CHAPTER 3

PLANT PROFILE
3.1. MUSTARD SEEDS PLANTS

3.1.1. BRASSICA NIGRA

**Botanical name:** *Brassica nigra* (L.) W.D.J. Koch

**Family name:** Brassicaceae

**Synonym:** Sinapis nigra, Sisymbrium nigrum, Brassica brachycarpa, Brassica sinapioides.⁷⁰

**Common names:**
- Sanskrit - Rajakshavak
- English - Black Mustard
- Marathi - Kali Mohari
- Hindi - Aslrai
- Tamil - Kadugu
- Telugu - Avalu
- Malayalam - Kaduku
- Kannada - Sasive
- Bengali - Shorshe
- Konkani - Saasma
- Oriya - Sorisa
- Urdu, Punjabi - Raj
- Tulu - Saaseme

**Taxonomic Hierarchy**
- **Kingdom:** Plantae – Plants
- **Subkingdom:** Tracheobionta – Vascular plants
- **Superdivision:** Spermatophyta – Seed plants
- **Division:** Magnoliophyta – Flowering plants
- **Class:** Magnoliopsida – Dicotyledons
- **Subclass:** Dilleniidae
- **Order:** Capparales
- **Family:** Brassicaceae – Mustard family
- **Genus:** Brassica L. – mustard
- **Species:** Brassica nigra (L.) W.D.J. Koch – black mustard (⁸⁰, ⁸¹)
Plant Profile

Cultivation

*Brassica nigra* is adaptable to a temperate and subtropical climatic regime with an annual temperature range of 6–27°C. It tolerates annual rainfall of 300–1,700 mm and is grown as a rainfed crop in areas of low or moderate rainfall. It is adaptable to a wide range of soils with pH 4.9–8.2. It thrives best on light sandy loams with pH 5–8 or deep rich fertile soils. It abhors heavy clay soils.

Habitat and Distribution

Europe, North Africa, South West Asia, India

Distribution in India: Kerala, Maharashtra, Karnataka 81,82

Description

*Brassica nigra* is an erect, branched, aromatic, fast-growing, sparsely pubescent annual herb, 0.3–2 (–3) m tall, sparsely pubescent basally and with taproot.

**Leaves:** The alternate leaves are up to 10" long and 3" across, becoming smaller as they ascend the stems. Lower leaves are deeply pinnatifid or pinnatisect, 6-25 cm long, 3-12 cm broad, 1-3-jugate with a large ovate terminal lobe and much smaller ovate-oblong lateral lobes, sinuate dentate, stalked; upper leaves becoming much smaller, narrowly elliptic or lanceolate, short stalked. The lower surface of leaves is usually glabrous, except for a few hairs along the central vein. The upper leaves are often lanceolate, broadly elliptic, or some other odd shape; they have 1-2 lobes or none. The stems are usually glabrous and glaucous; sometimes they have scattered stiff hairs toward the base.

**Flowers:** The upper stems terminate in narrow racemes of yellow flowers; these racemes are 0.5–2.0' long when fully mature. Each flower is 5.0-8.0 mm across, consisting of 4 yellow petals, 4 sepals, several stamens, and a pistil. The sepals are initially green, but become yellow while the flower blooms. The petals are 7.0-9.0 mm long, 3.0-4.0 mm broad, obovate, clawed, pedicel 2.0-3.0 mm long, about as long as the sepals in fruit otherwise shorter, appressed to the axis, not thickened. Sepals 3.0-5.0 mm long, 1.0-1.2 mm broad, oblong, obtuse, yellowish, glabrous stamens 4.0-5.0 mm. long; anthers 1.0 mm long.

**Fruit and seeds:** It has four sided siliquous fruit with very short stalk. Fruit is 10-20 mm long, 1.5-2.0 mm broad, including 1.5-3.0 mm long beak (with 1.0 mm long style and capitate stigma), oblong, subquadrangular; valve with a strong mid-vein, glabrous, subtorulous; septum not veined, membranous. The seeds within the fruit are dark brown or blackish, globose, 1.0-1.3 mm in diameter, minutely reticulate. After the maturity of the
plant, the aerial part is cut out and partially dried. The partially dried herb is beaten to collect the seeds. These are thoroughly dried in air.

Roots: The root system consists of a taproot. This plant spreads by reseeding itself.

Description of Seeds

1. Macroscopic Characters of seeds
   Colour: Black or dark brown
   Odour: None, crushed seeds have pungent odour
   Taste: Bitter
   Size: About 1 mm in diameter
   Shape: Nearly spherical
   The seeds are covered with a brittle testa. The kernel is greenish-yellow and cily. It has two cotyledons and embryo.

2. Microscopic characters of seeds
   The seed coat also known as testa, consist of two layers, outer layer being well developed, while the inner layer consist of collapsed cells. Epidermis is made up of polygonal tubular cells containing mucilage. Hypodermis consists of large polygonal cells. The endospermic cells contain aleurone grains and fixed oil. Embryo also contains fixed oil and aleurone grains in its polyhedral cells.

Chemical constituents

Leaves: Sinigrin, flavonol glycosides of kaempferol, quercetin and isorhamnetin.
Seeds: It contains about 30 % fixed oil, 20 % protein and 0.7-1.3 % volatile oil, 4 % sinigrin (Potassium myronate) and the enzyme myrosinase. In presence of water, this enzyme hydrolyzed sinigrin into allyl isothiocynate.

Edible plant parts and uses

Young Brassica nigra plants and leaves may be eaten as a salad or cooked green. The seeds are used primarily as a spice and condiment.\(^{81,82}\)

Medicinal properties

The seeds of Brassica nigra have anodyne, antidote, antiedemic, anti-inflammatory, antiscorbutic, carminative, cordial, diuretic, emetic, febrifuge, gastrotonic, insectifuge, memorigenic, pancreatonic, rubefacient, stimulant, stomachic abortifacient and antifertility.
Traditional uses

*Brassica nigra* seeds are often used as a rubefacient poultice in herbal medicine. The seed are eaten as a tonic and appetite stimulant. Traditionally they are used for abscess, adenopathy, ague, ameba, amenorrhea, angina, anorexia, apoplexy, arthosis, asthma, bloat, boil, bronchosis, cancer, chest cold and cough congestion, cramp, depression, dermatosis, dropsy, dysentry, dysmenorrhea, dyspepsia, ectoparasite, edema, enterosis, epilepsy, fever, fibroid, fibroma, gastrosis, glaucoma, headache, inflammation, nervousness, neuralgia, ophthalmia, otosis, pain, pharyngosis, phthisis, pleurisy, pneumonia, pulmonosis, respirosis, rheumatism, rhinosis, sciatica, sclorsis, sinusosis, splenosis, spine, stomacache, sore throat, stroke, syncope, tuberculosis, tumour, typhus, uterosis and worm infection. Decoction of the seeds is used in the treatment of indurations of the liver and spleen, to treat carcinoma, throat tumours, and imposthumes. Leaves are used for treating alopecia, epilepsy, snakebite, and toothache.\(^79,83\)

### 3.1.2. *BRASSICA JUNCEA*

**Botanical name:** *Brassica juncea* (L.) Czern.

**Family name:** Brassicaceae

**Synonym:** *Brassica japonica, Sinapis juncea, Brassica juncea japonica*

**Common names:**
- Sanskrit - Rajakshavak
- English - Brown Mustard
- Marathi - Mohari
- Hindi - Aslrai
- Tamil - Kadugu
- Telugu - Avalu
- Malayalam - Kaduku
- Kannada - Saasive
- Bengali - Shorshe
- Konkani - Saasma
- Oriya - Sorisa
- Urdu, Punjabi - Raj
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**Taxonomic Hierarchy**

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- **Superdivision**: Spermatophyta – Seed plants
- **Division**: Magnoliophyta – Flowering plants
- **Class**: Magnoliopsida – Dicotyledons
- **Subclass**: Dilleniidae
- **Order**: Capparales
- **Family**: Brassicaceae – Mustard family
- **Genus**: Brassica L. – mustard
- **Species**: *Brassica juncea* (L.) Czern. – India mustard

**Cultivation**

This plant often occurs in light (sandy), medium (loamy) and heavy (clay) soils and refers well-drained soil. It prefers moist soil. Suitable pH: acid, neutral and basic (alkaline) soils and can grow in very acid and very alkaline soils. It can grow in semi-shade or no shade.

**Habitat and Distribution**

Egypt and eastward to China, northwest provinces and Oudh, South of Russia and in the steppes northeast of the Caspian, Sarepta, saratoo and central Africa, India, Central and East Asia and Europe.

**Distribution in India**: Kerala, Punjab, West Bengal, Uttar Pradesh and Gujarat

**Description**

It is an annual erect herbs upto 1.0 m or more tall, densely long-branched especially above, glabrous and subglaucous.

**Leaves**: Alternate, lower and basal petiolate with lamina up to 20.0 x 10.0 cm, irregularly dentate, with 1-3 pairs of lateral lobes, not auriculate; upper 5.0-10.0 x 1.5-3.0 cm, petiolate to subpetiolate, lanceolate or oblanceolate and acute, to obovate and obtuse, coarsely dentate to subentire, not auriculate.

**Fruits and seeds**: Inflorescence is 15.0-30.0 cm long in fruit; pedicels 5.0-12.0 mm long, ascending. Sepals are 3.5-4.0 mm long, oblong. Petals are bright yellow, 4.5-8.0(-10) mm long, clawed with obovate limb. Anthers are 1.5-2.0 mm broad with conical beak 5.0-7.0 mm long, mid vein prominently keeled and seeds are 12-20 in number.
Macroscopic Characters of seeds
Colour: Dark reddish-brown
Odour: None, crushed seeds have pungent odour
Taste: Bitter
Size: About 2 mm in diameter
Shape: Nearly spherical
The seeds are covered with a brittle testa. The kernel is greenish-yellow and cily. It has two cotyledons and embryo.

Microscopic Characters
The seed coat, also known as testa, consists of two layers, outer layer being well developed, while the inner layer consists of collapsed cells. Epidermis is made up of polygonal tubular cells containing mucilage. Hypodermis consists of large polygonal cells. The endospermic cells contain aleurone grains and fixed oil. Embryo also contains fixed oil and aleurone grains in its polyhedral cells.

Chemical constituents
*Brassica juncea* contains the glucosinolate sinigrin (potassium myronate) and the enzyme myrosin (myrosinase); sinapic acid (3,5-dimethoxy-4-hydroxycinnamic acid); sinapine (sinapic acid choline ester); fixed oils (25–37 %), consisting mainly of glycerides of erucic, eicosenoic, arachidic, nonadecanoic, behenic, oleic, and palmitic acids, among others; proteins; and mucilage. Apart from the seeds, the flavonoid glycosides isorhamnetin 7-O- and 3,7-di-O-glucoside and kaempferol 7-O-triglucoside are present in the leaves.\(^{79,85}\)

Medicinal properties
*Brassica juncea* seeds have anodyne, antibiotic, aperient, diuretic, emetic, galactogogue, rubefacient and stimulant properties.

Traditional use
The plant is a folk remedy for arthritis, foot ache, lumbago, and rheumatism. The seeds are used in the treatment of stomachic, stimulant and anthelmintic, alleviates catarrh and rheumatic affections, in enlargement of liver, spleen and internal abscesses, tumors, externally applied in inflammation and skin diseases. Seeds are also found to be effective in internal congestion, spasmodic, neuralgic and rheumatic affections. The root is used as a galactagogue. Ingestion may impart a body odor repellent to mosquitoes. Seed oil is used
in the treatment of skin eruptions and ulcers. Believed to be aperient and tonic, the volatile oil is used as a counterirritant and stimulant. In Java the plant is used as an antisyphilitic emmenagogue. Leaves applied to the forehead are said to relieve headache. The Chinese eat the leaves in soups for bladder, inflammation or haemorrhage. Dried leaves and flowers are used as body odor repellent to mosquitoes, dengue fever.\textsuperscript{85,86}

3.2. **PUNICA GRANATUM**

**Botanical name:** *Punica granatum* L.

**Family name:** Lythraceae

**Synonym:** *Granatum punicum, Punica florida, Punica spinosa*

**Common names:**
- Sanskrit - Dadima
- English - Pomergranate
- Marathi - Dalimba
- Hindi - Anar, Anar-ke-per
- Telugu - Dadimbakaya, Dadimma
- Malyalam - Mathalam
- Kannada - Dalimba, Dalimbe haonu
- Bengali - Dadima, Dalim, Dalimgach
- Konkani - Dalimb
- Oriya - Dalimba
- Urdu, Punjabi - Anar
- Gujarati - Dadam, Dadam phala\textsuperscript{79}

**Taxonomic Hierarchy**

- **Kingdom** : Plantae-Plants
- **Subkingdom** : Tracheobionta-Vascular plants
- **Superdivision** : Spermatophyta- Seed plants
- **Division** : Magnoliophyta- Flowering plants
- **Class** : Magnoliopsida- Dicotyledons
- **Subclass** : Rosidae
- **Order** : Myrtales
Family : Lythraceae - Loosestrife family
Genus : Punica L. - Pomegranate
Species : Punica granatum L. – Pomegranate

Cultivation
It is primarily grown in mild temperature to sub-tropical and naturally adapted to regions with cool winters and hot summers, but can also be grown in warm tropical areas. Areas with mean annual temperature 20-24° C is ideal. The plant thrives in semi-arid condition with mean annual rainfall of 500 to 1000 mm and is extremely drought-tolerant. It is cultivated upto altitudes of 2000 m. It thrives on calcareous soil, alkaline soil, gravelly soil and on deep, acidic loams.

Habitat
Egypt, China, Afghanistan, Turkey, Syria, Pakistan, Bangladesh, Iran, Iraq, India, Myanmar and Saudi Arabia.
Distribution in India: Himachal Pradesh, Rajasthan, Gujarat, Nagaland, Orissa, Maharashtra, Karnataka, Andhra Pradesh, Tamil Nadu and Chhattisgarh

Description
A deciduous, branched, small tree or shrub 1.5-6 m high with a smooth, dark grey bark. Branches are terete, opposite and branchlets usually ending in spines.
Leaves: The leaves are evergreen, opposite, glabrous, coriaceous, glossy green, entire, simple oblong-lanceolate to obovate or elliptic, subpetiolate, apex sub-acute to obtuse.
Flowers: They are large, showy, scarlet red, or white, bisexual, upto 4 cm across, solitary or clusters at the shoot apex. Calyx is campanulate, reddish or purplish with six triangular, persistent, lobes, petals 6, broadly obovate, wrinkled, alternating with the sepal lobes, stamens numerous, multiseriate, persistent, inserted on floer tube, subglobose ovary, inferior with three cells in two-series, style one thick, reddish, stigma simple slightly simple, slightly bilobed. Fruit globose to subglobose, 6-8 in diameter, pale red to scarlet to purple brownish
Fruit: Fruit is 6.25-12.5 cm wide, has a tough, leathery skin or rind, basically yellow more or less overlaid with light or deep pink or rich red. The interior is separated by membranous walls and white spongy tissue into compartments packed with transparent sacs filled with tart, flavorful, fleshy, juicy, red, pink or whitish pulp (the aril). In each sac,
there is one white or red, angular, soft or hard seed. The seeds represent about 52% of the weight of the whole fruit.

**Macroscopic Characters of fruit peel**

*Colour*: Brown to reddish-brown externally and brownish-yellow internally

*Odour*: Distinct

*Taste*: Astringent

*Size*: 0.1 to 0.5 cm thick

*Shape*: More or less concave, salver shaped pieces, some pieces showing residual carpel walls and some having persistent toothed calyx tube along with withered stamens, styles and a few seeds; coriaceous, tough and nearly smooth; bearing impressions left by seeds.

*Fracture*: Short

**Microscopic Characters of fruit peel**

Epicarp single layered covered with thick cuticle; mesocarp consists of a wide zone of oval to polygonal thin walled parenchymatous cells; a few fibro-vascular bundles, tanniniferous vessels, secretory canals, oil globules, single and a number of groups of round or oval to elongated stone cells, simple and compound starch grains having 2 or 3 components with concentric striations and central hilum, and rosette crystals of calcium oxalate present in mesocarp.

*Seeds*: The seed kernel is greenish-yellow and cily. It has two cotyledons and embryo. It is covered with a brittle testa.\(^{90,92}\)

**Edible parts and Uses**

The fruit is relished fresh and consumed as juice. The juice can also be processed into a concentrate, syrup, jellies, jam and sauces. Dried pomegranate seeds, ‘anardana’, has culinary importance as spice.\(^{88}\)

**Chemical constituents**

*In Fruit*: It is rich in polyphenols that include flavonoids, tannins and hydrolysable tannins. *Punica granatum* fruit was reported to contain ellagic acid, gallic acid, punicalins and punicalagin, caffeic acid, luteolin and punicic acid; pelargonidin-3-galactose, cyanidin-3-glucose, gallic acid, quercetin, and myricetin, methyl gallate, catechin, isoquercitrin, D-mannitol, ursolic acid, oleanolic acid, β-sitosterol and daucosterol. The fruit was found to contain the lignans such as isolariciresinol, medioresinol, matairesinol, pinoresinol, secoisolariciresinol and syringaresinol. Anthocyanin pigments delphinidin 3-glucoside,
delphinidin 3,5-diglucoside, cyanidin 3-glucoside, cyanidin 3,5-diglucoside, pelargonidin 3-glucoside and pelargonidin 3,5-diglucoside were found to be responsible for the red colour of pomegranate juice. Fruit also contain estrogens.

**In Fruit peel:** *Punica granatum* fruit peel (PGFP) has been reported to be a rich source of hydrolyzable tannins called ellagitannins (ETs). The major fruit peel ETs were punicalagin (80–85 % w/w) and ellagic acid and unquantified amounts of punicalin and ellagitannin-glycosides (hexoside, rhamnoside and pentoside). Prodelphinidins and gallocatechins including gallocatechin, gallocatechin-(4–8)-catechin, gallocatechin-(4–8)-gallocatechin and catechin-(4–8)-gallocatechin were identified from pomegranate peels. Among the flavonoids, luteolin and luteolin 7-O-glucoside, naringenin 7-O-rutinoside, catechin, epicatechin and epigallocatechin 3-gallate, and quercetin, kaempferol, rutin, kaempferol 3-O-glucoside and kaempferol 3-O-rhamnoglycoside (flavonols), were identified in the fruit peel. Antifungal peptide designated as pomegranin was isolated from fresh pomegranate peels. Polysaccharide was isolated from pomegranate rind. Anthocyanins (delphinidin 3,5-diglucoside, delphinidin 3-glucoside, cyanidin 3-glucoside, cyanidin-pentoside-hexoside, cyaniding 3-rutinoside,cyaniding 3-pentoside, cyanidin 3-hexoside, cyanidin 3,5-diglucoside, pelargonidin 3-glucoside, pelargonidin 3,5-diglucoside) are also present in peels.

**In Seeds:** *Punica granatum* seed oil contains 8 % saturated fatty acids, 10 % monounsaturated, 10 % diunsaturated and approximately 70 % conjugated acid. The fatty acids present are punicic acid, linolenic acid, followed by linoleic acid, oleic acid, palmitic acid, stearic acid, gadoleic acid, lignoceric acid, arachidic acid and myristic acid. Seeds were found to have tocopherol, ursolic acid and β-sitosterol and estrogens.

**Medicinal properties of Punica granatum fruit and its peels**

*Punica granatum* fruit and its peels had numerous medicinal properties such as abortifacient, amebicide, alpha-amylase inhibitor, analgesic, anti-atherogenic, antibacterial, antifertility, antiherpetic, antioxidant, antipyretic antiseptic, antitubercular, antiviral, aphrodisiac, astringent, cardiotonic, ns-stimulant, collyrium, cytotoxic, diuretic, emmenagogue, fungicide, hemolytic, hemostat, hypcholesterolemic, hypoglycemic, lipogenic, molluscidic, nematicide, orexigenic, parasiticide, stimulant, stomachic, taenicide, uterotonic, vermifuge.86,91,92
Traditional use of *Punica granatum* fruit and its peels

*Punica granatum* fruit was commonly used in folk medicine for treatment of acne, ameba, amygdalosis, anorexia, asthma, atherosclerosis, biliousness, bleeding, bronchosis, burn, cardiopathy, cholera, colic, colitis, diarrhea, dysentery, dysmenorrhea, dyspepsia, enterosis, gastrosis, heartburn, hemorrhoid, hepatosis, high cholesterol; hyperglycemia; bacterial, fungal and parasitic infection, infertility; inflammation, jaundice, keratosis, malaria, pain, paralysis, stomachache and stomatosis.\textsuperscript{91,92}