Impact of organic nutrients on the incidence of major pests, leaf productivity in mulberry and food consumption and utilization of *Bombyx mori* L.

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ABSTRACT

The continuous use of inorganic fertilizers over a period of time cannot sustain the crop yield for a long time, in view of their harmful effects on soil aggregation, and poor root anchorage for normal nutrient and moisture uptake. The organic manures play an important role in supplying macro and micronutrients and improve the physical, chemical and biological property of the soil. The present study was undertaken to study the effect of organic nutrients supplementing through foliar spray of panchakavya (5 and 10%), vermiwash (10 and 15%) and seriboost (0.2%) on 15, 25 and 35 days after pruning following basal doses of vermicompost and inorganic fertilizers in normal recommendation in mulberry garden. The treatment of panchakavya and vermiwash showed better performance in mulberry growth parameter *viz*., number of shoots/plant, total biomass and leaf yield. The average incidence of pest tukra mealy bug *Maconellicoccus hirsutus* (Green), *Pseudodendrothrips mori,* leaf webber *D. pulverulentalis* were minimum in the treatment of panchakavya and vermiwash. On the food consumption and utilization of *Bombyx mori* L. larvae (CSR2 x CSR4) fed on leaves treated with panchakavya, vermiwash and seriboost revealed that with advancing instars, irrespective of the treatment food consumption increased, but the pattern of food consumption differed significantly. The rate of feeding (Cr), Assimilation (Ar), and production (Pr) were higher in larvae treated with panchakavya (10%) and vermiwash (15%), over control. The assimilation efficiency and larval growth of the larvae fed on leaves treated with panchakavya, vermiwash and Seriboost increased over control.

Key words: Mulberry, *Maconellicoccus hirsutus, Pseudodendrothrips mori,* Panchakavya, Vermiwash, *Bombyx mori,*

INTRODUCTION

Mulberry (*Morus alba* L.) is a deep rooted, foliage yielding and fast growing perennial crop grown for its leaf and is the sole food for silk worm (*Bombyx mori* L.). The growth and development of *B. mori* are influenced to a greater extent by the nutritional quality of the leaf. As cocoon production is directly dependant on the quality and quantity of leaf there is a tendency among the farmers for indiscriminate use of chemical fertilizers to get higher leaf yield. Bose and Majumdar (1996), studied on the effect of foliar application of different levels of various micronutrients to mulberry on the quality of bivoltine cocoon and silk. It has been widely accepted that organic farming alone could serve as a holistic approach towards achieving sustainable agriculture as it is nature based, environment friendly and ensures the conservation of resources for the future (Sangeetha and Thevanathan, 2010). Panchakavya, a mixture of products of cow in a specific ratio to enhance the biological efficiency of crop plants and the quality of fruits and vegetable (Natarajan, 2002). Gomathynayagam (2001) reported the physicochemical properties of panchakavya and revealed that they possess almost all the major nutrients, micronutrients and growth hormones (IAA and GA) required for crop growth, besides microorganism like yeast and lactobacillus. *Lactobacillus* produces various beneficial metabolites such as organic acids, hydrogen peroxides, and antibiotics, which are effective against other pathogenic micro organisms. Similarly, Shivasubramaniam and Ganesh kumar (2004), vermiwash would have enzymes, secretions of earthworms which would stimulate the growth and yield of crops and even develop resistance in crops through foliar spray. Mohammad Aslam and Mohammad Ashtag (2004) reported that three methods of mineral sources application *viz.*, stem injection, foliar spray and soil application , and found that foliar spray proved the best as it gave a maximum food consumption, larval body weight, larval length, cocoon recovery, gravid cocoon wt, empty cocoon wt and total larval duration. The present study was undertaken to study the impact of panchakavya,

vermiwash, and seriboost as nutrients through foliar spray on mulberry growth, pest incidence and silkworm economic traits.

MATERIALS AND METHODS

The field experiment was conducted at Dinnapalli village, Hosur taluk of Krishnagiri District in Tamil Nadu during 2006-2007 in an established mulberry garden of V1 variety with the spacing of (5+3) x 2 system. The experiment was laid out in randomized completely block design with six treatments and four replications. The experiment consists of six treatments involving application of panchakavya (5% , 10%), vermiwash (10%, 15%), seriboost (0.20%) and control were imposed and the foliar application was made 500 L/ha with knapsac sprayer in the evening hours thrice at 15, 25 and 35 days after pruning. An untreated check was also maintained, Plot size was one cent (8 x 5 m) and each treatment as replicated four times. The recommended doses of farm yard manure (20 MT/ha/yr) in two equal split doses and chemical fertilizers 350 N: 140 P: 140 K Kg/ha/yr for five crops in five equal split doses as normal recommendation were applied.

The plant growth parameters like number of shoots, total length of shoots, number of leaves/plants, total biomass leaf yield were recorded. Pre and post treatment count of percent infestation of shoot was recorded at weekly intervals for leaf webber, tukra by observing 25 plants selected in two diagonal lines at random in each plot. For thrips incidence numbers of nymphs/adults were recorded from 5 leaves/plant. Leaf yield from plot was recorded and worked out per hectare.

Food Consumption and utilization of *Bombyx mori*

To study the impact of nutrients on food consumption and utilization by silkworm *Bombyx mori*, larvae fed *ad libitum* by administering different doses of treated plot mulberry leaf after III instar stage. The larvae were reared individually in plastic terraria 1 x 1.5 sq. ft capacity and maintained at required temperature and humidity as per schedule. The larvae were weighed at the commencement of each instar, at the completion of larval development as well as at the commencement of pupation. By products of growth such as final instar exuvia and pupal cash were collected, dried and weighed. At each tested dose 4 replicates of 30 larvae each were maintained. All the weighings were made in Monoban balance to an accuracy of 1.0ug. The scheme of energy balance followed in the present study is the IBP formulae of Petrusewic and McFadeyan(1940), Waldbauer(1968) and Muthukrishnan and Pandian (1983, 1987).

RESULTS AND DISCUSSION

Effect of nutrients on mulberry growth parameters

The results of the experiment revealed that the mulberry growth characters such as no. of shoots/plant, total length of shoots, no. of leaves produced per plant, and biomass production were significantly influenced by foliar spray of different nutrients as compared to control with no spray. Among the different treatments, panchakavya (10%),vermiwash (15%), recorded significantly higher values of mulberry growth and yield.

Incidence of mulberry pests

The pest incidence of tukra mealy bug *M.hirsutus*, leaf webber *D. pulverulentalis* and thrips *Pseudodendrothrips mori* were recorded minimum in the treatment of vermiwash (15%), and panchakavya (10%).

Several reports revealed that application of vermiwash increased radish yield of 7**.**30% by Buckerfield *et al.* (1999), Paddy yield by Hangavel (2003), dry chilly yield by George *et al*. (2007), besides its potential application in sustainable development in agricultural biotechnology with respect to its origin, cost of effectiveness, easily availability, time saving reproducibility, reliability and eco friendliness. Zambare *et al.* (2008) reported that vermiwash contains enzyme of proteases, amylases, ureases and phosphatase besides nitrogen fixing bacteria like *Azatobacter* sp. *Agrobacterium* sp. and *Rhizobium* sp. and some phosphate solubilizing bacteria which influences significantly the growth of cow pea plant. Physico-chemical properties of panchakavya revealed that they possess almost all the major nutrients, micro nutrients and growth harmones (IAA & GA) required for crop growth. Predominance of fermentative microorganisms like yeast and lactobacillus might be due to the combined effect of low pH, milk products and addition of jaggery/sugarcane juice as substrate for their growth.

Sangeetha and Thevanathan (2010) reported that panchakavya a vedic formulation increased productivities and disease resistance in plants and also found that a modified formulation amended with sea weed extract (*Sargassum wightii*) on the enzyme activities namely, Nitrate reductase NR, Nitrite reductase NiR, glutamine synthetase GS, glutamate synthase GOGAi, and glutamate dehydrogenase GDH, in an leaves of the seedlings of the pulses *Vigna radiate*, *Vigna mungo*, *Arachis hypogeae*, *Cyanopsis tetragonolobo*, *Lablab purpureas*, *Cicer arietinum* and the cereal *Oryza sativa* var. Ponni and showed an increased in the levels of all enzymes in the experimental plants when used as manure at low concentrations i.e 10 and 100 (panchakavya:soil). Traditional panchakavya at 1:100 dilutions was able to exhibit an increase in the levels of NR and NiR only.

Raman Suresh Babu *et al*. (1994) reported that aqueous leaf extracts of *Azadiracta indica*, *Rhizophora apiculata*, *Adathoda vasica*, *Parthenium hysterophorus, Lantana camara*, and *Prosopis juliflora* used as foliar spray in the control of tukra disease revealed that the spray of the extracts

Table 1. Effect of organic nutrients on the mulberry growth parameters.

Treatment	No. of shoots	Total length of shoots	No. of leaves per plant	Biomass Kg/ha/crop	Leaf yield kg/ha/ crop
Panchakavya (5%)	12.88	100.54	185.45	8221.44	4267.35
Panchakavya (10%)	13.00	102.00	195.00	9699.40	4777.30
Vermiwash (10%)	12.16	103.40	184.95	9332.40	4632.80
Vermiwash (15%)	12.19	104.56	193.66	9587.90	4666.20
Seriboost (0.2%)	11.27	94.49	140.32	7254.80	3977.40
Control	10.22	95.06	133.56	7088.20	3721.87
CD (5%)	1.78 **	3.85 **	46.80 **	780.60 **	413.00 **

did not control the disease of the already diseased leaves but quite strikingly prevented further spread of the disease in all mulberry varieties. Foliar spray of the extracts did not affect the nutritional status and moisture content of the tukra leaves and all the morine factors *viz*., olfactory attractancts, bitting and chewing factors were found to be intact. Kolhar and Patil (1999) reported that highest leaf yield of 9.84 t/ha/crop was obtained in recommended dose of FYM-RDF, which was significantly superior to other treatments. The increased leaf yield with application of recommended dose of FYM+RDF was in agreement with the results of Patil (1961) and Ray *et al*. (1973). Similar findings were also reported by Shankar *et al*. (1988) whereas increased yield with *in situ* vermiculture @50000 eartrhwormsh and @100000 earthworms was in agreemenet with Tomati *et al.* (1990) who related the beneficial effect of earthworms with the release of growth regulating substances like gibberllins, cytokinens and auxins due to metabolic activity of the microbes harboured in the case which helped increasing the yield.

Venkataramana *et al.* (2008) studied the influence of foliar sprays of vermin wash and cow dung wash on leaf yield and leaf attributing parameters in comparison to control. This might be the reason for increasing chlorophyll and nitrogen contents in the leaf. Wang (2001) have reported humic acid containing organic fertilizer significantly enhanced chlorophyll content of soybean. It was also supported by Nandakumar *et al.* (2004) that foliar application of humic acid in combination with NPK increased soil nutrients (N,P,K,Fe, Mn, Zn abd Cu) availability at all growth factors of rice.

Meenatchi *et al.* (2011) reported the effectiveness of *in situ* vermiculture and vermiwash foliar application in suppressing the activity of bud borer, *Hendicasis duplifascialis* and thrips *Thrips orientalis* (Bagn.). Jadhav (1994) reported that more crude proteins, total CHO and sugars accumulated in mulberry leaves nourished with vermicompost which resulted in reduced activity of pests of mulberry. Rajashekar (1995) found that *in situ* vermiculture @ 50000 to 100000 / ha resulted in reduced thrips activity in mulberry. Organic amendments on translocation in to the plant tissues alter the activities within the plant system, *viz*. enzyme activity and result in accumulation of plant metabolites (Gour, 1984, Verma and Supare, 1997; Verghese,2003). Thus the lower activity of target

Table 2. Effect of organic nutrients on the incidence of tukra mealy bug M*aconellicoccus hirsutus, Diaphania pulverulentalis, Pseudodendrothrips mori*

Treatments	Pest	Pre treatment	Percent incidence of tukra mealy bug *M. hirsutus*			Average	Biomass kg/ha/ crop	Leaf yield kg/ha/ crop
			20 DAP	30 DAP	40 DAP			
Panchakavya (5%)	M. *hirsutus*	10.38	45.87	43.12	12.31	27.92	8221.44	4267.35
	D. pulverulentalis	6.53	11.80	10.25	12.90	10.37	8221.44	4267.35
	Pseudodendrothrips mori	6.32	15.06	9.56	4.02	9.55	8221.44	4267.35
Panchakavya (10%)	M. *hirsutus*	11.38	44.52	39.45	9.433	26.19	9699.40	4777.30
	D. pulverulentalis	6.18	10.10	9.60	11.15	9.25	9699.40	4777.30
	Pseudodendrothrips mori	7.32	15.03	9.03	3.75	9.26	8999.40	4277.30
Vermiwash (10%)	M. *hirsutus*	9.38	42.15	41.42	15.72	27.17	9332.40	4632.80
	D. pulverulentalis	6.42	10.60	12.50	11.30	10.20	9332.40	4632.80
	Pseudodendrothrips mori	5.68	15.00	7.82	4.55	9.10	9332.40	4632.80
Vermiwash (15%)	M. *hirsutus*	9.59	41.05	39.05	13.15	25.71	9587.90	4666.20
	D. pulverulentalis	6.33	9.80	10.40	10.25	9.19	9587.90	4666.20
	Pseudodendrothrips mori	7.66	11.25	7.77	4.30	7.79	9587.90	4666.20
Seriboost (0.2%)	M. *hirsutus*	9.87	46.12	43.56	18.18	29.43	7254.80	3777.40
	D. pulverulentalis	6.73	10.50	13.80	11.60	10.65	7254.80	3777.40
	Pseudodendrothrips mori	6.12	17.50	8.03	5.52	10.35	7254.80	3777.40
Control	M. *hirsutus*	10.66	48.25	47.85	21.15	31.97	7088.20	3721.87
	D. pulverulentalis	6.95	11.80	14.80	12.50	11.51	7088.20	3721.87
	Pseudodendrothrips mori	5.77	18.70	8.57	5.41	1.50	780.60	413.00

Figure1. Effect of nutrients on consumption, assimilation, production, and metabolic rate of *B. mori*.

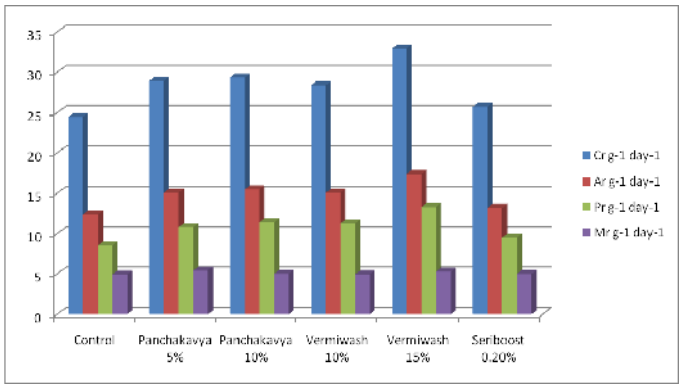
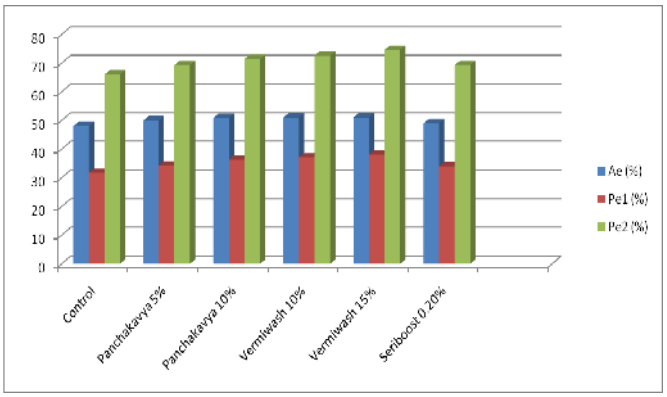


Figure 2. Effect of nutrients on assimilation, production, and net production efficiency (%) of *Bombyx mori*.



pests in the crop amended with vermicompost, vermiwash or in situ vermiculture could be attributed to the changed biochemistry of plant which would make the plant system defensive against pest infestation.

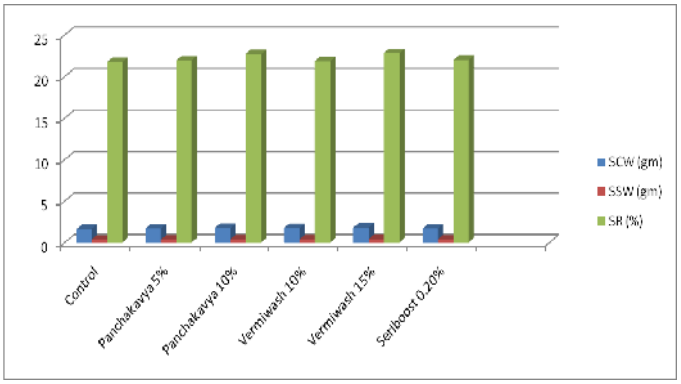
Effect of nutrients on food consumption and utilization of *Bombyx mori*

With advancing instar irrespective of the treatement food consumption by the larvae increased. The pattern of food consumption by the different instar fed with different treatment differed significantly. For instance food consumption of third instar of *B.mori* fed on the treatment of Vermiwash (15%) received leaf increased with advance stage. The extent of increase was greater in the higher instar than in the lower instar. The consumption rate (Cr), assimilation rate (Ar) and production rate (Pr) of *B. mori* displayed high in vermiwash (15%) followed panchakavya (10% and 5%), vermiwash (10%) and seriboost (0.20%) over control. The net conversion efficiency (Pe2%) of *B. mori* displayed higher in the vermiwash (15%) than panchakavya (10% and 5%), vermiwash (10%) and seriboost (0.20%) over control (Fig. 1-3).

Effect of nutrients on economic traits of *Bombyx mori*

The results on the economic traits of cocoon viz., Single Ccoon weight, Shell weight and SR (%) from the treatment of Vermiwash (15%) were found superior. followed by Panchakavya (10%), Panchakavya (5%), Vermiwash (10%), and Seriboost (0.20%) over control (Figure 3). Vishwanath *et al*. (1997) reported the supplementation of mulberry leaves with a combination of secondary micronutrients on the rearing performance of the silkworm *Bombyx mori* and found reduction in the larval duration, an increase the larval weight, shell weight as well as in the filament length as compared to those of untreated control. Jayapraksh Rao *et al*. (1998) reported that when mulberry leaves sprayed over with magnesium sulphate, zinc sulphate, potassium chloride, ferrus ammonium phosphate, copper sulphate and sodium sulphate were fed to *B. mori* (L.) all growth parameters were found to have increased with application of minerals. Maximum increase in larval growth was observed with ferrus ammonium sulphate followed by copper sulphate, potassium chloride and zinc sulphate treated leaves. Jadhav *et al*. (2000) reported that the application of organic and inorganic fertilizers, and in their combination revealed that the carbohydrate, and crude protein percentages of mulberry leaves increased which in turn significantly increased in larval body weight, silk gland weight, cocoon yield and silk ratio. The present finding are in agreement with those of Vishwanath *et al*. (1997), Jadhave *et al*. (2000) who reported that the nutritional sources effects not only the growth and development of the silkworm larvae but also its final silk produce. The foliar spray proved best with ready availability of the material at the real site of action, i.e. the leaves which are to be fed to larvae compared with other application.

Figure 3. Effect of nutrients on economic traits of *B. mori*. (SSW: Single cocoon weight, SSW: Single Shell weight, SR: Shell ratio)



REFERENCES

Bose, P.C., Singvi. N.R. and Dutta, R.K. 1974. Effect of micronutrients on above ground biomass and economics of mulberry leaf production. *Journal of sericulture*, **2**(182): 23-26.

Buckerfield, J.C., Flavel, T.C., Lee, K.E., Webster, K.A., Diazcozin, D.J., Jesus J.B., Trigo, D. and Garvin, M.H. 1999. Vermicompost in solid and liquid forms as a plant growth promoter. *Sixth International Symposium on Earthworm Ecology. Vigo, Sain.* 1998. *Pedobiologia*.**43**: 753-759.

Gomathynayagam, 2001. Indigenous paddy cultivation experiences of farmers. *Pesticide* I **9**:23.

Goar, A. C. 1984. Response of rice to organic matter - The Indian experience in organic matter and rice. *International Rice Research Institute. Philippnes*. 503-504 **PP.**

Jadhav, N. 1994. Role of vermiculture in mulberry and its impact on silkworm (*Bombyx mori*). M.Sc. (Agri.) Thesis, University of Agricultural Sciences. Dharwad (India),96 **P**.

Jadhav, S.N.B., Patil, G.M. and Glraddi, R.S. 2000. Effect of organic and inorganic manures and their combinations on M-5 mlberry and its impact on silkworm production. *Karnataka Journal of Agriculture Science,* **13**(3): 744-749.

Karthykeyan, M. 2008. Studies on the effect of organic nutrients through foliar spray on food consumption and utilization of *Bombyx mori* in mulberry. *M.Phil. Thesis* submitted to Dept. of Zoology and Biotechnology, A.V.V.M.Sri. Pushpam, College (Autonomous), Poondi, Thanjavur Dist.

Meenatchi. R., Giraddi, R.S., Patil, V.S., Vastrad, A.S. and Biradar, D.P. 2011. Effect of vermitechnologies on jasmine insect pests. *Karnataka Journal of Agricultural Science,* **24**(3): 312-315.

Muthukrishnan, J. and Pandian, T.J. 1983. Effect of temperature on growth and bioenergetics of a tropical moth. *Journal of Thermal Biology.* **8**: 361-367.

Muthukrishnan, J. and Pandian, T.J. 1987. Relation between feeding and egg production in some insects. In: *Proceeding of Indian Academy Sciences (Animal Science),* **96**:171-179.

Mohammad Aslam and Mohammad Ashfaq, 2004. Influence of methods of nutritional administration on the development and productive aspects of mulberry silkworm *Bombyx mori* L. *Pakistan Journal of Entomology*, **26** (1): 41-45.

Natarajan, K. 2002. Panchakavya – A manual. Other India Press. Mapusa. Goa. India. 33 **PP**.

Petrusewicz. K. and MacFadyen, A. 1970. Productivity of terrestrial animals. *Principles and Methods*, IBP hand book No. Blackwell, Oxford.

Rajashekar, C.K. 1995. Effect of in situ vermiculture on mulberry and cocoon yield. *M.Sc. (Agri.). Thesis,* University of Agricultural Science. Dharwad (India) 56 **P**.

Raman Suresh Babu, David Dorcus and Munisamy Vivekanandhan, 1994. Possible control of Tukra Disease in Mulberry Using Aqueous Plant Extracts of Natural Pesticide Origin. *Journal Sericulture Science, Japan.* **63**(3):175-182.

Sangeetha, V. and Thevanathan, R. 2010. Effect of Panchakavya on Nitrate assimilation by Experimental plants. *The Journal of American Sciences,* **6** (2): 76-82.

Shivasubramanaian, K. and Ganeshkumar, M. 2004. Influence of vermiwash on biological productivity of marigold. *Madras Agricultural Journal*, **91:**221-225.

Viswanath, G.K., Jayaramaiah, M. and Shankar, M. A. 1997. Feeding of mulberry leaves supplemented with secondary and micronutrients through foliage on the rearing performance of the silkworm *Bombyx mori*. *Mysore Journal of Agriculture Sciences*, **31**(2): 175-179.

Venkataramana, P., Narasimhamurthy, B., Krishnarao. J.V. and Kamble, C.K. 2009. Efficacy of foliar spray of vermin wash and cow dung wash on biochemical and yield attributes and yield of mulberry(*Morus alba* L.). *Karnataka Journal of Agricultural Science,* **22**(4):921-923.

Verma, N.R.G. and Supare, 1997. Effect of vermicompost in combination with FYM and chemical fertilizers against sucking pests of chilli. *Andhra Agricultural Journal,* **44**:186-187.

Verghese, T.S. 2003. Management of thrips, Scirtothrips dorsalis and mite, Polyphagotarsonemus latus on chilli using biorationals and imidacloprid. *M.Sc. (Agri.), Thesis*, University of Agricultural Sciences, Dharwad (India), 32**P**.

Waldbauer, G.P. 1968. The consumption and utilization of food by insects. *Advances of Insect Physiology,* **5**: 229-288.

Zambare, V.P., Padul, M.V., Yadav,A.A. and Shete, T.H. 2008. Vermiwash: Biochemical and microbiological approach as Ecofriendly soil conditioner. *ARPN Journal of Agricultural and Biological Science,* **3**(4):1-5.

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