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Insecticidal activity of methanolic pooled fractions of *Lantana wightiana* Wall.

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ABSTRACT

Three fractions (JMR1, JMR2 and JMR3) obtained from the methanolic extract of *Lantana wightiana* have been tested against the fourth instar larvae of *Spodoptera litura*. From the results it is evident that JMR1, JMR2 and JMR3 caused 100 % mortality during 96 h at 0.1%. At 0.0125%, JMR1 causes 80% mortality after 24 h of *S. litura* larvae. But similar percentage of mortality has been observed when 0.08% crude methanolic extract of *L. wightiana* treated with *S. litura* larvae. Total mortality of *S. litura* shows that JMR1 is the most effective toxic fraction followed by JMR2 and then JMR3. Comparison between JMR2 to JMR1 and JMR2 to JMR3 are statistically insignificant at 5% level by Duncan Multiple Range test (DMRT). When a correlation is made between the concentrations and total mortality, it is found to be highly significant [r = 0.98, 0. 97 and 0.93 for JMR1, 2 and 3, respectively]. It is evident from the results that JMR1 is found to be the most effective (0.0057%) to *S. litura* larvae followed by JMR2 (0.0092%) and then JMR 3 (0.0094%). It is very clear from the results that the LC_{50} value of *L. wightiana* fraction, JMR1 is about 3 times more effective than the crude methanolic extract on the fourth instar *Spodoptera litura* larvae.

Key words: *Lantana wightiana, Spodoptera litura*, crop pest, Column fraction, insecticide

INTRODUCTION

The order Lepidoptera includes some of the most destructive insect pest in agriculture. One of these, the polyphagous pest tobacco caterpillar, *Spodoptera litura* (Fab.) (Lepidoptera : Noctuidae) is in the forefront as a major pest of cotton, tobacco, castor and groundnut can cause much loss every year. *Spodoptera litura* is polyphytophagous, damaging numerous vegetables and field crops in China and many other Asian countries (Shu, 1959; Hill, 1975; Shivayogeshwara, 1991). *Spodoptera litura* is also known as the common or tobacco cutworm, or the cluster or tobacco caterpillar. Although it had been a sporadic pest of tobacco in northern China for many years, it has been becoming gradually a very important insect pest in recent years (Guan and Chen, 1999; Gao *et al*., 2004; Qin *et al*., 2004). It also becomes resistant to many commonly used insecticides, particularly pyrethroids and carbamates, resulting in failure of effective controls (Wu *et al.*, 1995; Kranthi *et al.*, 2002; Ahmad *et al.*, 2007; Huang and Han 2007). All these reports unanimously proved that *S. litura* has been developed resistance against the tested insecticides. Therefore, biological based alternative method is urgently required to replace the unsafe chemical methods of pest control.

Plants such as *Vitex negundo* Linn. (Subadra Bai and Kandasamy, 1985), *Nerium indicum* Mill leaf powder, *Thevitia perviam* Mrr. leaf powder and *Azadirachta indica* A. Juss. seed kernal powder (Sahayaraj and Paulraj, 1998), *Trichilia americana* (Wheeler and Isman, 2001), *Annona squamosa* (Leatemia and Isman, 2004); *Tridax procimbens* (Sahayaraj and Paulraj, 2000), *Coleus aromaticus* Benth (Sahayaraj *et al.*, 2002); *Pedalium murex* (Sahayaraj *et al.*, 2008), pteridophytes (Sahayaraj *et al*., 2007), *Syzygium cumini* L., *Ocimum basilicum* L., *Luffa aegyptica* Mill.,*Eichhornia crassipes* Mart., *Tamarindus indica* L., *Terminalia catappa* L., *Limonia acidissima* L., *Murraya koenigii* L., *Breynia retusa* (Dennst.)., *Jatropha curcas* L., *Tectona grandis* L., *Momordica charantia* L., *Mangifera indica* L., *Ricinus communis* L. and the seed extract of *Madhuca indica* Gmelin. (Peta Devanand and Pathipati Usha Rani, 2008) were evaluated in the laboratory on *Spodoptera litura*.

Lantana camara Linn. also has been used against economically important pests (Murugesan and Murugesh, 2009, Jun *et al.*, 2010). Anti-feeding impact of chosen plants was studied by Sahayaraj (1996). Latter *Synedrella nodiflora* Gaertn (Compositae) (Martin Rathi and Gopalakrishnan, 2005) and *Premna tomentosa* Willd (Martin Rathi and Gopalakrishnan, 2006) reported that these botanicals can be used for the management of this pest. Enormous number of works is available about the impact of *Lantana* on pests of various crops. For the first time Martin Rathi and Gopalakrishnan (2004) studied the impact of crude extracts of *Lantana wightiana* Wall. against this pest and reported that methanol extract can be used for the management of this pest. Very few references are reported about the impact of *Premna* on pests. However, no report is available on the insecticidal activity of *Synedrella* on any pests. Moreover, scanty information is available on the effect of plant-based products or plant-based insecticides on physiology of insects. Hence, in the present work an attempt has been made to study the effect of three locally available plants on the mortality, LC_{50} and body total carbohydrates, proteins and lipids content of *Spodoptera litura* by using feeding bioassay method. The term 'bioassay' covers a broad category of evaluating the various extracts as to their effects on the test animal.

MATERIALS AND METHODS

Methanolic extract of *Lantana wightiana*

The dry aerial parts powder of *Lantana wightiana* was successively extracted with petroleum ether ($40^0 – 60^0$ C), benzene, chloroform, methanol and water. Isolation and identification of chemical compounds of methanol extract was undertaken. The dark-green coloured methanol extract (20 g) of *Lantana wightiana* was subjected to the column chromatography over 170 g silica gel (60 – 120 mesh) (4 x 60 cm), eluted successively with petroleum ether (40^0– 60^0C), benzene, chloroform and ethanol. 1800 fractions (each of 100 ml) are obtained from the column. The various fractions are grouped individually by monitoring TLC behaviour. From the 1800 fractions four fractions such as 669 – 761 benzene : chloroform (70 : 30) (JMR3), 855 – 889 eluted with benzene : chloroform (40 : 60) (JMR2) and 1170 to 1199 eluted chloroform : ethanol (80 : 20) (JMR1) were selected and used for GC-MS analyses. GC – MS analyses were conducted with GCMS – QP5000 Shimadzu combined gas chromatograph – mass spectrometer using the column CBP – 5 (25m x 0.25 mm I.D x 0.2 mm film thickness).

Insecticidal activity

Three column chromatographic fractions *viz.*, JMR1, JMR2 and JMR3 obtained from the methanolic extract of *Lantana wightiana* were tested against the forth instar larvae of *Spodoptera litura* larvae. Four concentrations such as 0.0125, 0.025, 0.05 and 0.1 % were prepared and their impact on the mortality and LC_{50} were finding out by using the method of profit analysis. Ten grams of fresh castor leaves were dipped in the different concentrations of the three fractions separately for 15 minutes. For control, the leaves were dipped in methanol. After 15 minutes the leaves were taken out and shade-dried for 20 minutes and supplied to the pest larvae. Laboratory reared fourth instar *Spodoptera litura* larvae were released in four numbers each to plastic trough containing the extract treated castor leaves and the troughs were covered by muslin cloth. Same number of *Spodoptera litura* larvae, released into the container having respective solvent treated castor leaves and served as control. Five replications were made for each concentration and control respectively. The larvae were allowed to feed the respective solvents treated leaves as well as solvent extracts of the plant treated leaves for a period of 4 days continuously. Observations were taken at 24 hours interval and dead larvae were removed. Moribund larvae were also considered as dead larvae.

RESULTS AND DISCUSSION

Three fractions *viz.,* JMR1, JMR2 and JMR3 obtained from the methanolic extract of *Lantana wightiana* have been tested against the fourth instar larvae of *Spodoptera litura* and the results are presented in Figure 1. From the results it is evident that JMR1, JMR2 and JMR3 caused 100 % mortality during 96 h at 0.1%. At 0.0125%, JMR1 causes 80% mortality after 24 h of *S. litura* larvae. But similar percentage of mortality has been observed when 0.08% crude methanolic extract of *L. wightiana* treated with *S. litura* larvae. Total mortality of *Spodoptera litura* presented in Figure 1 shows that JMR1 is the most effective toxic fraction followed by JMR2 and then JMR3. Comparison between JMR2 to JMR1 and JMR2 to JMR3 are statistically insignificant at 5% level by Duncan Multiple Range test (DMRT). When a correlation is made between the concentrations and total mortality, it is found to be highly significant [r = 0.98, 0. 97 and 0.93 for JMR1, 2 and 3, respectively]. The LC_{50} results are presented in Table 1. It is evident from the results that JMR1 is found to be the most effective (0.0057%) to *Spodoptera litura* larvae followed by JMR2 (0.0092%) and then JMR 3 (0.0094%). It is very clear from the results that the LC_{50} value of *L. wightiana* fraction, JMR1 is about 3 times

Table 1. Pooled fractions of *L. wightiana* on profit analysis for *S. litura*

Fractions	LC_{30}	LC_{50}	LC_{090}	Regression equation	Variance	Chi-square
JMR 1	0.00500	0.00570	0.0142	Y = 1.631x + 3.76	0.1542	1.47
JMR2	0.00360	0.00928	0.0137	Y = 2.007x + 3.07	0.0422	1.16
JMR3	0.00429	0.009422	9.0135	Y = 2.080x + 2.97	0.0318	0.45

more effective than the crude methanolic extract on the fourth instar *S. litura* larvae.

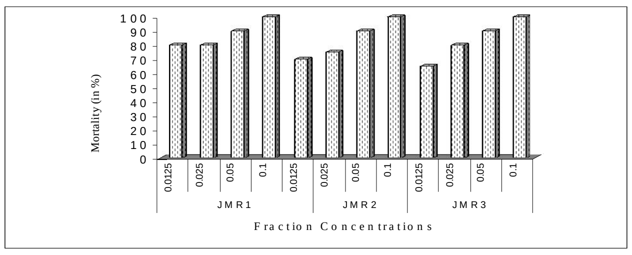

Figure 1. Fractions of *L. wightiana* on total corrected mortality (in %) of *S. litura*

As the insecticidal activity of the crude methanolic extract of *Lantana wightiana* is found to be the maximum among the three plants, GC-MS analysis as well as the insecticidal activity has been performed for three pooled fractions (JMR1, JMR 2 and JMR 3) of the coloumn chromatographic separation of the methanolic extract of the plant. Some of the steroidal compounds identified in these separated fractions *viz.*, 12â hydroxy androst-4-ene-3,17-dione (105), acetate of 20â-hydroxy 5á-pregnan-12-one (107) may be responsible for the insecticidal activity. However no attempt has been made in the present study for the isolation and insecticidal activity determination of the separated compounds.

REFERENCES

Ahmad, M., Arif M. and Ahmad, M. 2007. Occurrence of insecticide resistance in field populations of *Spodoptera litura* (Lepidoptera: Noctuidae) in Pakistan. *Crop Protection,* **26**: 809-817.

Gao, C. X., Bei, Y. W., Chen, T. H. and Gu, X. H. 2004. On factors causing outbreak of *Spodoptera litura* (Fabricius). *Acta Agriculturae Zhejiangensis,* **16**: 332-335.

Guan, B.B. and Chen, O. J. 1999. Biology and Ecology of *Spodoptera litura*. *Acta Entomologia Eastern China* **8**: 57-61.

Hill, D. 1975. *Spodoptera litura* (F.). **In:** Agricultural Insect Pests of the Tropics and their control. Cambridge University Press.

Huang, S. J. and Han, Z. J. 2007. Mechanisms for multiple resistances in field populations of common cutworm, *Spodoptera litura* (Fabricius) in China. *Pesticide Biochemistry and Physiology,* **87**: 14-22.

Jun, X. I., Zeng Ren Sen, Bi Hai Hong, Song Yuan Yuan, Wang Rui Long, Su Yi Juan, Chen Min, Chen Shi and Liu Ying Hu. 2010. Allelochemical mediated invasion of exotic plants in China. Allelochemical mediated invasion of exotic plants in China. *Allelopathy Journal*, **25**(1): (in press).

Kranthi, K. R., Jadhav, D. R., Kranthi, S., Wanjari, R.R., Ali. S. S. and Russell, D. A. 2002. Insecticide resistance in five major insect pests of cotton in India. *Crop Protection,* **21**: 449-460.

Leatemia, J. A. and Isman, M. B. 2004. Toxicity and antifee dant activity of crude seed extracts of *Annona squamosa* (Annonaceae) against lepidopteran pests and natural enemies. *International Journal of Tropical Insect Science,* **24**: 150-158.

Martin Rathi, J. and Gopalakrishnan, S. 2004. Insecticidal activity of *Lantana wightiana* (Wall.) on fourth instar larvae of *Spodoptera litura* (Fab.) (Lepidoptera : Noctuidae). *Entomologica Croatica.,* **8**(1 & 2): 5 – 11.

Martin Rathi, J. and Gopalakrishnan, S. 2005. Insecticidal Activity of Aerial Parts of *Synedrella nodiflora* Gaertn (Compositae) on *Spodoptera litura* (Fab.). *Journal of Central European Agriculture,* **6**(3): 223 – 228.

Martin Rathi, J. and Gopalakrishnan, S. 2006. *Premna tomentosa* Willd. – An Effective Insecticide. *Journal of Applied Zoological Research,* **17**(2): 138 – 141.

Murugesan, N. and Murugesh, T. 2009. Bioefficacy of some plant products against brinjal fruit borer, *Leucinodes orbonalis* Guenee (Lepidoptera : Pyrallidae). *Journal of Biopesticides,* **2**(1): 60-63

Peta Devanand and Pathipati Usha Rani. 2008. Biological potency of certain plant extracts in management of two lepidopteran pests of *Ricinus communis* L. *Journal of Biopesticides,* **1**(2):170 – 176.

Qin, H. G., Ye, Z. X., Huang, S. J., Ding, J. and Luo, R. H. 2004. The correlations of the different host plants with preference level, life duration and survival rate of *Spodoptera litura* Fabricius. *Chinese Journal of Eco-Agriculture,* **12**(2): 40-42.

Sahayaraj, K. 1998. Anti-feedant effect of some plant extracts on the Asian armyworm, *Spodoptera litura* (Fabricius). *Current Science,* **74**(6): 523-526.

Sahayaraj, K. and Paulraj, M. G. 1998. Screening the relative toxicity of some plant extracts to *Spodoptera litura* Fab. (Insecta: Lepidoptera: Noctuidae) of groundnut. *Fresenius Environment Bulletin,* **7**(9&10): 557-560.

Sahayaraj, K. and Paulraj, M. G. 2000. Impact of *Tridax procimbens* Leaf extract on *Spodoptera litura* Fab. behaviour and biometry. *Insect Environment,* **5**(4): 149 – 150.

Sahayaraj, K., Selvaraj, P. and Balasubramanian, R. 2007. Cell mediated immune response of *Helicoverpa armigera* Hubner and *Spodoptera litura* Fab. to fern phytoecdysoone. *Journal of Entomology,* **4**(4): 289 – 298.

Sahayaraj, K., Subasini, M. and Ravi, C. 2002. Influence of biorational insecticide *Coleus ambonicus* Lour (*aromaticus* Benth) to *Spodoptera litura* (Fab.) (Lepidoptera: Noctuidae) and its predator *Rhynocoris marginatus* (Fab.) (Hemiptera: Reduviidae) in laboratory conditions. *Journal of Nature Conservation,* **14**(1): 113 - 122.

Sahayaraj, K., Venkateshwari, M. and Balasubramanian, R. 2008. Insecticidal and antifeedent effect of *Pedalium murex* Linn. root on *Spodoptera litura* (Fab.) (Lepidoptera: Noctuidae). *International Journal of Agriculture Technology,* **4**(2): 73 - 80.

Shivayogeshwara, B., Mallikharjunaiah, H. and Krishnaprasad N. K. 1991. Integrated management of *Spodoptera litura* Fabricus (Noctuidae:Lepidoptera) in FCV tobacco crop. *Tobacco Research,* **17**(8): 59-61.

Shu, Y. N. 1959. *Spotoptera litura*, an important pest in China. *Insect Knowledge,* **5**: 106-107.

Subadra Bai, K. and Kandasamy, C. 1985. Laboratory induced mortality of *Spodotpra litura* Fab. Fed on the leaf disc of castor treated with the extracts of *Vitex negundo* Linn. and *Stachytrapheta urticifolia* (Salish) Sims. *Indian Journal of Agricultural Sciences,* **55**(22): 760 – 761**.**

Wheeler, D. A. and Isman, M. B. 2001. Antifeedant and toxic activity of *Trichilia americana* extract against the larvae of *Spodoptera litura*. *Entomology Experimental et Applicata*, **98:** 9-16.

Wu, S., Gu, Y. and Wang., D. 1995. Resistance of the tobacco armymoth (*Prodenia litura*) to insecticides and its control. *Acta Agriculture Shanghai*, **11**: 39-43.

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