Research Article

Cumin: The Flavour of Indian Cuisines-History, Cultivation and Uses

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Abstract
Cumin commonly known as "Zeera" is an important spice used for flavouring various food preparations. It has a warm aroma due to its essential oil content. Its main constituent aroma compounds are cuminaldehyde (a promising agent against alpha-synuclein aggregation) and cuminic alcohol. Though Zeera is used worldwide, but its production is mainly concentrated in India, Syria, Iran and Turkey. The spice has several production constraints responsible for its low yield. However by adopting the scientific package of practices, the yield can be considerably increased. In this paper, we reviewed the history, production technology, aroma profile and uses of zeera for advancement of knowledge regarding this valuable spice crop.

Keywords: Zeera, History, Cultivation, Uses

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Introduction

Cumin (*Cuminum cyminum*), commonly known as 'Jeera' or 'Zeera' is an important spice used in Indian kitchens for flavouring various food preparations. It is the second most popular spice in the world after black pepper. It is very pungent and aromatic, and is used whole and/or ground. Though Cumin is a native of Egypt, it is mostly produced in India. India is the largest producer of cumin in the world. Apart from India it is also grown in North Africa, China and America. Cumin's aromatic, nutty-flavoured seeds come in three colours: amber (the most widely available), white and black (both found in Asian markets). White cumin seed is interchangeable with amber, but the black seed has a more complex, peppery flavour. Cumin is one of the main ingredients in curry powders, and the combination of cumin and coriander leaves gives a characteristic smell to most Indian food. India produces 70% of the world supply and consumes 90% of that (which means that India consumes 63% of the world's cumin). Other producers are Syria (7%), Iran (6%), and Turkey (6%). The remaining 11% comes from other countries. In total, around 300,000 tons of cumin per year is produced worldwide. In 2007, India produced around 175,000 tons of cumin on an area of about 410,000 ha i.e. the average yield was 0.43 tons per hectare.

USA, European Union, Middle East, South East Asia are the major export markets for Indian Cumin Seed. In the international market, Nepal and Sri Lanka are the major importer preferring Cumin Seed of 95%-96% purity, whereas the European market has a strong preference for 100% purity for machine clean stocks. The main competitors in the international market are Turkey and Iran offering at cheaper rate. Though India is the largest producer of cumin seed, the country consumes most part of its produce and the rest is exported. Its produce commands premium prices in the global markets due to its quality and flavour. The cumin prices are also sensitive to the international demand and supply. Thus the production in the other countries like Turkey and Syria affects the export prices and volume of Zeera. The crop in Syria and Turkey is harvested during August- September so the Indian produce, which is harvested during February to April, gets enough time to find good market in overseas countries. India exports cumin seed to Bangladesh, Japan, Malaysia, Nepal, Pakistan, Singapore, South Africa, UAE, UK, USA and many other countries and cumin seed powder to Canada, UK, USA, etc. India also exports oleoresins of cumin seed and cumin seed oil to USA, UK, Germany, etc. Nepal was the largest importer of cumin seed from India in 2003 with 28.87% share of total exports, followed by USA (14.44%), UK (11.35%), Malaysia (9.76%), Singapore (6.51%) and Japan (6.24%).

In India, cumin seed is almost exclusively cultivated in Rajasthan and Gujarat. It grows abundantly in the mild, equable climate of Gujarat and Rajasthan where rich, well drained, sandy, loamy soil and the sunny conducive environment are available. Thus Gujarat and Rajasthan are the two main production centres in India. They contribute

more than 90% of total cumin production in the country. Rajasthan is the largest producer of cumin seeds contributing about 50-55% of the total production of India. Gujarat is the second largest producer of cumin seeds. As per some of the traders view, both the states produce almost equally. Due to cash payment, weight of commodity in front of farmers, lower market cess, high prices, availability of processors, exporters and brokers and better infrastructure facilities, a fairly large amount of Cumin arrives in Gujarat mandis for trading purpose. In Gujarat, Banaskantha, Sabarkantha, Mehsana, Patan, Surendranagar and Rajkot are the major districts producing cumin seed, whereas in Rajasthan Badmer, Jalore, Nagaur, Pali, and Jodhpur are the main producing districts. As per the trade, the annual demand for the Zeera is about 2000000 bags i.e. about 110000 tonnes. As India is the largest consumer of cumin seeds in the world, the remaining stock after consumption is meant for the export purposes. Zeera is an environmental sensitive crop. Various factors such as temperature, weather, irrigation facilities, clear sky etc affect the development of crop. Productivity is mainly dependent on the climatic conditions prevailing during particular season. Thus its production largely depends upon the climatic conditions and fluctuates largely depending on the same.

Botany

It is a flowering plant in the family Apiaceae, native from the east Mediterranean to South Asia. Cumin is the dried seed of the herb Cuminum cyminum, a member of the parsley family. The cumin plant grows to 30–50 cm tall and is harvested by hand. It is an annual herbaceous plant, with a slender, glabrous, branched stem that is 20–30 cm tall and has a diameter of 3–5 cm. Each branch has two to three sub-branches. All the branches attain the same height; therefore the plant has a uniform canopy. The stem is coloured grey or dark green. The leaves are 5–10 cm long, pinnate or bipinnate, with thread-like leaflets, divided into long, narrow segments like Fennel, but much smaller and are of deep green colour, generally turned back at the ends. The upper leaves are nearly stalking less, but the lower ones have longer leaf stalks. The flowers are small, white or pink, and borne in umbels. Each umbel has five to seven umbellts. Anthesis starts from outer umbelets and proceeds towards inwards. Anther dehiscence starts at 6-8 a.m.in the morning and continues till 2.00 p.m. Like other umbellifeorous plants, protoandrous condition is found in the crop. The flowers remain surrounded with stamens and experience self pollination. The fruit is a lateral fusiform or ovoid achene 4–5 mm long, containing two mericarps with a single seed. The seeds are elongated, approximately 6 mm long and light yellowish brown in colour. It has characteristic strong and heavy favour and is slightly bitter and somewhat disagreeable. On the external surface of the seeds, fine ridges are found, in between which four ridges are found. Along with these ridges, capillaries run parallel which serves as a strong organ of volatile oil in the seeds. The crop is diploid and 2n =14.

Origin and distribution

Cumin has been in use since ancient times. Seeds excavated at the Syrian site Tell ed-Der have been dated to the second millennium BC. They have also been reported from several New Kingdom levels of ancient Egyptian archaeological sites. In the ancient Egyptian civilization, cumin was used as spice and as preservative in mummification. Cumin is believed to be a native of Egypt and Syria, Turkistan and eastern Mediterranean region. It is extensively cultivated in Iran, India, Syria, Turkey, Morocco, China, Southern Russia, Indonesia and Japan. Iran being major exporter of cumin seed is the India's major competitor in foreign trade.

I II III

Figure 1 Botany of Cumin (I) Plant (II) Seed (III) Spice

Production Constraints

- Lack of suitable variety adapted to wide range of soil and climatic condition.
- Inherent poor production capacity.
- Shallow root system.
- Highly sensitive to soil and climate.
- Small seeds with low viability and vitality
- Unsolved chronic maladies of wilt and blight.

Breeding constraints

Cumin is a diploid species with 14 chromosomes (i.e. 2n = 14). The chromosomes of the different varieties have morphological similarities with no distinct variation in length and volume. Most of the varieties available today are selections. The variability in yield and yield components is high. Varieties are developed by sib mating in enclosed chambers or by biotechnology. Cumin is a cross-pollinator, i.e. the breeds are already hybrids. Therefore, methods used for breeding are in vitro regenerations, DNA technologies, and gene transfers. The in vitro cultivation of cumin allows the production of genetically identical plants. The main sources for the explants used in vitro regenerations are embryos, hypocotyls, shoot internodes, leaves and cotyledons. One goal of cumin breeding is to improve its resistance to biotic (fungal diseases) and abiotic (cold, drought, salinity) stresses. The potential genetic variability for conventional breeding of cumin is limited and research about cumin genetics is scarce.

Zeera cultivation

Climate and soil

Cumin is a drought-tolerant, tropical, or subtropical crop. It has a growth season of 100–120 days. The seeds can emerge at 2 to 5 °C, an optimum of 20–30 °C is required. Cumin is vulnerable to frost damage, especially at flowering and early seed formation stages. The optimum growth temperature ranges are between 25 and 30° C. The Mediterranean climate is most suitable for its growth. Cultivation of cumin requires a long, hot summer of three to four months. At low temperatures, leaf colour changes from green to purple. High temperature might reduce growth period and induce early ripening. High humidity during flowering and fruiting period initiate the development of diseases like blight and powdery mildew causing damage to the crop. It is grown as an irrigated crop during winter in Indian condition.

It can be successfully cultivated on well drained medium to heavy textured soil of average to high fertility. However, fertile, sandy or loamy soils with good aeration, proper drainage and high oxygen availability are preferred. The pH optimum of the soil ranges from 6.8 to 8.3.

Varieties developed

The improved varieties of cumin as described in **Table 1** give an average yield of 515-650 kg ha^{-1}.

Sowing

Cumin seedlings are sensitive to salinity and emergence from heavy soils is rather difficult. Therefore, a proper seedbed preparation (smooth bed) is crucial for optimal establishment of cumin [1]. To bring the soil to fine tilth, 3-4 ploughings followed by planking is required. The continuous cropping of cumin in the same field is not desirable because of the problem of soil borne diseases particularly wilt.

In India, cumin is sown from October until the beginning of December, and harvesting starts in February. The proper time for sowing is from mid November to first week of December. In Syria and Iran, cumin is sown from mid-November until mid-December [2] (extensions up to mid-January are possible) and harvested in June/July [3, 4].

A seed rate of 12-15 kg ha^{-1} is considered sufficient[8]. Two sowing methods are used for cumin, broadcasting and line sowing. For broadcasting, the field is divided into beds and the seeds are uniformly broadcast in these bed. Afterwards, they are covered with soil using a rake [5, 6]. For line sowing, shallow furrows are prepared with hooks at a distance of 20 to 25 cm. The seeds are then placed in these furrows and covered with soil. Line sowing offers advantages for intercultural operations such as weeding, hoeing, or spraying. The recommended sowing depth is 1–2 cm [7] and the recommended sowing density is around 120 plants per square metre. In case of tubers, 200 tubers per square meter with row spacing of 25 cm has been found to give the highest yield. The optimum depth of sowing of tubers has been found to be 12.5 cm [8].

Table 1 Yield and salient features of cumin varieties developed in India

S. No.	Variety	Dry seed yield (kg ha^{-1})	Essential oil (%)	Salient features
1	Mc. 43	580	2.7	Plant semi spreading, grains bold lustering withstand lodging and shattering, moderately tolerant resistant to *Fusarium* wilt, *Alternaria* blight & powdery mildew.
2	Guj. Cumin-1	550	3.6	Plants bushy and spreading, grains bold , linear oblong, withstands shattering and lodging, moderately tolerant to wilt, powdery mildew and blight.
3	RZ-19	560	-	Erect plant, pink flowers, bold, lustrous grain, gray pubescent, tolerant to wilt and blight suitable for late sowing season.
4	Guj. Cumin-2	620	4.0	Bushy plant, good branching habit, grains bold, medium sized, lustrous grain, tolerant to wilt and blight suitable for late sowing season
5	Guj. Cumin-3	620	4.4	Bushy dwarf plant, fruit medium sized, frost wilt resistant variety suitable for winter season in limited irrigation. Higher essential oil content, seed pungent with good aroma
7	RZ-209	650	-	A variety shows some resistance with blight and wilt disease
8	RZ-223	600	3-3.5	Wider adaptability, resistant to wilt, superior in yield and seed quality over RZ-19. Plants bushy, semi-erect, long bold attractive seeds, medium duration.
9	Ac-01-167	515	3.0	Bold seeds resistant to wilt.

Irrigation

Light irrigation should be given immediately after sowing followed by irrigation after 8-10 days. Germination will starts only after second irrigation. The first irrigation should not be heavy; otherwise it results in uneven distribution of plants. However if the day temperature is high with dry spell, a third irrigation may be given after 4-5 days to allow completion of germination. There after the crop should be irrigated at an interval of 20-30 days depending upon the weather condition and soil type. It has been found was found that the effect of irrigation is more pronounced at the time of pollination to seed filling [9]. The last irrigation at the time of seed formation should be slightly heavy which will supplement moisture requirement during the crop maturity stage. Irrigation during crop maturity stage should be avoided. The total water requirement of cumin is equal to 335 mm [10].

Manures and Fertilizers

Nutrients are important components of crop growth and development. Since dry matter production in cumin as compared to other crops such as wheat is much lower (two tons ha^{-1}), nutrient requirement for this crop is proportionally lower. However, nutrient requirement should be met by application of proper amounts of fertilizers. Application of FYM @ 15-20 t ha^{-1} should be applied as basal dressing during the land preparation. Afterwards, fertilizer dose of 30 kg N and 20 kg P_2O_5 ha^{-1} is recommended [11, 12]. Nitrogen is applied either as a single dose 30 days after sowing (DAS) or in two equal splits at 30 and 60 DAS [13].

Weeding

The open canopy of cumin allows only low proportion of the incoming light to be absorbed, resulting in a low leaf area index of about 1.5. This might be a problem that weeds compete with cumin for essential resources such as water and light and thereby lower yield. Besides this, the slow growth and a short stature of cumin favours weed competition. To facilitate proper growth of crop, the first weeding and hoeing should be done 30-40 days after sowing when the plant attain a height of 4-5 cm. The plants are thinned to 10-15 cm distance in the rows. Another 1-2 hoeing and weeding help in better crop growth if weeds appear again and crust formation takes place or the soil become hard. Zeeri (*Plantago pumile*) is an important weed in cumin fields having morphological similarity with cumin plant. As the weed is distinguishable only at the flowering stage, hand weeding is done only to avoid contamination of seeds. The weeds can be controlled by adopting soil solarization during summer at the time of field preparation and stale

seed bed technique. The use of preplant or pre-emergence herbicides is very effective, but this kind of herbicide application requires soil moisture for a successful weed control. Application of pre-emergent Terbutryn or Oxadiazone @ 0.5–1.0 kg ha^{-1} or pre-plant Fluchloralin or pre-emergent Penimethalin @ 1.0 kg ha^{-1} provides good control. For early post emergence weed control, oxadiargyl 6 % EC @ 62.5-75 ml ha^{-1} in 500 l of water at 15-20 days is recommended to control *Cyperus iria, Cyperus difformis, Eclipta alba, Ludwigia quadrifoliata, Chenopodium album, Rumex sp, Melilotus indica and Asphodelus tenuifolius.*

Pest management

The relative humidity in the centre of origin of cumin is rather low. High relative humidity (i.e. wet years) favours fungal diseases. Cumin is especially sensitive to Alternaria blight and Fusarium wilt. Early-sown crops exhibit stronger disease effects than late sown crops. The most important disease is Fusarium wilt, resulting in yield losses up to 80%. Fusarium is seed or soil borne and it requires distinct soil temperatures for development of epidemics. Inadequate fertilization might favour Fusarium epidemics. Cumin blight (Alternaria) appears in the form of dark brown spots on leaves and stems. When the weather is cloudy after flowering, the incidence of the disease is increased. Another, but less important, disease is powdery mildew. Incidence of powdery mildew in early development can cause drastic yield losses because no seeds are formed. Later in development, powdery mildew causes discoloured, small seeds. The diseases can be controlled by seed treatment with Captan or Thiram @ 2 g/kg seed and spraying the crop twice with mancozeb or Zineb @ 300 g/100 l of water

Cumin can be attacked by aphids (*Myzus persicae*) at the flowering stage. They suck the sap of the plant from tender parts and flowers. The plant becomes yellow, the seed formation is reduced (yield reduction), and the quality of the harvested product decreases. Heavily infested plant parts should be removed. Aphids can be controlled by spray of monocrotophos or Rogor @ 1 ml/l of water. Other important pests are the mites (*Petrobia latens*) which frequently attack the crop. Since the mites mostly feed on young leaves, the infestation is more severe on young inflorescences.

Harvesting

The crop matures in 80-120 days depending upon variety and agro-climatic conditions [14]. The harvesting is done when the crops turn yellow, leaves fall down and seeds turn light greyish brown. The crop is harvested by uprooting the individual plant or by cutting it close to the ground. The plant resembling zeera are rouged out from the field before harvesting to avoid admixture and contamination of seeds. Cumin seed is normally harvested from late May to late June in cold to moderate areas (i.e. Iran) and in January to February in subtropics and tropic areas (i.e. India). In the traditional system of harvesting, plants are cut with hand tools before shedding starts and seeds are separated from the straw by various means. However, in recent years attempts have been made to modify seed harvesters for this purpose [15]. The yield is affected largely by diseases, however by following standard agronomic practices and controlling the diseases properly, healthy and disease free crop can yield 6-8 q seed ha^{-1}. Generally cumin seeds are processed after drying in sun. The seeds should be dried to a moisture level of 8.5-9 %.

Nutritional value

Cumin seeds are nutritionally rich, providing high amounts of the energy, protein, fat, minerals and vitamins. The summary of the nutritional constituents is given in **Table 2**.

Aroma profile

Cumin's distinctive flavour is strong. It has a warm aroma due to its essential oil content. Its main constituent aroma compounds are cuminaldehyde (a promising agent against alpha-synuclein aggregation) and cuminic alcohol. Other important aroma compounds of toasted cumin are the substituted pyrazines, 2-ethoxy-3-isopropylpyrazine, 2-methoxy-3-sec-butylpyrazine, and 2-methoxy-3-methylpyrazine. Other components include γ-terpinene, safranal, pcymene and β-pinene.

Uses

Cumin seed is used as a spice for its distinctive flavour and aroma. Cumin can be found in some cheeses, such as Leyden cheese, and in some traditional bread from France. Cumin is an ingredient in chilli powder (often Tex-Mex or Mexican-style), and is found in achiote blends, adobos, sofrito, garam masala, curry powder, and bahaarat. In South Asian cooking, it is often combined with coriander seeds in a powdered mixture called dhana zeera. Cumin can be used ground or as whole seeds. It helps to add an earthy and warming feeling to food, making it a staple in certain

stews and soups, as well as spiced gravies such as curry and chilli. It is also used as an ingredient in some pickles and pastries.

Table 2 Nutritional composition of cumin

Nutrient	Unit	Value per 100 g
Proximates		
Water	g	8.06
Energy	kcal	375
Protein	g	17.81
Total lipids (fat)	g	22.27
Carbohydrates	g	44.24
Fibre, total dietary	g	10.5
Sugars, total	g	2.25
Minerals		
Calcium	mg	931
Iron	mg	66.36
Magnesium	mg	366
Phosphorus	mg	499
Potassium	mg	1788
Sodium	mg	168
Zinc	mg	4.80
Vitamins		
Vitamin-C	mg	7.7
Thiamin	mg	0.63
Riboflavin	mg	0.33
Niacin	mg	4.58
Vitamin-B6	mg	0.44
Folate-DFE	µg	10
Vitamin B-12	µg	0
Vitamin A	IU	1270
Vitamin E	Mg	3.33
Vitamin D	IU	0
Vitamin K	mg	5.4
Lipids		
Fatty acids, total saturated	g	1.54
Fatty acids, total monosaturated	g	14.04
Fatty acids, total polysaturated	g	3.28
Cholesterol	mg	0

In Sanskrit, cumin is known as Jiraka “that which helps digestion" and is called zira in Persian/Urdu. In the Ayurvedic system, dried cumin seeds are believed to have medicinal purposes. These seeds are powdered and used in different forms like kashaya (decoction), arishta (fermented decoction), vati (tablet/pills), and processed with ghee (a semifluid clarified butter). It is used internally and sometimes for external applications also. In southern Indian states, such as Kerala, Andhra Pradesh and Tamil Nadu, a popular drink called Jira water is made by boiling cumin seeds. Jeera is stimulant, antispasmodic and carminative. Because of its disagreeable flavour, its medicinal use at the present day is almost confined to veterinary practice, in which it is employed as a carminative. Formerly Cumin had considerable repute as a corrective for the flatulency of languid digestion and as a remedy for colic and dyspeptic headache. Bruised and applied externally in the form of a plaster, it was recommended as a cure for stitches and pains in the side caused by the sluggish congestion of indolent parts, and it has been compounded with other drugs to form a stimulating liniment.

Other Medicinal properties

Cumin is stomachic, diuretic, carminative, stimulant, astringent and antispasmodic. It is valuable in dyspepsia diarrhoea and hoarseness, and may relieve flatulence and colic. In the West, it is now used mainly in veterinary medicine, as a carminative, but it remains a traditional herbal remedy in the East. It is supposed to increase lactation

and reduce nausea in pregnancy. Used in a poultice, it relieves swelling of the breast or the testicles. Smoke in a pipe with ghee, is taken to relieve the hiccups. Cumin also stimulates the appetite.

Suitability of Zeera for Future

The product has an active cash market. The large players however, control a major section of the market. Though arrival of the commodity is only during March-May, its consumption is spread throughout the year. In addition, the consumption is spread throughout the country, though the cultivation is from Gujarat and Rajasthan. The prices display high volatility due to its seasonal nature and widespread demand within and outside the country. The product exhibits the normal homogeneity visible in agricultural commodities and can be effectively graded. Weather at the production centres, pests and diseases have an influence on the production of spices. The market is not perfectly organized and this influences the information flow. The major trading centres are Unjha (Gujarat), Niwai, Kekri (Rajasthan), Delhi, Jaipur and Rajkot.

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