Review Article

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BIOLOGY AND BIOTECHNOLOGY OF CUMIN

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Abstract: Cumin (*Cuminum cyminum* L.) is an important seed spice and one of the earliest known minor spices used by mankind. It has been grown and used as a spice since ancient times. It is globally popular and essential flavoring agent in many cuisines. Biotechnological tools such as molecular markers are one of the potent tools, which help the plant breeder to develop new varieties and breeding strategies for crop improvement programmes.

Keyword: *Cuminum cyminum*, Molecular Marker, Apiaceae, Clonal Propagation

INTRODUCTION

India produces a wide range of spices and holds a prominent position in world spice production. Because of the varying climates - from tropical to sub-tropical to temperate-almost all spices grow splendidly in India. In reality almost all the states and union territories of India grow one or the other spices.

Cumin (*Cuminum cyminum* L. Fam. Apiaceae) is an important seed spice and one of the earliest known minor spices used by mankind. It has been grown and used as a spice since ancient times. Originally, it is cultivated in Iran and in the Mediterranean region. it is mostly grown in India, Iran, Uzbekistan, Tajikistan, Turkey, Morocco, Egypt, Syria, Mexico, Chile, and China. The plant occurs as a rare casual in the British Isles, mainly in southern England, but the frequency of its occurrence has declined greatly.

Plant Description:

The Apiaceae (or Umbelliferae), commonly known as carrot or parsley family, are a family of mostly aromatic plants with hollow stems. The family is large, with more than 3,700 species spread across 434 genera. It is the 16th largest family of flowering plants. The characteristics feature of the Apiaceae is their inflorescence (umbel) with small pentamerous flowers with a bicarpellary ovary maturing into a schizocarpic fruit which separates into two mesocarps, each containing a single seed.

Cumin is a thin herbaceous annual plant growing to a height of 30-45 cm. The plant is slender, with a main stem that branches up to five secondary branches from the base, each branch may have 2-3 sub branches. All the branches attain the same height, giving the plant a uniform canopy. The plant has a branched glabrous stem, 3-5 cm in diameter, with a grey or dark green in color, having alternate, dissected leaves with filiform segments, angular, sparsely hairy, bluish green and petioles sheathing the stem at the base.

The inflorescence is a compound umbel with white or pinkish flowers. The leaves are pinnate or bi-pinnate with thread-like leaflets. The flowers are small and either white or pink colored. Typically to the Apiceae family the flowers are born in umbels, each umbel has 5-7 umbellets. The fruit is a schizocarp, 4-5 mm long, containing two mericarps with a single seed. Cross pollination, mediated through bees, is the rule although the occurrence and intensity of cross pollination varies. The fruit is a lateral fusiform or ovoid achene, containing a single seed. Seeds are smaller and dark brown in color. The fruits have eight ridges with oil canal. Seeds are hairy, in some varieties these hairs are prominent, and otherwise it is difficult to see them. The chromosome number of cumin is 2n=14.

Growth Conditions:

Cumin requires a moderately cool and dry climates for its growth, with a temperatures between 25°C to 30°C. The crop is highly sensitive to rain, and any rain during harvesting time reduces yield and crop quality. Crop quality is badly affected by diseases, and is reflected in a lower price once the seeds have turned black. It grows best on well drained sandy loamy soils with a pH range of 6.8 to 8.3. Acidic soils and alkaline soils reduce yield unless soil acidity is lowered to pH= 7.5[1].

Chemical Composition:

Distinctive flavor and strong warm aroma of cumin are due to its essential oil content. Its main constituent aroma compounds are cuminaldehyde and cuminic alcohol. Other important aroma compounds of toasted

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cumin are the substituted pyrazines, 2-ethoxy-3-isopropylpyrazine, 2-methoxy-3--butylpyrazine, and 2-methoxy-3-methylpyrazine. Other components include γ-terpinene, safranal, p-cymene and β-pinene.

Medicinal Value:

The seeds have astringent, cooling, stomachic, antispasmodic, sedative, stimulant, carminative, diuretic, digestive and antiseptic properties. According to ayurvedic materia medica, Jeera is pungent in taste and is light, dry, sharp and hot in effect. It acts as an anti-obesity, anti-inflammatory, blood purifier, diuretic, glactogauge (that enhances milk engendering during lactation) and uterine stimulant medicine. It also protects healthy cells and stimulates production of natural interferons in the body.

It has a marked digestive and carming effects, expels the wind, anti-colic and helps absorption in the intestines. It is also given in conditions where a patient complains of the anorexia, nausea, indigestion, abdominal distension, colic, piles and intestinal worms. It helps treat urinary stasis and prevents stone formation in the kidneys. It is also a very good medicine for mucous diarrhoea and non-specific colitis and is used in combination with other medicines to cure the irritable bowel syndrome. Tea made up of Cumin seeds, and dry Coriander helps vomiting and loss of appetite occurring during pregnancy. It acts as a galactogogue, carminative, purifies the blood, promotes healthy reproductive organ, in both male and female.

Tissue Culture Studies:

Cumin is generally propagated by seed. This method is generally slow and labour intensive. To meet the growing demand of this spice, its large scale cultivation has become essential. Plant tissue culture techniques offer an opportunity for rapid clonal propagation of desired spice in order to provide superior identified planting material for commercial cultivation. Earlier, *in vitro* embryogenesis of cumin hypocotyls segments have been reported[2]. Shoot regeneration in cumin through indirect somatic embryogenesis and indirect shoot organogenesis in callus culture derived from seedling explants such as hypocotyls and internodal stem segments have been reported[3,4]. A rapid and efficient method for regeneration of plantlets from embryo explants of cumin was reported[5]. Direct shoot regeneration from mature embryo as a rapid and genotype-independent pathway in tissue culture of heterogenous diverse sets of cumin (*Cuminum cyminum* L.) genotypes was also published[6]. Similarly, In 2007, reported that direct regeneration protocol in tissue culture of different genotypes based on pre-existing meristem[7]. This study supports the feasibility of combined direct regeneration protocols from embryo and node of cumin in germplasm conservation by *in vitro* cloning and genetic improvement programme. Adventitious shoot proliferation from aseptically germinated seedlings of *Cuminum cyminum* was reported[8].

Molecular Studies:

Molecular genetic markers are regions in the genome that are heritable as simple mendelian traits, and are easy to document. They are potent tools in the assessment of genetic variation as they have potential to reveal differences among genotypes, populations, species etc. at the DNA level and in disclosure of genetic relationships within and among individuals. It is reported that reported direct regeneration protocol in tissue culture of different genotypes based on pre-existing meristem[7]. This study supports the feasibility of combined direct regeneration protocols from embryo and node of cumin in germplasm conservation by *in vitro* cloning and genetic improvement programme. Studies on genetic diversity among 49 cumin ecotypes based on phenotypic (morphological and biochemical) characteristic were carried out[9]. Results indicated significant variations for all the measured traits among and within populations derived from different provinces. So the available genetic diversity among the Iranian cumin population can lead to produce high yield. In the year 2011, the evaluation of cumin landraces under drought stress based on some agronomic traits and reported that in drought stress condition number of seeds per plant was the greatest factor that is affected by draught stress[10]. There were significant differences among landraces for number of seeds per plant and seed yield. These results could be proposed that cumin is a drought tolerance crop. The molecular diversity in 49 cumin ecotypes belonging to 9 Iranian regional sub populations by using RAPD markers[11]. Twenty three RAPD markers were used for diversity assessment in which 21 showed polymorphic banding pattern. Based on the results, they concluded that there is a high potential of variability in Iranian cumin population which are very important sources of cumin breeding. Effect of cumin against oxidative damage to DNA were studied[12].

Future Prospects:

Fruits of *Cuminum cyminum* commonly consumed as condiment across the globe. Assessment of genetic polymorphism using modern biotechnological tools such as molecular markers are the vital part of plant breeding because its utilization helps the plant breeder to develop new varieties. Knowledge of genetic relationship is vital in several crop breeding programs e.g. improvement of cultivars, management of germplasm and evolution of conservation strategies. Molecular characterization of the genotypes gives precise information about the extent of genetic polymorphism which helps in the development of an appropriate breeding program. Therefore, there are certain possibilities that in future these

biotechnological tools especially molecular markers will become the most important contrivance to enhance the productivity and characterize them for various genetic improvement programmes.

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