Review of Literature
CHAPTER- II

REVIEW OF LITERATURE

Alternaria blight is one of the most widespread and destructive diseases of cruciferous crops in India. Under normal conditions, the damage due to disease is slight, but in years when the climatic conditions are favorable, the incidence of disease is higher resulting in considerable losses in yield. The plants are either killed at an early stage or become weak and succumb to it at a later stage. When the infection is severe on the leaves and pods, it results in great reduction in yield as well as the oil content (Vasudeva, 1958). The literature relevant to the present study is briefly reviewed as under:

2.1 Isolation, Identification, Symptomatology and Pathogenicity of A. brassicae

Isolation

*Alternaria brassicae* and *Alternaria brassicicola* have been reported from almost every continent on brassicae (Anon, 1969). Irwin (1976) found that the fungus caused typical leaf blight symptoms in isolated seeds. Sharma and Gupta (1978) trapped *Alternaria brassicae* spores from the air during the entire period...
(October to April) of growth in brown sarson under field conditions and observed that the conidia of Alternaria brassicaceae are intercepted at all hours of exposure.

Recent work by Chahal (1980) revealed that seed infection by Alternaria brassicaceae was confined to discoloured grey seeds and could not be eliminated by surface sterilization with 2% sodium hypochloride for 10 minutes. Conidia of Alternaria brassicaceae were present at all times over fields of sarson during the growing season. Galveze et al. (1988) found black, round or elongated necrotic spots on rape (B. Juncea).

On the basis of morphological characters, the pathogen isolated was identified as Alternaria brassicicola. Alternaria brassicaceae and Alternaria brassicicola were isolated from rape and Indian mustard. Alternaria raphani was most common on radish but also occurred on other Brassica vegetable and oil yielding crops (Verma and Saharan, 1993). Petric (1974) reported that Alternaria carthami occurred on 95% of untreated safflower seeds.

Identification

The pathogen Alternaria brassicaceae was characterized by dark pluriseptate hyphae, conidiophore erect, simple, 0-5 septate and brown to olivaceous. Conidia occurring in chains of at least two and
consisting of 3-11 cells with 1-6 longitudinal septa. The mycelium was usually light brown to brownish gray, spores were brown and produced singly with long beaks of 2-3 in sporangial chain (Changṣri and Weber, 1963). Verma and Saharan (1994) separated the small and big spore forms of Alternaria brassicae. Awadhiya (1992) identified Alternaria carthami in safflower seeds.

**Symptomatology**

Symptoms of the disease were characterized by the formation of spot on leaves, stem and siliquae. Three species of Alternaria (Alternaria brassicae, Alternaria brassicicola and Alternaria raphani) were reported to cause symptoms in the seedling stage on cotyledons and in the adult stage on leaves, petiole, stem, inflorescence, siliquae and seeds. In nature, Alternaria brassicae produced zonate spots accentuated by light brown colour of the spore, which grow upright like stubble. On Brassicae, the lesion on leaves due to Alternaria brassicicola were shooty black, velvety and conspicuously covered with black conidiophore and conidia, whereas those caused by Alternaria brassicae were gray, dense and sparsely covered with brown conidiophores and conidia (Changṣri, 1961). This parasite was more serious on thin leafed plants such as turnip, mustard and Chinese cabbage (Changṣri and weber, 1963). In some Brassica spp., formation of concentric rings in the lesion with yellow
halo zone was very prominent symptoms (Kadian and Saharan, 1983).

Pathogenicity

The primary infection results from the wind borne spores produced on plant debris of previous crop or on weeds and other collateral host growing in the vicinity. Conidia germinate in presence of moisture giving rise to germ tube, which emerged from any cell of the spore. Germ tubes from germinated spores of Alternaria penetrate undamaged tissue of the brassicaceous host directly.

Louvret and Billotte (1964) reported that free water was necessary for infection by Alternaria brassicae and penetration occurred within 6 hrs at an optimum temperature of 22°C. According to Singh (1980), optimum temperature for growth and sporulation of Alternaria brassicae was 22°C and optimum pH was 5.5. Alternaria brassicicola required higher temperature than Alternaria brassicae and Alternaria raphani and longer time for conidial germination (Degenhardt et al, 1982). According to Awasthi and Koli (1989), Alternaria blight of mustard developed best during rosette to flowering stage and produced more number of spots on mustard leaves.
2.2 The prevalence of Alternaria blight

The occurrence of Alternaria blight of cruciferous crops is worldwide. All the three species of Alternaria viz. Alternaria brassicae, Alternaria brassicicola, and Alternaria raphani were found to affect rapeseed and mustard crop quite commonly throughout the world. The disease caused by Alternaria brassicae is more destructive and occurs more frequently than the one caused by either of other two species. Many times, spots caused by Alternaria brassicae and Alternaria brassicicola occur together and could be seen simultaneously on the same plant.

The Alternaria blight appears in a severe form when stormy weather, high wind and over 80 percent relative humidity prevail during the development of the crops, especially at the silique formation stage (Anon, 1943 and Léveillé, 1958). Such conditions permit the conidia to disperse, germinate and infect leaves and silique. At least 24 hrs of saturated atmosphere was required for development of the disease (Sarker and Sengupta 1978). More infection was found in the dense crop and it develops rapidly under humid condition (Anon, 1984). The incubation period of Alternaria brassicae was shorter in rapeseed and mustard group crops compared to the vegetables (Kadian and Saharan, 1985). Humpherson and Brien (1985) reported that new infection by
*Alternaria brassicae* may occur even when period of spore release were separated by several days from weather conditions suitable for germination and infection. Gupta and Chaudhury (1992) reported that *Alternaria brassicae* was most severe and widely prevalent in Sikkim, infecting all 6 cruciferous crops.

### 2.3 Periodical development of Alternaria blight

Relative humidity from 67-73%, rainfall of 70 mm., 5-7 hrs sunshine per day, minimum temperature ranging from 7-10°C, maximum temperature ranging from 20-23°C were found to be positively correlated with *Alternaria* blight of mustard (Anonymous, 1998). Vasudeva (1958) found moist and warm weather or alternate periods of rains and sunshine to be favourable for the development of disease caused by *Alternaria brassicae*. The infection rate on siliquae was correlated with the amount of rainfall during flowering (Stankova, 1975).

Mukadam and Deshmukh (1977) reported that age of conidia is an important factor in infection and subsequent disease development as old spores (more than 20 days of formation), tend to show reduced germination. Degenhardt *et al* (1982) reported that more than 95% R.H. and <15°C temperature was required for conidial germination of *Alternaria brassicae*. 
Relative humidity during noon was found to have a positive influence on disease severity while minimum temperature was found to be significantly and negatively linked to higher disease severity (Anonymous, 2000). Gadre et al (2002) found a significant positive correlation of Alternaria blight with maximum air temperature, minimum air temperature, sunshine hours and crop age. The multiple regression analysis showed that among the various weather factors that could influence the incidence of disease, sunshine and crop age were highly significant. Minimum (evening) RH two weeks preceding the date of observation influenced the disease severity ($R^2: 0.9$) while the maximum temperature (18-26°C) indicated above also had a positive influence on the disease in both cv. Varuna and the local one (Anonymous, 2002).

2.4 Assessment of yield losses

Losses due to pod infection were more in yellow sarson followed by brown sarson and raya. Healthy and infected pods of 18 lines per varieties were assessed to determine the losses in grain yield caused by Alternaria brassicae. Damage due to this disease was related to pod infection that causes shattering of pods, discolouration and shrinkage of the seeds (Chahal, 1977).
Chahal and Kang (1979) also reported 45% losses in yield by *Alternaria brassicae* on cultivar BSH-1. Yield losses from 28.2 to 60.70% in *Brassica campestris* and 12.9 to 47.1% in *Brassica juncea* was reported by Chahal and Labans (1980). The losses in yield due to shriveling of seeds in rapeseed were reported to be about 15.66% under Punjab condition (Randhawa and Aulakh, 1981).

Infection by *Alternaria brassicae* reduced 1000 seed weight and seed yield by 35.38-46.57% in rapeseed and mustard (Kott et al., 1987). Yield losses were heavier in yellow sarson (38-45%), followed by brown sarson (26%) and mustard (17-18%) and reduction in oil content from 1-10% in infested seed was reported by Saharan (1992a). Verma and Saharan (1993) reported *Alternaria brassicae* to be most destructive reducing the yield. Barman and Bhagawati (1995) reported that *Alternaria* severity was negatively correlated with seed yield. Ashrafuzzaman et al. (1996) reported that seed yield of mustard was significantly reduced if leaf was defoliated by the infection of *Alternaria disease*. The infection of leaves, stem and siliquae generally results in heavy losses (10-70%) in seed yield and quality (Anonymous, 2002). The protected plots sprayed with 0.25% mancozeb showed reduced disease incidence but highest disease intensity was recorded during flowering and pod formation stage as reported by Prasad et al. (2003).
2.5 Management of Alternaria blight

2.5.1 Host resistance

VARIETAL resistance is the best management practice looking to its advantages and feasibility. Several workers evaluated large number of varieties for resistance to Alternaria blight. Bokar et al. (1988) evaluated 32 cultivars against Alternaria infection, among them 4 showed good survival resistance (70-100%). Prasad et al. (2002) tested 72 cultivars against Alternaria disease, of which 15 were found to be moderately resistant to the disease. Yadav et al. (1999) evaluated 75 germplasm, out of these none was found to be completely resistant while three were moderately resistant to Alternaria blight (PBR-176, PBR-178 and PBR-180). Pathak and Godika (2002) evaluated 27 rapeseed-mustard genotypes among them 5 genotypes (viz., RN-490, RN-505, PBC-9221, PBN-9501 and PBN-9502) had multiple resistance to powdery mildew, stem rot, Alternaria blight and white rust. Thirty-two entries were evaluated against Alternaria blight, among them PBN-2001, PBN-2002, PBC-9921 and EC-399296 had multiple resistance to White rust, Downy mildew, Alternaria blight and Sclerotium rot (Anonymous, 2002).
2.5.2 Plant extracts

The use of plant extracts has opened a new avenue for the control of plant diseases besides being safe and non phytotoxic. Plant extracts were time to time tested by different workers for their efficacy against Alternaria pathogen. Ahmed and Agnihotri (1977) studied *in vitro* antifungal activity of plant extracts from *Datura stramonium, Eucalyptus citriodara, Lantana camera, Azadirachta indica, and Canna indica*, against *Alternaria brassicae*. Bhowmic and Choudhary (1983) studied the effect of *Azadirachta indica* and *Acalypha indica* leaf extract on the growth, sporulation and spore germination of *Alternaria alternata*. Kazmi *et al.* (1993) reported that hexane extracts of *Azadirachta indica* seed and *Valeriana officinalis* rhizomes were inhibitory to growth of *Alternaria alternata*. The action of various plant products was pathogen specific and very little information is available on *Alternaria brassicae* (Asha Shivpuri and *et al.*, 1997). The leaf extracts of 25 locally available plant species including some medicinal and weeds were screened against, *Alternaria brassicae* for their antifungal properties (Kumar *et al.*, 1998). Antifungal activity of extracts of *Azadirachta indica, Ocimum sanctum, Allium cepa* and *Allium sativum* has also been reported by Singh and Majumdar (2001). Ferdous *et al.* (2002) used neem and
garlic crude extracts against Alternaria blight of mustard. They found spray of garlic and neem leaf crude extracts to be promising.

2.5.3 Chemicals

Several reports were published by different workers on the efficacy of chemical fungicides on *Alternaria* pathogen under *in vitro* and *in vivo* conditions. Some of the fungicides, which were found to be effective in controlling *Alternaria* disease and increasing the yield under field condition were Benlate (0.1%), Blitox-50 (0.3%), Captan (0.2%), Bavistin (0.1%), Dithane M-45 (0.2%) and Dithane Z-78 (0.2%) (Ansari et al., 1990). Saha (1989) reported that Ziram and Ceresan wet completely inhibited the growth of *Alternaria brassicae* followed by Dithane M-45 under *in vitro*:

In field-testing, large number of chemicals against *Alternaria* were used by Verma and Saharan (1993). Recent studies have shown that Iprodione (Rovral 0.25%) was most effective in controlling *Alternaria* blight of mustard (Anon, 1998). Godika and Pathak (2002) reported that Mancozeb (0.2%), Antracol and Copper oxichloride (0.3%) effectively reduced the *Alternaria* disease.

Yadav (2003) determined the efficacy of non-systemic and systemic fungicides including Mancozeb against *Alternaria* blight of mustard. Pooled data showed that all the fungicidal treatments were
significantly superior to the control in reducing leaf or pod infection and in increasing grain yield.

2.5.4 Cultural practices

Among the common cultural practices, use of clean cultivation, use of healthy seed, seed treatment, long crop rotation, field sanitation, planting date, use of balanced nutrients, proper plant density, have been advocated to control *Alternaria* disease of brassicaceous plants (Dixon 1981 and Kolt 1985). Mian and Akanda (1989) reported that the severity of *Alternaria* blight was increased with delay in sowing, being lowest in Oct. sown crops and highest in Dec. sowing. The delayed sowing of *varuna* after 15\textsuperscript{th} Oct. increased severity of the disease (Tomar et al, 1992 and Singh et al, 1998). Sinha et al (1992) found minimum disease incidence and increased seed yield when the crop was sown on 15\textsuperscript{th} Oct. In field condition, the effect of sowing dates (5\textsuperscript{th} Oct., 20\textsuperscript{th} Oct., 4\textsuperscript{th} Nov. and 19\textsuperscript{th} Nov.) on four *Brassica* species showed that the disease intensity remained low when sowing was done on 15 Oct (Kumar et al, 1996). Singh et al (1998) reported that Rohini gave the highest yield, and yield decreased with delay in sowing. Sowing on 30\textsuperscript{th} September resulted in the lowest incidence of *Alternaria* disease. Koul and Sing (1999) reported that early sowing (1\textsuperscript{st} Oct.) of
cv. Pusa bold reduced severity and gave higher seed yield (14.34q/ha).

Incidence of Alternaria blight on mustard leaves was found to be lower in the earliest sown crop (15th October), but the incidence of Alternaria blight on pods decreased with later sowing dates (30th October or 14th November). Crop yields were also higher in the earliest sown crops (Godika et al., 2001). Yadav et al. (2002) reported that delay in sowing increased the intensity of both Alternaria and White rust disease in mustard.