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Research Article

VARIATION IN THE BIOCHEMICAL COMPONENTS AND PHOTOSYNTHETIC PIGMENTS OF MULBERRY INFESTED BY THRIPS (PSEUDODENDROTHRIPS MORI) SAP SUCKER PEST

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ABSTRACT
As a polyphagous pest of mulberry (Morus Alba L), which is the main food for the silkworm Bombyx mori L, the Sap sucker thrips (Pseudodendrothrips mori) is a serious threat. This insect attacks the plant's fragile leaves, causing significant damage that degrades the leaf's quality. Under the threat of thrips (Pseudodendrothrips mori), the changes in the biochemical components, particularly the photosynthetic pigments (total chlorophyll, chlorophyll-a, chlorophyll-b, chlorophyll-a/b ratio, and Carotenoid), were analyzed across six well-known, high-yielding native mulberry varieties (Morus indica, Morus Alba, Morus laevigata, V1 (Victory), S36 (High yielding), and Sahana). Thrips eat bits of mulberry leaf tissue, which kills mesophyll cells, which are the chlorophyll containing cells. The gaps that result can be seen as holes or skeletonized portions on the leaves, which immediately lowers the area where photosynthesis can occur. Chlorophyll molecules become susceptible to light and oxidative enzymes when cells are damaged, which transforms them into colorless degradation products. As a result, the leaves turn yellow or brown from green, reducing photosynthesis and lowering the leaves' nutritional value for silkworms. The issue is made worse by ongoing harm, which lowers productivity and restricts development. The study revealed a reduction in the biochemical components of almost all of the types examined. All varieties had a substantial decrease in total chlorophyll, chlorophyll-a, and chlorophyll-b. Due to pest damage, the chlorophyll-a/b ratio decreased in Morus and Sahana mulberry but significantly increased in the V1 (Victory) cultivar. Except for V1 (Victory), every other variety displayed a drop in Carotenoid content. Changes in the biochemical composition of mulberry leaves will have a detrimental effect on the health, growth, and development of silkworms, resulting in a lower quality silk output. The production of premium mulberry leaves, which are necessary for silk production, is hampered by the presence of numerous insect pests. The population dynamics of Thrips (Pseudodendrothrips mori), a key pest of mulberry on a sericulture farm, are examined in this research. For this reason, the goal of this study is to ascertain how quickly thrips appear on mulberry trees. Sericulture rearers are advised to use successful integrated pest management techniques to protect mulberry plants from these herbivorous sap sucker pests.

Keywords: *Biochemical components, Sap Sucker thrips (Pseudodendrothrips mori), Mulberry, photosynthetic pigments (chlorophyll-a, Chlorophyll-b, Chlorophyll-a/b and Carotenoid*

INTRODUCTION
The silkworms, Bombyx mori L, which are vulnerable to several insect pests while growing, are fed by Morus leaves. Due to their short life cycles, many of these pests are around throughout the year. Symptoms of their presence include deformed leaves and stunted development. These sap sucker pests lessen the quantity and quality of the mulberry leaves that are gathered. Thrips are a major threat among the sap sucker because they are common and have caused significant damage to mulberry in recent years.

The fragile upper portion of the mulberry tree, where the larvae feed on the tender, young leaves, is where the young larvae are found. Usually, pest's larvae construct webs or fold leaves to provide themselves with a safe haven. The web made by the larvae in which they live keeps the borders of the upper leaves rolled and held in place. The web created by the larvae that remain inside sometimes molds one or two leaves into a cup form. For this reason, the common name for thrips is "mulberry thrips". The only food source for the silkworm Bombyx mori L in commercial sericulture is mulberry (Morus sp). This plant is well established, grows in a variety of agro climatic conditions around the world, and is renowned for its abundance of biomass and nutritious foliage (Ullal and Narasimhanna., 1981). Mulberry is essential to the quality and quantity of silk production, accounting for 38.20% of the cocoon crop's success (Miyashita, 1986; Mahadeva, A., 2017). Mulberry leaves are the only food source for silkworms during their whole larval period, and they utilize leaf proteins store in salivary gland to make silk. Therefore, it is obvious that mulberry is essential to the manufacturing of cocoons because it serves as a food source for silkworms. However, mulberry leaves are susceptible to harm from thrips pests and pathogens. In Southern India, the lepidopteron thrips (Pseudodendrothrips mori) has become a major threat among the several pests that attack mulberry. The microsporidia is a hazardous pathogen that causes pebrine disease in silkworms, is known to be carried by thrips found on mulberry farms and fields. This poses a serious threat to silkworm reproduction by way of infected mulberry leaves, promoting disease in spite of regular inspections of mother moths and hygiene procedures, which might have a negative impact on the sericulture sector (Ifat et al, 2011; Mahadeva, A., 2015). Thrips are particularly common during the rainy and winter months (Geethabai et al., 1997). Although they have an impact on crops all year long, their peak is between January and October. Reddy and Narayanaswamy (2003) reported that the pest might result in a 66% decrease in leaf production for the M5 type, followed by drops of 65% for MR2, 52% for V1, and 30% for S54. The young larvae live at the top of the mulberry shoot (the unopened leaves), where they consume the soft and tender leaf tissue by scraping it off, which causes the tip to dry up. The silk made by the larvae binds the injured leaves together. The word leaf roller comes from the fact that occasionally, a single leaf is rolled into a folded shape with the larva underneath the web. Sometimes, the larvae will bore into the soft top stem, resulting in the shoot drying out and Pests stunted growth in mulberry plants that are impacted. Areas that are severely infested exhibit a large amount of webbing on the mulberry leaves. Older larvae may consume such leaves entirely, resulting in a significant reduction in leaf output (Siddegowda et al., 1995). The harm that thrips do to mulberry may range from 20% to 40% in certain traditional areas of Karnataka (Veeranna, 1997: Shrey, AVMJ., 2014). Thrips feeding punctures and extracts sap, which strips chlorophyll and solutes. The loss of biochemical compounds weakens photosynthesis and reduces leaf nutritive value for silkworm. The nutritional value of mulberry leaves that have been impacted by thrips is not well studied. As a result, a study has been carried out to investigate how leaf thrips (Pseudodendrothrips mori) infestation affects the biochemical composition and photosynthetic pigments of mulberry leaves.

MATERIALS AND METHODS:

From mulberry plantations around India, we gathered the healthy, thrips (Pseudodendrothrips mori) infested leaves of six well-known indigenous mulberry varieties: Morus indica, Morus alba, Morus laevigata, Vi (victory), and Sahana mulberry. To estimate the photosynthetic pigments (total chlorophyll, chlorophyll- a, chlorophyll-b, chlorophyll- a/b ratio, and Carotenoid), the fresh mulberry leaves were processed and oven dried. 100 mg of fresh mulberry leaf tissue was placed in a flask with 7 ml of dimethyl sulfoxide (DMSO) and chlorophyll was extracted into the liquid at 65°C without grinding, followed by three hours of incubation. Using a DU-40 spectrophotometer, absorption spectra of the liquid were taken right away at 663 and 645 nm after it was converted into a graduated tube and diluted with DMSO to a total volume of 10 ml. Using the method proposed by (Arnon, 1949; Dixon, 1957), the total chlorophyll, chlorophyll-a, chlorophyll-b, chlorophyll-a/b, and Carotenoid content were determined.

The **formula used to determine the chlorophyll concentration was**:
(Total chlorophyll (mg/ml) = (0. 0202) X (O. D. 645) + (0. 00802) **x** (O.D. 663)**)**
Chlorophyll **"a"** (mg/ml) = (0. 0127) X (O. D. 663) – (0. 00269) × (O.D. 645)
Chlorophyll **"b"** (mg/ml) = (0. 0229) X (O. D. 645) **-** (0. 00468) **x** (O.D. 663)
Using the formula of **(Kirk and Allen, 1965), the Carotenoid concentration was calculated** and **represented** in milligrams per gram of fresh weight.
Total Carotenoid (μg/ml) = O. D. 480 + (0. 114 **x** O. D. 663 – 0. 638 **x** O.D. 645)

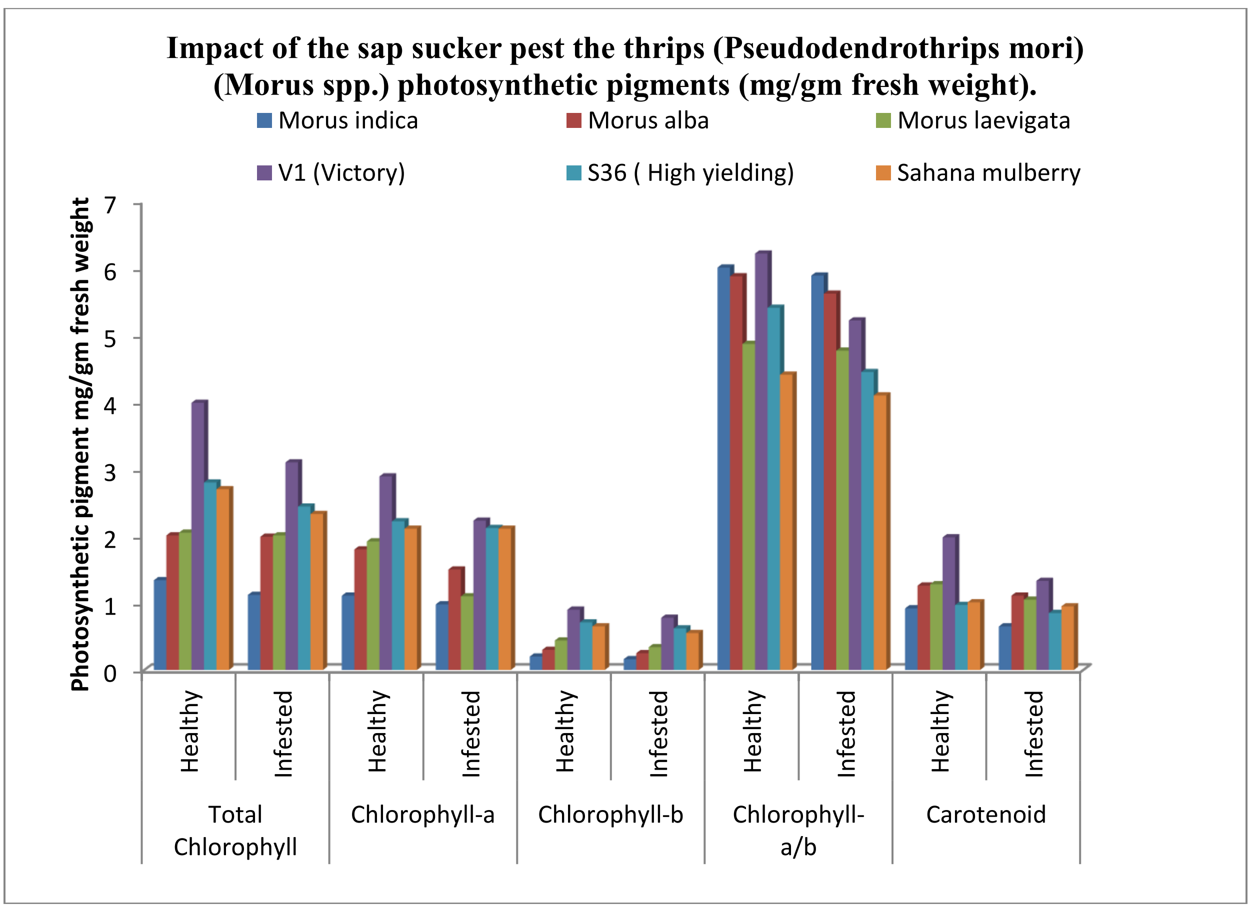
The data acquired was evaluated using Microsoft Excel's online Post=hoc test and statistically Two Way ANOVA. **Three replicates of each** value **were used to calculate** the values. **At the levels of** P<0. 05 and P<0. 01**, notable distinctions were found**.

RESULTS AND DISCUSSION

Thrips (Pseudodendrothrips mori) that infect mulberry leaves from six indigenous mulberry types (Morus indica, Morus alba, Morus laevigata, Vi (Victory), and Sahana) cause almost noteworthy changes in the photosynthetic pigments, such as total chlorophyll, chlorophyll-a, chlorophyll-b, the chlorophyll-a/b ratio, and Carotenoid. Mulberry Thrips (Pseudodendrothrips mori) infestation resulted in a noticeable reduction in the overall chlorophyll content, chlorophyll-a, and chlorophyll-b in the leaves of all six mulberry cultivars. The largest decreases in total chlorophyll, chlorophyll-a, and chlorophyll-b were seen in the high-yielding S-36 variety, with drops of 2.80 mg/g, 2.22 mg/g, and 0.71 mg/g, respectively. For healthy but infested leaves of the V1 (Victory) type, the chlorophyll-a/b ratio fell by 6.22 mg/g, the chlorophyll-b content decreased by 0.90 mg/g, and the total chlorophyll and chlorophyll-content were reduced by 3.99 mg/g and 2.89 mg/g, respectively. The thrips (Pseudodendrothrips mori) were influenced for the changes in the amounts of photosynthetic pigments. Similar results were seen when mulberry leaves were attacked by other pests, such as mealy bugs (Umesh et al., 1989), thrips (Das et al., 1994), and giant African snails (Ravi, 1997). The variation in photosynthetic pigments clearly depended on the severity of pest infestations, the extent of the damage, and the kind of mulberry. The variations in chlorophyll concentration had a detrimental effect on photosynthetic efficiency (Heldt., 1997) and productivity, which in turn decreased protein synthesis (Burd and Elliot., 1996). Consequently, the mulberry leaves suffered nutritional deficiency. In contrast to just affecting one particular process, pest invasions often cause or intensify a complicated chain of metabolic disturbances in the host plant. Pests impair crop photosynthesis in three main ways: by reducing light absorption, lowering photosynthetic efficiency, or upsetting the regular distribution of assimilates throughout the plant. This leads to variable net plant productivity (Hewett., 1977). The leaves are obviously nutritionally deficient. As a result, leaves that have been infested by thrips (Pseudodendrothrips mori) may have a negative impact on the growth and development of silkworms when given to them, leading to failures in the cocoon harvest (Pradeep et al, 1992; Ravi and Shree, 1998; Doureswamy and Chandramohan, 1999; Mahadeva and Shree, 2004a). Due to their known negative impact on the quality of silk cocoons, it is not recommended to feed silkworms mulberry leaves that are infected by pests or diseases. Since the mulberry tree is the only source of food for silkworms, it is essential to implement the necessary steps to prevent diseases and thrips pests from harming it. In several cases when mulberry leaves were damaged by other pests, such as defoliators sap suckers degrade and changes in the photosynthetic pigments brought on by thrips (Pseudodendrothrips mori) were observed. Changes in chlorophyll photosynthetic pigment levels, which eventually result in reduced protein production, are thought to be the cause of the detrimental effect on photosynthetic activity. This will result in a low nutritional value in mulberry leaves. Silkworm growth and development will be adversely affected if they feed mulberry that is so low in nutrients and overrun with pests, perhaps leading to cocoons of lower quality and quantity. Due to their impact on silk production, leaves that are infested with pests or diseases are not a good source of food for the silkworms and are not suitable for feeding. Given the mulberry plant's significance as the primary food source for silkworms, it is imperative to develop strategies to manage the pests and diseases that impact it. Carotenoid is a wide range of

Table: Impact of the sap sucker pest the thrips (Pseudodendrothrips mori) (Morus spp.) photosynthetic pigments (mg/gm fresh weight).

Mulberry Variety	Total Chlorophyll		Chlorophyll-a		Chlorophyll-b		Chlorophyll-a/b		Carotenoid	
	Healthy	Infested	Healthy	Infested	Healthy	Infested	Healthy	Infested	Healthy	Infested
Morus indica	1.34	1.12	1.11	0.98	0.2	0.16	6.01	5.89	0.92	0.65
Morus alba	2.01	1.99	1.8	1.5	0.3	0.25	5.88	5.62	1.26	1.11
Morus laevigata	2.05	2.01	1.92	1.1	0.44	0.34	4.87	4.77	1.28	1.05
V1 (Victory)	3.99	3.1	2.89	2.23	0.9	0.78	6.22	5.22	1.98	1.33
S36 (High yielding)	2.8	2.44	2.22	2.12	0.71	0.62	5.41	4.45	0.97	0.85
Sahana mulberry	2.7	2.33	2.11	2.11	0.65	0.55	4.41	4.1	1.01	0.95



Statistical Analysis: Analysis of variance Post hoc Test and Turkey simultaneous t-test.

ANOVA table					
Source	***SS***	***df***	***MS***	***F***	***p-value***
Factor 1	**19.0445**	**5**	**3.80891**	**34979.77**	**5.28E-188**
Factor 2	**490.1750**	**9**	**54.46389**	**500178.60**	**5.78E-270**
Interaction	**28.5834**	**45**	**0.63519**	**5833.35**	**1.02E-181**
Error	**0.0131**	**120**	**0.00011**		
Total	**537.8160**	**179**			

Post hoc analysis for Factor 1

Tukey simultaneous comparison t-values (d.f. = 120)

		Morus indica	**Morus laevigata**	**Shana mulberry**	**Morus alba**	**S36 (High yielding**	**V1 (victory)**
		1.841	1.989	2.085	2.175	2.264	2.866
Morus indica	1.841						
Morus laevigata	1.989	54.93					
Shana mulberry	2.085	90.69	35.75				
Morus alba	2.175	123.84	68.91	33.16			
S36 (High yielding	2.264	157.12	102.19	66.44	33.28		
V1 (victory)	**2.866**	380.43	325.50	289.75	256.59	223.31	

Critical values for experiment wise error rate:

0.05	2.90
0.01	3.44

organic molecules that may be found in animals and perform a variety of functions. With the exception of a few aphids, mites (Narayanaswamy TK 2003), and gall midges, the majority of animals get their essential Carotenoid solely through their food. Pseudodendrothrips mori is a common pest that flourishes in a variety of settings. The larvae feed on organic matter that may have varied amounts of Carotenoid, which are related to the green pigment chlorophyll that makes up the mulberry plant. We hypothesize that the Carotenoid content of an adult thrips' (Pseudodendrothrips mori) body would reflect the amount of Carotenoid in its mulberry larval diet. We raised mulberry caterpillars on feed with varying Carotenoid ratios and examined the Carotenoid profiles of the adults that came from it. Our results imply that the Carotenoid composition of adult mulberry larvae is related to the Carotenoid and chlorophyll concentration of their initial diet, but it is not a direct representation of it. It can be inferred from the research that thrips (Pseudodendrothrips mori) infection causes lower mulberry leaves due to alterations in nutritional components (both macro and micro), biochemical components, and photosynthetic pigments. These findings should be used to aid in identifying mulberry leaf infestations brought on by the thrips (Pseudodendrothrips mori) sap sucker pest. It is also recommended to use caution when choosing rearing substrates for mulberry larvae that are meant to be fed. The delivery of such lower quality leaves to silkworm larvae may have an adverse effect on their growth and development, resulting in a lower output and quality of natural silk fibers. The below statistical table shows an ANOVA (Analysis of variance) for mulberry varieties followed by Turkey Post-hoc comparison that the ANOVA both factors (Varieties and probably treatment) and interaction are highly significant (P-values = 0), meaning variety leaf traits differ strongly among the six genotypes (Morus indica, Morus alba, Morus laevigata, Vi (victory) and Sahana mulberry). Turkey test pair wise t-values (df=120) compare mean differences. Larger values indicate bigger gaps e.g., V1 vs. Morus indica = 380.43, for above the critical 2.90 (α =0.05) or 3.44 (α = 0.01), so V1 (victory mulberry) differ significantly from others varieties of mulberry. Smaller values like 1.841 fall below the critical thresholds, suggesting those pairs are not significantly.

CONCLUSION

In conclusion, the biochemical reactions of the investigated variables in peach leaves varied depending on the insecticides used to combat the thrips pest in mulberry leaves. Thrips infestations significantly decrease the photosynthetic pigments, such as Chlorophyll-a/b/a-b and Carotenoid, as a result of physical feeding injury and occasionally cause an increase in chlorophyll metabolism. This stress causes a decrease in soluble proteins and sugars, as well as an increase in overall chlorophyll and a Carotenoid level, which ultimately leads to nutrient like micronutrients pigment vitamins β-Carotenoid, calcium iron and bioactive compound are deficient in mulberry leaves, significantly reduced chlorophyll a/b ratios, and lower Carotenoid levels. Many times when mulberry leaves were damaged by pests like thrips (Pseudodendrothrips mori), changes in photosynthetic pigments were seen. Changes in chlorophyll content have a detrimental effect on photosynthesis activity of Morus plant, which ultimately results in lower protein synthesis. Consequently, mulberry leaves are nutritionally insufficient. Silkworms will suffer from the low nutritional value and thrips infestation of this mulberry, which may lead to difficulties in cocoon production. Because they are known to influence the quantity and quality of silk produced, the contaminated mulberry leaves, which exhibit pest damage, lack the nutrients that silkworm larvae feed almost exclusively on mulberry leaves. Thus it may inferred that the silk worms fed with infested mulberry leaves of mulberry plant suffered a significant reduction in silk production

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REFERENCES

Arnon DJ (1949). Copper enzymes in isolated chloroplasts. Polyphenol-oxidase in Beta vulgaris. Plant Physiol., **24:** 1-15.

Burd JD, Elliot NC (1996). Changes in chlorophyll a flourescence induction kinetics in cereals infested with Russian wheat aphid (Homoptera: Aphididae). J. Econ. Entomol**., 89**: 1332-1337.

Das C, Shivanath Rao KN, Ghosh PL, Sengupta D , Sengupta K (1994). Biochemical changes due to thrips infestation in mulberry. National Symposium on "Plant Science in Nineties". University of Kalyani, APSR., 5: 4.

Doureswamy S, Chandramohan N (1999). Investigation on the economic characters of silkworm Bombyx mori L. influenced by the spiralling whitefly damage on mulberry. National Seminar on Tropical Sericulture, December, 28-30, University of Agricultural Sciences, Bangalore, 65: 82.
Heldt HW (1997). The use of energy from sunlight by photosynthesis. In plant Biochemistry and Molecular Biology. Institute of Plant Biochemistry, Oxford University Press. New York, pp. 39-59.
Kirk JTO, Allen RL (1965). Dependence of chloroplast pigment synthesis on protein synthesis: Effect of acs-idione. Biochem. Biophys. Res. Commun., **21:** 530-532.
Ravi KK (1997). Biochemical changes in the leaves of snail infested mulberry plants and their effect on the growth and development of silkworms and cocoon characters. M.Phil., (Seric.,) thesis. Bangalore University, Bangalore, 34-40.
Ravi KK, Shree MP (1998). Impact of feeding leaves from snail infested mulberry plants on the growth and development of silkworms and cocoon characters. Him. J. Env. Zool., 12: 1-10.
Pradeep K, Kishore R, Noamani MKR, Sengupta K (1992). Effect of feeding tukra affected mulberry leaves on silkworm rearing performance. Indian J. Seric., 31(1): 27-29.
Mahadeva A, Shree MP (2004a). Impact of feeding mealy bug (Maconellicoccus hirsutus) infested mulberry (Morus spp.) leaves (tukra) on the nutritional efficiency and economic characters of silkworms (Bombyx mori L). Proceedings of the 91st Session of Indian Science Congress, Chandigarh, **14:** 22-23.
Hewett EW (1977). Some effects of infestation on plants: A physiological viewpoint. The New Zealand Entomologis, **6(3)**: 235-243.
Ifat B, Sharma SD, Shabir AB (2011). Screening of different insect pests of mulberry and other agricultural crops for microsporidian infection. Int. J. Biotechnol. Mol. Biol. Res., **2(8):** 138-142.
Umesh KNN, Shree MP, Ravi Kumar R (1989). Effect of "Tukra" on the biochemical contents of mulberry variety Vietnam. Geobios, **16(6):**283-284.
Siddegowda DK, Gupta VK, Sen AK, Benchamin KV, Manjuanath D,Prasad KS, Magdum SB, Datta RK (1995) . Diaphania species infests mulberry in South India. Indian Silk, **34(12)**: 6-8.
Ullal SR, Narasimhanna MN (1981). Hand Book of Practical Sericulture. Central Silk Board. Bombay.
Geethabai M, Marimadaiah B, Narayanaswamy KC, Rajagopal D (1997). An outbreak of leaf roller pest, Diaphania (margaronia) pulverulentalis (Hampson) on mulberry in Karnataka. Geobios New Reports, **16(2):** 73-79.
Miyashita Y (1986). A report on mulberry cultivation and training methods suitable to bivoltine rearing in Karnataka. 7-30.
Reddy DNR, Narayanaswamy KC (2003). Pest of Mulberry. Zen Publishers. Bangalore, pp. 56-60.
Dixon WJ, Massey FJJR (1957). Introduction to Statistical Analysis,2nd edn. McGraw-Hill Book. Company, New York.
Veeranna G (1997). Biochemical changes in tukra leaves of mulberry and its effects on economic characters of mulberry silkworm, Bombyx mori L. Entomon, **22(2):**129-133.
Narayanaswamy, T.K., Srinivasa Gowda, R. and Sannaveerappanavar,V.T. (2003). Leaf roller of mulberry. Indian Silk.41 (12):8-11.
Mahadeva, A and Shree, MP (2015). Evaluation of macro and micro nutritive elemental levels of Mealybug infested leaves of mulberry, J. Plant. Nutr, 38:96-107.
Mahadeva, A (2017). An investigation on changes in biochemical content mealy bugs infested mulberry foliage J. Plant. Sci. Res. Vol.3.
Shrey, AVMJ (2014). The predominant thrips species infesting mulberry Karnataka India insect environment, 20:88-92.