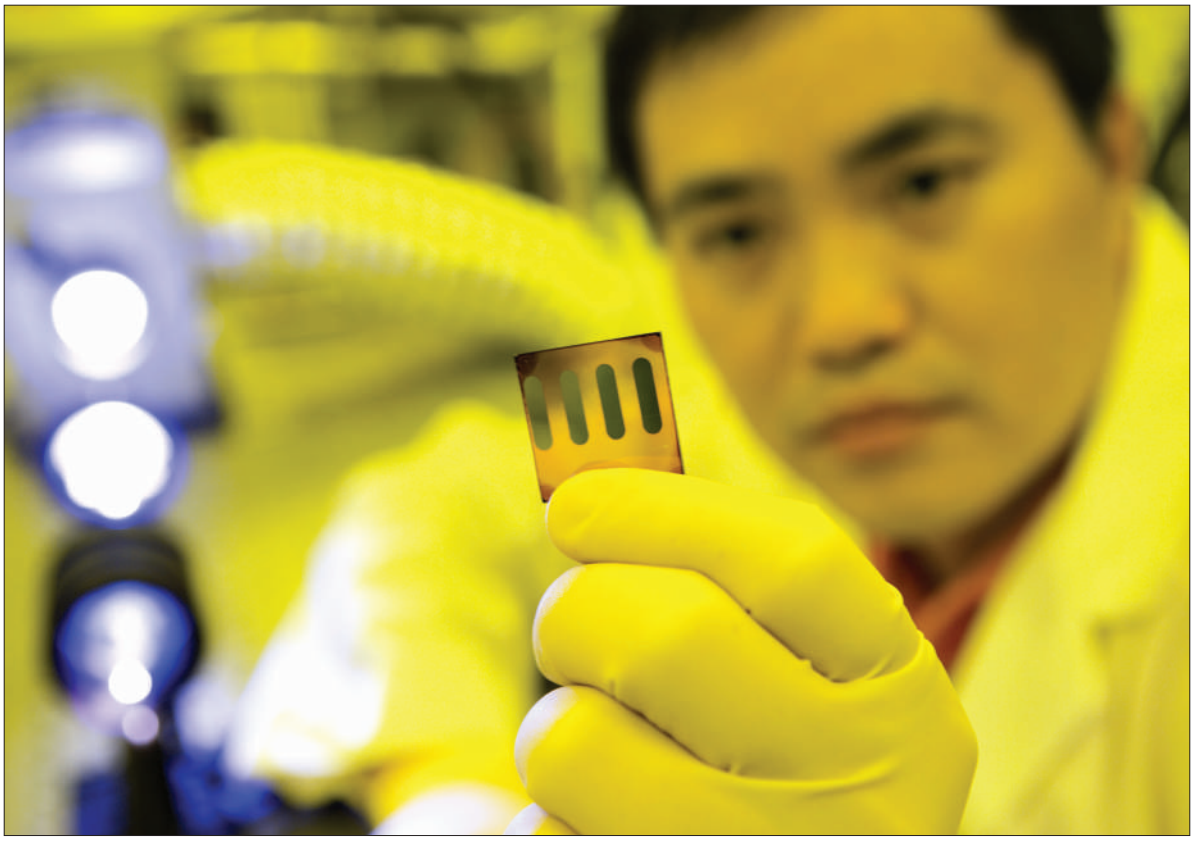

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Repellent Activity of Plant Derived Essential Oils against *Sitophilous oryzae* (Linnaeus) and *Tribolium castaneum* (Herbst)

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ABSTRACT

Several species of insect pests are known for attacking granaries and other food products since time immemorial. *Sitophilous oryzae* and *Tribolium castaneum* are major pests of stored grains including grains, flour, peas, nuts, dried fruits, spices etc. Use of synthetic pesticide for the management of these insect pest cause great hazards for environment and toxic to non-target livings. In the present investigation, in search of replacement of these synthetic pesticides, essential oils of Bael *(Aegle marmelos)*, Dhaniya (*Corriandrum sativum*), Laung (*Schyzygium aromaticum*) and Orange (*Citrus reticulata*) were evaluated for their repellent activity against *S. oryzae* and *T. castenium*. For repellency assays, different solutions of each essential oil were prepared in acetone and applied on half of the filter paper. The other half of the filter paper was treated with acetone only. Ten adults of insects were released at the centre of the each petri dish having treated and untreated filter paper and after 4 h. insect number in treated and untreated halves were noted. Highest repellent activity was observed for *S. aromaticum* essential oil against *T. castaneum* (90%) and *S. oryzae* are (90%),whereas, *C. reticulata* essential oil showed minimum repellent activity against these two insect pests (78 and 80%), respectively.

Key words: Insecticides, insect pest, repellent, essential oils, rice weevil, flour beetle

INTRODUCTION

Stored grain insect pests have been damaging our economy by infesting agricultural stored products. According to an estimate, the overall damage caused by stored-grain insect pests account for 10-40% of loss worldwide annually (Matthews, 1993). Rice weevil *Sitophilous oryzae* and red flour beetle *Tribolium castaneum* are the serious insect pests of stored products feeding on flour, cereals, meal, crackers, beans, spices, pasta, dried pet food, dried flowers, chocolate, nuts and even dried museum specimens (Aitken, 1975; Via, 1999; Weston and Rattlingourd, 2000). Adult stage of *T. castaneum* is very active and can breed throughout the year in warm areas (Pugazhvendon *et al*., 2009). They live two years or more, during which female produce nearly 1000 eggs (Shukla *et al*., 2010).

The continuous increasing pressure of expanding human population has created a critical problem of food scarcity. Thus protection of stored grains and other agricultural products from insect infestation is essential to feed the increasing population. Various synthetic insecticides have been used to minimize the loss caused by insect pests but pests developed resistance against most of these synthetic pesticides (Jember *et al*., 1995; Jovanovic *et al*., 2007). The uncontrolled use of these synthetic insecticides also causes great hazards for environment and consumers due to

residual property (White and Leesch, 1995; El-Kamali, 2009). Therefore, it is an urgent need to develop insecticides which should be ecologically safe, biodegradable and cause no toxicity in non-target animals like humans. In this regard, many plants products have been evaluated for their insecticidal properties against different stored-grain pests (Su, 1990; Mukherjee and Joseph, 2000; Carlini and Grossi-de-Sa, 2002; Mondal and Khalequzzaman, 2010). A number of plants produce essential oils which have been evaluated for insecticidal property against various insect pests (Shaaya *et al*., 1991; Ngamo *et al*., 2007b; Chaubey, 2007, 2008; Shukla *et al*., 2008). The present study assay the repellent activity of essential oils of different plants sources against stored grain insect pests.

MATERIALS AND METHODS

Isolation of essential oils: Essential oils from different parts of plants, fruits of *S. aromaticum,* leaves of *A. marmelos,* seed of *C. sativum* and peel of *C. reticulata* were extracted respectively. The different plants parts were dried in absence of sun light at room temperature (30±5°C) and grounded by domestic mixer. The dried powdered materials were hydro-distilled in Clevenger apparatus continuously for 5 h to yield essential oils. The oils were collected in glass container and kept at 5°C until their use in appendorff tube.

Insect rearing: Red flour beetles *T. castaneum* and Rice weevil *S. oryzae* were used to determine the repellent property of essential oils. The insects were reared on wheat flour and grain in laboratory at 30±2°C, 75±5% RH and at photoperiod of 10:14 (L: D) h.

Repellency: For repellency assays, four solutions of 0.05, 0.10, 0.15 and 0.20% of each essential oils were prepared by dissolving essential oils in acetone. Whatman No. 1 filter papers ware cut into two equal halves one half of each dish was treated with essential oil solution as uniform as possible by using micro pipette. The other half of the filter paper was treated with acetone only. The essential oil treated and acetone treated filter papers halves were dried to evaporate the solvent completely. Essential oil treated and acetone treated half-dish were then attached lengthwise, edge-to-edge with adhesive tape and placed at the bottom in glass petri dish (height 15 mm × radius 45 mm). Ten adults of insects were released at the centre of the petri dish and then petri dish were covered and kept in dark. Six replicates were set for each concentration of essential oils. Number of the insects on both the treated and untreated halves was recorded after four hours in mild light. The research work was carried out during April 2010 to July 2010 Zoology Department of M.G.P.G. College, Gorakhpur, India.

All the values obtained during observation were represented as mean±SE. Chi-square test was applied to establish the repellent activity of the oil tested (Sokal and Rohlf, 1973).

RESULTS

The repellent action of the *S. aromaticum, A. marmelos, C. sativum* and *C. reticulata* essential oils was studied against *S. oryzae* and *T. castaneum*. At highest concentration (0.2%) of essential oils, *S. aromaticum, A. marmelos, C. sativum* and *C. reticulata* against *S. oryzae* showed 90, 85, 83.3, and 78.3% repellency respectively (Table 1).

Similarly, at highest concentration (0.2%) of *S. aromaticum, A. marmelos, C. sativum* and *C. reticulata* essential oils, 90.0, 86.6, 83.3, 80.0% repellency was observed in *T. castaneum* respectively (Table 2). Chi-Square analysis revealed that *S. aromaticum* essential oil had strong and *C. reticulata* essential oil had weak repellent action against both insect pests.

Table 1: Repellency caused by *Aegle marmelos, Schyzygium aromaticum, Corriandrum sativum and Cittrus reticulata* agaiust adults of *Sitophilous oryzae* after four hours in filter paper test

Essential oils	Con.(%) vol: vol	Mean(%) of insect Untreated±SE	Mean (%) of insect treated±SE	χ^2 value p<0.5 (df = 5)
Aegle marmelos	0.05	50.0±3.6	50.0±3.6	0.038 ^{NS}
	0.10	66.6±3.3	33.3±3.3	0.944 ^{S}
	0.15	73.3±2.0	26.6±2.0	1.651 ^{S}
	0.20	85.0±2.2	15.0±2.2	3.355 ^{S}
Schyzygium aromaticom	0.05	56.6±4.1	43.3±4.1	0.104 ^{NS}
	0.10	71.6±3.0	28.3±3.0	0.997 ^{S}
	0.15	78.3±4.7	21.6±4.7	1.690 ^{S}
	0.20	90.0±3.6	10.0±3.6	3.336 ^{S}
Coriandrum sativum	0.05	53.3±3.3	46.6±3.3	0.105 ^{NS}
	0.10	66.6±3.3	33.3±3.3	0.890 ^{S}
	0.15	75.0±3.3	25.0±3.3	1.779 ^{S}
	0.20	83.3±4.1	16.6±4.1	2.956 ^{S}
Citrus reticulata	0.05	48.3±4.7	51.6 ±4.7	0.088 ^{NS}
	0.10	60.0±5.7	40.0±5.7	0.750 ^{S}
	0.15	66.6±4.9	33.3±4.9	1.410 ^{S}
	0.20	78.3±4.7	21.6±4.7	3.088 ^{S}

Adults of *S. oryzae* were used in filter paper repellency assay. For each concentration of essential oils six replicate were carried out and ten adults were used per replicate. Mean of untreated and treated halves in filter paper repellency assay. NS: Not significant as the calculated values of χ^2 were less than the table values at probability levels 99%. S: Significant at probability levels 99%

Table 2: Repellency caused by *Aegle marmelos, Schyzygium aromaticum, Corriandrum sativum and Cittrus reticulata* agaiust adults of *Tribolium castaneum* after four hours in filter paper test

Essential oils	Con. (%) vol: vol	Mean (%) of insect untreated±SE	Mean (%) of insect treated±SE	χ^2 value p<0.5 (df = 5)
Aegle marmelos	0.05	58.3±3.0	41.6±3.0	0.148 ^{NS}
	0.10	75.0±3.3	25.0±3.3	1.287 ^{S}
	0.15	78.3±4.7	21.6±3.3	1.645 ^{S}
	0.20	86.6±3.3	13.3±3.3	2.739 ^{S}
Schyzygium aromaticom	0.05	68.3± 3.9	31.6±3.9	0.482 ^{NS}
	0.10	76.6±4.9	23.3±4.9	1.117 ^{S}
	0.15	80.0±5.7	20.0±5.7	1.453 ^{S}
	0.20	90.0±2.5	10.0±2.5	2.698 ^{S}
Coriandrum sativum	0.05	65.0±3.3	35.0±3.3	0.492 ^{NS}
	0.10	71.6±3.0	28.3±3.0	0.997 ^{S}
	0.15	76.6±2.0	23.3±2.0	1.497 ^{S}
	0.20	83.3±3.3	16.6±3.3	2.326 ^{S}
Citrus reticulata	0.05	53.3±3.3	46.6±3.3	0.145 ^{NS}
	0.10	65.0±4.9	35.0±4.9	0.867 ^{S}
	0.15	73.3±3.3	26.6±3.3	1.746 ^{S}
	0.20	80.0±5.1	20.0±5.1	2.679 ^{S}

Adults of *T. castaneum* were used in filter paper repellency assay. For each concentration of essential oils six replicate were carried out and ten adults were used per replicate. Mean of untreated and treated halves in filter paper repellency assay. NS: Not significant as the calculated values of χ^2 were less than the table values at probability levels 99%. S: Significant at probability levels 99%

DISCUSSION

Different plants products, especially essential oils having considerable potential as insecticide compound are gaining tremendous importance particularly for the management of stored products as these are biodegradable and ecologically safe (Arnason *et al.*, 1989; Prakash and Rao, 1997; Rajendran and Sriranjini, 2008; Batisha *et al.*, 2008; Sahaf *et al.*, 2008; Cosimi *et al.*, 2009; Nerio *et al.*, 2009). The Brazilian pepper tree (*Schinus molle*) was used to evaluate repellent activity against *S. oryzae*. Leaf essential oil of *S. molle* showed repellent activity while fruit essential oil lacked repellent activity against *S. oryzae* (Benzil *et al.*, 2009). *Anna senegalensis, Hyptis specigera* and *Lippie regosa* essential oils were tested against the four major stored product insect pests *Sitophilous zeamais, Sitophilous oryzae, Callosobruchus maculates* and *Tribolium castaneum H. specigera* essential oil was the most active towards *S. oryzae, T. confusum* was the less sensitive insect to the three essential oils (Ngamo *et al.*, 2007a). The effect of essential oil of *Ocimum grattissimum* leaves on *S. zeamais* was assessed for repellency, mortality and maize damage. The oil was found to be moderately repellent to the maize weevil *S. zeamais* (Asawalam *et al.*, 2008). The essential oil from fruits of *Litsea cubeba* extracted by a water distillation method showed strongly repellency against *S. zeamails* and *T. castaneum* even at low concentration but its repellency was more marked towards *T. castaneum* (Ko *et al.*, 2009). *Ailanthus altissima* bark essential oil significantly repelled *Tribolium castaneum, Oryzaephilus surinamensis, Sitophilous oryzae* and *Liposcelis paeta pearman* adults (Lu and Wu, 2010). The essential oil extracted from *Coriandrum sativum* against eggs, larva and adults of *T. casteneum* was investigated in a series of laboratory experiments. These essential oils showed vapour toxicity and strong repellency on filter paper arena test towards all the stage used (Islam *et al.*, 2009). The essential oil of *A. marmelos* exhibited as botanical fumigant in protection of stored-grain and wheat by enhancing feeding deterrence and reducing grain damage and insecticidal activity against stored grain pests (Kumar *et al.*, 2008). Similarly in the present study *S. aromaticum* essential oil has shown maximum repellent activity and *C. reticulate* essential oil has shown minimum repellent activity against *S. oryzae* and *T. castaneum*. Varying activity by different essential oils indicated that the pest controlling and repellent factors were not uniformly present in every aromatic plant.

Therefore, essential oils of *Aegle marmelos, Corriander sativum, Schyzygium aromaticum* and *Citrus reticulat*a may be recommended as cheap, easily available at farmer level, eco-friendly and non toxic in Integrated Pest Management programme. It could further reduce the application of the synthetic chemicals.

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