Pakistan J. Agric. Res. Vol. 26 No. 3, 2013

REPELLENCY EFFECTS OF DIFFERENT PLANT EXTRACTS TO COTTON MEALY BUG, *PHENOCOCCUS SOLENOPSIS* TINSLEY (HEMIPTERA: PSEUDOCOCCIDAE)

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ABSTRACT:- Repelling effects of peach plant *Prunus persica* L. (Rosales: Rosaceae), Eucalyptus, *Eucalyptus globulus* L. (Myrtales: Myrtaceae), Ashok, *Polyalthia longifolia* (Magnoliids: Annonaceae), Milk thistle, *Silybum marianum* (Asterales: Asteraceae), and Sow thistle, *Sonchus oleraceus* (Asterales: Asteraceae) extracts each in petroleum ether, acetone and ethanol were evaluated at the concentration of 1000, 500 and 250 ppm against cotton mealy bug (*Phenococcus solenopsis*) in a free choice bioassay for two weeks. The ethanol extract of *Prunus persica* was the most effective against cotton mealy bug having highest repellency (72.5%) at 500 ppm dose. The lowest average repellency (26.3 %) was observed in acetone extract of *Silybum marianum* at 500 ppm dose.

Key Words: Phenococcus solenopsis; Repellent; Prunus persica; Eucalyptus globulus; Polyalthia longifolia; Silybum marianum; Sonchus oleraceus; Pakistan.

INTRODUCTION

Cotton (*Gossypium hirsutum* L.) is the most important fiber crop of Pakistan. It is used in textile as well as oil industries and earns foreign exchange through export in shape of raw cotton, cotton yarn, cloth, garments and other products. It makes about 80% of national edible oil production (Agha, 1994). Different insect pests infest cotton and reduce both yield and quality of cotton. Recently, mealybug, *Phenacoccus solenopsis* Tinsley has invaded cotton crop in Pakistan. It has threatened the cultivation of cotton in Pakistan and caused 14% loss of cotton crop during 2005 and has become a serious pest of cotton (Sahito et al., 2011). *P. solenopsis*, besides cotton, is devastating many other economic crops such as vegetables, fruits and ornamentals. It has been reported infesting 149 plant species (Afzal et al., 2009). The search for low risk eco-friendly alternative management technique has resulted in renewed interest in the use of plant extracts for reducing the impact of cotton mealy bug on yield and quality of cotton. The botanical insecticides are generally pest-specific and are relatively harmless to non-target organisms

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including humans. They are also biodegradable and harmless to the environment. Furthermore, unlike conventional insecticides which are based on a single active ingredient, the plant-derived insecticides comprise an array of chemical compounds, which act concertedly on both behavioral and physiological processes. Thus the chances of pests developing resistance to such substances are less (Rehman et al., 2009). One plant species may possess substances with a wide range of activities; for example, extracts from the neem tree *Azadirachta indica* are antifeedant, antioviposition, repellent and growth regulating. Monoterpenoids of essential oils provide effective lead molecules in the management of stored product insects and insect pests of publichealth importance (Ignacimuthu, 2004). Yasmin (2004) reported that of three plants, *Saussurea lappa* (Decaisne) (Asperales: Asteraceae), *Valeriana jatamans*i Jones (Dipsacales: Valerianaceae) and *Peganum harmala* L. (Sapindales: Nitrariaceae), extracted in petroleum ethere (a mixture of C5-7 alkanes), *P. harmala* was the most effective oviposition deterrent for *B. zonata*. Among the petroleum ether, acetone and ethanol extracts of turmeric, acetone extract was the best repellent and growth inhibitor against *Bactrocera zonata* (Siddiqui et al., 2006).

The plants used in the present studies are indigenous and abundantly available. These are locally used in ayurvedic medicines. Research data has demonstrated that the extract of Eucalyptus exhibited various biological effects, such as antibacterial and antihyperglycemic (Gray and Flatt 1998). Earlier, studies have reported antioxidant activity of oil from Eucalyptus species (Marzoug et al., 2011; Singh et al., 2009). The Milk thistle is not heavily attacked by diseases and pest insects (Andrzejewska et al., 2006). Similarly these plants are not or less infested by insects. Therefore, these plants were selected for the repellency test against cotton mealy bug *P. solenopsis*.

In the current study chemical profile of the test plants obtained through extraction with organic solvents of different polarities were tested for repellent effect on cotton mealy bug, *P. solenopsis* by offering treated and untreated paper in free choice tests.

MATERIALS AND METHOD

Plants and Plant Extracts

The plant leaves of peach *Prunus persica* L. (Rosales: Rosacese), Eucalyptus *Eucalyptus globulus* (Myrtales: Myrtaceae), Ashok *Polyalthia longifolia* (*Magnoliales: Annonaceae*), Sow thistle *Sonchus oleraceus* (Asterales: Asteraceae) and Milk thistle *Silybum marianum* (Asterales: Asteraceae) were collected from National Agricultural Research Centre, Islamabad, field area and placed on paper for drying under shade. Completely dried leaves were grinded to fine powder. Later on 50 g of each plant's powder was soaked separately in 100ml of acetone, ethanol and petroleum ether for 4 days and were stirred 2-3 times daily. After four days they were filtered with filter paper (Whatman No. 1). The filtered plant extracts were concentrated on rotary evaporator (Rotavapor R-IIA Buchi, Switzerland) and finally made solvent free in a vacuum

desiccator.

Rearing of Mealy Bug Culture (*Phenococcus solenopsis*)

The culture of *P. solenopsis* was maintained under controlled laboratory conditions at 28±1°C and 65±5% R.H in cages measuring (45cm x 40cm x 40 cm). The adults were reared on okra, potato and pumpkin seedling however, pumpkin and potato seedling showed better results.

Administering Plant Extracts

For the preparation of 1000 , 500 and 250 ppm doses, 50, 25, and 12.5 mg of each extract were weighed in glass beakers separately to which 50 ml of acetone was added respectively and stirred continuously for 10-15 minutes with a glass rod.

Treatment of Paper

The filter papers (Whatman No. 1) were cut according to the size and shape of petri dishes (9cm diameter). The papers were cut into two equal halves, one half was treated with plant extract and the second half was treated with acetone only. They were left over night for complete evaporation of acetone. Treated and untreated papers were joined together with the scotch tape and placed in the petri dishes. Ten crawlers of 2nd instar, were released in petri dishes. Half of the crawlers were released on treated portion and remaining half on untreated portion. First observation was made after 1 hour of release and 2nd was taken 6 hours after 1st observation. Experiment was replicated four times. The data were recorded for two consecutive weeks. For the repellency percentage only those crawlers were noticed which were found on the treated portion. Daily fresh crawlers were released in the petri dishes.

Statistical Analysis

Data were subjected to analysis of variance and means were compared by DMR test (Steel and Torrie, 1980)

RESULTS AND DISCUSSION

During first week at 1000 ppm dose the maximum repellency (71%) against *P. solenopsis* was observed in *P. persica* ethanol extract followed by petroleum ether and acetone extracts of *P. longifolia* with 68.5 % and 67.5% repellency, respectively(Table1). Significant low repellency (10.5%) was observed in acetone extract of *S. marianum* followed by petroleum ether extract of *S. oleraceus* (28.0%). During second week highest repellency was observed in ethanol extract of *P. persica* (70.5%) followed by petroleum ether extract of *P. longifolia* (70.0%) whereas, minimum repellency was observed in petroleum ether extract of *S. marianum* (36.0%). *S. oleraceous* was moderately repellent against *P. solenopsis*. On the basis of two week average *P. persica* ethanol extract and *P. longifolia* petroleum ether extract were on the top with higher repellency and were statistically at par with each other. *S. oleraceous* and *E. globulus* were moderately repellent while *S. marianum* acetone and petroleum ether extract showed minimum repellency and were significantly different from other plant extracts.

At the dose of 500 ppm during 1st week higher repellency against *P. solenopsis* was observed in *P. longifolia* and *P. persica* in all the

solvents (Table 1). Among the test materials, the acetone extract of *P. longifolia* (73.5%) was the most effective. Ethanol extract of *P. persica* was next in order with 73.0 % repellency. The petroleum ether extract of *P. persica* and ethanol extract of *E. globulus* were moderately repellent. The petroleum ether extract of *S. marianum* showed the lowest repellency (16.5%) followed by *S. oleraceus* in petroleum ether extract (21.5%). During 2nd week ethanol extract of *S. oleraceus* and petroleum ether extract of *P. persica* showed maximum repellency of 73.5% and 72.5%, respectively followed by ethanol extract of *P. persica* (72%). Petroleum ether extracts of *E. globulus* and *S. marianum* were least repellent against *P. solenopsis*. On the basis of two week average, ethanol extract of plant *P. persica* exhibited highest repellency followed by petroleum ether and acetone extracts of *P. longifolia*. However they were statistically at par with each other. Petroleum ether extract of *S. marianum* was least repellent as compared to other plant extracts. All other extracts had moderate to less degree of repellency.

At 250 ppm dose, during first week *P. longifolia* and *P. persica* extracts in all three solvent exhibited highest repellency against *P. solenopsis* and were statistically at par (Table1). However, they significantly differed from all other plant extracts. Maximum repellency was observed in ethanol extract of *P. persica* (73.0%) followed by ethanol extract (70.5%) and petroleum ether extract (70.0%) of *P. longifolia*. *S. oleraceus* petroleum ether extract and ethanol extract showed minimum repellency. Other plants had moderate to low repellency. During second week highest repellency was observed in ethanol extract of *P. persica* (67.5%) followed by ethanol extract of *S. oleraceus* (66%) and petroleum ether extract of *P. longifolia* (64.5%). The petroleum ether and acetone extracts of *E. globulus* had minimum effect with 35% and 40.5% repellency, respectively. The *S. oleraceus*, *P. persica* and *P. longifolia* showed better repellency as compared to other plant extracts. While all three extracts of *S. marianum* and ethanol extract of *E. globulus* were moderately effective against cotton mealy bug. On the basis of two week average, *P. longifolia* and *P. persica* showed maximum repellency but did not differ significantly with each other however, they were significantly different from other plant extracts. The ethanol extract of *P. persica* had maximum repellency. The petroleum ether and acetone extracts of *P. longifolia* were the second most effective against *P. solenopsis*. The *S. oleraceus*, *E. globulus* and *S. marianum* were comparatively less repellent than other plant extracts.

Current results indicate that all plants had various degree of repellency against *P. solenopsis*. It was noticed that in all three doses tested ethanol extract of *P. persica* had the highest mean repellency over two weeks. However on the basis of average of repellency of plant extract in three solvents, *P. longifolia* was slightly better repellent than *P. persica*. The order of repellency was *P. longifolia> P. persica> S. oleraceus> E. globulus > S. marianum*.

The use of such plant extracts can control the population of serious pests like mealy bug in an environmental friendly way. These plants have been previously reported to

Table 1. Repellency of plant extracts against cotton mealy bug at dose of 1000, 500, 250 ppm of petroleum ether, acetone and ethanol

(%)

Plant	1st week			2nd week			Average of two weeks		
	P. Ether	Acetone	Ethanol	P. Ether	Acetone	Ethanol	P. Ether	Acetone	Ethanol
1000 ppm									
Sonchus oleraceus	28.0 ^{g}	42.5 ^{ef}	33.5 ^{fg}	60.0 ^{ab}	54.0 ^{bcd}	59.5 ^{abc}	44.0 ^{c}	48.3 ^{c}	46.5 ^{c}
Eucalyptus globulus	43.0 ^{ef}	45.0 ^{de}	57.5 ^{bc}	46.5 ^{cde}	40.5 ^{e}	44.0 ^{de}	44.0 ^{c}	42.8 ^{c}	50.8 ^{c}
Prunus persica	56.0 ^{cd}	65.0 ^{abc}	71.0 ^{a}	65.0 ^{ab}	67.0 ^{ab}	70.5 ^{a}	60.5 ^{a}	66.0 ^{ab}	70.8 ^{a}
Silybum marianum	29.0 ^{g}	10.5 ^{h}	37.0 ^{efg}	36.0 ^{e}	42.0 ^{de}	54.5 ^{bcd}	32.5 ^{d}	26.3 ^{d}	45.8 ^{c}
Polyalthia longifolia	68.5 ^{ab}	67.5 ^{ab}	60.0 ^{abc}	70.0 ^{a}	63.0 ^{ab}	66.5 ^{ab}	69.3 ^{ab}	65.3 ^{ab}	65.8 ^{ab}
500ppm									
Sonchus oleraceus	21.5 ^{e}	39.5 ^{c}	42.5 ^{c}	57.5 ^{cdef}	64.0 ^{abcd}	73.5 ^{a}	39.5 ^{fg}	51.8 ^{de}	58.0 ^{cd}
Eucalyptus globulus	39.0 ^{c}	34.5 ^{cd}	55.5 ^{b}	38.5 ^{g}	46.0 ^{fg}	47.0 ^{efg}	38.8 ^{g}	40.3 ^{fg}	51.3 ^{de}
Prunus persica	58.0 ^{b}	68.5 ^{a}	73.0 ^{a}	72.5 ^{ab}	61.0 ^{bcd}	72.0 ^{ab}	65.3 ^{abc}	64.8 ^{abc}	72.5 ^{a}
Silybum marianum	16.5 ^{e}	36.5 ^{c}	25.0 ^{de}	39.0 ^{g}	59.0 ^{cde}	53.0 ^{def}	27.8 ^{h}	47.8 ^{ef}	39.0 ^{g}
Polyalthia longifolia	64.5 ^{ab}	73.5 ^{a}	70.0 ^{a}	69.0 ^{abc}	67.0 ^{abc}	58.0 ^{cdef}	66.8 ^{ab}	70.3 ^{ab}	64.0 ^{bc}
250 ppm									
Sonchus oleraceus	22.0 ^{e}	37.5 ^{bcd}	28.0 ^{de}	61.0 ^{ab}	65.0 ^{a}	66.0 ^{a}	41.5 ^{cd}	51.3 ^{b}	47.0 ^{bc}
Eucalyptus globulus	35.0 ^{bcd}	41.0 ^{bc}	44.5 ^{b}	35.0 ^{d}	40.5 ^{d}	48.5 ^{bcd}	35.0 ^{d}	40.8 ^{cd}	46.5 ^{bc}
Prunus persica	62.5 ^{a}	64.5 ^{a}	73.0 ^{a}	64.5 ^{a}	58.5 ^{abc}	67.5 ^{a}	63.5 ^{a}	61.5 ^{a}	70.3 ^{a}
Silybum marianum	31.0 ^{cde}	33.5 ^{cd}	36.0 ^{bcd}	48.5 ^{bcd}	46.0 ^{cd}	46.0 ^{cd}	39.8 ^{cd}	39.8 ^{cd}	41.0 ^{cd}
Polyalthia longifolia	70.0 ^{a}	68.5 ^{a}	70.5 ^{a}	65.8 ^{a}	64.0 ^{a}	56.0 ^{abc}	67.8 ^{a}	66.3 ^{a}	63.3 ^{a}

Means followed by same letters do not differ significantly at P ≤ 0.05

possess repellent and insecticidal properties against different insect species. El-Kamali (2009) tested alcoholic extracts of ten species of medicinal plants for insecticidal activity against the storage pest, *Tribolium castaneum*. Of all the plants tested, *Sonchus oleraceus*, *Ageratum conyzoides* and *Ambrosia maritime* were found to be the most active species against *Tribolium castaneum*. Hateem et al. (2009) also found that the hexane extracts of *Sonchus olearceous* L. were highly toxic to fourth instar larvae of Egyptian cotton worm (*Spodoptera littoralis*). Singh et al. (2012) evaluated the repellent property of leaf extracts of *Azadirachta indica* A. Juss; *Eucalyptus globulus* L. and *Ocimum basilicum* L. against aphids and mealybugs. The highest repellency was recorded in *A. indica* leaf extract which gives 99% and 97% followed by *E. globules* leaf extract giving 96% and 93%. While minimum repulsion was seen in *O. basilicum* leaf extract 91% and 88%, respectively. Koul et al. (2008) also found *E. globulus* Labill. as a good repellent against insects. Soliman (2005) has reported toxic effect of hexane extracts of *S. marianum* against adults of the whitefly (*B. tabaci)*.

Results obtained from the laboratory bioassay demonstrated good potential of these plant extracts. Plants selected for the studies are indigenous and are abundantly available. These plants are locally used in many traditional medicines. Therefore, the plant products can be utilized for preparing phytochemical products which are good alternatives to conventional synthetic insecticides as they are comparatively safe and economical. Based on the results obtained from the present study, it can be concluded that the leaf extracts of *Prunus persica*, *Polyalthia longifolia*, *Sonchus oleraceous*, *Eucalyptus globulus* and *Silybum marianum* have certain degree of repellent effect against cotton mealy bug under laboratory conditions. However further investigations are needed before their application on large scale.

LITERATURE CITED

Afzal, M., S.U. Rahman, and M.T. Siddiq. 2009. Appearance and management of a new devastating pest of cotton, *Phenacoccus solenopsis* Tinsley, in Pakistan. Beltwide Cotton Conference, San Antonio, Texas, p. 5-8.

Agha, H.K.1994. Crop Production. Published by Pakistan Book Foundation, Islamabad p.6.

Andrezejewska, J., L. Robert, and Z. Skinder. 2006. Assessing the extent of damage caused by *Cleonus piger* scop. and other Entomofauna in the cultivation of milk thistle *Silybum marianum*. J. Pl. Prot. Res. 46(1): 49-59.

Gray, A.M., and P.R. Flatt. 1998. Anti hyperglycemic actions of *Eucalyptus globulus* (Eucalyptus) are associated with pancreatic and extra-pancreatic effects in mice. J. Nutr. 128: 2319-2323.

Hateem, A.E., S.S.M. Abdel-Samad, H.A. Saleh, M.H.A. Soliman, and A.I. Hussien. 2009. Toxicological and physiological activity of plant extracts against *Spodoptera littoralis* (Boisduval) (Lepidoptera: Noctuidae) larvae. Boletín de Sanidad Vegetal, Plagas, 35 (4): 517-531.

Ignacimuthu, S. 2004. Green

pesticides for Insect Pest Management. Curr. Sci. 86: 1059-1060.

El-Kamali, H. H. 2009. Effect of certain medicinal plants extracts against storage pest, *Tribolium castaneum* Herbst. American-Eurasian J. Sustainable Agric. 3(2): 139-142.

Koul, O., S.Walai, and G.S. Dhaliwal. 2008. Essential oils as green pesticides: Potential and constraints. Biopestic. Int. 4 (1): 63-84.

Marzoug, H. N.B., M. Romdhane, A. Lebrihi, F. Mathieu, F. Couderc, M. Abderraba, M. L. Khouja, and J. Bouajila. 2011. *Eucalyptus oleosa* essential oils: Chemical composition and antimicrobial and antioxidant activities of the oils from different plant parts (stems, leaves, flowers and fruits). Molecules. 16: 1695-1709.

Rehman, J., G. Jilani, M. A. Khan, M. Rafiq, and K. Sadia. 2009. Repellent and oviposition deterrent effects of indigenous plant extracts to peach fruit fly, *Bactrocera zonata* Saunders (Diptera: Tephritidae). Pakistan J. Zool. 41(2): 101-108.

Sahito, H.A., H.A. Ghulam, S.S. Tajwer, M. A. Shafique, M. Bhugro, M. and Sakhawat. 2011. Screening of pesticides against cotton mealybug *Phenacoccus solenopsis* Tinsley and its natural enemies on cotton crop. Intern. Res. J. Biochem. and Bioinform. 1 (9): 232-236.

Siddiqi, A.R., G. Jilani, J.U. Rehman, and S. Kanvil. 2006. Effect of turmeric extracts on settling response and fecundity of peach fruit fly (Diptera: Tephritidae). Pakistan J. Zool. 38: 131-135.

Singh, H.P., S. Mittal, S. Kaur, D. R. Batish, and R. K. Kohli. 2009. Characterization and antioxidant activity of essential oils from fresh and decaying leaves of *Eucalyptus tereticornis*. J. Agric. Food Chem. 57: 6962-6966.

Singh, A., R. Kataria, and D. Kumar. 2012. Repellence property of traditional plant leaf extracts against *Aphis gossypii* Glover and *Phenacoccus solenopsis* Tinsley. African J. Agric. Res. 7(11):1623-1628.

Soliman, M. M. M. 2005. Insecticidal activity of some wild plant extracts and plant essential oils against whitefly, *Bemisia tabaci* (Genn.). Bull. Nat. Res. Centre (Cairo). 30(5): 467-476.

Steel, R.G.D., and J.H. Torrie. 1980. Principles and procedures of statistics. A biological approach. 2nd edn. McGraw Hill Book Company Inc., New York, USA.

Yasmin, S. 2004. Repellent and growth inhibiting effects of *Saussurea lappa*, *Peganum harmala* and *Valeriana officianalis* derivatives on peach fruit fly (Diptera: Tephritidae). M.Sc. thesis. Fatima Jinnah Women University, Rawalpindi, Pakistan.