UNIVERSITA' DEGLI STUDI DI PALERMO

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ANTIFEEDANT ACTIVITY IN HERBACEOUS MEDITERRANEAN PLANTS

The toxicity of many ordinary pesticides for environment and man is, today, well recognized both by the scientific collectivity and by consumers. Consequently, a new interest arises towards the individuation and experimentation of active principles of natural origin, able to coniugate a good efficiency against pest insects with a higher environmental care. These compounds are required to have two basic characteristics: the nontoxicity for man, animals and useful insects and a fast degradation and therefore a low persistence in the environment. A new input has been given to the studies concerning plant-derived pesticides, and the literature shows many works about the isolation, screening and testing of products coming from plants which show some effectiveness as means for pest control. Among these, a distincyion may be made between the **directly-acting** insecticides and the **indirect** ones. During the history of agriculture, many vegetable products have been successfully used as insecticides. Although today the market is dominated by chemically-derived substances, some active principles of natural origin, such as pyrethrins, rotenone, sabadilla and ryania, have been up to now largely used all over the world.

Plants yield many compounds classable among **indirect insecticides.** Each of them exerts some specific action inside the insect-plant relationships, in the insect-insect one and in some processes inside the insect itself. This **high specificity** is mostly considered as an advantage: besides a lower toxicity for man and a good protection level for useful insects, it implies higher difficulty for the rising of resistance phenomena, due to the strong structural similarity of these active principles with other natural compounds that are necessary to the insects life processes.

An **antifeedant** (Munakata, 1975) is a chemical compound that prevents the insect from feeding, but does not kill it directly; generally the insect remains near the treated material and finally dies of starvation. The effect is absolutely different from that of an olfactory repellent, that generally is a volatile compound that repels the insect before it starts feeding; the action mechanism of the antifeedants, however, is not completely elucidated yet.

Many Salvia species have shown an effective antifeedant activity

Family/Species	Identified active compounds	Chemical class of the active compounds	Activity level	Bibl. Ref.
Amarillidaceae				
Agave Americana L.	n.d.	alkaloids	*	Simmonds, 1997
Lycoris radiata (L'Herit.) Herbert	n.d.	alkaloids	*	Simmonds, 1997
Apiaceae				
Angelica sylvestris L.	bisabolangelone helenalin eupatoriopicrin bakkenolide A	sesquiterpenes	*** *** *** ***	Van Beek and de Groot, 1986
Centella asiatica (L.) Urban	stigmasterol, stigmasterone	steroids	**	Srivastava et al., 1997
Araceae				
Acorus calamus L.	n.d.	asarons	*	Simmonds, 1997
Aristolochiaceae				
Aristolochia spp.	aristolochic acid	-	*	Simmonds, 1997
Asteracee				
Artemisia Absinthium L.	absinthin	sesquiterpenes	**	Vigneron, 1978
Centaurea spp.	n.d.	sesquiterpenes alkaloids coumarins	*** ** **	Simmonds, 1997
Cichorium intybus L.	lactupicrin 8-deoxy-lactucin	sesquiterpenes	* *	Van Beek and de Groot, 1986.
Encelia farinosa Torr. & A.Gray	encechalin	sesquiterpenes	*	Van Beek and de Groot, 1986.
Eupatorium Cannabinum L.	eupatopicrine	sesquiterpenes	**	Picman, 1986.
Eupatorium quadrangulare DC	elemanolide 4-deoxy-8-epi-ivanguline	sesquiterpenes	* *	Van Beek and de Groot, 1986.
Grindelia humilis H. & A.	6- -hydroxygrindelic acid 6- -hydroxygrindelic acid	diterpenes labdanic acids	** **	Rose *et al.*, 1981.
Inula helenium L.	alantolactone isoalantolactone	sesquiterpenes	*** ***	Van Beek and de Groot, 1986
Melampodium spp.	melamponidin	sesquiterpenes	**	Van Beek and de Groot, 1986.
Melampodium Divaricatum (Rich.) DC	caryophillene oxyde spathulenole guaianole kolavenole	sesquiterpenes	* * * *	Van Beek and de Groot, 1986.
Neurolaena lobata (L.) R. Br.	lobatin A lobatin B neurolenin A neurolenin B neurolenin C neurolenin D	sesquiterpenes (furanoheliango lides	** * * ** * *	Passreiter and Isman, 1997
Pentanema indicum L.	vicolide A vicolide B vicolide C vicolide D	sesquiterpenes	* ** * *	Vasanth et al., 1999
Senecio spp.	n.d.	sesquiterpenes alkaloids	** *	Simmonds, 1997
Tagetes spp.	n.d.	n.d.	*	Simmonds, 1997
Tanacetum balsamita	tanabaline	diterpenes	**	Kubo *et al.*, 1996.
Tricholepis glaberrima DC	n.d.	sesquiterpenes	*	Duke, 1990; Daniewski *et al.*, 1997
Vernonia amygdalina	11,13-dihydrovernorodeline	sesquiterpenes	*	Van Beek and de Groot, 1986.
Vernonia glauca	glaucolid A	sesquiterpenes	**	Van Beek and de Groot, 1986.
Viguera buddleiformis		sesquiterpenes (furanoheliango lides	**	Passreiter and Isman, 1997
Cannaceae				
Canna spp	n.d.	n.d.	*	Simmonds, 1997
Chenopodiaceae				
Beta spp.	n.d.	alkaloids	*	Simmonds, 1997
Chenopodium spp.	n.d.	n.d.	*	Simmonds, 1997
Convolvulaceae				
Calistegia spp.	n.d.	n.d.	*	Simmonds, 1997
Convolvolus spp.	n.d.	n.d.	*	Simmonds, 1997
Ipomoea spp.	n.d.	alkaloids	*	Simmonds, 1997
Cruciferae				
Iberis amara	cucurbitacin E cucurbitacin I	triterpenes	** **	Vigneron, 1978
Guttiferae				
Vismia spp.	vismion A vismine harunganine -hydroxyferrunginine	anthranoids	** ** ** **	Simmonds *et al.*, 1985
Labiatae				
Ajuga chamaepitys (Schreb.)	ajugapitin 14-15 dihydroajugapitin	diterpenes (neoclerodanes)	**** ***	Belles *et al.*, 1985
Ajuga decumbens (Thunb.)	ajugacumbin A ajugacumbin B ajugacumbin C	diterpenes (neoclerodanes)	** *** ***	Min *et al.*, 1989
Ajuga iva (L.) Schreb. = *Ajuga pseudoiva* Robill & Castagne	ivaine I, II, III, IV 2 acetilivaine I	diterpenes (neoclerodanes)	** **	Belles *et al.*, 1985;. Van Beek and de Groot, 1986
Ajuga remota Benth.	ajugarin I, II, III clerodin	diterpenes (neoclerodanes)	**** n.d.	Kubo *et al.*, 1976; Van Beek and de Groot, 1986; Simmonds *et al.*, 1989
Ajuga reptans L.	ajugareptansin 14 dihydroajugareptansin ajugareptanson A	diterpenes (neoclerodanes)	* **** *	Belles *et al.*, 1985; Van Beek and de Groot, 1986
Isodon inflexus (Kudo)	inflexin	diterpenes (ent-kaurenoids)	*	Vigneron, 1978
Isodon shikokianus var. *intermedius*	isodomedin	diterpenes (ent-kaurenoids)	*	Vigneron, 1978
Nepeta cataria L.	nepetalacton ajugarin	diterpenes	*** ****	Simmonds, 1997
Salvia spp.	ajugarin	diterpenes (neoclerodanes)	****	Simmonds *et al.*, 1996
Salvia keerlii	kerlinolide	diterpenes (neoclerodanes)	**	Esquivel *et al.*, 1985; Simmonds *et al.*, 1996
Salvia melissodora Lag.	13,14-dihydro 34 epoxy hellixodoric methylester neoclerodandiolide melisodoric acid	diterpenes (neoclerodanes)	*** *** n.d.	Simmonds *et al.*, 1996
Scutellaria alpina	scutalpin C	diterpenes (neoclerodanes)	****	Bruno *et al.*, 1995; Munoz *et al.*, 1997.
Scutellaria galericulata L.	jodrellin A jodrellin B jodrellin T	diterpenes (neoclerodanes)	**** **** ****	Cole *et al.*, 1990.
Scutellaria rubiconda Hornem.	scutecyprole B	diterpenes (neoclerodanes)	****	Bruno *et al.*, 1999
Scutellaria woronowii (Juz.)	jodrellin A jodrellin B	diterpenes (neoclerodanes)	**** ****	Anderson *et al.*, 1989
Teucrium spp.	many	diterpenes (neoclerodanes)	from * to ****	Simmonds *et al.*, 1989; Bruneto, 1995; Bruno *et al.*, 1995; Piozzi *et al.*, 1998
Teucrium africanum Thunb.	tafricanin A tafricanin B	diterpenes (neoclerodanes)	* **	Hanson *et al.*, 1982; Van Beek and de Groot, 1986
Teucrium japonicum Houtt.	teucjaponin A teucjaponin B	diterpenes (neoclerodanes)	** **	Miyase et al., 1981; Van Beek and de Groot, 1986; Simmonds *et al.*, 1989
Teucrium Massiliense L.	6-19 diacetylteumassilin	diterpenes (neoclerodanes)	****	Savona *et al.*, 1984; Simmonds *et al.*, 1989; Bruno *et al.*, 1995; Piozzi *et al.*, 1998
Leguminosae				
Arachis paraguaensis	n.d.	fenilpropanoids	*	Simmonds, 1997.
Glycine max (L.) Merr.	gliceoline	isoflavonoids	*	Simmonds, 1997.
Lonchocarpus spp; *Lonchocarpus Eriocaulinalis* M. Micheli	isolonchocarpine	flavonoids	***	Schery, 1954; Simmonds, 1997; Simmonds *et al.*, 1990.
Tephrosia vogelii	5-metoxy-isolonchocarpine	flavonoids	***	Simmonds *et al.*, 1990.
Piperaceae				
Piper futokadsura (Sieb et Zucc.)	piperanone	lignans	***	Simmonds, 1997; Vigneron, 1978.
Plumbaginaceae				
Plumbago spp.	plumbagin	naphtochinones	*	Simmonds, 1997.
Poligonacee				
Polygonum hydropiper	poligodial	sesquiterpenes	***	Simmonds, 1997; Duke, 1990; Kubo *et al.*, 1976; Van Beek and de Groot, 1986.
Rheum officinale Baill.	n.d.	n.d.	*	Simmonds, 1997
Rubiaceae				
Galium aparine L.	Nordamnacanthal 1	anthraquinones	*	Morimoto et al., 2002
Rutaceae				
Amyris spp.	xanthotoxin racemosin	coumarins	* *	Simmonds, 1997
Atalanta spp.	xanthotoxin racemosin	coumarins	* *	Simmonds, 1997
Limonia spp.	xanthotoxin racemosin	coumarins	* *	Simmonds, 1997
Orixa japonica Thunb.	isopimpinellin bergaptene	furocoumarins	** **	Munakata, 1975; Vigneron, 1978.
Ruta spp.	xanthotoxin racemosin	coumarins	** **	Simmonds, 1997.
Solanaceae				
Atropa spp.	atropine	alkaloids	*	Simmonds, 1997.
Lycopersicon spp.	tomatin solanin	alkaloids	*	Simmonds, 1997.
Lycopersicon Esculentum Mill.	quercetin-3-rutinoside	flavonoids	**	Simmonds, 1997.
Physalis alkekengi L.	n.d.	witanolides	n.d.	Simmonds, 1997.
Solanum spp.	solanin chaconin leptin I, II demissin tomatin	alkaloids	* * * * *	Vigneron, 1978
Whitania somnifera (L.) Dunal	n.d.	witanolides	n.d.	Simmonds, 1997.
Verbenaceae				
Callicarpa japonica Thunb.	phytol	diterpenes	*	Hosozawa *et al.*, 1974c
Caryopteris divaricata Maxim.	caryoptin dihydrocaryoptin caryoptin hemiacetal clerodin dihydroclerodin I clerodin hemiacetal caryoptinol dihydrocaryptinol	diterpenes (neoclerodanes)	** *** ** *** *** *** ** ***	Hosozawa *et al.*, 1973; Hosozawa *et al.*, 1974; Hosozawa *et al.*, 1974a; Hosozawa *et al.*, 1974c; Van Beek and de Groot, 1986
Clerodendron calamitosum L.	3-epi-caryoptin	diterpenes (neoclerodanes)	**	Hosozawa *et al.*, 1974b; Van Beek and de Groot, 1986
Clerodendron cryptophyllum	clerodendrin A	diterpenes (neoclerodanes)	**	Kato *et al.*, 1972.
Clerodendron tricotomum Thunb.	clerodendrin A clerodendrin B clerodin B	diterpenes (neoclerodanes)	** ** **	Kato *et al.*, 1972; Van Beek and de Groot, 1986
Stachyarpheta mutabilis	ipolamiide	monoterpenes	**	Van Beek and de Groot, 1986.