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Integrated Pest and Disease Management (IPDM) Approach in Mulberry Sericulture of Jammu & Kashmir

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Abstract

Jammu and Kashmir is one of the traditional sericultural states of India, produces 735 MT of cocoons which is converted into 98 MT of raw silk. Spring is the major silkworm rearing season of J&K when fresh mulberry leaf is available for rearing the silkworm, *Bombyx mori* L. The food plant of silkworm, mulberry is affected by various insect pests *viz*., *Glyphodes pyloalis*, *Spilosoma oblique*, *Amsacta lactinea*, *Hemerophilla atrilineata etc*., and diseases like leaf spot and powdery mildew. In integrated pest and disease management of mulberry various factors such as cultural, mechanical, biological and bio-pesticides management practices have been adopted to control the pests as well as the diseases of mulberry. The major diseases are powdery mildew and leaf spot which affect the foliage of the mulberry plant thereby reducing the quality and quantity of the silkworm feed. The present study was conducted to identify the suitable IPDM approach to manage pest and diseases in mulberry sericulture of Jammu & Kashmir. Results showed that the impact of IPDM the incidence of insect pest to an extent of 43.66% and 48.82% by leaf Webber and semilooper respectively. Leaf spot and powdery mildew disease of mulberry was also reduced up to 39.56% and 49.92% respectively. By adopting 100% IPDM module cocoon yield was increased up to 4 kg 100 disease free laying (dfl).

Keywords: Groundnut, Imidacloprid, Pod damage, Seed treatment

Introduction

Sericulture is practiced more than fifty countries in the world. Mulberry is the only host plant of the silkworm *Bombyx mori* L. Apart from mulberry; there are three more silkworms, Eri, Muga and Tasar. These non-mulberry varieties of silks are generally termed as vanya silks. India has the unique distinction of producing all these commercial varieties of silk. To get the successful silkworm crop mulberry plant and its foliage should be free from certain insect pests and diseases, so that quality leaf could be fed to the silkworm during the rearing. Besides, affecting the quality of mulberry leaf, Pests and diseases reduces the quantity of the feed also thereby effecting the total production. The leaf yield gets affected to the extent of about 30% (Sharma and Tara, 1985). The extent of leaf loss caused by the important insect pests and diseases in traditional states of India is estimated 20-25% at an average of 6,000 kg ha^{-1} $year^{-1}$ (Rajadurai, 2005). Jammu and Kashmir being a traditional sericulture state of the country produces 735 MT of cocoons which is converted into 98 MT of raw silk. Like other states, in J&K mulberry is affected by certain insect pests and diseases which hamper 2nd and 3rd cocoon crop in the region. Though, due to repeated leaf harvests, the pest and disease menace is considerably checked, still a number of pests and diseases have been reported on mulberry (Rangaswami *et al.*, 1978; Teotia and Sen, 1994). In Jammu and Kashmir, among insect pests of mulberry, are Leaf Webber - *Glyphodes pyloalis* Wlk. Lepidoptera: pyralidae (Figure 1); Black hairy caterpillar - *Amsacta lactinea* - Cramer (Figure 2); Looper - *Hemerophila atrilineata* Butler Lepidoptera: Geometriidae (Figure 3); and Stem Borer - *Batocera rufomaculata* De Geer (Figure 4) (Khan *et al.*, 2006). Among various mulberry diseases affecting

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mulberry foliage, the most common is leaf spot (*Cercospora moricola* Cook & *Phlespora maculans* Ber.): Deuteromycetes - Moniliales (Figure 5) and powdery mildew (*Phyllactinia corrylea* Pers. Karst.) Ascomycete - Erysiphales (Figure 6). In general, to manage the insect pest incidence and diseases in mulberry, farmers are using chemical insecticides/ pesticides, which harm the ecosystems and create residual toxicity. To overcome such important issue work on IPDM in mulberry sericulture has been conducted under Central Sericultural Research and Training Institute, Central Silk Board, Pampore, J&K to reduce the use of chemicals in mulberry cultivation of J&K. Integrated Pest and Disease Management (IPDM) being multidisciplinary, ecological approach has not only reduced the use of chemicals, besides minimized the insect pest/ disease incidence, but has increased cocoon yield also.

Materials and Methods

Prevalence, Severity and Distribution

First a comprehensive survey was conducted in selected sericultural area of Jammu and Kashmir covering all major mulberry farms of farmers as well Govt. mulberry nurseries. Each farm was visited after every fortnight and data was recorded on prevalence of each major infestation. Second, a separate data sheet was prepared to record the data on severity of each insect pest and diseases based on the grades of infestation. Then each insect pest and disease was tabulated under the caption of pest and diseases incidence percentage and percent pest damage/ disease index (PI & DI) and (PDI). Thirdly, each insect pest and disease based on its occurrences in different areas was recorded to confirm their distribution on different mulberry varieties area wise having diverse agro climatic conditions.

Study on prevalence, severity and distribution of each pest and diseases helped to prepare future road map to formulate the module of IPDM in the region. Cultural, mechanical, physical, biological, bio-chemical & chemical control were adopted in different experiments by using various concentrations of bio-chemical solutions, maintaining control of existing practices to compare the results. During formation of bio-chemicals, locally available plant extracts such as *Allium sativum* L., *Artimesia absenthium* L. and *Euphorbia linularia* Roxb., were screened against insect pests and diseases of mulberry and incorporated in the IPDM module. Synthetic chemicals like Dimethoate, Carbendazim and Chloropyrophos were also included in the IPDM module but their spray schedule and quantity was reduced more than 50%. Insect pests and diseases of mulberry pass a reasonable period in dormancy during winters. During the survey, it was also confirmed that insect pests hide themselves in the dried leaves, soil and cleaves of mulberry plants as pupae and pathogenic spores of leaf spot and powdery mildew retain on the dried leaves in the mulberry farm. These overwintering pests and disease organisms multiply very fast and, if not managed will damage mulberry foliage to a large extent in next season. Hence, various cultural, mechanical control strategies were adopted to destroy these overwintering enemies.

Results and Discussion

Based on the results of integrated insect pests and diseases module in mulberry, it is inferred that collective management measures could reduce insect pest and diseases of mulberry considerably and keep the damage below the economic threshhold level. Hence, an IPDM module having all the components compatible with the agronomical practices for mulberry cultivation in Jammu & Kashmir is depicted in table 1.

The components of the IPDM in mulberry cultivation in Jammu & Kashmir are as follows.

Cultural Control

• Burning of winter leaf debris in the month of November destroys completely overwintering pupae of *Glyphodes pyloalis* and pathogen spores of *Phyllactinia corylea* and *Cercospora moricola*.

Table 1: Integrated Pest and Disease Management of Mulberry Module in J&K

Month	Period	Activity
November	1st Week	Collection of dried mulberry leaf from plots and burning.
November-December	Any Time	Winter Hoeing, exposure of overwintering pupae of insect pests to predatory birds.
March	2nd to 3rd week	•1st fungicidal spray of 0.2% carbendazim (150 litre acre^{-1}). • Spring hoeing and keeping water pots in the mulberry farm to increase movement of birds.
April	2nd to 3rd week	• 1st spray of *A. sativum* conc. 3% (alcoholic) 6% (Aqueous) extracts to mulberry plants @ 200 litre acre^{-1} and 250 litre acre^{-1} respectively.
June	After pruning (Last week)	• Spraying 3% alcoholic extract of *Artimesia* @ 200 litre acre^{-1}. • Installation of light traps having white mercury bulbs.
August	1st week	• 1st spray of *A. sativum* conc. 3% @ 200 litre acre^{-1}. • 2nd spray of *Artimesia* conc. 3% @ 200 litre acre^{-1}. • Spray of *Euphorbia* conc. 3% @ 200 litre acre^{-1}.
October	1st week 2nd week 3rd week	• Spraying of Dimethoate 0.2% @ 100 litre acre^{-1}. • Spraying of Carbendazim 0.2%. • Spraying of Chloropyrophos 0.2%.

• Winter Hoeing in the month of November/ December followed by March exposes the hidden pupae in the soil and expose them to predators and birds.

• Preferring tree type of plantation as compared to bush and dwarf reduces the infestation of insect pests and diseases. It was observed pest incidence (PI) of *G. pyloalis* was less 11.22% in tree type plantation whereas it was 19.46% in bush and 26% in dwarf type of plantation. Likewise, low leaf spot was observed on tree (0.31 PDI) followed by bush (1.53 PDI) and 4.13 PDI in dwarf plantations. Powdery mildew was recorded 7.82 followed by 10.28 and 12.47 PDI in tree, dwarf and bush respectively.

Mechanical Control

• Installation of light traps in the mulberry at adult stage of *Glyphodes pyloalis* in the month of March/ April attracts the new emerging adults.

Biological Control

• While observing hyper activity of natural enemy complex, *Apentteles obliquae* was found to be most predominant larval parasitoid against *G. pyloalis*, followed by *Pristomerous sculci* and *Bracon hebtor*. Extent of parasitism by *A. oblique* ranged from 28% in the month of August to 30.64% in October.

• *Halzia tschitscherni* Semenor (Coleoptera: coccinellidae) a lady bird beetle was found potential biological control agent against powdery mildew diseases of mulberry. It was observed that five numbers of beetles are having potential to consume 100% *P. coreylea* patch of 1.25 cm^2 within 24 hours.

Bio-Pesticides/ Plant Extracts

• Certain locally available plant extracts screened for insect repellent and anti fungal activity were *Juglans regia*, *Datura straumonium*, *Euphorbia* sp., *Artimesia* sp., *Allium sativum* and two bio-insecticides and bio-fungicides, Praghat and Prabal respectively showed variable results. It was also found that alcoholic extract of these plant materials were more effective than that of aqueous extracts. Among the above plant extracts, *Juglans regia*, *Datura straumonium* showed highly repellent character thereby making mulberry feed unpalatable. However, *Artimesia*, *Allium sativum* and *Euphorbia* showed high efficacy against insect pests and fungal spores.

Chemical Control

• Different chemical insecticides and fungicides used as a component of IPDM was selected based on their less toxicity level. Chemicals like, Dichlorovos, Dimethoate, Endosulphan and Chloropyrophos in case of insect pests. For mulberry diseases, Captan, Mancozeb, Carbendazim were tested. It was revealed by the results that 0.2% Carbendazim is less toxic and 0.2% Dimethoate and Chloropyrophos are giving best results in controlling insect pests and diseases in mulberry.

Host Plant Selection

• Different mulberry varieties *viz*., Ichinose, Goshoerami, Rokokuyaso, Kairyoroso, Kokuso, Kasuga and Chinese white were screened for *G. pyloalis* infestation. It was found that Rokokuyaso was least infested by the pest. Powdery mildew was found highest on TR-10 mulberry variety and least in Chinese white. Leaf spot disease was found least on Rokokuyaso and Goshoerami.

By using all the above management components, the input cost and returns to the seri-farmers, three to six kg of extra cocoon yield per 100 dfls is depicted in the table 2 and 3.

Integrated Pest and Diseases Management (IPDM) in

Table 2: Input cost on IPDM module for mulberry in Jammu and Kashmir

Sl. No.	Input cost	Input cost		Area 1.00 acre	
		Availability (lit. kg^{-1})	Rs.	Qty (Kg)	Cost (Rs.)
1	*Allium sativum* L.	Locally market	80.00	34 kg	2,720.00*
2	*Artimesia absenthium* L.	Labour for collection	500.00	17 kg	500.00
3	*Euphorbia* sp.	Labour for collection	500.00	17 kg	500.00
4	Dimethoate 2 ml	Locally available (litre)	270.00	0.2 ml	55.00
5	Chloropyrophos 2 ml	Locally available (litre)	210.00	0.2 ml	45.00
6	Carbendazim 2 ml	Locally available (kg)	400.00	0.4 ml	160.00
			Total Cost involved on material		3,980.00
					Say, Rs. 4,000.00

*input cost could be nil if farmer will grow A. sativum as intercropping with tree mulberry

Table 3: Silkworm rearing performance after using IPDM Module in one acre of mulberry farm

Treatments	Spring Rearing Season (DH)*			Autumn Rearing Season (DH)*		
	Avg. yield 100 $dfls^{-1}$ (Kg)	Increase in yield (Kg)	Increase in income (Rs.)	Avg. yield 100 $dfls^{-1}$ (Kg)	Increase in yield (Kg)	Increase in income (Rs.)
IPDM Module	74.12	3.92	1,568.00	47.59	5.97	2,388.00
Control	70.20			41.62		

*Double hybrid

mulberry cultivation in sericulture has brought a positive trend in the sericulture industry of Jammu and Kashmir. It has not only decreased the use of chemicals in the field but increased the crop of mulberry and silk cocoons as well. It was reported that there are various insect pests and diseases of mulberry affecting sericulture industry of Jammu & Kashmir (Khan *et al.*, 2004). The infestation study of major and important insect pests and diseases of mulberry was made a base for developing IPDM module which is eco-friendly, economic and effective. Stern *et al.* (1959) put forth concept of integrated pest management in economic crops by adding biological control with chemical control, after that various workers added different compatible components and made the management practices more effective. It was also evident from the results that one or two management components, like chemical control along with cultural practices do not get desirable results as compared to multiple management components in mulberry cultivation. Same procedure was advocated by Manjunath (2004). Cultural and mechanical control is old age concept of managing various pests and diseases in economic crops (Kogan, 1998; Singh *et al.*, 2000) and is still in use. It comprises of crop rotations, traps *etc*., and has been successful since years. An important component added in the IPM and IDM is biological control in which natural enemies of a certain pest or diseases are augmented to keep the pest menace in control without disturbing the ecosystem (Mittal *et al.*, 2011). In the present study various parasitoids have been identified, which are potential in controlling the insect pests such as *G. pyloalis*. Their occurrences have been encouraged by restricting use of any insecticide during that period. Andow (1997) suggested that during the peak period of natural enemy movement, insecticides/ pesticides should be strictly avoided. Illahi *et al.* (2011) studied the potential of consuming powdery mildew mycelia from mulberry leaf by *Halyzia tschitscherini* (Coleoptera: Coccinellidae), the movement of such lady bird beetle could bring down the menace of such fungal disease. Another, component is to raise mulberry as tree, which has reduced the disease and pest infestation in the mulberry because of wide gap between soil and foliage. In Jammu & Kashmir tree type of mulberry plantation has became a trend as it has multiple advantages as compared to bush or dwarf type of plantation (Illahi *et al.*, 2019). The last component after bio-pesticides/ insecticides is chemical control. Our country is rich in flora having certain medicinal and curative properties, which has been used from decades. In the present study anti fungal activity of *A. sativum* and *Euphorbia* sp. has been explored to mange *G. pyloalis* and leaf spot as well as powdery mildew disease of mulberry. *Artimesia* sp. has been identified as repellent character, which helps in keeping insect pests away from the mulberry leaf for few days without using any chemical. Ertian (2003) also described such control practices in the mulberry cultivation. Chemical control is inevitable in IPM and IDM but extensive use of chemicals must be avoided and the time of spraying chemicals must be decided with extra care. In the present study, all chemical sprays were used after leaf shedding, so that there should be no harm to

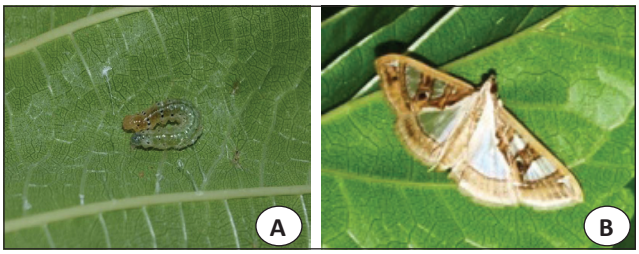

Figure 1: *Glyphodes pyloalis* Wlk. [(a) Larva and (b) Adult]

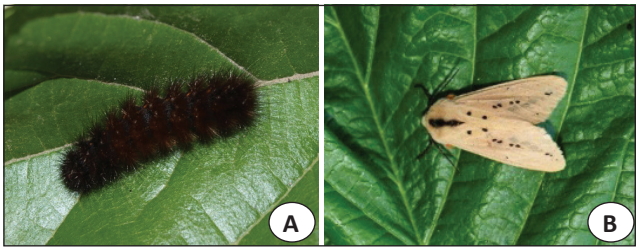

Figure 2: *Amsacta lactinea* (Cramer) [(a) Larva and (b) Adult]

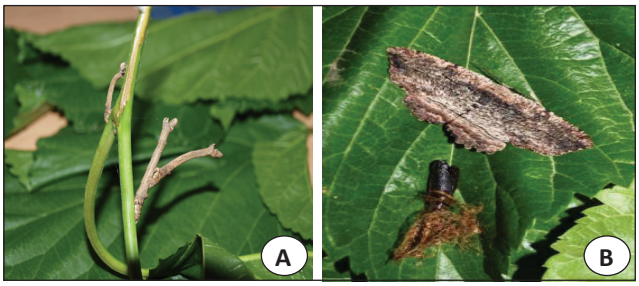

Figure 3: *Hemerophila atrilineata* Butler [(a) Larva and (b) Adult]

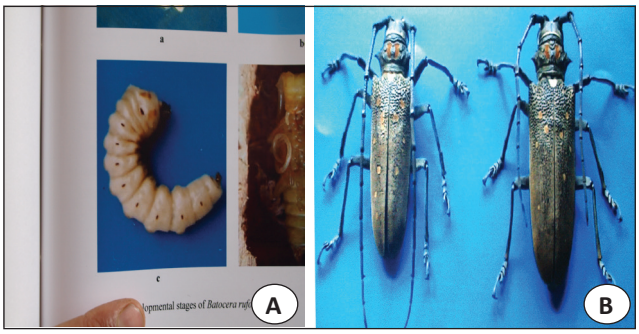

Figure 4: *Batocera rufomaculata* De Geer. [(a) Larva and (b) Adult]

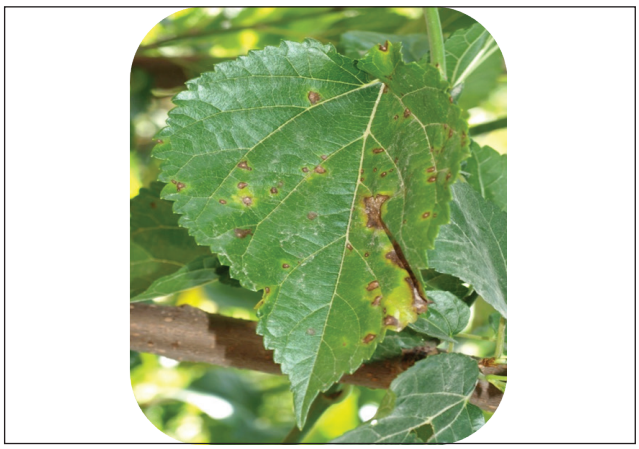
Figure 5: Leaf spot of mulberry

Figure 6: Powdery Mildew of Mulberry

silkworms at all. Also, after spraying the chemicals, there is a prolonged season of snow and rains, in which the toxicity of chemical is washed out and overwintering pupae of certain insect pests as well as pathogenic fungal spores are killed due to their contact action. Therefore, if IPDM is followed with same intention and lines in every sericulture state of India, there will be drastic change in sericultural scenario, but its success depends upon hundred percent adoptions of farmers in their fields.

Conclusion

Based on the study carried out above, it is inferred that collective management measures could reduce insect pest and diseases of mulberry considerably and keep the damage below economic threshold level. Hence, integrated pest and disease management (IPDM) module having all the possible components compatible with the agronomical practices for mulberry cultivation has been put forth for the sericultural farmers to increase their yield and income.

References

Andow, D.A., 1997. Integrating biological control in IPM system. In: *Ecological Interactions and Biological Control*, D.A. Andow, D.W. Ragsdale and R.F. Nyvall (Eds.), Westview Press, pp. 71-86. DOI: 10.1201/9780429041686.

Ertian, H., 2003. *Protection of Mulberry Plants*. Oxford & IBH Pub. Co. Pvt Ltd, New Delhi. pp. 34-56.

Illahi, I., Gull, A., Akhter, J., Chowdhury, S.R., 2019. Raising of Mulberry Tree plantation for sustainable sericulture in Jammu and Kashmir, India. *Research Journal of Agriculture Sciences* 10(2), 445-449.

Illahi, I., Khan, M.A., Zeya, S.B., Aslam, M., Mittal, V., 2011. Feeding potential of a mycophagous beetle *Halyzia tschitscherini* (Coleoptera: Coccinellidae) against powdery mildew *Phyllactinia corylea* in mulberry. *Indian Phytopath* 64(2), 140-143.

Khan, M.A., Illahi, I., Dhar, A., Dhar, S.L., 2006. Insect pests and their management in mulberry farming under temperate and sub-tropical areas of North India. Paper presented in workshop on "*Stabilization of second silkworm crop in North India*" at Asia Hotel, Jammu on 20th-21st February, 2006. p. 17.

Khan, M.A., Dhar, A., Zeya, S.B., Trag, A.R., 2004. *Pests and diseases of mulberry and their management*. Singh, B., Singh, M.P. (Eds.), Publishers and Distributors of Scientific Books. Dehradun, India. pp. 4-38.

Kogan, M., 1998. Integrated pest management: Historical perspectives and contemporary developments. *Ann. Rev. Entomol.* 43, 243-270. DOI: 10.1146/annurev.ento.43.1.243.

Manjunath, D., 2004. Pests of mulberry and their management. In: *Advances in Disease and Pest Management in Sericulture - Lead Paper*. Govindan, R., Naika, R.K., and Sannappa, B. (Eds.). Seri Scientific Publishers, Bangalore, pp. 31-39.

Mittal, V., Illahi, I., Dhar, A., Khan, M.A., 2011. Natural enemies of mulberry pyralid, *Glyphodes pyloalis* Walker (Lepidoptera: Pyralidae) in temperate climate of Kashmir. *Journal of Biological Control* 25(1), 55-57. DOI: 10.18311/jbc/2011/3842.

Rangaswami, G., Narasimhanna, M.N., Kasiviswanathan, K., Sastry, C.R., Jolly, M.S., 1978. Sericultural Manual 1. Mulberry cultivation, FAO. Agricultural Bulletin, Rome. pp. 68-82.

Rajadurai, S., 2005. Mulberry pest management. In: *A Text Book on Mulberry Crop Protection*. Published by Central Silk Board, Ministry of Textiles, Govt. of India, Bangalore – 560068, India. pp. 311-358.

Sharma, B., Tara, J.S., 1985. Prevention and control of important insect pests of mulberry in Jammu & Kashmir state. *Research & Development Reporter* 2(2), 72-74.

Singh, R.N., Samson, M.V., Datta, R.K., 2000. Pest management in sericulture. Indian Pub. Distributor, New Delhi. pp. 8-17.

Stern, V.M., Smith, R.F., van den Bosch, R., Hagen, K.S., 1959. The integration of chemical and biological control of the spotted alfalfa aphid: The integrated control concept. *Hilgardia* 29(2), 81-101. DOI: 10.3733/hilg.v29n02p081.

Teotia, R.S., Sen, S.K., 1994. Mulberry diseases in India and their control. *Sericologia* 34(1), 1-18.