Induced systemic resistance through various organic cakes on the management of pink mealybug, *Maconellicoccus hirsutus* infesting mulberry

S. Balasaraswathi, S.M.H. Qadri, S. Masilamani, R. Balakrishna

Central Sericultural Research and Training Institute, Mysore 570008, India, Email: sbs1966@gmail.com

ABSTRACT

Field evaluation of certain organic cakes like neem cake, custard apple cake, jatropha cake, mahua cake, pungam cake, castor and gingelly cake each at 1000 kg/ha with FYM at 20 MT/ha against *Maconellicoccus hirsutus* infesting mulberry. All the treatments were incorporated in to the soil after 15 days of pruning. Plot size was one cent and each treatment was replicated thrice. The number of shoots infested with *M. hirsutus* in 20 randomly selected plants was counted and percentage damage worked out. The combination of FYM + neem cake recorded the lowest population (3.81%) as against 20.92 and 17.06% in the treatment with recommended NPK and the untreated control. FYM + neem cake recorded the maximum leaf yield (8100 kg/ha/crop) followed by the treatment with the recommended NPK (7960 kg/ha/crop). The inorganic fertilizers increased the plant growth by providing the nutrients to the plants in large quantity for shorter period of time. Thereby the plants were endowed with luxuriant growth which offered adequate and highly preferred food to the insects leading to heavy infestation of mealybugs. The remarkable difference in the population of *M. hirsutus* in organic cakes applied plots might have been attributed by low nitrogen and high phenol contents in the leaves which exhibited induced resistance.

Keywords: induced systemic resistance, mulberry, mealybug, *Maconellicoccus hirsutus*, organic fertilizers

INTRODUCTION

Mulberry (*Morus* sp.) leaf is the only natural food consumed by the silkworm, *Bombyx mori* L. to produce a highly commercial commodity of the silk cocoons which up on reeling produce the most elegant and valued fiber called silk. Like most of the other economic plantation and field crops, mulberry is also prone to attack by varied pest complex belonging to a large number of insect orders. So far over 300 insect and non-insect species of pests are known to infest mulberry in varying intensities during different seasons and stages of the crop development (Naik, 1997). The major insect species known to have attained status of pests in mulberry belong to order, Lepidoptera, Hemiptera, Coleoptera, Thysanoptera, Orthoptera and Isoptera (Biradar, 1989). Among the sap feeders infesting mulberry, *M. hirsutus* in mulberry has assumed greater significance in recent years as it causes both qualitative and quantitative damage. It is reported to cause an estimated leaf yield loss of 4500 kg/ha/year, thus depriving the farmer of a brushing of 450 dfls/ha/year resulting in reduced cocoon production by 150 kg/ha/year. Moreover leaf quality is affected also reduction in leaf quality further leads to inferior performance of silkworm crop (Sathyaprasad *et al.,* 2000). Frequent and large scale application of pesticides for the control of

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diseases and pests in crop plants has led to the ecological imbalance in agro ecosystem. Insecticides kill the natural enemies which led to outbreak of secondary pests. Development of resistance to insecticides and resurgence in the insects are the other serious problems posed by the frequent use of insecticides. Mulberry being the sole food plant of *Bombyx mori*, use of chemical insecticides leave toxic residues in mulberry leaves as well as soil. Development of an appropriate insect pest management strategy that takes care of the mulberry ecosystem may provide a meaningful solution to avoid the above problems. Management of the insect pests through botanicals is emerging as a viable option. Keeping this in view, the present investigation was carried out to find out the efficacy of different oil cakes in reducing the incidence of *M. hirsutus* infesting mulberry and their influence on mulberry leaf yield.

MATERIALS AND METHODS

The field experiment was conducted in the farmers holding at Valkadu village, Salem district, Tamil Nadu, India during April-May and August-September. Standard package of mulberry cultivation were adopted uniformly for all the treatments. The experimental details are variety - MR_2, design – RBD, plot size - 100 m^2, spacing - 90×90 cm and three replications were maintained. Various treatment was followed as FYM @ 20 MT/ha + Neem cake @ 1000 kg/ha, FYM @ 20 MT/ha + Custard apple seed cake @ 1000 kg/ha, FYM @ 20 MT/ha + Jatropha cake @ 1000 kg/ha, FYM @ 20 MT/ha + Mahua cake @ 1000 kg/ha, FYM @ 20 MT/ha + Pungam cake @ 1000 kg/ha, FYM @ 20 MT/ha + Castor cake @ 1000 kg/ha, FYM @ 20 MT/ha + Gingelly cake @ 1000 kg/ha, FYM alone 20 MT/ha, recommended NPK 300:120:120 Kg/ha and untreated control.

Additionally, treatments T1 to T8 were supplemented with 25% of recommended nitrogen. All oil cakes were incorporated into the soil as per the treatment schedule at 15 days after pruning. Data on plant growth and yield parameters like number of shoots per plant, total length of shoots per plant, number of leaves per plant, total biomass production per plant were recorded. The number of shoots damaged by *M. hirsutus* was recorded after I, II, III and IV weeks of treatment from 20 randomly selected plants and expressed in percentage. For recording total leaf yield all the plants from net area of each plot were harvested and the yield/ha was calculated and expressed in Kgs.

RESULTS AND DISCUSSION

The tukra symptom caused by mealy bug varied significantly in different treatments. One week after treatment, significantly lower tukra incidence was recorded in plots treated with FYM + neem cake (3.01%), FYM + pungam cake (3.82%), FYM + mahua cake (3.94%), FYM + custard apple seed cake (4.12%) and FYM+ jatropha cake (4.43%), as against sole NPK application (16.21%). After two weeks of treatment, the tukra incidence among various treatments ranged from 4.21 to 25.25% with NPK recording the maximum incidence. The per cent reduction of tukra incidence over NPK was observed in FYM + neem cake (83.33%) and it was followed by FYM + mahua cake (77.70 %) and FYM + custard apple seed cake (77.39 %).

Three weeks after treatment, the incidence of *M. hirsutus* varied from 5.21 to 27.22% in various treatments, NPK as inorganic form and untreated control recorded 27.22 and 22.0% respectively. Among the various oil cakes applied, FYM + neem cake significantly reduced the tukra incidence by 80.86% followed by addition of FYM + pungam cake, FYM + mahua cake (77.59%) and FYM + custard apple seed cake (77.22%) which were statistically on par. Four weeks after treatment, the incidence of tukra ranged from 2.81 to 15.00% in various treatments. Among these, FYM + neem cake combination significantly reduced the incidence of tukra by (81.27%).

This was followed by FYM + pungam cake (79.00%), FYM + custard apple seed cake (78.53%) and FYM + mahua cake (78.53%) which were statistically on par. The recommended treatment of

NPK alone recorded the maximum infestation of *M. hirsutus* (15.00%) followed by control (12.22%). Pooled data for all the periods of observation revealed that the tukra incidence was less than 5% in treatments, FYM + neem cake (3.81%), FYM + mahua cake (4.78%), FYM + custard apple seed cake (4.81%) and pungam cake (4.85%) (Table 1). It was more than 5% in all other treatments with NPK alone treatment recording the maximum (20.92%) compared to least in control (17.06 %).

In the present investigation the mulberry plots treated with FYM + neem cake @ 1000 kg/ha showed significantly less damage percent of *M. hirsutus* over NPK application as inorganic form. This is in agreement with the earlier findings on the efficacy of neem cake either alone or in combination with other manures and sprays in reducing the population of aphids, thrips and mites in chillies (Krishnamoorthy *et al*. 2001; Rajendiran and Chandramani, 2002; Gundannavar *et al.*, 2007; Giraddi and Varghese, 2007). The superiority of neem cake in the present study is in line with the findings of Varghese and Giraddi, (2005) who reported that neem cake @ 500 kg/ha along with normal doses of NPK was superior in having least population of thrips and mites in chilli. The present study revealed the consistent effect of FYM + neem cake or mahua or pungam cake in reducing the incidence of *M. hirsutus* than other treatment combinations and NPK. It is in line with the findings of Samuthiravelu *et al.* (2004) and Ravikumar *et al.* (2005) in mulberry.

The inorganic fertilizers increase the plant growth by providing nutrients to the plants in large quantity for shorter period of time. Thus the plants are endowed with the luxuriant growth which may offer adequate and highly preferred food to the insects leading to heavy insect population. On the other hand, the nutrient release from organic sources like oil cakes was rational and slow and thus making the plants less prone to insect attack. Effectiveness of organic amendments like neem cake and vermicompost besides neem derivatives against sucking pests has been documented by various workers (Varghese and Giraddi 2005, Giraddi and Smitha (2004), and Mallikarjuna Rao *et al.* (1999a,b). Application of FYM + neem cake resulted in the production of more number of branches/plant (10.00), leaves/plant (325), total biomass (14305 kg/ha/crop) and leaf yield (8100 kg/ha/crop) when compared to other oil cakes and NPK alone (Table 2).

This is in corroboration with the finding of Samuthiravelu *et al.* (2004) that the neem cake @ 60 kg/ac + 75% N fertilizer showed better performance of mulberry. Neem cake contains fair amount of organic nitrogen (2.0 to 2.5%) and other nutrients besides various insect antifeedant constituents which might be the possible reason for preventing damage by pests and also resulting in to good leaf yield in mulberry. Also the efficacy of neem cake persists for longer periods providing extended period of protection from the pests as it is applied to the soil and thus escaping from the fast degradation of the active ingredients like neem oil under high temperature and UV light. Further neem cake make the soil more fertile due to an ingredient that blocks soil bacteria from converting nitrogenous compounds into nitrogen gas and acts as a nitrification inhibitor and prolongs the availability of nitrogen in both short and long duration crops.

The present investigations concluded that the neem cake altered the biochemical contents in the mulberry and finally induced systemic resistance in mulberry plant against pests. Additionally, it has increased the leaf yield as well as quality and thereby increasing the productivity of silkworm crops. It is therefore concluded that natural products of neem can be employed as low priced alternatives to synthetic insecticides which can help to reduce pest incidence, protect mulberry ecosystem and are also affordable to small scale farmers in developing countries like India.

Table 1. Pooled data on effects of different oil cakes on *M. hirsutus* in mulberry.

Treatments	Weeks after treatment * %								Mean	
	I		II		III		IV		%	
	tukra incidence	reduction over NPK	tukra incidence	reduction over NPK	tukra incidence	reduction over NPK	tukra incidence	reduction over NPK	tukra incidence	reduction over NPK
FYM + neem cake	3.01 (9.97) [a]	81.43	4.21 (11.68) [a]	83.33	5.21 (13.18) [a]	80.86	2.81 (9.63) [a]	81.27	3.81 (11.24) [a]	81.79
FYM +custard apple seed cake	4.12 (11.68) [d]	74.58	5.71 (13.81) [b]	77.39	6.20 (14.42) [b]	77.22	3.22 (10.30) [b]	78.53	4.81 (12.66) [b]	77.00
FYM + Jatropha cake	4.43 (12.11) [e]	72.67	6.22 (14.22) [d]	75.37	6.91 (15.23) [d]	74.61	3.63 (10.94) [c]	75.80	5.30 (13.31) [c]	74.67
FYM + Mahua cake	3.94 (11.39) [c]	75.69	5.63 (13.69) [b]	77.70	6.10 (14.30) [b]	77.59	3.22 (10.30) [b]	78.53	4.78 (12.66) [b]	79.15
FYM + Pungam cake	3.82 (11.24) [b]	76.43	5.92 (14.06) [c]	76.55	6.52 (14.77) [c]	76.05	3.15 (10.14) [b]	79.00	4.85 (12.79) [b]	76.82
FYM + Castor cake	10.83 (19.19) [f]	33.19	13.21 (21.30) [e]	47.68	14.91 (22.71) [e]	45.22	8.24 (16.64) [d]	45.07	11.80 (20.05) [d]	43.59
FYM + Gingelly cake	10.84 (19.19) [f]	33.13	15.21 (22.95) [e]	39.76	16.54 (23.97) [f]	39.24	10.14 (18.53) [e]	32.00	13.19 (21.30) [e]	36.95
FYM alone	11.82 (20.05) [g]	27.08	15.14 (22.87) [f]	40.03	17.25 (24.50) [g]	36.63	10.23 (18.63) [e]	31.80	13.61 (21.64) [f]	34.94
Recommended NPK alone	16.21 (23.73) [h]	--	25.25 (30.20) [h]	--	27.22 (31.44) [i]	--	15.00 (22.79) [h]	--	20.92 (27.20) [i]	--
Untreated control	13.00 (21.13) [h]	19.80	21.00 (27.27) [g]	16.83	22.00 (27.97) [h]	19.18	12.22 (20.44) [g]	18.53	17.06 (24.43) [h]	18.45
CD (P=0.05)	0.54		0.54		0.54		1.08		0.56	
CV (%)	0.64		0.59		0.60		1.22		0.63	

* Mean of three replications.
In a column mean followed by same letter(s) are not significantly different at P=0.05 by LSD.
Figures in parentheses are arc sin transformed values.

Table 2. Pooled data on the effects of different oil cakes on mulberry leaf production.

Treatments	Number of shoots/plant *	Total length of shoots* (cm)	Number of leaves /plant*	Total biomass yield (kg/ha/crop)*	Leaf yield (kg/ha/crop)*
FYM + neem cake	10.0 [a]	1315 [a]	325 [a]	14305 [a]	8100 [a]
FYM +custard apple seed cake	8.5 [d]	1290 [d]	306 [d]	13900 [d]	6780 [d]
FYM + Jatropha cake	8.7 [d]	1290 [d]	308 [d]	13910 [d]	6790 [d]
FYM + Mahua cake	9.9 [c]	1300 [c]	310 [c]	13990 [c]	6970 [c]
FYM + Pungam cake	10.1 [d]	1290 [d]	310 [c]	13900 [d]	6770 [d]
FYM + Castor cake	9.9 [d]	1288 [d]	309 [d]	14000 [d]	6710 [d]
FYM + Gingelly cake	9.2 [d]	1280 [d]	306 [d]	14010 [d]	6710 [d]
FYM alone	8.2 [e]	1081 [e]	301 [e]	13600 [e]	6600 [e]
Recommended NPK alone	10.2 [b]	1300 [b]	320 [b]	14240 [b]	7960 [b]
Untreated control	5.9 [f]	930 [f]	214 [f]	11210 [f]	5215 [f]
CD (P=0.05)	2.3	20.1	17.2	22.2	2.42
CV (%)	0.89	24.2	18.2	24.2	0.7

* Mean of three replications; In a column mean followed by same letter(s) are not significantly different at P=0.05 by LSD.

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