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The Effectiveness of Different Insecticides against Cotton Mealybug, *Phenacoccus solenopsis* in District Awaran

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Abstract: *The effectiveness of different insecticides Methidathion 40EC, Spirotetramat 240SC, Chlorpyrifos40EC, Profenofos 50EC and Control (Un-treated) on the cotton mealybug (Phenacoccus solenopsis) infestation was studied to evaluate their potential as a management strategy. The 5 treatments that is Methidathion 40EC, Spirotetramat 240SC, Chlorpyrifos 40EC, Profenofos 50EC and Control plot were applied in three replications. The Profenofos 50EC insecticide showed the best control against cotton mealybug population. Spirotetramat 240SC insecticide and Chlorpyrifos 40EC insecticide notably lower the cotton mealybug population while Methidathion 40EC insecticide is not full control the population of cotton mealybug. It is suggested that the Spirotetramat 240SC insecticide and Chlorpyrifos 40EC insecticide can be applied during initial or low cotton mealybug infestation, however the Profenofos 50EC insecticide should remain as the last option during heavy infestations of the cotton mealybugs in cotton crop.*

Keywords: Effectiveness; Different Insecticides; *Cotton*; Mealybugs; *Phenacoccus solenopsis*

1. INTRODUCTION

Cotton crop has experienced a new and emerging threat from mealybug Phenacoccus solenopsis Tinsley (Hemiptera: Pseudococcidae) that has attained the status of a serious pest (Arif et al., 2009). This pest has been reported from 35 localities of various ecological zones of the globe (Ben-Dov et al., 2009) with initial reports from Texas, USA (Fuchs et al., 1991). From Pakistan, it has been recorded as a serious pest since 2005 on cultivated cotton Gosspium hirsutum in Punjab and Sindh (Abbas et al., 2007; Muhammad, 2007; Hodgson et al., 2008). It has also been reported as a serious pest in India (Nagrare et al., 2009) and as a potential threat in China (Wang et al., 2009). Cotton mealybug is a soft-bodied insect that sucks the cell sap and plays havoc with the crop (Aijun et al., 2004). The attacked cotton plants remain stunted and produce fewer bolls of a smaller size; leaves become distorted, yellow and eventually drop off (Dhawan et al., 198
Mark 0; & Gullan, 2005). The insect also produces honey dew resulting in sooty mold growth, which hinders photosynthesis process (Saeed et al., 2007).
Winged males and wingless females of mealybug (P. solenopsis) have two and three nymphal instars, respectively (Hodgson et al., 2008). Eggs are normally laid in an ovi-sac (McKenzie, 1967; Hodgson et al., 2008). This pest is also suspected as a vector of plant diseases (Culik & Gullan, 2005) and has a wide range of variation in morphological characters, biological adaptations and ecological adjustability (Hodgson et al., 2008). It has been recorded from 154 plant species including field crops, vegetables, ornamentals, weeds, bushes and trees (Arif et al., 2009; Saini et al., 2009). Most of these belong to the family Malvaceae, Solanaceae, Asteraceae, Euphorbiaceae, Amaranthaceae and Cucurbitaceae, however, the economical damage has been observed on cotton, brinjal, okra, tomato, sesame, sunflower and China rose (Arif et al., 2009).
Integrated pest management of mealybug could be the safest and cheapest method of pest control (Ahmad et al., 2003). However, the use of insecticides is inevitable to check the mealybug outbreaks as compared to predators and parasitoids (McKenzie, 1967; Joshi et al., 2010). Several insecticides belonging to different groups have been documented as effective against cotton mealybug. For example, Suresh et al. (2010) recommended a need based application of insecticides like profenofos 50 EC 2 mL/L, chlorpyriphos 20 EC 2 mL/L,

dimethaote 2 mL/L, imidacloprid 0.6 mL/L and thiamthoxam 0.6 g/L. Other insecticidal solutions like Buprofezin against nymphal and adult population of bunch infestation (Muthukrishnan et al., 2005) besides insect growth regulators and nicotine based insecticides in some vineyards (Danne et al., 2006). Some other non-insecticidal chemical control measures include use of petroleum spray, oils and soap sprays (Jain Hua, 2003).

Keeping in view the hazardous nature of insecticides and complete knowledge of control against P. solenopsis, the current study was planned to evaluate the efficacy of different insecticides for control of cotton mealybugs aiming to develop the best package of management practices for mealybug control.

2. MATERIALS AND METHODS

2.1 The Research Experiment Land:

The research trail was conducted at the farmer Abdul Ghafoor Agriculture field at District Awaran, Balochistan. The climate of district Awaran is hot in the summer and cool in the winter. Dust storms are frequent throughout the year. The storms become very severe from May to September, when they are locally known as "Livar".

The Research Experiment Layout and Materials: The cotton variety "MNH-992" seeds were drilled in flat bed land one acre area during Kharif season, 2023. The experiment was laid out under Randomized Complete Block Design (RCBD) with three replications. Five treatments were applied in each replication and each treatment was of "2500 square feet". The five treatments included Methidathion 40EC, Spirotetramat 240SC, Chlorpyrifos 40EC, Profenofos 50EC and Control (Un-treated).

On the whole, various insecticides were applied for the control of mealybug i.e., Methidathion 40EC, Spirotetramat 240SC, Chlorpyrifos 40EC, Profenofos 50EC. Four types of insecticides were tested viz., (Methidathion 40EC @ 800ml/acre), (Spirotetramat 240SC @ 1000ml/acre), (Chlorpyrifos 40EC @ 800ml/acre) and (Profenofos 50EC @ 800ml/acre). The insecticides were sprayed with the help of knapsack sprayer. Five applications of insecticides were made throughout the research experiment.

The Research Experiment Data and Analysis:

The four insecticides were applied at 10 days intervals. Data on mealybug population (per plant) was recorded at 10 days intervals. 10 plants were observed randomly in each treatment for mealybug population. The cotton mealybugs on the plant were counted including stems and leaves irrespective of their life stage. Mean population of cotton mealybug in different insecticides and control plots, was compared with that of control plot to know their effectiveness. Percent population change (increase or decrease) among treatments in relation to control was calculated by using modified Abbot's formula (Flemings & Ratnakaran 1985).

Data on mealybug populations was subjected to statistical analysis using one way Analysis of Variance (ANOVA) and the means were compared by LSD test at P=0.05.

3. RESULTS

Table I: Mean population (per plant) and percent population increase or decrease (%) ofcotton mealybug before and after treatment applications

Treatmants	1ST Spray		2nd Spray		3rd Spray		4th Spray		5th Spray	
	Before	After	Before	After	Before	After	Before	After	Before	After
Methidathion	75.60	80.5 a (44.62)	103.72	93.7 ab (15.59)	96.20	109.8 a (-3.86)	108.22	89.7 b (20.07)	107.20	93.8 b (-5.12)
Spirotetramat	73.94	68.5 a (50.82)	84.94	78.47 bc (11.28)	88.27	83 b (9.94)	96.42	83.08 bc (19.28)	98.54	79.5 c (2.32)
Chlorpyrifos	99.27	91.9 a (52.51)	94.34	87.94 b (9.26)	103.61	108 a (-0.21)	111.34	92.9 b (22.02)	104.81	89.66 bc (-5.327)
Profenofos	71.21	57.74 a (56.96)	71.27	58.74 c (20.77)	82.74	74.8 b (14.86)	77.41	68.07 c (15.63)	81.87	53.14 d (22.57)
Control (Un-treated)	41.71	72.5 a (0.00)	68.25	112.08 a (0.00)	116.27	122.06a (0.00)	130.94	137.74 a (0.00)	147.68	122.4 a (0.00)

*Figures in parentheses refer to the percent increase or decrease of mealybugs in treatments over control

There was significant difference in mealybug population (df = 4.0, f = 4.60, p = 0.027) before the application of insecticides during the 1st observation. First application of insecticides Methidathion, Spirotetramat, Chlorpyrifos and Profenofos were applied at the 2nd observation, there was a non-significant difference (df = 4.0, F = 1.37, P = 0.316) among the four treatments and control plots. However, the maximum population decrease was observed in Profenofos insecticide, (Table I).

The 3rd observation during the research trial were revealed significant differences (df = 4.0, F = 4.431, P = 0.030) in cotton mealybug population among treatments. The 2nd application of insecticides were applied and the 4th observation of data were recorded at this stage, there was a significant difference (df = 4.0, F = 8.572, P = 0.004) among the four treatments and control plots however, Profenofos insecticide was showed maximum population decrease followed by Methidathion insecticide and others two insecticide Chlorpyrifos and Spirotetramat could not effectively reduce the cotton mealybug population

The 5th observation were revealed significant differences (P<0.01) in mealybug population among the five treatments.

The 3rd application of insecticides were done at and the data was recorded during the research trial. The 6th observation revealed significant (P<0.01) differences in mealybug population among the five treatments. At this stage, mealybug population decreased only in the plots, where Profenofos and Spirotetramat were applied. However, in Methidathion and Chlorpyrifos treatments mealybugs increased slightly.

The 7th observation showed that there were significant (P < 0.01) differences among mealybug populations of five treatments.

The 4th application of insecticides were done at followed by 8th observation at this stage, there were significant (P<0.01) differences among the four treatments and control plots. Contrary to the previous observations, the Methidathion and Chlorpyrifos plots proved to be the best towards lowering the cotton mealybug population.

The 9th observation taken during the experiment were revealed a significant (P<0.01) difference in cotton mealybug population among the five treatments.

The last (5th) application of insecticides were done at and the 10th observation were showed significant (P<0.01) differences for mealybug population among the five treatments. At this stage, the population high decrease was observed only in Profenofos plots, while other three treatments proved the less decrease.

The seasonal dynamic pattern of controlplot revealed a sharp increase in mealybug population, where population increase was from 41.71±9.61 to 112.08±7.88 individuals/plant. After wards a slow but continuous increase in population wasevident until the end of the research; the time when the maximum population (147.68±6.49 individuals/plant) was observed. Beyond this stage, a sharp decline in mealybug population was observed with a population of 53.54±21individuals/plant during the research.

The percent population change obtained through modified Abbot's formula revealed that population change in Spirotetramat and Profenofos plots was always positive (decreasing) whereas a couple of negative trends (increasing) were observed in Chlorpyrifos and Methidathion plots after 3rd and 5th sprays. Comparison of seasonal averagepopulation of mealybugs among the five treatments indicated best control offered by Profenofos followed by Spirotetramat and Chlorpyrifos. Methidathion 40EC is not full control the population of cotton mealybug.

4. DISCUSSION

The population of mealybug was not similar statistically before the application of insecticides during the research trial. This is a usual problem faced in such kind of studies, where crop is grown under natural field conditions and natural infestation of insects is accounted for(Hanchinal *et al*., 2009). To overcome this problem in this study, a transformed Abbot formula (Flemings & Ratnakaran, 1985) was used in which percent mortality was predicted out of the average populationsamongst pre and post treated and control plots.

The results showed that Profenofos (50 EC) insecticide effectively controlled cotton mealybug(*P. solenopsis*) and had lowest population over other treatments during all the observation dates throughout the crop season. Organophosphates have alreadybeen reported to be the best for mealybug control e.g., methomyl, chlorpyrifos, methidathion and profenofos (Saeed *et al*., 2007; Aheer *et al*., 2009; Suresh *et al*., 2010) along with some other insecticides belonging to synthetic Pyrethroid group e.g., Mustang 380 EC (ethion + zeta

In conclusion, it is suggested that "Spirotetramat insecticide" and "Chlorpyrifos insecticide" can be applied during initial or lower mealybug infestations, while heavy infestations require the use of " Profenofos insecticide". The validity of this experimentally derived recommendation needs further profundity of the management approaches by all four integrating insecticides for evolvingeffective and efficient strategies of cotton mealybug suppression.

5. CONCLUSION

The "Profenofos" 50EC insecticide gave best results among all the insecticides and control, therefore "Profenofos" 50EC insecticide is recommended against Cotton mealybugs in district Awaran province of Balochistan, Pakistan. The Cotton should be regularly monitored for cotton mealybugs attack and if the number increased mealybugs population per plant the crop should be sprayed with recommended insecticide on recommendeddose. The spray can be repeated

10 days intervals if the cotton mealybugs population exceeds the number.

REFERENCES

Abbas, G., M.J. Arif, S. Saeed and H. Karar, 2007. *Increasing Menace of a New Mealybug Phenacoccus Gossypiphilous to the Economic Crops of Southern Asia,* p: 30. *In* Abstract XI Int. Symp. on Scale Insect Studies (ISSIS), 24-27 Sept. 2007, Oeiras, Portugal

Aheer, G.M., R. Ahmad and A. Ali, 2009. Efficacy of different insecticides against cotton mealybug, *Phenacoccus Solenai* Ferris. *J. Agric. Res*., 47: 47–52

Ahmad, N., B. Fatima, G.Z. Khan, Nasrullah and A. Saleem, 2003. Field management of insect pests of cotton through augmentation of parasitoid and predators. *Asian J.Plant Sci*., 2: 563–565

Aijun, Z., A. Divina, S. Shyam, S.S. Miguel, A.F. Rosa, E.O. James, A.K. Jerome, R.A. Jeffrey, E.M. Dale and L.L. Stephen, 2004. Sex pheromone of the pink hibiscus mealybug, *Maconellicoccus hirsutus*, contains an unusual cyclobutanoid monopterpene. *The Nat. Acad. Sci*. *USA*, 101: 9601–9606

Arif, M.I., M. Rafiq and A. Ghaffar, 2009. Host plants of cotton mealybug (*Phenacoccus solenopsis*): a new menace to cotton agroecosystem of Punjab, Pakistan. *Int. J. Agric.Biol*., 11: 163–167

Bekele, T., 2001. Insecticidal screening against enset root mealybug*Paraputo* spp. Addis Ababa, Ethiopia. *AgriTopia*. *News Lett.*, 16: 2– 3

Ben-Dov, Y., D.R. Miller and G.A.P.Gibson, 2009. *ScaleNet: A Searchable Information System onScale Insects*. Available on-line at http://www.sel.barc.usda.gov/scale net/scalenet.htm.

Caboni, P., G. Sarais, A. Angioni, A.J. Garcia, F. Lai, F. Dedola and P. Cabras, 2006. Residues and Persistence of Neem Formulations on Strawberry after Field Treatment. *J. Agric. Food Chem.,* 54: 10026– 10032

Culik, M.P. and P.J. Gullan, 2005. A new pest of tomato and other records of mealybugs (Hemiptera:Pseudococcidae) from Espírito Santo, Brazil. *Zootaxa.*, 964: 1–8

Danne, K.M., W.J. Bentley, V.M. Waltan, R. Malakar-Kuenen, J.G. Millar,

C.A. Ingels, E.A. Weber and C. Gispert, 2006. New control investigated for vine mealybug. *California Agric*.,60: 31–38

Dhawan, A.K., J. Sing and A.S. Sidhu, 1980. *Maconellicoccus* sp. Attacking *Arboreum* cotton in Punjab. *J. Sci. Culture*,46: 258

Dinesh, K.P., M. Sachin, B.J. Veena, H.G. Seetharama, K. Sreedharan and P.K.V. Kumar, 2003. Evaluation of botanicals against mealybug *Planococcus citri* Risso and its effect on parasitoid and attendant ant. *J. Coff. Res*., 31: 139–152

Fleming, R. and A. Ratnakaran, 1985. Evaluating single treatment datausing Abbot's formula with modification. *J. Econ. Entomol*., 78: 1179

Fuchs, T.W., J.W. Stewart, R. Minzenmayer and M. Rose, 1991. First record of *Phenacoccus solenopsis* Tinsley in cultivated cotton in the United States. *Southwestern Entomol.*, 16: 215–221

Furness, G.O., 1977. Chemical and integrated control of long tailed mealybug, *Pseudococcus longispinus* (Targioni-tozzetri), (Hemiptera: Coccidae) in riverland of south Africa. *Australian J. Agric. Res*., 28: 319–332

Gahukar, R.T., 2000. Use of neem products/pesticides in cotton pest management. Intern. *J. Pest Manage*., 46: 149–160

Geetha, B. and M. Swamiappan, 1998. Improved adult rearing cages for the predator, *Chrysoperla carnea*.*Madras Agric. J*., 85: 333–334

Gross, S., D. Gefen, N. Rotman, U. Tadmor, B. Zemer, A. Gotlib and Y. Gefen, 2001. Chemical control of spherical mealybug (*Nipaecoccus viridis)* (Newsttead) in citrus. *Alon Hanotea*., 54: 234– 240

Hanchinal, S.G., B.V. Patil, M. Bheemanna, A.C. Hosamani and Sharanabasappa, 2009. Incidence of mealybug on cotton in Tungbhadra project area: *In: Proc. Dr. Leslie C. Coleman Memorial Nation. Ssymp. Pl. Prot.* Dec., 4–6, 2008, University of Agriculture Science, GKVK, Bangalore

Hasan, M., F. Ahmad, A. Ali and M. Ahmad, 1996. Some studies on the

effect of synthetic growth regulators and neem oil materials against sucking insect pest of cotton. *Pakistan Entomol*., 18: 1–2

Hassan, I., M.A. Raza, M. Khalil and R. Ilahi, 2004. Determination of Optimum Cropping Pattern in the Faisalabad Division (Pakistan). *Int.J. Agric. Biol*., 6: 901–903

Hoddle, M. and L. Robinson, 2004. Evaluation of factors influencing augmentative releases of *Chrysoperla carnea* for control of *Scirtothrips perseae* in California avocado orchards. *Biol. Cont.*, 31: 268–275

Hodgson, C.J., G. Abbas, M.J. Arif, S. Saeed and H. Karar, 2008. *Phenacoccus solenopsis* Tinsley (Sternorrhyncha: Coccoidea: Pseudococcidae), a new invasive species attacking cotton in Pakistanand India, with a discussion on seasonal morphological variation. *Zootaxa*, 1913: 1–33

Huang, B.K., J.H. Qiu and F. Jiang, 1983. A study of citrus root mealybug, a new insect on citrus in china. *J. Fujian Agric. Coll.*, 12: 183–193

Johnson, P.J., 2009. Mealybugs on Orchids. *Insect Research Collection Box 2207A*. South Dakota State University, Brookings, SD 57007

Joshi, M.D., P.G. Butani, V.N. Patel and P. Jeyakumar, 2010. Cotton mealy bug, *Phenacoccus solenopsis*. *Agric. Rev*., 31: 113–119

Mark, P.C. and P.J. Gullan, 2005. A new pest of tomato and other records of mealybugs (Hemiptera: Pseudococcidae) from Espírito Santo, Brazil. *Zootaxa*, 964: 1–8.

McKenzie, H.L., 1967. Mealybugs of California with Taxonomy, Biology and Control of North American Species (Homoptera: *Coccoidea*: *Pseudococcidae)*, p: 526. University of California Press, Berkeley.

Mohyuddin, A.L., G. Jillani, A.G. Khan, A. Hamza, I. Ahamad and Z. Mahmood, 1997. Integrated pest management of cotton pests by conservation, redistribution and augmentation of natural enemies in Pakistan. *Pakistan J. Zool*., 29: 393–398

Muhammad, A., 2007. *Mealybug: Cotton Crop's Worst Catastrophe. Centre for Agro-Informatics Research (CAIR), journal of Pakistan*. http://agroict.org/pdf_news/Mealybug.

Muthukrishnan, N., T. Manoharan, P.S.T. Thevan and S. Anbu, 2005. Evaluation of buprofezin for the management of grape mealybug, *Maconellicoccus hirsutus* (Green). *J. Entomol. Res.*, 29: 339–344

Nagrare, V.S., S. Kranthi, V.K. Biradar, N.N. Zade, V. Sangode, G. Kakde,

R.M. Shukla, D. Shivare, B.M. Khadi and K.R. Kranthi, 2009. Widespread Infestation of the Exotic Mealybug Species, *Phenacoccus Solenopsis* (Tinsley) (Hemiptera: Pseudococcidae), on Cotton in India. *Bull. Entomol. Res.*,99: 537– 541

Pawar, A.D., 1991. Integrated pest management in cotton in India. *Pakistan Cott*., 5: 165–181

Saeed, S., M. Ahmad, M. Ahmad and Y.J. Kown, 2007. Insecticidal control ofthe mealybug *Phenacoccus gossypiphilous* (Hemiptera: Pseudococcidae), a new pest of cotton in Pakistan. *Entomol. Res*., 37: 76–80

Saini, R.K., S.S.P. Sharma and H.R. Rohilla, 2009. Mealybug, *Phenacoccus solenopsis* Tinsley and its survival in cotton ecosystem in Haryana *In*: *Proc. Nation. Symp. on Bt-cotton: Opportunities and Prospectus, Central Institute of Cotton Research*, p: 150. Nagpur, November 17- 19

Sunitha, N.D., S.B. Jagginavar and A.P. Biradar, 2009. Bioefficacy botanicals and newer insecticides against grape vine mealybug, *Maconellicoccus hirsutus* (Green). *Karnataka J. Agric. Sci*., 22: 710–711

Suresh, S., R. Jothimani, P. Sivasubrmanian, P. Karuppuchamy, R. Samiyappan and E.I. Jonatha, 2010. Invasive mealybugs of Tamil Nadu and their management *Karnataka J. Agric. Sci*., 23: 6–9

Wang, Y.P., S.A. Wu and R.Z. Zhang, 2009. Pest risk analysis of a new invasive pest, *Phenacoccus so1enopsis*, to China. *Chinese Bull.Entomol*., 46: 101–1