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Certain essential oil against the field pest army worm, *spodoptera litura* (lepidoptera:noctuidae)

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Abstract

Plant essential oil, especially botanical insecticides, are currently studied more and more because of the possibility of their use in plant protection. Biological activity of fifteen essential oil were studied using fourth instar larvae of armyworm, *Spodoptera litura* (Lepidoptera: Noctuidae).Larvicidal activity of *Acorus calamus, Cinnamomum camphora, Citrus limonum, Cuminum cyminum, Cymbopogan citrates, Ocimum basilicum, Origanum compactum, Origanum vulgare, Mentha arvensis, Mentha piperata, Rosmarinus officinalis, Thymus vulgaris, Pelargonium graveolens, Zingiber officinales,* and *Coriandrum sativum*were used in this study. During preliminary screening, the extracts were tested at 1,000 ppm concentration. The larval mortality was observed after 24 h of exposure. All Essential oil are showed moderate larvicidal effects; however, the highest larval mortality was found in the essential oil of *Zingiber officinales, Citrus limonum , Acorus calamus, Rosmarinus officinalis, Ocimum basilicum, Cuminum cyminum* ,and *Coriandrum sativum* ($LC_{50=}$15, 34.55, 36.13, 38.2, 57.55, 63.99 and 65.07 ppm) and the lowest larval mortality was found in the essential oil of *Origanum vulgare, Cinnamomum camphora, Cymbopogan citrates , Mentha arvensis* and *Pelargonium graveolens* ($LC_{50=}$ 110.77, 112.03, 114.43, 120.59 and 134.27ppm) The result that the Essential oils promising as larvicidal activity against armyworm, *Spodoptera litura* agricultural important lepidopteron pest. © 2010 IJRSR. All rights reserved.

Keyworkds: *Spodoptera litura,* larvicidal activity, Essential oils.

1. Introduction

There is increasing scientific interest in the role of secondary plant metabolites in insect – plant interaction, particularly in host acceptance and rejection (Jacobson 1989). While plant metabolities may produce toxic effects when ingested by insects. Antifeeding activity may determine the extent of Insect herbivory. Several paper have been published on the entomotoxic properties of crude extracts from different plant species (Sadek 1997; Rodriguez – Saona and Trumble 1999; Ciccia *et al* 2000; Tapondou *et al* 2005).Among various approaches that are available today, the screening of pant extract for deleterious effects on different organism (Jacobson, 1989; Schmutterer 1990; 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). 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 million of year, plant have accumulated specific secondary metabolities to counteract insect damage (Kanniyan, 2002). World wide 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). Neem tree is a promising source for botanical insecticides at present (Lowery and Isman 1995).

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Spodoptera litura (Lepidoptera: Noctuidae) is a major polyphagous pest and it is commonly known as armyworm. It infects 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).

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; 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; Raghault-Roger *et al*., 2005; Elumalai *et al*., 2008; Pugazhvendan *et al*.,2009; Anandan *et al*., 2010). 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 Elumalai *et al*., 2010a; Elumalai *et al*., 2010b; krishnappa *et al*., 2010). 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 certain essential oil against the field pest army worm, *Spodoptera litura* .

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 transfers to the glass jars 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 fifteen medicinal plants essential oil were collected from various part of Tamilnadu and the harvesting period in year 2009. The voucher specimen has been deposited in the laboratory of zoology, Annamalai University, Annamalai nagar, Tamilnadu.

2.3. *Essential oil distilation*

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

2.4. *Larvicidal bioassay*

During preliminary screening with the laboratory trial, 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, 4°C).From the stock solution 1,000 ppm was prepared with dechlorinated tap water. Polysorbate 80 (Qualigens) was used as an emulsifier at the concentration of 0.05% in the final test solution. 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 samples against *S.litura.* The leaf disks per dose were separately dipped in each test solution for 30s. Solvent were evaporated under a fume hood for 2h. Castor leaves were washed with 70% double distilled alcohol and ari-dried for 15 min before dipping into the required amount of plant product. The larvae transferred individually on treated and control (disks treated with solvent, polysorbate 80 and distilled water only). Leaf disks places in Petri plates 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 12h with an additional initial check after 6h. A total of 50 larvae were exposed in five replicates of ten larvae each. Mortality was determined 24h after larvae were placed on disks. All moribund pest larvae were considered as dead.

2.5. *Dose-response bioassay*

From the stock solution, different concentrations ranging from 15 to 1000 ppm were prepared. Based on the preliminary screening results, fifteen essential oil were subjected to dose-response bioassay for larvicidal activity against *S.litura*. It was observed that the activity of the test samples was significantly and negatively correlated with contact

Table 1. List of essential oils: species, family, part used, oil yield

Botanical name	Family	Part used	Yield (%)
Acorus calamus	Araceae	Rhizome	2.3
Cinnamomum camphora	Lauraceae	Aerial part	1.7
Citrus limonum	Rutaceae	Peel	2.5
Cuminum cyminum	Umbilliferae	Herb	3.1
Cymbopogan citratus	Graminaccae	Aerial part	3.3
Ocimum basilicum	labiataceae	Herb	3.9
Origanum compactum	Lamiaceae	Arial part	2.8
Origanum vulgare	Lamiaceae	Herb	2.5
Mentha arvensis	Lamiaceae	Herb	27
Mentha piperata	Lamiaceae	Aerial part	1.8
Rosmarinus officinalis	Lamiaceae	Leaf	1.7
Thymus vulgaris	Lamiaceae	Herb	2.2
Pelargonium graveolens	Graminaceae	Leaf	3.6
Zingiber officinales	Zingiberaceae	Rhizome	3.4
Coriandrum sativum	Umbelliferaceae	Herb	2.8

Table 2: Larvicidal activity of essential oils against fourth – instar larvae of *spodoptera litura* at 1.000 ppm

Botanical name	% mortality (ppm) ± S.D. exposure time			
	12 hrs	24 hrs	36 hrs	48 hrs
Acorus calamus	53±3.57	73±2.88	92±1.14	100±0.00
Cinnamomum camphora	33±1.92	45±4.00	66±3.421	75±4.35
Citrus limonum	55±4.00	76±1.92	94±1.30	100±0.00
Cuminum cyminum	49±5.40	66±2.38	87±2.07	100±0.00
Cymbopogan citratus	32±3.50	49±5.40	62±2.88	83±2.70
Ocimum basilicum	51±1.92	71±2.77	90±1.58	100±0.00
Origanum compactum	45 ±4.00	67±5.45	80±2.23	100±0.00
Origanum vulgare	34± 1.78	50±3.53	73±5.59	87±2.07
Mentha arvensis	31±2.28	45±3.87	68±5.59	82±3.28
Mentha piperata	40± 3.39	51±3.70	72±3.91	89±1.92
Rosmarinus officinalis	52 ±3.64	73±5.59	86±1.48	100±0.00
Thymus vulgaris	36±3.56	52±3.64	70±3.39	84±1.48
Pelargonium graveolens	31± 2.28	49±5.40	63±4.15	77±2.60
Zingiber officinales	58± 2.70	76±2.58	91±1.30	100±0.00
Coriandrum sativum	48±4.39	62±2.88	89±1.92	100±0.00

Table 3. LC_{50} values (ppm/insect) for 24 h with their 95% fiducial (lower and upper) limits, regression equation and chi-square (x2) certain essential oil against fourth lastar larvac of *S.litura*

Plant name	LC_{50} with fiducial limits	Regression equation	X^2 (df=4)
Acorus calamus	36.13 (31.55 – 40.71)	Y = 3.73 x - 0.04	2.02
Cinnamomum camphora	112.03 (94.91 – 132.17)	Y = 0.40 x -2.24	2.34
Citrus limonum	34.55 (31.77 – 37.18)	Y = 0.58 x -4.11	7.87
Cuminum cyminum	63.99 (55.20-72.76)	Y = 0.09 x -2.82	2.41
Cymbopogan citrates	114.43(96.73-135.59)	Y = 0.48 x -2.19	1.95
Ocimum basilicum	57.55 (48.28 – 66.45)	Y = 0.55 x -2.26	2.47
Origanum compactum	76.78(67.52-86.88)	Y = 0.20 x -3.10	2.62
Origanum vulgare	110.77 (95.14 – 128.51)	Y = 0.16 x -2.53	3.69
Mentha arvensis	120.59(112.04-129.58)	Y = 6.84 x -5.68	0.16
Mentha piperata	81.63 (71.70 – 92.81)	Y = 0.46 x -2.89	3.77
Rosmarinus officinalis	38.2 (25.1 – 50.5)	Y = 0.08 x -0.84	8.61
Thymus vulgaris	99.72 (83.39-120.55)	Y = 0.56 x -2.22	0.91
Pelargonium graveolens	134.27(114.67-154.41)	Y = 0.38 x- 2.53	1.73
Zingiber officinales	15 (6.2-28.7)	Y = 3.17 x -2.69	7.4
Coriandrum sativum	65.07 (39.2-104.4)	Y = 0.06 x -1.16	11.42

time. The numbers of dead larvae were counted after 24h of exposure, and the percentage mortality was reported from the average of five replicates. However, at the need of 24h, the selected test samples turned out to be equal in their toxic potential

2.6. *Statistical analysis*

The average mortality data were subjected to probit analysis for calculating LC_{50}, 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. Results

Biological activity of fifteen essential oil were studied using fourth instar larvae of armyworm, *Spodoptera litura*. Larvicidal activity of *Acorus calamus, Cinnamomum camphora, Citrus limonum, Cuminum cyminum, Cymbopogan citrates, Ocimum basilicum, Origanum compactum, Origanum vulgare, Mentha arvensis, Mentha piperata, Rosmarinus officinalis, Thymus vulgaris, Pelargonium graveolens, Zingiber officinales,* and *Coriandrum sativum*were used in this study. During preliminary screening, the extracts were tested at 1,000 ppm concentration. The larval mortality was observed after 24 h of exposure. All Essential oil are showed moderate larvicidal effects; however, the highest larval mortality was found in(Table-2) the essential oil of *Zingiber officinales, Citrus limonum , Acorus calamus, Rosmarinus officinalis, Ocimum basilicum, Cuminum cyminum* ,and *Coriandrum sativum* ($LC_{50=}$15, 34.55, 36.13, 38.2, mortality was found in the essential oil of *Origanum vulgare, Cinnamomum camphora, Cymbopogan citrates* , *Mentha arvensis* and *Pelargonium graveolens* ($LC_{50=}$ 110.77, 112.03, 114.43, 120.59 and 134.27ppm) The result that the Essential oils promising as larvicidal activity against armyworm, *Spodoptera litura* agricultural important lepidopteron pest.

4. Discussion

Among the five oils tested, neem oil showed greater performance in terms of oviposition deterrent activity as it is evident from the data. It was observed that 12.64 ± 3.54, 14.35± 4.01, 18.24 ± 4.25 and 38.62 ± 6.55% of deterrent activity was observed from 0.25, 0.50, 1.0 and 2% concentrations respectively. Earlier Elumalai *et al.*, 2007a reported ovipositional deterrent activity of *H. suaveolens* and *M. corchorifolia* against *H. armigera*. The ovipositional deterrent activity of mentha and neem oils found to have more deterrent activity against the gravid moths of *S. litura* and their significance are apparent. It may due to the consequence volatile present in the oils which makes malfunctioning of the ovariole in female moths. Earlier, Hermawan *et al*., 1998 reported that the leaf extract of *Andrographis paniculata* significantly reduced the egg laying performance of the diamond back moth *Plutella xylostella*. Our findings are also corroborating with the reports of earlier workers with other species, (Patel *et al*., 1994; Mehta *et al*., 1994; Jayakumar *et al*., 2003; Raja *et al.*, 2004 and Elumalai *et al*.,2007a and b.)mentha oil showed minimum ovicidal activity at 0.25% concentration 18.33 ± 3.15 and maximum ovicidal activity at highest concentration tested (2.0% - 28.99 ± 7.11). Ovicidal activity recorded from 0.50 and 1.0% were less significant (23.25 ± 4.66 and 24.74 ± 5.47 respectively). Neem oil showed maximum ovicidal activity at 2.0% concentration. Present findings are in corroborate with the earlier findings of Jeyasankar *et al*., 2002. The disturbance of these extracts with egg morphology may plug the micropyles of the chorion thereby preventing the airflow in and out *vice versa*. The disturbances with egg cytoplasm was reflected in the form of dead eggs with black spot stage and it seems to be arresting of further development of embryo inside the egg. Bhatnagar and Sharma 1994 noticed similar anatomical and physiological disturbances of plant extracts on maize stem borer, *Chilo partellus*.after neem oil and mentha oil treatment the biochemical parameters and enzymatic profiles were markedly affected. It is evident that exposure to botanical insecticides in larval diet has significant effects on activities of several enzymes found in the late instars larvae and adult *S. litura*. Botanical insecticides such as neem derivatives may interfere with the production of certain types of proteins. This activity is apparently strongest during pupation; pupae were very susceptible after larval exposure *(*Senthil Nathan, 2004; Huang, 2004; Senthil Nathan, 2005; Smirle, 1996*)*.

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