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Enhancing protection against *Lasiodermaserricorne* Fab. damage in seed spices using seed spice oils

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Abstract

Seed Spice oils of coriander (*Coriandrum sativum* L.), cumin (*Cuminum cyminum* L.), fennel (*Foeniculum vulgare* Miller), and ajwain (*Trachyspermum ammi* L.) were used as impregnation on seed surface on same seed as protectant against cigarette beetle *Lasiodermaserricorne*. All seed spice oils were able to significantly reduce the population of *L. serricorne* at all stages of observation. The application of fennel oil was proved to be most detrimental against development of population of *L. serricorne* in fennel seed as only 11.3 beetle developed after 90 days against 54.6 beetle in control treatment. Uses of higher concentration of oil applied results more effective to reduce the population growth of beetle. The finding indicates the application of seed spice oil is good source of repellent for management of cigarette beetle during storage of seed spices.

Keyword: Seed Spices, *Lasioderma serricorne*, spice oil, damage, storage pest

Introduction

Spices comprise fragrant products of plant origin used for flavouring food and beverages. Among different group of spices, seed spices includes the single largest group of spices coming under it. Seed spices are annual herbs whose seed or small dried fruit are used as condiments. Important Major seed spices of India are coriander (*Coriandrum sativum* L.), cumin (*Cuminum cyminum* L.), fennel (*Foeniculum vulgare* Miller), fenugreek (*Trigonella foenum-graecum* L.) and ajwain (*Trachyspermum ammi* L.) which occupy large area. These are put to culinary uses as taste enhancers, flavouring agent, aromatics, appetizer, digestives antifatulents and other beneficial effects to human health (Silva *et al.*, 2017; Sowbhagya, 2013). Seed spice crops occupy a prominent place in the total basket of spices of the country and play a significant role in rural economy. These crops are mainly cultivated in Rajasthan and Gujarat state of India.

Seed spices are generally stored for a year or more at farmer's level. In most cases insect infestation come from field and other sources is the store house. The insect infestation generally remains undetected until adult emerged out from infested seeds. By the time these adult are detected much of seed are already damaged. The most common species

infesting seed spices during storage are cigarette beetle (*Lasioderma serricorne* Fab.), Drugstore beetle (*Stegobium panicum* L.), Seed Spices wasp (*Systole albipennis* Walker), Red rust flour beetle (*Tribolium* spp.), **Warehouse Beetle (*Trogoderma* spp.) and Variegated Carpet Beetle (*Anthrenus* spp.). Others are** Rice moth (*Corcyra cephalonica*) and Almond moth (*Cadracautella* Syn. and *Ephesiacauteilla* Walker) (Abdelghany, 2010; Magd El Din, 2003). Infestation level during storage is highly dependent on seed moisture content, temperature and other abiotic conditions.

The most common insect species infesting seed spices that cause maximum loss during storage is cigarette beetle (*Lasioderma serricorne*) Fab. It is found world-wide in tropical and sub-tropical areas causing huge economic losses to numbers of products (Rees, 2008). Besides the dubious honour of being the most damaging pest of stored tobacco, the cigarette beetle also is a major pest of many stored food. Most of seed spices are belonging to Apiaceae family and storage losses due to insect pests are common to most of the spices. Maximum damage to stored products is caused by larval feeding of cigarette beetle while adults make damage by making holes to penetrate or escape from packaged commodities. Beside the damage due to feeding, the presence of dead insects, cast skins, residues from different larval life stages, pupal cases, and frass become contaminants in spices and render them unfit for consumption (Highland, 1991; Minor, 1979). Insecticidal or repellent activity of plants oils and volatile compound has been found against numbers of pests. Fumigation of essential oils from three common spices, *Trachyspermum ammi*, *Anethum graveolens* and *Nigella sativa* against wheat flour insect pest *Tribolium castaneum* showed total mortality of immature and adult stages were at LC 50 of 11.62, 14.78, 9.46 and 13.48, 16.66, 10.87 μ l, respectively (Chaubey, 2007). Cumin (*Cuminum cyminum* L.) essential oil-loaded nanogels (OLNs) were found more toxic than *C. cyminum* oil against granary weevil (*Sitophilus granaries* L) and confused flour beetle *Tribolium confusum* Jacquelin du Val. (Ziaee et al., 2014). Tunc et al., 2000 reported that complete mortality of the eggs of *Tribolium confusum*, and the Mediterranean flour moth, *Ephesiakuehniella* achieved through exposure to vapours of essential oils from anise and cumin. Therefore, insecticidal efficacy of total oil of coriander (*Coriandrum sativum* L.), cumin (*Cuminum cyminum* L.), fennel (*Foeniculum vulgare* Miller), and ajwain (*Trachyspermum ammi* L.) was determined against cigarette beetle *L. serricorne*.

Material and Methods

Culture of *L. serricorne*

Test insect of *L. serricorne* Fab. was collected from the entomology laboratory of NRCSS, in which culture was maintained on cumin (*C. cyminum*) seed. For experiment adult beetles were collected from the stock culture and released in separate jar having non infested cumin seed, after eggs lying and larval emergence all the beetle were removed from the culture. Fresh emerged adult beetle of two to three days old from this culture were collected having mix of male and female population and was used for the study.

Preparation of total oil

The fixed oils of different seed spices were extracted using soxhlet method (AOAC, 1965) and was mixed in the own respective seed of coriander (*C. sativum*), cumin (*C. cyminum*), ajwain (*T. ammi*), and fennel (*F. vulgare*) at ratio of 0.5, 1.0 and 1.5 % w/v separately for each spices.

Mixing of total oil on seed spices

One year old seed spices were brought from seed store of the Institute for the study. The seeds were thoroughly cleaned and packed in polythene bag of 500 gauge thickness and kept in temperature of -20°C in a deep freezer for 10 days to kill all the contaminated stored insect pests eggs/immature stages if any. After that all the seed materials were stored at room temperature (30±2°C) for 30 days to examine and ensure insect free seed materials. One hundred gram seed of each spice was taken for each treatment and kept in plastic jar (Tarson®, India) of 500 g capacity. Total of 10 adult were introduced in each container having treated seeds and mouth of container was sealed with muslin cloth. Each treatments were replicated five times and kept at room temperature in the laboratory in 1st week of July month for feeding and reproduction. Observation on total population of beetle including immature, dead and live insects were recorded at 30, 60 and 90 days after inoculation.

Statistical Analysis :Total population of beetle data were statistically analyzed in Complete Randomized Design (CRD) using SAS 9.2 software.

Results & Discussion:

The results showed that all the treatments were found effective as growth retardant against *L. serricorne* population in all the spice crop (Table 1). Seeds impregnated with higher concentration of seed spice oil applied results more effective to reduce the population

growth. The observation at 30 days showed lower variation of population growth in different treatments than at observation taken at 60 and 90 days, respectively. Among different oils applied, use of fennel oil was proved to be most detrimental against development of population of *L. serricorne* in fennel seed followed by ajwain, coriander and cumin. At 30 days significantly lower population growth were observed in increased level of oil applied except in case of ajwain oil where lower population was recorded at 1.0 % application (Fig.1). The levels of population growth at observation of 60 and 90 days showed similar pattern where higher concentration of oils applied lower the population growth. At 60 days population of beetle in coriander was more at seed treated with 0.5% oil than control. However, in other crop seeds population was significantly lower than control (Fig.2). Growth pattern of beetle population observed at 90 days showed lower population at higher concentration of oil coating on seed. Populations of beetles were significantly higher in non treated seeds (control) than the seed treated with oil of respective spice (Fig.3). There are several volatile compound and plant oil showed insecticidal or repellent activities against the *L. serricorne*. Capillin (1-phenyl-2,4-hexadiyn-1-one) isolated from flower buds of *Artemisia capillaris* (Asteraceae) Imai *et al.*, 2009, essential oil of *Pistacia lentiscus* L. (Anacardiaceae) (Mediouni-Ben Jemâa, J. *et al.*, 2010), *Melaleuca leucadendron* L. and *Callistemon citrinus* Curtis (Anju Viswan *et al.*, 2014) showed insecticidal value against *L. serricorne*. The exposure to vapours of essential oils from anise and cumin resulted in 100% mortality of the eggs of *Tribolium confusum*, and the Mediterranean flour moth, *Ephestia kuehniella*. (Tunc *et al.*, 2000). Therefore insecticidal efficacy of total oil of coriander (*Coriandrum sativum* L.), cumin (*Cuminum cyminum* L.), fennel

(*Foeniculum vulgare* Miller), and ajwain (*Trachyspermum ammi* L.) was determined against cigarette beetle *L. serricorne*. The result showed significant lower population development on the seeds coated with various oils of seed spices. Coriander oil (10 µl) showed activity against the cereal storage pest bruchid *Callosobruchus maculatus* (P. Villalobos, 2003). Ovicidal activity of cumin oil (LC50= 7.65 µL L⁻¹ air) recorded against Two-spotted Spider Mite, *Tetranychus urticae* (Acari: Tetranychidae) (Kheradmand *et al.*, 2015). Kim, Soon-Il (2003) reported *Foeniculum vulgare* fruit extract in closed cups (3.5 mg/cm²) showed more effective against *L. serricorne* adults in and it indicate that the insecticidal mode of action may be largely attributable to fumigant action. Similarly acaricidal activities of components derived from fennel seed oils against *Tyrophagus putrescentiae* adults using direct contact application and compared with compounds such as benzyl benzoate, dibutyl phthalate and N, N-diethylm- toluamide. The bioactive constituent of the fennel seeds was characterized as (+)-carvone by spectroscopic analyses. The most toxic compound to *T. putrescentiae* was naphthalene, followed by dihydrocarvone, (+)-carvone, (-)-carvone, eugenol, benzyl benzoate, thymol, dibutyl phthalate, N,N-diethyl-mtoluamide, methyl eugenol, myrcene and acetyleugenol, on the basis of LD50 values (Lee *et al.* 2006). It has clear from the study that application of total oil of seed spices has potential to protect the same crop without compromising the stringent quality parameter of the product. Future breeding of spice varieties having higher oil content may prove detrimental to pest infestation.

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Table 1: Effect of different seed oil on population growth of *L. serricorne* Fab.

Fixed Oil (w/v)	At 30 Days				At 60 Days				At 90 Days			
	Coriander	Ajowan	Cumin	Fennel	Coriander	Ajowan	Cumin	Fennel	Coriander	Ajowan	Cumin	Fennel
0.5%	4.5 (2.3)*	7.1 (2.8)	4.7 (2.3)	3.6 (2.1)	14.4 (3.9)	11.3 (3.5)	9.3 (3.2)	4.4 (2.3)	13.8 (3.8)	54.4 (7.4)	6.8 (2.7)	11.3 (3.5)
1.0%	4.1 (2.2)	3.3 (2.0)	3.7 (2.1)	3.5 (2.1)	6.5 (2.7)	3.6 (2.1)	6.8 (2.7)	3.0 (2.0)	8.3 (3.0)	9.6 (3.2)	10.5 (3.3)	2.8 (1.9)
1.5%	3.7 (2.1)	4.0 (2.2)	3.4 (2.1)	3.3 (2.0)	2.3 (1.8)	2.3 (1.8)	9.0 (3.1)	1.2 (1.4)	6.5 (2.7)	3.3 (2.0)	8.5 (3.0)	1.5 (1.6)
Control	5.2 (2.4)	58.4 (7.7)	42.6 (6.6)	15.5 (4.0)	8.2 (3.0)	27.6 (5.3)	73.8 (8.6)	92.0 (9.6)	70.4 (8.4)	179.1 (13.4)	34.4 (5.9)	54.6 (7.4)
SEM	0.03	0.06	0.05	0.04	0.04	0.05	0.07	0.07	0.07	0.11	0.06	0.06
CD at 5%	0.10	0.19	0.16	0.12	0.14	0.15	0.23	0.22	0.23	0.35	0.20	0.18

*square root transformation

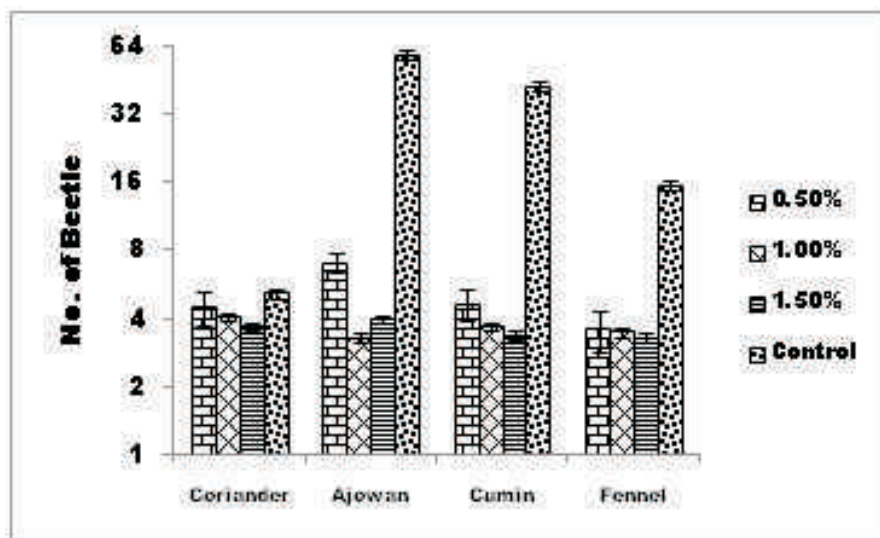


Fig.1. Population of *L.serricorne* at 30 days on seed spices

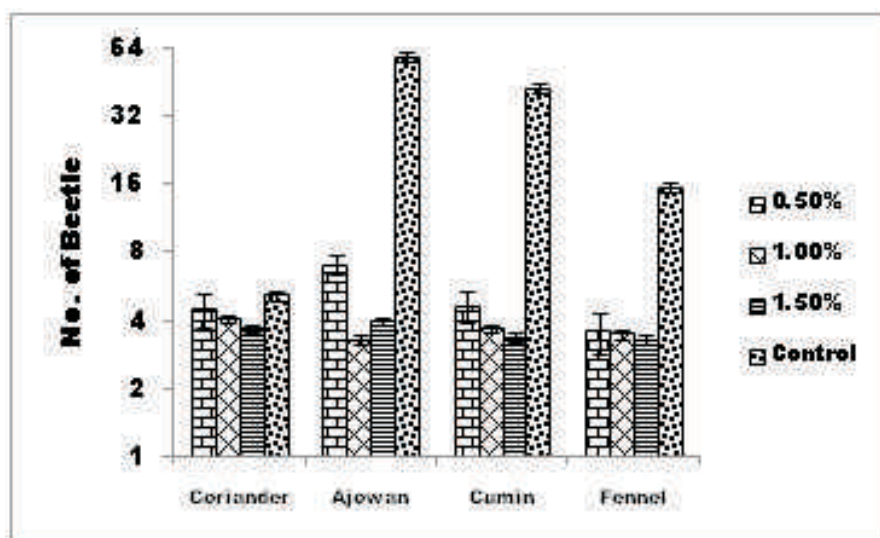


Fig.2. Population of *L.serricorne* at 60 days on seed spices

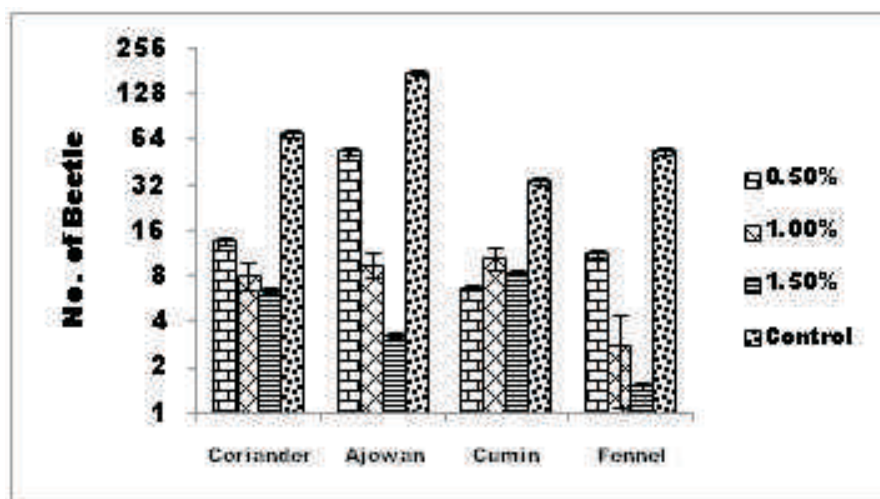


Fig.3. Population of *L.serricorne* at 90 days on seed spices

Conflicts of Interest : The authors declare no conflicts of interest.

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