Essential oils in stored product insect pest control

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Supplementary Methods

Supplementary Method 1 String used on Scopus database to retrieve the overwide literature for scientometric analyses (Scopus database search: February 2nd, 2018)

(TITLE-ABS-KEY(“Essential oil” AND pest OR insect) AND TITLE-ABS-KEY(“stored product” OR food-stuff OR “Internal feeding insect” OR “external feeding insect)AND TITLE-ABS-KEY(“Pest Management” OR toxicity OR mortality OR repellen* OR control OR efficacy OR effectiveness OR insecticid* OR fumigant OR Effect)) AND PUBYEAR > 2003

Abbreviations

AChE= Acetylcholinesterase
ATPases= Adenosine triphosphatases
CArE = Carboxylesterase
EONPs= Essential oil nanoparticles
FDI= Feeding deterrent index
GST= Glutathione S-transferase
IR= Inhibition rate
KT= Knock-down time
LC= Lethal concentration
LD= Lethal dose
LT= Lethal time
MFOs= Mixed function oxidases
PT= Persistence time
RD= Repellence dose
RT= Residual activity (time)

Supplementary Tables

Table S1 Overview of reviewed studies on EO contact (CT) and ingestion (IT) toxicity towards stored product pests.

Plant Family	*Plant species*	*Insect Species*	Tested activity	Main Results	References
Amaryllidaceae	*Allium sativum*	*Sitophilus oryzae*	CT	Mortality= 100% after 5 days at 250 mg/kg grain	[1]
				Mortality= 100% after 4 days at 1.250 mg/kg grain	"
		Tribolium castaneum	CT	Mortality= 100% after 6 days at 40 mg/kg grain	"
				Mortality= 100% after 6 days at 400 mg/kg grain	"
Anacardiaceae	*Schinus molle*	*Sitophilus oryzae*	CT	LC_{50}= 0.16 mg/cm^2	[2]
	Schinus terebinthifolius	*Sitophilus oryzae*	CT	LC_{50}= 0.42 mg/cm^2	"
Annonaceae	*Dennettia tripetala*	*Sitophilus oryzae*	CT	Mortality= 100% after 24h at 2 mg/cm^2	[3]
	Xylopia aethiopica	*Sitophilus oryzae*	CT	Mortality= 100% after 24h at 2 mg/cm^2	"
Apiaceae	*Astoma seselifolium*	*Sitophilus oryzae*	CT	LC_{50}= 0.15 mg/cm^2	[2]
	Carum copticum	*Sitophilus granarius*	CT	Mortality= 90% in combination with diatomaceous earths (size <37μm); Synergistic effect	[4]
		Tribolium confusum	CT	Mortality= 36-74% in combination with diatomaceous earths (size <37; < 149 μm); both synergistic and antagonistic effects	"
	Coriandrum sativum	*Callosobruchus chinensis*	CT	LC_{50}= 27.26 μg/cm^2	[5]
		Corcyra cephalonica	CT	LC_{50}= 47.93 μg/cm^2	"
		Sitophilus oryzae	CT	LC_{50}= 36.68 μg/cm^2	"
	Crithmum maritimum	*Oryzaephilus surinamensis*	CT	70.33 ± 0.70% after 72h with 10% EO solution	[6]
		Rhizopertha dominica	CT	83.26 ± 7.50% after 72h with 10% EO solution	"
		Sitophilus granarius	CT	50.00 ± 0.58% after 72h with 10% EO solution	"
		Sitophilus oryzae	CT	93.30 ± 3.20% after 72h with 10% EO solution	"
		Tribolium castaneum	CT	22.16 ± 1.91% after 72h with 10% EO solution	"
		Tribolium confusum	CT	33.26 ± 0.21% after 72h with 10% EO solution	"
	Pituranthos tortuosus	*Sitophilus oryzae*	CT	LC_{50}= 0.19 mg/cm^2	[2]
Araceae	*Acorus calamus*	*Callosobruchus chinensis*	CT	LD_{50}= 13.30 μg /cm^2 after 24h	[7]
		Sitophilus oryzae	CT	LD_{50}= 54.46 μg /cm^2 after 24h	"
		Tribolium castaneum	CT	LD_{50}= 166.78 μg /cm^2 after 24h	"
Asparagaceae	*Liriope muscari*	*Lasioderma serricorne*	CT	LD_{50}= 11.28 μg /cm^2	[8]
		Liposcelis bostrychophila	CT	LD_{50}= 21.37 μg /cm^2	"
		Tribolium castaneum	CT	LD_{50}= 13.36 μg/adult	"
Asteraceae	*Artemisia absinthium*	*Oryzaephilus surinamensis*	CT	LD_{50}= 0.209; LD_{95}= 1.963 μL	[9]
		Tribolium castaneum	CT	LD_{50}= 2.261; LD_{95}= 5.921 μL	"
	Artemisia anethoides	*Lasioderma serricorne*	CT	LD_{50}= 24.03 μg/adult	[10]
		Tribolium castaneum	CT	LD_{50}= 28.80 μg/adult	"
	Artemisia herba-alba	*Callosobruchus maculatus*	CT	Mortality= 100% at 20 μL	[11]
		Oryzaephilus surinamensis	CT	LD_{50}= 2.242; LD_{95}= 16.864 μL	[9]
		Tribolium castaneum	CT	LD_{50}= 7.43; LD_{95}= 133.32 μL	"
	Artemisia judaica	*Sitophilus oryzae*	CT	LC_{50}= 0,08 mg/cm^2	[2]
	Artemisia monosperma	*Sitophilus oryzae*	CT	0,15 LC_{50}mg/cm^2	"
	Artemisia stolonifera	*Lasioderma serricorne*	CT	LD_{50}= 12.68 μg/adult, worse than terpinen-4-ol	[12]
		Tribolium castaneum	CT	LD_{50}= 8.60 μg/adult, better than single compounds	"
	Aster ageratoides	*Sitophilus zeamais*	CT	LD_{50}= 27.16 μg/adult	[13]
		Tribolium confusum	CT	LD_{50}= 8.09 μg/adult	"
	Calendula officinalis	*Sitophilus granarius*	CT	Mortality= 99% after 24h with 2.5 mL/kg of EO, 100% after 12h with 5 mL/kg of EO	[14]
	Dahlia pinnata	*Sitophilus oryzae*	CT	LD_{50}= 163.55 μg/cm^2 (flowers EO)	[15]
				LD_{50}= 424.00 μg/cm^2 (roots EO)	"
				LD_{50}= 485.29 μg/cm^2 (leaves EO)	"
				LD_{50}= 524.31 μg/cm^2 (stem EO)	"
		Sitophilus zeamais	CT	LD_{50}= 308.11 μg/cm^2 (flowers EO)	"
				LD_{50}= 403.05 μg/cm^2 (roots EO)	"
				LD_{50}= 627.34 μg/cm^2 (leaves EO)	"
				LD_{50}= 828.79 μg/cm^2 (leaves EO)	"
	Laggera pterodonta	*Lasioderma serricorne*	CT	LD_{50}= 32.97 μg/adult	[16]
		Liposcelis bostrychophila	CT	LD_{50}= 28.53 μg/adult	"
	Tagetes erecta	*Callosobruchus maculatus*	CT	LD_{50}= 504.5; LD_{95}= 725.2 μg/g adult	[17]
		Sitophilus oryzae	CT	LD_{50}= 392.6; LD_{95}= 623.2 μg/g adult	"
		Tribolium castaneum	CT	LD_{50}= 420.5; LD_{95}= 679.3 μg/g adult	"
	Tagetes minuta	*Callosobruchus maculatus*	CT	LD_{50}= 310.2; LD_{95}= 497.8 μg/g adult	"
		Sitophilus oryzae	CT	LD_{50}= 192.0; LD_{95}= 342.5 μg/g adult	"
		Tribolium castaneum	CT	LD_{50}= 213.5; LD_{95}= 372.4 μg/g adult	"

Plant Family	*Plant species*	*Insect Species*	Tested activity	Main Results	References
	Tagetes patula	*Callosobruchus maculatus*	CT	LD_{50}= 429.8; LD_{95}= 601.7 µg/g adult	"
		Sitophilus oryzae	CT	LD_{50}= 222.8; LD_{95}= 365.7 µg/g adult	"
		Tribolium castaneum	CT	LD_{50}=" 308.1; LD_{95}= 492.4 µg/g adult	"
Atherospermataceae	*Laurelia sempervirens*	*Sitophilus zeamais*	CT	2.3 LC_{50} mL/kg grain	[18]
Chenopodiaceae	*Chenopodium ambrosioides*	*Callosobruchus chinensis*	CT	Mortality= 40% with 5-10% of EO contained in the formulations. Protectant action for up to six months of seed storage.	[19]
				LD_{50}= 2.8 µL	[19]
		Callosobruchus maculatus	CT	Mortality= 40% with 5-10% of EO contained in the formulations. Protectant action for up to six months of seed storage.	[19]
				LD_{50}= 2.5 µL	[19]
	Clausena pentaphylla	*Callosobruchus chinensis*	CT	Mortality= 40% with 10% of EO contained in the formulations. Protectant action for up to six months of seed storage.	[19]
Cupressaceae	*Cupressus lusitanica*	*Acanthoscelides obtectus*	CT	LC_{50}= 0.07 % v/w after 168h	[20]
		Sitophilus zeamais	CT	LC_{50}= 0.12% v/w after 168h	"
		Tribolium castaneum	CT	LC_{50}= 0.79% v/w after 168h	"
	Cupressus macrocarpa	*Sitophilus oryzae*	CT	LC_{50}= 0.32 mg/cm^2	[2]
	Cupressus sempervirens	*Sitophilus oryzae*	CT	LC_{50}> 0.6 mg/cm^2	"
	Juniperus formosana	*Liposcelis bostrychophila*	CT	LD_{50}= 81.50 µg/adult	[21]
		Tribolium castaneum	CT	LD_{50}= 29.14 µg/adult	"
	Thuja occidentalis	*Sitophilus oryzae*	CT	LD_{50}= 0.3 mg/cm^2	[2]
Elaengnaceae	*Hippophae rhamnoides*	*Sitophilus granarius*	CT	Mortality of 95% after 48h and 100% after 24h at 2.5 mL/kg	[14]
Euphorbiaceae	*Mallotus apelta*	*Liposcelis bostrychophila*	CT	LD_{50}= 211.02 µg/adult	[22]
		Sitophilus zeamais	CT	LD_{50}= 46.69 µg/adult	"
Geraniaceae	*Geranium maculatum*	*Plodia interpunctella*	CT	LD_{50}= 37.2; LD_{90}= 63.7 µg/cm^2	[23]
	Pelargonium sp	*Rhizopertha dominica*	CT	LC_{50}< 0.006% EO; LC_{50}< 0.004 PEG-EO-Nanoparticles. Residual contact toxicity of PEG-EO-nanoparticles for 24 weeks	[24]
		Tribolium castaneum	CT	LC_{50}< 0.2% EO; LC_{50}< 0.15 EO-PEG-EO-Nanoparticles. Residual contact toxicity of PEG-EO-nanoparticles for 16 weeks	"
	Pelargonium graveolens	*Sitophilus oryzae*	CT	LC_{50}= 0.17 mg/cm^2	[2]
Lamiaceae	*Adhatoda vasica*	*Callosobruchus chinensis*	CT	LD_{50}= 6.8 µL	[19]
		Callosobruchus maculatus	CT	LD_{50}= 8.4 µL	"
	Calamintha glandulosa	*Tribolium castaneum*	IT	Mortality= 96.67% at 1.14% of EO after 96h.	[25]
	Dracocephalum moldavica	*Sitophilus zeamais*	CT	LD_{50}= 22.10 LD_{50} µg/adult	[26]
		Tribolium confusum	CT	LD_{50}= 18.28 µg/adult	"
	Hyptis spicigera	*Sitophilus oryzae*	CT	LD_{50}= 112.0 ppm	[27]
	Hyptis suaveolens	*Callosobruchus maculatus*	CT	LD_{50}= 57 µg/mg w of adult	[28]
		Rhizopertha dominica	CT	LD_{50}= 126 µg/mg w of adult	"
		Sitophilus oryzae	CT	LD_{50}= 101 µg/mg w of adult	"
		Tribolium castaneum	CT	LD_{50}= 167 µg/mg w of adult	"
	Lavandula angustifolia	*Plodia interpunctella*	CT	LD_{50}= 76.3; LD_{90}= 129.2 µg/cm^2	[23]
		Sitophilus granarius	CT	LD_{50}= 83.8; LD_{90}= 379.7 µg/adult after 24h	[29]
			IT	Mortality= 74.8 and 100% at 2.245 and 4.490 mg/disk (insects fed for 3 days)	"
	Lavandula officinalis	*Sitophilus oryzae*	CT	LC_{50}= 0.07 mg/cm^2	[30]
		Tribolium castaneum	CT	LC_{50}= 0.26 mg/cm^2	"
	Mentha longifolia subsp. capensis	*Sitophilus zeamais*	CT	LD_{50}= 0.14 µL/g grain	[31]
	Mentha piperita	*Plodia interpunctella*	CT	LD_{50}= 53.8; LD_{90}= 77.5 µg/cm^2	[23]
	Mentha sp.	*Sitophilus oryzae*	CT	LD_{50}= 0.044 µL/mL	[32]
	Mentha viridis	*Sitophilus oryzae*	CT	LC_{50}= 239 and 158 ppm after one and two weeks respectively	[33]
	Mosla soochowensis	*Sitophilus zeamais*	CT	LD_{50}= 25.45 µg/adult	[34]
		Tribolium confusum	CT	LD_{50}= 10.23 µg/adult	"
	Ocimum basilicum	*Sitophilus zeamais*	CT	LD_{50}= 0.130 mg/adult	[35]
		Tribolium castaneum	CT	LD_{50}= 0.361 mg/adult	"
	Ocimum canum	*Sitophilus oryzae*	CT	LD_{50}= 42.9 ppm	[27]
	Ocimum gratissimum	*Sitophilus zeamais*	CT	LC_{50}= 37.9; LC_{95}= 152.3 µg/mL of EO contained in the powder formulation	[36]
	Origanum vulgare	*Sitophilus oryzae*	CT	LC_{50}= 0.11 mg/cm^2	[2]
		Tribolium castaneum	IT	Mortality= 10% at 1.14% of EO after 96h.	[25]
	Perilla frutescens	*Lasioderma serricorne*	CT	LD_{50}= 1.46 µg/adult. 6 times less toxic than pyretrin	[37]
		Tribolium castaneum	CT	LD_{50}= 1.20 µg/adult, 4.5 times less toxic than pyretrin	"
	Rosmarinus officinalis	*Sitophilus oryzae*	CT	LC_{50}= 0.18 mg/cm^2	[2]

Plant Family	*Plant species*	*Insect Species*	Tested activity	Main Results	References
		Tribolium castaneum	CT	Mortality= 78.3% fon non formulated EO and 100% for encapsulated EO at 129.40 µL/30.17 cm^2	[38]
	Salvia leriifolia	*Callosobruchus maculatus*	CT	Mortality= 100% at 4.66 mg/cm^2, after 24h	[39]
		Sitophilus oryzae	CT	Mortality= 100% at 4.72 mg/cm^2, after 24h	"
		Tribolium castaneum	CT	Mortality= 92%% at 4.80 mg/cm^2, after 24h	"
	Salvia officinalis	*Tribolium castaneum*	IT	No Mortality at the higest tested concentrations (1.14% of EO)	[25]
	Salvia sclarea	*Tribolium castaneum*	IT	No Mortality at the higest tested concentrations (1.14% of EO)	"
	Salvia veneris	*Oryzaephilus surinamensis*	CT	Mortality= 81.64 ± 2.50% after 72h with 10% EO-acetone solution	[40]
		Rhizopertha dominica	CT	Mortality= 67.09 ± 0.94% after 72h with 10% EO-acetone solution	"
		Sitophilus granarius	CT	Mortality= 70.00 ± 0.00% after 72h with 10% EO-acetone solution	"
		Sitophilus oryzae	CT	Mortality= 71.45 ± 2.50% after 72h with 10% EO-acetone solution	"
		Tribolium castaneum	CT	Mortality= 32.78 ± 1.52% after 72h with 10% EO-acetone solution	"
		Tribolium confusum	CT	Mortality= 53.50 ± 1.40% after 72h with 10% EO-acetone solution	"
	Satureja hortensis	*Ephestia kuehniella*	CT	LC_{50}= 0.27 µL/cm^2	[41]
		Plodia interpunctella	CT	LC_{50}= 0.19 µL/cm^2	"
	Satureja montana	*Tribolium castaneum*	IT	No Mortality at the tested concentrations (1.14% of EO)	[25]
	Schizonepeta multifida	*Sitophilus zeamais*	CT	LD_{50}= 30.17 µg/adult	[42]
		Tribolium castaneum	CT	LD_{50}= 2.75 µg/adult	"
	Teucrium chamaedrys	*Tribolium castaneum*	IT	Mortality= 10% at the tested concentrations (1.14% of EO) after 96h	[25]
	Teucrium polium	*Tribolium castaneum*	IT	No Mortality at the tested concentrations (1.14% of EO)	"
	Thymus marschalianus	*Tribolium castaneum*	IT	No Mortality at the tested concentrations (1.14% of EO)	"
	Thymus serpyllum	*Tribolium castaneum*	IT	Mortality= 13.33% at the tested concentrations (1.14% of EO) after 96h	"
	Vitex agnus-castus	*Sitophilus oryzae*	CT	LC_{50}= 0.39 mg/cm^2	[2]
Lauraceae	*Cinnamomum aromaticum*	*Callosobruchus maculatus*	CT	LD_{50}= 27.56 ± 3.78 at 24h; 23.16 ± 3.76 µg/cm^2 at 48h; Concentration-dependent effect on egg hatching and adult emergence	[43]
	Cinnamomum camphora	*Lasioderma serricorne*	CT	LD_{50}= 7.6-21.3 µg/adult depending on the part of plant	[44]
		Tribolium castaneum	CT	LD_{50}= 19 >50 µg/adult depending on the part of plant.	"
	Laurus nobilis	*Sitophilus oryzae*	CT	LC_{50}= 0.44 mg/cm^2	[30]
		Tribolium castaneum	CT	LC_{50}= 0.4 mg/cm^2	"
	Litsea cubeba	*Lasioderma serricorne*	CT	LD_{50}= 27.33 µg/adult	[45]
		Liposcelis bostrychophila	CT	LD_{50}= 71.56 µg/cm^2	"
	Litsea salicifolia	*Sitophilus zeamais*	CT	LD_{50}= 0.079; LD_{95}= 0.144 µL/insect	[46]
		Tribolium castaneum	CT	LD_{50} and LD_{95}= 0.111 and 0.304 µL/insect	"
Monimiaceae	*Laurelia sempervirens*	*Tribolium castaneum*	CT	LD_{50}= 38.94, LD90= 78.7 µg/mg insect	[47]
				LD_{50}= 44.05; LD90= 102.49 µg/mg insect	"
Myrtaceae	*Callistemon viminals*	*Sitophilus oryzae*	CT	LC_{50}= 0.09 mg/cm^2	[2]
	Eucalyptus camaldulensis	*Sitophilus oryzae*	CT	LC_{50}= 0.34 mg/cm^2	[30]
		Tribolium castaneum	CT	LC_{50}= 0.46 mg/cm^2	"
	Eucalyptus citriodora	*Tribolium castaneum*	CT	LC_{50}= 5.1 % (w/v)	[48]
	Eucalyptus globulus	*Plodia interpunctella*	CT	No mortality at the teseted application rates	[23]
	Eucalyptus obliqua	*Callosobruchus chinensis*	CT	LC_{50}= 59.29 µg/cm^2	[5]
		Corcyra cephalonica	CT	LC_{50}= 56. 47 µg/cm^2	"
		Sitophilus oryzae	CT	LC_{50}= 52.77 µg/cm^2	"
	Eucalyptus procera	*Callosobruchus maculatus*	CT	LC_{50}= 0.124 µL/cm^2	[49]
		Tribolium castaneum	CT	LC_{50}= 0.129 µL/cm^2	"
	Eucalyptus saligna	*Acanthoscelides obtectus*	CT	LC_{50}= 0.003 % v/w after 168h	[20]
		Sitophilus zeamais	CT	LC_{50}= 0.005 % v/w after 168h	"
		Tribolium castaneum	CT	LC_{50}= 0.51 % v/w after 168h	"
	Myrtus communis	*Sitophilus oryzae*	CT	LC_{50}= 0,31 mg/cm^2	[2]
	Syzygium aromaticum	*Sitophilus oryzae*	CT	LC_{50}= 0.04 mg/cm^2	[30]
		Tribolium castaneum	CT	LC_{50}= 0.13 mg/cm^2	"
	Syzygium cumini	*Sitophilus oryzae*	CT	LC_{50}=>0.60 mg/cm^2	[2]
Pinaceae	*Pinus longifolia*	*Callosobruchus chinensis*	CT	LC_{50}= 74.95 µg/cm^2	[5]
		Corcyra cephalonica	CT	LC_{50}= 64.16 µg/cm^2	"
		Sitophilus oryzae	CT	LC_{50}= 77.30 µg/cm^2	"
Poaceae	*Cymbopogon citratus*	*Sitophilus oryzae*	CT	LD_{50}= 0.027 µL/mL	[32]
		Tribolium castaneum	CT	LC_{50}= 20 %(w/v) after 48h	[48]

Plant Family	*Plant species*	*Insect Species*	Tested activity	Main Results	References
	Cymbopogon giganteus	*Tribolium castaneum*	CT	LC_{50}= 6.4 %(w/v) after 48h	"
	Cymbopogon martinii	*Plodia interpunctella*	CT	LD_{50}= 22.8; LD_{90}= 44.3 µg/cm^2	[23]
	Cymbopogon schoenanthus	*Tribolium castaneum*	CT	LC_{50}= 8.5 %(w/v) after 48h	[48]
Rutaceae	*Atalantia guillauminii*	*Lasioderma serricorne*	CT	LD_{50}= 24.07 µg/cm^2	[50]
		Liposcelis bostrychophila	CT	LD_{50}= 55.83 µg/cm^2	"
		Tribolium castaneum	CT	LD_{50}= 17.11 µg/cm^2	"
	Citrus × bergamia	*Rhizopertha dominica*	CT	Residual toxicity= 6 weeks at 0.6%; 20 weeks PEG EOsNP (w/w wheat)	[24]
		Tribolium castaneum	CT	Residual toxicity= 4 weeks at 0.05%; 12 weeks PEG EOsNP (w/w wheat)	"
	Citrus aurantifolia	*Sitophilus oryzae*	CT	LC_{50}= 0.15 mg/cm^2	[2]
	Citrus bergamia	*Plodia interpunctella*	CT	LD_{50}= 116.2; LD90= 188.7 µg/cm^2	[23]
	Citrus lemon	*Sitophilus oryzae*	CT	LC_{50}= 0.2 mg/cm^2	[2]
	Citrus paradisi	*Sitophilus oryzae*	CT	LC_{50}= 0.27 mg/cm^2	"
	Citrus sinensis	*Rhizopertha dominica*	CT	LD_{50}= 351.05 mg/kg; antagonistic effects in combination with diatomaceous earths; synergistic effects in combination with kaolin	[51]
		Sitophilus oryzae	CT	LC_{50}= 0.29 mg/cm^2	[2]
				LC_{50}= 0.43 mg/cm^2	[30]
		Sitophilus zeamais	CT	LD_{50}= 0.074 mg/adult	[35]"
		Tribolium castaneum	CT	LD_{50}= 0.257 mg/adult	"
				LC_{50}= 2.42 mg/cm^2	[30]
	Clausena anisum-olens	*Lasioderma serricorne*	CT	LD_{50}= 12.44 µg/adult	[52]
		Liposcelis bostrychophila	CT	LD_{50}= 74.46 µg/adult	"
	Clausena pentaphylla	*Callosobruchus maculatus*	CT	Mortality= 40% with 10% of EO contained in the formulations. Protectant action for up to six months of seed storage.	[19]
	Dictamnus dasycarpus	*Lasioderma serricorne*	CT	LD_{50}= 12.4 µg/adult	[53]
		Liposcelis bostrychophila	CT	LD_{50}= 27.2 µg/cm^2	"
	Vepris heterophylla	*Sitophilus oryzae*	CT	LD_{50}= 349.8 ppm	[27]
	Zanthoxylum armatum	*Lasioderma serricorne*	CT	LD_{50}= 18.74 µg/adult	[54]
		Tribolium castaneum	CT	LD_{50}= 32.16 µg/adult	"
	Zanthoxylum dissitum	*Attagenus piceus*	CT	Mortality= 22% with EO (leaves) and 100% with EO (roots) at 50%(in hexane)	"
		Lasioderma serricorne	CT	Mortality= 33.3% with EO (leaves) and 100% with EO (roots) at 50%(in hexane); LD_{50} (EO roots)= 13.8 µg/adult	"
		Tribolium castaneum	CT	Mortality= 53.3% with EO (leaves) and 100% with EO (roots) at 50%(in hexane); LD_{50} (EO roots)= 47.3 µg/adult	"
Schisandraceae	*Kadsura heteroclita*	*Sitophilus zeamais*	CT	LD_{50}= 25.57 µg/adult	[55]
Verbenaceae	*Caryopteris incana*	*Sitophilus zeamais*	CT	LD_{50}= 122.65 µg/adult	[56]
	Lippia javanica var. javanica	*Sitophilus oryzae*	CT	LC_{50}= 6.22 mg/mL	[57]
	Lippia javanica var. whytei	*Sitophilus oryzae*	CT	LC_{50}= 2.96 mg/mL	"
Vitaceae	*Cayratia japonica*	*Sitophilus zeamais*	CT	LD_{50}= 32.06 mg/adult	[58]
		Tribolium castaneum	CT	LD_{50}= 44.49 mg/adult	"
Winteraceae	*Drimys winteri*	*Tribolium castaneum*	CT	LD_{50} Bark EO= 75.14, LD_{90} Bark EO= 132.29 µg/mg insect	[47]
				LD_{50} Leaf EO= 84.05, LD_{90} Leaf EO= 162.47 µg/mg insect	"
Zingiberaceae	*Alpinia blepharocalyx*	*Lasioderma serricorne*	CT	LD_{50}= 15.02 mg/adult	[59]
	Amomum maximum	*Liposcelis bostrychophila*	CT	LD_{50}= 67.46 µg/adult	[60]
		Tribolium castaneum	CT	LD_{50}= 29.57 µg/adult	"
	Amomum tsaoko	*Lasioderma serricorne*	CT	LD_{50}= 6.14 µg/adult	[61]
		Tribolium castaneum	CT	LD_{50}= 16.52 µg/adult	"
	Etlingera yunnanensis	*Liposcelis bostrychophila*	CT	LD_{50}= 47.38 µg/adult	[62]
		Tribolium castaneum	CT	LD_{50}= 23.33 µg/adult	"
	Zingiber officinale	*Ephestia kuehniella*	CT	LC_{50}= 0.61; LC_{90}= 1.88 µL/cm^2	[63]
		Plodia interpunctella	CT	LC_{50}= 0.81; LC_{90}= 2.68 µL/cm^2	"
		Sitophilus oryzae	CT	LD_{50}= 0.136 µL/mL	[32]
	Zingiber purpureum	*Lasioderma serricorne*	CT	LD_{50}= 16.3 µg/adult	[64]
		Tribolium castaneum	CT	LD_{50}= 39.0 µg/adult	"
Plant combination	*Hyptis + Ocimum*	*Sitophilus oryzae*	CT	LD_{50}= 75.8 ppm	[27]
	Hyptis + Vepris	*Sitophilus oryzae*	CT	LD_{50}= 182.1 ppm	"
	Ocimum + Vepris	*Sitophilus oryzae*	CT	LD_{50}= 103.8 ppm	"

Table S2 Overview of reviewed studies on EO fumigant toxicity towards stored product pests.

Plant Family	Plant species	Insect Species	Main Results	References
Altingiaceae	*Liquidambar orientalis*	*Sitophilus oryzae*	LC_{50}= 22.8 µL/L air; LC_{90}= 31.6 µL/L air	[65]
Amaryllidaceae	*Allium sativum*	*Tribolium castaneum*	LC_{50}= 1.52 µL/L air; LC_{95}= 5.49 µL/L air	[66]
Anacardiaceae	*Cotinus coggygria*	*Sitophilus oryzae*	LC_{50}> 60 µL/L air	[65]
	Pistacia atlantica	*Tribolium castaneum*	Gum EO= LC_{50}= 29, 57 µL/L air; Fruit EO= LC_{50}= 39.66 µL/L air; Leaves EO= LC_{50}= 64.84 µL/L air	[67]
	Pistacia lentiscus	*Callosobruchus maculatus*	Mortality= 90% after 48h at 8 µL/L air	[68]
		Lasioderma serricorne	LC_{50}= 28.03 µL/L air; LC_{95}= 63.46 µL/L air; LT_{50}= 18.58h and LT $_{95}$= 51.46h at 114 µL/L air	[69]
			LC_{50}= 8.44 µL/L air; LC_{95}= 43.68 µL/L air	[70]
		Sitophilus granarius	Mortality= 33% after 96h at 40 µL	[71]
		Tribolium castaneum	LC_{50}= 8.44 µL/L air; LC_{95}= 43.68µL/L air; LT_{50}= 41.05h and LT_{95}= 79.89h at 114µL/L air	[69]
			LC_{50}= 28.03 µL/L air; LC_{95}= 63.46 µL/L air	[70]
		Tribolium confusum	Mortality= 67% after 96h at 40 µL	[71]
	Pistacia terebinthus	*Sitophilus granarius*	Mortality= 43% after 96h at 40 µL	"
		Tribolium confusum	Mortality= 40% after 96h at 40 µL	"
	Schinus molle	*Sitophilus oryzae*	LC_{50}= 26.89 mg/L	[2]
	Schinus terebinthifolius	*Sitophilus oryzae*	LC_{50}= 28.16 mg/L	"
Apiaceae	*Apium nodiflorum*	*Sitophilus oryzae*	LC_{50}= 20.7 µL/L air; LC_{90}= 39.3 µL/L air	[65]
	Astoma seselifolium	*Sitophilus oryzae*	LC_{50}= 44.43 mg/L	[2]
	Azilia eryngioides	*Sitophilus granarius*	LC_{50}= 20.05 µL/L air; LT_{50}= 21.04h at 37.03 µL/L air	[72]
		Tribolium confusum	LC_{50}= 46.48 µL/L air; LT_{50}= 24.96h at 37.03 µL/L air	"
	Bupleurum fruticosum	*Sitophilus oryzae*	Crop cultivar LC_{50}= 24.9 µL/L air; LC_{90}= 33.5 µL/L air	[65]
			Wild plants LC_{50}= 35.2 µL/L air; LC_{90}= 106.7 µL/L air	"
	Carum copticum	*Sitophilus granarius*	LD_{80}= 24.22 µL/L air; Mortality= 89% at 18 µL/L air of EO and 100% at 12 µL/L of EO-Nanogel after 48h	[73]
			LC_{50}= 10.85 µL/L air; LC_{90}= 18.77 µL/L air	"
		Sitophilus oryzae	LC_{50}= 0.91 µL/L air	[74]
		Tribolium castaneum	LC_{50}= 33.14 µL/L air	"
		Tribolium confusum	LD80= 66.47 µL/L air; Mortality= 72% at 43 µL/L air of EO and 100% at 29 µL/L air of EO-Nanogel after 48h;"	[73]
			LC_{50}= 26.56 µL/L air; LC_{90}= 52.23 µL/L air	"
	Coriandrum sativum	*Callosobruchus chinensis*	LC_{50}= 16.25 µg/cm^2 on 10 cm^2 filter paper	[5]
		Callosobruchus maculatus	LC_{50}= 72.167 µL/L air; LC_{99}= 267.462 µL/L air	[75]
		Corcyra cephalonica	LC_{50}= 18.25 µg/cm^2 on 10 cm^2 filter paper	[5]
		Ephestia kuehniella	LC_{50}= 62.633 µL/L air; LC_{99}= 221.237 µL/L air	[75]
		Lasioderma serricorne	LC_{50}= 5.25 µL/L air; LC_{95} =102.31 µL/L air	[76]
		Plodia interpunctella	LC_{50}= 50.956 µL/L air; LC_{99} =221.495 µL/L air	[75]
		Sitophilus oryzae	LC_{50}= 18.11 µg/cm^2 on 10 cm^2 filter paper	[5]
			LC_{50}= 145.49 µL/L air; LC_{95}= 10124.20 µL/L air	[76]
		Tribolium castaneum	LC_{50}= 276.29 µL/L air; LC_{95}= 4543.74 µL/L air	"
	Crithmum maritimum	*Oryzaephilus surinamensis*	Mortality= 90.75 ± 7.00% at 10%(v/v) acetone solution after 48h	[6]
		Rhizopertha dominica	Mortality= 4.53 ± 3.41% at 10%(v/v) acetone solution after 48h	"
		Sitophilus granarius	Mortality= 100.00 ± 0.00% 10%(v/v) acetone solution after 48h	"
		Sitophilus oryzae	Mortality= 100.00 ± 0.00% 10%(v/v) acetone solution after 48h	"
			LC_{50}= 17.7 µL/L air; LC_{90}= 23.4 µL/L air	[65]
		Tribolium castaneum	Mortality= 0.00% 10%(v/v) acetone solution after 48h	[6]
		Tribolium confusum	Mortality= 0.00% 10%(v/v) acetone solution after 48h	"
	Cuminum cyminum	*Sitophilus granarius*	Mortality= 18% after 24h, 80% after 48h at 16 µL/L air of EO; Mortality= 97% after 24h, 100% after 48h at 16 µL/L air of EO-Nanogel. PT_{50}= 3 days EO and 11 days EO-Nanogel	[77]
		Sitophilus oryzae	LC_{50}= 0.136 mL/mL air	[78]
		Tribolium castaneum	LC_{50}= 0.271 mL/mL air	"
			LC_{50}= larvae= 15.02 µL and adults= 16.26 µL	[79]
		Tribolium confusum	Mortality= 27% after 24h, 94% after 48h at 20 µL/L air of EO; Mortality= 61% after 24h, 100% after 48h at 20 µL/L air of EO-Nanogel; PT_{50}= 4 days EO and 21 days EO-Nanogel	[77]
	Ferula gummosa	*Sitophilus granarius*	LC_{50}= 44.25 µL/L air; LC_{90}= 82.88 µL/L air	[80]
	Foeniculum vulgare	*Tribolium castaneum*	LC_{50}: larvae= 17.48 µL; adults= 18.55 µL	[79]

Plant Family	*Plant species*	*Insect Species*	Main Results	References
	Petroselinum crispum	*Callosobruchus maculatus*	LC_{50}= 71.071 µL/L air; LC_{99}= 272.487 µL/L air	[75]
		Ephestia kuehniella	LC_{50}= 52.412 µL/L air; LC_{99}= 243.219 µL/L air	“
		Plodia interpunctella	LC_{50}= 55.197 µL/L air; LC_{99}= 208.107 µL/L air	“
	Pimpinella anisum	*Tribolium confusum*	Mortality= 75.6% after 14days at 1.5 mL/cm^2	[81]
		Trogoderma granarium	Mortality= 88.3% after 14days at 1.5 mL/cm^2	“
	Pituranthos tortuosus	*Sitophilus oryzae*	LC_{50}= 41.01 mg/L	[2]
Asteraceae	*Achillea wilhelmsii*	*Callosobruchus maculatus*	LC_{50}= 2.65 µL/L air	[82]
		Tribolium castaneum	LC_{50}= 10.02 µL/L air	“
	Aphyllocladus decussatus	*Sitophilus zeamais*	LC_{50}= 212.12 µL/L air	[83]
	Artemisia absinthium	*Oryzaephilus surinamensis*	LC_{50}= 5.22 µL/L air; LC_{95}= 45.18 µL/L air; LT_{50}= 10.750h and LT_{95}= 18.258h at 56.82 µL/L air	[9]
		Tribolium castaneum	LC_{50}= 35.18µL/L air; LC_{95}= 59.87 µL/L air; LT_{50}= 75.576h and LT_{95}= 98.167 h at 56.82 µL/L air	“
	Artemisia anethoides	*Lasioderma serricorne*	LC_{50}= 8.04 mg/L air	[10]
		Tribolium castaneum	LC_{50}= 13.05 mg/L air	“
	Artemisia dracunculus	*Tribolium castaneum*	LC_{50}= 67.2 µL/L air	[84]
		Tribolium confusum	LC_{50}= 178.4 µL/L air	“
	Artemisia dubia	*Liposcelis bostrychophila*	LC_{50}= 0.74 mg/L air	[85]
		Tribolium castaneum	LC_{50}= 49.54 mg/L air	“
	Artemisia herba-alba	*Callosobruchus maculatus*	LC_{50}= 99.35 µL/L air	[86]
		Oryzaephilus surinamensis	LC_{50}= 3.05 µL/L air; LC_{95}= 13.41 µL/L air; LT_{50}= 3.725h and LT_{95}= 7.119h at 56.82 µL/L air	[9]
		Rhizopertha dominica	LC_{50}= 76.48 µL/L air	[86]
		Tribolium castaneum	LC_{50}= 27.76 µL/L air; LC_{95}= 37.63 µL/L air; LT_{50}= 17.308h and LT_{95}= 35.57 h at 56.82 µL/L air	[9]
			LC_{50}= 564.40 µL/L air	[86]
	Artemisia judaica	*Sitophilus oryzae*	LC_{50}= 29.97 mg/L	[2]
	Artemisia khorassanica	*Plodia interpunctella*	LC_{50}= 9.6 µL/L air; LC_{90}= 24.85 µL/L air	[87]
	Artemisia monosperma	*Sitophilus oryzae*	LC_{50}> 50 mg/L	[2]
	Artemisia scoparia	*Callosobruchus maculatus*	LC_{50}= 1.46 µL/L air; LC_{95}= 7.83 µL/L air	[88]
		Sitophilus oryzae	LC_{50}= 1.87 µL/L air; LC_{95}= 7.52 µL/L air	“
		Tribolium castaneum	LC_{50}= 2.05 µL/L air; LC_{95}= 11.12 µL/L air	“
	Artemisia sieberi	*Callosobruchus maculatus*	LC_{50}= 1.45 µL/L air; LC_{95}= 7.95 µL/L air	[89]
			LC_{50}= 1.64µL/L air; LC_{95}= 8.84 µL/L air	“
		Sitophilus oryzae	LC_{50}= 3.86 µL/L air; LC_{95}= 15.55 µL/L air	“
			LC_{50}= 4.41 µL/L air; LC_{95}= 18.06 µL/L air	“
		Tribolium castaneum	LC_{50}= 16.76 µL/L air; LC_{95}= 57.32µL/L air	“
			LC_{50}= 20.31 µL/L air; LC_{95}= 76.03 µL/L air	“
	Artemisia stolonifera	*Lasioderma serricorne*	LC_{50}= 0.99 mg/L air, better than single components	[12]
		Tribolium castaneum	LC_{50}= 1.86 mg/L air, better than single components	“
	Artemisia vulgaris	*Tribolium castaneum*	Mortality= adults 100%, 12, 14 and 16 days larvae 49%, 53% and 52% at 8.0 µL/mL; Mortality= eggs 100% at a concentration 20µL/L air	[90]
	Aster ageratoides	*Sitophilus zeamais*	LC_{50}= 13.73 mg/L	[13]
		Tribolium confusum	LC_{50}= 12.14 mg/L	“
	Dahlia pinnata	*Sitophilus oryzae*	LC_{50}= 14.10 mg/L air	[15]
		Sitophilus zeamais	LC_{50}= 18.80 mg/L air	“
	Eupatorium glabratum	*Sitophilus zeamais*	LC_{50}= 18 µL/mL air (females 16 µL/mL air and males 20 µL/mL air); LC_{95}= 72 µL/mL air (females 59.8 µL/mL air and males 73 µL/mL air); LT_{50}= 102h at 25- 75 µL/mL air	[91]
	Pulicaria gnaphalodes	*Callosobruchus maculatus*	LC_{50}= 1.54µL/L air	[82]
		Tribolium castaneum	LC_{50}= 297.9 µL/L air	“
	Tagetes erecta	*Callosobruchus maculatus*	LD_{50}= 41.7 ppm and LD_{95}= 66.2 ppm	[17]
		Sitophilus oryzae	LD_{50}= 35.2 ppm and LD_{95}= 68.8 ppm	“
		Tribolium castaneum	LD_{50}= 43.9 ppm and LD_{95}= 57.9 ppm	“
	Tagetes minuta	*Callosobruchus maculatus*	LD_{50}= 20.8 ppm and LD_{95}= 38.1 ppm	“
		Sitophilus oryzae	LD_{50} =22.5 ppm and LD_{95}= 40.3 ppm	“
		Sitophilus zeamais	No mortality	[83]
		Tribolium castaneum	LD_{50}= 25.2 ppm and LD_{95}= 41.9 ppm	[17]
	Tagetes patula	*Callosobruchus maculatus*	LD_{50}= 25.7 ppm and LD_{95}= 45.7 ppm	“
		Sitophilus oryzae	LD_{50}= 27.6 ppm and LD_{95}= 43.7 ppm	“
		Tribolium castaneum	LD_{50}= 30.1 ppm and LD_{95}= 46.7 ppm	“
	Tanacetum armenum	*Acanthoscelides obtectus*	LC_{50}= 272.88 µL/L air; LC_{99}= 607.14 µL/L air	[92]
		Tribolium castaneum	No mortality	“
	Tanacetum nubigenum	*Tribolium castaneum*	LC_{50}= 8.32µL in 0.25L air after 48h	[93]
	Tanecetum armenum	*Ephestia kuehniella*	LC_{50}= 7.93 µL/L air after 12h; LC_{99}= 17.65 µL/L air after 12h	[94]
Atherospermataceae	*Laurelia sempervirens*	*Sitophilus zeamais*	LC_{50}= 177 µL/L air	[18]
Brassicaceae	*Brassica rapa*	*Callosobruchus maculatus*	LC_{50} adult= 1.20 ppm; young larvae= 3.94 ppm; old larve= 3.89 ppm; pupae= 3.88 ppm	[95]
		Sitophilus zeamais	LC_{50} adult= 1.21 ppm; young larvae= 4.64 ppm; old larvae= 5.83 ppm; pupae= 6.17 ppm	“

Plant Family	*Plant species*	*Insect Species*	Main Results	References
Chenopodiaceae	*Chenopodium ambrosioides*	*Sitophilus zeamais*	Mortality= 100% after 24hat 500 µL/L air	[96]
		Tribolium confusum	Mortality= 100% after 14days at 1.5 mL/cm^2	[81]
		Trogoderma granarium	Mortality= 92% after 14days at 1.5 mL/cm^2	"
	Chenopodium botrys	*Acanthoscelides obtectus*	LC_{50}= 302.08 µL/L air; LC_{99}= 628.90 µL/L air	[92]
		Ephestia kuehniella	LC_{50}= 32.74 µL/L air after 12h; LC_{99}= 63.53 µL/L air after 12h	[94]
		Tribolium castaneum	No mortality	"
Cupressaceae	*Cupressus macrocarpa*	*Sitophilus oryzae*	LC_{50}= 30.34 mg/L	[2]
	Cupressus sempervirens	*Sitophilus oryzae*	LC_{50}= 17.16 mg/L	"
	Juniperus polycarpus	*Tribolium castaneum*	LC_{50}= 368 µL/L air after 24h	[97]
	Juniperus sabina	*Tribolium castaneum*	LC_{50}= 302 µL/L air after 24h	"
	Platycladus orientalis	*Callosobruchus maculatus*	Levaes EO LC_{50}= 2.99 µL/L air after 48h; LC_{95}= 18.06 µL/L air after 48h; Fruit EO LC_{50}= 3.98 µL/L air after 48h; LC_{95}= 27.19 µL/L air after 48h	[98]
		Sitophilus oryzae	Leaves EO LC_{50}= 11.08 µL/L air after 48h; LC_{95}= 43.44 µL/L air after 48h; Fruit EO LC_{50}= 14.27 µL/L air after 48h; LC_{95}= 54.15 µL/L air after 48h	"
		Tribolium castaneum	Leaves EO LC_{50}= 26.31 µL/L air after 48h; LC_{95}= 114.69 µL/L air after 48h; Fruit EO LC_{50}= 29.23 µL/L air after 48h; LC_{95}= 197.57 µL/L air after 48h	"
	Thuja occidentalis	*Sitophilus oryzae*	LC_{50}= 43.11 mg/L	[2]
Euphorbiaceae	*Mallotus apelta*	*Liposcelis bostrychophila*	LC_{50}= 3.21 mg/L air	[22]
		Sitophilus zeamais	LC_{50}= 48.42 mg/L air	"
	Ricinus communis	*Lasioderma serricorne*	No mortality	[99]
		Tribolium castaneum	No mortality	"
Geraniaceae	*Geranium maculatum*	*Plodia interpunctella*	KT_{50}= 32.6 min and KT_{90}= 43.6 min at 40µL; RT_{50}= 2.532 at 0.05%(w/w) in 20 g of whole grain wheat	[23]
	Pelargonium	*Rhizopertha dominica*	Mortality= higher for PEG EONP than for pure EO at 3%(w/w wheat)	[24]
		Tribolium castaneum	Mortality= higher for PEG EONP than for EOs at 0.25%(w/w wheat)	"
	Pelargonium graveolens	*Sitophilus oryzae*	LC_{50}> 50 mg/L	[2]
Hypericaceae	*Hypericum hyssopifolium*	*Sitophilus granarius*	Mortality= 43% after 96h at 40 µL	[71]
		Tribolium confusum	Mortality= 50% after 96h at 40 µL	"
	Hypericum scabrum	*Ephestia kuehniella*	Mortality= 72% at 10 µl in 4L air	[100]
		Sitophilus granarius	Mortality= 73% at 10 µl in 4L air	"
Lamiaceae	*Agastache foeniculum*	*Lasioderma serricorne*	LC_{50}= 21.565 µL/L air	[101]
		Oryzaephilus surinamensis	LC_{50}= 18.781 µL/L air	"
		Rhizopertha dominica	LC50= 14.17 µL/L air; LC_{95}= 166.01 µL/L air; LT_{50}= 10.05h LT $_{95}$= 62.22h at 42 µL/L air	[102]
		Tribolium castaneum	LC_{50}= 22.24 µL/L air; LC_{95}= 129.93 µL/L air; LT_{50}= 12.47h and LT $_{95}$= 48.66h at 42 µL/L air	"
	Dracocephalum moldavica	*Sitophilus zeamais*	LC_{50}= 2.65 mg/L air	[26]
		Tribolium confusum	LC_{50}= 0.88 mg/L air	"
	Hyptis spicigera	*Callosobruchus maculatus*	LC_{50}= 1.30 µL/L air; LC_{90}= 2.84 µL/L air	[103]
		Sitophilus zeamais	Mortality= 68% after 2days at 2 µL/L air	[104]
		Tribolium castaneum	Mortality= 3% after 2days at 2 µL/L air	"
	Hyptis suaveolens	*Callosobruchus maculatus*	LC_{50}= 5.53 µL/L air; LC_{90}= 7.80 µL/L air	[103]
			LC_{50}= 4.7 mg/L air	[28]
		Rhizopertha dominica	LC_{50}= 12.0 mg/L air	"
		Sitophilus oryzae	LC_{50}= 10.6 mg/L air	"
		Tribolium castaneum	LC_{50}= 23.2 mg/L air	"
	Hyssopus officinalis	*Ephestia kuehniella*	Mortality= 14% at 10 µl in 4L air	[100]
		Sitophilus granarius	Mortality= 14% at 10 µl in 4L air	"
	Lavandula angustifolia	*Plodia interpunctella*	KT_{50}= 35.2 min and KT90= 48.3 min at 40µL; RT_{50}= 1.309 at 0.05%(w/w) in 20 g of whole grain wheat	[23]
		Sitophilus granarius	LC_{50}= 1.6 mg/L air and LC_{90}= 4.1 mg/L air in absence of grains; LC_{50}= 10.9 mg/L air and LD90= 47.6 mg/L air in presence of grains	[29]
	Lavandula officinalis	*Sitophilus oryzae*	LC_{50}= 36.57 mg/cm^2 on 6 cm^2 filter paper	[30]
		Tribolium castaneum	LC_{50}>100 mg/cm^2 on 6 cm^2 filter paper	"
	Lavandula stoechas	*Lasioderma serricorne*	LC_{50}= 3.835 µL/L air	[105]
		Rhizopertha dominica	LC_{50}= 5.66 µL/L air	"
		Tribolium castaneum	LC_{50}= 39.685 µL/L air	"
	Mentha × piperita	*Corcyra cephalonica*	LC_{50}= larvae= 343.96 µL/L air	[106]
		Sitophilus oryzae	LC_{50}= adults= 85.04 µL/L air	"
	Mentha longifolia	*Callosobruchus maculatus*	LC_{50}= 2.05 µL/L air	[82]
		Tribolium castaneum	LC_{50}= 13.05 µL/L air	"
	Mentha longifolia subsp. capensis	*Sitophilus zeamais*	Mortality= 60-80% after 3days at 24 -32 µL/L air	[31]

Plant Family	Plant species	Insect Species	Main Results	References
	Mentha piperita	*Plodia interpunctella*	KT_{50}= 27.1 min and KT_{90}= 47.2 min at 40µL; RT_{50}= 3.081 at 0.05%(w/w) in 20 g of whole grain wheat	[23]
		Sitophilus oryzae	LC_{50}= 0.135 mL/mL air	[78]
		Tribolium castaneum	LC_{50}= 0.421 mL/mL air	"
	Mentha pulegium	*Lasioderma serricorne*	LC_{50}= 8.46 µL/L air	[99]
		Sitophilus granarius	LC_{50}= 0.038 µL/L air; LC_{90}= 0.137 µL/L air	[107]
		Tribolium castaneum	LC_{50}= 11.57 µL/L air	[99]
	Mentha sp.	*Sitophilus oryzae*	LC_{50}= 3.51 µl/cm^2	[32]
	Mentha spicata	*Ephestia kuehniella*	LD_{50}= 0.5 µL/L; LD_{99}= 2.4 µL/L	[108]
		Plodia interpunctella	LD_{50}= 0.4 µL/L; LD_{99}= 2.1 µL/L	"
	Micromeria fruticosa	*Ephestia kuehniella*	Mortality= 24% at 10 µl in 4L air	[100]
		Sitophilus granarius	Mortality= 12% at 10 µl in 4L air	"
	Minthostachys verticillata	*Sitophilus zeamais*	LC_{50}= 116.61 µL/L air	[83]
	Mosla soochowensis	*Sitophilus zeamais*	LC_{50}= 12.19 mg/L air	[34]
		Tribolium confusum	LC_{50}= 10.26 mg/L air	"
	Ocimum americanum	*Callosobruchus maculatus*	LC_{50}= 0.23 µL/L air; LC_{90}= 0.71 µL/L air	[103]
	Ocimum basilicum	*Callosobruchus maculatus*	Mortality= 0-100% at 5 µL depending on genotype (i.e. 18 genitypes tested)"	[109]
		Ephestia kuehniella	LD_{50}= 1.4 µL/L; LD_{99}= 4.1 µL/L	[108]
		Plodia interpunctella	LD_{50}= 1.2 µL/L; LD_{99}= 3.8 µL/L	"
		Sitophilus oryzae	Mortality=>95% at 3mL of acetone solution (10% v/v)	[110]
		Sitophilus zeamais	LC_{50}= 0.014 mg/cm3 air	[35]
		Tribolium castaneum	LC_{50}= 0.106 mg/cm3 air	"
		Tribolium confusum	Mortality= 86.3% after 14days at 1.5 mL/cm^2	[81]
		Trogoderma granarium	Mortality= 100% after 14days at 1.5 mL/cm^2	"
	Ocimum gratissimum	*Callosobruchus chinensis*	LC_{50}= 0.20 after 24h µL/L air	[111]
		Oryzaephilus surinamensis	LC_{50}= 0.19 after 72h µL/L air	"
		Rhizopertha dominica	LC_{50}= 0.20 after 72h µL/L air	"
		Sitophilus oryzae	LC_{50}= 0.50 after 72h µL/L air	"
		Tribolium castaneum	LC_{50}= 24.9 after 72 µL/L air	"
	Origanum acutidens	*Ephestia kuehniella*	Mortality= 79% at 10 µl in 4L air	[100]
			Mortality= 88.3 ± 1.9 third instar larvae after 72h at 2 µL/L air	[112]
		Lasioderma serricorne	Mortality= 100.0 ± 3.1 adults after 72h at 2 µL/L air	"
		Sitophilus granarius	Mortality= 93.3 ± 1.6 adults after 72h at 2 µL/L air	"
			Mortality= 74% at 10 µl in 4L air	[100]
	Origanum majorana	*Acanthoscelides obtectus*	LC_{50}= 45.31 µL/L air; LC_{99}= 70.75 µL/L air	[92]
		Ephestia kuehniella	Egg Mortality: LT_{50}= 57.98h and LT_{99} =127.82h at 200 µL/L air	[113]
			LC_{50}= 3.27 µL/L air after 12h; LC_{99}= 5.13 µL/L air after 12h	[94]
		Plodia interpunctella	Egg Mortality: LT_{50}= 35.66h and LT_{99}= 90.19h at 200 µL/L air	[113]
		Tribolium castaneum	LC_{50}= 3.32 µg/mL	[114]
			LC_{50}= 92.80 µL/L air; LC_{99}= 159.03 µL/L air	[92]
	Origanum minutiflorum	*Tribolium castaneum*	LC_{50}= 34.571 µg/mL	[114]
	Origanum onites	*Acanthoscelides obtectus*	LC_{50}= 209.29 µL/L air; LC_{99}= 360.08 µL/L air	[92]
			LC_{50}= 236.42 µL/L air; LC_{99}= 444.68 µL/L air	[115]
		Ephestia kuehniella	LC_{50}= 7.52 µL/L air; LC_{99}= 12.72 µL/L air	"
			LC_{50}= 9.81 µL/L air after 12h; LC_{99}= 25.03 µL/L air after 12h	[94]
		Plodia interpunctella	LC_{50}= 4.06 µL/L air; LC_{99}= 5.77 µL/L air	[115]
		Tribolium castaneum	LC_{50}= 52.91 µg/mL	[114]
			LC_{50}= 270.71 µL/L air; LC_{99}= 479.09 µL/L air	[92]
	Origanum syriacum	*Tribolium castaneum*	LC_{50}= 10.93 µg/mL	[114]
	Origanum vulgare	*Sitophilus oryzae*	LC_{50}= 1.64 mg/L	[2]
		Tribolium castaneum	LC_{50}= 72.75 µg/mL	[114]
	Perilla frutescens	*Dermestes maculatus*	LC_{50}: Adults= 0.06 µL/L; Larvae= 0.09 µL/L; Pupae= 0.16 µL/L; Eggs= 0.10 µL/L. With CO_2 (25% or 60%) LC_{50} decreased 3 and 6 times respectively	[116]
		Lasioderma serricorne	LC_{50}= 4.16 mg/L air	[117]
			LC_{50}= 1.21 mg/L air	"
		Tribolium castaneum	LC_{50}= 4.10 mg/L air	"
	Perovskia abrotanoides	*Sitophilus oryzae*	LC_{50}= 18,75µL/L air; LC_{95}= 53.00 µL/L air; LT_{50}= 11.54h and LT_{95}= 17.55h at 32 µL/L air	[118]
		Tribolium castaneum	LC_{50}= 11.39µL/L air; LC_{95}= 45.46 µL/L air; LT_{50}= 4.53h and LT_{95}= 9.21 at 32 µL/L air	"
	Perovskia atriplicifolia	*Tribolium castaneum*	Mortality= 5% with 7.65 µL/L EO and 25.8 % with 7.65 µL/L EO combined with 230 Gy irradiation	[119]

Plant Family	Plant species	Insect Species	Main Results	References
			LD_5, LD_{25} and LD_{50} were increased 8.5, 13.0 and 16.0 times, respectively, in combination with irradiation (900 Gy)	[120]
	Rosmarinus officinalis	*Ephestia kuehniella*	LC_{50}= 100.52 µL/L air	[80]
		Plodia interpunctella	LC_{50}= 0.93 µL/L air; LC_{90}= 6.33 µL/L air	[107]
		Sitophilus oryzae	LC_{50}= 26.71 mg/L	[2]
		Tribolium castaneum	Mortality= 71.6% after 24h at 27.76 µL/L of EO and 96.6% at 27.76 µL/L of polycaprolactone nanocapsules loading EO	[38]
			LC_{50}= 1.17 µg/mL	[114]
			LC_{50}= 103.28 µL/L air	[80]
			Mortality= 5% with 4.84 µL/L EO and 50% with 4.84 µL/L EO combined with 230 Gy irradiation	[119]
	Salvia cryptantha	*Acanthoscelides obtectus*	LC_{50}= 120.27 µL/L air; LC_{99}= 253.34 µL/L air	[92]
		Tribolium castaneum	LC_{50}= 372.550 µL/L air; LC_{99}= 654.27 µL/L air	"
	Salvia fruticosa	*Sitophilus oryzae*	Cultivated crop: LC_{50}= 15.5 µL/L air; LC_{90}= 27.0 µL/L air	[65]
			Wild plant: LC_{50}= 7.4 µL/L air; LC_{90}= 10.1 µL/L air	"
	Salvia leriifolia	*Callosobruchus maculatus*	Mortality= 100% after 24h at 5.21mg/cm^2 for EOs from vegetative and flowering plants	[121]
		Rhizopertha dominica	LC_{50}= 25.87 µL/L air after 48h; LC_{95}= 333.65 µL/L air after 48 ; LT_{50}= 29.26h and LT $_{95}$= 89.02h at 40 µL/L air	[122]
		Sitophilus granarius	LC_{50}= 56.12µL/L air after 48h; LC_{95}= 744.76 µL/L air after 48h; LT_{50}= 30.46h and LT $_{95}$= 107.99h at 65 µL/L air	"
		Sitophilus oryzae	Mortality= 100% after 24h at 5.21 mg/cm^2 for EOs from vegetative and flowering plants	[121]
		Tribolium castaneum	Mortality= 88% and 100% after 24h at 5.21 mg/cm^2 for EOs from vegetative and flowering plants, respectively	"
	Salvia limbata	*Ephestia kuehniella*	Mortality= 6% at 10 µl in 4L air	[100]
		Sitophilus granarius	Mortality= 7% at 10 µl in 4L air	"
	Salvia microphylla	*Sitophilus oryzae*	LC_{50}> 60 µL/L air	[65]
	Salvia nemerosa	*Ephestia kuehniella*	Mortality= 0% at 10 µl in 4L air	"
		Sitophilus granarius	Mortality= 10% at 10 µl in 4L air	"
	Salvia officinalis	*Callosobruchus maculatus*	Mortality= 100% after 48h at 4 µL/L air	[68]
		Sitophilus granarius	LC_{50}= 342.97 µL/L air; LC_{90}= 614.05 µL/L air	[80]
		Sitophilus oryzae	LC_{50}= 9.9 µL/L air; LC_{90}= 17.4 µL/L air	[65]
			LC_{50}= 311.09 µL/L air; LC_{90}= 508.09 µL/L air	[80]
		Tribolium castaneum	LC_{50}= 4.74 µg/mL	[114]
	Salvia pomifera	*Sitophilus oryzae*	LC_{50}= 4.4 µL/L air; LC_{90}= 6.5 µL/L air	[65]
	Salvia veneris	*Oryzaephilus surinamensis*	Mortality= 90.75 ± 7.00% at 1 µL/mL air of 10% acetone solution (v/v) after 48 h	[40]
		Rhizopertha dominica	Mortality= 0.00% at 1 µL/mL air of 10% acetone solution (v/v) after 48 h	"
		Sitophilus granarius	Mortality= 97.63 ± 7.00% at 1 µL/mL air of 10% acetone solution (v/v) after 48 h	"
		Sitophilus oryzae	Mortality= 100.00 ± 0.00% at 1 µL/mL air of 10% acetone solution (v/v) after 48 h	"
		Tribolium castaneum	Mortality= 0.00% at 1 µL/mL air of 10% acetone solution (v/v) after 48 h	"
		Tribolium confusum	Mortality= 0.00% at 1 µL/mL air of 10% acetone solution (v/v) after 48 h	"
	Satureja hortensis	*Ephestia kuehniella*	Mortality= 62% at 10 µl in 4L air	[100]
			LC_{50}= larvae= 80.9 µL/L air after 9h	[41]
		Plodia interpunctella	LC_{50}= larvae= 139.8 µL/L air after 9h	"
		Sitophilus granarius	Mortality= 66% at 10 µl in 4L air	[100]
		Tribolium castaneum	LC_{50}= 192.35 µL/L air	[41]
	Satureja thymbra	*Acanthoscelides obtectus*	LC_{50}= 104.99 µL/L air; LC_{99}= 215.41 µL/L air	[92]
			LC_{50}= 124.75 µL/L air; LC_{99}= 336.64 µL/L air	[115]
		Ephestia kuehniella	Egg Mortality= LT_{50}= 58.58h and LT $_{99}$= 158.50h at 50 µL/L air	[113]
			LC_{50}= 10.34 µL/L air; LC_{99}= 21.27 µL/L air	[115]
			LC_{50}= 13.92 µL/L air after 12h; LC_{99}= 33.11 µL/L air after 12h	[94]
		Plodia interpunctella	Egg Mortality= LT_{50}= 34.64h and LT $_{99}$= 81.88h at 50 µL/L air	[115]
			LC_{50}= 3.43 µL/L air; LC_{99}= 7.72 µL/L air	[115]
		Tribolium castaneum	LC_{50}=133.85 µL/L air; LC_{99}= 221.21 µL/L air	[92]
	Schizonepeta multifida	*Sitophilus zeamais*	LC_{50}= 8.33 mg/cm^3	[42]
		Tribolium castaneum	LC_{50}= 26.41 mg/cm^3	"
	Sideritis perfoliata	*Acanthoscelides obtectus*	Mortality= 100% at 70 and 140 µL/L air	[123]
		Tribolium castaneum	Mortality= 76.7% and 100% at 70 and 140 µL/L air, respectively	"
	Teucrium capitatum	*Sitophilus oryzae*	LC_{50}= 37.9 µL/L air; LC_{90}= 90.9 µL/L air	[65]

Plant Family	*Plant species*	*Insect Species*	Main Results	References
	Teucrium polium	*Callosobruchus maculatus*	LC_{50}= 148.96 µL/L air	[124]
		Tribolium castaneum	LC_{50}= 360.25 µL/L air	"
	Thymbra capitata	*Sitophilus oryzae*	LC_{50}= 3.4 µL/L air; LC_{90}= 5.8 µL/L air	[65]
	Thymus daenensis	*Ephestia kuehniella*	LC_{50}= 1instar larvae= 16.30 µL/L air; 3instar larvae= 4483 µL/L air; adults= 0.191 µL/L air	[125]
		Plodia interpunctella	LC_{50}= 1instar larvae= 25.32 µL/L air; 3instar larvae= 3480 µL/L air; adults= 0.274 µL/L air	"
	Thymus persicus	*Sitophilus oryzae*	LC_{50}= 3.34 µL/L air	[126]
		Tribolium castaneum	LC_{50}= 236.9 µL/L air	"
	Thymus sipyleus	*Acanthoscelides obtectus*	LC_{50}= 27.36 µL/L air; LC_{99}= 43.05 µL/L air	[92]
		Tribolium castaneum	No mortality	"
	Thymus vulgaris	*Ephestia kuehniella*	Mortality= 24% at 10 µl in 4L air	[100]
		Sitophilus granarius	Mortality= 4% at 10 µl in 4L air	"
		Tribolium castaneum	LC_{50}= 8.14 µg/mL	[114]
	Vitex agnus-castus	*Sitophilus oryzae*	LC_{50}= 39.85 mg/L	[2]
	Vitex pseudo-negundo	*Plodia interpunctella*	LC_{50}= 23.05 µL/L air; LC_{90}= 56.84 µL/L air	[87]
		Sitophilus oryzae	LC_{50}= 31.96 µL/L air	[127]
		Tribolium castaneum	LC_{50}= 47.27 µL/L air	"
	Zataria multiflora	*Plodia interpunctella*	LC_{50}= 1.75 µL/L air; LC_{90}= 24.26 µL/L air	[107]
	Ziziphora clinopodioides	*Ephestia kuehniella*	LC_{50}= larvae= 54.61 µL/L air; adults= 1.39 µL/L air	[128]
Lauraceae	*Cinnamomum aromaticum*	*Callosobruchus maculatus*	LD_{50}= 434.69 ± 32.56 µg/cm² after 24h	[43]
	Cinnamomum camphora	*Lasioderma serricorne*	LC_{50}: Flowers <3.3 mg/L air; Leaves= 2.5 mg/L air; Barks= 3.0 mg/L air	[44]
		Tribolium castaneum	LC_{50}: Flowers= 5 mg/L air;Leaves<3.1 mg/L air; Barks<3.2 mg/L air	"
		Trogoderma granarium	Mortality= 100% after 14days at 1.5 mL/cm²	[81]
		Tribolium confusum	Mortality= 89% after 14days at 1.5 mL/cm²	"
	Laurus azorica	*Sitophilus oryzae*	LC_{50}= 33.7 µL/L air; LC_{90}= 56.2 µL/L air	[65]
	Laurus nobilis	*Acanthoscelides obtectus*	LC_{50}= 108.09 µL/L air; LC_{99}= 208.55 µL/L air	[92]
		Callosobruchus maculatus	Mortality= 90% after 48h at 4 µL/L air	[68]
		Ephestia kuehniella	Egg Mortality: LT_{50}= 46.26h and LT $_{99}$= 120.23h at 200 µL/L air	[113]
			LC_{50}= 1.6 µL/L air; LC_{95}= 13.01 µL/L air	[129]
			LC_{50}= 14.16 µL/L air after 12h; LC_{99}= 31.38 µL/L air after 12h	[94]
		Plodia interpunctella	Egg Mortality: LT_{50}= 38.98h and LT $_{99}$= 108.87h at 200 µL/L air	[113]
		Rhizopertha dominica	LC_{50} and LT_{50}= Tunisia= 113.42 µL/L air and 19.58h; Algeria= 98.95 µL/L air and 17.58h; Marocco= 67.9 µL/L air and 14.25h	[130]
		Sitophilus oryzae	LC_{50}= 41.7 mg/cm² on 6 cm² filter paper	[30]
			LC_{50}= 8.0 µL/L air; LC_{90}= 11.0 µL/L air	[65]
		Tribolium castaneum	LC_{50}= 47.02 mg/cm² on 6 cm² filter paper	[30]
			LC_{50}: adults= 243.78 µL/L air and larvae= 69.63 µL/L air; LC_{90}= adults= 685.85 µL/L air and larvae= 211.64 µL/L air	[131]
			LC_{50}= 192.78 µL/L air; LC_{99}= 300.13 µL/L air	[92]
			LC_{50} and LT_{50}= Tunisia= 217.10 µL/L air and 55.67h; Algeria= 193.95 µL/L air and 51.53h; Marocco= 172.37 µL/L air and 43.05h	[130]
	Litsea cubeba	*Lasioderma serricorne*	LC_{50}= 22.97 mg/L air	[45]
		Liposcelis bostrychophila	LC_{50}= 0.73 mg/L air	"
	Litsea salicifolia	*Sitophilus zeamais*	LC_{50}= 4.4 µL/L air; LC_{95}= 174.6 µL/L air	[46]
		Tribolium castaneum	LC_{50}= 845.2 µL/L air; LC_{95}= 1345 µL/L air	"
Monimiaceae	*Laurelia sempervirens*	*Tribolium castaneum*	Bark EO: LC50= 1.63 µL/L air after 24h; LC_{90}= 8.61 µL/L air after 24h; LT_{50} =9-3days andLT_{90}= 17-7days at 25-100µL/L air	[47]
			Leaves EO (LC_{50})= 1.66 µL/L air after 24h; LC_{90}= 8.44 µL/L air after 24h; LT_{50} =9-4days andLT_{90}=19-9days at 25-100 µL/L air	"
Moringaceae	*Moringa oleifera*	*Cryptolestes ferrugineus*	Average Mortality= 20.44% µL/L air	[132]
		Tribolium castaneum	Average Mortality= 12.03% µL/L air	"
		Trogoderma granarium	Average Mortality= 9.41% µL/L air	"
Myrtaceae	*Callistemon viminals*	*Sitophilus oryzae*	LC_{50}= 16.17 mg/L	[2]
	Eucalyptus camaldulensis	*Callosobruchus maculatus*	LC_{50}= 3.97 µL/L air; LC_{95}= 10.86 µL/L air	[133]
		Cryptolestes ferrugineus	Average Mortality= 23.31% µL/L air	[132]
		Sitophilus oryzae	LC_{50}= 22.22 mg/cm² on 6 cm² filter paper	[30]
			LC_{50}= 12.06 µL/L air; LC_{95}= 16.94 µL/L air	[133]
		Tribolium castaneum	Average Mortality= 17.43% µL/L air	[132]
			LC_{50}= 57.7 mg/cm² on 6 cm² filter paper	[30]
			LC_{50}= 33.50 µL/L air; LC_{95}= 92.59 µL/L air	[133]
		Trogoderma granarium	Average Mortality= 14.27% µL/L air	[132]
	Eucalyptus citriodora	*Tribolium castaneum*	LC_{50}= 2.0 mL/L air	[48]
	Eucalyptus floribundi	*Oryzaephilus surinamensis*	LC_{50}= 43.54 µL/L air; LC_{95}= 174.47 µL/L air	[134]
		Rhizopertha dominica	LC_{50}= 34.39 µL/L air; LC_{95}= 77.07 µL/L air	"
	Eucalyptus globulus	*Callosobruchus maculatus*	Mortality= 92% after 48h at 4 µL/L air	[68]

Plant Family	*Plant species*	*Insect Species*	Main Results	References
		Lasioderma serricorne	LC_{50}= 11.222 µL/L air	[135]
		Plodia interpunctella	KT_{50}= 8.34 min and KT90= 17.4 min at 40µL ; RT_{50}= 0.444 at 0.05%(w/w) in 20 g of whole grain wheat	[23]
		Rhizopertha dominica	LC_{50}= 3.529 µL/L air	[135]
	Eucalyptus intertexta	*Callosobruchus maculatus*	LC_{50}= 2.55 µL/L air; LC_{95}= 8.46 µL/L air	[133]
		Sitophilus oryzae	LC_{50}= 6.93 µL/L air; LC_{95}= 13.40 µL/L air	"
		Tribolium castaneum	LC_{50}= 11.59 µL/L air; LC_{95}= 16.10 µL/L air	"
	Eucalyptus leucoxylon	*Callosobruchus maculatus*	LC_{50}= 2.76 µL/L air	[136]
		Sitophilus oryzae	LC_{50}= 8.48 µL/L air	"
		Tribolium castaneum	LC_{50}= 13.15 µL/L air	"
	Eucalyptus obliqua	*Callosobruchus chinensis*	LC_{50}= 21.70 µg/cm² on 10 cm² filter paper	[5]
		Corcyra cephalonica	LC_{50}= 22.37 µg/cm² on 10 cm² filter paper	"
		Sitophilus oryzae	LC_{50}= 30.29 µg/cm² on 10 cm² filter paper	"
	Eucalyptus procera	*Callosobruchus maculatus*	LC_{50}= 11.722 µL/L air after 24h	[49]
		Tribolium castaneum	LC_{50}= 13.9 µL/L air after 24h	"
	Eucalyptus radiata	*Callosobruchus maculatus*	Mortality= 100% after 48h 8 µL/L air	[68]
	Eucalyptus sargentii	*Callosobruchus maculatus*	LC_{50}= 3.87 µL/L air; LC_{95}= 11.18 µL/L air	[133]
		Sitophilus oryzae	LC_{50}= 12.91 µL/L air; LC_{95}= 19.17 µL/L air	"
		Tribolium castaneum	LC_{50}= 18.38 µL/L air LC_{95}= 27.93 µL/L air	"
	Melaleuca alternifolia	*Sitophilus zeamais*	LC_{50}= 8.42 mg/L air after 24h, 7.70 mg/L air after 48h, 6.78 mg/L air after 72h mg/L air	[137]
	Myrtus communis	*Acanthoscelides obtectus*	LC_{50}= 27.36 µL/L air; LC_{99}= 43.05 µL/L air	[92]
			LC_{50}= 49.58 µL/L air; LC_{99}= 76.07 µL/L air	[115]
		Callosobruchus maculatus	Mortality= 100% after 48h at 8 µL/L air	[68]
		Ephestia kuehniella	Egg Mortality: LT_{50}= 22.23h and LT $_{99}$= 53.36h at 200 µL/L air	[113]
			LC_{50}= 0.6 µL/L air; LC_{95}= 4.00 µL/L air	[129]
			LC_{50}= 12.74 µL/L air; LC_{99}= 29.43 µL/L air	[115]
			LC_{50}= 15.15 µL/L air after 12h; LC_{99}= 29.85 µL/L air after 12h	[94]
		Plodia interpunctella	Egg Mortality: LT_{50}= 50.42h and LT $_{99}$= 179.33h at 200 µL/L air	[113]
			LC_{50}= 22.61 µL/L air; LC_{99}= 41.74 µL/L air	[115]
		Sitophilus oryzae	LC_{50}= 27.4 mg/L	[2]
			LC_{50}= 20.3 µL/L air; LC_{90}= 49.4 µL/L air	[65]
		Tribolium castaneum	LC_{50}= adults= 56.11 µL/L air and larvae= 183.659 µL/L air; LC_{90}= adults= 144.01 µL/L air and larvae= 656.84 µL/L air	[131]
			LC_{50}= 56.98 µL/L air; LC_{99}= 89.73 µL/L air	[92]
	Syzygium aromaticum	*Sitophilus oryzae*	LC_{50}= 41.76 mg/cm² on 6 cm² filter paper	[30]
		Tribolium castaneum	LC_{50}>100 mg/cm² on 6 cm² filter paper	"
			LC_{50}= 6.63 ppm at 72h	[138]
	Syzygium cumini	*Sitophilus oryzae*	LC_{50}> 50 mg/L	[2]
Pinaceae	*Pinus longifolia*	*Callosobruchus chinensis*	LC_{50}= 33.11 µg/cm² on 10 cm² filter paper	[5]
		Corcyra cephalonica	LC_{50}= 33.75 µg/cm² on 10 cm² filter paper	"
		Sitophilus oryzae	LC_{50}= 47.88 µg/cm² on 10 cm² filter paper	"
Piperaceae	*Piper nigrum*	*Corcyra cephalonica*	LC_{50}= larvae= 530.53 µL/L air	[106]
		Sitophilus oryzae	LC_{50}= adults= 287.70 µL/L air	"
		Tribolium castaneum	LC_{50}= larvae= 14.02 µL and adults= 15.26 µL	[79]
Poaceae	*Cymbopogon citratus*	*Oryzaephilus surinamensis*	LC_{50}= 33.1 µL/L air	[139]
		Sitophilus oryzae	LC_{50}= 4.15 µl/cm²	[32]
		Sitophilus zeamais	LC_{50}> 604 µL/L air	[139]
		Tribolium castaneum	LC_{50}= 4.2 mL/L air	[48]
	Cymbopogon giganteus	*Tribolium castaneum*	LC_{50}= 2.1 mL/L air	"
	Cymbopogon martinii	*Oryzaephilus surinamensis*	LC_{50}= 37.2 µL/L air	[139]
		Plodia interpunctella	KT_{50}= 92.6 min and KT_{90}= 119.3 min at 40µL; RT_{50}= 4.855 at 0.05%(w/w) in 20 g of whole grain wheat	[23]
		Sitophilus zeamais	LC_{50}= 159 µL/L air	[139]
	Cymbopogon nardus	*Oryzaephilus surinamensis*	LC_{50}= 46.9 µL/L air	"
		Sitophilus zeamais	LC_{50}> 604 µL/L air	"
	Cymbopogon schoenanthus	*Tribolium castaneum*	LC_{50}= 2.3 mL/L air	[48]
Ranuncolaceae	*Nigella sativa*	*Cryptolestes ferrugineus*	Average Mortality= 22.95% µL/L air	[132]
		Tribolium castaneum	Average Mortality= 20.06% µL/L air	"
			LC_{50}= 4.64 at 72h ppm	[138]
		Trogoderma granarium	Average Mortality= 10.94% µL/L air	[132]
Rutaceae	*Atalantia guillauminii*	*Lasioderma serricorne*	LC_{50}= 12.06 mg/L air	[50]
		Liposcelis bostrychophila	LC_{50}> 16.75 mg/L air	"
		Tribolium castaneum	LC_{50}= 17.60 mg/L air	"
			LC_{50}= 101.69 µL/L air; LC_{90}= 244.43 µL/L air	[140]
		Sitophilus oryzae	LC_{50}= 113.67 µL/L air; LC_{90}= 261.98 µL/L air	"
	Citrus × bergamia	*Rhizopertha dominica*	Mortality= higher for PEG EONP than for EO at 0.6%(w/w wheat)	[24]

Plant Family	*Plant species*	*Insect Species*	Main Results	References
		Tribolium castaneum	Mortality= higher for PEG EONP than for EO at 0.05%(w/w wheat)	"
	Citrus aurantifolia	*Sitophilus oryzae*	LC_{50}= 29.37 mg/L	[2]
	Citrus aurantium	*Tribolium confusum*	LC_{50}= 4.08*10^{-3} %(v/v EO/air)	[141]
	Citrus bergamia	*Plodia interpunctella*	KT_{50}= 68.7 min and KT90= 96.9 min at 40µL; RT_{50}= 0.631 at 0.05%(w/w) in 20 g of whole grain wheat	[23]
		Tribolium confusum	LC_{54}= 33.02*10^{-3} %(v/v EO/air)	[141]
	Citrus lemon	*Sitophilus oryzae*	LC_{50}= 9.89 mg/L	[2]
	Citrus limon	*Acanthoscelides obtectus*	LC_{50}= 121.23 µL/L air; LC_{99}= 260.72 µL/L air	[92]
		Ephestia kuehniella	Egg Mortality: LT_{50}= 52.92 h and LT $_{99}$= 185.65h at 200 µL/L air	[113]
			LC_{50}= 4.05 µL/L air after 12h; LC_{99}= 5.57 µL/L air after 12h	[92]
		Plodia interpunctella	Egg Mortality: LT_{50}= 50.23h and LT $_{99}$= 193.26h at 200 µL/L air	[113]
		Tribolium castaneum	LC_{50}= 664.87 µL/L air; LC_{99}= 1311.75 µL/L air	[92]
		Tribolium confusum	LC_{50}= 5.09*10^{-3} %(v/v EO/air)	[141]
	Citrus paradisi	*Sitophilus oryzae*	LC_{50}= 24.13 mg/L	[2]
	Citrus reticulata	*Tribolium castaneum*	Mortality: 78.8% and 81% after 24h and 48h at 28 µL/L air	[142]
			LC_{50}= 33.8 at 24h µL/L air and 28.2 µL/L air at 48h for pure EO; LC_{50}= 18.1 µL/L airat 24h and 12.2 µL/L air at 48h for EO in combination with diethyl maleate	[143]
		Tribolium confusum	LC_{50}= 3.49*10^{-3} %(v/v EO/air)	[141]
	Citrus sinensis	*Callosobruchus maculatus*	LC_{50}= 201.17 µL/L air; LC_{90}= 275.83 µL/L air	[107]
		Sitophilus granarius	LC_{50}= 367.75 µL/L air; LC_{90}= 508.91 µL/L air	"
		Sitophilus oryzae	LC_{50}= 19.67 mg/L	[2]
			LC_{50}= 63.89 mg/cm^2 on 6 cm^2 filter paper	[30]
		Sitophilus zeamais	LC_{50}= 0.020 mg/cm3 air	[35]
		Tribolium castaneum	LC_{50}= 35 mg/cm^2 on 6 cm^2 filter paper	[30]
			LC_{50}= 0.130 mg/cm3 air	[35]
			LC_{50}= 362.40 µL/L air; LC_{90}= 442.69 µL/L air	[107]
		Tribolium confusum	LC_{50}= 4.03*10^{-3} %(v/v EO/air)	[141]
	Zanthoxylum armatum	*Lasioderma serricorne*	LC_{50}= 12.54 mg/L air	[54]
		Tribolium castaneum	LC_{50}= 4.28 mg/L air	"
	Zanthoxylum bungeanum	*Stegobium paniceum*	Adults were more vulnerable to fumigant treatment than the larvae	[144]
	Zanthoxylum dissitum	*Attagenus piceus*	Mortality= 13.3% and 3.3% for EOs from leaves and roots, respectively, at 50% hexane solution (v/v)	[145]
		Lasioderma serricorne	Mortality= 40% and 10% for EOs from leaves and roots, respectively, at 50% hexane solution (v/v)	"
		Tribolium castaneum	Mortality= 13.3% for both EOs from leaves and roots at 50% hexane solution (v/v)	"
Schisandraceae	*Kadsura heteroclita*	*Sitophilus zeamais*	LC_{50}= 14.04 mg/L air	[55]
Solanaceae	*Datura stramonium*	*Cryptolestes ferrugineus*	Average Mortality= 28.49% µL/L air	[132]
		Tribolium castaneum	Average Mortality= 18.90% µL/L air	[132]
		Trogoderma granarium	Average Mortality= 14.46% µL/L air	"
Verbenaceae	*Aloysia polystachya*	*Sitophilus zeamais*	LC_{50}= 218.65 µL/L air and 230.74 µL/L air for EOs with different origin	[83]
	Caryopteris incana	*Sitophilus zeamais*	LC_{50}= 10.05 mg/L	[56]
	Lippia javanica var. javanica	*Sitophilus oryzae*	LD_{50}= 254 µg/cm3 at 72h, 216 µg/cm3 air at 120h	[57]
	Lippia multiflora	*Callosobruchus maculatus*	LC_{50} 0.47 µL/L air; LC_{90}= 6.44 µL/L air	[103]
Vitaceae	*Cayratia japonica*	*Sitophilus zeamais*	LC_{50}= 10.05 mg/L air	[58]
		Tribolium castaneum	LC_{50}= 15.67 mg/L air	"
Winteraceae	*Drimys winteri*	*Tribolium castaneum*	Bark EO: LC50= 10.45 µL/L air after 24; LC_{90}= 24.86 µL/L air after 24h; LT_{50} =13-3days andLT_{90}= 24-5days at 25-100 µL/L air	[47]
			Leaves EO: LC50= 8.96 µL/L air after 24h; LC_{90}= 31.54 µL/L air after 24h; LT_{50} =11-4days andLT_{90}= 23-9days at 25-100 µL/L air	"
Zingiberaceae	*Alpinia blepharocalyx*	*Lasioderma serricorne*	LC_{50}= 3.83 mg/L air	[59]
	Alpinia conchigera	*Sitophilus zeamais*	LC_{50}= adults= 85 µL/L, eggs> 593 µL/L, larvae= 437 µL/L, pupae= 278 µL/L	[146]
		Tribolium castaneum	LC_{50}= adults= 73 µL/L, eggs> 593 µL/L, larvae= 196 µL/L, pupae= 414 µL/L	"
	Amomum maximum	*Tribolium castaneum*	LC_{50}= 23.09 mg/L air	[60]
	Amomum tsaoko	*Lasioderma serricorne*	LC_{50}= 8.70 mg/L air	"
		Tribolium castaneum	LC_{50}= 5.85 mg/L air	"
	Curcuma zedoaria	*Sitophilus zeamais*	Mortality= 6% at 593 µL/L	[146]
		Tribolium castaneum	No mortality	"

Plant Family	*Plant species*	*Insect Species*	Main Results	References
	Elettaria cardamomum	*Callosobruchus maculatus*	LC_{50}= 78.79 mg/cm3 air after 24h and 55.27 mg/cm3 air after 48 h; LC_{90}= 175.24 mg/cm3 air after 24h and 95.56 mg/cm3 air after 48h	[147]
		Ephestia kuehniella	LC_{50}= 1.57 mg/cm3 air after 24h; LC_{90}= 3.87 mg/cm3 air after 24h; LT_{50} 11.78-12.96h and LT_{90}= 19.02-17.77h at 3.32-4 mg/cm3	“
		Sitophilus granarius	LC_{50}= 220.76 µL/L air; LC_{90}= 353.94 µL/L air	[80]
		Tribolium castaneum	LC_{50}= 482.70 mg/cm3 after 24h and 402.93 mg/cm3 after 48h; LC_{90}= 891.23 mg/cm3 after 24h and 600 mg/cm3 after 48h	“
	Zingiber officinale	*Ephestia kuehniella*	LC_{50}= 258.95 µL/L air and LC_{90}= 2831.65 µL/L air after 9h	[63]
		Plodia interpunctella	LC_{50}= 69.05 µL/L air and LC_{90}= 182.15 µL/L air after 9h	“
		Sitophilus oryzae	LC_{50}= 1.18 µl/cm^2	[32]
		Tribolium castaneum	LC_{50}= 374.95 µL/L air and LC_{90}= 1124.2 µL/L air at 48h	[63]
	Zingiber purpureum	*Lasioderma serricorne*	LC_{50}= 9.3 mg/L air	[64]
		Tribolium castaneum	LC_{50}= 13.6 mg/L air	“
	Zingiber zerumbet	*Sitophilus zeamais*	Mortality= 4% at 593 µL/L	[146]
		Tribolium castaneum	No mortality	“

Table S3 Overview of reviewed studies on EO repellence towards stored product pests.

Plant Family	*Plant species*	*Insect Species*	Main results	References
Anacardiaceae	*Pistacia lentiscus*	*Callosobruchus maculatus*	Repellency rate= 71.87% at 12 µL; 100% of Repellency at 16 µL	[68]
		Rhizopertha dominica	RD_{50} = 0.01 µL/cm^2	[148]
		Sitophilus zeamais	RD_{50} = 0.037 µL/cm^2	"
		Tribolium castaneum	RD_{50} = 0.025 µL/cm^2	"
Annonaceae	*Cananga odorata*	*Tribolium castaneum*	Better repellent activity than the commercial repellent IR3535 at the highest tested concentration (5 mL/g)	[149]
	Dennettia tripetala	*Callosobruchus maculatus*	Repellent at 10 µL EO solution (1 mg/mL)	[150]
		Sitophilus oryzae	Repellent at 10 µL EO solution (1 mg/mL)	"
	Xylopia aethiopica	*Sitophilus oryzae*	Repellent at 10 µL EO solution (1 mg/mL)	"
Apiaceae	*Anethum graveolens*	*Plodia interpunctella*	100% of Repellency at 2µL of EO.	[151]
	Carum carvi	*Plodia interpunctella*	88% of Repellency at 2µL of EO.	"
	Coriandrum sativum	*Lasioderma serricorne*	RD_{50} = 0.049 µL/cm^2; RD_{95}= 20.948 µL/cm^2	[76]
		Sitophilus oryzae	RD_{50} = 0.084 µL/cm^2; RD_{95}= 4.592 µL/cm^2	[76]
		Tribolium castaneum	RD_{50} = 0.136 µL/cm^2; RD_{95}= 7.684 µL/cm^2	[78]
	Cuminum cyminum	*Sitophilus oryzae*	60.4% of Repellency at 5 µL	"
		Tribolium castaneum	66.4% of Repellency at 5 µL	"
			Repellent at 0.2% concentration (v/v)	[79]
	Foeniculum vulgare	*Cryptolestes ferrugineus*	70% of repelled insects after 5h at 0.1% EO-methanol solution (v/v)	[152]
		Plodia interpunctella	32% of Repellency at 2µL of EO	[153]
		Sitophilus zeamais	41.2% of repelled insects after 5h at 0.1% EO-methanol solution (v/v)	[152]
		Tenebrio molitor	68% of repelled insects after 1h at 0.1% EO-methanol solution (v/v)	"
		Tribolium castaneum	Repellent at 0.2% concentration (v/v)	"
	Petroselinum sativum	*Plodia interpunctella*	9.48% of Repellency at 2µL of EO	[151]
	Prangos acaulis	*Callosobruchus maculatus*	71.60% of Repellency at 2µL of EO	[153]
		Sitophilus oryzae	83.60% of Repellency at 2µL of EO	"
		Tribolium castaneum	63.60% of Repellency at 2µL of EO	"
Asparagaceae	*Liriope muscari*	*Lasioderma serricorne*	Repellency= 86% at 78.63 nL/cm^2 of EO after 2h	[8]
		Liposcelis bostrychophila	Repellency= 96% at 6.32 nL/cm^2 of EO after 4h	"
		Tribolium castaneum	Repellency= 92% at 15.73 nL/cm^2 of EO after 2h	"
Asteraceae	*Achillea millefolium*	*Plodia interpunctella*	32% of Repellency at 2µL of EO	[151]
	Achillea wilhelmsii	*Plodia interpunctella*	60% of Repellency at 2µL of EO	"
	Artemisia absinthum	*Plodia interpunctella*	64% of Repellency at 2µL of EO	[153]
	Artemisia anethoides	*Lasioderma serricorne*	Percentage Repellency= 60 after 4 h at 15.73nL/cm^2	[10]
		Tribolium castaneum	Percentage Repellency= 100 after 2 and 4h at 15.73nL/cm^2	"
	Artemisia dracunculus	*Plodia interpunctella*	40% of Repellency at 2µL of EO.	[151]
	Artemisia dubia	*Liposcelis bostrychophila*	Repellent activity similar to DEET at the highest tested concentration of 63.16 nL/cm2	[85]
		Tribolium castaneum	Repellent activity similar to DEET at five tested concentrations after 2 h exposure	"
	Artemisia scoparia	*Callosobruchus maculatus*	Mean repelled insects= 48.57%	[88]
		Sitophilus oryzae	Mean repelled insects= 62.01%	"
		Tribolium castaneum	Mean repelled insects= 63.80%	"
	Artemisia stolonifera	*Lasioderma serricorne*	Repellency > 80% at 39.32 nL/ cm^2	[12]
		Tribolium castaneum	Repellency > 80% at 39.32 nL/ cm^2	"
	Artemisia vulgaris	*Tribolium castaneum*	75% of repelled insects at 0.6 µL/mL after 3h	[90]
	Eupatorium glabratum	*Sitophilus zeamais*	Repellence index= 0.72 (females) at 0.4 µL oil/cm^2; 0.56 (males) at 0.4 µL oil/cm^2	[91]
	Laggera pterodonta	*Lasioderma serricorne*	Repellency >90% at 78.63 nL/cm^2	[16]
		Liposcelis bostrychophila	Repellency >90% at 63.17 nL/cm^2	"
	Tagetes erecta	*Tribolium castaneum*	45% of oviposition reduction at 70,000 ppm	[17]
	Tagetes lucida	*Tribolium castaneum*	Repellency= 95% at 5 µL/g grain	[149]
	Tagetes minuta	*Tribolium castaneum*	88% of oviposition reduction at 70,000 ppm	[17]
	Tagetes patula	*Tribolium castaneum*	45% of oviposition reduction at 70,000 ppm	"
	Tanacetum nubigenum	*Tribolium castaneum*	Repellency= 74-87% 20 µL/plate; FDI= 83-94% at µL/0.25L air	[93]
Atherospermataceae	*Laurelia sempervirens*	*Sitophilus zeamais*	Repellence index (RI)= 0.46 mL/kg grain (RI < 1 repellent)	[18]
Chenopodiaceae	*Chenopodium ambrosioides*	*Callosobruchus chinensis*	Strong oviposition repellence	[154]
		Callosobruchus maculatus	84.21% FDI at 5% concentration	[19]
			Strong oviposition repellence	[154]
	Clausena pentaphylla	*Callosobruchus chinensis*	100% FDI at 5% EO concentration	[19]
Cucurbitaceae	*Citrullus colocynthis*	*Rhizopertha dominica*	FDI= 27.17-52.59% with 2 mL of 2-6% EO-acetone solution	[155]
		Tribolium castaneum	FDI= 37.22-71.74% with 2 mL of 2-6% EO-acetone solution	"

Plant Family	***Plant species***	***Insect Species***	**Main results**	**References**
		Trogoderma granarium	FDI= 32.54-62.83% with 2 mL of 2-6% EO-acetone solution	“
Cupressaceae	*Cupressus lusitanica*	*Acanthoscelides obtectus*	Repellency= 32.2% at 0.2% v/w after 30 days	[20]
		Sitophilus zeamais	Repellency= 49.30% at 0.2% v/w after 30 days	“
		Tribolium castaneum	Repellency= 13.2% at 0.2% v/w after 30 days	“
	Juniperus formosana	*Liposcelis bostrychophila*	Repellence > 70% at 63.17 nL/cm^2 after 4 h	[21]
		Tribolium castaneum	Repellence > 90% at 63.17 nL/cm^2 after 4 h	“
	Juniperus polycarpus	*Tribolium castaneum*	96% of repelled insects at 15 µL/mL EO-acetone solution after 24h	[97]
	Juniperus sabina	*Tribolium castaneum*	82.67% of repelled insects at 15 µL/mL EO-acetone solution after 24h	“
Euphorbiaceae	*Croton malambo*	*Tribolium castaneum*	92 and 86% of repelled insects at 0.2$\mu L/cm^2$ after 2 and 4 hours respectively	[156]
	Ricinus communis	*Lasioderma serricorne*	50% of repelled insects after 5h at 0.214 $\mu L/cm^2$	[99]
		Tribolium castaneum	Repellency of 60-80% during 1-24h of exposure at 0.314 $\mu L/cm^2$	“
Geraniaceae	*Pelargonium*	*Rhizopertha dominica*	FDI= 39-83% depending on formulation (EO vs EO-nanoparticles), the EOs alone produced the higher FDI	[24]
		Tribolium castaneum	FDI= 3-60% depending on formulation (EO vs EO-nanoparticles), the EOs alone produced the higher FDI	“
Lamiaceae	*Adhatoda vasica*	*Callosobruchus chinensis*	Repellency= 36% at 1 µL/mL	[154]
		Callosobruchus maculatus	Repellency= 36% at 1 µL/mL	“
	Hypericum hemsleyanum	*Tribolium castaneum*	Repellency of 70% after 72h at 31.5 $\mu g/cm^2$	[157]
	Hyptis spicigera	*Sitophilus oryzae*	Repellency= 62.5% after 2h (0.031, 0.062, 0.125, and 0.251 $\mu L/cm^2$)	[27]
	Hyptis suaveolens	*Callosobruchus maculatus*	Repellence of 85% after 5h at 9.2 mg/cm^2	[28]
		Rhizopertha dominica	Repellence of 70% after 5h at 9.2 mg/cm^2	“
		Sitophilus oryzae	Repellence of 69% after 5h at 9.2 mg/cm^2	“
		Tribolium castaneum	Repellence of 44% after 5h at 9.2 mg/cm^2	“
	Hyssopus officinalis	*Plodia interpunctella*	Repellency= 7.69% at 2 µL	[151]
	Laurus nobilis	*Cryptolestes ferrugineus*	Repellence= 60% after 5h at 0.1% v/v	[152]
		Sitophilus zeamais	Repellence= 13.7% after 5h at 0.1% v/v	“
		Tenebrio molitor	Repellence= 75% after 1h at 0.1% v/v	“
	Lavandula angustifolia	*Plodia interpunctella*	62% of Repellency at 2µL of EO.	[151]
		Sitophilus granarius	FDI= 8.9% at 1.125 mg/disk	[29]
	Lavandula hybrida	*Cryptolestes ferrugineus*	no Repellency at 0.1 =% v/v	[152]
		Sitophilus zeamais	Repellency= 50% after 5h at 0.1% v/v	“
		Tenebrio molitor	no Repellency at 0.1% v/v	“
	Melissa officinalis	*Plodia interpunctella*	Repellency= 40% at 2 µL	[151]
	Menta piperita	*Tenebrio molitor*	Luring effect in Y-tube and wind tunnel	[158]
	Mentha haplocalyx	*Tribolium castaneum*	Repellency of 83% after 72h at 31.5$\mu g/cm^2$	[157]
	Mentha longifolia subsp. capensis	*Sitophilus zeamais*	Rellency= 90–100% at 24-32$\mu L/cm^2$	[31]
	Mentha piperita	*Plodia interpunctella*	Repellency= 56% at 5 µL	[151]
		Sitophilus oryzae	Repellency= 55.2% at 5µL	[78]
		Tribolium castaneum	Repellency= 61.2% at 5 µL	“
	Mentha pulegium	*Lasioderma serricorne*	RD_{50}= 0.010 $\mu L/cm^2$; RD_{95}= 0.526 $\mu L/cm^2$	[99]
		Tribolium castaneum	RD_{50}= 0.015 $\mu L/cm^2$; RD_{95}= 0.370 $\mu L/cm^2$	“
	Mentha viridis	*Rhizopertha dominica*	Repellency of 94.6% at 1.75% w/w (treated packaging)	[159]
		Sitophilus granarius	Repellency of 100% at 1.75% w/w (treated packaging)	“
		Stegobium paniceum	Repellency of 96.5% at 1.75% w/w (treated packaging)	“
		Tribolium castaneum	Repellency of 99.7% at 1.75% w/w (treated packaging)	“
	Ocimum canum	*Sitophilus oryzae*	Repellency= 33.7% after 2h (0.031, 0.062, 0.125, and 0.251 $\mu L/cm^2$)	[27]
	Ocimum gratissimum	*Callosobruchus chinensis*	Repellency= 93% after 24h at 0.2 µL/g grain	[111]
		Rhizopertha dominica	Repellency= 79% after 24h at 0.2 µL/g grain	“
		Sitophilus oryzae	Repellency= 100% after 24h at 0.2 µL/g grain	“
		Tribolium castaneum	Repellency= 78% after 24h at 0.2 µL/g grain	“
	Perilla frutescens	*Lasioderma serricorne*	Repellency > 70% after 2 and 4h at 7.86nL/cm^2	[37]
			Repellency > 70% after 2 and 4h at 7.86nL/cm^2	[117]
		Tribolium castaneum	Repellency > 90% after 2 and 4h at 7.86nL/cm^2	[37]
	Rosmarinus officinalis	*Plodia interpunctella*	Repellency= 100% at 5 µL	[151]
	Salvia multicaulis	*Plodia interpunctella*	Repellency= 80% at 5 µL	“
	Salvia officinalis	*Callosobruchus maculatus*	Repellency rate= 82.18%(4-16 µL tested)	[68]
		Plodia interpunctella	Repellency= 32% at 2µL	[151]
	Satureja hortensis	*Ephestia kuehniella*	Repellency= 80% at 3.2µL/L air	[41]
		Plodia interpunctella	Repellency= 55% at 3.2µL/L air	“
		Tribolium castaneum	Repellency= 82.5% at 3.2µL/L air	“
	Teucrium polium	*Callosobruchus maculatus*	Repellency= 52% at 3 µL/mL acetone	[124]
		Tribolium castaneum	Repellency= 60% at 3 µL/mL acetone	“

Plant Family	*Plant species*	*Insect Species*	Main results	References
	Thymus daenensis	*Ephestia kuehniella*	Repellency= 64.4% at 22.22 µL/L air	[125]
		Plodia interpunctella	Repellency= 85.8% at 2.77 µL/L air	"
	Thymus vulgaris	*Plodia interpunctella*	Repellency= 93.33% at 2µL	[151]
	Ziziphora clinopodioides	*Ephestia kuehniella*	Repellency of 89.89% at 8,000 ppm	[128]
		Plodia interpunctella	Repellency= 68% at 2µL	[151]
Lauraceae	*Cinnamomum aromaticum*	*Callosobruchus maculatus*	Dose-dependent effect on oviposition deterrence. Egg laying reduction of 60-11.7% at 62.5-7.86 µg/cm^2	[43]
	Cinnamomum camphora	*Ephestia kuehniella*	Treated packaging penetration reduced of 64%	[160]
		Sitotroga cerealella	Treated packaging penetration reduced of 63%	"
	Laurus nobilis	*Callosobruchus maculatus*	Repellency rate= 72.75%(4-16 µL tested)	[68]
		Ephestia kuehniella	Repellency= 84.2% at 2 µL/L air	[129]
		Lasioderma serricorne	RD_{50} = 37.84 µL/cm^2	[161]
		Rhizopertha dominica	RD_{50}: Tunisia= 0.036; Algeria= 0.033; Marocco= 0.013 µL/cm^2	[130]
		Tribolium castaneum	RD_{50}: Tunisia= 0.139; Algeria= 0.096; Marocco= 0.045 µL/cm3	"
	Litsea cubeba	*Lasioderma serricorne*	Repellencies of 78% and 82%(after 2-4h) at 78.63 nL/cm^2	[45]
		Liposcelis bostrychophila	Repellencies of 84% and 78%(after 2-4h) at 31.58 nL/cm^2	"
	Litsea salicifolia	*Sitophilus zeamais*	Repellency of 72-100% after 5h at 0.16-0.63 µg/cm^2	[46]
			FDI= 29.63% at 10% EO concentration	"
		Tribolium castaneum	Repellency of 76-100% after 5h at 0.16-0.63 µg/cm^2	"
			FDI= 84.62% at 10% EO concentration	"
Meliaceae	*Azadiracta indica*	*Rhizopertha dominica*	FDI= 60% at 2 mL of 2-6% EO-acetone solution	[155]
		Tribolium castaneum	FDI= 80% at 2 mL of 2-6% EO-acetone solution	"
		Trogoderma granarium	FDI= 40% at 2 mL of 2-6% EO-acetone solution	"
	Melia azadiracta	*Rhizopertha dominica*	FDI= 55% at 2 mL of 2-6% EO-acetone solution	"
		Tribolium castaneum	FDI= 70% at 2 mL of 2-6% EO-acetone solution	"
		Trogoderma granarium	FDI= 35% at 2 mL of 2-6% EO-acetone solution	"
Monimiaceae	*Laurelia sempervirens*	*Tribolium castaneum*	Repellency= 93% after 4h at 0.032µL/cm^2	[47]
			Repellency= 97% after 4h at 0.032µL/cm^2	"
Moringaceae	*Moringa oleifera*	*Cryptolestes ferrugineus*	FDI= 45.72%	[162]
		Tribolium castaneum	FDI= 33.8%	"
		Trogoderma granarium	FDI= 15.4%	"
Myrtaceae	*Eucalyptus*	*Tenebrio molitor*	Repellent in Y-tube and wind tunnel	[158]
	Eucalyptus astringens	*Oryzaephilus surinamensis*	55% of repelled insects at 0.08 µL/cm^2 after 24h	[163]
		Rhizopertha dominica	58.75% of repelled insects at 0.08 µL/cm^2 after 24h	"
	Eucalyptus camaldulensis	*Cryptolestes ferrugineus*	FDI= 72.44%	[162]
		Tribolium castaneum	FDI= 37.5%	"
		Trogoderma granarium	FDI= 18%	"
	Eucalyptus citriodora	*Tribolium castaneum*	Repellency= 90% at 5 µL/g grain	[149]
	Eucalyptus floribundi	*Oryzaephilus surinamensis*	FDI= 79.25% at 75 µL/L air	[134]
			FDI= 88.89% at 140 µL/L air	"
		Rhizopertha dominica	FDI= 81.11% at 75 µL/L air	"
			FDI= 74.61% at 140 µL/L air	"
	Eucalyptus globulus	*Callosobruchus maculatus*	Repellency rate= 81.31%(4-16 µL tested)	[68]
	Eucalyptus radiata	*Callosobruchus maculatus*	Repellency rate= 81.31%(4-16 µL tested)	"
	Eucalyptus saligna	*Acanthoscelides obtectus*	Repellency= 49.3%% at 0.2% v/w after 30 days	[20]
		Sitophilus zeamais	Repellency= 17.8%% at 0.2% v/w after 30 days	"
		Tribolium castaneum	Repellency= 33.6%% at 0.2% v/w after 30 days	"
	Myrtus communis	*Callosobruchus maculatus*	Repellency rate= 74.75%(4-16 µL tested)	[68]
		Ephestia kuehniella	Repellency= 61.3% at 2 µL/L air	[129]
	Syzygium aromaticum	*Ephestia kuehniella*	Treated packaging penetration reduced of 76%	[160]
		Lepinotus reticulatus	No Repellency (used as negative control)	[164]
		Liposcelis bostrychophila	Repellent (used as negative control)	"
		Liposcelis brunnea	Repellent (used as negative control)	"
		Liposcelis corrodens	No Repellency (used as negative control)	"
		Liposcelis decolor	No Repellency (used as negative control)	"
		Liposcelis entomophila	Repellent (used as negative control)	"
		Liposcelis paeta	Repellent (used as negative control)	"
		Sitotroga cerealella	Treated packaging penetration reduced of 75%	[160]
		Tribolium castaneum	Repellency= 94% at 0.08% concentration	[138]
Piperaceae	*Piper nigrum*	*Tribolium castaneum*	Repellent at 0.2% v/v	[79]
Poaceae	*Cymbopogon citratus*	*Oryzaephilus surinamensis*	RD_{50} = 0.05 µL/cm^2	[139]
		Sitophilus zeamais	RD_{50} = 0.06 µL/cm^2	"
	Cymbopogon martinii	*Oryzaephilus surinamensis*	RD_{50} = 0.07 µL/cm^2	"
		Sitophilus zeamais	RD_{50} = 0.03 µL/cm^2	"
	Cymbopogon nardus	*Oryzaephilus surinamensis*	RD_{50} = 0.03 µL/cm^2	"
		Sitophilus zeamais	RD_{50} = 0.04 µL/cm^2	"
Poaceaee	*Cymbopogon citratus*	*Tribolium castaneum*	Repellency= 95% at 5 µL/g grain	[149]

Plant Family	*Plant species*	*Insect Species*	Main results	References
	Cymbopogon distans	*Liposcelis bostrychophila*	Repellency of 88% and 64% at 26 and 13 nL/ cm^2	[165]
		Tribolium castaneum	Repellency of 96% and 90% at 26 and 13 nL/ cm^2	"
	Cymbopogon nardus	*Tribolium castaneum*	50% of infestation reduction at 0.2 g/m2 carton board	[166]
Ranuncolaceae	*Nigella sativa*	*Cryptolestes ferrugineus*	FDI= 42.98%	[162]
		Tribolium castaneum	87.33% of repelled insects at 0.08% EO concentration	[138]
			FDI= 39.2%	[162]
		Trogoderma granarium	FDI= 16.8%	"
Rosaceae	*Prunus amygdalus*	*Rhizopertha dominica*	Repellency of 99.2% at 1.75% w/w (treated packaging)	[159]
		Sitophilus granarius	Repellency of 100% at 1.75% w/w (treated packaging)	"
		Stegobium paniceum	Repellency of 97.8% at 1.75% w/w (treated packaging)	"
		Tribolium castaneum	Repellency of 100% at 1.75% w/w (treated packaging)	"
Rutaceae	*Atalantia guillauminii*	*Lasioderma serricorne*	Repellency= 82-64% after 4h at 78.63 and 15.73 nL/cm^2	[50]
		Liposcelis bostrychophila	Repellency= 92-88% after 4h at 31.58 and 6.32 nL/cm^2	"
		Tribolium castaneum	Repellency=> 82% at 3.15-78.63 nL /cm^2	"
	Atalantia monophylla	*Callosobruchus maculatus*	Repellency= 85.24% after 3h at 25µL	[140]
		Sitophilus oryzae	Repellency= 75.24% after 3h at 25µL	"
	Citrus × bergamia	*Rhizopertha dominica*	FDI= 2 mg/disc, the EOs alone produced the higher FDI mg/flour disc	[24]
		Tribolium castaneum	FDI= 2 mg/disc PEG EOsNP more feeding deterrent than EOs mg/flour disc	"
	Citrus bergamia	*Cryptolestes ferrugineus*	Repellency 85% after 5h at 0.1% v/v	[152]
		Sitophilus zeamais	Repellency 56.3% after 5h at 0.1% v/v	"
		Tenebrio molitor	no Repellency at 0.1 =% v/v	"
	Clausena anisum-olens	*Lasioderma serricorne*	Repellency= 86-96% after 2-4h at 39.2 nL/cm^2	[52]
		Liposcelis bostrychophila	Repellency= 94-92% after 2-4h at 39.2 nL/cm^2	"
	Clausena pentaphylla	*Callosobruchus maculatus*	FDI= 88.52% at 5% EO concentration	[19]
	Dictamnus dasycarpus	*Lasioderma serricorne*	Repellency= 66-67% after 2-4h at 7.86 nL/cm^2	[53]
		Liposcelis bostrychophila	Repellency= 92-98% after 2-4h at 6.32 nL/cm^2	"
	Evodia calcicola	*Lasioderma serricorne*	Repellency= 34% after 4h at 39.32 nL/cm^2	[167]
		Liposcelis bostrychophila	Repellency= 86% after 4h at 31.58 nL/cm^2	"
		Tribolium castaneum	Repellency= 90% after 4h at 7.86 nL/cm^2	"
	Evodia trichotoma	*Lasioderma serricorne*	Repellency= 76% after 4h at 39.32 nL/cm^2	"
		Liposcelis bostrychophila	Repellency= 94% after 4h at 31.58 nL/cm^2	"
		Tribolium castaneum	Repellency= 86% after 4h at 7.86 nL/cm^2	"
	Glycosmis lucida	*Liposcelis bostrychophila*	Repellency= 100% at 31.58 nL/cm^2	[168]
		Tribolium castaneum	Repellency= 100% at 78.63 nL/cm^2	"
	Murraya alata	*Tribolium castaneum*	Repellency= 96% after 2h and 100% after 4h at 15.73 nL/cm^2	[169]
	Murraya euchrestifolia	*Tribolium castaneum*	Repellency= 92% after 2h and 89% after 4h at 15.73 nL/cm^2	"
	Murraya exotica	*Tribolium castaneum*	Repellency= 66% after 2h and 76% after 4h at 15.73 nL/cm^2	"
	Murraya koenigii	*Tribolium castaneum*	Repellency= 59% after 2h and 44% after 4h at 15.73 nL/cm^2	"
	Murraya kwangsiensis	*Tribolium castaneum*	Repellency= 85% after 2h and 98% after 4h at 15.73 nL/cm^2	"
	Murraya microphylla	*Lasioderma serricorne*	Repellent as the positive control DEET after 2h exposure	"
	Murraya tetramera	*Tribolium castaneum*	Repellency= 94% after 2h and 100% after 4h at 15.73 nL/cm^2	"
	Vepris heterophylla	*Sitophilus oryzae*	Repellency= 42.5% after 2h (0.031, 0.062, 0.125, and 0.251 µL/cm^2)	[27]
	Zanthoxylum armatum	*Lasioderma serricorne*	Repellency > 90% after 4 h at 15.73 nL/ cm^2	[170]
		Tribolium castaneum	Repellency > 90% after 4 h at 15.73 nL/ cm^2	"
	Zanthoxylum bungeanum	*Stegobium paniceum*	Oviposition deterrent	[144]
	Zanthoxylum dimorphophyllum	*Lasioderma serricorne*	Repellency > 90% after 4 h at 15.73 nL/ cm^2	[170]
		Tribolium castaneum	Repellency > 90% after 4 h at 15.73 nL/ cm^2	"
	Zanthoxylum dimorphophyllum var. spinifolium	*Lasioderma serricorne*	Repellency > 90% after 4 h at 15.73 nL/ cm^2	"
		Tribolium castaneum	Repellency > 90% after 4 h at 15.73 nL/ cm^2	"
	Zanthoxylum dissitum	*Lasioderma serricorne*	Repellency > 90% after 4 h at 78.63 nL/ cm^2	"
		Tribolium castaneum	Repellency > 90% after 4 h at 15.73 nL/ cm^2	"
	Zanthoxylum piasezkii	*Lasioderma serricorne*	Repellency > 90% after 4 h at 78.63 nL/ cm^2	"
		Tribolium castaneum	Repellency > 90% after 4 h at 15.73 nL/ cm^2	"
	Zanthoxylum stenophyllum	*Lasioderma serricorne*	Repellency > 90% after 4 h at 78.63 nL/ cm^2	"
		Tribolium castaneum	Repellency > 90% after 4 h at 15.73 nL/ cm^2	"

Plant Family	***Plant species***	***Insect Species***	**Main results**	**References**
Solanaceae	*Datura stramonium*	*Cryptolestes ferrugineus*	FDI= 78.79%	[162]
		Tribolium castaneum	FDI= 38.9%	"
		Trogoderma granarium	FDI= 20%	"
	Eucalyptus camaldulensis	*Rhizopertha dominica*	FDI= 30% with 2 mL of 2-6% EO-acetone solution	[155]
		Tribolium castaneum	FDI= 40% with 2 mL of 2-6% EO-acetone solution	"
		Trogoderma granarium	FDI= 25% with 2 mL of 2-6% EO-acetone solution	"
	Nicotiana tabacum	*Rhizopertha dominica*	FDI= 40% with 2 mL of 2-6% EO-acetone solution	"
		Tribolium castaneum	FDI= 60% with 2 mL of 2-6% EO-acetone solution	"
		Trogoderma granarium	FDI= 30% with 2 mL of 2-6% EO-acetone solution	"
Stemonaceae	*Stemona japonica*	*Tribolium castaneum*	no Repellency at all tested concentrations	[157]
Verbenaceae	*Lippia alba*	*Tribolium castaneum*	Repellency= 95% at 5 µL/g grain	[149]
Winteraceae	*Drimys winteri*	*Tribolium castaneum*	Repellency= 100% after 4h at 0.2µL/cm^2	[47]
			Repellency= 97% after 4h at 0.2µL/cm^2	"
Zingiberaceae	*Amomum maximum*	*Liposcelis bostrychophila*	Repellency= 84% at 63.17 nL/cm^2	[60]
		Tribolium castaneum	Repellency= 100% at 78.63 nL/cm^2	"
	Elettaria cardamomum	*Callosobruchus maculatus*	Oviposition deterrent at highest doses	[147]
	Etlingera yunnanensis	*Liposcelis bostrychophila*	Repellency= 70% at 15.73 nL/cm^2	[62]
		Tribolium castaneum	Repellency= 80% at 15.73 nL/cm^2	"
	Zingiber officinale	*Ephestia kuehniella*	Repellency= 80% at 3.2 µL/L air	[63]
		Plodia interpunctella	Repellency= 90% at 3.2 µL/L air	"
		Tribolium castaneum	Repellency= 77.5% at 3.2 µL/L air	"
	Zingiber purpureum	*Lasioderma serricorne*	88% of repelled insects after 4h at 39.32 nL/cm^2	[64]
		Tribolium castaneum	86% of repelled insects after 4h at 39.32 nL/cm^2	"
Combined plant family	*Hyptis + Ocimum*	*Sitophilus oryzae*	Repellency= 77.5% after 2h (0.031, 0.062, 0.125, and 0.251 µL/cm^2)	[27]
	Hyptis + Vepris	*Sitophilus oryzae*	Repellency= 41.2% after 2h (0.031, 0.062, 0.125, and 0.251 µL/cm^2)	"
	Ocimum + Vepris	*Sitophilus oryzae*	Repellency= 62.5% after 2h (0.031, 0.062, 0.125, and 0.251 µL/cm^2)	"

Table S4 Overview of reviewed studies on EO sublethal physiological effects towards stored product pests.

Plant Family	*Plant species*	*Incesct Species*	Main results	References
Amaryllidaceae	*Allium sativum*	*Sitophilus oryzae*	Reduction in number of adult developing from eggs, larvae or adults treated with EO alone or in combination with diatomaceous earth (DE).	[1]
		Tribolium castaneum	Reduction in number of adult developing from eggs, larvae or adults treated with EO alone or in combination with diatomaceous earth (DE).	"
Anacardiaceae	*Pistacia lentiscus*	*Callosobruchus maculatus*	Hatching inhibition at 12-16 µl of EO/50g seeds	[68]
Apiaceae	*Carum copticum*	*Sitophilus granarius*	The movement pattern of insects increases when exposed to the EO.	[4]
		Tribolium confusum	The movement pattern of insects increases when exposed to the EO."	"
	Heracleum persium	*Callosobruchus maculatus*	EO reduces the female longevity (26.98%), the fecundity rate (39.58%) and the fertility rate (29,6%).	[171]
	Pimpinella anisum	*Tribolium confusum*	IR= 80.4% after 14 days at 78.78 mL/cm^2	[81]
		Trogoderma granarium	IR= 92.1% after 14 days at 78.78 mL/cm^2	"
Asteraceae	*Artemisia herba-alba*	*Callosobruchus maculatus*	90% egg hacthing reduction 100% egg laying reduction	[11] "
	Artemisia khorassanica	*Plodia interpunctella*	Biological parameters were affected by EO treatment= Larval period, body weight, pupal period, developmental time, Female longevity, fecundity and fertility. Reduction of protein, lypids and glycogen	[87]
	Tagetes erecta	*Tribolium castaneum*	Egg hatchability reduction of 64.4% at 70,000 ppm	[17]
	Tagetes minuta	*Tribolium castaneum*	Egg hatchability reduction of 91.4% at 70,000 ppm	"
	Tagetes patula	*Tribolium castaneum*	Egg hatchability reduction of 84.3% at 70,000 ppm	"
Atherospermataceae	*Laurelia sempervirens*	*Sitophilus zeamais*	Dose dependent reduction of adult emergenge.	[18]
Chenopodiaceae	*Chenopodium ambrosioides*	*Tribolium confusum* *Trogoderma granarium*	IR= 100% at 1.5 mL/cm^2 IR= 92.1% at 1.5 mL/cm^2	[81] "
Geraniaceae	*Geranium maculatum*	*Plodia interpunctella*	Significant decrease in egg laying	[23]
Lamiaceae	*Lavandula angustifolia*	*Plodia interpunctella*	Significant decrease in egg laying	[23]
		Sitophilus granarius	In the range of sublethal doses between 1.125 and 0.281 mg/disk, RGR values did not vary significantly and were similar to those of control.	[29]
	Mentha piperita	*Plodia interpunctella*	Significant decrease in egg laying	[23]
	Mentha viridis	*Sitophilus oryzae*	Dose dependent reduction of adult emergenge.	"
	Ocimum basilicum	*Tribolium confusum* *Trogoderma granarium*	IR= 88.7% at 1.5 mL/cm^2 IR= 100% at 1.5 mL/cm^2	[81] "
	Salvia officinalis	*Callosobruchus maculatus*	Hatching inhibition and total fecundity reduction at 4-16 µl of EO/50g seeds."	[68]
	Salvia verbenaca	*Callosobruchus maculatus*	Dose dependent reduction of egg hactching, egg laying and longevity	[11]
	Vitex pseudo-negundo	*Plodia interpunctella*	Biological parameters were affected by EO treatment= Larval period, Body weight, pupal period, Female longevity, Fecundity and Fertility. Reduction of protein, lypids and glycogen	[87]
	Ziziphora clinopodioides	*Ephestia kuehniella*	Dose dependent reduction of egg hactching and egg laying.	[128]
Lauraceae	*Cinnamomum aromaticum*	*Callosobruchus maculatus*		[43]
	Cinnamomum camphora	*Trogoderma granarium*	IR= 100% at 1.5 mL/cm^2	[81]
	Cinnamomum camphora,	*Tribolium confusum*	IR= 82.7% at 1.5 mL/cm^2	"
	Laurus nobilis	*Callosobruchus maculatus*	Dose dependent reduction of egg hatching and adult emergence	[68]
Liliaceae	*Scilla maritima*	*Callosobruchus maculatus*	egg hactching, egg laying and longevity	[11]
Myrtaceae	*Eucalyptus camaldulensis*	*Callosobruchus maculatus*	EO reduces the female longevity (28.44%), the fecundity rate (27.58%) and the fertility rate (14.71%)."	[171]
	Eucalyptus floribundi	*Oryzaephilus surinamensis*	RGR decline at 25-75 µl/l air	[134]

	Rhizopertha dominica	RGR decline at 25-75 µl/l air	"
Eucalyptus globulus	*Callosobruchus maculatus*	Hatching inhibition and total fecundity reduction at 4(8)-16 µl of EO/50g seeds."	[68]
	Plodia interpunctella	Significant decrease in egg laying	[23]
Eucalyptus radiata	*Callosobruchus maculatus*	Hatching inhibition and total fecundity reduction at 4(8)-16 µl of EO/50g seeds."	[68]
Myrtus communis	*Callosobruchus maculatus*	Hatching inhibition and total fecundity reduction at 4(8)-16 µl of EO/50g seeds."	"
Cymbopogon martinii	*Plodia interpunctella*	Significant decrease in egg laying	[23]
Citrus sinensis	*Rhizopertha dominica*	Dose depentend reduction of progeny production; sinergism EO-inert dusts	[51]

Table S5 Overview of reviewed studies on EO mode of action towards stored product pests.

Plant Family	***Plant species***	***Insect Species***	**Main Results**	**References**
Apiaceae	*Carum carvi*	*Trogoderma granarium*	Severe effects found in mid-gut of the EO treated larvae	[172]
			Ovarioles affected, after the treatment with 0.50 mL diluted EO. The germarium and the follicular epithelium of developing oocytes of the ovarioles showed faint nuclei	"
Asteraceae	*Artemisia dracunculus*	*Tribolium castaneum*	Esterases activity equal to the control; GST activity positively correlated to the different EO concentrations. MFOs decrease with increase of EO concentration	[84]
		Tribolium confusum	Esterases activity equal to the control; GST activity negatively correlated to the different EO concentrations. MFOs increase with increase of EO concentration	"
	Artemisia judaica	*Sitophilus oryzae*	AChE I_{50}= 16.1 mg/L; ATPases I_{50}= 21.4 mg/L	[2]
	Artemisia khorassanica	*Plodia interpunctella*	Reduction of body protein, lypids and glycogen	[87]
	Artemisia monosperma	*Sitophilus oryzae*	AChE I_{50}= 120 mg/L; ATPases I_{50}= 24.6mg/L	[2]
Lamiaceae	*Origanum vulgare*	*Sitophilus oryzae*	AChE I_{50}= 61.3 mg/L; ATPases I_{50}= 6.07 mg/L	"
	Vitex pseudo-negundo	*Plodia interpunctella*	Reduction of body protein, lypids and glycogen	[87]
Myrtaceae	*Callistemon viminals*	*Sitophilus oryzae*	AChE I_{50}= 28.5 mg/L; ATPases I_{50}= 4.69 mg/L	[2]
	Melaleuca alternifolia	*Sitophilus zeamais*	EO significantly inhibites the activity af GTS, CarE and AChE. RNA-Seq identified a total of 3,562 differentially expressed genes (DEGs), of which 2,836 and 726 were up-regulated and down-regulated.	[137]
Rutaceae	*Atalantia monophylla*	*Callosobruchus maculatus*	Total Protein, total esterase, AChE and GST affected at LC_{10}-LC_{30} EO application rates.	[140]
		Sitophilus oryzae	Total Protein, total esterase, AChE and GST affected at LC_{10}-LC_{30} EO application rates.	"
	Citrus aurantifolia	*Sitophilus oryzae*	AChE I_{50}= 29.4 mg/L; ATPases I_{50}= 11.4 mg/L	[2]
	Citrus lemon	*Sitophilus oryzae*	AChE I_{50}= 20.2 mg/L; ATPases I_{50}= 9.69 mg/L	"

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