

26.BOTANICALS – CHARACTERISTICS, PREPARATION AND USE OF NEEM PRODUCTS, NICOTINE AND PYRETHRUM

Botanical insecticides

Toxicants derived from plants are used in insect control and among them neem products, nicotine and pyrethrum are well known.

Insecticidal butylamides

Several members of the Compositae and Rutaceae groups of plants contain insecticidal unsaturated butylamides. Example: Pellitorine and Fagaramide. These compounds like several of the pyrethrins, have a rapid knock down effect of flying insects; their practical application as insecticides is unfortunately, limited by chemical instability. However a number of synthetic analogues have been examined and several show promise as insecticides.

Azadirachtin

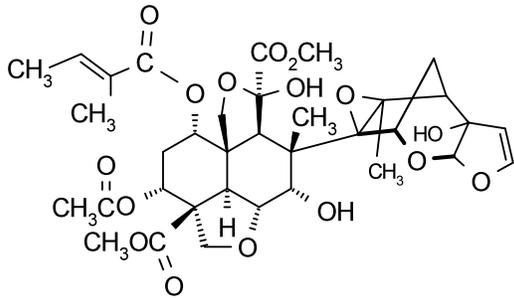
Neem – derived from Persian word Asad-dilakt-I-hind, which means free tree of India - *Azadirachta indica* A. Juss.

In India 14 million trees (1959 survey) of which 50 % in UP. Though not a forest tree it grows wild in the forests of AP, Tamil Nadu and Karnataka. Full-grown neem tree yields 50 kg fruit annually and 350 kg of leaves. India probably produces 0.7 million tones of fruits and 5 million tones of leaves every year.

Almost every part of the tree is bitter and finds its application in indigenous medicine. Oil and cosmetic industries are the users of neem. The refined and purified neem seed oil has many therapeutic properties. Considerable quantities of oil are used in cosmetic preparations. The neem cake after oil recovery is used for slow release of nitrogenous fertilizers.

Neem oil contains limonoids, a class of compounds that act as antifeedants or growth regulators in insects. They do not kill instantly but wipe out a whole generation of insects by preventing the young ones from maturing and the adults from reproducing.

The most effective of the limonoids is a compound called azadirachtin.



It is similar to the insect hormone ecdysone, which is needed for moulting during insect development. It works at a concentration of 1-10 ppm by blocking ecdysone's action, thereby preventing the larvae from shedding their external skeletons and maturing. It also prevents feeding in about 200 insects at a concentration of 10-100 ppm.

The knowledge about neem in India is at least a few centuries ago. Indian scientists had been studying neem for about 70 years and isolated some active compounds by 1960's.

A number of neem formulations are being produced by small-scale formulators and marketed as insecticides. (Neemguard, Margocode, Nimbicidine, Neemplus, Sukrina, Achook etc.).

Neem oil has some of the less known antifeedants like., salanin, nimbin and epoxyzadiradione.(4 International conferences were held discussing regarding production, structure elucidation, isolation of ai, residue analysis).

Nicotine (C₁₀ H₁₄ N₂).

Its chemical name is 1-methyl-2,3 (pyridyl) pyrrolidine. It is the principal alkaloid in tobacco (An alkaloid may be defined in general as a naturally occurring heterocyclic, optically active nitrogenous base of relatively high molecular weight and having marked physiological activity). Nicotine is found in the leaves of *Nicotiana tabacum* and *N. glauca* in the range of 2 to 14 per cent. Among the twelve alkaloids present in tobacco nicotine is the most important one contributing about 97 per cent and the other two of insecticidal value are (i) Nicotinic acid (C₉ H₁₂ N₂) 2-(3-pyridyl pyrrolidine) (ii) Anabasine (Neonicotinic acid, 3-(2-piperidyl) pyridine).

Pyrethrum

The insecticidal principle in pyrethrum is found in the flower heads of certain plants of chrysanthemum genus, family compositeae. Only a few species like *C. roseum*,

C. cinerariaefolium, *C. marshalli* and *C. tamrutene* have been found to be valuable sources of this insecticide. It is used as dusts and sprays.

The flowers are dried at 54.4°C. These flowers are ground to a fine powder and extracted with the solvents. The solvent is repeatedly percolated through the ground flowers and the weak extracts are evaporated in a vacuum still to recover the solvent. The extracted powder (pyrethrum) containing traces of pyrethrins is sometimes used as carriers in dust preparations. Dust concentrates are made from concentrated pyrethrum extracts with a non-volatile solvent and a suitable absorbent carrier and then diluted before use with an inert diluent. Antioxidants such as tannic acid or hydroquinone are used to stabilise the pyrethrins in dust preparations. Concentrated extracts of pyrethrum in acetone, alcohol or a hydrocarbon solvent together with an emulsifier is sold on the market.

Miscellaneous compounds

Picrotoxinin (PTX) has been isolated from the seeds of *Anamirta cocculus* and is moderately toxic to insects. E.g. Cockroaches, but is more toxic to mice. PTX, like avermectins act on GABA regulated chloride ion channels and functions as a GABA receptor antagonist.

Other compounds with a similar mode of action include the trioxabicyclooctanes. Eg. The phosphorus ester and bicycloorthocarboxylates: all are nerve poisons, which are not cholinesterase inhibitors. The compounds were generally more toxic to mammals than insects; the bicycloorthocarboxylates, however, can sometimes show selective activity to house flies and cockroaches and consequently, have potential for development as novel insecticides.

Insect neuropeptides (INPs) generally containing 5 – 10 amino acid residues play a vital role as circulating neurohormones and neurotransmitters. They control many aspects of insect's growth, development and reproduction together with important physiological and metabolic processes. Twenty five such processes are thought to be mediated via these neuropeptides. By 1988, some 27 INPs have been identified and their structures elucidated. For instance, in the locust, the adipokinetic hormones AKH I and II, stimulate lipid metabolism during periods of sustained activity. Eg. Migratory flight. Increased knowledge of the structures and physiology of INPs should provide new potential target

sites for the design of novel insecticides. Peptide synthesis is one possible area of exploitation – if certain physiologically active peptides were introduced to the insect at the wrong time. Severe disruptive effects would result.

If the gene coding for INPs could be introduced into crop plants, then insects attacking the crop could be killed. Another promising line of research would be the design of novel peptides and other molecules to block the INP receptors.