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Efficacy of combination insecticide and biopesticide against *Phenacoccus solenopsis* in laboratory condition on Okra

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Abstract
The bioefficacy studies on *Phenacoccus solenopsis* were studied in laboratory conditions on okra (*Abelmoschus esculentus* L.) host plant. The study was conducted to evaluate the toxic effect of different insecticides at different concentrations against *Phenacoccus solenopsis*. Leaf-dip bioassays were achieved to measure the toxicity of combination insecticides and biopesticide. The results revealed that the highest mortality were recorded at 1% concentration of each treatment by Profenophos + cypermethrin (90%), Aza-d 1% (96.67%) followed by chlorpyriphos + cypermethrin (75%) and Aza-d 1% (96.67%) showed the significantly different result as compared to all other treatment. Lowest mortality was recorded by Triazophos + deltamethrin (39.33%), *Verticillium* (36.67%), *Beauveria* (34%) and Aza-d 0.1% (23.33%) after 12 hours. LC_{50} values were calculated, among all the value, 0.025 LC_{50} at 1% concentration of Azad-d 1500ppm gave the better result as compare to the other value of LC_{50}. However among all the value of LT_{50} values among all the value calculated, LT_{50} 1.2 hour in case of Profenophos + cypermethrin 44EC at 1% concentration was declared best.

Keywords: *Phenacoccus solenopsis*, okra, natality, mortality

Introduction
Okra (*Abelmoschus esculentus* L. Moench) is the important vegetable crop in the Malvaceae family and is very common in the Indo-Pak subcontinent. In India, it ranks number one in its consumption. It is one of the first cultivated crop and currently grown in many countries and is extensively distributed from African continent to Asia, southern European countries and America.

Mealybug, P. solenopsis, besides cotton is devastating to many other economic crops such as; vegetables, ornamental plants and has been reported infesting 149 plant species (Afzal *et al*., 2009) [1].

This highly polyphagous mealy bug infests 149 plant species including numerous crops, weeds vegetable, ornamentals and medicinal plants (Hodgson *et al*., 2008; Arif *et al*., 2009; Wang *et al.*, 2010) [10, 4, 15]. In case of cotton infestation by cotton mealybug adversely affect the boll opening and leading to the reduction in yield ranging 58-73% (Dhawan, 1980) [7].

Integrated pest management of mealybug is the safest and inexpensive method of pest control (Ahmad *et al*., 2003) [3]. Yet, the use of insecticides is unavoidable to checked the mealybug eruptions and attack as associated to predators and parasitoids (Joshi *et al*., 2010) [11]. Numerous insecticides have its place to diverse groups have been recognized as actual beside cotton mealybug Suresh *et al*., (2010) [14].

While number of chemicals and biological control agents are active against cotton mealy bug (*P. solenopsis*). Parthenogentic reproduction of this pest can provide births to several young ones which may act as biotypes of this pest and can lead to resistance agasinst these insecticides and biological control agents.

Material and Methods
To attain the goals the present studies were conducted out on *A. esculentus* (L.) Moench under laboratory conditions in the Department of Plant Protection of Faculty of Agricultural Sciences, Aligarh Muslim University, Aligarh (U.P.) India during late summer (kharif) season. Laboratory studies on evaluation of different combination insecticides and biopesticides against the insect, *Phenacoccus solenopsis* on okra was carried out in the year 2017 and 2018.

Studies on the evaluation of certain synthetic combination insecticides and biopesticides against *Phenacoccus solenopsis* in laboratory conditions

Newly moulted second instar nymphs of the cotton mealybug *Phenacoccus solenopsis* were collected from okra crop, these nymphs were reared and multiplied on okra fruit and bioassays were conducted using a standard size okra fruit plucked from okra plant**.** Three concentration of combination insecticide including median dosage of recommended field rates were taken, three concentrations of fungal biopesticides and six concentration of neem based insecticide of their commercial formulation were taken (Table-1). Test solutions were made in distilled water. Okra fruits plucked from unsprayed okra plants, were washed and dried before treatment. These fruits were dipped in test solutions for 10s with gentle agitation, and then were placed on tissue paper for drying, with the adaxial surface facing up. After drying, they were placed in 5 cm plastic Petri dishes that contained moist filter paper at their bottoms, to avoid desiccation. Five second instar nymphs were placed on each petri plate. Each treatment was replicated four times and nymphs were exposed to treated okra fruits. Mortality was assessed after 6, 12 and 18 hrs of treatment for the evaluation and determination of LC_{50} and LT_{50} by using the software SPSS and Minitab.

Table 1: Treatment details of evaluation of synthetic combination insecticides and biopesticide against *Phenacoccus solenopsis* in laboratory condition.

Common Name	Trade Names & Formulation	Recommended concentration
Triazophos + Deltmethrin	(DELTEX) 36 EC	0.5 ppm, 1ppm and 1.5ppm
Profenophos + Cypermethrin	(HITCEL) 44EC	0.5ppm, 1ppm and 1.5ppm
Cypermethrin + Chlorpyriphos	(GAMBHIR) 55EC	0.5ppm, 1ppm and 1.5ppm
Neem 1500 ppm	(Aza-D) 1500 ppm	1%, 2% and 3%
Neem 1500 ppm	(Aza-D) 1500 ppm	0.01%,0.02% and 0.03%
Beauveria bassiana	(BABA) ($1X10^8$CFU/ml)	1%, 2% and 3%
Verticillium	(VARSHA) cell content 10^9/ml	1%, 2% and 3%

Results

Efficacy of combination insecticide and biopesticide formulation against *Phenacoccus solenopsis.*

Six commercial formulation of insecticide with three concentration of 1%, 2% and 3% and 1ppm, 2ppm and 3ppm were tested against the second instar nymph of *P. solenopsis* to check their efficacy under laboratory conditions. The data obtained from this experiment subjected to regression analysis, LC_{50} and LT_{50} values were calculated. It was observed that the highest mortality were recorded at 1% concentration of each treatment by Profenophos + cypermethrin (90%), Aza-d 1% (96.67%) which is significantly different and more efficient concentration followed by chlorpyriphos + cypermethrin (75%). Lowest mortality was recorded by Triazophos + deltamethrin (39.33%), *Verticillium* (36.67%), *Beauveria* (34%) and Aza-d 0.1% (23.33%) after 12 hours (figure 1).

At 2% and 2ppm concentration highest mortality was recorded by Profenophos + cypermethrin (100%) followed by Aza-d (90%) and chlorpyriphos + cypermethrin (80.33%). Lowest mortality was recorded by *Beauveria* (34.66%) and Aza-d (33.67%) (Figure - 2).

At 3% and 3ppm concentration Profenophos + cypermethrin (100%) followed by Aza-d (92.67%) and chlorpyriphos + cypermethrin (90.67%) found highly effective. *Verticillium* with 79.33% mortality proved moderately effective. Lowest mortality recorded on *Beauveria* 35.33% and Aza-d 0.03% (26.67%) (Figure -3).

LC_{50} values were calculated as 0.731, 0.273, 0.731, 2.170, 1.799, 0.025 and 1.933, it showed 0.025 LC_{50} at 1% concentration of Azad-d 1500ppm gave the better result as concentration for each treatment as 12.193, 12.193, 12.280. 4.268, 1.2, 2.713, 5.81, 6.73, 8.098, compare to the other value of $LC_{50.}$ (Table-3). However, LT_{50} values were calculated at three 12.193, 13.163, 12.131, 21.073, 21.072, 21.071,7.137, 5.194, 5.345, 38.59, 14.09 and 16.50 at three readings i.e. 6 hours, 12 hours and 18 hours in which LT_{50} 1.2 hour in case of Profenophos + cypermethrin 44EC at 1% concentration was declared best (Table-2).

Table 2: LC_{50} and LT_{50} values of combination insecticide on *Phenacoccus solenopsis*

S. No	Chemical	Recommended Concentrations (ppm)	LT_{50} value	LC_{50} value
1	Triazophos + Deltamethrin 36EC	0.5	12.193	0.731
		1	12.193	
		1.5	12.280	
2	Profenophos + Cypermethrin 44EC	0.5	4.268	0.273
		1	1.2	
		1.5	2.713	
3	Cypermethrin + Chlorpyriphos 55 EC	0.5	5.81	0.731
		1	6.73	
		1.5	8.098	

Table 3: LC_{50} and LT_{50} values of biopesticides on *Phenacoccus solenopsis*

S. No	Biopesticide	Recommended concentrations (%)	LT_{50} value	LC_{50} value
1	*Beauveria bassiana* ($1X10^8$CFU/ml)	1	12.193	2.170
		2	13.163	
		3	12.131	
2	*Verticillium lecanii*	1	21.073	1.799
		2	21.072	

	(cell content 10^9/ml)	3	21.071	
3	Neem (1500)	1	7.137	0.025
		2	5.194	
		3	5.345	
4	Neem (1500)	0.01	38.59	1.933
		0.02	14.09	
		0.03	16.50	

Discussion

Least mortality was noted in case of Triazophos + deltamethrin (39.33%), *Verticillium* (36.67%), *Beauveria* (34%) and Aza-d 0.1% (23.33%) after 12 hours. Likewise mortality, LC_{50} and LT_{50} values were resolute at 2% followed by 3% (Table-2) relatively similar result were obtained by Saeed *et al*., (2007) [13] which shows that the pyrethroids, bifenthrin had the lowest LC_{50} value, particularly after 48 h of exposure. Both carbamates had high LC_{50} suggesting their uselessness against *P. gossypiphilous* and efficient control of the root mealybug and the spherical mealybug *Nipaecoccus viridis* by chlorpyrifos was suggested by Bekele (2001) [6] and Gross *et al* (2001), [9] respectively. Deltamethrin showed 90% mortality 72 h after treatment in the laboratory, relatively similar result was found by Arshad *et al*.,(2015) [5] he showed that the combination insecticide, cypermethrin + profenophos (Polytrin-C), is more accomplished against *P. citri* females. One of the possible reasons for its efficacy would be its dual mode of action because profenofos is a organophosphate inhibiting acetylcholinesterase (AChE), while the other insecticide, cypermethrin, is a pyrethroid pointing sodium channel transmission of insect nervous system. El-Zahi Saber El-Zahi., (2016) [8] showed the relatively similar results in field condition which indicates that methomyl, imidacloprid, thiamethoxam and chlorpyrifos effectively controlled the cotton mealybug recording 92.3, 89.2, 84.6 and 80.4% average decrease, respectively, in *Phenacoccus sonenopsis* populations compared to the untreated plots.

Ahmad *et al*., (2011) [3] showed that the Profenofos (50 EC) effectively controlled the cotton mealybug (*P. solenopsis*) and had deepest population ended other treatments throughout all the observation dates during the crop period. Organophosphates have previously been described to be the greatest for mealybug control e.g., methomyl, chlorpyrifos, methidathion and profenofos (Saeed *et al*., 2007; Aheer *et al*., 2009; Suresh *et al*., 2010) [13, 2, 14] along with some other insecticides belonging to synthetic Pyrethroid group e.g., Mustang 380 EC (ethion + zeta Cypermethrin) and bifenthrin, followed by plant based insecticide (Neemosal 0.5% EC; 0.5% azadirachtin) was the next best control strategy after insecticidal control, relatively same result was found as showed in the (table-8) at six concentration in case of Aza-d (1500ppm) i.e. 1%, 2%, 3%, 0.01%, 0.02%, and 0.03% in which highest mortality was recorded at 1%, 2%, and 3% concentration.

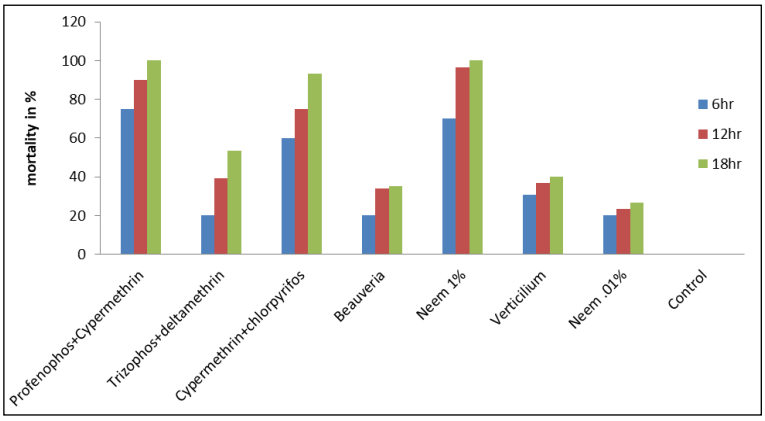

Fig 1: Concencentration at 1% and 1ppm, (ppm for combination insecticide, % for biopesticide)

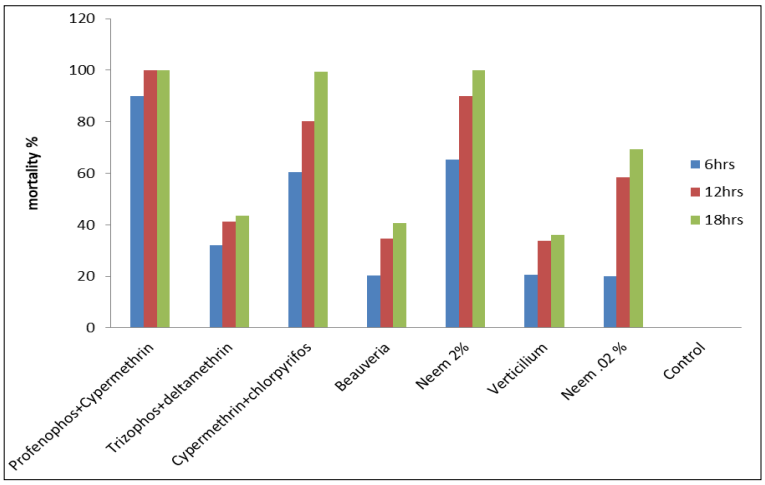

Fig 2: Concencentration at 2% and 2ppm, (ppm for combination insecticide, % for biopesticide)

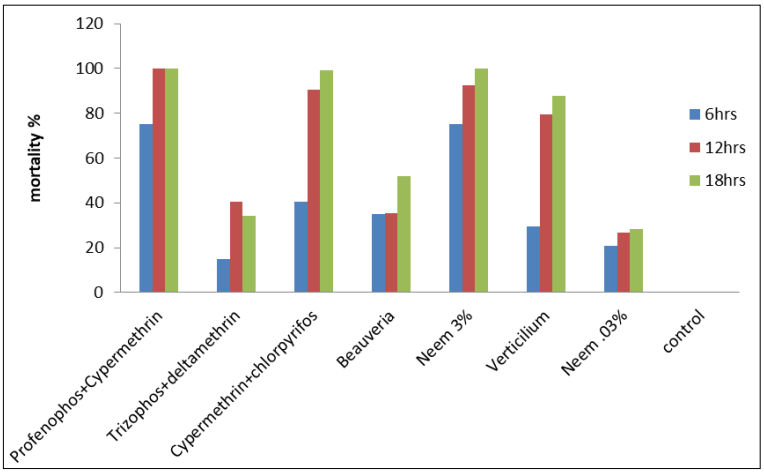

Fig 3: Concencentration at 3% and 3ppm, (ppm for combination insecticide, % for biopesticide)

Table 4: Effect (Mortality) of various treatment at different concentration on 2nd instar of *Phenacoccus solenopsis*

Treatment	Recommended Concentration.	6hr	12hr	18hr
Profenophos+Cypermethrin	0.5 ppm	75[a]	90[a]	100[a]
Trizophos+deltamethrin	0.5 ppm	20[c]	39.33[c]	53.33[b]
Cypermethrin+chlorpyrifos	0.5 ppm	60[a]	75[b]	93.33[a]
Beauveria	1%	20[c]	34[c]	35.33[c]
Aza-d 1%	1%	70[a]	96.67[a]	100[a]
Verticilium	1%	30.67[b]	36.67[c]	40[b]
Aza-d .01%	0.01%	20.33[c]	23.33[d]	26.67[c]
Control		0	0	0
Profenophos+Cypermethrin	1 ppm	90[a]	100[a]	100[a]
Trizophos+deltamethrin	1 ppm	32[c]	41.33[e]	43.67[c]
Cypermethrin+chlorpyrifos	1 ppm	60.33[b]	80.33[c]	99.33[a]
Beauveria	2%	20.33[c]	34.66[e]	40.67[c]
Aza-d 2%	2%	65.33[b]	90[b]	100[a]
Verticilium	2%	20.66[c]	33.67[f]	36[c]
Aza-d .02%	0.02%	20[d]	58.33[d]	69.33[b]
Control		0	0	0
Profenophos+Cypermethrin	1.5 ppm	75[a]	100[a]	100[a]
Trizophos+deltamethrin	1.5 ppm	15[d]	40.66[d]	34[b]
Cypermethrin+chlorpyrifos	1.5 ppm	40.67[b]	90.67[b]	99.33[a]
Beauveria	3%	35[b]	35.33[d]	52[b]
Aza-d 3%	3%	75.33[a]	92.67[b]	100[a]
Verticilium	3%	29.33[b]	79.33[c]	87.67[a]
Aza-d .03%	0.03%	20.66[c]	26.67[e]	28.33[b]
control		0	0	0

References

1. Afzal M, Rahman SU, Siddiqui MT. Appearance and management of a new devastating pest of cotton, *Phenacoccus solenopsis* Tinsley. InPakistan. Belt-wide Cotton Conference, San Antonio, Texas, 2009, pp. 5-8.
2. Aheer GM, Ahmad R, Ali A. Efficacy of different insecticides against cotton mealybug, Phenacoccus Solenai Ferris. Journal of Agricultural Research. 2009; 47:47-52.
3. Ahmad F, Akram W, Sajjad A, Imran AU. Management Practices against Cotton Mealybug, *Phenacoccus solenopsis* (Hemiptera: Pseudococcidae). International Journal of Agriculture & Biology. 2011; 13(4).
4. Arif MI, Rafiq M, Ghaffar A. Host plants of cotton mealybug (*Phenacoccus solenopsis*): a new menace to cotton agroecosystem of Punjab, Pakistan. International Journal of Agriculture & Biology. 2009; 11(2):163-167.
5. Arshad M, Majeed MZ, Ullah MI, Ahmad K, Tayyab M, Yahya M. Laboratory evaluation of some insecticides against citrus mealybug Planococcus citri, (Homoptera: Pseudococcidae). Journal of Entomology and Zoological Studies. 2015; 3:20-23.
6. Bekele T. Insecticidal screening against enset root mealybug, Paraputo spp. AgriTopia. 2001; 16:2-3.
7. Dhawan BN, Dubey MP, Mehrotra BN, Tandon JS. Screening of Indian plants for biological activity: Part IX. Indian Journal of Experimental Biology. 1980; 18:594-602.
8. El-Zahi EZ, Aref SA, Korish SK. The cotton mealybug, *Phenacoccus solenopsis* Tinsley (Hemiptera: Pseudococcidae) as a new menace to cotton in Egypt and its chemical control. Journal of plant protection research. 2016; 56(2):111-5.
9. Gross S, Gefen D, Rotman N, Tadmor U, Zemer B, Gotlib A, Gefen Y. Chemical control of spherical mealy bug (Nipaecoccus viridis) (Newstead) in citrus, Alon Hanotea. Alon Hanotea. 2001; 54:234-240.
10. Hodgson C, Abbas G, Arif MJ, Saeed S, Karar H. *Phenacoccus solenopsis* Tinsley (Sternorrhyncha: Coccoidea: Pseudococcidae), an invasive mealybug damaging cotton in Pakistan and India, with a discussion on seasonal morphological variation. Zootaxa. 2008;

24(1913):1-35.
11. Joshi MD, Butani PG, Patel VN, Jeyakumar P. Cotton Mealy Bug, *Phenacoccus solenopsis* Tinsley–A Review. Agricultural Reviews. 2010; 31(2):113-119.
12. Kondo T, Gullan P, Ventura J, Culik M. Taxonomy and biology of the mealybug genus Plotococcus Miller &Denno (Hemiptera: Pseudococcidae) in Brazil, with descriptions of two new species. Studies on Neotropical Fauna and Environment. 2005; 40(3):213-227.
13. Saeed S, Ahmad M, Ahmad M, KWON YJ. Insecticidal control of the mealybug *Phenacoccus gossypiphilous* (Hemiptera: Pseudococcidae), a new pest of cotton in Pakistan. Entomological Research. 2007; 37(2):76-80.
14. Suresh SR, Jothimani P, Sivasubrmanian P, Karuppuchamy R, Samiyappan EI. Jonatha. Invasive mealybugs of Tamil Nadu and their management Karnataka Journal of agricultural research. 2010; 23:6-9.
15. Wang YG, Watson W, Zhang R. The potential distribution of an invasive mealybug *Phenacoccus solenopsis* and its threat to cotton in Asian Agricultural and Forest Entomology. 2010; 12:403-416.