes it constitutes a cluster of 2 - 5 flowers. This character is dependent on the variety or hybrid.

Flowers: The flowers are large, violet-colored and either solitary or in clusters of two or more. Flower is complete, actinomorphic and hermaphrodite. Calyx is five lobed, gamosepalous and persistent with or without spines depending on the cultivar types. It forms a cup like structure at the base. Corolla is five lobed gamopetalous with margins of lobes incurved. There are five stamens which are free and inserted at the throat of corolla. Anthers are cone shaped, free and with apical dehiscence. Ovary is hypogynous, bicarpellary, sycarpous and with basal placentation. Four types of flowers have been reported depending on the length of styles, viz. (i) long styled with big ovary, (ii) medium styled with medium sized ovary, (iii) pseudo short styled with rudimentary ovary and (iv) true short styled with very rudimentary ovary.

Fruits: The fruit is pendent and is fleshy berry borne singly or in clusters. The shape of fruit varies from ovoid, oblong, obovoid, or long cylindrical. The colour of the mature fruit varies from monocoloured purple, purple black, yellowish, white, green and variegated types of purple with white stripes, green with light green / white stripes or even combination of three colours.

Plant

Leaf

Flower buds

Plant with flowers

Flower with long style

Flower with long style

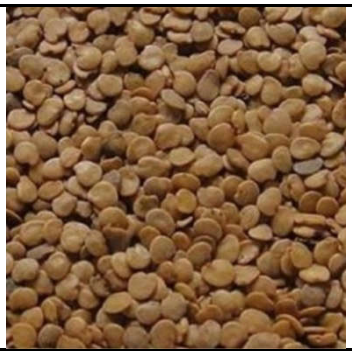
Flower with medium style

Flower with short style

Plants

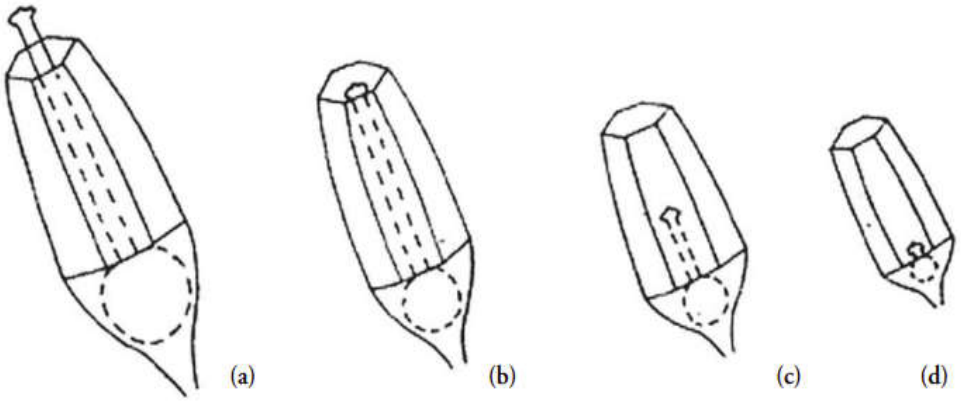
Fruit

Mature fruits



Seeds

Fig. 5. Botanical Description



a. Long- styled (big ovary). b. Medium- styled (medium ovary). c. Pseudo short- styled (rudimentary ovary). d.True short-styled (very rudimentary ovary)

Fig. 6. Types of brinjal flowers on the basis of length of styles

Seeds: The seeds are borne on the fleshy placenta and the placentae with the seeds completely fill the locular cavity. The number of seeds per fruit varies from few (50) to many. The seed color is white, light yellow, brownish yellow, brown to black brown for different varieties (Fig. 5 & 6) (GEAC, 2023).

Floral biology and Pollination: Eggplant is usually self-pollinated but the extent of cross-pollination has been reported as high as 29% and hence, it is classified as often cross-pollinated or facultative cross-pollinator. Out-crossing takes place with the help of insects (bumble bees, wild bees and domestic bees). Flowers generally emerge 40-45 days after transplanting. Anthesis occurs at about 6-8 a.m. in August-September and usually between 9.30 to 11.15 a.m. during winter (December-January). Stigma receptivity is highest during anthesis, i.e. flower opening. Anthers usually dehisce 15 to 20 minutes after the flowers have opened. The receptivity of the stigma can be observed from its plump and shiny appearance which gradually becomes brown with the loss of receptivity. The period of effective receptivity ranges from a day prior to flower opening until about four days after opening. Pollen usually remains viable for a day during summer and 2-3 days in winter under field conditions. For emasculation, a healthy long or medium styled, well developed bud from the central portion of the plant is selected. The bud is opened gently with the help of fine pointed forceps one or two days before the opening of the bud and all the five anthers are carefully removed. For pollination, freshly dehiscing anthers are picked up and are slit vertically with fine needle to get sufficient pollen at the tip of the needle. Pollens are applied on the stigma of the emasculated flower bud. It is labelled and covered with small pollination bag. Emasculation is done in afternoons followed by pollination in next morning. Emasulated buds are covered with pollination paper bags and bags are secured with U clip. The pollinated buds are covered with the same bag but now bags are stappled (Vidhi, 2023). It has been reported that long and medium-styled flowers produce fruits whereas pseudo-short and short-styled flowers do not set any fruits. Further, chances of cross pollination are more in long style flowers. The percentage of long and medium styled flowers is a varietal character. Fruit setting of long styled flowers varies from 70% to 86.7% in different varieties. In medium styled flowers, fruit set ranges from 12.5% to 55.6%. All varieties have flowers with different style length. The position of the stigma in relation to stamens varies with the cultivars and can also vary in different flowers of same cultivar. Stigmas are either found above, on the same level as or below the stamens (GEAC, 2023).

Seed Dormancy: Some wild species of brinjal germinate much slower than cultivated species. Seed dormancy is sometimes observed, which varies according to cultivars and harvest conditions. Storage for a few months at an ambient temperature, or a few weeks at chilled conditions lessens this dormancy. Seed dormancy was reported in some of the cultivated brinjal species also. Seed dormancy in fresh seeds of eggplant cultivars has been reported. The germination of two month old seeds of two brinjals varieties cv. Arka Keshav and Arka Neelkanth was 0 % and 2 % respectively, revealing the presence of dormancy. However, there was a gradual decline in the seed dormancy with the ageing of seeds under ambient conditions and complete breakdown of dormancy occurred after 12 months of storage (GEAC, 2023).

GENETIC DIVERSITY

In brinjal we find oval, long and slim, and melon-shaped eggplants with white, green, pink, orange, and even striped skin (Watson, 2023). Many of us are most familiar with eggplants that are large and dark purple, but the shape, size, and color can vary from small and oblong to long and thin and from shades of purple to white or green (Medicalne, 2023). A variety of cultivars, varying in tastes, shapes, colors, and sizes, are grown in India. The cultivars range from small to large and pendulous, from oblong to round, from oval or egg-shaped to long and club-shaped; they come in colors such as green, white, or yellow, degrees of purple pigmentation to almost black, among others, or even striated shades and color gradients (Gowda, 2010).

There are 2,500 varieties of brinjal in various shapes and colours. Its diversity in India also finds place in songs and religious rituals. Mattu Gulla, the traditional variety in Udupi district, Karnataka, has been grown for 500 years and is a religious offering at the Sode Matha temple (Sood, 2012). Large variation in yield parameters and in fruit quality parameters have been documented in the germplasm collection. The varieties of *Solanum melongena* L. display a wide range of fruit shapes and colours, ranging from oval or egg-shaped to long club-shaped; and from white, yellow, green through degrees of purple pigmentation to almost black (Rajeshbhu, 2023) (Fig. 7,8, 9). According to Zeven and Zhukovsky (1975), brinjal is originated from India, and China is believed to be the secondary centre of origin. Knowledge on genetic divergence among the breeding materials is very essential to a plant breeder for an efficient choice of parents for crossing programme. The proper choice of parents is a prerequisite in sound breeding. Genetic diversity is one important criterion for selection of parents in production of a hybrid. Eggplant genetic resources consist of three genepools. The primary genepool consists of traditional and modern cultivars of *Solanum melongena*; the diversity is important in terms of fruit size (from some tens of g to over one kg), fruit shape (from globose to snake-shaped, furrowed or smooth) and fruit colour (white, green, pink to violet or purple or even black, uniform, striped, mottled or netted) (Daunay and Chadha, 2004). Morphological characterization of 27 S. melongena, two S. macrocarpon, one S.nigrum, three S. violaceum and one S. torvum accessions was conducted. The aim of the present study was to assess and measure morphological diversity in eggplant genetic resources conserved at the National gene bank in Mauritius in order to promote their conservation, effective management, sustainable use and legal protection. 9 quantitative and 14 qualitative traits were characterized based on eggplant descriptor list. Significant ($P < 0.01$) correlations were observed between several related traits of high agronomic importance and breeding potentials in selection of genetically divergent parents for hybridization. Yield was positively correlated with leaf area ($r = 0.2$), fruit length and width ($r > 0.5$) and fruit weight ($r = 0.8$) but inversely related with number of fruits per plant ($r = -0.6$) and plant height ($r = -0.5$). The phenogram constructed through UPGMA clustering method showed the phenetic relationship between S. melongena accessions, their related species and wild types. It classified the S. melongena accessions into Long, Semi long, Round and Oblong cultivar groups based on fruit shape, colour and size. Principal Component Analysis revealed that fruit characters were important marker traits with a large coefficient of variation (> 40 percent) that most effectively discriminated between eggplant accessions and hence useful in establishing a simple but effective eggplant classification system at the gene bank (Naujeer and Banu, 2009).

A collection of 238 eggplant breeding lines, heritage varieties and selections within local landraces provenanced from Asia and the Mediterranean Basin was phenotyped with respect to key plant and fruit traits, and genotyped using 24 microsatellite loci distributed uniformly throughout the genome. STRUCTURE analysis based on the genotypic data identified two major sub-groups, which to a large extent mirrored the provenance of the entries. With the goal to identify true-breeding types, 38 of the entries were discarded on the basis of microsatellite-based residual heterozygosity, along with a further nine which were not phenotypically uniform. The remaining 191 entries were scored for a set of 19 fruit and plant traits in a replicated experimental field trial. The phenotypic data were subjected to principal component and hierarchical principal component analyses, allowing three major morphological groups to be identified. All three morphological groups were represented in both the "Occidental" and the "Oriental" germplasm, so the correlation between the phenotypic and the genotypic data sets was quite weak. The relevance of these results for evolutionary studies and the further improvement of eggplant are discussed. The population structure of the core set of germplasm shows that it can be used as a basis for an association mapping approach (Cericola *et al*., 2013). Morphological diversity in 92 eggplant genotypes based on twenty one characters was estimated using Mahalanobis's D2 statistics. The highest intra-cluster distance was observed in cluster VIII (2.13), containing seven genotypes and the lowest intra-cluster

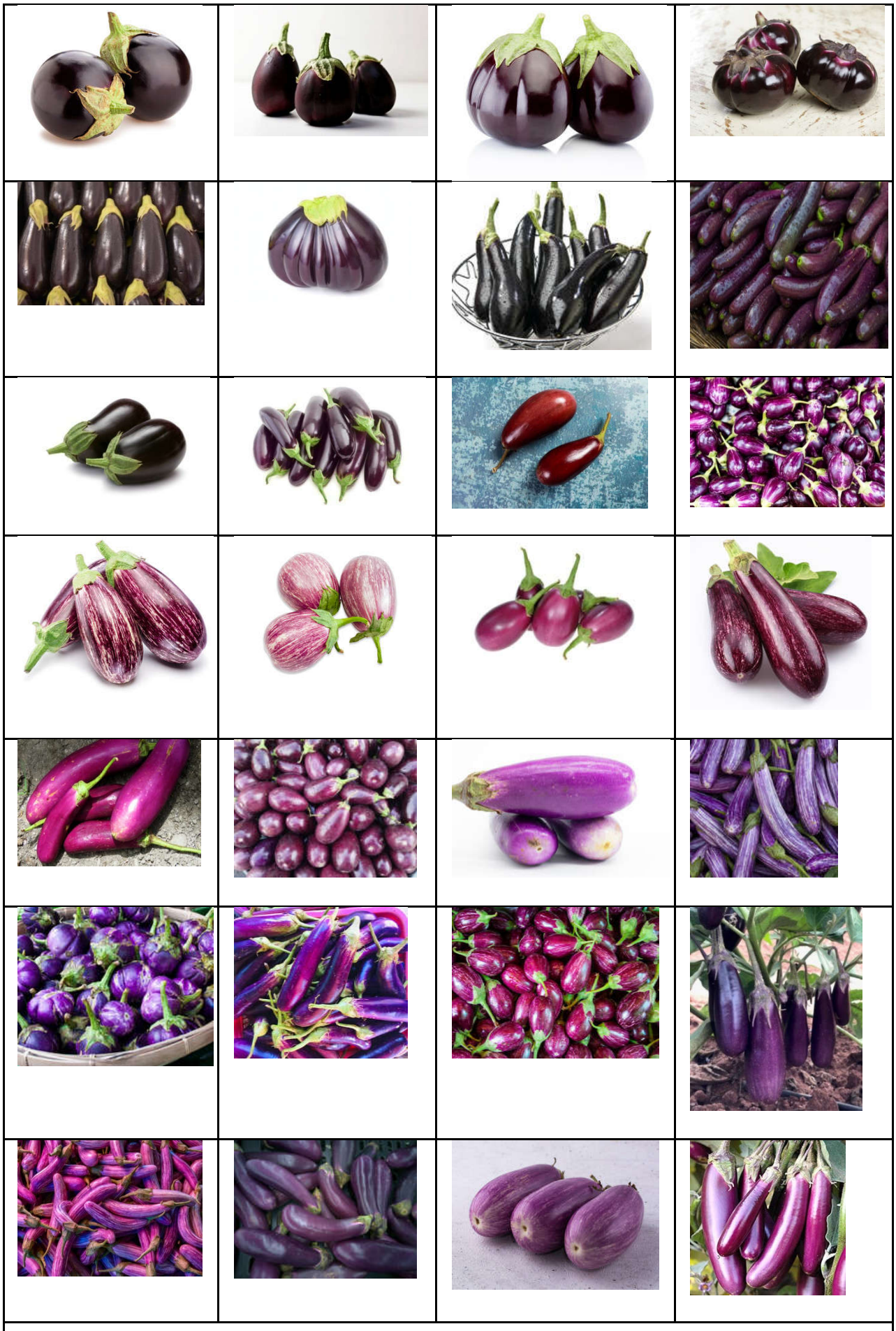


Fig. 7. Variability for fruit shape, size and color of brinjal

Fig. 8: Variability for fruit shape, size and color of brinjal

distance (1.18) was observed in cluster IV having four genotypes. Ninety two eggplant genotypes were grouped into ten different clusters by non-hierarchical clustering. The cluster X had the maximum number (17) of genotypes and cluster II and III had minimum number (3) of genotypes. The highest inter-cluster distance was observed between cluster II and VIII (30.86) indicated the genotypes in these clusters were more diverged than those of other clusters. The lowest inter-cluster distance was observed between the clusters V and X (3.72) suggesting a close relationship among the genotypes included within these clusters. Cluster II constitute three genotypes and produced the highest mean value for number of flowers per inflorescence (4.67) and yield per plant (812.33) and the lowest mean value days to 1st flowering (108.22). Cluster IV constitute three genotypes namely EP-080, EP-081, EP-089 and produced fruits for longer duration (82.33). Cluster VIII constitute seven genotypes and showed the lowest mean value for number of infected shoots per plant (1.57). Cluster X established with 17 genotypes produced the lowest mean value for number of infected fruit per plant (8.26). Therefore, more emphasis should be given on cluster II, IV and VIII for selecting genotypes as parents for crossing which may produce new recombinants with desired traits (Begum *et al*., 2013).

Table 2. Abbreviation, germplasm collection code, group (based on eggplant skin colour, G1 = black-purple, G2 = striped, G3 = white, G4 = reddish purple) and origin of the 31 eggplant landraces used in the study

Abreviation code	Genbank code	Group	Original location
B1	BGV005769	G2	Alcira, Valenica, Spain[a]
B2	BGV005770	G2	Gandia, Valencia, Spain[a]
B3	BGV005771	G4	Gandia, Valencia, Spain[a]
B4	BGV005774	G1	Paraco, Valencia, Spain[a]
B5	BGV005776	G2	Valencia, Spain[a]
B6	BGV005778	G2	Orihuela, Alicante, Spain[a]
B7	BGV005781	-	Benijofar, Alicante, Spain[a]
B8	BGV005780	G1	San Fulgencio, Alicante, Spain[a]
B9	BGV005783	G2	Aspe, Alicante, Spain[a]
B10	BGV005784	G1	Novelda, Alicante, Spain[a]
B11	BGV005785	G1	Elche, Alicante, Spain[a]
B12	BGV005787	G1	Mutxamel, Alicante, Spain[a]
B13	BGV005788	G2	Benejama, Alicante, Spain[a]
B14	BGV005789	G1	Gandía, Valencia, Spain[a]
B15	BGV005790	G2	Orihuela, Alicante, Spain[a]
B16	BGV015751	G3	Alacuás, Valencia, Spain[a]
B17	BGV008284	G2	Moncada, Valencia, Spain[a]
B18	BGV015630	G3	Torreblanca, Castellón, Spain[a]
B19	BGV015745	G1	Benimasot, Alicante, Spain[a]
B20	BGV015762	-	Alcudia de Crespins, Valencia, Spain[a]
B21	BGV015847	G2	Onteniente, Valencia, Spain[a]
B22	BGV015763	G1	Onteniente, Valencia, Spain[a]
B23	BGV015848	G1	Onteniente, Valencia, Spain[a]
B24	BGV015849	-	Paraco, Valencia, Spain[a]
B25	BGV015850	G2	Paraco, Valencia, Spain[a]
B26	BGV015834	G1	Paraco, Valencia, Spain[a]
B27	BGV015835	G4	Paraco, Valencia, Spain[a]
B28	BGV015836	G3	Paraco, Valencia, Spain[a]
B29	BGV014500	G2	Villarreal, Castellón, Spain[a]
B30	B-81	G2	Gandía, Valencia, Spain[b]
B31	B-76	G1	Alginet, Valencia, Spain[b]

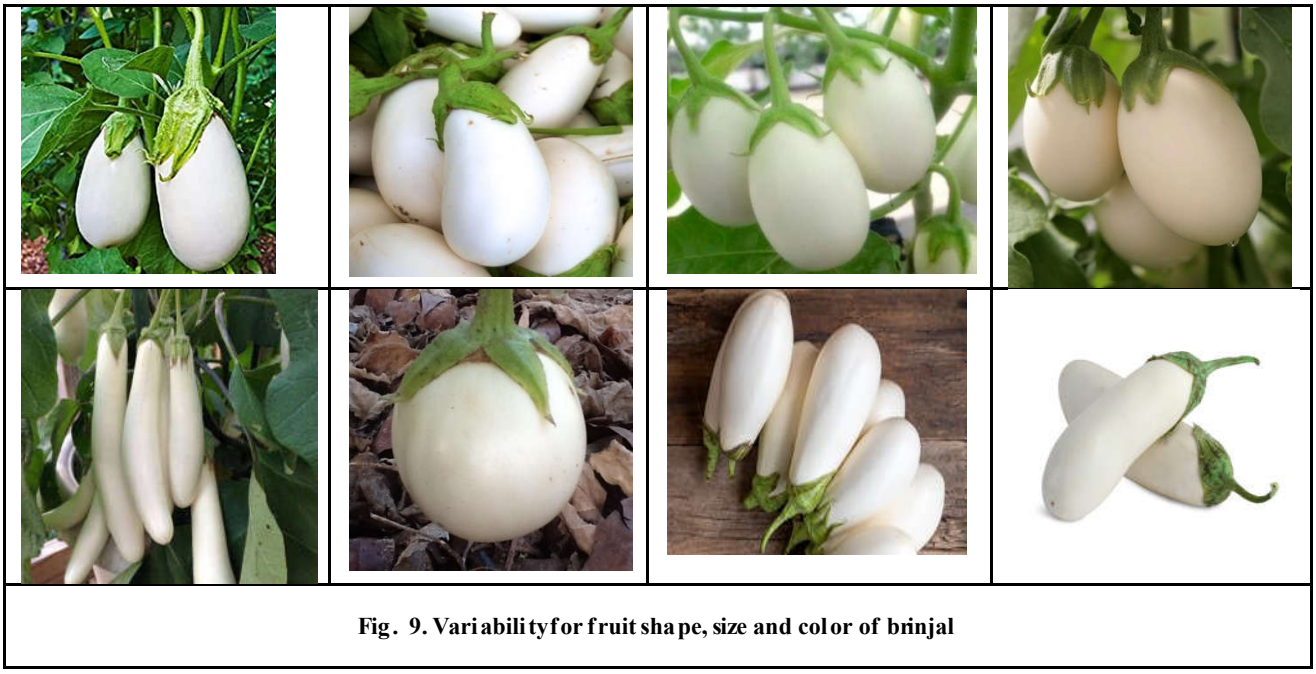


Fig. 9. Variability for fruit shape, size and color of brinjal

Multivariate analysis of twenty six genotypes of eggplant were done to estimate the genetic diversity and to select the potential parents for a successful hybridization program. As per PCA, D2 and cluster analysis, the genotypes were grouped into five clusters. The highest inter-cluster distance was between Cluster II and Cluster III (37.82) and the lowest between Cluster I and Cluster III (4.39). Cluster III showed the maximum intra-cluster distance (1.58), whereas Cluster II showed the lowest intra-cluster distance (0.48). Considering the magnitude of genetic distance and agronomic performance, the genotypes SM 208 and SM 209 from Cluster II and SM 201, SM 218 and SM 227 from Cluster III might be suitable for efficient hybridization program. On the other hand the genotypes of Cluster I (SM 206, SM 210, SM 211, SM 212, SM 213, SM 215, SM 216, SM 217, SM 221, SM 224, SM 225 and SM 226) possess all the superior characters in respect of yield and yield related component. Thus the genotypes SM 206, SM 216, SM 217, SM 224 and SM 225 from this Cluster could be selected to develop high yielding eggplant varieties (Karim *et al.,* 2016). *Solanum* L., with ca. 1400 species, is one of the largest genera of flowering plants (Frodin, 2004) and has been the subject of much recent taxonomic and phylogenetic work. Landraces were grouped based on their fruit skin colour (black-purple, striped, white, and reddish). Landraces B7, B20, and B24 were left out for their distinctive fruit characteristics. Wide variation for plant, leaf, flower, and fruit phenology traits was observed across

the local landraces, and fruit descriptors were considered the most important ones. In a second experiment, landraces, B14, B16, and B17 were selected to determine fruit quality. By contemplating the benefits provided by antioxidants and sugars for human health, pulp antioxidant capacity, total phenolic, ascorbic acid, carotenoid, flavonoid, and total sugar content were determined. Significant differences were observed across these three landraces, and B14 was highlighted for its antioxidant properties, while B17 stood out for its high sugar content. B16 did not stand out for any traits (Aubriot *et al.,* 2018). The results indicate the wide variability in eggplants for their phenotypic and nutritional characteristics, which emphasises the importance of traditional varieties as the main source of agricultural biodiversity (Martínez-Ispizua *et al.,* 2021). Thirty-one eggplant landraces from Spain were characterised with 22 quantitative and 14 qualitative conventional morphological descriptors. Landraces were grouped based on their fruit skin colour (black-purple, striped, white, and reddish). Landraces B7, B20, and B24 were left out for their distinctive fruit characteristics. Wide variation for plant, leaf, flower, and fruit phenology traits was observed across the local landraces, and fruit descriptors were considered the most important ones. In a second experiment, landraces, B14, B16, and B17 were selected to determine fruit quality. By contemplating the benefits provided by antioxidants and sugars for humanhealth, pulp antioxidant capacity, total phenolic, ascorbic acid, carotenoid, flavonoid, and total sugar content were determined. Significant differences were observed across these three landraces, and B14 was highlighted for its antioxidant properties, while B17 stood out for its high sugar content. B16 did not stand out for any traits. The results indicate the wide variability in eggplants for their phenotypic and nutritional characteristics, which emphasises the importance of traditional varieties as the main source of agricultural biodiversity (Martínez-Ispizua *et al.,* 2021)

The passport data are indicated in Table 2. Landraces were selected according to fruit colour and morphology to study as much phenotypic diversity as possible (Figure 10). The results showed the high degree of diversity among the selected traditional eggplant varieties. Among morphological characteristics that may be of interestfor handling jobs like crop harvesting, are included having an erect growth habit, low branch density, lack of hairiness on leaves, no prickles on the calyx and the development of elongated and not excessively heavy fruits. Between groups G1 and G2, which include similar varieties to those marketed today, landraces B4, B12, and B19 could be highlighted based on the previous traits. Trade in the G3 and G4 varieties could also be promoted because: white-fruited varieties (G3) produce many flowers and somewhat elongated fruits of an attractive colour for consumers, while the reddish fruit entries (G4) produce elongated but not too heavy fruits, with a few thorns on the calyx, which could be interesting options. As the nutritional profile is helpful for promoting the commercialisation and consumption of local varieties, and according to the nutritional quality part of this study, variety B14 could be promising for human consumption, mainly for its antioxidant properties. Taken together, this information could be relevant for future plant breeding programmes to obtain easily manageable and harvestable eggplant varieties (Martínez-Ispizua *et al.,* 2021). Study was conducted using 130 local germplasm of brinjal to select diverse parents based on the multiple traits selectionindex for the future breeding program. This selection was performed focusing on 14 qualitative and 10 quantitative traits variation and genetic parameters namely, phenotypic and genotypic variance (PV and GV) and genotypic and phenotypic coefficients of variation (GCV and PCV), broad-sense heritability (hBS), genetic advance, traits association, genotype by trait biplot (G × T), heat map analysis and multi-trait index based on factor analysis and genotype-ideotype distance (MGIDI). Descriptive statistics and analysis of variance revealed a wide range of variability for morpho-physiological traits. Estimated hBS for all the measured traits ranged from 10.6% to 93%, indicating that all the traits were highly inheritable. Genetic variances were low to high for most morpho-physiological traits, indicating complex genetic architecture. Yield per plant was significantly correlated with fruit diameter, fruits per plant, percent fruits infestation by brinjal shoot and fruit borer, and fruit weight traits indicating that direct selection based on fruit number and fruit weight might be sufficient for improvement of other traits. The first two principal components (PCs) explained about 81.27% of the total variation among lines for 38 brinjal morpho-physiological traits. Genotype by trait (G × T) biplot revealed superior genotypes with combinations of favorable traits. The average genetic distance was 3.53, ranging from 0.25 to 20.01, indicating high levels of variability among the germplasm. The heat map was also used to know the relationship matrix among all the brinjal genotypes. MGIDI is an appropriate method ofselection based on multiple trait information. Based on the fourteen qualitative and ten quantitative traits and evaluation of various genetic parameters, the germplasm G80, G54, G66, and G120 might be considered as best parents for the future breeding program for eggplant improvement (Uddin *et al*., 2021). In the present study, 22 eggplant varieties from the different ecogeographical regions were evaluated for nine quantitative and twenty-two qualitative morphological characters. A significant divergence was observed in all characters and wide regional variations for plant characteristics, flower, and fruit characteristics. The study showed that the *Solanum melongena* accessions belonging to Pakistan and other geographical regions of the world possess marked variation in fruit weight, fruit shape, fruit color, leaf spine, number of locules in fruit, plant height, and flower color (Zohaib Younas *et al.,* 2022). The 22 eggplant accessions showed more diversity in inflorescence and flower characteristics. The flower color ranged from purplish to light purplish and white (Fig. 11) (Zohaib Younas *et al*., 2022). The color of purple skin cultivars is due to the anthocyanin nasunin. The browning of eggplant flesh results from the oxidation of polyphenols, such as the most abundant phenolic compound in the fruit, chlorogenic acid **(**WIKI, 2023**).** Different cultivars of the plant produce fruit of different size, shape, and color, though typically purple. The less common white varieties of eggplant are also known as Easter white eggplants, garden eggs, Casper or white eggplant. A much wider range of shapes, sizes, and colors is grown in India and elsewhere in Asia. Larger cultivars weighing up to a kg grow in the region between the Ganges and Yamuna Rivers, while smaller ones are found elsewhere. Colors vary from white to yellow or green, as well as reddish-purple and dark purple. Some cultivars have a color gradient—white at the stem, to bright pink, deep purple or even black. Green or purple cultivars with white striping also exist **(**WIKI, 2023**).**

BREEDING

Germplasm: The World Vegetable Center (WorldVeg) holds a large public germplasm collection of eggplant, which includes the three cultivated species and more than 30 eggplant wild relatives, with more than 3,200 accessions collected from 90 countries (Taher *et al.*, 2017). Over the last 15 years, more than 10,000 seed samples from the Center's eggplant collection have been shared with public and private sector entities, including other genebanks. An analysis of the global occurrences and genebank holdings of cultivated eggplants and their wild relatives reveals that the WorldVeg genebank holds the world's largest public collection of the three cultivated eggplant species. The composition, seed dissemination and utilization of germplasmfrom the Center's collection are highlighted. In recent years more than 1,300 accessions of eggplant have been characterized for yield and fruit quality parameters (Taher *et al*., 2017)

Breeding: Eggplant is an autogamous species, with a strong tendency to cross pollination whenever there are pollinating insects (mostly *Hymenoptera*). Therefore controlled pollination is necessary for the maintenance of pure lines. The wide genetic diversity in *Solanum melongena* germplasm (e.g. fruit traits, earliness, resistance to diseases and agro-climatic adaptation) is more widely used by breeders from tropical countries than by those from temperate countries, where the production and marketing are highly standardized (Daunay and Chadha, 2004). The creation of transgenic eggplants for resistance to insects and abiotic stress factors is actively pursued in many countries.

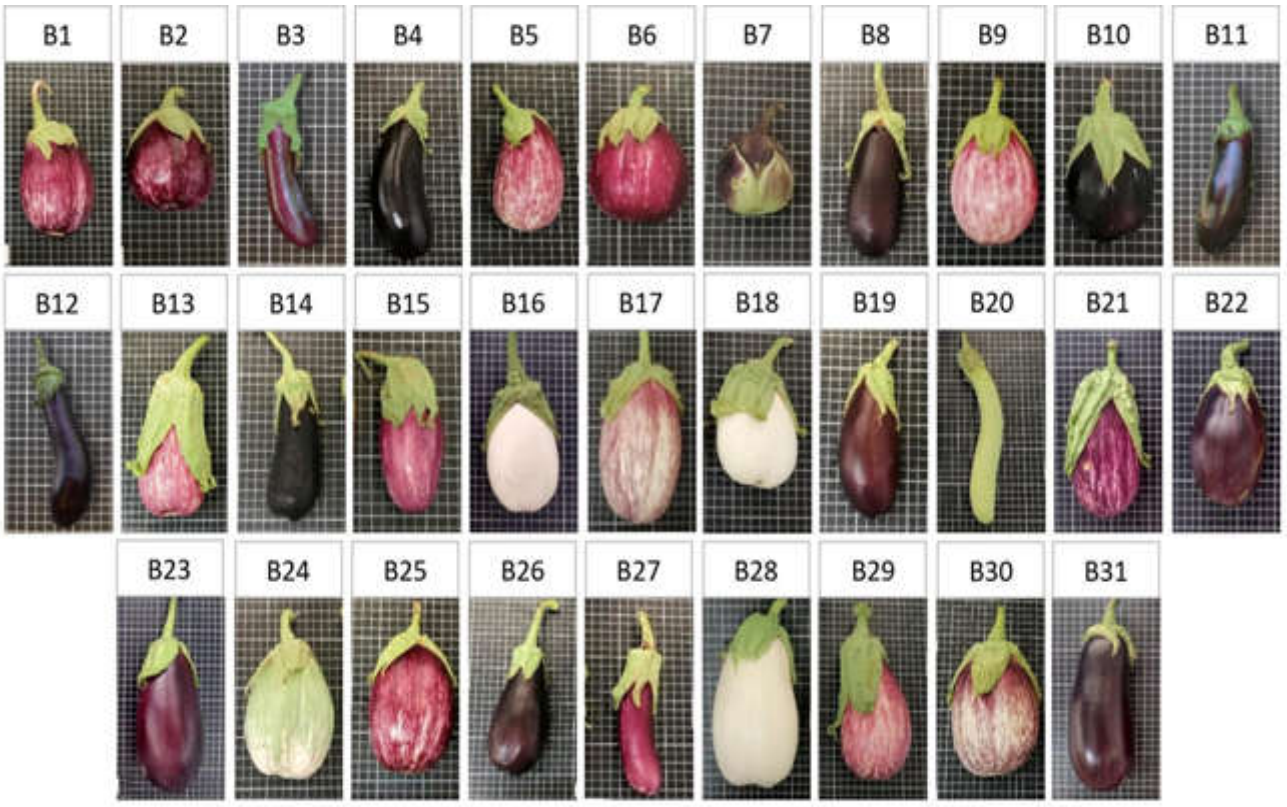


Fig. 10. Variability for fruit skin color of 31 cultivated eggplant landraces of Spain

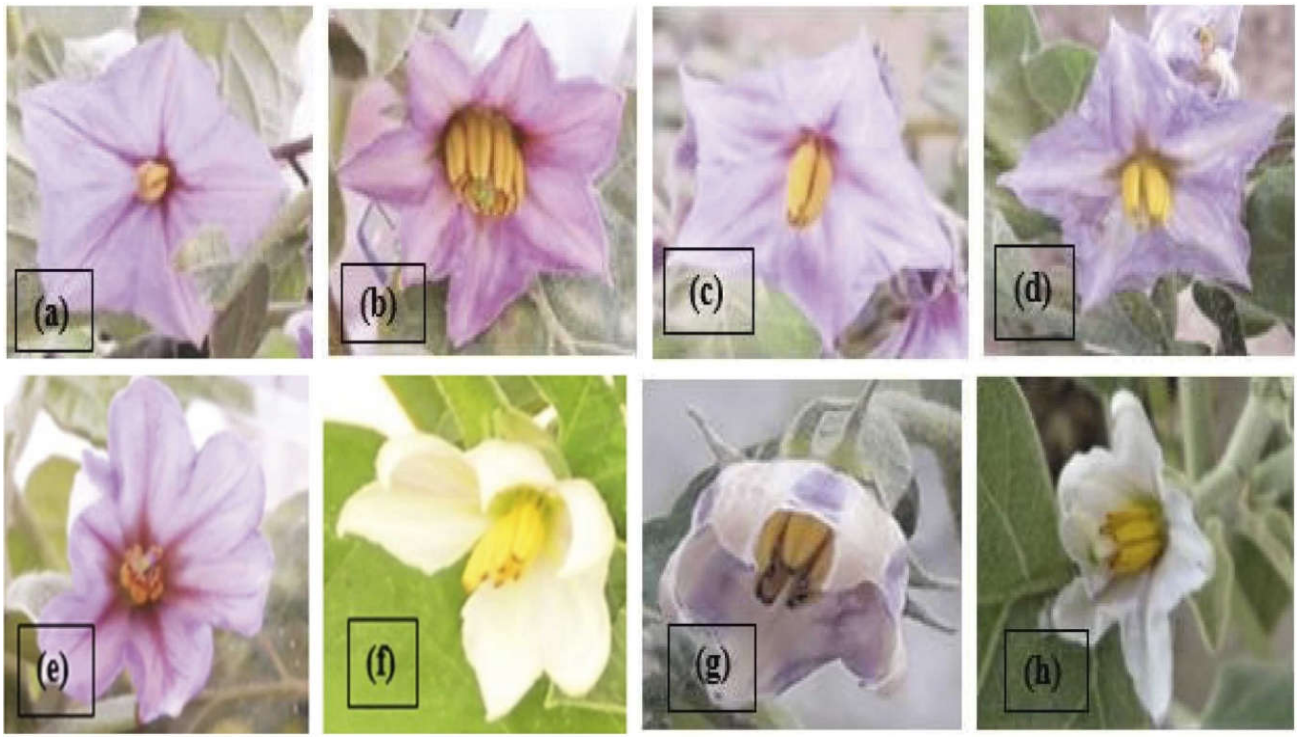


Fig. 11: Morphological variation in flower color, number of corollas, and corolla margin among 22 eggplant accessions. (a) Eggplant variety PI-321018 having a light purple colored flower with 5 winged petals. (b) Eggplant variety BARI-1 having a dark purple colored flower with 7 pointed petals. (c) Eggplant variety PI-381288-A having a light purple colored flower with 5 pointed petals. (d) Eggplant variety PI371849 having a light purple colored flower with 5 pointed petals. (e) Eggplant variety PI-606711 having a light purple colored flower with 6 rounded petals. (f) Eggplant variety PI-251506 having a white colored flower with 6 pointed petals. (g) Eggplant variety Xiangzue-6 371849 having a light purple colored flower with 5 pointed petals. (h) Eggplant variety white egg

The emergence of transgenic cultivars can be expected in a short time, though their superiority over conventionally bred cultivars remains to be demonstrated (Daunay and Chadha, 2004)

Breeding Objectives: Breeding activities in brinjal have been targeted at the development of high-yielding, early, better quality and disease resistant varieties.

The colour, size and shape of the fruit, proportion of seeds to pulp, short cooking time and lower solanine levels are important traits in assessing quality. As brinjal is susceptible to several pests and diseases such as wilt, Phomopsis , little leaf and root-knot nematodes and to insects such as shoot and fruit borer, jassids, epilachna beetle, etc. the development of pest resistant varieties is a major challenges. Plants are susceptible to both low and high temperature; therefore attempts are being made to develop chilling or frost- tolerant and heat-tolerant varieties. Specific breeding objectives in brinjal in Indian context are: i. Exploitation of heterosis for increasing productivity ii. Incorporation of resistance against insect pests including fruit and shoot borer iii. Breeding wilt and other disease resistance-host plant resistance iv. Development of cultivars of better quality and yield v. Development of locally preferred cultivars which are distinct in appearance (GEAC, 2023). According to Vidhi (2023) the breeding objectives are 1. High yield; 2. Earliness; 3. Fruit shape, size and colour as per consumers' preference; 4. Low proportion of seed/higher seed depending upon use; 5. Soft flesh; 6. Fruit colour retention in summer; 7. Lower solanine content; 8. Upright sturdy plant free from lodging; 9. resistance to diseses and tolerance to insects.

Breeding Methods: The common breeding methods applicable to brinjal are: 1. Pure-line selection; 2. Pedigree method; 3. Bulk method; 4. Modified pedigree (single seed descent); 5. Combination of bulk and pedigree methods; 6. Backcrossing and 7. Heterosis breeding (Vidhi, 2023).

Pure-line selection is applicable to landraces/heterogeneous materials collected from farmers' field. In this method original stock seed is space planted, preferably in wilt-sick plot. Individual plants are examined at full fruiting stage and superior individual plants based on earliness, fruit shape, size, colour, yield (visual estimate) plant type, resistance to diseases/pests are selected and harvested separately. Next year, individual plant progenies (6 m long, 5 rows) are planted and uniform progenies with desirable traits are selected and seeds of plants within a selected progeny row are bulked and a new line is thus constituted for further trials. In case some individual plant progenies show segregation, individual plant selection may be repeated (Vidhi, 2023).

In pedigree method individual plants are selected in the segregating generations from a cross on the basis of their desirability adjudged individually and on the basis of a pedigree record. Selection of parental cultivars is crucial for the success of this method. The parental lines selected are usually superior lines lacking in a few desirable traits only and of better general combing ability. Pusa Purple Long, Pusa Purple Cluster, Pant Samrat, Pant Rituraj, PH 4, Pusa Kranti, KT 4, Azad Kranti, H 7, Hisar Shyamal (H 8), Jamuni Gola, Punjab Barsati, NDB 25 and bacterial wilt resistant cultivars such as BB7, BWR12, Singnath, Bholanath, Green Star, Blue Star and Hazari are developed using this method (Vidhi, 2023).

Back crossing should normally be followed to transfer genes conferring resistance to diseases, for example, bacterial wilt resistance which has been shown to be under a single dominant gene (Vidhi, 2023).

Single seed descent method is a selection procedure in which F_2 plants and their progenies are advanced by single seed from each plant until genetic purity is virtually attained i.e. up to F_6, after which, the same procedure is applied as applicable under pedigree method. Under this method, less resources are required and 2 generations can be easily accommodated per year as even poor crop can be advanced to the next generation because a few seeds are collected from each plant without exercising any selection (Vidhi, 2023).

Considerable heterosis for fruit yield, quality and resistance to diseases has been reported in eggplant. F_1 hybrids are becoming popular day by day where manual emasculation and pollination are very much in practical use. In Maharashtra, people prefer small, round/oval fruits with purple colour, small oval fruits with purple + white stripes, small oval fruits with purple + white + green stripes and preferably with spines on the calyx. In south India, medium long fruits with green colour are preferred. Small round or oval fruits with violet colour are preferred in Tamil Nadu. Besides these dominant geographical types, there are some other types as well in small pockets. This is quite natural as eggplant originated in India (Vidhi, 2023).

Varieties (Farmnest, 2022; Bighaat, 2023; Rajeshbhu, 2023; Gowda, 2010).

Pusa purple Long: It is extra early variety, becomes ready for picking in about 75-80 days after sowing during autumn-winter season and takes 100-110 days during spring-summer season. After normal transplanting it becomes ready for picking in about 45 days. It is a selection from a mixed batia variety commonly grown in Punjab, Delhi and Western Uttar Pradesh. It has semi-erect to bushy habit, me3dium in height. Fruits are long, slender, purple, and glossy, 25-25 cm long tend to drop drown and touch the ground. It is heavy yielder. Average yield is 300 q/ha

Pusa Purple Cluster: A medium- early variety, developed at IARI. New Delhi, Fruits are 10-12 cm long, deep purple in colour and borne in clusters of 4-9 suitable for southern and northern hills, moderately resistant to bacteria wilt.

***Azad Kranti*:** A variety identified in 1983 from Kalyanpur. Fruits uniformly thick, oblong. 15-20 cm long, dark purple with a shining green colour and less seeded.

Arka Keshev: Fruits 18-20 cm long. 5-6 cm in diameter and dark purple. They are bright, soft and contain less seed. Yields 300-400 q/ha

Arka Shirish: Fruits are very long, soft, thick, attractive and light green in colour. Seeds are absent or very less in half fruit towards the stalk. Flesh is nutritive. It yields 380 q/ha.

Pusa Hybrid-5: Plants are vigorous, non-spiny, with semi-erect branches. Fruits long, glossy attractive, dark purple with partially pigmented weighing about 100 g each. It takes 80-85 days from sowing to first picking. It is an early hybrid and high yielding (510q/ha)

Pusa Purple Round: It was developed at IARI, New Delhi, Each weighs 137g. It is tolerant to little leaf and shoots and fruit borer.

Pant Rituraj: A derivative of T-3×PPC from Pantnager. Fruits are almost round. Attractive purple in colour, soft, less seeded and endowed with good flavour. Average yield is 400q/ha. It possesses field resistance to bacterial wilt.

Punjab Bahar: It is a thorn less variety developed mainly for cultivation in the spring season. Fruit dark purple with shining surface each weighing 200-300g. The fruit is plumpy and contains less seeds.

T-3 **:** It was developed at Kanpur through selection from S-16. Fruits round, light purple with whitish green colour at stigmatic end. It is moderately resistant to little leaf and bacterial blight.

Arka Navneet (F1): A cross between IIHR 22-1×Supreme from Bangalore. Fruits oval- round and free from bitterness. Fruit skin attractive, deep purple, Flesh soft and while with few seeds. Yeild is 650- 700 q/ha

Pusa Uttam: Plants are semi-upright, vigorous, well branches and free of spines. Mature plants appear green with occasional light pigmentation on growing shoots. Flowers appear in clusters. Fruits pendent, oval, large sized, glossy with dark purple skin and green peduncle. The bearing habit is solitary and single fruit weight 250-300 g. Average yield is 400 q/ha

Dudhia: Fruits are oval, oval, milky white, shining and attractive. Most suitable for winter season cultivation. Especially suitable for the preparation of Bhurta.

BH-2(F1): Plants is medium, erect, spreading and thorn less with green and purplish leaves. Fruits are oblong and deep purple weighing 300 g, It is highly suitable for cooking as Bhurta. It is tolerant to borer

Arka Nidhi (BWR - 12): Released by IIHR, Bangalore. High yielding variety with resistance to bacterial wilt. Fruits borne in cluster. Calyx purplish green. Fruits free from bitter principles with slow seed maturity and good cooking quality. Crop is ready for picking in 150 days. Average yield is 48 t/ha

Arka Kusumaker: An improvement over the local collection (IIHR-193) from Karnataka. Fruits small, long, borne in clusters of 5 to 7, good in texture and cooking qualities and skin light green. Average yield is 330 q/ha.

Pusa Safed Baingan-1*:* It is the first white coloured oval fruited brinjal variety which has been developed by single plant selection from an indigenous material collected from the farmer's field of West Garo Hills, Meghalaya by the Division of Vegetable Science, ICAR-Indian Agricultural Research Institute, Pusa, New Delhi. The materials were highly variable and single plant selection was carried out till the progeny became homozygous.

Surya: It is a violet coloured variety which is resistant to bacterial wilt, gives a high yield and is released from Kerala Agricultural University. The fruits are oval, medium and glossy violet in colour with an average yield of 12 t/ac.

Pusa Barsati: It was developed in PAU Ludhiana, which is a dwarf variety without thorns. The fruits are purple with an average yield of 14 t/ac.

Haritha: It was developed by Kerala Agricultural University, which has bacterial wilt disease resistance and gives high yield. It gives an average yield of 25 t/ac and the fruit is light green in colour and of elongated shape**.**

Vaishali: It was developed in MPKV, Maharashtra and it is a dwarf variety, with purple coloured oval fruit with white strips on it. It gives an average yield of 12 t/ac.

Manjri Gota: It was developed in MPKV, Maharashtra and the variety is a dwarf one with oval shaped purple coloured fruit, which attains a golden yellowish colour on maturation. It gives an average yield of 6 – 8 t/ac.

Arka Ankur: It was developed in IIHR, Bangalore and fruits are oval and small in size with purple colour which is glossy in appearance. It can be picked after 45 days of transplantation**.**

Swetha: It is resistant to bacterial wilt and gives a high yield. It was developed in Kerala Agricultural University and gives an average yield of 12 t/ac. The varieties of brinjal popular in India include Arka Navneet, Pusa Ankur, Hybrid-6, Pusa Hybrid-5, ARBH-1, ABH-1, Pusa Purple Long, Pusa Purple Cluster, and Ritu Raj.

Genetically engineered brinjal: Bt brinjal is a transgenic eggplant that contains a gene from the soil bacterium *Bacillus thuringiensis*. This variety was designed to give the plant resistance to lepidopteran insects such as the brinjal fruit and shoot borer (*Leucinodes orbonalis*) and fruit borer (*Helicoverpa armigera*). Bt brinjal was approved for commercial cultivation in Bangladesh in 2013 **(**WIKI, 2023**).** Brinjal (Solanum melongena), is a popularly consumed vegetable grown throughout Asia that is prone to vicious and sustained attack by the eggplant fruit and shoot borer (EFSB) (Leucinodes orbonalis) throughout the growing season. Yield losses in Bangladesh because of EFSB infestation have been reported as high as 86%. Farmers reduce crop losses by frequent applications of insecticide. To counter the EFSB pest, Bangladesh has developed and released four Bt brinjal varieties expressing Cry1Ac (Bt brinjal). Bangladesh is the first developing country to release a commercial genetically engineered (GE) food crop. In this article, we discuss the development and adoption of Bt brinjal in Bangladesh from initial distribution to 20 farmers in 2014 to cultivation by more than 27,000 farmers in 2018. Bt brinjal provides essentially complete control of EFSB, dramatically reduces insecticide sprays, provides a six fold increase in grower profit, and does not affect non-target arthropod biodiversity. A major focus is to ensure its durability through stewardship. Bangladesh has shown great leadership in adopting biotechnology for the benefit of its farmers and serves as an example for other countries (Fig. 12) (Shelton *et al*., 2019).

Bt Technology for Eggplant: After 7 years of field and greenhouse trials in various locations, Bangladesh became the first country in the world to approve the commercial planting of Bt brinjal, which started in 2014. Four varieties of Bt brinjal were approved for release on October 30, 2013 in time for the 2013-2014 growing season. The Ministries of Environment and Forests (MoEF) and Agriculture (MoA), and the Bangladesh Agricultural Research Institute (BARI) approved the following: Bt Uttara, Bt Kajla, Bt Nayantara, and Bt ISD006. On January 22, 2014, Agriculture Minister Matia Chowdhury officially distributed Bt brinjal seedlings to 20 farmers from Jamalpur, Gazipur, Pabna, and Rangpur districts. Bt brinjal was initially planted on 2 hectares during the spring season of 2014. Based on experimental data, Bt brinjal can increase yield by at least 30 % and reduce the number and cost of insecticide applications by 71-90%. In 2017, approximately 34,500 farmers planted Bt brinjal on ~2,975 hectares of land (Daunay and Chadha, 2004). Bt stands for Bacillus thuringiensis**,** a common soil bacterium that contains a gene which produces a protein harmful to FSB. Scientists have incorporated this gene to eggplant to confer insect resistance (Daunay and Chadha, 2004).

In India, Bt brinjal was developed by the Maharashtra Hybrid Seeds Company (Mahyco). Despite the conduct of field trials from 2002-2006, a moratorium was issued in October 2009, and a government ban was implemented in February 2010.12 Results of the multilocation research trials showed that Bt brinjal can reduce insecticide use by 77%. Marketable fruits may increase to 116% over conventional hybrids and 166% over popular open-pollinated varieties. Researchers have estimated that Bt brinjal will deliver farmers a net economic benefit of Rs.16, 299 (US$330) to Rs.19,744 (US$397) per acre with national benefits to India exceeding $400 million per year (Daunay and Chadha, 2004)

Status of Biotechnological Interventions: Fruits and shoot borer i.e. Leucinodes orbonalis being the most destructive pest in brinjal crop, efforts have been made to develop insect resistant brinjal varieties by incorporating cry1Ac gene in brinjal from a bacterium mainly Bacillus thuringiensis, commonly known as Bt brinjal. The Bt brinjal developed by M/s Maharashtra Hybrid Seeds Company Limited containing cry1Ac gene (Event EE1) is in the advanced stages of regulatory consideration. MAHYCO has also transferred Bt brinjal technology to public sector institutions viz. Tamil Nadu Agricultural University (TNAU), Coimbatore, University of Agricultural Sciences (UAS), Dharwad and Indian Institute of Vegetable Research (IIVR), Varanasi, who have successfully backcrossed Event EE1 into locally adopted open pollinated brinjal varieties. The technology has been also transferred to Institute of Plant Breeding of the University of Philippines, in the Philippines and Bangladesh Agricultural Research Institute and East West Seeds Limited in Bangladesh. National Research Centre on Plant Biotechnology (NRCPB), New Delhi has also developed Bt brinjal by incorporating cry1Fa1 gene into brinjal and transferred to the same to few seed companies for further biosafety studies and field evaluation. The Indian Institute of Horticultural Research (IIHR), Bangalore is also developing Bt brinjal using cry1Ab gene construct in two important brinjal varieties (GEAC, 2023).

USES

The immature fruit of eggplant is eaten when it is attractively coloured and glossy, and the seeds are still immature. When mature, the fruit flesh is fibrous and bitter, and the seeds are hard. The fruit can be eaten fresh or after rehydration of dried slices. The flesh has a fine texture and a taste close to that of mushrooms, but sometimes stronger or even quite bitter. Most often the fruits are eaten grilled, fried or steamed, or stewed with other vegetables, meat or fish, or roasted, braised in ashes and seasoned with garlic, onion, spices, sugar, oil, soybean sauce etc. The fine texture and taste go together harmoniously with various vegetables, meat, fish and spices, making it a popular vegetable in many countries. Saponins play an important role in the development of the richness of the flavour. In South-East Asia, the fruits of certain cultivars are used raw. They are also made into pickles in vinegar (Iran, Egypt) or sweet jam (Turkey, Greece), and can be preserved by air-drying, e.g. Turkish 'dolma', or by freeze-drying, canning or deep freezing. Eggplant is also widely used for medicinal purposes. Various plant parts are used in decoction, as powder or ash for curing ailments such as diabetes, cholera, bronchitis, dysuria, dysentery, otitis, toothache, skin infections, asthenia and haemorrhoids. Eggplant is also ascribed narcotic, anti-asthmatic and anti-rheumatic properties. Eggplant has magical uses in several countries. It is used as a symbol of protection, good health and female fertility (Daunay and Chadha, 2004). Brinjal fruits are commonly considered as vegetables. They are cooked in various ways such as baking, barbecuing, frying or pickling. They can also be pureed, flavoured, and used as a dip or chutney as in Mediterranean and Indian cuisines. In Indian cuisine, they are used in curries and even made into soufflés. The cut fruits are typically soaked in cold salted water before cooking to avoid discoloration and to remove its mild bitterness (Ratnala, 2004). Brinjal is grown commonly in almost all the parts of the country and liked by both poor and rich. It is a main vegetable to the plains and is available more or less throughout the year. Used primarily as cooked vegetable, brinjal is popular for the preparation of various dishes in different regions of the country. It is supposed to contain certain medicinal properties in ayurvedic medicines. It is rich in Vitamin A and B (Ikisan, 2023). In traditional Chinese medicine, all parts of the plant are used to stop intestinal bleeding. The fruit of the plant is also used as an antidote for mushroom poisoning. In Indochina, parts of the plant are used as a purgative. In traditional Malay medicine, the ashes of the fruit are used in dry, hot poultices to treat haemorrhoids. To treat ulcers, the root is pounded and applied inside the nostrils. The Amboinese take the juice of the root of a wild variety of the plant to ease a difficult labour. Arabs believe that the fruit has high "heating" properties that in turn cause melancholia and madness. For this reason, Malay and Indian women do not consume brinjal for the first 40 days after giving birth (Ratnala, 2004).

Cooking and preparing: Raw eggplant can have a bitter taste, with an astringent quality, but it becomes tender when cooked and develops a rich, complex flavor. Rinsing, draining, and salting the sliced fruit before cooking may remove the bitterness. The fruit is capable of absorbing cooking fats and sauces, which may enhance the flavor of eggplant dishes. Eggplant flesh is smooth. Its numerous seeds are small, soft and edible, along with the rest of the fruit, and do not have to be removed. Its thin skin is also edible, and so it does not have to be peeled. However, the green part at the top, the calyx, does have to be removed when preparing an eggplant for cooking. Eggplant can be steamed, stir-fried, pan fried, deep fried, barbecued, roasted, stewed, curried, or pickled. Many eggplant dishes are sauces made by mashing the cooked fruit. It can be stuffed. It is frequently, but not always, cooked with oil or fat **(**WIKI, 2023**).**

NUTRITIONAL VALUE

Eggplant fruits contain per 100 g edible portion: water 92.9 g, energy 64 kJ (15 kcal), protein 0.9 g, fat 0.4 g, carbohydrate 2.2 g, fibre 2.3 g, Ca 10 mg, P 16 mg, Fe 0.3 mg, carotene 70 µg, thiamin 0.02 mg, riboflavin 0.01 mg, niacin 0.1 mg, folate 18 µg, ascorbic acid 4 mg . Eggplant contains saponin steroids, in particular glycoalkaloids; the main eggplant glycoalkaloids are solasonine and solamargine. It also contains saponins without a nitrogenous nucleus, called melongosides. The bitter taste in eggplant is due to these substances and depends on their concentration; in high concentrations, far above the palatability threshold, they are toxic. Flavonoids isolated from eggplant fruits showed potent anti-oxidant activity. They had significant hypolipidemic action in normal and cholesterol fed rats. Delphinidin showed inhibitory effect on human fibrosarcoma HT-1080 cell invasion. The anthocyanin nasunin, isolated from the fruit peel, can protect against lipid peroxidation. (Daunay and Chadha, 2004). The food value of brinjal is tabulated in Table 3and 4. Raw eggplant is 92% water, 6% carbohydrates, 1% protein, and has negligible fat (table). It provides low amounts of essential nutrients, with only manganese having a moderate percentage (11%) of the Daily Value. Minor changes in nutrient composition occur with season, environment of cultivation (open field or greenhouse), and genotype **(**WIKI, 2023**).**

Eggplants are rich in fiber and antioxidants. A serving of eggplant can provide at least 5% of a person's daily requirement of fiber, copper, manganese, B-6, and thiamine. It also contains other vitamins and minerals. In addition, eggplants are a source of phenolic compounds that act as antioxidants. Antioxidants are molecules that help the body eliminate free radicals — unstable molecules that can damage cells if they accumulate in large amounts. Foods that contain antioxidants may help prevent a range of diseases. Among the antioxidants in eggplants are anthocyanins, including nasunin, lutein, and zeaxanthin (Medicalne, 2023). Brinjal is low in calories and fats, contains mostly water, some protein, fibre and carbohydrates. It is a good source of minerals and vitamins and is rich in total water soluble sugars, free reducing sugars, amide proteins among other nutrients. The composition per 100 g of edible portion of brinjal is given below: Calories 24.0, Sodium (mg) 3.0, Moisture content (%) 92.7, Copper (mg) 0.12, Carbohydrates (%) 4.0 , Potassium (mg) 2.0, Protein (g) 1.4 , Sulphur (mg) 44.0, Fat (g) 0.3 , Chlorine (mg) 52.0, Fiber (g) 1.3, Vitamin A (I.U.) 124.0, Oxalic acid (mg) 18.0, Folic Acid (µg) 34.0, Calcium (mg) 18.0 , Thiamine (mg) 0.04, Magnesium (mg) 15.0 , Riboflavin (mg) 0.11, Phosphorus (mg) 47.0, B-carotene (µg) 0.74, Iron (mg) 0.38, Vitamin C (mg) 12.0, Zinc (mg) 0.22, Amino Acids 0.22 (Gopalan *et al*., 2007).

HEALTH BENEFITS

The eggplant has been an ingredient in traditional medicine for thousands of years. In the ancient Indian system of ayurvedic medicine, practitioners used white eggplant to treat diabetes and the roots to relieve asthma. While eggplant isn't the most nutritious vegetable, it does give you a decent supply of potassium and fiber. Eggplant has antioxidants like vitamins A and C, which help protect your cells against damage. It's also high in natural plant chemicals called polyphenols, which may help cells do a better job of processing sugar if you have diabetes. Early lab studies in cells suggest that eggplant protects against the type of DNA damage that leads to cancer. But researchers still need to confirm this benefit in humans (Watson, 2023).

According to Medicalne (2023) the health benefits of brinjal are as given below:

- The fiber, potassium, vitamin C, vitamin B-6, and antioxidants in eggplants all support heart health.
- .Eggplant contains fiber, and this may benefit cholesterol levelsTrusted Source. A cup of cooked eggplant cubes, weighing 96 grams (g), contains around 2.4 g of fiberTrusted Source.
- Chlorogenic acid, a primary antioxidant in eggplants, may decrease levels of low density lipoprotein, or "bad," cholesterol and reduce the risk of nonalcoholic fatty liver disease.
- The polyphenols in eggplant may help protect the body from cancer. Anthocyanins and chlorogenic acid protect cells from damage caused by free radicals. In the long term, this may help prevent tumor growth and the spread of cancer cells.
- Anthocyanins may help achieveTrusted Source this by preventing new blood vessels from forming in the tumor, reducing

inflammation, and blocking the enzymes that help cancer cells spread.

- Nasunin, an anthocyanin in eggplant skin, may help protect brain cell membranes from damage caused by free radicals. Nasunin also helps transport nutrients into cells and move waste out.
- Anthocyanins also help prevent neuroinflammation and facilitate blood flow to the brain. This could help prevent memory loss and other aspects of age-related mental decline.
- Dietary fiber can help people manage their weight. A person who follows a high-fiber diet is less likely to overeat, as fiber can help a person feel fuller for longer.
- Eggplants contain fiber and are low in calories — they can contribute to a healthful, low-calorie diet.
- Eggplant also contains the antioxidants lutein and zeaxanthin. Lutein appears to play a roleTrusted Source in eye health, and it may help prevent age-related macular degeneration, which can lead to vision loss in older people.

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