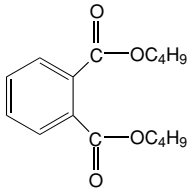
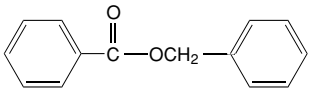
DIBUTYL PHTHALATE



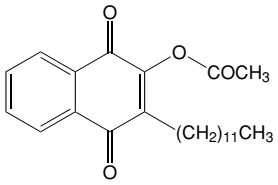
di-n-butyl phthalate

BENZYL BENZOATE (ticks, chiggers)



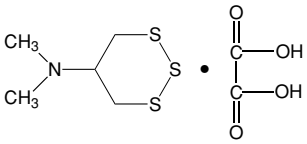
benzyl benzoate

ACEQUINOCYL (Kanemite®, Piton®)



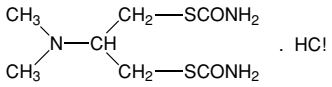
3-dodecyl-1,4-dihydro-1,4-dioxo-2-naphthyl acetate

THIOCYCLAM (Evisect®)



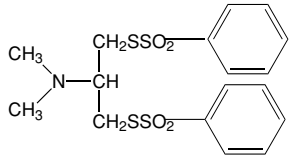
N,N-dimethyl-1,2,3-trithian-5-amine hydrogen oxalate

CARTAP (Agrotap®, Eatan®)



S,S'-2-dimethylaminotrimethylene bis
(thiocarbamate) hydrochloride

BENSULTAP (Bancol®)



S.S'-2-dimethylaminotrimethylene di(benzenethiosulfonate)

indoors to household floors, walls, bathroom and other non-food contact surfaces to repel cockroaches and ants. The manufacturer will formulate this compound in multipurpose cleaner/insect repellent products, which in theory, make the area and household unattractive to these universal pests.

NEW NOVEL INSECTICIDE CLASSES

At the dawn of the 21st Century six new classes of insecticides have made their appearance. The insecticides listed are in new classes because their structures do not conveniently fit the existing classes, though some may bear partial structural resemblance to some of these established classes. Because most of the products covered have only recently been announced information on them is somewhat sparse. Published information will dramatically increase as these products mature commercially. Moreover, new examples of some of these classes are likely to appear in coming years.

Methoxyacrylates: Fluacrypyrim (Titaron®) is an acaricide for fruit and currently is the only example of this class. It is registered for use on fruit in Japan.

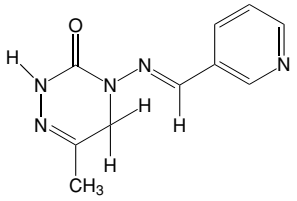
Napththoquinones: Acequinocyl (Kanemite®, Piton®) is a miticide with insecticidal activity for pome fruit, nut crops, citrus and ornamentals. It is the only member of this group at present and the mode of action is not yet determined. It is registered in Korea and Japan but not in the U.S.

Nereistoxin analogues: These include thiocyclam (Evisect®), cartap (Agrotap®, Eatan®, Padan®), bensultap (Bancol®) and thiosultap-sodium (Pilarhope®, Helper®). Analogues of nereistoxin have been known for decades. They generally are stomach poisons with some contact action and often show some systemic action. A major share of the development and use of these compounds has taken place in Japan. They are based on a natural toxin of the marine worm *Lumbriconereis heteropoda*. Of the many analogs synthesized only those that were metabolized back to the original nereistoxin after application were active. In this sense, members of this class are *proinsecticides,* meaning that they are applied in their manufactured form but are known to degrade to a specific active component. Members of this group tend to be selectively active on Colopteran and Lepidopteran insect pests. Cartap is a broad spectrum insecticide with good activity against rice stem borer. Bensultap is used to control the Colorado potato beetle and other insect pests. Thiosultap-sodium is used to control selected beetle and Lepidopteran pests on rice, vegetables and fruit trees. Thiocyclam is used to control similar pests in several crops.

Members of this class act as acetylcholine receptor agonists at low concentrations and as channel blockers at higher concentrations. Although there has been commercial interest in thiocyclam for use in the U.S., we do not believe there are commercial examples that will receive U.S. registration.

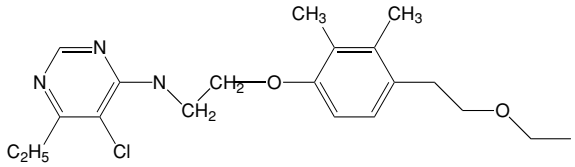
Pyridine azomethine: Pymetrozine (Fulfill®, Endeavor®), first registered in 1999 by EPA has a unique mode of action that is not fully understood. It appears to act by preventing insects from the Order Homoptera from inserting their stylus into plant tissue. Compounds from this chemical class have not previously been used as pesticides and this is the only current member of the class. Pymetrozine is used to control aphids and whiteflies in vegetables, potatoes, tobacco, citrus, fruit, hops and ornamentals. Although of low toxicity it did produce some evidence of tumorigenicity in both rats and mice.

PYMETROZINE (Fulfill®, Endeavor®)



1,2,4-triazin-3(2H)-one, 4,5-dihydro-6-methyl-4-[(3-pyridinylm-ethylene)amino]-.

PYRIMIDIFEN (Miteclean®)

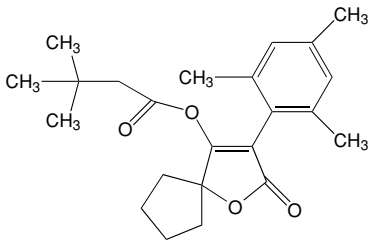


5-chloro-*N*-(2-[4-(2-ethoxyethyl)-2,3-dimethylphenoxy]ethyl)-6-ethylpyrimidin-4-amine

Pyrimidinamines: Pyrimidifen (Miteclean®) is an insecticide and miticide. As a miticide the product controls spider and rust mites in deciduous fruits, citrus, vegetables and tea. As an insecticide it controls diamondback moth in vegetables. Very little information is available on the other insecticidal member of this class, flufenerim (S-1560).

Tetronic acids: Spirodiclofen (Envidor®) and spiromesifen (BSN2060) are the only members of this recently introduced class. Spirodiclofen (Envidor®) has broad-spectrum activity against mites and controls scale crawlers and psyllid nymphs. Action is good on eggs and quiescent stages. Target crops are citrus, grapes, nuts, pome and stone fruits. Initial registrations in the U.S., Europe and Japan are expected by 2004.

SPIROMESIFEN



3-mesityl-2-oxo-1-oxaspirol[4,4]non-3-en-4-yl 3,3-dimethylbutyrate

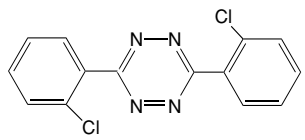
MISCELLANEOUS

New molecular structures are being synthesized routinely by basic manufacturers in the search for new insecticides with new modes of action.

The products reviewed below are substances that have emerged in recent years from the R&D programs of various manufacturers and are presented in this section because they do not conveniently fit the chemical classes presented elsewhere in this chapter.

Clofentezine belongs to the unique group, the tetrazines. Its primary use is as an acaricide/ovicide for deciduous fruits, citrus, cotton, cucurbits, vines and ornamentals. A newer but similar agent is etoxazole (TerraSan®, Baroque®, Secure®, Tetrasan®). Etoxazole is an acaricide registered in 2002 for ornamentals grown in greenhouses. Though not yet registered, it will be used for cotton, pome fruit and nut crops and vines. The mode of action for clofentezine is not known but in some manner it acts to inhibit mite

CLOFENTEZINE (Apollo®, Acaristop®)



3,6-bis(2-chlorophenyl)-1,2,4,5-tetrazine