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K Thanga Roja
Scholar, Department of Sericulture, Tamil Nadu Agricultural University, Coimbatore (District), Tamil Nadu, India

Dr. KA Murugesh
Professor, Department of Sericulture, Tamil Nadu Agricultural University, Coimbatore (District), Tamil Nadu, India

Dr. M Saratha
Scientist B, Regional Extension centre, Gobichettipalayam, Erode, Tamil Nadu, India

Corresponding Author:
K Thanga Roja
Scholar, Department of Sericulture, Tamil Nadu Agricultural University, Coimbatore (District), Tamil Nadu, India

Significance of foliar organic growth stimulators on cocoon productivity

K Thanga Roja, Dr. KA Murugesh and Dr. M Saratha

Abstract
Around the world, silk is a lucrative commerce product. According to statistics from the International Sericulture Commission (2022), India is the second top producer of silk, with 36582 thousand MT of raw silk output. To increase mulberry productivity, sericulture farmers use an excessive amount of inorganic inputs, which is harming the ecosystem over time. The simplest approach to supply vital major and minor nutrients, substances that regulate plant growth for a rapid boost to mulberry leaf productivity, control foliar diseases and pests, and increase the production of high-quality cocoons is to apply organic foliar formulations on mulberry. It has been discovered that using different organic inputs and organic foliar formulations like panchagavya, vermiwash, effective microorganisms, jeevamirtham, dasagavya, and amirthakaraisal can help increase leaf yield and improve the quality of silk. Therefore, applying foliar organic fertilizer in place of chemical fertilizer at the appropriate time and in the ideal amount will increase the mulberry's productivity and quality of the silk cocoon within shortened period of time.

Keywords: Cocoon, mulberry, organic formulations, panchakavya, pest and diseases

Introduction
The hardy, perennial, fast-growing deciduous mulberry (*Morus* sp.) is a member of the Moraceae family of plants. Being the only food plant for silkworms, *Bombyx mori* L., it is of considerable economic significance in the sericulture sector. The nutritional state of the mulberry leaf has a direct and stronger bearing on the growth and development of *B. mori*. A mulberry garden requires more than a year to fully grow, and further years are needed to attain its maximum production. In an effort to increase mulberry productivity, sericulture producers employ an excessive amount of inorganic inputs, which is harming the ecosystem over time. Numerous pests and diseases cripple the mulberry crop, causing financial losses and ultimately affecting silkworm development and cocoon production.
Sucking pests, including mealy bugs, thrips, and whiteflies, as well as defoliators, like leaf webbers, hoppers, and ash weevil, among others, have a detrimental effect on mulberry crops and are managed chemically. The use of different pesticides not only raises the price of leaf productivity but also degrades the mulberry garden's soil quality. The safe provision of ecological conditions and the maintenance of dynamic soil nutrient status are achieved by the application of organic inputs. When it comes to boosting mulberry yield and enhancing silk quality, different organic inputs like green manures, bio-fertilizers, vermicompost, farm yard manure, certified organic fertilizers, and organic foliar formulations like panchagavya, vermiwash, effective microorganisms, jeevamirtham, dasagavya, and amirthakaraisal are effectively used. But, publications regarding the application of organic foliar formulations on mulberry crops are few because there hasn't been much research done in this area. Bearing in mind the implications of applying organic foliar formulations to improve mulberry growth and cocoon productivity, the current review aims to determine the effectiveness of various organic foliar formulations on some of the crops and mulberry growth, pests and diseases, as well as their influence on silkworm economic traits.

Importance of foliar fertilization on mulberry production
The application of foliar fertilization is an important crop management strategy. Foliar fertilization is the means of supplementation of plant nutrients in available form at right time

to increase the yield and quality of mulberry. According to plant species and varieties, the nutrients uptake by plants varied which ultimately depends on leaf morphology and physiology process. Since, mulberry is a deep rooted plant which was not well absorbed the nutrients in soil so, foliar application of available plant nutrients in a right time to increase the level of nutrient absorption by the foliage in crop growth and development (Narahari *et al.*, 1997) [41].

Lokanath and Shivashankar (1986) [32] found the positive effect on foliar application of plant nutrients to enhance the yield and quality of mulberry. The application of kinetin based plant growth regulators as foliar spray significantly increased the photosynthetic rate, chlorophyll and sugar content that enhance the leaf yield by 30 % on mulberry (Das *et al.*, 2002) [11]. Jyothi *et al*. (2002) [27] studied that the effect of foliar application of multifunctional organic acids with essential nutrients to improve nutrient uptake, protein synthesis and enzyme action in mulberry plant. Commercially available plant growth regulators as foliar application *viz.*, IAA and GA3 showed significant improvement in leaf lobation and quality in local cultivars of mulberry (Govinda and Basavaiah, 2006) [18].

Compared to soil application, foliar application was more effective at 8 to 10 times as much better than soil application and also 90 % nutrients uptake by mulberry leaves within 60 minutes of foliar application which was reported by Kumar Venkatesh *et al.* (2012) [30].

Effect of organic foliar formulations on quantitative and qualitative attributes of crop productivity.

Buckerfield *et al*. (1999) [7] conducted experiment that foliar application of vermiwash on radish increased yield by 7.3 %. Yield enhancement in chilli by foliar application of vermisol by 7.3% was reported by Lozek and Gracova (1999) [33]. Studies by Jasmin (1999) [24] found that the application of vermiwash at 12.5 % to increased crop growth and yield of tomato. Jayashankar *et al*. (2002) [26] reported that increased the yield substantially on field bean after the foliar application of 3% panchagavya.

There was significantly enhanced the growth of seedlings with the combined foliar application of organic promoters like panchagavya, jeevamrutham and beejamrutham and also noticed that the increased the yield and dry matter production in chilli who was opined by (Chandrakala, 2008) [8]. The application of organic growth promoters like panchagavya and EM solution contributed for higher plant height, number of leaves per branch and enhance total crop yield of brinjal (Mohan and Bindumathi, 2008). Gore and Sreenivasa (2011) [17] studied that the combined foliar application of organic formulations *viz.*, panchagavya, beejamurtha and jeevamurtha on 75 and 160 DAS of tomato increased the plant growth, root biomass and improve the enzymatic activities and uptake of nutrients by plants.

The foliar spray of fish amino acid on red amaranthus to increase the crop and yield by 20% was reported by Abhilash (2011) [1]. The application of Beejamurtha on soyabean had significant improvement in seedling length and seedling vigour due to presence of several beneficial bacteria (Sreenivasa *et al.*, 2010) [61] and the foliar application of vermiwash at 50ml plant^{-1} on bhendi to increase crop growth and yield who was reported by Nishana (2005) [43].

Effect of foliar spray of panchagavya on quantitative and qualitative attributes of mulberry and other crops

Venkataramana *et al*. (2009) [70] studied the effect of organic manures and *Panchagavya* as foliar spray on mulberry (*Morus alba* L.) production and found that application of organic manures and 3% *Panchagavya* foliar spray significantly increased the mulberry leaf yield. The recommended dose of NPK through chemical fertilizers along with the 3% organic foliar spray of *Panchagavya* had recorded maximum leaf yield. The other yield attributing characters *viz*., number of branches per plant (12.00), number of leaves per plant (142.00) and weight of leaves per plant (1.200 kg) as well as leaf quality parameters *viz*., leaf moisture content (73%) and leaf moisture retention capacity (88%) were increased significantly with 3% panchagavya as foliar spray.

Uppar (2011) [68] conducted experiment on the effect of foliar application of organic formulations on mulberry. The different organic foliar formulations was applied as foliar spray and recorded significantly increased the morphological and yield attributing characters such as plant height, number of leaves per branch, number of shoots per plant, fresh weight and dry weight of leaves in the treatment with panchagavya at 3%.

Samuthiravelu *et al*. (2012) [53] observed the effect of panchagavya at two different concentration at 5 per cent and 10 per cent by applying it on 15, 25, 35 days after pruning of mulberry. Among the different concentrations, panchagavya at 10% which significantly increased the number of shoots/plant, total biomass and leaf yield. The foliar application of panchagavya at 3% thrice with recommended dose of fertilizers to increase the yield of baby corn (7226 kg ha^{-1}) that was reported by Vimalendran and Wahab (2013) [72].

Jain *et al*. (2014) [23] found that the application organic supplement (panchagavya) as foliar spray to improve the root and shoot length, fresh and dry weight of the seedling, water-soluble macronutrients including pH and metal on various crops. The foliar application of panchagavya at 3% concentration (30ml/lt of solution) at 10 days interval produce highest plant height (80.17 cm) and highest yield/ha (21.95 q) of chilli who was studied by Swain *et al*. (2015) [65]. The use of panchagavya as foliar application enhanced the growth parameters such as length of plant, number of branches, yield/ plant in treated plants respectively (Rao *et al.*, 2015) [49]. The application of panchagavya at 6 per cent on 25, 50, 75 and 100 DAP contributed for higher plant height, number of branches and total crop yield which might be due to adequate supply of nutrients and presence of growth regulators in panchagavya (Boraiah *et al.*, 2017) [6].

Rakesh *et al*. (2017) [48] recorded maximum plant height, number of leaves, fresh weight and dry weight of leaves when panchagavya was applied at different concentrations (Control, 1%, 3%, 5% and 7%) at weekly interval up to 45th day after sowing as foliar spray. The exo morphological characters such as shoot length, internode length, diameter of the internode, number of leaves and leaf surface area were significantly increased in the treatment of panchagavya as foliar spray on crops (Maheswari *et al.*, 2017) [35]. The foliar application of panchagavya resulted in significantly higher shoot length (16.53cm) root length (18.25 cm) and protein content (23.79 %) as compared to control in green gram (Shariff *et al.*, 2017) [56].

Choudhary *et al*. (2017) [10] studied that the foliar application of panchagavya 4% was significantly increases dry matter (7.20 g plant-1), leaf area index (1.92), test weight (38.46 g), biological yield (2536 kg ha-1) and also increases uptake of nitrogen, phosphorus, potassium, sulphur, zinc and iron content in seed and improves protein content of blackgram.

Kumar Venkatesh *et al*. (2012) [30] studied the effect of different bio enhancers which was significantly increased the vegetative and yield parameters such as plant height (26.73 cm), number of leaves (14.67), at 15, 30 and 45 DAT, whole plant weight(1341 g) and yield (29.04 t/ha) at 15, 30 and 45 days after treatment in 4 % panchagavya as foliar spray on mulberry. Vinnolit *et al*. (2018) [73] studied comparative effect of organic fertilizers panchagavya as foliar application and vermicompost as soil application that enhanced the various growth parameters such as plant height, number of leaves/plant, leaf length and economic part of the crop in treatment with 3% panchagavya.

Gunasekar *et al*. (2018) [19] conducted on experiment that the foliar application of leaf extracts and panchagavya and its effects on black gram. The results revealed that significantly increased the morphological and yield attributing characters such as plant height (39.70 cm), number of leaves per plant (16.00), number of branches per plant (3.90) due to presence of plant growth substance, growth enzymes, various amino acids, vitamins, nutrients, growth regulators and also acts as a medium for the growth of beneficial microbes present in panchagavya. Dutta *et al*. (2018) [12] reported that the combined foliar application BD-501 and Panchagavya emerged as the best treatment to maximize the yield of 15.56 t ha^{-1} with higher ascorbic acid (220.00 mg 100 g^{-1}) and protein (16.25%) which had positive effect on growth, quality and yield of garden pea.

Effect of foliar spray of Vermiwash on quantitative and qualitative attributes of mulberry and other crops

Venkataramana *et al*. (2009) [70] found that foliar application of vermiwash and cow dung wash at improved yield attributing parameters of mulberry. After 65-70 DAP, the mulberry leaves showed height per plant (199.50 cm), length of shoot per plant (189 cm), number of branches per plant(13.00), number of leaves per plant (155) and weight of leaves per plant (1.200 kg) nitrogen (3.92%), phosphorus (0.55 %) and potassium (3.36%), chlorophyll a (3.86 mg/g), chlorophyll b (0.89 mg/g), total chlorophyll (4.75 mg/g), soluble protein (33.50 %) and total carbohydrate (42.35%) were significantly higher in treatment 200 ppm vermiwash. Samuthiravelu *et al*. (2012) [53] observed the effect of vermiwash at two different concentration of 10 per cent and 15 per cent with the application on 15, 25, 35 days after pruning. Among the different concentrations, vermiwash at 15 per cent significantly increase the number of leaves per plant, number of shoots/plant, total biomass and leaf yield.

The foliar application of vermiwash at different concentrations *viz.*, 10 per cent, 25 per cent and 50 per cent on mulberry leaves which showed significant increase in carbohydrate, protein and lipid content of mulberry leaves by Pooncli and Tlzcmjcwur (2012) [45]. Karthikairaj and Isaiarasu (2013) [28] studied the effect of vermiwash on growth of mulberry. Vermiwash was used in five different concentrations *viz.*, 10, 20, 30, 40 and 50 per cent as foliar spray on mulberry leaves. The results revealed that the number of buds, number of leaves and weight of leaves increased significantly after the treatment of vermiwash at 50% as foliar application applied on 30 days after pruning of mulberry. Moreover, the total carbohydrate and soluble protein content were increased about 0.930±0.020 and 0.960±0.010 in foliar application of vermiwash while compared to soil application on mulberry

Kumar and Kumar (2014) [31] attempted to improve the growth and biochemical contents in the mulberry leaves through foliar combination of *Spirulina*, soybean and vermiwash. The concentrations of 15, 30 and 45 µg mL^{-1} of bio-foliar were sprayed on five different mulberry varieties. The results showed that bio-foliar application at 45 µg mL^{-1} concentration on BR-2 and S-1635 mulberry varieties was an effective treatment for growth and productivity of mulberry, which also enhanced the biochemical constituents of mulberry leaf without causing any substantial loss to the ecosystem. The foliar application of vermiwash at 7 per cent on V1 mulberry variety along with recommended doses of fertilizers twice during every crop on 30 and 40 DAP that significantly improves the photosynthetic efficiency and qualitative attributes of mulberry leaves reported by Sudhakar *et al*. (2018) [63].

Ansari (2008) [2] studied the effect of vermicompost and vermiwash on the productivity of Spinach (*Spinacia oleracea*). The different combinations of vermicompost @ 6 tonnes and vermiwash at different concentrations were applied through foliar application on spinach. The results revealed that the foliar application of vermiwash at 1:10 significantly increased number of leaves and fresh leaf yield. Gopal et al. (2010) [16] studied the effect of coconut leaf vermiwash at different dilutions that observed the significant increase nitrogen, phosphorus and potassium content and improves absorption of nutrient from the vermiwash which enhance the growth and yield of cowpea. Suthar and Surindra (2010) [64] reported that the highest level of chlorophyll, total proteins, total sugar and starch in fresh leaves were in 100 per cent vermiwash treatment on biochemical attributes of fenugreek and guar.

The maximum nitrogen content was observed in the treatment of vermiwash at 69 ppm as compared to control and also has more values of nitrogen content in vermiwash treated plants due to a large source of nitrogen for mineralization. There was greater percentage of fats and protein content in okra in the combination of vermicompost and vermiwash [VW+VC] as compare to control reported by Ansari and Sukhraj (2010) [3]. Hegde et al. (2010) [20] conducted experiment that effect of foliar spray of vermiwash on growth and yield performance of curry leaf. The different nutritional treatments such as foliar spray of vermiwash (50%), FYM and vermicompost were applied on crop at particular intervals after each clipping. Among the different nutritional treatments, the foliar spray of vermiwash was significantly increased in plant height, number of primary branches and fresh leaf yield.

More et al. (2013) [37] attempted to study the effect of integrated nitrogen management with vermiwash on growth and yield corn. The different nitrogen treatments were applied through both soil amendments and foliar sprays of vermiwash. By the combined analysis of various nitrogen treatments, the foliar spray of vermiwash was increased 11.21% grain and 10.28% stover yield over control. Elumalai et al. (2013) [13] investigated the influence of vermiwash on *Abelmoschus esculentus* as foliar spray. The results revealed that the 15% vermiwash showed growth enhancing effects followed by 10% vermiwash.

Rekha et al. (2013) [51] studied the influence of the different concentrations vermiwash on growth of black gram which recorded significantly increase the plant height, shoot length, number of internodes, number of leaves/shoot and number of branches/plant in the treatment of vermiwash at 150 µm. Jadhav et al. (2014) [22] studied that effect of different proportion of vermiwash spray on growth and yield of radish. The different proportion of vermiwash with water were1:1, 1:2, 1:3 and 1:4 which were sprayed during early hours twice

at specific intervals. The results revealed that the foliar spray of vermiwash (1:4) at twice was significantly higher than all other treatments in growth and yield attributes

Sharma *et al*. (2014) [57] observed the effect of vermiwash on growth and yield of okra. The application of vermiwash was sprayed five times at specified intervals after 30 days after sowing. The observed results were significantly higher by the application of vermiwash in plant height, internodal length and number of nodes per plant. The liquid biofertilizer vermiwash was applied as foliar supplementation on chilli which showed the positive effects on growth parameters such as root and shoot length as well as number of leaves in vermiwash treated plant (Varghese and Prabha, 2014) [69].

Kularathna and Devasinghe (2016) [29] investigated the effect of foliar application of vermiwash on lettuce which was significantly increased the shoot length, number of leaves, shoot fresh weight and shoot dry weight in treated plants. Maheswari *et al.* (2017) [35] studied growth promoting effects of vermiwash on lablab which showed better morphological growth parameters such as s shoot length, internode length, diameter of the internode, number of leaves, leaf surface area in treated plants as effective foliar spray than untreated plants.

Effect of foliar spray of EM on quantitative and qualitative attributes of mulberry and other crops.

Under this heading, most of literature speaks which have been carried out on various horticultural crops but the reports on foliar application of EM or microbial inoculants on mulberry are either very scanty or not available at all. Also, the foliar application of microbial inoculants on mulberry and its impact on silkworm and cocoon productivity have not been studied well. Hence, use of EM as foliar application on mulberry that enhance the crop productivity and improves economic traits of silkworm to help the agro based cottage industry to achieve the sustainable eco friendly progress.

Effective microorganism consists of mixture of live natural cultures of microorganisms isolated from fertile soils that were used to improve crop production. It act as soil-plant interaction to suppress plant pathogens and disease, to conserve energy, to solubilize soil minerals, to aid the balance and ecology of soil microbes, and to improve photosynthetic efficiency and biological nitrogen fixation in crops (Olle and Williams, 2013) [44].

Foliar application of three nitrogen fixing bacteria (NFBs) namely *Azotobacter, Azospirillum* and *Beijerinckia* in mulberry (*Morus* sp.) along with half of the recommended dose of N as a basal application of chemical fertilizer improved the growth and yield attributing parameters of mulberry (Sudhakar *et al.*, 2000) [62]. Ganeshkeremane *et al*. (2004) [14] opined that EM application as foliar spray in three mulberry varieties exhibited positive effect on the growth of the crop. Further studies to elucidate effect on crop productivity indicated that there was an increase in the plant growth and yield attributing parameters by the foliar spray of EM on 0.1 per cent in mulberry compared to the control plots (Gnanaselvi, 2007) [15] Vijayan *et al*. (2007) [71] observed that foliar application of *Azatobactor chroococcum* to mulberry grown under saline soil conditions showed significant level of improvement in morphological parameters such as plant height, number of branches, leaf size and leaf yield of mulberry. Vinoj (2008) [74] reported that treatment of mulberry seed cuttings with EM along with vermicompost and biofertilizers *viz., Azospirillum*, PSB and *Rhizobium* resulted in higher sprouting, survival, total soluble sugars, total soluble protein, chlorophyll content, total phenol and other growth parameters in mulberry.

Yadav (2002) [76] studied the performance of effective microorganism (EM 0.2% at 15 days intervals foliar spray) on growth and yield attributes of cabbage and radish in which results revealed that increased in yield of 91.05% and 71.50% compared with (no EM foliar spray) controls, respectively. Yousaf *et al*. (2000) [77] conducted an experiment that foliar spray of EM on ground nut showed more growth and yield attributing characters such as plant height, number of branches and weight of branches than other treatments. The foliar application of effective microorganism in combination with proper soil amendment enhanced growth and yield attributing parameters of such as shoot length, shoot dry weight, root dry weight and number of pods per plant than other treatments (Javaid, 2006) [25].

The field experiment was conducted by Yue *et al*. (2002) [78] revealed that the increased the photosynthetic rate and stomatal conductance on EM treated leaves of soybean and there was significant improvement the seed protein and crude fat content thereby increase the crop yield. The study on the effect of three different concentrations of EM solution on papaya as foliar spray to increase the growth, quality and yield of crops was reported by Huong and Lien (2010) [21]. Shaheen *et al*. (2017) [55] conducted an experiment to study the effects of co-application of effective microorganism with organic and inorganic fertilizers that results observed that increases in plant height (35 cm), number of leaves (16.4), fresh foliage yields (330 g pot^{-1}), dry foliage yields (32 g pot^{-1}), leaf length (40.5 cm) and leaf area (238.4 mm^2) in press mud applied with EM than other treatments in spinach.

The influence of foliar application of effective microorganism on bitterguard which was recorded higher values of growth parameters such as number of shoots, number of leaves and shoot length in treated plants over the control (Sivashankary *et al.*, 2013) [60]. Nadarajah and Seran (2013) [40] determined the morphological parameters such as plant height, shoot root ratio and economic part of crop increased when effective microorganism was applied as foliar supplementation. Nibin *et al*. (2016) [42] studied the soil and foliar application of effective microorganism and its effects on bhendi at different concentrations which was significantly increased the plant height, number of leaves per plant and number of branches per plant in the treatment of foliar application of EM at 1 per cent.

Effect of organic foliar formulation against pests of crops.

Samuthiravelu *et al.* (2012) [53] studied the impact of organic nutrients *viz.*, panchagavya and vermiwash on major pest incidence of tukra mealy bug, thrips and leaf webber on mulberry which was recorded minimal infestation of pests after the treatment of organic nutrients. There was minimal level of tukra (4.61 %) and thrips (2.79 %) infestation in all replicated plots at ETL with the foliar application of panchagavya and vermiwash on mulberry who was reported by Sudhakar *et al.* (2018) [63]. Vivekanandan (1999) [75] reported that foliar application of panchagavya in annual Moringa, which increased the yield besides besides giving resistance to pests.

The foliar spray of panchagavya was effective against white fly (*Bemisia tabacci*) and leaf hopper (*Amrasca biguttula*) who was reported by Boomiraj *et al*. (2004) [5] in okra. Tuat and Trinh (2002) [62] found that minimum level pest infestation due to application of EM in vegetables. The combination of panchagavya and NSKE was found to be effective against *Spodoptera litura* larvae followed by

panchagavya and Vitex nigundo and calotropis in groundnut and soybean who was reported by Bharath (2005) [4]. Sajjan (2006) [52] proved that the controlling DBM in cabbage by the combined application of panchagavya and cow urine with NSKE over spinosad and also Shrinivas and Balikai (2009) [58] reported that application of panchagavya against shootfly in sorghum. Senthil Kumar *et al.* (2015) [54] studied that the application of panchagavya at different concentrations against pest infestation on teak in which result revealed that the 7 percent diluted panchagavya was found to be effective against controlling the pests and affordable to the tree growers.

Silkworm growth and development as influenced by foliar spray of nutrients on mulberry

Rawgol *et al*. (2011) [50] studied the efficacy of vermiwash-smeared mulberry leaves on cocoon characters of mulberry silkworm. The vermiwash was smeared on mulberry leaves just 2h before feeding. The results showed a significant positive effect on larval growth in terms of larval and silk gland weight and cocoon characters including fresh cocoon weight, wet weight of deflossed cocoons, dry weight of deflossed cocoons and shell ratio per cent compared to controls.

Samuthiravelu *et al.* (2012) [53] reported on the food consumption and utilization of *B. mori* larvae (CSR2 x CSR4) fed on mulberry leaves treated with panchakavya, vermiwash and seriboost. The results revealed that the rate of feeding (Cr), assimilation (Ar) and production (Pr) were higher in larvae treated with panchagavya (10%) and vermiwash (15%), over the control. Sudhakar *et al.* (2018) [63] conducted a bioassay studies on vermiwash and panchagavya sprayed mulberry leaves fed by larvae in which result revealed that there was no marked variations among the treatments. The larval and cocoon parameters in PM x NB4D2 silkworm could be significantly increased by feeding M-5 mulberry sprayed with 'Seriboost' at 2.5 ml/lit on 16, 23 and 30 days after pruning (Rajegowda *et al.*, 1999) [47].

Green leaf at 0.5 per cent sprayed mulberry leaves were fed by the silkworm, PM x NB4D2 which had better cocoon weight (1.679 g), shell weight (0.319 g), pupal weight (1.336 g) and filament length (1054.58 m) (Chikkaswamy *et al.*, 1999) [9]. There was improvement in the cocoon shell weight and shell ratio of 21.17 and 6.63 with larvae fed by seriboost sprayed mulberry leaves was revealed by Singhvi *et al*. (2002) [59].

A bio assay study was conducted by Prasanna Kumar *et al.* (2001) [48] with foliar spray of Green leaf on different mulberry varieties using bivoltine and multivoltine hybrids and this could be resulted in increased cocoon weight, shell weight, shell ratio and filament length by different treated mulberry varieties with both hybrids. In M-5 mulberry leaves sprayed with biofert at different concentrations could not increases the cocoon weight and pupal weight but significantly improved the shell ratio, filament length and reelability percentage (Mahadeva *et al.*, 2006) [34].

Pooncli and Tlzcmjcwur (2012) [45] conducted a bioassay studies that the different concentration of vermiwash applied mulberry leaves which significantly increase the weight of larva and silk gland, cocoon weight, shell weight and pupal weight. Also, there was significantly increase the acid phosphatase and alkaline phosphatase in the silkworm body *Bombyx mori*. Murari *et al*. (2008) [39] reported that, fifth instar silkworm reared on mulberry leaves sprayed with aqueous extract of *Cucumis sativus* at 6 per cent concentration recorded significantly maximum cocoon weight, shell weight and shell ratio compared to control.

The selected plant extracts such as *Capsicum sativus* and *Capsicum annum* were sprayed on mulberry leaves that exhibited significant differences with respect to economic traits of silkworm such as larval weight, effective rate of rearing during summer season (Thimmaraju, 2008) [66]. Murari *et al.* (2011) [38] found that, the silkworm fed on mulberry leaves sprayed with extract of *C. sativus* recorded more food consumption on first day (80.02 g/100 larvae) to seventh day (123.57 g/100 larvae) of fifth instar. Among interactions, this botanical at 6 per cent recorded more food consumption as observed from first day (81.62 g/100 larvae) to seventh day (125.02 g/100 larvae) in fifth instar. Similarly, the treatment *C. sativus* at 6 per cent recorded maximum food digestion from first day (50.12 g/100 larvae) to seventh day (59.59 g/100 larvae) of fifth instar silkworm.

Conclusion

From the above reviews it is clear that organic foliar formulations as foliar sprays could reduce the pest infestation on crops and increase the growth, quality and yield of crops in several ways *viz.*, by supplying essential nutrient in available form, providing soluble nutrients at correct time, increasing uptake of nutrients for further growth of crops.

Conflict of Interest

Not available

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Not available

Reference

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