

Supplementary Material S1

Table S1 *Spodoptera* pest species on which the toxicity of EOs was evaluated

Spodoptera species	Occurrence in the literature
<i>S. littoralis</i>	109
<i>S. litura</i>	81
<i>S. exigua</i>	18

Table S2 Methods used in *S. littoralis*, *S. litura* and *S. exigua* to assess the toxicity of EOs

Toxicity methods	Occurrence in the literature
Topical application	123
Fumigant	47
Toxicity by ingestion	41
nd	1

nd: non determined.

Table S3 Times at which the mortality of *S. littoralis*, *S. litura* and *S. exigua* was recorded.

Time	Occurrence in the literature
24 h	146
72 h	27
48 h	17
96 h	4
nd	3
12 h	1
120 h	1
168 h	1

nd: non determined.

Table S4 Larval stages of *S. littoralis*, *S. litura* and *S. exigua* used to assess the toxicity of EOs.

Larval stage	Occurrence in the literature
3	175
2	20
4	10
1	1
5	1

Table S5 Families whose essential oil has been studied as an insecticide against *S. littoralis*, *S. litura* and *S. exigua*.

Plant family	Occurrence in the literature
Lamiaceae	89
Apiaceae	30
Zingiberaceae	19
Rutaceae	16
Araceae	11
Cupressaceae	9
Myrtaceae	9
Asteraceae	9
Verbenaceae	6
Pinaceae	6
Lauraceae	5
Poaceae	4
Annonaceae	3
Myoporaceae	2
Illiciaceae	1
Valerianaceae	1
Geraneacea	1
Cardiopteridaceae	1
Burseraceae	1
Santalaceae	1
Cannabaceae	1
Amaryllidaceae	1

Table S6 Plant species whose Essential oils are evaluated as insecticides against *S. littoralis*, *S. litura* and *S. exigua*.

Plant specie	Occurrence in the literature
<i>Foeniculum vulgare</i>	13
<i>Acorus calamus</i>	11
<i>Crithmum maritimum</i>	8
<i>Curcuma longa</i>	7
<i>Salvia officinalis</i>	7
<i>Alpinia pyramidata</i>	6
<i>Coleus amboinicus</i>	6
<i>Lantana camara</i>	6
<i>Lavandula latifolia</i>	5
<i>Origanum majorana</i>	5
<i>Pelargonium graveolens</i>	5
<i>Lavandula angustifolia</i>	4
<i>Mentha arvensis</i>	4
<i>Ocimum basilicum</i>	4
<i>Amyris balsamifera</i>	3
<i>Artemisia absinthium</i>	3
<i>Juniperus virginiana</i>	3
<i>Melissa officinalis</i>	3

<i>Mentha spicata</i>	3
<i>Pogostemon cablin</i>	3
<i>Rosmarinus officinalis</i>	3
<i>Zingiber officinale</i>	3
<i>Abies siberica</i>	2
<i>Citrus aurantifolia</i>	2
<i>Citrus limonum</i>	2
<i>Cymbopogon winterianus</i>	2
<i>Eucalyptus globulus</i>	2
<i>Eugenia caryophyllata</i>	2
<i>Juniperus communis</i>	2
<i>Melaleuca quinquenervia</i>	2
<i>Mentha citrata</i>	2
<i>Mentha pulegium</i>	2
<i>Myoporum bontiodides</i>	2
<i>Nepeta cataria</i>	2
<i>Origanum compactum</i>	2
<i>Origanum vulgare</i>	2
<i>Pelargonium roseum</i>	2
<i>Salvia sclarea</i>	2
<i>Spheranthus amaranthroids</i>	2
<i>Tagetes bipinata</i>	2
<i>Thuja occidentalis</i>	2
<i>Thymus mastichina</i>	2
<i>Thymus vulgaris</i>	2
<i>Tsuga canadensis</i>	2
<i>Aframomum citratum</i>	1
<i>Allium sativum</i>	1
<i>Alpinia galanga</i>	1
<i>Angelica archangelica</i>	1
<i>Artemisia nakaii</i>	1
Basil ^a	1
Bergamot ^a	1
<i>Cannabis sativa</i>	1
<i>Chloroxylon swietenia</i>	1
<i>Cinnamomum verum</i>	1
<i>Cinnamomum zeylanicum</i>	1
Cinnamon ^a	1
Citronella ^a	1
<i>Citrus aurantium</i>	1
<i>Citrus bergamia</i>	1
<i>Citrus limon</i>	1
Clary sage ^a	1
Clove bud ^a	1
<i>Coriandrum sativum</i>	1
<i>Cuminum cyminum</i>	1
<i>Cymbopogon nardus</i>	1
<i>Cupressus sempervirens</i>	1

Cypress ^a	1
<i>Daucus carota</i>	1
<i>Eucalyptus radiata</i>	1
Fennel ^a	1
Fennel sweet ^a	1
Frankincense ^a	1
Geranium ^a	1
<i>Hedychium coccineum</i>	1
<i>Helosciadium nodiflorum</i>	1
<i>Illicium verum</i>	1
Lavander (Bulgariam) ^a	1
Lavander (french) ^a	1
Lemon ^a	1
Lemongrass ^a	1
<i>Majorana hortensis</i>	1
Mandarin ^a	1
Marjoram ^a	1
<i>Mentha aquatica</i>	1
<i>Mentha longifolia</i>	1
<i>Mentha x piperita</i>	1
<i>Monodora myristica</i>	1
<i>Ocimum tenuiflorum</i>	1
<i>Ocimum gratissimum</i>	1
Orange sweet ^a	1
<i>Origanum creticum</i>	1
<i>Origanum syriacum syriacum</i>	1
Patchouli ^a	1
Peppermint ^a	1
<i>Pimpinella anisum</i>	1
Pine ^a	1
<i>Ridolfia segetum</i>	1
Rosemary ^a	1
<i>Salvia hispanica</i>	1
<i>Salvia veneris</i>	1
Sandal wood ^a	1
Spearmint ^a	1
Sweet thyme ^a	1
<i>Thymus serpyllum</i>	1
<i>Valeriana jatamansi</i>	1
<i>Xylopi aethiopica</i>	1
ylang ylang	1
<i>Wedelia prostrata</i>	1
<i>Zanthoxylum armatum</i>	1
Camphor essential oil ^a	1
Castor essential oil ^a	1
withe thyme	1
<i>Hyssopus officinalis</i>	1
<i>Matricaria recutita</i>	1

<i>Syzygium aromaticum</i>	1
<i>Pinus mugo</i>	1
<i>Cinnamomum verum</i>	1
<i>Cinnamomum cassia</i>	1
<i>Satureia hortensis</i>	1

^aCommercial EOs. Plant species name not provided.

Table S7 Lethal effects of EOs tested by the Topical application method in 3rd larval stage of *Spodoptera litura*, *S. littoralis* and *S. exigua*.

Spodoptera species	Essential oil	50% Lethal Doses (LD ₅₀ ; µg/ insect)	Reference
<i>S. exigua</i>	<i>Rosmarinus officinalis</i>	5.85 x 10 ^{-4*1}	[160]
	<i>Salvia hispanica</i>	18.4 ²	[110]
	<i>Salvia hispanica</i>	24.8 ¹	[110]
	<i>Salvia veneris</i>	69 ¹	[161]
	<i>Citrus bergamia</i>	146.17* ²	[160]
	<i>Citrus aurantium</i>	276.74* ²	[160]
	<i>Amyris balsamifera</i>	334.78* ¹	[160]
	<i>Cymbopogon winterianus</i>	533.44* ¹	[162]
<i>S. littoralis</i>	<i>Nepeta cataria</i>	3.6 x 10 ^{-5*1}	[162]
	<i>Lavandula latifolia</i>	5.4x 10 ^{-5*1}	[162]
	<i>Mentha citrata</i>	3.7 x 10 ^{-4*1}	[162]
	<i>Thymus mastichina</i>	5.13 x 10 ^{-4*1}	[162]
	<i>Ocimum basilicum</i>	5.85 x 10 ^{-4*1}	[162]
	<i>Lavandula angustifolia</i>	8.28 x 10 ^{-4*1}	[162]
	<i>Eugenia caryophyllata</i>	29.3 ¹	[162]
	<i>Ocimum gratissimum</i>	30.2 ¹	[163]
	<i>Melaleuca quinquenervia</i>	31.1 ¹	[162]
	<i>Ridolfia segetum</i>	37.9 ¹	[164]
	<i>Pimpinella anisum</i>	57.3 ¹	[165]
	<i>Mentha spicata</i>	58 ¹	[162]
	<i>Mentha pulegium</i>	63 ¹	[162]
	<i>Thymus vulgaris</i>	71 ¹	[162]
	<i>Pogostemon cablin</i>	78 ¹	[162]
	<i>Origanum vulgare</i>	82 ¹	[162]
	<i>Rosmarinus officinalis</i>	89 ¹	[162]
	<i>Salvia officinalis</i>	93 ¹	[162]
	<i>Origanum compactum</i>	96 ¹	[162]
	<i>Cuminum cyminum</i>	100 ¹	[165]
	<i>Origanum syriacum</i>	103.3 ¹	[166]
	<i>Helosciadium nodiflorum</i>	116.7 ¹	[167]
	<i>Aframomum citratum</i>	119.2 ¹	[168]
	<i>Cannabis sativa</i>	152.3 ¹	[169]
	<i>Tsuga canadensis</i>	318.16 ¹	[162]
	<i>Abies siberica</i>	596.54 ¹	[162]
<i>S. litura</i>	<i>Alpinia pyramidata</i>	13.26 ¹	[170]
	<i>Curcuma longa</i>	120.4 ¹	[170]
	<i>Coleus amboinicus</i>	123.6 ¹	[170]
	<i>Alpinia pyramidata</i>	130.4 ¹	[170]
	<i>Curcuma longa</i>	137.6 ¹	[170]
	<i>Alpinia pyramidata</i>	142.5 ¹	[170]
	<i>Curcuma longa</i>	168.6 ¹	[170]
	Basil ^a	242.7 ¹	[171]
	Lemongrass ^a	243.5 ¹	[171]
	Spearmint ^a	243.8 ¹	[171]

Geranium ^a	247.1 ¹	[171]
Peppermint ^a	263.3 ¹	[171]
Clove bud ^a	266.2 ¹	[171]
Fennel sweet ^a	277.2 ¹	[171]
Patchouli ^a	289.1 ¹	[171]
sweet thyme ^a	307.6 ¹	[171]
Citronella ^a	398.1 ¹	[171]
Marjoram ^a	648.4 ¹	[171]
Frankincense ^a	>1000 ¹	[171]
Lavander (Bulgarian) ^a	>1000 ¹	[171]
Rosemary ^a	>1000 ¹	[171]

All values marked with an asterisk (*) were recalculated for comparison.

¹Determined at 24 hs.

²Determined at 48 hs.

^aCommercial EOs. Plant species name not provided.

Table S8 *Spodoptera* pest species on which the toxicity of pure VOCs was evaluated

Spodoptera species	Occurrence in the literature
<i>S. littoralis</i>	58
<i>S. litura</i>	12
<i>S. exigua</i>	1

Table S9 Methods used in *S. littoralis*, *S. litura* and *S. exigua* to assess the toxicity of pure VOCs

Toxicity methods	Occurrence in the literature
Topical application	67
Toxicity by ingestion	6
Fumigant	2
Immersion	2
nd	1

nd: non determined.

Table S10 Times at which the mortality of *S. littoralis*, *S. litura* and *S. exigua* was recorded.

Time	Occurrence in the literature
24 h	66
48 h	4
nd	3
96 h	2
72 h	1

nd: non determined.

Table S11 Larval stages of *S. littoralis*, *S. litura* and *S. exigua* used to assess the toxicity of pure VOCs

Larval stage	Occurrence in the literature
3	48
4	25
2	1
nd	1

nd: non determined.

Table S12 Pure VOCs used to evaluate toxicity against *S. littoralis*, *S. litura* and *S. exigua*

Pure VOC	Occurrence in the literature
carvacrol	5
eugenol	4
limonene	4
thymol	4
β -pinene	3
(+)-camphor	3
1,8-cineole	3

γ -terpinene	3
linalool	3
p-cymene	3
(-)-camphene	3
α -terpineol	3
trans-anethole	3
β -caryophyllene	3
pogostone	3
gallic acid	2
canillin	2
α -pinene	2
(-)-borneol	2
(\pm)-citronellal	2
cinnamyl alcohol	2
terpinen-4-ol	2
2,6-dimethoxyphenol	1
2-ethylphenol	1
2-methoxy-4-methylphenol	1
4-allylanisole	1
4-ethylguaiacol	1
4-ethylphenol	1
β -citronellol	1
caffeic acid	1
cinnamaldehyde	1
dimethyl sulfide	1
estragole	1
ferulic acid	1
geijerene	1
geraniol	1
guaiacol	1
isoeugenol	1
L-carvone	1
menthone	1
myrcene	1
p-coumaric acid	1
phloroglucinol	1
pregeijerene	1
rotenone	1
sabinene	1
salicylaldehyde	1
salicylic acid	1
sinapic acid	1
syringic acid	1
terpinolene	1
trans-cinnamic acid	1
vanillic acid	1
α -phellandrene	1
3-carene	1

α -thujone	1
(-)-bornyl acetate	1
α -caryophyllene	1
γ -elemene	1
α -humulene	1
(E,E)- α -farnesene	1
2,6-octadienal, 3,7-dimethyl-, (Z	1
eucalyptol	1
p-menth-1-en-8-ol	1
1,6-octadien-3-ol, 3,7-dimethyl	1
1-cyclohexyl-2-buten-1-o	1
pulegone	1

Table S13 Lethal effects of pure VOCs tested, on 3rd larval stage of *Spodoptera littura*, *S. littoralis* and *S. exigua*, by Topical application method.

Spodoptera specie	Compound	50% Lethal Doses (LD ₅₀ ; µg/ insect)	Reference
<i>S. littoralis</i>	thymol	9 ¹	[172]
	γ-terpinene	11.86 ¹	[173]
	carvacrol	15 ¹	[172]
	terpinen-4-ol	16.2 ¹	[173]
	trans-anethole	18 ¹	[172]
	L-carvone	18 ¹	[172]
	menthone	25 ¹	[172]
	geraniol	25.2 ¹	[168]
	(±)-citronellal	31 ¹	[172]
	β-citronellol	31 ¹	[172]
	cinnamaldehyde	32 ¹	[172]
	γ-terpinene	34 ¹	[172]
	4-allylanisole	35 ¹	[172]
	eugenol	40 ¹	[172]
	α-terpineol	43 ¹	[172]
	isoeugenol	44 ¹	[172]
	sabinene	45.1 ¹	[168]
	p-cymene	46 ¹	[172]
	terpinolene	52 ¹	[172]
	p-cymene	52.3 ¹	[168]
	α-phellandrene	54.6 ¹	[168]
	1,8-cineole	56 ¹	[172]
	cinnamyl alcohol	61 ¹	[172]
	(-)-β-pinene	65 ¹	[172]
	(+)-camphor	71 ¹	[172]
	β-pinene	84.5 ¹	[168]
	linalool	85 ¹	[172]
	γ-terpinene	89 ¹	[172]
	myrcene	89 ¹	[172]
	α-pinene	97 ¹	[172]
	(R)-(+)-limonene	122 ¹	[172]
	α-pinene	123.5 ¹	[168]
	(-)-camphene	>300 ¹	[172]
	trans-cinnamic acid	>300 ¹	[172]
	vanillin	>300 ¹	[172]
	gallic acid	>300 ¹	[172]
	(-)-borneol	>300 ¹	[172]
	dimethyl sulfide	>300 ¹	[172]
<i>S. litura</i>	thymol	22 ¹	[174]
	carvacrol	38.3 ¹	[166]
	carvacrol	42.7 ¹	[174]
	anethole	62 ¹	[174]
	citronellal	110 ¹	[174]
	terpineol	141.3 ¹	[174]
	estragole	142.2 ¹	[171]
	eugenol	157.6 ¹	[174]
	linalool	178.6 ¹	[171]

	limonene	395.6 ¹	[171]
<i>S. exigua</i>	α -thujone	37.1 ²	[110]
	α -caryophyllene	40.4 ²	[110]
	p-cymene	50.7 ²	[110]
	(R)-(+)-limonene	67.2 ²	[110]
	3-carene	77.4 ²	[110]
	(-)-bornyl acetate	82.6 ²	[110]
	β -pinene	102.4 ²	[110]
	1,8-cineole	104.2 ²	[110]
	borneol	120 ²	[110]
	linalool	124.2 ²	[110]
	β -caryophyllene	134.8 ²	[110]
	(+)-camphor	161.2 ²	[110]
	camphene	194.6 ²	[110]

All values marked with an asterisk (*) were recalculated for comparison.

¹Determined at 24 hs.

²Determined at 48 hs.

^aCommercial EOs. Plant species name not provided.