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Efficacy of Indigenous Materials and Profenophos Combinations against *P. Solenopsis* under Laboratory Conditions

B Lavanya, B Ratna Kumari, T Madhumathi and V Prasanna Kumari
Department of Agricultural Entomology, Agricultural College, Bapatla, A. P.

ABSTRACT

A present study were conducted to evaluate the efficacy of different kinds of indigenous materials and combinations against mealy bug, *Phenacoccus solenopsis* Tinsley (Pseudococcidae: Hemiptera) at laboratory condition during 2018 - 19. Different concentrations of soap solution, starch, neem oil and NSKE and their combinations with profenophos were tested for their effect on *P. solenopsis* crawlers and adults by leaf dip method of bioassay. Combinations treatments of profenophos and indigenous material revealed that the treatment neem oil + profenophos was found to be the most effective against the *P. solenopsis* crawlers and adults as it had recorded high mean per cent mortality (92.86 per cent & 85.96 per cent). The treatment starch + profenophos was least effective combination against the *P. solenopsis* crawlers and adults with mean per cent mortality of 87.72 per cent & 82.72 per cent, respectively.

Key words: *Combinations, Efficacy, LC_{50} and LC_{90} values, Lethal concentrations, Indigenous materials, Phenacoccus solenopsis, Profenophos,*

Cotton, "white gold" is an important fiber as well as cash crop of India. Sucking pests of cotton *viz.*, leafhopper (*Amrasca devastans* Distant), whitefly (*Bemisia tabaci* Genn), aphids (*Aphis gossypii* Glover), thrips (*Thrips tabaci* Lindeman) and mealybug (*Phenacoccus solenopsis* Tinsely) damage the crop with regular infestation at different growth stages and reduce the yield up to 21.20 per cent (Dhawan *et al.*, 1998). Cotton mealybug was an invasive pest in India since 1991 (Fuchus *et al.,* 1991). Initially, it was a minor sucking pest and after 2007 it has emerged as a serious pest (Nagrare *et al.,* 2009). It attacks plants by sucking cell sap from the phloem tissue (Aijun *et al.*, 2004). It secretes honeydew which makes sooty mould on the surface of the leaves, that decreases leaf area for photosynthesis, resulting in the death of plant tissues (Mark *et al*., 2005). In cotton, *P. solenopsis* attacked plant parts show bunchy top appearance and stunted growth, chlorosis, and produce fewer bolls of smaller size with bad opening which ultimately affects the seed cotton yield up to 44.21% (Dhawan *et al*., 2007). Some organophosphates, neonicotinoids, insect growth regulators (IGRs) and bio-pesticides had been recommended for the control of mealybug (Suresh *et al*., 2010 and Rashid *et al.* 2011). The regular and frequent application of chemical insecticides is quite effective but creates lot of problems *viz.*, secondary pest outbreak, pest resurgence, development of resistance, increased cost of cultivation and residual toxicity in soil. In this context, ecologically viable and economically feasible non chemical pest management methods can play a viable alternative against *P. solenopsis* in cotton ecosystem. Hence, the present study was aimed to evaluate the indigenous materials and combinations against *P. solenopsis* under laboratory and field condition.

MATERIAL AND METHODS

Cotton mealy bug, *P. solenopsis* was mass cultured on sprouted potato tubers using standard method (joshi *et al.,* 2003). Laboratory reared newly moulted third instar nymphs of *P. solenopsis* were collected and bioassays were conducted by leaf dip method. Indigenous materials were prepared as per concentrations given in table 1. Soap solution concentrations were prepared by dissolving the required quantities of soap powder using distilled water in 100 ml volumetric flasks.

Required quantity of starch powder was weighed, dissolved in 100 ml of water, boiled until the contents become sticky and then allowed to cool.

Stock solution of 1% (10000 ppm) neem oil was prepared by dissolving 1 ml of neem oil (commercial formulations) in 100 ml of distilled water. Using this stock solution, working solutions of desired concentrations were prepared by serial dilution method.

Neem fruits were collected during bearing season (July) and shade dried for three months. About 50 g of powdered neem seed kernels was taken and soaked in one litre of water for 24 hours. The soaked material was squeezed to extract the azadirachtin in to aqueous suspension to set the neem seed kernel

extract. The contents were filtered through muslin cloth and filterate was made up to one litre. Stock solution of 5% NSKE was prepared by dissolving 5 ml of NSKE in 100 ml of distilled water. Using this stock solution, working solutions of desired concentrations were prepared by serial dilution method. Water was kept as control treatment. Surfactant (wetcit 1%) was used for preparing working solutions of neem oil and NSKE.

The laboratory bioassay was carried out against mealybug using the best concentration of indigenous material alone and also by combination of best concentration of profenophos *i.e.* the concentrations with least LC_{50} values (Table 1). About 50 ml of best concentration of profenophos solution and 50 ml of indigenous material solutions were mixed to prepare a combination treatment.

Cotton leaves with 20 crawlers (or) adults were sprayed with three ml of test solutions using hand atomizer with different concentrations of indigenous material and profenophos combinations and then observed for the mortality per cent by replicating each treatment three times.

Table 1. Details of indigenous material and profenophos combinations tested against *P. solenopsis*

S.No.	Test insecticide
Crawlers	
1	Soap 2%
2	Soap 2% + profenophos 14 ppm
3	Starch 3%
4	Starch 3% + profenophos 14 ppm
5	Neem oil 0.01%
6	Neemoil 0.01% + profenophos 14 ppm
7	NSKE 0.012 %
8	NSKE 0.012% + profenophos 14 ppm
9	Water
Adults	
1	Soap 3%
2	Soap 3% + profenophos 30 ppm
3	Starch 6%
4	Starch 6% + profenophos 30 ppm
5	Neem oil 0.025%
6	Neemoil 0.025% + profenophos 30 ppm
7	NSKE 0.03%
8	NSKE 0.03% + profenophos 30 ppm
9	Water

The data on mortality (crawlers and adults that did not move when touched with a fine brush were considered as dead) was recorded after 24 hours of application of treatments. Such individuals were also exposed to sunlight to confirm their death. The concentrations giving the mortality ranging from 20 to 80 per cent were selected. The mortality was converted to per cent mortality and corrected per cent mortality of the mealybug was calculated as per Abbott's (1925) by using the formula:

$$\text{Corrected per cent mortality} = \frac{\text{\% mortality in treatment -\% mortality in control}}{\text{100 - \% mortality in control}} \times 100$$

The data obtained in evaluation of indigenous material and profenophos combination per cent mortality was transformed into arc sine transformation and then subjected to analysis of variance (ANOVA) in completely randomized block design (CRBD) with three replications for the test of significance and calculation of critical differences (Snedecor and Cochran, 1967).

RESULTS AND DISCUSSION

The effect of different concentrations of soap solution, starch, neem oil, NSKE and their combinations with profenophos against *P. solenopsis* crawlers was recorded. The data on mortality of *P. solenopsis* crawlers presented in table 2& fig 1, indicated significant variations in the mortality after 24h of the application of individual indigenous material and indigenous material and profenophos combinations. The highest mortality was observed in T_6 (92.86 per cent) followed by T_2 (91.23 per cent) and T_8 (89.34 per cent). The least effective treatment (starch + profenophos) showed 87.72 per cent mortality of *P. solenopsis* crawlers after 24h of application. However, neem oil and NSKE, starch and soap solution when applied singly at different concentrations showed lower mortality than their combinations. Effect of combinations of indigenous materials with profenophos against *P. solenopsis* has not been reported in available literature and hence the present finding lack comparison.

Addition of surfactant (wetcit) in the preparation of working solutions of neem oil and profenophos might have increased the efficacy by improving the spreading nature and thus recording high mortality per cent.

The data on mortality of *P. solenopsis* adults was presented in table 3 & fig 2. The highest mortality was observed in T_6 (85.96 per cent) followed by T_8 (84.63 per cent) and T_2 (83.88 per cent). The least effective treatment (starch + profenophos) showed 82.72 per cent mortality of *P. solenopsis* adults after 24h of application. However, neem oil and NSKE,

Table 2. Efficacy of indigenous material and profenophos combinations against *P. solenopsis* crawlers under laboratory conditions

S.No.	Treatments	Mean mortality %*
1	T_1 Soap 2%	47.37 (43.47) [c]
2	T_2 Soap 2% + profenophos 14 ppm	91.23 (72.92) [ab]
3	T_3 Starch3%	50.88 (45.48) [c]
4	T_4 Starch3% + profenophos 14 ppm	87.72 (69.54) [b]
5	T_5 Neem oil 0.01%	49.21 (44.52) [c]
6	T_6 Neem oil 0.01% + profenophos 14 ppm	92.86 (74.66) [a]
7	T_7 NSKE 0.012%	50.88 (45.48) [c]
8	T_8 NSKE 0.012% + profenophos 14 ppm	89.34 (70.92) [ab]
9	T_9 Water	3.50 (10.58) [d]
	SEm (±)	1.28861
	CD (P≤ 0.05)	3.828677
	CV (%)	4.20576
	SEd(±)	1.822379

Table 3. Efficacy of indigenous material and profenophos combinations against *P. solenopsis* adults under laboratory conditions

S.No.	Treatments	Mean mortality %*
1	T_1 Soap 3%	52.63 (46.49) [cd]
2	T_2 Soap 3% + profenophos 30 ppm	83.88 (66.30) [ab]
3	T_3 Starch 6%	49.88 (44.91) [d]
4	T_4 Starch 6% + profenophos 30 ppm	82.72 (65.43) [b]
5	T_5 Neem oil 0.025%	54.39 (47.50) [c]
6	T_6 Neem oil 0.025% + profenophos 30 ppm	85.96 (68.05) [a]
7	T_7 NSKE 0.03%	50.88 (45.48) [d]
8	T_8 NSKE 0.03%+ profenophos 30 ppm	84.63 (66.90) [ab]
9	T_9 Water	1.75 (7.29) [e]
	SEm (±)	0.94744
	CD (P≤ 0.05)	2.81499
	CV (%)	3.222194
	SEd(±)	1.33988

Figures in the parenthesis are Angular transformed values
*Mean of the three replications

starch and soap solution when applied singly at different concentrations showed lower mortality than their combinations.

Indigenous combinations on *P. solenopsis* were not reported in the previous studies. Compared to individual concentrations of indigenous materials, different combinations of indigenous materials even at the lowest concentration along with profenophos were highly effective against *P. solenopsis* in this study. Thus, the combined action of two different combinations might be more toxic against the *P. solenopsis.* Among all the combinations, neem oil + profenophos and NSKE + profenophos combinations were found better in controlling *P. solenopsis*.

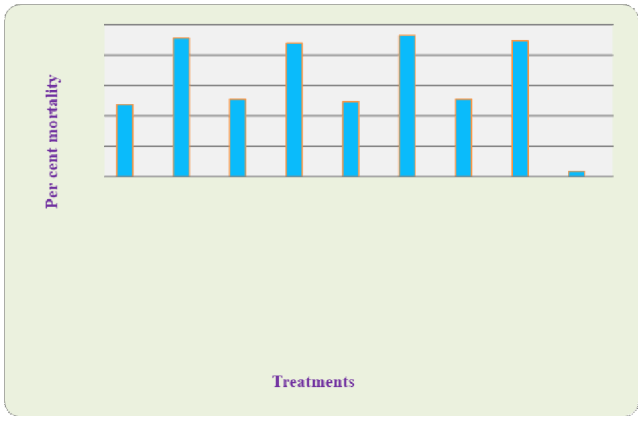

Fig. 1 Efficacy of indigenous material and profenophos against *P. solenopsis* crawlers

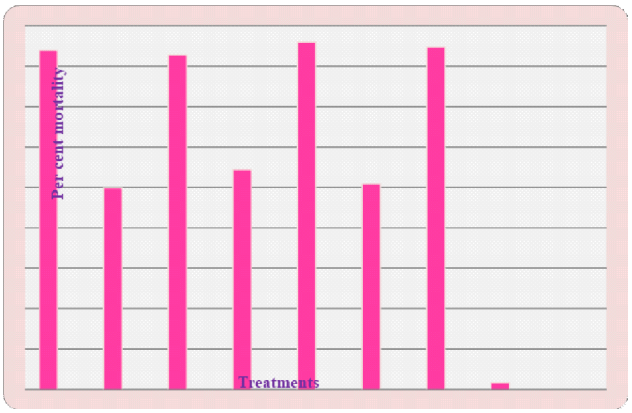

Fig. 2 Efficacy of indigenous material and prophenophos against *P. solenopsis* adults

CONCLUSION

Evaluation of combinations revealed that the treatment neem oil + profenophos was most effective against the *P. solenopsis* crawlers and adults as it has recorded high mean per cent mortality (92.86 per cent & 85.96 per cent). One of the possible reasons for its efficacy was because of its double mode of action. As the pest has started developing resistantance against already available insecticides, this combination may be helpful in pest resistant management strategy for mealybug.

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