CHAPTER-1

1. Introduction

1.1 Cumin plant morphology and botany

Cumin is mostly produced, consumed, and exported by India. One of the first seed spices used globally is cumin (*Cuminum cyminum L*), often known as jeera. The seeds are longitudinally curved and brownish in color, similar to other members of the *Apiaceae* family, but much like caraway seeds (Chandola et al. 1970). After black pepper, it's the next most commonly used condiment worldwide. Cumin has different names depending on the country, such as cumin in German, jeera in Hindi, fake anise in French, and comin' in Belgium. It stands 20 to 30 cm tall and has a thin stem with a diameter of 3 to 5 cm. It is stemless and branched, greenish early in life and grayish at maturity (Hussein and Batra, 1998).

Cumin plants thrive with numerous small white flowers on the same stem length and same height. The cumin fruit resembles a cremocarp and grows from the lower part of the ovary. The fruits are light brown or greyish, ovoid or spindle-shaped. The cumin fruit is called the seed, but when it germinates, the pericarp is split open to reveal the true seed. cumin seeds are dried and capsuled and split into two pieces. At maturity, only one seed has grooves in the walls. It has a wide range of medicinal effects (Singh et al. 2017). To assist researchers in creating more efficient management measures against the wilt & blight disease and to increase efforts to disseminate them to cumin producers, we examine a variety of cumin-producing nations that have grown over the past many years. This chapter describes the plant description, Area and production**,** Nutritional value of cumin, the Cultivation of cumin, the medicinal importance of cumin, the economic importance of cumin, symptomatology, cumin diseases, and its management for the production of high-yielding cumin crops.

1 Origin:

Although it originated in the East Mediterranean and South Asia, cumin is now grown all over the world for its flavor, and fragrant seeds. The Eastern Mediterranean region, Turkestan, Syria, and Egypt have been considered to be its initial habitats.

1.1.2 Cumin production

India is one of the major producers worldwide, producing 100,000–200,000 tonnes each year. The nation has the most land set apart for the production of cumin, at over 52,500 hectares. Both cumin production and the overall area planted have greatly expanded in recent years. Situation and present cumin production in India Since 2010, cumin has now produced, consumed, and exported more frequently in India than in any other nation in the globe. In 2018–19, 10.27 lakh hectares of cumin were planted. It produced 6.08 lakh MT of goods and had an annual production rate that was 0.59 Mt/ha. In India, 394330 tonnes of seed are produced on around 593979 acres of land. The current world's top producer of cumin, India also exports some of its output. Annual cumin exports from India are over 8000 tonnes.

1.1.3 International Scenario:

Cumin is produced and consumed most widely in India, which accounts for over 70% of global output. Syria, Iran, Turkey, and other nations follow each accounting for 8%, 8%, and 6% of global consumption, respectively. As it accounts for around 88% of the country's output, Khorasan in Iran is a major producer. Even in Jordan, productivity isn't very high. India, the UK, Indonesia, Singapore, Malaysia, Nepal, and Bangladesh are the top global consumers. Other nations that produce cumin seeds include the region of North Africa, the USA, Asia, Indonesia, China, Algeria, Egypt, and Libya. The majority of India's cumin seed production is used at home, while the rest is exported. Cumin oil and seeds are mostly exported from our nation worldwide. Due to its high quality and flavor, its output demands higher prices in the international markets. In the years 2021–2022, Over 119 thousand tonnes of cumin seed were shipped from India. Additionally, India exports cumin seed byproducts such as cumin seed lubricants and cumin oil. Due to their ability to manufacture the spice at far less expensive prices and the fact that nearly all of their harvest is used for export, countries like Turkey and Iran pose a serious threat to India's cumin exports.

1.1.4 Indian Scenario:

India leads the international market with significant markets for export in Vietnam, the US, Bangladesh, the UAE, the UK, and many more countries. Many nations, including Spain, Brazil, the UK, Malaysia, and Saudi Arabia, import cumin seeds and cumin seed powder from India. India also exports oily products to the US, UK, and Germany, along with cumin seed oil. The major importers of cumin on the international market are the USA of America, the nation of Sri Lanka, the UK, Japan, the Netherlands, and Brazil. The most cumin-consuming nations are the nation of Mexico, Portugal, Spain, the nation of Turkey, China, Japan, the Netherlands, France, and Morocco. India is the country that consumes the greatest amount of cumin seeds.

The top two producers in India are Rajasthan and Gujarat, accounting for 70% of all output. Gujarat produces 44% of the total, and Rajasthan produces 56% of the cumin in India. According to the year 2018 survey, Gujarat produces 200,000 tonnes of cumin, compared to Rajasthan's 284,000 tonnes. The districts of Jalore, Pali, Barmer, Ajmer, Tonk, and Jodhpur are the key locations for the cultivation of cumin, which is a significant crop in western Rajasthan. The majority of India's cumin seed production is used at home, while the rest is exported. Cumin oil and seeds are mostly exported from our nation worldwide. Due to its high quality and flavor, its output demands higher prices in the international markets. In the years 2016–17, 119 thousand tonnes of cumin seed are exported by India. Additionally, India exports cumin seed byproducts such as cumin seed lubricants and cumin oil. India's cumin exports face strong competition from nations like Turkey and Iran because these nations can produce the spices at considerably lower costs and because a large portion of their crop is utilized for export.

1.2 Nutritional value of cumin

Among the seed spices, cumin is a high-quality source of various nutrients, vitamins, and minerals. Dried cumin seeds contain 20-30 % fat, 8-12% Protein,10-12% Fiber (10–12%), and free amino acids (Sowbhagya,2013). Cumin also contains higher amounts of biomolecules like copper, zinc, B-complex, vitamins such as riboflavin, thiamine, niacin, vitamins A, E, and C, and antioxidants (Bettaieb et al. 2011). It is also an excellent source of manganese, according to the World's Healthiest Foods rating, which improves hemoglobin and improves the immune system. The taste and special medicinal effects of the seeds of cumin are due to having 2–5% volatile oil and aldehyde content (Agarwal, 1950; 1996). Cumin seeds also include perillaldehye, cumin alcohol, pinene (20%), dipentene, and -phellandrene, as well as cumin aldehyde (p-isopropyl benzaldehyde, 26-36%). The seeds contain oil, the main component of which is cuminol, so the seeds have a typical pleasant aroma. The therapeutic properties of herbs or their seeds are being investigated by a large number of researchers through experimental verification due to the pleasant component in herbs.

1.3. Medicinal importance of cumin

Cumin has multiple medicinal properties and is used to treat stimulant, carminative, stomachic, and restorative properties of diarrhea and indigestion (Malhotra & Vashishtra; 2008). It is also used to treat the various symptoms of the diseases like fever, nausea, vomiting, abdominal discomfort, edema, and postpartum discomfort (Johri, 2011 Deepak, 2013: Mnif and Aifa 2015). Cumin oil has been used as a multifunctional glow dye or in topical dressing Ointments, used as a carminative, digestive, astringent, antitussive, and analgesic for bronchopulmonary disease and in the treatment of mild digestive disorders (De et al. 2003). It serves as an active reservoir for various bioactive compounds with therapeutic applications (Hajlaoui et al. 2010; Johri, 2011). All of these characteristics highlight the plant's potential as a medicine and offer insightful data on the reaction of the body to salt stress (Pandey et al. 2015).

Many people worldwide do not consume enough iron daily through diet. One of the most common nutrient deficiencies that can be prevented is iron deficiency, which affects up to 10% to 15% of the wealthiest countries and almost 20% of the world's population (Levi et al., 2016). According to Ancuceanu et al. (2015), cumin seeds naturally contain a high amount of iron, with one teaspoon of ground cumin containing 1.5mg iron, or 17.5% of the adult RDI.

1.4 Cultivation of cumin

Cumin seedlings are very sensitive to salt. Appropriate and improved agricultural practices can increase crop production and productivity. In addition, resources such as seeds, fertilizers, pesticides, and insecticides can be saved, and labor can be saved for the better cultivation of cumin.

1.4.1 Soil

Soil conditions play an important role in plant productivity. The best soils for growing cumin are sandy to loamy soil with proper drainage, good ventilation, and high oxygen availability. The preferred soil pH range is between 6.8 and 8.3 (Lal et al. 2018). Cumin is mainly grown in light-textured soils which are very low in nitrogen and have a low water-holding capacity. Soils are favorable to wilt pathogens due to the recurrent cultivation of vulnerable genotypes as well as low organic matter, low microbial populations, and low water holding capacity.

1.4.2 Climate

A warm subtropical climate favors better cultivation. Cumin cultivation requires three to four months of long, hot summers. It cannot withstand high humidity and heavy rain. At low temperatures, the leaves change color from green to blue. The rapid development and early maturation brought on by the high temperatures. It requires a cool, dry climate (temperatures up to 24–30°C) for better growth. Cumin is commonly grown in arid regions such as Gujarat and Rajasthan**.**

1.4.3 Varieties

It is advantageous to cultivate improved varieties with increased production potential, such as MC-34, Gujarat cumin-1, cumin-2, cumin-3, cumin-4, S-404, RS-21, UC-189, RZ-18, etc., developed by the Agriculture University of Gujarat and Rajasthan. The period from planting for maturation ranges from 110 to 115 days, according on the diversity.

1.4.4 Time of sowing

Cumin is sown in India between late October and early December, with harvesting starting in February. Cumin is planted in Syria and Iran from mid-November to mid-January, and it is harvested in June or July.

1.4.5 Sowing method

Between the first week of November and the first week of December, seeds are sown either by spreading them out or planting them in rows with 30 cm holes. Depending on the planting method and soil type, the seed rate might range from 12 to 15 kilograms per hectare. Seeds must be sowed at a depth of 1 to 2 cm. Soaking seeds for eight hours prior to sowing aids in the best potential germination. To aid in spreading, wet seeds must dry in the shade. By spreading seedlings at a deeper level, the germinating process of seeds is impeded. In order to reduce the possibility of disease and pest outbreaks, crop rotation should be used.

1.4.6 Manure and fertilizers

For a good cumin yield, fertilizers should be used based on soil surveys. Normally, 20 quintals per acre of cow dung should be applied to the field during tillage. After that, 25 kg of DAP and 4 kg of urea should be added per acre at the time of sowing. At the first irrigation, 3 kg of urea should be given per acre.

1.4.7 Irrigation/Watering in cumin farming

Lightly water the seeds immediately after sowing, and then a second watering 7-10 days after the first watering. Subsequent watering should be done depending on the type of soil and climatic conditions. A final heavy watering should be done at the time of sowing. Watering during seed filling should be avoided as it increases the incidence of rot, powdery mildew, and wilt.

1.4.8 Harvesting time of cumin seedsH

arvest time is usually 110-120 days after sowing, depending on the variety selected. Occurs in the first week of March when seeds are sown in November. Seeds can be harvested by tapping the stems on the clean ground or can be done in a cumin thresher.

1.5 Cumin pest and diseases

Cumin is affected by several diseases, making its cultivation particularly challenging. According to Dange (1995), the three major diseases that mostly impact cumin crops are wilt (*F. oxysporum*) blight (*A. burnsii*), and powdery mildew (*Erysiphe polygoni*)

The cultivation of cumin is negatively impacted by a lack of superior cultivars, and a lack of scientific agricultural methods and is susceptible to infections like wilt, powdery mildew, and blight caused by *Fusarium oxysporum*, *Alternaria burnsii*, and *Erysiphe polygoni*, respectively.

The inability to produce crops using scientifically sound methods, the absence of superior cultivars, and the risk of catching diseases such as wilt, powdery mildew, and blight, in the production of cumin caused by *F. oxysporum*, *Erysiphe polygoni* and *Alternaria burnsii*, respectively.

Some common diseases are caused by a Fungal infection.

- Wilt disease in cumin is caused by *F. oxysporum.*
- *Alternaria burnsii* is responsible for cumin blight
- Powdery mildew is due to the fungus *Erysiphe polygoni* (Vaha, Weltzien)
- *Pythium aphanidermatum* (Edson) is responsible for damping off.
- **Nematode disease**
- Root-knot disease can be passed on by a parasite *Meloidogyne spp*.

1.5.1 Cumin wilt:

***F. oxysporum* responsible for cumin wilt**

This fungus grows naturally in both soil and seeds. Patel (1968) investigated the causes of pathogen penetration and emphasized the possibility that fungi are transmitted by endolysis. After some time, the function of the interior of the inoculum was recognized (Singh et al.1972). When developing the fungal infection develops an abundance of white mycelium. The 4.8-12.8 µm mycelium is covered in many microconidia. 90% of the conidia produced are macroconidia, which are typically 2-3 septa and 34.44 x 3.28 µm in length. 8.2µm overall diameter on average, chlamydospores are smooth, globose, terminal, or interstitial, and they may survive for as long as ten years in the soil. (Mathur & Mathur 1965). Altered hyphal growth and virulence were discovered in eight Foc strains (Champawat & Pathak 1989). Arafa (1985) showed a wide range of pathogenicity in Jordan for the isolation of damaged crops (El-mina and Assiut). Foc chlamydospores were severely affected by elevated temperature and exposure time. After 45°C, the time required to completely kill chlamydospores decreased significantly with each 5°C increase.

The wilt disease comes from the fungus *Fusarium oxysporum*. The disease manifests as wilting signs in seedlings. The stem exhibits a reddish discoloration when sliced lengthwise. In their 1956 study on the cumin wilt in Rajasthan, Mathur & Mathur revealed *F. oxysporum* has been identified as the responsible fungus. *F. oxysporum* was a designation that was eventually given to it by Patel and Prasad (1963) based on host specificity. Pandemics are frequently generated in fields where insufficient fertilization leads to soil temperatures between 12.5 and 14^{0}C.

The wilt disease's causative agent, *F. oxysporum*, is a saprophyte that survives on the plant waste of diseased plants such as mycelium and chlamydospores. It is soil- and seed-borne and spreads across short distances via water, rainfall, and wind, as well as by intercultural interactions. It invades tissues after an infected plant dies, 342 sporulates, and continues to infect nearby plants. The disease's adverse effects lead to a significant decrease in cumin yield. During the week of December, when the crop is one month old, it contracts wilt. After the infection and the affected plant begin drying, patches are visible. In contrast to late-grown crops, the disease effect appears to be stronger in early-sown crops.

Identification of the fungi that cause the disease wilt in Rajasthan, India, was initially discovered by Gaur (1949). The infectious agent and the fungus's destructive potential were identified by Patel et al. in 1957. Gujarat's yield loss as a result of the disease, per the research, ranged from 10 to 45%. In some areas of Rajasthan, wilt has been associated with cumin harvest decreases of as much as 35 percent (Mathur & Vyas, 2002). Dange et al. noted losses of 7.0-30.6% in Gujarat in 1992. At that time, it travelled to many different countries throughout the globe, such as Egypt (Arafa 1985), Argentina (Madia & Gaetan 1993), Greece (Elena & Pappas 1997), Syria, Iran (Omer et al. 1997), Afghanistan, Turkey, and Pakistan.

Production limitations have been a common problem (Alawi 1969; Champawat & Singh 1972). Studies have shown losses in the Indian region that produces cumin range from 5% to 60% (Prasad 1963 Patel et al 1957). Infection rates, still vary between 24% to 40%. and, in exceptional instances, approach 70% (Gaur 1949). In India's dry regions, where cumin is frequently grown in the winter, yield losses of about 40% have been seen (Lodha et al. 1986). Producers who have been cultivating in the dry ground for several years frequently have no choice to stop.

1.5.1.1 Symptoms

- Although the disease affects crops during all phases of development of the crop, it normally appears in the field in patches while the harvest has become approximately thirty days older.
- Before drying up, the damaged plants wilt, shrivel up, and show characteristic wilt symptoms.
- The tops of the branches droop in the early stages, and the afflicted plant eventually dries up.
- Plants with the disease have dark brown roots.
- When the roots are torn apart, the vascular bundles show signs of having fungus mycelium because they are brown in color.
- In extreme situations, the entire plant wilts and the stems shrivel.
- The disease spreads through the compromised soil. The inoculum may be passed on to the next season by the afflicted seeds.

1.5.2 Cumin Blight disease:

The most harmful disease produced by *Alternaria burnsii* is cumin blight, which together with wilt is the second most common disease. Blight causes stem tips to bend downward and manifests as dark brown blotches on leaves and stems. In India, seed-borne *A. alternata* has reportedly been linked to seedling blight. After flowering, cloudy weather raises the disease's prevalence in cumin. Only preventive methods are advised for effective preventative measures against blight due to the disease's rapid spread. Seeds get shriveled and easily blown away during winnowing. Early cumin cultivation results in high disease intensity and unmarketable seed production. Blight conidia can survive over several months in warm, dry environments.

Causal Organism: *Alternaria burnsii*

Class: *Deuteromycetes*

Order: *Moniliales*

Local Name Kali Charmi

First report: B. N. Uppal first reported the disease in 1938 in the Gujarat district of Kheda.

1.5.2.1: Economic Impact

It has been reported to be widely distributed throughout Rajasthan's cumin farming region. When the weather is ideal, the disease takes a severe form and can result in yield losses of more than 70%.

1.5.2.2: Blight symptoms

- Little, independently, ash-white necrotic spots on the crop's apical portions, particularly on the ends of young leaves, are the infections distinctive.
- Necrotic regions progressively expand and combine, changing color from purple to brown to black.
- Both leaves and blooms are more impacted and destroyed by the illness when

- the plant is damp, which also causes it to spread to the stem and flowers.
- The entire plant dried out and became black when it was burned at extreme temperatures.
- In some cases, no seeds develop at all, or if they do, they are shrivelled, black in color, light in weight, and unapproachable.

1.5.2.3: Disease cycle:

- The primary source of the disease is seed, which is responsible for 10 to 32% of the cycle.
- The infectious agent also survives in contaminated field debris.
- For a period of ten months, the fungus can survive on seed and debris.
- Conidia that are carried by the wind promotes secondary dissemination.

1.5.2.4: Favorable circumstances:

- Plants that are growing adjacent to irrigation systems are particularly hazardous.
- Conidial germination occurs at 26–27°C.
- Plants grow more sensitive after rainfall, gloomy, humid weather, and temperatures between 23 and 28 degrees Celsius favor the sickness.
- Cool, muggy, and overcast conditions Wind and unseasonal rain encourage the development of diseases.
- Growing only cumin crops on the same field year after year Disease-favoring soil has water logging issues or poor drainage.

1.6 Management

Cumin diseases can be treated with cultural, biological, and chemical-based approaches. The occurrence of wilt in the field has been reduced by the invention of many different management strategies. Cumin cultivation can be successful when realistic and affordable solutions are included in a particular agroclimatic zone. By combining antipathogen, and environmental manipulation techniques, this objective can be accomplished. Different techniques that combine cultural, biological, chemical, and host resistance can be used to make diseases less severe. All elements of the disease pyramid must be handled to reach critical levels of disease control and significant pathogen control.

1.6.1 Cultural method

Due to the host-specificity of the pathogen, field wilt can be successfully treated by sowing cumin at the appropriate time and rotating it with non-host crops (Mathur et al. 1967). It has been discovered that alternating cumin crops with coriander during both the wet and dry periods, minimize the prevalence of wilting in desert regions of India. Disease incidence was greatly decreased by summer tillage (Champawat & Pathak 1990). Improvements in seed yields and a marked decrease in wilt incidence were seen after 3 to 1 summer tillage. When there is abundant sunlight and warm soil temperatures in the summer, this strategy performs very well. However, this approach is not advised in regions with strong summer winds since the wind might sweep away the farmland's most rich soils. In fields with plenty of sunlight, soil solarization has been shown to be a successful method for lowering soil populations, plant pathogen density, and disease-induced outbreaks. There is information on irradiance and soil temperature during non-cultivation times (Katan 1981).

It has been demonstrated that using organic ingredients such as cakes, residues, and compost is preferable. Many nations use cumin as a withering control. These modifications increase the number of Foc antagonists as well as the populations and activities of soil microbes. It has been demonstrated that the soil uptake of cruciferous leftovers lowers the population of soil-born plant diseases, which are mostly caused by toxic volatiles like mercaptans, methyl sulphide, and isothiocyanates. (1993, Gamliel & Stapleton). In the treated soil, a higher population of Foc-antagonizing actinomycetes was observed. This might have also helped to reduce the number of pathogens. When soils were amended with mustard residues or oil cakes to reduce the occurrence of cumin wilt during the rainy season, cumin wilt incidence significantly decreased (Mawar & Lodha 2002), demonstrating the effectiveness of cruciferous residues in controlling wilt disease. When treated in the summer instead of during the rainy season, the reduction in wilt incidence was dramatically increased. This may be the result of a chain reaction involving biotoxic volatiles generated during residue decomposition when temperatures in the soil are high (27 to 45ºC) and bacterial disagreement occurs.

1.6.2 Chemical methods

According to Champawat and Pathak (1988a), the wilting rate was 23% at 31kg/ha and 27.8% at 15:5:5 NPK kg/ ha. The incidence of withering was decreased with higher K+ dosages. According to Pathak (1988b), pre-sowing applications of carbofuran 3G @ 66 kg ha-1, Aldicarb, and phorate, each at 10G per 20 kg ha-1 were the most successful in lowering the occurrence of wilt.

The incidence of wilting was effectively decreased by Carbendazim treatment of the seeds at three kilograms of seed paired with carbendazim (0.1%) spraying, or benomyl (0.05%) (Champawat & Pathak 1991a). The SMDC (Vapam) soil application proved successful in reducing wilting and boosting plant vigor. The application of the drug grains for a week after the seeds had been planted proved to be effective (Jadeja et al. 2022). In addition to carbendazim spraying (0.1%), 3 kg of seed should be treated with fungicides. Thiophanate-methyl is used in seed dressing and soil soaking. The use of carbendazim improved seed output while reducing the occurrence of wilting. According to Patel and Patel (1993), fungicides were found to prevent the growth of Foc mycelium. Benomyl, carboxim+thiram, iprodione+carbendazim, and captan were reported to inhibit the growth of mycelium by (Aghnoom et al 1999) who analyzed fungicides' effects. The effects of pre-sowing therapy were decreased *Fusarium* infection and enhanced seed output of the plant in comparison to controls. According to Tawfic and Allam (2004), the most effective method for decreasing fungal infections was a two-day primer combination of water and *T. harzianum*.

1.6.3 Biological control

Many producers have started employing bioagents regularly as a result of the potential that they have demonstrated in numerous studies for managing the wilt disease. To reduce disease incidence by 65%, the plant treated with *Trichoderma harzianum T2* strain was shown to be significantly more successful than the seed treatments with pesticide. To keep cumin plants from wilting, *Aculospora* was utilized (Champawat & Pathak 1991b). The growth of *Fusarium* was similarly suppressed in the lab by biochemical agents such as *A. niger, A. flavus,* and *T. harzianum* (Patel & Patel 1998a). By creating volatile and nonvolatile antibiotics from *Trichoderma spp*., Vyas and

Mathur (2002) successfully reduced the growth *Fusarium oxysporum f. sp.* in a laboratory. Additionally, they discovered that incorporating *Trichoderma* atroviride and *T. harzianum* into seeds before planting them in the soil led to noticeably higher germination rates and a decline in diseases.

According to Sharma and Trivedi (2005), *T. harzianum* isolates grow most readily on tea lees and antagonize. Three harmful bacterial stains—*P. fluorescens, Rhizobium* and *Bacillus subtilis* is species—that appeared on Yeast Emanat Broth, King's Broth and Nutrient Broth, respectively. Using easily decomposable organic materials with dual purposes as a soil conditioner and a nutritional foundation for fungal development increases the number of bioactive compounds. In Egypt, research on the the efficiency of groundnut particle circulation method for *Trichoderma* species using manure (T. harzianum, T. hamatum, and T. koningii) to suppress wilt was conducted (Haggae & Abo-seder 2005). Although the fact that cumin seeds supply is constant, wilting poses a persistent danger to its successful cultivation. The absence of resistance in established germplasm globally is a significant barrier to the treatment of wilt disease. A few fields with resistant forms were identified through extensive germplasm screening, but collaborative research efforts still need to be strengthened. Due to the small flowers, umbelliferous plants are typically difficult to develop using traditional breeding techniques (Hunault et al 1989).

1.7 Purpose of Research:

Many different toxic chemical fungicides were found effective against cumin blight like Mancozeb, Carbendazim, Hexaconazole, Copper oxychlorides, Propiconazole, etc (Sharma et al., 2013). Many different toxic chemical fungicides were found effective against cumin wilt like Mancozeb, Trimethyl thiuram disulfide, Carbendazim and copper oxychloride, etc. Chemical fungicides are hazardous to human health and the environment.

However, current research has concentrated on developing long-lasting, ecologically safe biocontrol methods for treating plant diseases. To manage the disease nontoxic and ecofriendly materials are required. Many different botanical extracts were found effective against blight like *Calotropis*, *Aloe Vera* and *Piper betel*, etc. Many different botanical extracts were found effective against Wilt like Datura, Calotropis, Caster,

Jatropha, Neem, etc. (Sharma & Trivedi, 2002). According to Kagale et al. (2004), plant-based compounds can be used as the basis for new agrochemicals that can be used to treat plant diseases. The extract of plants has antibacterial properties that can be used to treat plant diseases like early blight and other plant diseases both in vitro as well as in vivo.

Additionally, systematic, readily biodegradable, and nonphytotoxic biocides of plant origin exist (Qasem and Aau-Blan, 1996). Further under organic cultivation of cumin use of toxic agrochemicals is not allowed. Under this situation, it was felt necessary to test various botanical extracts for cumin blight & cumin wilt cultivation. So, the objectives of the research work are given in the next chapter.