Research Journal of Chemical and Environmental Sciences
Res J. Chem. Environ. Sci. Vol 11 [3] June 2023: 01-07
Online ISSN 2321-1040
CODEN: RJCEA2 [USA]

Website: www.aelsindia.com/rjces.htm

RJCES

REVIEW ARTICLE

Intercropping in Mulberry (*Morus* spp.): A Review

A. R. Rafiqui, A. H. Ganie, A. H. Mir, O. B. Ayoub, M. R. Mir, I. L. Khan and R. K. Sharma
College of Temperate Sericulture, Mirgund
Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir, Jammu and Kashmir (India)
Corresponding Author: aroos.rafiqui@gmail.com

ABSTRACT
Mulberry cultivation is the principle component of sericulture as it forms the only food to silkworm (Bombyx mori L.) which is reared to produce silk- the queen of textiles. However, the industry is facing tough competition with other agricultural and horticultural crops because of many reasons. This invites the interest of researchers to develop mutual harmony between sericulture and agriculture for a sustainable co-existence and integration and intercropping, the growing of two or more crops in close proximity in the same field, in mulberry provides an effective, feasible and long lasting solution. Under temperate and sub-tropical conditions, the subsidiary nature of sericulture makes the farmers reluctant to devote their land exclusively to mulberry cultivation as only two commercial cocoon crops are possible. The activities pertaining to silkworm rearing last for to a maximum of three months in a year. Intercropping in mulberry can help generate work and revenue throughout the year besides helping in effective and efficient utilization of land and other resources. This in turn will go a long way in popularization of sericulture in the region and improvement in cocoon crop production. The present review is an attempt to highlight the feasibility and benefits of intercropping in mulberry.
Keywords: *Mulberry, sustainable, intercropping, feasibility*

Received 20.03.2023 Revised 12.03.2023 Accepted 12.06.2023

INTRODUCTION

Intercropping is a farming technique where two or more crops are grown together in the same field during a growing season [17]. This practice has been used for centuries by farmers all over the world as a way to increase yields, improve soil health, and reduce risks associated with monoculture farming. It is important practice of agriculture allowing farmers to make the most efficient use of their land and other resources besides taking advantage of complementary growth patterns, nutrient uptake and pest control, ultimately leading to increased productivity and yield. Intercropping has also been recognized to be an environmentally sustainable way to produce food.

Mulberry (*Morus* spp.), which belongs to family *Moraceae*, is the only food to silkworm (*Bombyx mori* L.) and possess amazing characteristics of being strongly flexible and adopted to wider geographical conditions across countries particularly India, China, Japan, North Africa and South Europe. It is an important perennial crop which forms the only food for the silkworm (*Bombyx mori* L.). The agriculture today is faced with several emerging challenges and is at crossroads. Sericulture is no exception. The sector is facing tough competition due to fast declining land resources [1] and its competition with other farming activities. Other reasons which hinder the adoption of sericulture among the farming community is its subsidiary nature , marginal land holding of farmers besides mulberry cultivation in isolation (monoculture) as there is a deep rooted belief with the farmers that no other crop can grow as intercrop with mulberry. A sustainable existence of the venture demands a more efficient use of resources in an ecofriendly way and intercropping of mulberry with other agricultural crops provides a practical way with multiple benefits to the farmer, soil and the environment. for the module to be successful several considerations like maturity of crops, time of planting, plant density, compatibility of crops have to be kept in mind before and during the practice. Fortunately the annual growth cycle of mulberry tree under temperate and sub-tropical climatic conditions gives it an edge over other tree species of the region for its

utility as a component for intercropping. The gestation period (4-5yrs) between transplantation of the saplings and its establishment as trees can be very successfully used for intercropping besides the annual pruning and leaf fall in mulberry give an added advantage of using it for intercropping with other agricultural crops especially those with shallow roots. The mulberry growing land can very conveniently and successfully be used for inter cropping [2]. The mulberry tree due to its growth and rearing practices remains without foliage during most of the time in a year. Further, the chances of intercropping are much more in mulberry since it is cultivated as tree with wider spacing (9'×9' or 9'×8') and canopy above the ground enough to allow light to be available for crops growing below as intercrops. Further mulberry and the intercrops do not compete with each other due to differential canopy height, growth cycle, requirement of nutrients and position of root in the soil. The adoption of pruning technology in mulberry cultivation is another factor which eliminates the shade effect. Lastly there is least or no spray of chemicals (fungicides) in mulberry plantation as against other horticultural crops like apple where there is frequent spray of chemical at farmers' level .Thus any crop grown beneath mulberry is chemical-free and safe for human and animal consumption. Thus, an equitable and judicial utilization of land resources with intercropping promises higher returns with low investment to the farmers. Short duration crops with low canopy and shade- loving crops which offer less competition as intercrops are considered to give better results in mulberry [33]. The benefits of intercropping in mulberry are highlighted below in brief:

Increased productivity

Intercropping of mulberry with other crops can lead to increased productivity and yield in both intercrop and main crop compared to when the crops are grown separately. Intercropping effectively increases mulberry leaf yield due to the enhanced growth rate, reduced weed growth, reduced pest and disease incidence and effective resource utilization [4]. Murugesh [18] investigated the potential for intercropping of mulberry with cluster bean, cowpea, green gram, soybean, gingelly and coriander. The study found that intercropping of cluster-bean and cowpea in mulberry maximizes yield of mulberry both quantitatively and qualitatively as compared to monoculture farming.

Another study was carried out in Pakistan to investigate how the main crop (mulberry) affected the intercrop (turmeric). The yield performance of four varieties of turmeric *viz.,* CLL 326, Kesari, Kasturi, and CA 69 which were grown as an intercrop with mulberry plantation at different planting distances (20, 40 and 60 cm) was evaluated. The results indicated that the four turmeric varieties showed varying responses and the highest turmeric yield was achieved at a planting distance of 40 cm. Among the varieties, Kesari had the best yield (50.33 ± 2.517 tons/ha) when intercropped with mulberry at a planting distance of 40 cm. The study highlights the potential benefits of intercropping in mulberry plantations to optimize resource utilization [19]. Intercropping with mulberry leads to increased productivity per unit area of land and time besides helping in impartial and judicious application of land and farming inputs including labour through cultivation of short duration crops between the rows of mulberry without affecting the quantity and quality of mulberry leaf [30]. Seeing the performance of mulberry and the intercrops, Madhusudan *et al*. [14] suggested that mulberry can be successfully intercropped with medicinal plants.

Improved soil health

Soil has a direct bearing upon the growth and development of any crop as it is the soil which provides the plant with all the necessary conditions required for growth. Therefore, soil health is fundamental to healthy crop production. Intercropping of mulberry with legumes or other nitrogen-fixing crops can improve soil health by increasing soil fertility and organic matter content. Legumes can fix atmospheric nitrogen, which can be used by mulberry thereby reducing the need for synthetic fertilizers. Increased covered ground after the intercropping of mulberry field, effectively intercepted surface runoff and soil erosion. Intercropping in mulberry can lead to increased soil organism accumulation, improve soil structure and physicochemical character, accelerates soil-ripening process and improves mulberry orchard soil fertility.

A study conducted in China found that intercropping mulberry (*Morus alba* L.) with peanut (*Arachis hypogaea* L.) improves the diversity and richness of soil microorganisms in farmland and promotes soil humus [9]. Another study carried as a pot experiment revealed that *M. alba* - *L. bicolor* intercropping significantly increased total carbon, total nitrogen and total phosphorus contents in the soil and improved soil nutrients. However, the soil nutrients had no significant effect on the bacterial community composition but greatly influenced the fungal community richness, diversity and uniformity [10].

Rajegowda *et al.* [24] while conducting studies on growing intercrops on growth and yield of tree mulberry and its influence on cocoon yield reported that the soil fertility status was enhanced in the soils where the intercrops were taken up as compared to sole cropping of tree mulberry.

Qadri *et al*. [23] have reported that by limiting the use of chemical fertilizers and supplementing the nutritional requirement of mulberry by organic sources such as intercropping with pulses makes the soil more productive and enhances the quality of mulberry.

Enhanced income

Intercropping has proven to be a better option than sole cropping. Intercropping often leads to increased economics and higher monetary returns. Short duration fodder crops *viz., Trifolium alexandrinum* (Barseem) in winter, *Sorghum vulgare* (Chari) in monsoon and *Vigna radiata* (Moong), in summer seasons have been tested as intercrops in mulberry in Kandi area of rural sub-Himalayan India. In the study, it was found that annually, from an acre of land, around 100 kg of silk cocoons were harvested from two cocoon crops (spring and autumn) besides 200 quintals of Barseem fodder in winter, 1.25 quintal of moong in summer and 48 quintals of Chari fodder in monsoon from an acre of land besides around 3 kg mulberry fruit per tree annually in spring season (Pandey and Dhar, 2013). Similarly, mulberry with field crops (French beanm, groundnut, mustard, vegetables) for valley land and grasses for mid-hill situations has been found suitable for possible adoption in the North-Eastern hill region of India [5].

Intercropping of mulberry with other crops can provide farmers with an additional source of income, especially during the off-season when mulberry leaf production is less. Five intercropping combinations *viz.,* Mulberry-Onion-Rajmash, Mulberry-Garlic-Rajmash, Mulberry-Turnip-Rajmash, Mulberry-Peas-Sag, Mulberry-Sag-Rajmash with mulberry (Goshoerami) maintained as trees with spacing of 9ft×8ft were evaluated against sole mulberry cropping under temperate conditions of Kashmir for a period of 2 years [6]. The results revealed that all the intercropping combinations were profitable over sole cropping. However, highest B:C ratio of 3.98 was realized with Mulberry-Turnip-Rajmash combination. Another field study conducted on similar lines in Kolar district of Karnataka for two consecutive years assessed the feasibility of three intercrops *viz.,* Ragi, Groundnut and field bean with mulberry maintained with a tree spacing of 10ft×10ft under rain-fed conditions. An improvement in net returns per hectare was registered in all the intercropping system over mulberry as a sole crop. Additional returns of Rs. 15727, 40743 and 66966 per hectare were realized respectively through the sale of Ragi, Groundnut and field beans. However, highest B: C ratio of 5.56 was realized with Mulberry-Field bean combination [26]. In Hassan district of Karnataka, a study was conducted at farmers' level to compare the economics of intercropping of mulberry against farmers' practice (sole mulberry). Short durations crops *viz.,* Ragi, Groundnut, Cowpea were sown between the inter-row spaces. Both the total gross return (Rs/ha) and net return (Rs/ha) were better in intercropping over sole cropping. Cowpea- Mulberry combination resulted in highest total gross return of Rs. 67779, net return of Rs. 42079 per hectare and highest B: C ratio of 2.63 [23]. The feasibility of solonacious vegetables (potato, chilli, brinjal, tomato, capsicum, paprika and pungent capsicum) as intercrops at farmers' level in Karnataka showed a higher net return from mulberry-tomato intercropping system and higher cost benefit ratio (3.61) from mulberry-brinjal intercropping system without any affect on growth and yield parameters of mulberry [29]. In another study, four different intercrop combinations *viz.,* Mulberry-Cowpea, Mulberry-Groundnut, Mulberry-Horesgram and Mulberry-Ragi were tested and highest B: C ratio of 2.67 was realized with Mulberry-Groundnut combination [6]. Intercropping of mulberry with *Allium sativum* (garlic), *Allium cepa* (onion) and *Daucus carota* (carrot) in Maharashtra resulted in generation of additional income to farmers by harvesting cocoons and intercrops [24].

Intercropping of mulberry with cash crop can act as a booster for enhancing farm income. Medicinal plants such as Rauvolfia, Plumbago, Asparagus and Sarpagandha have been grown as an intercrop with mulberry without affecting sericulture in Uttarakhand [21]. Other medicinal plants like *Lavendula officinalis* (Lavender), *Atropa belladonna* (Belladonna) and *Echinecea purpurea* (Purple coneflower) have been grown successfully under temperate climatic conditions of Kashmir as intercrop with mulberry [20]. Intercropping of *Cymbopogon citratus* (Lemon grass) and *Mentha piperita* (Mentha) has also been documented [3]. Mulberry can successfully be intercropped with *Aloe barbadensis* (Aloe vera), *Asparagus racemosus* (Asparagus) and *Acorus calamus* (Sweet flag) [11]. The prospects of intercropping of seven medicinal plants *viz., Aloe barbandense* (Aloe vera), *Asparagus racemosus* (Asparagus), *Andrographis paniculata*, *Acorus calamus* (Sweet flag), *Plumbago zeylanica*, *Rauvolfia serpentine* and *Cyperus scarious* under tree system of plantation has been evaluated [12]. Intercropping of mulberry with *Crocus sativus* (Saffron) which is a major cash crop of the region in Kashmir is reported to yield a significant income through sericulture during the lean period when there are no operations related to saffron cultivation [13].

Reduction of pests and diseases

Intercropping is an important cultural practice in pest management and is based on the principal of reducing insect pests by increasing the diversity of the ecosystem (Risch, 2005). Several studies indicated that diversification practices are beneficial because these reduce pest damage.

Intercropping can help to reduce pests and diseases by promoting natural pest control and reducing the build-up of pests and diseases that are specific to one crop. Several investigations have indicated that intercropping of soya bean; green gram and forage crops such as ragi and maize between mulberry rows under wider spacing reduce the incidence of red rust [28, 29, 30, 5]). In another study, intercropping of amaranth (*Amaranthus viridis* L.) between two rows of mulberry in nematode infested field reduced the disease severity (galls/plant) to an extent of 75-80 per cent [3]. Similarly, intercropping daincha (*Sesbania aculeata*) with mulberry had an impact on the population dynamic of natural enemies within the mulberry ecosystem. A study by Qadri *et al.* [21]) found that in mulberry fields intercropped with daincha, 13 species of predators and three species of parasitoids were observed due to a favourable microclimate.

Environmental sustainability

Intercropping in mulberry can reduce the negative environmental impacts associated with monoculture farming by reducing the need for synthetic fertilizers and pesticides which can be harmful to the environment and human health. Intercropping with legumes can be used as alternatives for chemical fertilizers in a sustainable production system [34]. A number of weed control practices are used in mulberry cultivation but most of them have a limitation in adoption. Manual weeding adds significant amount to the cost of cultivation and spraying of herbicide increases the chances of toxicity [10]. Thus intercropping can be effectively used to combat weed invasion in mulberry farms as intercrops restrict the growth of weeds. This will also lead to chemical-free produce (mulberry leaf and intercrops) in an eco-friendly manner. Apart from this, intercropping can also reduce erosion and enhance soil conservation [27].

FACTORS AFFECTING INTERCROPPING IN MULBERRY

Competition for resources

Competition for resources is one of the key factors affecting intercropping in mulberry. Since intercropping involves growing two or more crops in the same field, this can lead to competition for resources such as water, nutrients, and sunlight. Mulberry is a high-demand crop that requires substantial amounts of water, nutrients, and sunlight to grow. When intercropped with other crops without proper planning, the competition for resources can adversely affect the growth and yield of both crops. Therefore, it is important to select intercrops that have similar resource requirements or complementary resource use to avoid competition and maximize the benefits of intercropping. Proper spacing and timing of intercrops are two important factors which can help to reduce competition for resources and promote optimal growth and yield.

Crop selection

Crop selection is an important factor to consider while going for intercropping in mulberry. The intercrop should be selected based on its compatibility with mulberry, its ability to fix nitrogen or provide additional nutrients, its pest and disease resistance and its marketability. Further the intercrops should have roots that do not reach the same depth and canopy that do not have the same height as that of mulberry to avoid competition for soil nutrients, space and sunlight. Additionally, the intercrop should be chosen based on the local agro ecological conditions to ensure that it can thrive in the specific environment. Legumes, such as soybeans, peanuts and moong beans are good intercrops for mulberry as they have the ability to fix nitrogen and improve soil fertility. Cereal crops can also be intercropped with mulberry but care should be taken to avoid competition for resources.

Soil conditions

Soil conditions like soil type, pH, and nutrient availability are important factors to consider while going for intercropping in mulberry as these can affect the growth and yield of both mulberry and the intercrop. Mulberry is known to thrive in well-drained soils with a pH range of 6.2 to 6.8. The intercrop should be selected based on its ability to adapt to the soil conditions. Additionally, soil management practices, such as soil amendment and conservation should be used to maintain soil health and fertility.

Management practices

Intercropping in mulberry requires proper management practices to ensure optimal growth and yield of both the main crop and the intercrop. Management practices for intercropping in mulberry include irrigation, fertilization, weed control and pest and disease management and of some operations meant for the two components overlap, this will lead to saving the labour and reducing cultivation cost.

Pest and disease management

Pest and disease management is another important factor to consider when intercropping in mulberry. The presence of an intercrop can increase the risk of pest and disease outbreaks, as it provides a new host for pests and pathogens. Therefore, it is important to choose intercrops that are resistant to pests and diseases or that can provide natural pest control. Additionally, integrated pest management practices should be used to manage pest and disease pressure in both the crops. Further toxicity for the silkworm has to be kept in mind while going for any chemical control.

FUTURE PROSPECTS AND RECOMMENDATIONS

Intercropping in mulberry is a promising farming practice that can provide a range of benefits to farmers, the environment, and the society at large. However, there is always scope for improvement which can be achieved by knowing all the aspects of intercropping and implement this practice in mulberry well. Further research is needed to better understand the interactions between mulberry and different inter-crops. This could include looking at factors such as competition for resources, nutrient budgeting, complementarity in resource use and allelopathic effects which can help to identify the best crop combinations and management practices to maximize the benefits of intercropping in mulberry.

An extensive research is also needed to investigate how intercropping in mulberry can impact soil health and biodiversity and how best to manage these impacts. Some crop combinations may help to reduce soil erosion or increase soil organic matter while others may have negative impacts on soil structure or soil microorganisms. While intercropping can provide a range of benefits, it is important to also consider the economic viability of this practice as interacting different crops can create new market opportunities and revenue streams for farmers. The adoption and success of intercropping in mulberry can be influenced by socio-economic factors, such as access to credit, labour and markets. Further research is needed to investigate how these factors impact the adoption and success of intercropping in mulberry and to identify appropriate support mechanisms to help farmers overcome these challenges. This could include looking at issues such as the availability of credit for small farmers or the need for market infrastructure to support the sale of intercropped products. Intercropping can also be a promising approach for building resilience to climate change. Research is needed to investigate how intercropping in mulberry can help farmers adapt to climate change and reduce their vulnerability to climate-related risks such as drought or pest outbreaks. This could include looking at factors such as the ability of different crop combinations to maintain productivity under changing climatic conditions or their ability to provide ecosystem services that support climate resilience such as soil carbon sequestration. Addressing these research gaps can help to improve our understanding of the benefits and challenges of intercropping in mulberry which can ultimately support the adoption of intercropping as a sustainable and resilient farming practice that can contribute to food security, poverty alleviation and environmental sustainability.

Several recommendations for farmers and policymakers interested in implementing intercropping in mulberry to achieve these goals are briefly mentioned below:

Select appropriate crop combinations: Farmers should select crop combinations that are compatible with mulberry and have the potential to provide mutual benefits. This can include crops that fix nitrogen, provide pest control or add diversity to the farm system. Farmers can consult local extension services, research institutions or other farmers to identify suitable crop combinations.

Implement appropriate management practices: Intercropping requires careful management to optimize the benefits and minimize the risks. Farmers should consider factors such as crop spacing, irrigation, fertilization and pest management. Mulberry and intercropped crops may have different management requirements so it is important to tailor practices to the specific needs of each crop.

Monitor and evaluate performance: Farmers should regularly monitor the performance of intercropping systems to assess their impact on mulberry growth and yield as well as on the intercropped crops. This can help to identify opportunities for improvement and to make adjustments to management practices as needed. Evaluation of intercropping systems can also help to identify best practices and inform the development of policies that support the adoption of intercropping.

Promote knowledge sharing and capacity building: Farmers and policymakers can promote knowledge sharing and capacity building about intercropping in mulberry. This can include training programs, farmer field schools and exchange visits. It is important to involve local communities, research institutions, and other stakeholders in the development of intercropping systems to ensure that they are appropriate and sustainable.

Support policies that promote intercropping: Policymakers can play a critical role in supporting the adoption of intercropping in mulberry by developing policies that promote this practice. This can include incentives for farmers such as subsidies or tax breaks, as well as policies that promote research and

development in intercropping systems. Policymakers can also support the development of markets for intercropped products which can provide farmers with an additional source of income.

CONCLUSION

Mulberry is one of the economically important crops which possess all the possible characteristics required to be integrated in an intercropped system with other agricultural crops. Though several studies confirm the possibility of intercropping in mulberry, it has not been fully explored yet. It can be concluded from the above review that attention of public and private sectors and policy makers for further research and subsequent implementation of intercropping in mulberry is required to make our country self sufficient in silk production.

COMPETING INTERESTS

The authors declare no conflict of interest in the publication of this manuscript. All the authors read and approved the manuscript in its final form.

REFERENCES

1. Ahasn, M. M., Dhar, K. L., Fotedar, R. K. and Dhar, A. (1989). Studies on the intercropping of short durations crops with mulberry. *Indian Journal of Sericulture* **28**(2): 194-199.
2. Das, P. K., Gururaj, R., Magadum, S. B., Doreswamy, C. and Murthy, S. 2011. Intercropping in mulberry with cereals, pulses and oil seeds under rainfed conditions of Chamarajnagar district.
3. Datta S. C. and Datta R. 2007 Intercropping amaranth with mulberry for managing root knot nematodes and improving sericulture. *Sericologia* **47**: 297-302
4. Dhyani, S. K., Chauhan, D. S., Kumar, D., Kushwaha, R. V. and Lepcha, S. T. 1996. Sericulture-based agroforestry systems for hilly areas of north-east India. *Agroforestry Systems* **34**: 247-258.
5. Eskandari, H. 2012. Intercropping of maize (*Zea mays*) with cowpea (*Vigna sinensis*) and mungbean (*Vigna radiata*): effect of complementarity of intercrop components on resource consumption, dry matter production and legumes forage quality. *Journal of Basic and Applied Scientific Research* **2**: 355-360.
6. Fotadar, R. K. and Dhar, A. 2012. Intercropping mulberry with aromatic plants in Jammu and Kashmir. *Indian Silk* **3**(7/8): 14-16.
7. Gupta, R. D., Arora, S., Gupta, G. D. and Sumberia, N. M. 2010. Soil physical variability in relation to soil erodibility under different land uses in foothills of siwaliks in N-W India. *Tropical Ecology* **51**(2): 183-187.
8. Kanta, 2015. Intercropping of some medicinal plants with mulberry. *Cibtech Journal of Bio-Protocols* **4**(1): 27-30.
9. Khan, S. A., Hussain, M., Noureen, N., Fatima, S., Ane, N. U. and Abbas, Z. 2015. Yield performance of turmeric varieties intercropped with mulberry plantations *American-Eurasian J. Agric. & Environ. Sci.,* **15**(10): 2076-2079.
10. Khare, T. R., Sobhana, V. and Kalpana, G.V. 2022. Weed management in mulberry (*Morus alba*): A Review. *Agricultural Reviews*.
11. Kour, R., Mir, M. R., Khan, M. A., Nazir, S. 2002. Intercropping of mulberry with saffron in the valley-Convenient and profitable. *Indian Silk* **41**(2): 5-6.
12. Li, M., Wei, Y., Yin, Y., Ding, H., Zhu, W. and Zhou, Y. 2022. The effect of intercropping mulberry (*Morus alba* L.) with peanut (*Arachis hypogaea* L.), on the soil rhizosphere microbial community. *Forests* **13**: 1757.
13. Liu, J., Wei, Y., Du, H., Zhu, W., Zhou, Y. and Yin, Y. 2022. Effects of intercropping between *Morus alba* and nitrogen fixing species on soil microbial community structure and diversity. *Forests* **13**: 1345.
14. Madhusudan, C. V. K., Varshney, P. K., Pandey, S. R., Kanta, S. 2015. Intercropping of some medicinal plants with mulberry. *Cibtech Journal of BioProtocols* **4**(1): 2-30.
15. Madhusudan, C. V. K., Varshney, P. K., Srinivasan, R. P. and S. Kanta. 2015. Intercropping of some medicinal plants with mulberry. *Cibtech J. Bio-Protocols* **4**(1): 2-30.
16. Mir, M. R., Khan, I. L., Baqual, M. F. and Sharma, R. K. 2022. Mulberry based farming system, an effective way of land utilization for silkworm rearers of Kashmir, India. *The Pharma Innovation Journal* SP: **11**(7): 4208-4210.
17. Mousavi, S. R. and Eskandari, H. 2011. A general overview on intercropping and its advantages in sustainable agriculture *J. Appl. Environ. Biol. Sci.,* **1**(11): 482-486.
18. Murugesh, K. A. 2009. Effect of intercrops on quantitative and qualitative leaf yield of mulberry (*Morus Alba* L.) *Trends in Biosciences* **2**(2): 50-52.
19. Palb, A. K. H. 2013. Studies on intercropping of legumes on the growth and yield of mulberry and rearing performance of the silkworm (*Bombyx Mori* L.)
20. Pandey, R. K. and Dhar, A. 2013. Mulberry intercropping for sustainable livelihood in kandi area of rural sub-himalayan, India. *Research Journal of Agricultural Sciences* **4**(4): 484-487.
21. Prasad, K. V., Dayakar, Y. B. R. and Sullia, S. B. 1999. Screening of mulberry varieties for resistance to leaf rust caused by *Peridiospora mori*. *Sericologia* **39**: 77-90.
22. Qadri, S. H. M., Humayun, S. Y., Dhahira, B. N. and Mani, A. 2004. Organic farming for sustainable sericulture *Indian Silk* **43**(8):11-13.
23. Qadri, S. M. H., Balasaraswathi, S. and Masilamani, S. 2005. Effects of mulberry intercropped with daincha (*Sesbania aculeata*) in different seasons on pest population and natural enemies. In abstracts of National

Symposium on Biodiversity and insect pest management, held at Loyola College, Chennai, Tamil Nadu on February 3-4: 26.
24. Rajegowda, B. S. Vinutha, C. Vanitha and Sanath Kumar, V. B. 2020. Effect of growing intercrops on growth and yield of tree mulberry and its influence on cocoon yield. *International Journal of Current Microbiology and Applied Sciences* **9**(05): 3134-3139.
25. Rathore, M. S., Srinivasulu, Y., Kour, R., Dhar, A. and Sahaf, K. A. 2012. Biochemical analysis of mulberry associated with intercropping of medicinal plants under temperate climatic conditions. *Journal of Pharmaceutical and Scientific Innovation* **1**(4): 54-57.
26. Risch, S. J. 2005.Intercropping as cultural pest control: Prospectus and limitations. *Environmental Management* **7**(1):9-14.
27. Sharma, D. D. and Govindaiah. 1996. Thermotherapy for eradication of *Meloidogyne incognita* infecting mulberry (*Morus alba* L.). *Indian J. Seric.* **35**: 142-143.
28. Sharma, N. K., Singh, R. J., Mandal, D., Kumar, A., Alam, N. M., Keesstra, S. 2017 Increasing farmer's income and reducing soil erosion using intercropping in rainfed maize-wheat rotation of Himalaya, India. *Agriculture, Ecosystems & Environment*. **247**: 43-53.
29. Shashidhar, K. R., Chikkanna, G. S., Haveri, N., Thulasiram, K. and Naik, U. 2022. Studies on suitable intercrops under tree mulberry for additional income in Kolar district of Karnataka. *The Pharma Innovation Journal* **11**(10): 587-590
30. Singhvi, N. R. and Katiyar, R. L. 2009. Performance of moong bean as intercrop in newly planted mulberry garden. *International Journal of Plant Sciences* **4**(2): 365-366.
31. Srivastav, P. K., Thapliyal, C., Chamoli, M., Bhat, M. M. and Khan, M. A. 2010. Blending of sericulture with medicinal industries. *Annals of Forests* **18**(2): 243-253.
32. Vishaka, G. V., Bharath, R. H. R., Narayanaswamy, T. K., Harinikumar, K. M. and Narayanareddy, R. 2017. Intercropping of solonaceous vegetables in mulberry- a profitable way to farming community. *Scire Sci. Multidiscip. J.* **1**(1):36-45.
33. Vishaka, G. V., Raj, H. R. B., Shwetha, N. V. and Naika, R. 2016. Innovative technique in crop improvement-feasibility of intercropping of solonacious vegetables in mulberry *Progressive Research* **11**(Special-IX): 6348-6350.
34. Yengeje, L. V., Amini, R. and Nasab, A. D. M. 2019. Chemical compositions and yield of essential oil of Moldavian balm (*Dracocephalum moldavica* L.) in intercropping with faba bean (*Vicia faba* L.) under different fertilizers application. *Journal of Cleaner Production* **239**: 118033.

CITE THIS ARTICLE

A. R. Rafiqui, A. H. Ganie, A. H. Mir, O. B. Ayoub, M. R. Mir, I. L. Khan and R. K. Sharma.Intercropping in Mulberry (*Morus* spp.): A Review . Res. J. Chem. Env. Sci. Vol 11 [3] June 2023. 01-07