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Larvicidal and ovicidal activity of seven essential oil against lepidopteran pest *S.litura* (lepidoptera: noctuidae)

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Abstract

The larvicidal and ovicidal effects of seven medicinal plant oil were investigated against the fourth-instar larvae of *S.litura*, (Lepidoptera: Noctuidae). The aim of this study was to evaluate the toxic effects of *Zingiber officinale, Ocimum basilicum, cyperus scariosus, Pimpinella anism, Nigella sativa, Rosmarinus officinais,* and *Cercuma longa* were exposed to different concentrations. All essential oils showed moderate toxic effect on lepidopteran agricultural pest of armyworm after 24hr of exposure; However, the highest larvel mortality was found in (Table 1) The leaf of *O.basiliucm*, The rhizone of *Z.officinale*, the rhizome of *C.longa* and the shoot of *C.Scariosus* (L_{C50} = 27.3, 29, 30.6, 31.2, L_{C95} = 43.6, 48.2, 56 and 51.4 ppm) and lowest larvel mortality was recorded the *p.anisum* (LC_{50} = 38.5 and LC_{95} = 78 ppm). Respectively chi-square value was significant at $P<0.05$ level. Ovicidal activitiy of above mentioned the seven medicinal plant essential oil were used in the study. During preliminary screening, the essential oil wer etested at different concentrations (50, 100, 150, 200, 250 and 300 ppm). The percentage of eggs hatchability was assessed 120 hr post treatment (Table 2). All essential oil showed moderate ovicidla effects; however, the highest Ovicidal activity was found in *O.basilicum* and *Z.officinale*. *S.litura* eggs was 100% of mortality (No hatchability) recorded at 200, 250 and 300 ppm concentration of *O.basilicum, Z. Officinale, C.longa,* and *C.Scariosus* may serve as lepidopteran agricultural pest of armyworm control in their oil form, essential oil have the potential to be used as an ideal eco-friendly approach for the control of agricultural pest of *S.litura.*

Keyworkds: Larvicidal activity, Ovicidal activity, essential oil, *S.litura*

1. Introduction

Spodoptera litura (Lepidoptera: Noctuidae) is a major polyphagous pest and it is commonly known as armyworm. It infect more than 180 plant species (Holloway, 1989). This is the serious pest of various economically important crops such as. Cotton, groundnut, chilly, tobacco, caster, bendy and pulses etc. (Dhir *et al*., 1992: Armes *et al*. 1997; Niranjankumar and Regupathy, 2001). Causing considerable economic loss to many vegetable and field crops. Crop loss due to insect pest varies between 10% and 30% for major crops (Sanjrani *et al*., 1989; Ferry *et al.*, 2004). This pest may become serious during the seedling stage, the majority of the *S.litura* (Fab) strains collected in South India exhibited high resistance level of 61-to-148 fold to organic pesticides(Kranthi *et al.*, 2002).Among various approaches that are available today, the screening of pant extract for deleterious effects on different organism (Jacobson, 1989; Schmutterer 1992; Koul, 1993; Arnason *et al* 1993; Isman, 1995). Biopesticides provide an alternative to synthetic pesticides because of their generally low environmental pollution, Low toxicity to human and other advantages (Liu *et al* 2000). Bio-pesticides have positive impacts on pest management (Ge and Ding., 1996).

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According to Feinstein (1952) more than 2,000 species of plants representing 170 families are said to have insecticides properties. Plant and insects have co-evolved over millions of year, plant have accumulated specific secondary metabolities to counteract insect damage (Kanniyan, 2002). Worldwide attention how focuses towards alternative method of pest control, which is derives from naturally available resources.The practice of using plant derivatives or botanical insecticides as we no know them, in agriculture dates back at least two millennia in ancient China, Egypt, Grace, and India (Ware, 1883; Thacker, 2002). Natural chemical of plant Orgin, Namely alkoloids (Bentley *et al*. 1984), terpenoids (Mordue & Blackwell 1993) and steroids (Bergamasco & Horn 1983) have been shown to have diverse biological effects on insects numerious plant species have been identified as possessing pesticidal properties and have shown potential as alternative to chemical pesticides (Ahmad *et al* 1984; Singh 2000; Kaushik and Kathuria 2004). However, synthetic Insecticides led to numerous problems unforeseen at the time of their introduction: acute and chronic poisoning of applicators, form workers, consumer, fish, birds and other wild life animals etc. (Forget *et al*., 1993; Marco *et al*, 1987; National Research council, 2000; Ferry *et al.*, 1998; WattandChari and Tintanon, 1999; Rohani *et al.*, 2001). The plant secondary metabolities that show feeding deterrent or toxic effect to insects in laboratory biology and botanical insecticides have been the subject of several recent volumes (Dev and Koul, 1997; Hedin *et al.,* 1997; Prakesh and Rao, 1997 and Raghault-Roger *et al*., 2005). Plant essential oil have been subjects as alternative sources for insect control, because some selective, biodegradable to non-toxic products, and have few effects on non-target organism and the environment (Singh and Upadhyay, 1993; Isman, 2006; Pavela, 2007a). Essential oil have also been documents to exhibits acute toxic effects against insects. Several experiments have been conducted on the Insecticidal properties of essential oil against various mosquitoes (Shalaby *et al.,* 1998; Zaridah *et al*., 2006; Knio *et al.,* 2008). Plant of the family Myrtaceae, Owing to presence of essential oil and Tannins are subjects to great interest in this context (CSIR 1981; Dales, 1996; Roger and Hamraoui, 1995). Biological activities of plants belonging to the myrtacea against stored grain insets are well documented (Sharma *et al*., 2001; Stampolous, 1991; Tunc *et al*., 2000). A comparison of the biological activity of commercially produce essential oils is therefore highly value in the narrow selection of suitable plant species development of suitable cultivation technology, extraction and subsequent formation of plant insecticides. . In this present study was aimed at assessing the potential of plant essential oil for use as commercial insecticides. The toxicity of seven essential oil against larvicidal and ovicidal activity of *Spodoptera litura* was assessed.

2. Materials and methods

2.1. Collection of insects

Spodoptera litura (third and fourth instar lavae). The test insects were collected from the agricultural field, Koothur , Vaitheeswaran Koil, Nagai Dist, Tamil Nadu India.

Under controlled condition in a BOD incubator. Maintained at 27±1°C, 65-70% RH and 14:10 L/D photoperiod. During last instar 10-15 larvae were transferes to the glass jairs and daily observed. The adult were kept separately and mated on the third day of emergence in a Perspex cage (20x20x20cm) adult were fed on 10% honey solution filter paper strips were provided for egg laying. Egg hatched in 3-5 days. The laboratory colony maintained on above 20 generation.

2.2. Collection of plants

Various parts of seven medicinal plants: ginger (*Zingiber officinale* Rosc., rhizome), tulsi (*Ocimum basilicum* L., leaf), nut grass (*Cyperus scariosus* L., shoot), anise (*Pimpinella anisum* L., seed), black cumin (*Nigella sativa* L., seed), rosemary (*Rosmarinus officinalis* L., shoot), and turmeric(*Curcuma longa* L., rhizome),were collected from the Tamil Nadu, India in March 2009. The harvesting period in year 2009. The voucher specimen has been deposited in the laboratory of Zoology, Annamalai University, Annamalai Nagar Tamil Nadu.

2.3. Essential oil distribution

The essential oil were obtained by hydrodistillation in a Clevenger type apparatus for eight hours. The oils thus obtained were dried over anhydrous magnesium sulphate to extract the oil.

2.4. Studies activity

Essential oil of different plant species were evaluated at the 100 mg of essential oil delivered in 1µl acetone. (Lee *et al.,* 1997) acetone was used as control. Each with 10 larvae was put into vial and each oil there were five replication. Observation on larval mortality was recorded after 24 hours the larvae were considered dead, All moribund pest larvae were considered as dead .

Table 1: Larvicidal activity of seven essential oil against fourth instar larva of *S.litura*

Plants name	LC_{50}(ppm)	LC_{95}(ppm)	Slope	Degrees of freedom	Chi-square (x^2)
Zingiber officinale	29	48.2	7.42	7	0.1
Ocimum bassilicum	27.3	43.6	8.10	7	0.1
Cyperus scariosus	31.2	51.4	7.58	7	4.5
Pimpinella anisum	38.5	78	5.18	7	2.5
Nigella sativa	35.1	55	8.42	13	2.0
Rosmarinus officinalis	40	70.4	6.69	7	0.5
Curcuma longa	30.6	56	6.25	10	20.5

Control – nil mortality. Significant at $P < 0.05$ level.
LC_{50} lethal concentration that kills 50% of the exposed larvae, LC_{95} lethal concentration that kills 95% of the exposed larvae, x^2 chi-square, df degrees of freedom.

2.5. Larvicidal activity

The larvae of *S.litura* were collected from the insect rearing cage. One ml of essential oil was first dissolved in 100ml of respective solvent (stock solution). From the stock solution was prepared different concentration 50, 100, 150, 200, 250, and 300 ppm. Polysorbate 80 (Qualigens) was used as an emulsifier, experiments were conducted for 24 h at room temperature (28+2°C 65+2% relative humidity and a photo period of 16:8 (L/D). A leaf – dipping method (Park *et al*.,2002) was used to evaluate the activity of the test samples. Leaf disk (6.5cm) of castor were used for evaluating larvicidal activity of the sample against *S.litura* three leaf disks per dose were separately dipped in each test solution for 30s. Solvents were evaporated under a fume hood for 2h. Castor leaves were washed with 70% double distiller alcohol and air-dried for 15 min before dipping in to the required amount of plant products. The larval were transferred individually on treated and control (disk treated with solvent, polysorbate 80 and distilled water only) leaf disks places in petri disk. Treated leaves were fed to fourth – instar larvae of *S.litura*. To calculate the larvae feeding activity. The percentage of leaf damage was gravimetrically estimated every 12 hours. With an additional initial check after 6 hours mortality was determined 24 hours after larvae were placed on disks. All moribund pest larvae were considered as dead.

2.6. Ovicidal activity

For ovicidal activity, scales from the egg mass of *S.litura* were carefully removed using fine brush. 500 egg from *S. litura* were separated into five lots each having 100 eggs and dipped in, 50,100 , 150, 200,250 and 300 ppm concentration of plant essential oil and controls as mentioned above. Number of eggs hatched in control and treatments were recorded and the percentage of ovicidal activity was calculated by the following formula, for each experiment, five replicates were maintained at a time. The hatch rate was assessed 120h post treatment.

$$\frac{\text{Number of hatched larvae}}{\text{Total number of eggs}} \; x\ 100$$

2.7. Statistical analysis

The average mortality data were subjected to probit analysis for calculating LC_{50}, LC_{95} and other statistics chi-square values were calculated by using the software developed by Raddy *et al*., (1992). Result with $P<0.05$ were considered to be statistically significant.

3. Result and discussion

The larvicidal and ovicidal effects of seven medicinal plant oil were investigated against the fourth-instar larvae of *S.litura,* (Lepidoptera: Noctuidae). The aim of this study was to evaluate the toxic effects of *Zingiber officinale*, *Ocimum basilicum, cyperus scariosus, Pimpinella anism, Nigella sativa, Rosmarinus officinalis,* and *Curcuma longa* were exposed to different concentrations. All essential oils showed moderate toxic effect on lepidopteran agricultural pest of armyworm after 24hr of exposure; However, the highest larvel mortality was found in (Table 1) The leaf of *O.basiliucm,* The and the shoot of *C.Scariosus* (LC_{50} = 27.3, 29, 30.6, 31.2, LC_{95} = 43.6, 48.2, 56 and 51.4 ppm) and lowest larvel mortality was recorded the *p.anisum* (LC_{50} = 38.5 and

Table 2: Ovicidal activity of seven essential oils against eggs of *S.litura*

Plants Name	Percentage of eggs hatchability, concentration of plant essential oil in ppm						
	50	100	150	200	250	300	Control
Zingiber officinale	43.5	21.0	13.6	NH	NH	NH	100.0
Ocimum bassilicum	36.6	21.3	11.0	NH	NH	NH	100.0
Cyperus scariosus	41.3	32.6	21.0	14.3	NH	NH	100.0
Pimpinella anisum	91.6	78.6	41.3	24.3	13.0	NH	100.0
Nigella sativa	96.0	71.0	54.3	22.3	11.6	NH	100.0
Rosmarious officinalis	93.3	70.3	42.0	25.0	12.3	NH	100.0
Curcuma longa	44.0	33.3	25.0	18.0	NH	NH	100.0

NH – No hatchability (100% mortality)

LC_{95} = 78 ppm). Respectively chi-square value was significant at P<0.05 level. Ovicidal activitiy of above mentioned the seven medicinal plant essential oil were used in the study. During preliminary screening, the essential oil wer etested at different concentrations (50, 100, 150, 200, 250 and 300 ppm). The percentage of eggs hatchability was assessed 120 hr post treatment (Table 2). All essential oil showed moderate ovicidal effects; however, the highest Ovicidal activity was found in *O.basilicum* and *Z.officinale*. *S.litura* eggs was 100% of mortality (No hatchability) recorded at 200, 250 and 300 ppm concentration of *O.basilicum, Z. Officinale, C.longa,* and *C.Scariosus* may serve as lepidopteran agricultural pest of armyworm control in their oil form, essential oil have the potential to be used as an ideal eco-friendly approach for the control of agricultural pest of *S.litura*. The result of this study indicate the plant-based compound may be effective alternative to conventional synthetic pesticides undoubtedly, plant derived toxicants are a variable source of potential insecticides. These and other naturally occuring insecticides may play a more prominent role in pest control programs in the future (Mordue and Blackwell 1993) the result of this study will contribute to a great reduction in application of systematic insecticides. Botanical insecticide less expensive, easily biodegradable to non-toxic products and potentially suitable for use in pest control programme.The crude solvent extract of *O.canum, O.sanctum and R. nasutus* are repellent to *S.litura* larvae, but larvae still consume small amount of treated leaf showed 100% mortality (Kamaraj *et al*., 2008) *C. sinensis* chloroform extract and *O.canum* methanol extract against the larval of *H.armigera* (Kamaraj *et al*., 2008). Larvicidal activity of cucurbitaceae plants; *C.colocynthis* petroleum ether extracts, *C.indica, C.sativus and M.charantia* methanol extracts, *T.anguina* acetone extract against *A. aegypti, C.quinquefaciatus* (Abdul Rahuman and Venkatesan., 2008). *T.patula* essential oil compounds are known to posses antifeedant activity against a variety of agricultural field. (Agarwal *et al*., 1993). In general the mortality increase with increasing concentration of compounds and exposuretime.The abnormalities in the metamorphosis might be due to imbalance in hormones (Karmegam *et al*., 1997) prolonged larval and pupal periods while using plant extracts have been reported by saxena and saxena (1992) and Daniel *et al.*, (1995). Bioassays showed that *T.Patula* oil was most toxic against *S.Litura*. Pathak *et al.,* (2000) also reported higher susceptibility of the three mosquito species (*A.aesypti, An. Stephensi and C. quinquefasciatus*). *T. Patula* was less active and only 50% larvae were killed at higher concentration (100ppm). It has been demonstrates that insecticidal activity and chemical composition of marigold species vary considerably depending on geographic location, growing conditions, plant part from which they are extracted, developmental stage of plant, solvent used for extraction, photosensitivity of some of the compounds in the extract, and are methods used to isolate the essential oils (singn *et al* 2001; wells,1993). Further, essential oil against antifeedant, repellents. And toxic towards stored product beetle (chander *et al.*, 1999; Tripathi *et al*., 2002). In general neem limonoids act as larvicides, adultcides, respellents, deterrents and growth inhibitors in a variety of test insect species (Schmutterer, 1990; mordue and Blackwell, 1993). Antifeedant, insecticidal activity and inhibition of hormone and enzyme activity have been attributed to the tetranortriterpenoid azadirachtin in the extract (Ma *et al*., 2000; Sendhilnathan *et al.*, 2004, 2005a, b, c, d, e). The plant extracts drastically reduced the fecundity of the females and only few adults survived. Neem extracts reduced adult longevity. These and other naturally occurring insecticides may play a more prominent role in mosquito control programs in the future (mordue and Blackwell, 1993). The highest concentration tested significantly reduced larvicides and adulticides. The neem limonoids would act as an oviposition repllent and / or deterrent to *A. Stephensi* (Zebitz, 1984; Su and Mulla, 1999).the larvicidal activity of crude acetone, ethyl acetate, hexane, methonal and petroleum ether extract of the leaf of *C.asiatica* and *Mukia scabrella* against the early fourth instar larvae of *C.quinquefasciatus* Rahuman *et al.,* 2008b LC_{50} value of petroleum ether extract of *Jatropha curcas, pedilanthus tithymaloides, phyllanthas amarus*. *Euphorbia hirta* and *Euphorbia tirucalli* against *A.aegypti* and *C.quinquefasciatus* Rahuman *et al.,* 2008a. Kamaraj *et al.,* (2008a) have reported that the peel methanol extract of *C.sinensis*, leaf and flower ethyl acetale extract of *O. canum* against the larvae of *A.stephensi.* The dose will have to be standardized, depending on the geographical location and the pest insect species, but these results suggest that the use of botanical pesticide may help in reducing the environmental ill effects otherwise caused by the synthetic pesticides.

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