A Review on Major Diseases In Mulberry And Silkworm – Their Management Practices

ArasakumarE[1], K.ThangaRoja[2], S.Ranjith Kumar[3], M.Mithilasri[4]
FOREST COLLEGE AND RESEARCH INSTITUTE, METTUPALAYAM - 641 301

Abstract- *The economic part of mulberry plant is leaves, which is fed to the silkworms to synthesis the natural silk fibre. The quantity and quality of the leaves are destroyed by the several diseases that either caused by fungi or bacteria or virus such as rot, powdery mildew, leaf spot, leaf rust, leaf blight, etc. Those diseased leaves fed to the silkworms are poor in nutrition and they may influence to develop the viral, bacterial and fungal diseases in silkworms like grasserie, flacherie and muscardine with varied environmental conditions. So, the diseases of mulberry and silkworm are reduced by adopting the different control measures such as cultural, botanical, biological and chemical measures. These control measures are found to significantly reduce the diseases in both mulberry field and silkworm rearing room without showing residual effects*

Keywords- Mulberry, silkworm, diseases and management practices.

I. INTRODUCTION

Mulberry is one of the economically important perennial plant cultivated under wide range of agro climatic conditions and grow optimally at 24-27^{o}C. It is widely cultivated from temperate regions of Europe and North America to tropics of Asia and Africa. Mulberry leaves contributes about 40 per cent towards successful rearing. It is reported that silk proteins produced by the silkworm are directly derived from the mulberry leaves. Mulberry forms the basic food material for silkworm and its leaves are sole source of nutrition for the growth of silkworm. Production of mulberry leaves on scientific lines is essential for organizing sericulture on sound economic lines. These plants are grown as bush in tropical countries and as middling and tree in temperate countries where the rate growth is slow and entered into the dormant stage.

Plant diseases are known from time immemorial. The old writings including Bible mentioned about the plant diseases such as rusts, mildews, blights and blasts causing hazards to a plant when it does not get essential environment for its normal growth. There are different kinds of diseases in mulberry which are caused by fungi, bacteria, viruses and mineral deficiencies. The incidence of diseases varies with season, mulberry varieties and cultivation practices. Mulberry being perennial in nature, the pathogens seem to readily perpetuate and spread extensively to other areas. Certain alternate and collateral hosts (mainly weeds) also play some role in perpetuation of some of the pathogen there by affecting the economy of sericulture both in quality and quantity of leaves produced. Mulberry plants are attacked by number of diseases due to the interactions of the pathogens, host, and environment which results in leaf yield loss. Among important diseases of mulberry, powdery mildew, leaf spot and leaf rust are main foliar fungal diseases and root rot also causing considerable yield reduction in tropical regions.

II. MAJOR DISEASES IN MULBERRY

A large number of diseases were recorded in mulberry, so far twenty diseases caused by fungi, bacteria, viruses, mycoplasma and nematodes had been reported (Sukumar and Padma, 1999). Powdery mildew disease is characterized by white dust-like mycelia that develop over abaxial leaf surfaces. Heavily infected tissues develop chlorosis and senesce prematurely. The resulting foliage loss, typically 20 per cent reduces substantially the cocoon yield (Gupta 2001).

Biswas *et al*. (2002) studied five mulberry diseases, *viz*., Powdery mildew, Anthracnose, Leaf rust, Red rust and Bacterial blightfor their occurrence in four mulberry cultivars, Kosen, BC259, Tr- 10 and S146in hilly regions of Darjeeling. Co-efficient of disease index varied significantly with host genotypes, crop seasons and years for all the diseases except bacterial blight. Kosen was found to be most tolerant to foliar diseases and its tolerance towards leaf rust was less as compared to variety BC259. Rainy season was reported to favor the occurrence of anthracnose, while autumn season, favored leaf rust. In spring season comparatively less disease were recorded.

Among the various soilborne diseases of mulberry,the infection of root knot and root rot results in severe leaf yield loss apart from deterioration in leaf quality (Sharma *et al.*, 2003). Chowdary, (2006) reported that the root rot caused by soil borne fungi is more alarming due to the epidemic nature of pathogens, its potential to kill the plant and moreover lack of effective control measures against the disease. However, the dry root rot caused by *F. solani*, black root rot caused by *Botryodiplodiatheobromae* and charcoal root rot caused by *M. phaseolina* were reported from India (Chowdary *et al.*, 2003).

Ghosh *et al.* (2003) studied leaf spot disease incidence on five high yielding and one localmulberry cultivars during the month of May to September. Among the six varieties studied, the local cultivars were found to be highly susceptible to *Cercospora*and highest disease incidence of 55.60 per cent was recorded. On the other hand, cultivars BM-4 (16.97%) and BM-5 (18.46 %) were found to be moderately resistant.

Dikshit *et al.* (2006) observed high incidence of powdery mildew during August-December and lesser incidence of disease during March-June, because of prevalent dry weather conditions.

Maji *et al.*(2009) screened 56 indigenous and 29 exotic mulberry varieties against powdery mildew and leaf spot under field condition of West Bengal. Four mulberry genotypes *viz*.,Thailand lobed, *Morusmulticaulis*, Italian,*M. australis* were found to be highly resistant. Nine lines were found to be resistant, 43 lines were moderately resistant and 29 lines were susceptible to the disease complex. Powdery mildew showed significant positive correlation with *Pseudocercospora*(leaf spot) and recommended highly resistant varieties for utilization for future disease resistance breeding programme.

Chattopadhyay *et al.*(2010) screened 147 germplasm mulberry sources for resistance to *Phyllactiniaguttata* under field and greenhouse conditions after exposure to natural and artificial inoculums respectively. In the field, the level of plant response to disease was assessed from 30 to 62 days after pruning. The area under the disease progress curve (AUDPC) values were 13.5 fold higher in most susceptible accession. Moreover, field screening results had high correlation with values obtained from green house evaluation wherein artificial inoculums were used.

Chauhan *et al.* (2010) studied the incidence of powdery mildew on eight different mulberry varieties namely Tr-10, S-1, S-146, S-13, S-1635, AR-12, AR-14 and Br-2 in autumn season. The disease severity ranged from few spots to numerous lesions covering entire leaves resulting into decrease in quality of mulberry leaves to a tune of 50 per cent.The results revealed that powdery mildew was significantly less prevalent in Br-2 variety during autumn season.

Dutta *et al.* (2011) studied different disease severity of mulberry varieties S-1 and S1635and reported that disease not only reduced leaf yield but also caused degradation in leaf quality. Maximum severity of rust (PDI-15.79) was observed during November and severity of ETL was more during September to November.Low incidence of rust (<ETL) was observed during June to August and April.

Illahi*et al.* (2011) studied the prevalence of mulberry diseases in Kashmir along with seasonality and severity on five mulberry varieties from July to October and reported that the powdery mildew was prevalent throughout Kashmir valley. The disease incidence (DI) and percent disease index (PDI) of 3.47 and 1.04 was respectively observed in the month of October. Powdery mildew incidence was least (5.4%) on Chinese white and maximum (41.57%) on Goshoerami. Irrespective of the mulberry varieties the incidence of disease ranged from 18.47 to 29.35 per cent. Irrespective of locations, it ranged from 9.71 (KNG) to 35.39 percent (Tr-10). Leaf spotprevalence was also noticed throughout the valley with incidence and severity levels ranging between 9.12 and 2.66 per cent to 18.58 and 5.14 per cent, respectively.

Mir *et al.* (2012) studied mechanism of resistance on four year old mulberry trees ofGoshoerami, Ichinose, Kairynezamigaeshi, Rokokuyaso, Chinese-white, Tr-10 and local genotype Chattatual for leaf spot and powdery mildew diseases. The authors reported that plants defend themselves against pathogens by mean of structural characteristics which act as physical barriers and inhibit pathogen from gaining entrance and spread through host. They further reported that the anatomical features play an important role to hinder the infection and spread of the pathogens causing the disease.

Dutta *et al.* (2012) reported maximum severity of leaf rust was observed during November (PDI 16.89) and minimum severity during September (PDI 1.47) in S1635 mulberry variety.

(Chandra Datta and Rupa Datta, 2012) reported that leaf spot disease caused by *Cercosporamoricola*resulted in leaf yield reduction of around 10-35 per cent with considerable decline in moisture, protein contents. They also observed that powdery mildew disease reduced the leaf yield by 10-30 per cent the crude protein by 33 per cent.

Maji *et al.* (2013) carried out evaluation of powderymildew disease to response of S-1635 under organic versus conventional farming system with application of vermicompost (15 T) + biofertilizers + NPK (168:90:56) which results that powdery mildew severity was significantly reduced with PDI of 4.07.

The diseases caused by various pathogens like fungi, bacteria and viruses in mulberry decreased the leaf yield by 12-25 per cent either by depletion in nutritive value or defoliation (Vijaya Kumari, 2014).

Chikkaswamy*et al*. (2014) studied incidence of major foliar fungal diseases of mulberry (leafspot, rust and powdery mildew) in twenty villages at monthly intervals. The incidence of leaf spot wasfound to be maximum in the month of November, while it was minimum in the month of May. Theincidence of leaf rust was maximum in November and June and minimum in February and May. Powderymildew was found maximum in July to November and minimum from December to April. It was furtherreported that relative humidity for leaf spot, rainfall for leaf rust, maximum temperature and rainfall forpowdery mildew had significant negative relationship with the diseases incidence.

Vijaya kumari, (2014) reported that root rot caused by a fungus *Fusarium solani*and *Fusarium oxysporum*and resulted in yield loss to 30-40 per cent. Further mulberry also affected by nematodes, are microscopic roundworms have a spear-like stylet mouthpart, require free water to move about, and reproduce by eggs. They cause root knot disease in mulberry more prevalent in sandy, irrigated soils in summer season and recorded maximum infestation upto 80 % (Nishitha Naik et al., 2003). The affected plant shows root galls, stunted growth, marginal necrosis and yellowing of leaves. Nematodes are also known to cause disease complexes in association with other pathogens resulting in huge yield loss.

Management of diseases in mulberry

Chemical control measures

Naik *et al.* (2004) reported that to control the damping of disease in mulberrywere conducted experiment on treatment of cuttings, soil drenching and foliar spray alone and in combinations. Among these treatments integration of cuttings treatment and soil drenching of Dithane M-45 (Mancozeb 75% WP) + Bavistin (Carbendazim 50% WP) followed by foliar spray of these fungicides (after 35 days of plating) resulted in better survivability of saplings (93.3 %) on 90’th day and controlled the pre and post emergence damping off by (100 %) and (89.5%) respectively over the check.

Chowdary *et al.* (2011)*Alternaria alternata*caused leaf blight disease in mulberry that can be controlled by application of Ferrous sulphate at(0.2%) in two foliar sprays which is effectively reduced the disease severity to extent of (85.62%)and increased the leaf yield upto (23.04%).

Narayanan *et al.* (2015) reported that following fungicides such as carbendazim, carbendazim + mancozeb at (0.1 %) showed the complete reduction of mycelial growth (100 %) of *F. solani*followed by tebuconazole 0.1 per cent reduced (66. 5 %) of mulberry root rot in pot culture experiment.

Monir & Mandal (2016) suggested different chemical measures to manage the major foliar diseases of mulberry followed as bavistin (Carbendazim 50 WP) at (0.2 %) 1 kg dissolved in 500 litres of water and sprayed to prevent leaf spot and powdery mildew diseases.Kavach (Chorotholonil WP) 1 kg dissolved in 500 litres of water and sprayed to prevent leaf rust. Dithane M-45 (Mancozeb 75 WP) 1 kg dissolved in 500 liters of water and sprayed to prevent leaf blight due to fungi and bacteria. Zinc sulphate (agro grade) 4.4 kg in 440 liters of water to increase leaf quality and quantity.
Application of nematicides like Aldicarb or carbofuran at the rate of 40kg/ hectare/ yr in four equal splits along with fertilizer is good to control the nematode. Also chemicals like dibromochloropropane or chloropicrin also found to be effective against nematode (Govindaiah*et al.,* 1997; Ertian 2003).

Biological control measures

Choudhari*et al*. (2012) reported that *T. viride* reduced (73. 6 %) the mycelial growth of *F. solani*in mulberry.Three antagonists,*Trichoderma viride, T. harzianum* and *Pseudomonas fluorescence* and five fungicides carbendazim, captan, dithane M-45, thiophanate methyl and thiram were tested against *F. solaniin vitro*. *T. viride* was best in inhibiting the growth of pathogen by 73.6 per cent. Among the fungicides carbendazim, completely inhibited the growth of pathogen at all concentrations 100, 250 and 500 ppm (Choudhari*et al.,* 2012).

Mangement of root rot by dipping the saplings in (0.1 %) bavistin solution for an hour and dusting of Dithane M-45 in the pits before plantation is recommended and biocontrol formulation called Raksha containing *T.harizhianum*and integrated with another bioformulation of *Pseudomonas flourescens* is recommended @ 500 g/plant (Vijayakumari, 2014).

Antagonist and organic amendments bioconsortia (seri bed waste+Pf1+Bs4+Th1+neem cake) were found to be restricting the *F. solani* pathogen in mulberry roots by inducing inherent plant defense enzymes such as peroxidase, polyphenoloxidase, phenylalanine ammonia lyase, phenols, catalase and superoxide dismutase which reduced the incidence of mulberry wilt in glasshouse condition (Narayanan *et al.*, 2016).

Bio-nematicide like bionemais used to manage nematode population. It contains *Verticillium chlamydosporium* which parasitizes nematode eggs. When applied with neem oil cake death of nematode larvae were recorded (Sharma, 1999).

Botanical control measures

Maji *et al*. (2005) reported that brown leaf spot of mulberry caused by *Myrothecium roridum*was best controlled *in vitro* by spraying leaf extract of *Allium cepa*L. (33.3 % inhibition of colony growth), followed by neem extract (25 % inhibition).

Application of water extract of *A. sativum* or *Datura metel*L. against *Pseudocercospora mori* (Hara) Deighton that causes grey leaf spot resulted in maximum inhibition (33 %) in mycelial growth (Maji *et al*. 2005).

Thecommercial product, Akasmoni 200C(containing crude aqueous extract of the funicles (ovary stalks) of *Acacia auriculiformis* and *A. Cunn*.) reduced the incidence of *Cercospora*leaf spot up to 50 per cent (Datta and Datta 2007).

In *in vitro* tests, the highest mycelial growth inhibition (72.6 %) of *Cercosporamoricola*Cooke (white leaf spot) was recorded for water extract (10 %) of *Eucalyptus globules* Labill., and was followed by 49 per cent inhibition with extract (10 %) of *O. sanctum*(Rajagopal Reddy *et al*., 2009).

Cold water extracts of the six plants were tested *in vitro* against mulberry leaf spot pathogens, *C. moricola*, *Alternaria alternata*and *Cladosporium cladosporiodes*and extracts of plants *viz*., *Artemisia absanthemum*, *A. sativa*, *Euphorbia ligularia*Roxb, *Zingiberofficinale*and *D. metel*showed more than 85 per cent conidial inhibition *in vitro* with a 94.56 per cent in *A. absanthemum*and more than 50 per cent decrease in leaf spot disease incidence. All the plant extracts showed more than 50percent mycelial inhibition with respect to control (water). The highest mycelial inhibition of more than 70 per cent was found in *E. ligularia*followed by *Z. officinale*in all the three pathogens. So, these plants with anti-fungal properties could be utilized against these pathogens, at least to lessen the impact of these pathogens (Ul-Haq*et al.*, 2014).

Major silkworm diseases

Viral diseases

The silk industry faces severe setbacks due to frequent disease outbreaks since most of the commercially reared silkworm speciesare highly susceptible to the diseases like pebrine, flacherie, grasserie and muscardine. In India approximately 40 per cent crop lossis attributed to these diseases (Sheebarajakumari*et al.*, 2007).

Bontha*et al.*(2009) reported that, grasserie and flacherie incidence were maximum in summer season and minimum in winter season, whereas, muscardine was observed high in winter season and rarely in rainy season.

Mahalingam *et al*. (2010) reported that grasserie incidence was maximum in the month of May (20.55 %) followed by April (18.07 %) whereas, least incidence was observed during September (2.48 %). They subjected to high temperature and high humidity inside the rearing room and fluctuations in diurnal temperature and humidity might be the causes for high grasserie incidence during summer.

Chakrabart*et al*, (2013) reported that symptoms of grasserie disease in silkworm which is commonly known as jaundice or milky disease.The larvae affected with the virusbecome restless and impatient, incessant crawling around the edge of rearing trays, larval integument becomes shiny and thin with swelling between the segmentsand integument becomes fragile and ruptures easily liberating turbid haemolymph containing innumerable polyhedral bodies.

Grasserie disease in silkworm caused by Nuclear Polyhedrosis (NPV) due to the prevalence of high temperature, high humidity and feeding of poor quality mulberry leaves fed to the silkworm (Sneh, 2017).

Bacterial diseases

Mulberry silkworm is prone to bacterial infection which is most serious as it occurs throughout the year (Taha, 2002). The flaccidity caused by bacteria to the silkworm is referred to as bacterial flacherie the most commonly associated bacteria for bacterial flacherie in India is the species of *Streptococci* and *Staphylococci* (Nataraju*et al.*, 2005). The occurrence of bacterial flacherie disease was more during silkworm rearing under unfavourable conditions crop losses up to 30 to 40 per cent(Santha*et al*., 2007).

Predominant species of disease causing bacterial pathogens *viz*., *Bacillus subtilis*, *Streptococcus pneumoniae*, *Staphylococcus aureus*, *E.coli*, *Pseudomonas fluorescence*, *Bacillus cereus* and *Klebsiella cloacae* were isolated by Sakthivel *et al.* (2012) from silkworm cadavers.

Fungal diseases

Aspergillus spp. wasrecorded that among 72 per cent of farmers in Karnataka during Chawki rearing stage which is affected the newly hatched larva, which are susceptible and mortality was 100%. This mortality is slow and continuous, when infection takes places at the advanced larval stages (Chandrashekariah*et al*., 2002).

In India, the percentage of *Aspergillus* diseaseincidence ranged from 5.32 (February-March) to 21.36 (July-August) (Vineet Kumar *et al.*, 2004).

According to Maribashetty*et al.* (2010)*Aspergillus* spp. cause brown muscardine disease in silkworm during early instars and cause crop loss upto13.04 Kg / 100 Dfls.

Hou Chengxiang*et al.* (2014) reported that *Beauveria bassiana* pathogenic fungus cause white muscardine disease to the silkworm. The infected silkwormsbecome white chalk and oily spots appear on the body surface, which is the typical symptom of white muscardine.

Low temperature and high humidity conditions are favorable for the growth of *Aspergillus*, which results in reduction of (10-20 %) cocoon yield (Shobha *et al*., 2016).

Management of silkworm diseases

Botanical measures

Manimegalai*et al.* (2000) reported that the efficacy of turmeric powder + chalk powder (1:5), dust formulations of *Psoraliacoryleifolia* and *T. terrestris* against grasserie disease of silkworm, *B. mori* and found that application of turmeric powder + chalk powder (1:5) @ one kg/100 DFLs once during third, fourth and fifth instars immediately after moulting resulted in reduction of grasserie by 63.16 and 62.45 per cent in summer and winter, respectively besides enhancing the larval and cocoon characters.

Seri-Rich is a plant based anti-viral formulation comprising of antiviral substances isolated from plants and is reported to be effective against all silkworm diseases (Anonymous, 2005). Oral administration of 10 per cent *Spirulina platensis* was found to be resistant to *Bm*NPV (Mahesh Babu*et al.*, 2005).

Manimegalai and Chandramohan (2006) reported that the seed extract of *P. corylifolia*and extract of *Plectranthusamboinicus*to third instar larvae of silkworm crossbreed, PM×NB_4D_2 resulted in reduction of 57.63 and 59.78 percent mortality as against 61.63 percent incidence in standard check.

Padma and Manimegalai (2007) reported that the aqueous extract of *P. amboinicus*and *P. corylifolia*were effective in suppressing grasserie with mortality of 24.00 and 25.33 per cent in the cross breed, PM x CSR2. The per cent mortality was found to be higher in bivoltine single hybrid than the bivoltine double hybrid.

MadanaMohanan*et al.* (2007) reported that among the plant extracts (PE)tested, 5 per cent aqueous crude extract of the bulb of *A. sativum* has been found to be most effective against *B. bassiana*. The radial growth of*B. bassiana**in vitro* was inhibited to the tune of 54.9 per cent in aqueous extract and 54.4 per cent in ethanolic extract of *A. sativum* and correspondingly mycelia dry weight gave rise to 110.7 mg and 108.7 mg against 201.7 mg in control 15 days post treatment.Similarly, silkworm larvae topically inoculated with the *B. bassiana* conidia (1.8×10^6/ml) registeredsurvival up to 53.0 per cent against 0.0 per cent in control aftertreatment with aqueous extract of *A. sativum*.Silkwormlarvae put to rear in conidia contaminated seatpaper instantly treated with aqueous extract of *A. sativum* that increased survival up to 61.0per cent against 4.6 per cent in control.

Mahalingam*et al.* (2010) recorded mortality of 1.35 percent in the treatment with (TNAU seridust +*Psoralia*extract per os application), followed by 1.50 per cent in treat with(Vijetha+ *Psorali*extract *per os*application). Highest mortality of 3.28 percent was recorded in untreated control.

Isaiarasu*et al.* (2011) carried out *in vitro*studiesto assessthe efficacy of some herbal extracts for the containment of these microbes through turbidimetry analysis andzone of inhibition test. The observations revealed that the aqueous and alcoholic extracts of three herbs *Acalyphaindica*, *Oscimum sanctum* and *T. procumbens*were effective againstmuscardine diseases in silkworm. The comparison of their effects indicatedthat alcoholic extracts were generally more effective than aqueous extracts.

Sahib *et al*. (2011) reported that aqueous, alcoholic and ethyl acetate extracts of leaves of *Terminalia alata, T.arjuna, T. bellerica, T. catappa* and *T. chebulla* were found to act against *A.flavus, A.niger, Alternaria alternate and Helminthosporiumtetramera* (plants and seeds) at 0.5ml concentration.

Karthikairaj*et al.* (2013) reported the leaf extracts along with biologically active principles from threemedicinal plants such as Pakarkai (*Momordiacharendia*), Thulasi (*Ocimum sanctum*) and Nilavembu(*Andrographis paniculata*) were tested for the bacterial flacherie in silkwormand has been reported to be caused by bacteria like *Bacillus,Pseudomonas, Staphylococcus, Serratia* and *E. coli.* The antibacterial activity of medicinal plant extracts were tested in both aqueous andalcoholic extracts with the concentration of 50, 100 and 150 µl. The sensitivity rate was much effective in bothaqueous and alcoholic extracts of *A. paniculata*, when compared to *M. charentia*and *O. sanctum* and it canbe used for the control of flacherie disease.

According to the Thangavel*et al.* (2015) extract of five medicinal plants such as *Emblica officinalis, Calendula officinalis, Cassia fistula, A. sativum* and *Pelorgoniumhortroum* for controlling the grasserie disease. Among thetreatments*E.officinalis* (1000ppm) gave lower larval mortality (43 %) which was on par with*C. officinalis* (1000ppm) which gave (45 %) and untreated control (57 %). Higher larval mortality (65 %) reportedin 1000ppm of *A.sativum* treatment. The treatment *E. officinalis* (1000ppm) gave higher cocoon weight (1.03g) which was on parwith the untreated control (0.98g) and *C. officinalis* (1000ppm) (1.04g) which was also on par with the untreated control. *A. sativum* (1000ppm) recorded the lowest values of cocoon weight (0.83g).

Studies carried out *in vitro* to assess efficacy of some herbal revealed that the aqueous extracts of five herbs such as, *Ecliptaprostrata, Phyllanthus niruri, Punicagranatum, Acalyphaindica*and*Cannamomumzeylenica*were effective against microbes causing flacherie and muscardine disease in silkworm. Of the five herbal extracts *Acalyphaindica* and *Cannamomumzeylenica* were found to be more effective antibacterial nature than the others (Jansi Rani *et al.,* 2016).

Chemical measures

Kawakami (2001) reported that spray of 0.3 per cent slaked lime solution in addition to usual disinfection procedure is recommended prior to rearing whenever high incidence of grasserie was experienced in the preceding crop.

Phillips *et al.* (2004) reported that antibiotics *viz*., penicillin, streptomycin, tetracycline and chloramphenicol were effective against grasserie.

The antibiotics such as Gentamycin, Ampicillin and Tetracycline were found to be effective in reducing the mortality of silkworms by 23-25 per cent without affecting the cocoon parameters. Supplemention of these antibiotics with mulberry leaves resulted in significant reduction in the occurrence of both grasserie and flacherie diseases (Santha*et al*., 2007).

According to Bontha*et al.* (2009 a) 2 per centbleaching powder is commonly used as adisinfectant in rearing roomkillsthe pathogens causing flacherie, grasserie and muscardinediseases to the silkworm.

Venkatesh Kumar and Amit Srivastava (2010) reported that antibiotics are among the most frequently advocated medications in modern medicine which show promising results in controlling bacterial and viral diseases insilkworm.

Asthra and Ankush used for the management of silkworm diseases and test verified and found effective. These two products were commercialized for large-scale production and showing wide acceptance among farmers (Balavenkatasubbaiah *et al.*, 2014).

III. CONCLUSION

Conclusion of this review study the above mentioned various control measures for both mulberry and silkworm diseases, botanical and biological control measures showed significant reduction of pathogens they act as antagonism effects with pathogens in low level of disease incidence where as the disease become more severe chemical measures helps to reduce the pathogens at considerable rate. However, the chemical measures showed the toxicant effects on the silkworm that may be avoided by adopting the integrated disease management strategies. To increase the potential yield of sericulturalists the appropriate disease control measures must be followed in field level.

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