Effect of Organic Nutrition In Enhancing Mulberry And Silkworm Productivity-Review

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Abstract- *Mulberry is the sole food for the silkworm (Bombyx mori L.). The healthy growth of the silkworm and economic traits are mainly influenced by the nutritional status of mulberry leaves fed to silkworm. Use of high dosage of chemical fertilizers leads to the depletion of nutrients in mulberry and cause toxicity to silkworms. Application of organic manure to mulberry crop not only increases the growth but also nutritional quality of mulberry leaves, this in turn influences the silkworm growth and its economic traits.(Sangeethaet al., 2012) conducted the study on influence of composted manure of silkworm litter - Pupal waste (SLPW) with other organic manures on growth and leaf yield parameters of mulberry. The compost made out of SLPW was found rich in nutrients N-3.11%, P -0.39%, K-2.48% than the farm yard manure and vermicompost.The effect of organic nutrients supplementing through foliar spray of Panchagavya (5 and 10%), vermiwash (10 and 15%) and Seri boost (0.2%) along with basal doses of vermicompost and normal recommended dose of fertilizer in mulberry garden. The mulberry garden sprayed with Panchagavya and vermiwash showed better performance in mulberry growth parameter and reduced pest incidence in the mulberry garden (Samuthiraveluet al., 2012). Organically produced foliar sprays viz., vermiwash, bio digester and Panchagavya sprayed on M-5 mulberry. Application of vermiwash significantly stimulated plant growth and biochemical constituent of mulberry also the silkworm growth, cocoon and silk traits (Vivek and Rayar, 2014).Whereas with respect to the efficacy of different sources of organic manures on mulberry (V-1 variety) and its influence on economic performance of PM x CSR2 silkworm results that the batch of silkworms fed on mulberry leaves shown significantly higher yield compared to chemical form of fertilizers (Ramakrishna Naika et al., 2011).*

Keywords- Organic nutrients, Mulberry, Silkworm,

I. INTRODUCTION

Mulberry is the sole food source for the silkworm (*Bombyx mori.L*). The healthy growth of the silkworm and economic traits are largely influenced by the nutritional status of mulberry leaves fed to the silkworm. Intensive use of high dosage of chemical fertilizers leads to the depletion of nutrients and causes toxicity to the silkworms. By application of organic manure to mulberry crop increases the growth and also nutritional quality of mulberry leaves, this intern influence silkworm growth and its economic traits. The quality and quantity of raw silk production and consequent growth of sericulture industry depend largely on quality and quantity of the mulberry leaves produced. The quality of mulberry leaves varies with the environmental conditions, soil fertility, quality and quantity of nutrients supplied and other agronomical operations, the mulberry crop responds well to the application of chemical fertilizers and complements the growth and development of silkworm and cocoon yield. However indiscriminate use of chemicals results in environmental pollution, soil fatigue, reduced net returns. The organic production system aims at utilization of available biomass to enrich soil productivity, to supply balanced nutrients to crop plants and to reduce the cost of production (Sangeetha *et al.,* 2012)

Organic nutrition supply is being advocated as an alternate farming system for achieving sustainability, encourages healthy soils and crops by reducing the use of chemical fertilizers and increasing the use of organic material viz., compost FYM, vermicompost, green manure, oil cakes etc. the sustainable crop production involves sufficient use of available natural resources, reducing the cost of production and increasing the farm income.

Organic nutrients

"The materials which are organic in origin, bulky and concentrated in nature and capable of supplying plant nutrients and improving physical and chemical properties of soil" Natural fertilizers derived from plants, animals and human residues .The product resulting from the controlled biological decomposition of organic matter

Why organic manures

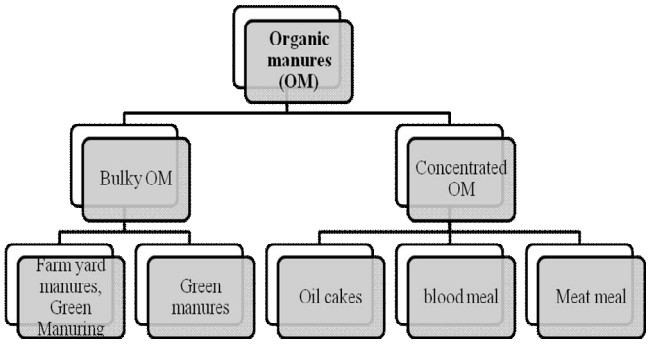
Once planted, mulberry is being maintained for several years with continuous agronomical practices in bimonthly intervals. Chemical based inputs are much preferred by the farmers because of short term results and economy. Residues of the chemicals (fertilizers / weedicides / insecticides / fungicides) used in the mulberry garden pose a potential risk of environmental pollution besides adverse effects on the users, silkworms, natural enemy complex, beneficial micro-organisms *etc.* (Sakthivel *et al.*, 2014).

Though chemical farming initially yields good results, the sericulture farmers certainly experience its negative impacts on leaf yield as well as quality and cocoon productivity, few years after mulberry cultivation. Therefore, promotion of organic farming is need of the hour in sericulture to avoid indiscriminate use of chemicals in mulberry garden. In this context, this bulletin enumerates possible organic inputs and their utility in mulberry farming as well as recent advancements in eco-friendly agronomical package of practices developed for sustainable sericulture.Whereas the availability of these organic sources are scanty and costlier to cultivators, has led to shift in usage organic sources to sewage waste, urban composts and night soil use. This showed a greater loss to silk and mulberry industry global wide to develop a high yielding varieties and cultivars to come across various agro-climatic zones.

Source of organic nutrition

The sources of organic nutrition is categorized into different groups *viz.*,Animal based, Plant based, Animal cum plant based and Miscellaneous. The animal based organic nutrition is very essential to mulberry plant growth and development to resist various biotic and abiotic stress viz., drought, high temperature, and browsing, lopping, pest and disease attack.

Major sources of organic nutrients are obtained from Farm yard manure, Compost and Vermicompost, Vermiwash, Poultry manure, Sheep and goat manure, Green manure, Bio fertilizers, Oil cake, Pressmud and Panchagavya.



Farm yard Manure (FYM)

FYM is bulky organic manure prepared simply by storing cow / buffalo dung, droppings of sheep, goat, poultry *etc.*, along with leftover fodders (available from own source of livestock culture of farmers) in pits for few months for decomposition (Sakthivel *et al.*, 2014). The well decomposed FYM contains approximately 0.5 % N, 0.2 % P O and 0.5 % K O. However to realize the full nutrient potential of livestock wastes, they must be properly decomposed, through suitable method of composting.

Being bulky and cheap source of organic manure, FYM is an integral part of soil health and Integrated nutrient management (INM) strategies in India. In sericulture, soil test based FYM application is highly appreciable. The dosage of FYM varies with soil organic carbon content as given below.

Soil organic carbon (%)	Dosage (MT/ ac / year)	No. of splits
<0.35	12	3
0.35 - 0.65	10	2
0.65 – 1.00	8	2

With respect to the usage of FYM in cultivation of mulberry has led to increase in 5-7 times in overall productivity of mulberry and silkworm than the high usage of chemical based fertilizers (Gangopadhyay, 2009).

Compost

Compost is a product of biodegradation of organic wastes available from differentSources like crop residues, weeds, green and dry leaves, cow dung, poultry wastes, Urban wastes, wastes from agro based industries (pressmud, sericulture wastes etc.,) Which is carried out by diverse group of heterotrophic microorganisms such as bacteria? fungi, actinomycetes and protozoa (Ravi Kumar *et al.*, 2014).

The principles behind composting are narrowing down of C: N ratio, the total destruction of harmful pathogens and weed seeds by high temperature evolved during decomposition and stabilization. When the organic materials broken down in thePresence of oxygen the process is called aerobic decomposition and end product formed are carbon dioxide, humic substances and release of available plant nutrients. The quality of compost is depending upon the availability of organic wastes and their composition besides the judicious mixing and preparation. However it holds rich nutrient value than FYM. The nutrient value of compost can further be increased by application of superphosphate or rock phosphate @ 10 to 15 kg / MT of raw material at the initial stage of filling the compost pit.

Vermicompost

Earthworms as friends of farming community, renders help in soil improvement, organic matter decomposition and in enhancing the quality of agricultural produce. Vermicomposting is a bio-oxidation process of organic wastes involving a joint action of earthworms and micro-organisms. In this process earthworms act as versatile bioreactors converting organic materials into fine granules called vermicast (excreta of earthworms). Vermicompost is rich in plant nutrients, enzymes, antibiotics, plant growth hormones and large beneficial microbial populations which help to increase the quality and yield of mulberry leaves suitable for higher productivity of silk (chikkanna *et al.,* 2014). Application of 10 MT of vermicompost with 50% reduction in the application of recommended dose of chemical fertilizers (NPK) / ha/ year could produce leaf yield at par with application of 20 MT of FYM /ha/year with full recommended dose of chemical fertilizers.

Poultry Manure

Poultry manure is good source of organic nutrients and used after decomposition. Poultry droppings have nitrogen (4.55 to 5.46 %), phosphorus (2.46 to 2.82 %), potassium (2.02 to 2.32 %), calcium (4.52 to 8.15 %), magnesium (0.52 to 0.73 %) and appreciable quantities of micronutrients like Cu, Zn, Fe, Mn etc., besides cellulose (2.26 to 3.62%), hermicellulose (1.89 to 2.77 %) and lignin (1.07 to 2.16 %). This can be decomposed with suitable organic amendment like chopped paddy straw or coir pith by adding fungal inoculums of *Pleurotussajor-caju*1.25 kg and 0.5 kg respectively (Kerenhap*et al.,* 2007)

Sheep and Goat Manure

The sheep and goat droppings have more nutrients than farmyard manure and compost. This manure consists of 3 % N, 1 % P O and 2 % K O. There are two methods of application of droppings of sheep or goat. In first method, the decomposed droppings of sheep or goat in pits applied later to the field where in the nutrients present in the urine are wasted. In the second method, sheep and goats are kept overnight in the field by which urine and faecal matter incorporated to the soil in shallow depth by using working blade harrow or cultivator (sakthivel*et al.,* 2014)**.**

Green manures

Green manuring can be defined as a practice of incorporating the soil with the un-decomposed green plant tissues for improving its physical structure as well as fertility. It is a best alternative to FYM in the prevailing situation of its scarcity and high cost due to decline in livestock farming in recent past. Green manure crop is grown in inter rows of mulberry plants and incorporated in soil at pre flowering stage because they are grown only for their biomass which is high in organic matter and nutrients. The green-manure crop also supplies additional nitrogen due to its ability to fix nitrogen from the air with the help of its root nodule bacteria.

Further *in-situ* composting of green manure promotes the build-up of beneficial rhizosphere micro-flora in the garden which enhance the availability and mobilization of soil nutrients to the plants. Green manures will break down in to the soil gradually and add some nutrients to the soil for the next crop too. Green manuring in mulberry with Dhaincha (*Sesbaniaaculeata*) and sun hemp (*Crotalaria juncea*) @ 15 kg seeds / acre is recommended for alkaline and neutral soil conditions respectively (Sakthivel *et al.,* 2014).

The seeds are treated with *Rhizobium* (200g) with sufficient quantity (300 ml) of rice gruel in room temperature and shade dried for 30 minutes. After sowing, it is better to give splash irrigation for 2-3 times followed by flood irrigation. The green manure crop is incorporated in the soil before flowering (approximately 40-45 days after sowing) either by trampling method or by power tiller. About 15-17 tons of green biomass per hectare per year can be incorporated to soil by green manuring with Dhaincha or sun hemp in mulberry garden annually for soil fertility improvement. The additional benefit of green manuring is that it prevents weed growth and saves the weeding cost.

Bio-Fertilizers

A bio-fertilizer is a substance which contains living microorganisms which, when applied to seed, plant surfaces or

soil, colonizes the rhizosphere or the interior of the plant and promotes growth by increasing the supply or availability of primary nutrients to the plant. In present scenario, bio-fertilizers are the one of the inevitable alternative to chemical fertilizers.

Certain common bacteria like *Azotobacterchroococcum, Azospirillum*spp. (*A. brasilense, A. lipoferum, A. amazonense, A. halopraeferens*and *A. irakense*) are capableof fixing atmospheric nitrogen (biological nitrogen fixation). However, the *Azospirillum*plays additional role that it secretes growth promoting substance (Indole Acetic Acid) in thesoil, induces disease resistance and drought tolerance in the plants. Similarly, anotherbacterium, *Bacillus megaterium*called as phosphorus solubilizing bacteria (PSB) which iscapable of solubilizing insoluble phosphorus and making available to the plants (Ram rao*et al.*, 2007).

It is recommended to apply *Azatobacter*or *Azospirilium*@ 8kg / acre/ year and PSB @ 10 kg / acre /year along with 500 kgs of well powdered FYM in 5 splits which curtails use of 25 % of N & P chemical fertilizers respectively. Bio-fertilizers are applied on 6th – 7th day after pruning.Bio-fertilizer should be applied near to root zone, covered with soil and irrigated immediately.A minimum of 15 days required between chemical and bio-fertilizer application. The bio-fertilizers should be stored in cool place and used before expiry date.

Vesicular- arbuscular mycorrhizae (VAM)

Vesicular-arbuscular mycorrhizae is a symbiotic fungus also called endomycorrhizae having harmonious relationship with mulberry root. The benefit of mycorrhizae to plants is mainly attributed to increased uptake of nutrients, especially phosphorus while in exchange of sugars provided by the plants. The fungus colonizes the root cortex of mulberry plants forming mycelia network characteristics vesicles (bladder like structures) and arbuscules (branched finger like hyphae). The vesicles are the terminal swellings of hyphae. The VAM hyphae grow several centimeters out of the roots with huge surface area than the root hairs of the plant. Hence, they absorb more nutrients and mobilize quickly to the plants than the root system does not have VAM association. The rate of inflow of phosphorus into mycorrhizae can be up to six times that of the root hairs. Further, the VAM also make available of insoluble rock phosphate to the plants (Sakthivel *et al.*, 2014)

Neem oil cake (NOC)

Among the different organic sources, the non-edible oilcakes in general and NOC in particular contain high amount of plant nutrients and alkaloids which induces immunity against pests and diseases in mulberry besides its higher nutrient content than other oil cakes. The alkaloid contents (Nimbin and Nimbicidine) which inhibit the nitrification process of N transformation in soil while applying nitrogenous fertilizers and makes N available slowly. However, the application of 800 kg /ac in 4 split doses at an interval of 3 months during inter-cultural operations is recommended to control root knot disease.

Pressmud

Pressmud plays important role in alkaline soil amelioration. The fresh material as such is not advisable due to generation of heat at thermophilic stage of decomposition in the soil. Hence, decomposition of the pressmud is inevitable before its application in the soil. The composting is done by spreading fresh pressmud to 1 meter width and 3 meter length (depending upon the quantity) to about 15 cm thicknesses. Then microbial culture of *Pleurotus*or *Trichodermaviride*(1 kg / MT of pressmud), urea (5 kg / MT) and cow dung as a starter (50 kg/MT) are sprinkled over this layer by mixing them in water. Then another layer of pressmud to a thickness of 30 cm is added and again the microbial culture, urea and cow dung are sprinkled. This process is repeated until reach a height about one meter. The top layer is covered with soil. Water is sprinkled to moisten it to 50% water holding capacity. This moisture level is to be maintained throughout (Ram *et al.*, 2017). Decomposition will be over within 6 to 8 weeks. Rock phosphate, ferrous Sulphate, zinc Sulphate *etc*., can also be added to improve the nutrient contents. The pressmud thus composted is dark in colour with narrow C: N ratio (about 12:1). It contains about 2.08 % N, 3.63 % PO , 1.40 % K and 22.38 % organic carbon.

II. ORGANIC FOLIAR SPRAYS

Vermi-wash

Vermi-wash is a collection of excretory products and mucus secretion of earthworms along with micronutrients from the soil organic molecules and used as foliar spray. It contains plant growth hormones like auxins and cytokinins apart from nitrogen, phosphorus, potash and other micro-nutrients. Adult worms measuring 100g of same species are collected, released into a container having 50ml of lukewarm water (37o- 40oC) and agitated for two minutes (Venkataramana, *et al.*, 2009). Then earthworms are taken out

and washed in another 50ml of water at room temperature for two minutes and released back into tanks. Dilute 1 litre of vermi-wash with 4-5 liters of water and spray as foliar spray during the late evening hours. A mixture of vermi-wash (1 liter) with cow urine (1 liter) in 10 liters of water acts as bio pesticide cum liquid manure.

Panchagavya

Panchagavya is a well-known organic product which plays major role in promoting growth and immunity in plant system. Panchagavya is prepared using five cow products *viz.*, cow dung (7kg), cow urine (10 liters), milk (3 liters), curd (2 liters), ghee (1kg) and other ingredients *viz.*, jaggery (3kg), well ripened poovan banana (1 dozen), tender coconut water (3 liters) and plain water (10 liters). Initially, cow dung and ghee are mixed thoroughly in a plastic container and stirred once at morning and evening hours for 3 days. Then it is added with cow urine & water and allowed for 15 days with regular stirring as above. After 15 days, milk, curd, tender coconut water, jaggery and banana are mixed. Panchagavya will be ready after 30 days. The container should be kept under shade and covered with a wire mesh or mosquito net to prevent development of housefly maggots in the solution (Venkataramana, *et al.,* 2009).

Panchagavya has all macro and micro nutrients apart from the growth hormones (IAA and GA) essential for production of quality mulberry leaves. It holds low pH value due to the production of organic acids by the fermentative microbes. *Lactobacillus* present in the Panchagavya produces various beneficial metabolites such as organic acids, hydrogen peroxide and antibiotics, which are effective against pathogenic microorganisms.

III. INFLUENCE OF DIFFERENT SOURCES OF ORGANIC NUTRTION ON SILKWORM PRODUCTIVITY

Larval Parameters:

Larval traits viz., mature larval weight, fifth instar and total larval durations differed considerably when worms fed on mulberry grown by the application of varied sources of organic manures. Mature larval weight was significantly highest with enriched vermicompost (100% N) + recommended P and K (38.38 g/10), while fifth instar and total larval durations were least with vermicompost (100% N) + recommended P and K (7.17 and 25.13 days). However, these traits were inferior with coir pith compost (100% N) + recommended P and K and FYM (100% N) + recommended P and K. The mature larval weight exhibited significant positive relationship with foliar constituents viz., crude protein, chlorophyll ‘a’, ‘b’ and total chlorophyll, nitrogen, phosphorus, calcium, magnesium and sulphur, while the trend was negative between total larval duration with these constituents. The foliar constituents raised under varied sources of organic manures had negative non-significant relationship with disease incidence except for total carbohydrates, which was significant.

Rearing Parameters:

Statistical variations were observed among the sources of organic manures when applied to mulberry in respect of rearing traits. The rearing performance was superior when the group of silkworms fed on mulberry raised by supplementing with vermicompost (100% N) + recommended P and K in respect of ERR (94.00%), cocoon yield (67.06 kg/100DFLs) and silk productivity (4.74 cg/day) over rest of the sources of organic manures. However, all these traits were inferior with coir pith compost (100% N) + recommended P and K (85.48%, 57.63 kg and 3.53 cg, respectively). The foliar constituents of mulberry showed marked positive influence on rearing parameters viz., ERR, cocoon yield and silk productivity except with leaf moisture and total carbohydrates which had non-significant effect on the rearing performance in PM x CSR-2 silkworm (Mahesh *et al.*,2014).

Cocoon Parameters:

The cocoons spun by the silkworms fed on mulberry obtained by supplying the crop with different sources of organic manures had notable influence on cocoon traits. Significantly highest cocoon weight, shell weight and shell ratio were encountered with vermicompost (100% N) + recommended P and K (1.82g, 0.34g and 18.68%). However, cocoon traits were inferior with coir pith compost (100% N) + recommended P and K (1.72, 0.29 and 16.86%, respectively). The study on correlation between cocoon parameters with foliar constituents of mulberry revealed that majority of the nutrients favoured for improvement of cocoon traits excepting leaf moisture and total carbohydrates. The silkworm rearing with mulberry leaves obtained by application of FYM and vermicompost revealed cocoon yield improvement in vermicompost (61.80 kg / 100DFL’s) followed by FYM (54.14 kg/100DFL’s). This clearly indicated that the mulberry leaves of vermicompost applied plots have more nutrient value than that of other treatments which in turn influences the silkworm cocoon quality (Krishna Rao*et al.*, 2005).

Post - Cocoon Parameters:

Marked impact was exerted on post – cocoon parameters among the batches of silkworms fed on mulberry raised with the application of varied sources of organic manures. The post – cocoon parameters were significantly more in vermicompost (100% N) + recommended P and K with respect to single cocoon filament length (820.87 m) and fibroin (78.16%) with thin denier (2.13) and sericin (20.64%). On the other hand, these characters were inferior with coir pith compost (100% N) + recommended P and K (815.82 m, 75.46, 2.51 and 23.45%) over the other sources of organic manures. Among the post-cocoon parameters single cocoon filament length in PM x CSR-2 showed significant positive relationship with leaf constituents viz., crude protein, chlorophyll 'a', 'b', nitrogen, phosphorus, potassium, calcium, magnesium and sulphur.

Disease Incidence:

The incidence of diseases *viz*., muscardine, flacherie and grasserie varied much among the batches of silkworms fed on mulberry raised by the application of different sources of organic manures under irrigated condition. Significantly lowest incidence of muscardine (1.00%), flacherie (2.00%), grasserie (1.25%) and total incidence of disease (4.25%) were noticed with vermicompost (100% N) + recommended P and K. However, the remaining sources of organic manures favoured higher incidence of diseases.

IV. CONCLUSION

By the effective utilization of organic sources quality mulberry leaf can be obtained, which are rich in nutrient contents and free from pest and disease incidence. Improvement in the biochemical constituents of mulberry by the application of organic nutrients increases the rearing parameters, cocoon parameters and post cocoon parameters of the silkworm. Thus we can improve the sericulture and silk productivity to greater extent. Organic nutrition in sericulture is in neonate stage and requires comprehensive and multidimensional approach to maximize the sericulture productivity.The information on possible utilization of biogas spent slurry, coir pith compost, press mud and urban solid compost is scanty and needs further study in this direction large scale trails may be necessary to design the proportion of organic source to be applied to mulberry gardens of different soils of different agro climatic zones.

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