CHAPTER 2

REVIEW OF LITERATURE

Persea bombycina King ex. Hook (f) Kost. commonly known as som is the primary food plant of muga silkworm *Anthera assama* W. w. or *Antheraea assamensis* Helfer. which produces golden colored silk fibre. According to Bennet (1987), som was formerly known as *Machilus bombycina* which is a group of woody tree which belongs to the family Lauraceae, and order Laurales. The family is distributed from Australia extending to South China and Japan i.e. mostly in the South East Asia. It contains 40 numbers of genera with 100 species. In recent times, Lauraceae is distributed in Brazil, Chile and U.S.A. extending to Canada. (Hooker, 1885). Som is indigenous to North East India and also extending from Lower Himalayans to Almora as far as Nepal, Burma and Indonesia up to altitude of 1,500 MSL (Hooker, 1885; Choudhury, 1970; Kanjilal, 1992). According to Choudhury(1981), som is distributed in Assam, Meghalaya, Arunachal Pradesh, Tripura, Mizoram, Nagaland, Manipur, North Bengal, Uttaranchal and Himachal Pradesh in India. For the economic growth of the industry it is essential for the production of quality leaves in scientific way. Hence, to produce golden fabric from muga silkworm the leaves of som plant has economic importance.(Choudhury, 1981). Report reveals that the som leaves fed muga silkworms have better quantitative characters like shell ratio and reeling ability than soalu leaves fed muga silkworms. (Choudhury, 1970). An extensive survey of literature reveals that research work on som plant *(Persea bombycina* King ex. Hook (f) Kost.) and various aspects of fungal ecology such as air, soil and phylloplane mycoflora and diseases related to muga food plant as well as its leaves are very few . According to Saratchandra (2006), in Assam *Persea bombycina* (Som) is extensively cultured, which accounts for more than 95% productivity.

According to Singh (1996), epidemiology is an important aspect of study of plant diseases which deals with outbreak and spread of diseases in a host population. One of the major foliar disease of som plant is grey blight which is caused by *Pestalotiopsis disseminata* as identified by Bharali (1969). On a similar experiment Das and Benchamin estimated the leaf loss in grey blight disease were 1273 kg/hectare/annum. The disease intensity was the highest during March to September with 48-59% of the plant infection with destruction of leaf area up to 13.8-21.6%, as per their report. Many workers have reported *Pestalotiopsis*

disseminata which cause various disease to other crops (Philip and Govindaiah, 1995; Singh, 1996; Singh and Devi, 2001; Sridhar, 1978). Das and Benchamin (2000) in their study reported that the major foliar diseases of som, occurred throughout the year were leaf blight, leaf spot, leaf rust and leaf curl. Gogoi *et* al. (2013) reported that foliar diseases leaf spot and leaf blight of som caused by fungi *Phyllosticta perseae* and *Colletotrichum gloeosporioides* respectively during aherua and bhodia seed crops and jethua and kotia commercial crops adversely affect the quantity and quality of leaf and silkworm rearing during summer and autumn season. The biology, diversity, epidemiology and control of the disease along with morphological, pathological and molecular characters is also reported by various workers. (Chakraborty *et* al., 1997; Chand *et* al., 1968; Chowdappa *et* al., 2009; Gupta *et* al., 2010; Hegde and Hegde, 1986; Hubballia *et* al., 2011; Jayalakshmi and Seetharaman, 1998; Kamanna, 1996; Kanappa 1998; Kumar *et* al., 1995; Kumar *et* al.,2012a; Kurian *et* al., 2008; Manjunath,2009; Old *et* al., 2000; Pandey, 2011; Ramesh *et* al., 2004; Rao and Satyanarayana, 1989; Saxena, 2002; Shampatkumar *et* al., 2007; Sharma *et* al., 1994; Sharma *et* al., 2005; Sharma and Verma, 2007; Singh and Prasad, 1967; Yashodha *et* al., 1993)

For air born microorganisms, air is the natural media for their growth. In India Cumminghum (l873) first studied the air born micro-organism by air sampling method. Nutrient agar media is used for analysis of air spora for which the petriplates with nutrient agar media is exposed for air sampling (Bernstein & Feinberg 1942, Hyde and William 1953). With the change of time, season and weather as well as plants height, the atmospheric air spore concentration fluctuates accordingly. Chandwani *et* al. (1963) studied the occurrence of aerobiology of paddy field in different period in relation with temperature and relative humidity. They reported that seasonal variation had affected the occurrence of air spora. They have also reported that with temperature and relative humidity, *Cladosporium* and *Alternaria* species showed seasonal variation. Bordoloi and Barua (1964) investigated the atmospheric air flora in tea plantation area at different seasons and with different plants height. Where they reported *Aspergillus, Cladosporium, Curvularia, Fusarium, Mucor, Penicillium, Pestaloptia,* and *Phytopthora* were dominant fungal species. They further reported that seasonal variation influence the occurrence of these fungi and spore concentration gradually decreased by increasing plants height. Hamilton (1968) on her study on the aerospora of coffee plantation field reported that occurrence of *Penicillium* is higher during winter than in summer season. She mentioned with increasing rain concentration, the

pollen and fungal spore gradually decline. According to Konger and Barua (1970), increase in temperature and relative humidity influence the concentration of air spores. Langenberg *et* al. (1977) reported that in air most commonly found aerospora such as *Alternaria* sp., *Cladosporium* sp., rust, smut etc of a particular area diminish significantly with prolonged heavy rainfall as well as increased wind velocity. In Manipur, Singh (1994) studied the leaf spot of broad bean caused by *Cercospora zonata* and recorded maximum incidence of the disease during February to April. Sing *et al.* (1999) studied the indoor aeromycoflora of grain storage at Udaypur in different seasons and reported higher percentage of *Aspergillus* sp. which was highest during August to November. Similar studies were performed by Pugalmaran and Vittal (2000), where they encountered *Aspergillus* sp. and *Penicillium* sp. as the most predominant aeromycoflora in grain storage during August to November and which gradually declined in other period. Sharma and Bhattacharyee (2001) studied seasonal variation of aeromycoflora in Banana plantation area of Kamrup district of Assam. He reported the dominant species encountered throughout the year were *Alternaria, Aspergillus, Botrydiploidia, Botrytis, Cercospora. Cladosporium, Mucor, Penicillium* species. During August to September, highest load of aeromycoflora were recorded which gradually declined towards the last part of January. Shahny and Purwar (2002) studied seasonal variation of indoor aeromycoflora in Allahabad University campus and reported a total of 525 fungal colonies belonging to 15 genera, among which 86.66% belonged to *Deuteromycotina* and rest to *Zygomycotina* (13.33 %). Maximum fungal colonies were recorded in rainy summer season. Sharma and Dutta (2002) studied the aeromycoflora of Jute plants in Silchar area where they isolated and identified a total of 22 fungi belonging to 15 genera. Among 15 genera *Aspergillus* sp. were found to be 39% , *Penicillium* sp. 16.45% and rest of genera included *Alteraria* sp., *Cladosporium* sp., *Curvularia* sp., *Fusarium* sp., *Geotrichum* sp., *Humicola sp., Nigrospora* sp., *Torula* sp. and *Trichoderma* sp. Ramesh *et* al., (2003) studied the occurrence of air spora in different seasons and plant height in Lavender plantation in Dharward, Karnataka. They reported that *Alternaria* sp., *Aspergillus* sp., *Curvularia* sp., *Fusarium* sp., *Mucor* sp., *Penicillium* sp., *Torula* sp. as air borne mycoflora and up to the height of 10ft, these fungi were adaptable in all seasons. Kasprzyk *et* al. (2004) mentioned that different atmospheric conditions influence the fungal spore concentration. They reported that during October to December maximum spore concentrations were found in Rzeszow bright during sunny and less windy days and on the other hand during January to April spore load on the atmosphere were less. Das, *et* al. (2005) studied the seasonal variation of fungal

air spora in muga food plant soalu in different heights of the plants where they reported maximum fungal spora in summer rainy season up to 6ft height and minimum during winter season gradually decreased by increasing plant height. Stepalska and Wolek (2006) reported that variation of fungal spore concentrations in taxa associated areas of Poland was depend upon the weather condition. The bright sunny days and optimum temperature in between 27-31 °C in Crascow areas produced highest number spores concentration in air. Giorgio *et* al. (2006) studied on air borne microflora in the city of Marseilles. Where they reported that with temperature and wind velocity the amount of air borne bacteria increased where as air borne fungi increased with temperature and varied with wind direction in urban and natural areas. Kasprazyk and Worek (2007) studied the concentration of air mycoflora in Poland city and country side areas. The results showed that frequency of occurrence of fungi in rural areas were more than 50% than the country side. The most common species isolated were *Botrytis, Cladosporium, Ganoderma* and *Torula* which were significantly higher in the rural areas.

Soil is the diverse habitat of various microbiological communities where the entire phenomenon for their existence occurs. Soil microorganisms are essential components of the biotic community in natural forests, responsible for breakdown of organic materials, mobilisation of nutrients and maintenance of soil plant quality and ecosystem biogeochemistry (Hackel *et* al., 2004). Alongwith increase in depth and areas the characterstics of the soil components varies. As a result the physical, chemical and microbiological properties of the soil gets affected alongwith the microbial population (Rangaswami, 1988; Kagti, 1964). The fertility of the soil, organic matter decomposition, diseases of roots and production of antibiotics are greatly influenced by soil i.e. nonrhizosphere and rhizosphere microflora . The climatic and edaphic factors greatly influence the distribution pattern of microfungi in the soil of perennial plant. (Warcup, 1951, Saxena, 1954). Parkinson (1967) reported that the little attention has been given to the effect of soil temperature and moisture on the microflora of roots of healthy plants. The seasonal influence acted on the distribution of microfungal population in the forest soil (Agarwala and Chauhan, 1988). The soil depth is also responsible for soil fungal community. Saxena (1954) also reported both quantitative as well as qualitative reduction in fungal colonies with increasing the depth of the soil. The similar results had been observed by Warcup (1957) in wheat field soil. The fungal growth and multiplication in soil mostly depends soil moisture. On a study by Mukhopadhya and Nandi (1977), they found that the fungal population of

fungi per gm of soil was higher in the rhizosphere soil samples then the normal field of jute cultivation. Manoharachary *et al.* (1977) studied on mycoflora of rhozosphere and non-rhizosphere soil of four different plants where they found except few species most of the fungi appeared common in both the soils. The further study showed that with the crop, soil and climate, the domination of certain fungal genera and species might vary. Patil and Chandra (1980); Gangawane and Kulkani (1985) studied the density of fungal population in rhizosphere soil of cotton and ground nut plants. Where they reported that the climatic factors along with some basic characteristics of the plant play vital role for occurrence of rhizosphere fungal population. The mycoflora in rhizosphere of ground nut grown in sewage and sludge treated soil had difference. In sewage treated soil higher numbers of species were recorded than sludge as against a minimum numbers in untreated soil. Dutta (1981) isolated some fungi from rhizosphere soil of tomato plants and the consequent prospect for the control of *Verticillium* wilt with antagonistic microorganisms. Srivastava and Dayal (1986) studied the production of antibiotic complexes by soil microorganisms of *Abelmoschus esculentas*. On a study on rhizosphere and non-rhizosphere mycoflora of barley plant Ansari and Prakash(1986) observed that in rhizosphere and non rhizosphere soil occurrence of *Aspergillus niger* were the highest while occurrence of *Memnoniella echinata* were the lowest respectively. Ivarson and Mack (1972) studied rhizosphere mycoflora of Soybean in relation to soil temperature and moisture in a field environment. Where they reported that high soil and incubation temperature encouraged greater root populations of *Rhizoctonia* early in the season , *Trichoderma* and *Aspergillus* throughout the growing season, and *Fusarium* late in the season. Where as low soil temperature favoured the growth of *Pythium*, *Mortierella*, *Mucor*, *Alternaria*, *Cladosporium* throughout the growing season.Tamini *et al.* (1987), studied seasonal variation in the rhizosphere fungi of potato where they observed that the fungal population started increasing in May, reached in peak during September. They also found a correlation between the dominance of *Aspergillus* and *Penicillium* and the population dynamics of potato was pathogenic fungi. In the rhizosphere mycoflora of four hybrid varieties of *Sorgham vulgare,* Patil and Thite (1987) studied the rhizosphere mycoflora at 15 days intervals from seedling to mature plants during two seasons. It was observed by them that probably due to lower rainfall fewer fungal species were present in the previous year than next year. According to Rangaswami and Bagyaraj (1988), occurrence of rhizosphere mycoflora depends on nutritional and physiological condition, the depth of the root system, nature of the soil and its various physiological and biological properties. Dublish *et al.* (1989)

recorded more numbers of fungal species in rhizosphere soil of disease plant than the normal plant soil. The predominant fungi, isolated included *Aspergillus flavus, A. niger, A. sydowi* and *Trichoderma viride.* Nagaraja (1990) studied rhizosphere mycoflora of *Strychnos nux-vomica* and observed that the most abundant species *were Aspergillus* followed by *Rhizopus, Mucor, Penicillium* and *Fusarium.* The composition of the mycoflora varied according to the season. Heavy rainfall and temperature reduced the fungal population of the rhizosphere and nonrhizosphere soil. Seasonal variation and distribution of microfungal population in Sal (*Shorea robusia)* forest soil was studied by Baruah and Bara (1995). A well marked distinction with seasonal variation of fungal population were recorded by them with physico-chemical properties of the soil. On the other hand, the least number of fungal population were recorded during winter season and gradually increased the number during rainy and summer season. The rhizosphere microflora of agar plant of Assam was studied by Das and Dubey (2001). They mentioned that total 60 percent microbial population were isolated from rhizosphere soil and rest 40 percent from non rhizosphere soil. The rhizosphere soil has capacity to produce more numbers of microbial population due to physiological affect of root system. Rhizosphere mycoflora of *Aquttaria agllocha* was studied by Borthakur *et* al.(2001). There were 15 numbers of fungal species isolated from rhizosphere soil and 9 numbers from non-rhizosphere soil. Ramesh *et* al. (2002) reported the fungal diversity of rhizosphere of cotton *(Gossypium* sp.) of Dharwad, Karnataka where a total of 45 species belonging to 24 genera were isolated. More fungal population were found in rainy season and least number were obtained in winter season. Microbial population from rhozosphere and non-rhizosphere soil in different seasons of Pigonpea was studied by Upadhya and Pandey (2004). They reported that the fungal population increased in rhizosphere and non-rhizosphere soil in general December to February, particularly in case of *Aspergillus* and *penicillium* .They also mentioned that this is due to the soil temperature which increases from December to February and at moderate temperature (February) microbial activity is much more than cool temperature in December. Sing *et al.* (2007) studied the microbial community in rhizosphere and non rhizosphere structure in grass land soil. They reported that both bacterial and fungal community influenced the plant growth which were abundantly recorded from rhizosphere soil. Least number of microbial community harbour from the nonrhizosphere area of grass land soil. Dongmo and Oyeyiola (2009) reported a total of five species of *Fusarium*, namely *Fusarium oxysporum*, *F. Semitectum*, *F.poae*, *F.solani* and *F.moniliforme* in root zone of tomato . Among which they have reported *F.oxysporum* as

predominant species. They also mentioned that the frequency of occurrence of *Fusarium* species were generally higher in the rhizoplane than in rhizosphere soil. Oyeyiola (2009) studied rhizosphere mycoflora of okro (*Hibiscus esculentus*), where he reported that the rhizosphere soil contained a greater spectrum of fungal species than either the rhizoplane or the non rhizosphere soil , the experimental soil were sandy loam in texture. Oyeyiola (2010) studied rhizosphere and non rhizosphere flora of *Amaranthus* hybrid in a sandy loam textured soil of Nigeria. Bhattacharyya and Jha (2011), studied the seasonal and depthwise variation in microfungal population numbers in Nameri forest soil, Assam, Northeast India where they reported 21 fungal species belonging to 14 genera from all depths throughout the seasons with highest populations and relative abundance of *Aspergillus flavus* (8.4%), followed by *Penicillium chrysogenum* (8.0%) and lowest by *Rhizopus oryzae*, *Rhizopus nodosus*, and *Trichophyton sp.* (2.8% each). Sule and Oyeyiola (2012) studied physicochemical as well as mycological charcterstics of soils as well as the root region of *Cassava cultivar*. Dalal (2012) studied incidence and diversity of soil mycoflora of Wardha (M.S.) area with seasonal variation. Where he reported *Rhizopus stolonifer*, *Aspergillus* and *Penicillium* as dominant soil mycoflora. Sharma and Raju (2013) studied the frequency and percentage of occurrence of soil mycoflora in different crop fields at HD Kote of Mysore district. The most common among them were *Aspergillus flavus*, *Aspergillus niger*, *Aspergillus terreus*, *Aspergillus fumigatus*, *Curvularia lunata, Fusarium oxysporum, Fusarium solani, Penicillium chrysogenum, Penicillium fumiculosum, Rhizopus stolonifer*, *Trichoderma harzinum* and *Trichoderma viridae.* Shiny *et* al, (2013) studied an investigation on soil mycoflora of 8 different crop fields at Narasannapeta Mandal, Srikakulam district. Kaushal and Singh (2013) reported seasonal variation and diversity of soil fungi were isolated from surrounding area of upper lake , Bhopal, Madhyapradesh where a total of 55 genera and 94 species were recorded from the study area. Srinivas and Krishnamurthy (2014) studied both the rhizosphere and rhizoplane mycoflora of *Crotalaria pallid* and *Caesalpinia mimosoides* where they isolated twenty five species belonging to sixteen genera where *Aspergillus*, *Alternaria*, *Cladosporium, Fusarium* and *Penicillium* are the dominant genera observed during all the three month period. Jalander and Mamatha (2015) studied rhizosphere and non rhizosphere mycoflora of some leguminous crop plants in relation to age of plant growth. It was reported that the rhizosphere mycoflora were higher than the non rhizosphere in all the three crops used for the experiment Bengal gram, Green gram and Black gram. The most abundant fungal species recorded were *Aspergillus*, *Cladosporium sp.*, *Penicillium* and *Rhizoctonia*.

Along with the aeromicrobiological studies on the aerial surface of plants, study of fungal pathogens on leaves, stem and fruits, saprophytic fungi were recorded since long time. In Britain, Last (1955) studied the distribution of member of the *Sporobolomycetaceae* on wheat and barley. Ruinen (1961) investigated the occurrence a nitrogen fixing bacteria *Beijerinckia,* on leaves from Indonesia. These two works independently introduced the term 'Phyllosphere' to describe the leaf-surface habit. Moreover aerial mycoflora of dead leaves and inflorescence axes were done by several workers. Subsequently, Last and Deigton (1965) reviewed in details on habit and development of leaf surface mycoflora in perennial plants. In recent times phylloplane mycoflora in different plants have been studied by various workers. Vankatashwaralu and Monoharachary (1976) studied on leaf surface mycoflora of some oil yielding and medicinal plants among which maximum number of fungi were recorded in phyllosphere of *Helianthus.* The isolated fungi were *Alternaria alternata, Aspergillus candidus, Aspergillus fumigatus, Aspergillus niger, Aspergillus terreus, Cladosporium herbarum* and *Penicillium lilacinum.* Phyllosphere mycoflora of three potato varieties in relation to various climatic factors were investigated by Kumar and Gupta (1976). They found due to climatic variation and other factors the fungal populations differ. Also, from their results it was evident that with the increase in age of the plants there was a gradual increase in the fungal population on both the young and old leaves. Occurrence of fungal population increases with the age of the plant. Cox and Hall (1978) studied on the occurrence and behaviour of microfungi of *Quercus robur* (oak tree). They reported that the younger trees showed less fungal colonies than the old tress. However, Sharma and Gupta (1984) studied the seasonal variation of phyllosphere mycoflora of brown sarson where they recommended that with the seasonal advance i.e. from December to March the population of microorganisms showed an increasing pattern and touched peak in the month of March. Garg and Sharma (1987) studied a comparative study on the phylloplane microfungi of both healthy and disease (rust) infected leaves of barley and triticale. They reported that on both barley and triticale, few fungi were found only either type of leaves but few were common on both types of leaves. Leaf surface mycoflora of *Azadirachta indica* were studied by Thakur *et al.* (1987), where maximum fungal population reported on leaf washing method. During October, *Cunninghamella echinulata* was only present on dorsal side of the leaflet while species of *Fusarium* were present up to November which totally disappeared in other months and during December and January dark coloured sterile forms were dominant. Sharma and Tiwari (1988) investigated phylloplane microflora of healthy and diseased plant of *Solarium*

khasianum and found maximum filamentous fungi on diseased leaves, and on healthy leaves maximum bacteria and yeast were observed. While some fungi were found common in both the types of leaves. Similar studies were done by Singh *et al.,* (1990) on *Colocasia antiquorum* where they isolated a total 30 fungal species belonging to various group of fungi. Most of them were common in both healthy and blight infected leaves. Fungal species like *Actinomucor repens, Aspergillus terreus, Cuvularia tuberculata, Fusarium sp.* were present in non-infected leaves while *Colletotrichum sp., Humicola brevis* and *Nigrospora* were present in blight infected leaves. A quantitative and qualitative analysis of phylloplane microflora of yellow sarson and tamarind in relation to microclimatic factors were studied by Sharma *et* al. (1992) where they reported that the phylloplane microflora of yellow sarson and tamarind decreased from November onwards up to January with fall of temperature and increasing relative humidity, a reverse trend was observed during February with maximum microfloral population with increasing temperature and decreasing relative humidity. During the experiment it were reported that fungi were the dominant microflora followed by bacteria and actinomycetes. Phylloplane mycoflora of rice, cotton and citrus has antagonistic and preinoculative protective ability toward pathogenic microorganisms (Anuratha and Gnanamamickam, 1987; Santhi *et* al., 1987; Saikia and Chowdhury, 1993). Deb *et* al. (1999) studied phyllosphere mycoflora of tea and the soil mycoflora of an experimental tea plantation area of Cachar. Where they reported that *Aspergillus* , *Fusarium spp.* And *Penicillium* were the dominant mycoflora on the tea phyllosphere and in soil *Aspergillus, Fusarium, Cephalosporium* and *Penicillium* were the most dominant genera. Seasonal incidence of phylloplane mycoflora of guava (*Psidium guajava*) was studied by Pandey and Dwivedi (2000). They observed a remarkable change in the phylloplane mycoflora with the maturity of leaves in different seasons. The maximum fungal population was recorded by them in rainy and minimum in summer season. The overall seasonal patterns of isolation from infected and non-infected materials were similar. In summer *Aspergillus, Penicillium* and *Paecilomyces* sp. were most dominant, while *Aureobasidoum pullalans, Ascochyta, Colletotrichum gloeosporioide, Curvularia* sp. and *Fusarium* sp. were extensively present in rainy season. During winter, *Cephalosporium, Cladosporium, Pestolatia* were dominant and *Phoma* were dominant in rainy season. Phylloplane mycoflora of green and dead stored leaves of three grasses namely, *Heteropogon contortus, Themeda anathera and Setaria glauca* was studied by Adhikari, (2002). He reported appearance of different fungal species which depend on the climatic condition as well as biochemical nature of the substrate.

Highest fungal population were recorded during August and September and least during the period of December to February. Bora *et al.* (2004) studied the occurrence of phylloplane mycoflora of three mung bean in different growing seasons, where they observed that with the increased age of the plants the fungal population were gradually increased with maximun occurrence of fungal species during November to December *i.e.* at the time of harvesting. Das *et al.* (2005) studied on occurrence of phylloplane mycoflora in soalu plant during different muga silkworm rearing period in tender, semi-tender and mature leaves. In mature leaves maximum fungal population were recorded in all the seasons among them particularly the occurence were highest during spring crop. Also, they have reported *Aspergillus fumigatus* as dominant species occurred throughout the year. Steven *et* al., (2007) mentioned that specially the bacterial and fungal community of atmosphere were found mostly on the leaf surface. They also mentioned that the long and broad leaves harbour more microorganisms which may induce leave protection from various diseases.

Comparative study of the air, phyllosphere and soil mycoflora of the tea plantation area of Cachar district, Assam were studied by Dutta *et* al. (2010) , where they reported a total of 34 fungal species from air, phylloplane and soil of the tea plantation area. Among them *Aspergillus sp.*, *Curvularia sp.*, *Fusarium sp.* and *Penicillium sp.* dominated in all the conditions i.e. air, phyllosphere and soil. Bhuyan *et* al. (2013) studied the phyllosphere microflora of muga silkworm host plant som leaves in Jorhat district of Assam, India. Where they have reported positive correlation between temperature and microbial population, where as negative correlation was observed against relative humidity. During their study they reported *Penicillium* species as the dominant fungal species.

Fungal diversity in phylloplane of castor plant during summer as well as winter season alongwith meterological parameters were studied by Borgohain *et* al., (2014). Where they reported a total of 11 fungi, among which *Alternaria alternata* and *Cercospora ricinela* were found to be most abundant fungi during all the seasons where as few fungal species were restricted to summer or winter season only.

The silkworm nutrition is completely depended upon the leaves quality of the food plant. The growth and development of the silkworm larvae, production of cocoon and the quality of raw silk are influenced by the quality of the leaves. Moreover leaves with high nutritive value increases silkworm resistance against diseases. Jolly *et* al. (1975) analyzed the

food plants of tasar silkworm and reported that minimum crude fibre occurred in *Terminalia arjuna* (7.71%) and maximum in *Lagerstoemia parviflora (20%).*Yadava and Goswami (1992) analyzed the leaf constituents of som and soalu where they reported crude fat, starch contents and total minerals in higher amount. Again, the crude protein and the value of total nitrogen were recorded more in soalu than som leaves. It was also reported that the moisture content, crude fibre, organic carbon and sugar content were non-significant between som and soalu. The crude fibre and protein content are significantly less in disease infected leaves as compared to healthy leaves. Umesh kumar (1992) reported that due to leaf spot disease protein content of *Shorea robusta* leaves were reduced. Hazarika *et* al., (l996) determined the quality of som leaves for rearing of muga silk worm and obsereved significant variation in soluble protein, soluble sugar and total phenol. Better rearing performance was recorded in ecotypes having highest amount of soluble protein and phenol. Singha *et al.* (1992) reported that among all the three primary food plants of tasar silkworm *(Antheraea mylita), Terminalia tomentosa* was better than *Terminalia arjuna* and *Shorea robusta* in respect of moisture, total nitrogen and total mineral contents. Pandey *et* al. (1993) reported higher larval weight in younger shoots than the matured shoots of oak tasar food plants as younger shoots contains higher amount of moisture and proteins, on the other hand leaves of matured shoots contained more amount of carbohydrate and crude fibers. Sharma and Sharma (1993) reported that the reduction of amino acids content in blight infected leaves and also infected mulberry plants could be due to their utilization by the pathogen or degradation by enzyme. Kakati and Hazarika (1997) reported significant variation in lipid contents of som and soalu where they reported highest amount of lipids in som (10 to 20%) followed by soalu (8.2%) and in mejankari lowest amount of lipid content (7.5%) were recorded. The diseased leaves are poor in biochemical constituents such as moisture, proteins and sugars etc. It is found to have adverse affect on the larvae by feeding such diseased leaves to silkworm which results in poor yield. The amino acids content, chlorophyll, reducing sugars, sugar and total soluble proteins etc differs in healthy and diseased leaves of the food plants of all silk worms (Shree and Chandraramma, 1999). Dutta *et al.* (1997) reported variation in nutritional constituents in four different food plants of muga silkworm. Majumder *et* al. (2003) studied the ascorbic acid content in healthy and diseased leaves of mulberry silkworm food plants, where they reported that the amount of ascorbic acid were higher in healthy leaves than the diseased leaves of mulberry plants. Kofalvi *et* al. (2007) studied the biochemical changes of wheat leaves infected by virus. They reported that the biochemical products synthesized by wheat leaves

drastically reduced due to infection of mosaic virus, but the phenolic content significantly increased. Various literatures are available for several field and horticultural crop (Krishnakumar *et* al, 1990; Kahle *et* al., 1992; Curtin *et* al., 1994). For undertaking any crop protection process, primary knowledge on the nutrient status of the soil system is the first step for planning an effective crop production management system (Sharma *et* al., 2013). Reports on physicochemical properties and classification of garden soils in India were conducted by several workers. (Basavanna and Bose, 1989; Bongale, 1993; Bongale and Siddalingaswamy, 1996; Bongale and Lingaiah, 1998; Thimmareddy *et* al., 1999; Samanta *et* al., 2001).

All plants, wild and cultivated are subjected to various plant diseases. Depending on environmental conditions, crop varieties, pathogens present, the occurrence and prevalence of diseases varies with season. An effective practice in som cultivation to minimize the diseases are regular monitoring and harvesting of infected leaves and twigs at the initial stage. To control various plant diseases a wide range of fungicides have been successfully used since long time. (Tandon *et* al., 1967; Sankhla *et* al, 1972; Bhowmik, 1974; Padule and Hande, 1980). An effective chemical control agent must not harm the plant, have low risk to animals including humans and have less effect on the normal microbiology of plants and the soil. A plant pathogen *Pestalotiopsis disseminata* has been recorded from a wide range of host, mostly from their leaves, fruits and rhizosphere (Bilgrami *et* al., 1979).In an in *vitro* test Harsh *et* al. (1987) reported that 0.1% of Bavistin, 0.3% of Dithane M 45 were effective in controlling of the foliar disease of *Diospyros melanoxylan* caused by *Pestalotiopsis varsicolor* among the all fungicides used. Several workers (Tripathi *et* al., 1987; Sukumar *et* al.1994; Gunasekhar *et* al., 1995; Yokoyama, 1996; Vala, 1996; Chattopadhyay, 1999; Wong and Wilcox, 2001; Upadhaya and Gupta, 2003; Islam *et* al., 2004; Joshi *et* al. 2004; Quadri *et* al., 2004; Harlapur *et* al. 2007; Shahnaz *et* al., 2007) have studied the effect of various fungicides in controlling different diseases in different hosts/plants. The fungicides were effective in controlling the diseases they are used for. Several fungicides have been identified and evaluated to control different diseases on different crops caused by *Pestalotiopsis disseminata* at different places (Govindaiah *et* al., 1990; Pandey *et* al., 2006) but information related to grey blight of som are very less. Devanath, *et al.* (1994) screened the different fungicides for controlling of leaf blight disease of guava plant. All five fungicides were found to be superior to control in preventing the disease incidence and among the fungicides; Dithane M-45 recorded the lowest disease incidence and highest yield. Various workers have

reported that Bavistin, Tilt 250, EC, Cupravit and Dithane M 45 performed best against *Pestalotia palmarum* (Kundalkar *et* al., 1991; Khaleqizaman *et* al., 2001). The complete inhibition of *Pestalotiopsis mangiferae* in vitro by 0.1% concentration of carbendazim was reported by Pandey *et* al. (2006). Saju *et* al. (2011) reported carbendazim at 0.05% can inhibit the *Pestalotiosis sp.* infecting large cardamom (*Amomum sublatum* Roxb.) upto 88.6%. Das and Jha (2008) tested five fungicides against *Pestaloptiopsis disseminta* causing grey blight of som, among which carbendazim was found most inhibitory followed by Topsin M. Out of five fungicides carbendazim, thiophanate methyl and phenyl pyrrole had completely inhibited the growth of pathogen at all concentration. Mancozeb was found effective at higher concentration. Copper oxychloride was found least effective. *Colletotrichum gloeosporioides* (Penz.) Penz. and Sacc. is one of the most common and widely distributed plant pathogen causing anthracnose in India. Khanna and Chandra (1976) studied control of guava fruit rot caused by *Pestalotia pridii* and *Colletotrichum gloeosporioides* with Aretan. Shekhar *et* al. (1989) reported Bavistin and Diethene-M at 0.1% and 0.2% concentration effective on *Z. Mauritiana* cv. Kajhali infected by *Prarthgada zizyphi*. Seven fungicides namely Bavistin and Dithene_M 45 including others were found effective in controlling *Alternaria brassicae* leaf spot under field conditions as reported by Singh *et* al. (1990). Mulberry foliar blight disease can be controlled by spraying 0.05% Blitox or Bavistain (Philip and Govindaiah, 1995). They have reported that these fungicides can completely suppressed the growth of fungal mycelium at 0.05, 0.1 and 0.2% concentration of the fungicides. Foltaf and Kavach at 0.2% concentration were recommended by Govindaiah *et* al., (2002) for controlling leaf rust of mulberry. They also reported that the fungicides sprayed leaves can be used for rearing of silkworm without any toxicity to the silkworms. Mohanan *et* al. (1991) reported variability in growth of *Colletotrichum gloeosporioides* isolates pathogenic on cacao in response to fungicides, antibiotics and detergent. Considerable literature is available on the screening of disease resistance sources against leaf spot and leaf blight in other plants. (Funk *et* al., 1981; Saksena and Kumar, 1985; Goncalves *et* al. 1999; Erpelding and Prom, 2004). Yokoyama (1996) reported the effectiveness of Bordeaux mixture for disease control of Powdery mildew in field condition. Dinocap at 0.1 percent and Morestan at 0.025 and 0.050 percent were found to be effective for blight disease. Residual toxicity of Dinocap lasted for 10 days while Morestan was free from any toxicity to silkworm (Iyenger, 1995). Various works have been done on the rust diseases for different crops. Their control measure had been studied. Parzate and Dithane Z-78 have been used for control of wheat rust in India. Chemicals containing

nickel have been successfully used for control of black brown rust and yellow rust. (Forsyth and Peterson, 1960; Hardison, 1963). Powelson and Shanner (1966) reported an effective chemical seed treatment for the systematic control of seedling infection by strips rust (*Puccinia striiformis*). Patel and Joshi (2002) reported efficiency of different fungicides against guava wilt pathogens. Venkataravanappa and Nargund (2002), evaluated different fungicides against anthracnose disease of mango caused by *Colletotrichum gloeosporioides*. Das *et* al. (2003) recommended three sprays Indolfil M-45 to control the leaf spot of som. Joshi *et al.* (2004) reported control of powdery mildew using Karathane at 0.03 percent or sulfex at 0.2 percent. Vereijessen *et* al. (2007) studied *Cercospora* leaf spot of sugar beet and reported its control by application of various fungicides. Among them, Foltaf at 0.1% and Bavistin at 0.2% effectively controlled the disease up to 83 to 86%. Also, they have mentioned that in field level, proper sanitation of the field is very necessary for controlling of disease. Efficacy of different fungicides against leaf and fruit spots of pomegranate caused by *Colletotrichum gloeosporioides* was reported by Patel *et* al. (2007) and Patel (2009). Gunashekar and Govindaiah (1999) reported that the most effective controlling measures for powdery mildew and leaf rust disease in mulberry plants are Carbendazim and Captan at the rate of 0.1 to 0.2 percent either individually or in combination. Singh *et* al., (2015) studied leaf spot disease of ginger caused by *Phyllosticta* under the field conditions and control measures with the help of fungicides were determined. Along with which chemical treatment measures Chakravorty *et* al., (2007) recommended burning of disease infected leaves, twigs etc. immediately after every muga crop rearing which will control grey blight disease up to some extent. Reduction of inoculums, pathogen eradication along with host protection is the main aspect of plant disease management by chemical methods. Moreover one of the main goal of sericulture industry is nothing but production of quality leaves to feed silkworms by the modern scientific way for quality production. Das and Das (2003) reported that the grey blight diseases of som plant can be controlled by spraying of 0.1 percent Bavistin. Das *et al.* (2005), studied powdery mildew of castor, a food plant of eri silkworm and reported that by spraying Captan with 2 gram per litre of water before 15 days of leaves harvesting can control the disease. Testing of various fungicides against leaf spot disease in mulberry plant were done by Quadri *et* al. (2004). Management of foliar diseases of groundnut were reported by Biswas and Sing (2005) at ICAR, Tripura where they reported carbendazim and tridemoph fungicides mixture as the most effective combination for controlling of leaf spot and rust diseases of groundnut. Jorgensen and Olsen (2007) studied wheat spot disease caused by

Drechslera tritici-repentis in Denmark and they also reported that the disease severity was significantly reduced up to 84% after the application of 0.2% Dithan M-45. Pesticides can cause toxicity to humans and other non target organisms. Hence, many agriculturally important pesticides are banned by the World Health Organisation (WHO) due to this cause. (Barnard *et* al., 1997).

Chemical fungicides are phytotoxic and they require skilled personel. Moreover they are expensive. When chemicals are sprayed to control the disease of host plants of silkworms it can cause residual toxicity to silkworms. Hence Gangwar *et* al. (2000) reported that using of chemicals to control food plants diseases of silkworms is a risky management practices. On the other hand plants and their products have selective properties and safety to ecosystem and also they are less expensive. Due to hazardous consequences and high cost of chemicals, fungicides and pesticides etc. use of biodegradable materials such as plant products are gaining importance in crop protection. (Ahmed and Grainge,1982; Mitra *et al,* 1994; Jespers and Wards,1993). An extensive study on plant products to control various plant diseases was done by Ahmed and Grainge (1982) where 1134 species possessed antimicrobial and insectisidal properties among 5280 plant species they tested. Effect of *Zingiber officinale* extract on powdery mildew disease of mulberry plant was reported by Singh *et* al. (1991). Results showed that the extract was highly effective without any adverse effect on silkworm. Moreover improvement of coccon quality was also further observed. Activity of aqueous extract of some common weeds were reported by Iqbal *et* al (2001). Shivapuri and Gupta (2002) worked on evaluation of 15 plant extracts against the leaf spot disease of mustard plant. Out of which *Azadirachata indica, Datura alba, Oscimun sanctum* and *Vinca rosea* were found most effective at 20 percent concentration. An in*vitro* and in*vivo* study against control of powdery mildew disease of mulberry plant were done by Gangwar *et al.* (2002). Where they used 21 different plants extracts and among which 10 were highly effective against the disease. Similarly, Vidhyasagar and Rajasab (2003) also studied control of powdery mildew disease by using neem and garlic extracts at different concentrations in mulberry plants. Various works have been done in India on control of anthracnose diseases using plants as well as plant parts. (Deshmukh *et* al., 2012; Kuberan *et* al., 2012; Prashanth *et* al., 2008; Pandey *et* al., 2009; Saju *et* al., 2012; Rampersad, 2011). Moreover, antagonistic fungi like *Beauveria bassiana* and *Trichoderma viridae* were also being used to control anthracnose disease in India. (Babu *et* al., 2008; Ghosh and Chakraborty, 2012). Acetone extracts of seven common invasive plant species *Campuloclinium macrocephalum*, *Cestrum*

laevigatum, *Datura stramonium, Lantana camara, Nicotiana glauca*, *Ricinus communis* and *Solanum mauritianum* against *Colletotrichum gloeosporioides* were studied by Mdee *et* al. (2009). Among which *C. laevigatum* leaf extract was most active against *Colletotrichum gloeosporioides* with an MIC of 0.05 mg/ml. Singha *et* al. (2004) in an in*vitro* study on antifungal activities of different plant extracts against *Colletotrichum capsid*. Where they have considered *Azadiracta indica, Cassia tora, Datura stromonium, Ocimum sanctum* and *Parthenium histoporum.* They observed that radial growth alongwith sporulation of *C. capsid* were maximum in *A. indica* and minimum radial growth were observed in *O. Sanctum* while other plant extracts inhibited the radial growth and sporulation upto some extent. Singh *et* al. (2015) evaluated seven medicinally important plant species viz. *Acorus calamus*, *Azadirachta indica*, *Melia azedarch*, *Melothria perpussila*, *Pheogacanthus thyrsiflorus*, *Vitex trifolia* and *Zingiber officinale* against powdery mildew of oak tree caused by *Phyllactinia corylea*. Kagale *et* al. (2007) reported that the leaf extracts of *Datura metel* significantly reduced the disease severity of leaf spot of rice caused by *Rhizoctonia solani.* According to Verma *et* al. (2007), phytochemicals such as alkaloids, terpenoids, polyacetylenes, phenolics and unsaturated isobutylamides are richest source of bioactive compounds hence fungicides derived from plant products are safer alternatives against disease control. Crude extracts of *Allium sativum* , *Artimesia vulgaris*, *Capsicum annuum*, *Eupatorium adenophorum*, *Gaultheria fragrantissima* and *Phyllanthus emblica* were tested against potato tuber rot caused by *Fusarium solani* in*vitro*.(Shreshtha & Tiwari, 2009). Neem *(A. indica)* is widely known for its antifungal activities that abundantly grows in anywhere, which can control fungal diseases of leaves, roots and seeds (Achimu and Schloesse, 1992; Hossain and Schloesser, 1993). Antifungal activities of neem leaf extracts on different fungal species were studied by various workers. (Tewari and Nayek, 1991; Al-Abed *et* al., 1993; Sarvamangala *et al.* 1993; Ganapaty and Narayanaswamy, 1994;Qasem *et* al., 1996; Amadioha. 1998; Amadioha, 2003; Mondali *et* al., 2009; and Suleiman, 2011). Antimicrobial activity of crude methanolic and acetone extracts of *Lantana camara* were recorded by Saraf *et* al. (2011) against 8 fungal and 13 bacterial strains. Prince and Prabakaran, (2012) reported antifungal activity of eight different medicinal plants against plant pathogenic fungus *Colletotrichum falcatum*. Among the plant tested *Vitex negundo* showed maximum antifungal activity against the plant pathogen. Saju *et* al. (2011) evaluated antifungal activity of *Artemissia vulgaris* and *Schima wallichi* against *Pestalotiopsis sp.* infecting large cardamom. An in*vitro* comparative study of antibacterial and antifungal extracts against five bacterial and fungal species were

studied by Sanguri *et* al. (2012). Antifungal activity of plant extracts against plant pathogenic fungi *Colletotrichum gloeosporioides* Penz. were reported by various workers. (Bussaman *et* al., 2012; Fokunang *et* al., 2000; Silva *et* al., 2008). Amadioha (2003) studied the effectiveness of alcohol and water extracts of *Citrus limon, Ocimum sanctum and Piper nigrum* against *Colletotrichum lindemuthianum which causes* leaf spot disease of cowpea where he reported that *P. nigrum* extracts were the best in inhibiting the growth of the pathogen. Antifungal activity of 11 commonly found weed extracts against *Fusarium oxysporum* wilt were investigated by Pal and Kumar (2013). They reported *Ageratum conyzoids*, *Agremone maxiacana* and *Cannabis sativa* as most effective against *F. oxysporum*. Pal *et* al. (2013) suggested that chloroform and methanol extracts of *Ageratum conyzoides* and methanol extract of *Parthenium hysterophorus* can be effective against phytopathogenic fungus *Alternia spp*. Ganie *et* al. (2013) studied antifungal activity of five plant extracts against leaf spot of mustard and wilt of tomato caused by *Alternaria brassicae* and *Fusarium oxysporum* respectively. Devi and Chehetry, (2013) studied antifungal properties of certain plants against brown leaf spot of rice caused by *Drechslera oryzae* in Manipur valley. Harde and Suryawanshi (2014) investigated antifungal activity of some botanicals against *Alternaria brassicae* which causes *Alternaria* blight of mustard. Among the botanicals used i.e. *Allium sativum, Azadirachta indica*, *Bougainveillia spectabilis*, *Datura metal*, *Eucalyptus globules, Lantana camara*, *Lawsonia innermis*, *Oscimum sanctum*, *Parthenium hysterophorus*, *Polyalthia longifolia*, *Tridax procumbens* , *Vinca rosea* and *Zingiber officinale* it was reported that *A. indica* was found most effective against the fungal pathogen with a growth inhibition of 80.46 % and *P. hysterophorus* was found least inhibitory with a growth inhibition of 16.05%. In*vitro* antifungal activity against plant pathogenic *Fusarium oxysporum* by the different weed *Capparis deciduas*, *Lantana camara* and *Tridax procumbens* extracts were reported by Sharma and Kumar, (2014). Das *et* al. (2014) studied the effect of leaf extracts of 18 different plant species against foliar blight of Soalu (*Litsea monopetela*) which is also a primary food plant of muga silkworm caused by *Colletotrichum gloeosporioides* Penz. Among which, *Bougainvillea spectabilis* , *Alium sativum* and *Chromolaema odoratum* were found most effective at all concentration. Nutritionally rich and high yielding varieties of food plants are one of the major criteria of Silkworm industries. The food plants of silkworms are always threatened by various factors such as foliar diseases, pests and others (Anonymous, 1962). Diseased leaves are poor in its biochemical constituents such as proteins, sugars and moisture. Silkworms feeding on such

leaves has been found adverse affect on the growth and health of larvae resulting in poor cocoons production.