BIOPESTICIDES ADD ON PAGE

BIONEEM

A Botanical Insecticide

Neem tree i.*e.Azadirachta indica* was well known in India and neighboring countries for more than 2,000 years. A related species with similar properties grows in Thailand where in villages the beneficial properties of neem were appreciated for a long time. The Sanskrit name of the neem tree is Arishtha, 'reliever of sickness', and for centuries the fruits, leaves, oil, bark and roots of the tree were used in Ayurvedic and Unani medical treatments. Although villagers used neem leaves to protect stored rice and used neem twigs to brush their teeth, no convincing experiments were performed and no wider publicity was given to uses of neem until quite recently. The insect repellent ability of neem was first reported in India in 1928 but for the next 30 years little further work was done concerning neem's insect controlling potential.

In 1959, Dr. Heinrich Schmutterer, a young German scientist trained in entomology and plant pathology, worked in the Sudan during a locust invasion. He noticed that neem trees were the only plants that remained green and healthy while all other vegetation was completely destroyed by the locust plague. Swarms of locusts settled also on neem trees but left without feeding. Schmutterer wondered why neem was not touched by locusts and he decided to study this unusual phenomenon in depth. During the following 35 years he, his students, associates and scores of scientists throughout the world, were stimulated by Schmutterer and turned into 'neem believers', studies the properties of the compounds of neem and their mode of action.

The past 3 decades witnessed a marked increase in interest in the study of neem and a considerable body of knowledge has accumulated. While interest in neem has advanced enormously, publications have appeared that exceeded in quality and quantity anything that existed before these fertile years. This information was widely scattered throughout various journals and other publications, including proceedings of three international conferences organized by Prof. Schmutterer and supported by the German 'Gesellschaft fur Technische Zusammenarbeit (GTZ) GmbH'.

Recently the importance of neem has been recognized by the US National Academy of Sciences, resulting in a 1992 report entitled "Neem-a tree for solving global problems". Panelists, supported by Prof. Schmutterer, presented the results of carefully planned and executed experiments in a popular manner. The following statement summarizes their conclusions: 'Neem is a fascinating tree. On one hand, it seems to be one of the most promising of all plants and may eventually benefit every person on the planet... this plant may usher in a new era in pest control, provide millions with inexpensive medicines, and perhaps even reduce erosion'.

The use of synthetic pesticides during the last half century has often been careless and indiscriminate, and led to number of well-known problems. Some of these are contamination of food, soil ground water, rivers, lakes, oceans, air, etc. with toxic residues, side effects on non-

target insects and other organisms, increase of the number of pests species resistant to pesticides, and pest resurgence, In addition, many non-lethal as well as lethal accidents occurred due to mishandling of highly toxic synthetic products.

As a logical consequence of the undesirable side effects of a number of these products, there is a growing awareness in industrialized and also in developing countries, of the toxicological and environmental problems involved in the use of synthetic pesticides. This awareness has led to a steadily increasing movement towards a more environment-oriented, sustainable agriculture with low or no input of toxic synthetic pesticides and other agricultural chemicals in an attempt to preserve and protect the environment as well as human health.

The plant kingdom is by far the most efficient 'factory' of compounds. It synthesizes countless products which can partly be considered as weapons to defend plants against pests and diseases which have competed with them since times immemorial. Numerous plant ingredients are highly toxic to a wide spectrum of organisms, including man, but others are compounds less toxic or nontoxic to mammals, other vertebrates and invertebrates. The last mentioned sometimes evince highly sophisticated modes of action against pests such as insects-one of the most important groups of harmful organisms.

It is well known that some insecticides of plant origin have been in use for a long time; for instance, pyrethrum, obtained from the flower heads of *Chrysanthemum cinerariifolium* (=*C.cinerariaefolium),* was already known during the time of the Persian king Darius the Great (521-486 B.C.) Nicotine and derris (rotenone) have been used in the last centuries and some other are still in use on limited scale.

During the last 20 years, in the course of an increasingly intensive search by many research groups all over the world, the plant family Meliaceae (mahogany family) was identified as one of the most promising sources of compounds with insect-control properties. In particular, some members of the genera *Azadirachta* and *Melia* were outstandingly effective against insect, and their components are useful also in many other respects. Of further interest, for instance, are their medicinal properties. These findings were not completely new, as parts of meliaceous plants or simple extracts made from them, have long been used by some Asian peoples to protect stored food, clothes, etc. against pest infestation. In southern Asia, for instance, dried leaves of the neem tree, *Azadirachta indica,* are mixed with rice to reduce pest infestations, or leaves of the Persian lilac, *Melia azedarach,* are placed in books to control booklice. However, a real breakthrough in using components of Meliaceae in pest control was possible only after the knowledge on insect behavior and physiology had improved greatly the last two decades and after sophisticated instruments became available, which could identify very small amounts of compounds and elucidate their structural formulae.

Azadirachtin, a very complex tetranortriterpenoid obtained form the seed kernels of *A. indica* and in low concentrations from tissue culture, has proved to be one of the most promising plant ingredients for integrated pest management at the present time. This remarkable compound, the synthesis of which might be possible but hardly economic, displays an array of effects on insects, acting inter alia, as a phago-and oviposition deterrent, repellent, antifeedant, growth-retardant, molt-inhibitor and sterilant. Furthermore, it disturbs a number of vital physiological processes in insects so that their activity (e.g.the ability to walk, to jump, to fly, to copulate, etc.) is strongly affected. Among these various modes of action, the effect on metamorphosis is the most important from the practical pest control point of view.

Nowadays, when ecological and toxicological aspects are of steadily increasing interest in integrated pest management (IPM), it is of special importance that azadirachtin and related compounds form A.indica have a very low toxicity or are practically non-toxic to warm-blooded organisms including man. It is also important from the ecotoxicological and economical standpoints that, in general, only about 20-50 g of the active principle is sufficient to treat one hectare of area to achieve a satisfactory reduction in pest populations, and that the products decompose in about one week.

Weak or inconsequential side effects of neem against natural enemies of pests and other non-targets, such as pollinators, have been recorded by several authors .These properties underline the outstanding suitability of neem products for use in IPM, considering their selectivity towards beneficial insects.

Development of resistance of insects to insecticides is today a serious and steadily worsening problem of pest control when using synthetic products and certain biopesticides (*Bacillus thuringiensis*);. Therefore wise use of neem products, preferably applies in IPM programs, is strongly recommended to avoid the fate of many synthetic products in the past.

Chemical pesticides today constitute a major and critical input in the production of agricultural and horticultural crops all over the world. While the chemical pesticides are instrumental in achieving significant increase in crop productivity, it has to be appreciated that they constitute serious ecological and human health hazards. Instances of application hazards and residual toxicity hazards to human beings are well known and documented. But, even more important, and serious, are the environmental hazards, world attention to which was drawn some decades back by the renowned authoress, Rachel Carson, in her monumental book, "The Silent Spring". Salient among health hazards include emergence of pesticide resistant races in crop pest populations. Again, while chemical pesticides destroy predators and parasites (which play an important role in exercising a natural check in the growth of pest populations), beneficial insects (e.g. honeybees, silkworms) and other useful animal species.

Extensive field use of chemicals pesticides thus seriously upsets the ecological balance.

In view of this, the use of "Pesticides" of plant origin (e.g. Neem, karanj) provides an excellent alternative for protecting crops from depredations of injurious insect pests. The word "Pesticides" is inappropriate to describe them. For, they do not kill insects; they serve as anti-feedants (insect repellents) and as insect growth regulators (impairing insect fecundity, oviposition and larval growth). They also do not destroy the beneficial parasites and predators. More importantly there is no question of emergence of resistant races of pest species, as happens in the case of chemical pesticides. In short, these "bio-pesticides are equally effective, far cheaper and fully eco-friendly.

The late Professor K.C.Gulati and the late Professor S.Pradhan, both working at the Indian Agricultural Re-search Institute, New Delhi, demonstrated during 1960's the importance and value of Neem *(Azadirachta indica*) and later karanj *(Pongamia pinnata*) products in crop pest control. Since then, world interest in "pesticides" of plant origin has grown considerably.

A wealth of literature is now available on the efficacy of Neem products in controlling crop pests. Three international conferences of scientists,(Germany, 1981 and 1983 and Kenya, 1987) specifically on neem have been held. H.Schmutterer and R.P.Singh have listed 413 species of insects which are susceptible to neem products.

Besides insect pests, a number of species of mites and a number of species of nematodes (microscopic eelworm like animalcules) can be effectively controlled by neem pro-ducts. Another

important finding, in relation to agriculture, is that if neem cake is mixed with urea and the mixture is applied to crops (rice, sugarcane and others)it acts as nitrification inhibitor and thereby economizes considerably in the fertiliser application.

Ajay Bio-tech (India) Ltd have established a modern facility for extraction of active principles of neem with the help of India's premier finance institution (Industrial Development Bank of India) in Western India near Pune and have come out with *BIONEEM.*

- BIONEEM is modern insecticide based on herbal extract of Neem, the wonder indian tree.
- BIONEEM controls insects which are harmful in agriculture, forestry and horticulture, and can be used in place of chemical insecticides .
- When mixed with chemical insecticides, BIONEEM improves their performance
- BIONEEM is environment friendly, which means it does not toxify the air we breath, food we eat, soil we cultivate nor the water we use for irrigation.
- BIONEEM is effective against more than 400 pests of economic importance.
- BIONEEM does not develop resistance in insects, i.e. product remains effective after repeated sprays.

- **Integrated Pest Management (IPM)** demands that :

- The total quantity of insecticides required is reduced so that the crop contains less toxic residues and there is less contamination of the environment.
- Development of resistance in the pest population should be prevented.
- Natural enemies of pests should be conserved.
- The total cost of control may be reduced.

BIONEEM is ideally suited for these concepts **and is tailor-made for organic farming .**

The chemical insecticide residues are not permitted in fruits, vegetables and cereals meant for exports. BIONEEM can be profitably used to control insects in these crops.

Mode of action of BIONEEM

a) Anti-feedant effect : BIONEEM spray deters insects from feeding on the crop treated with it.

b) Repellent effect : The insects get turned off by the smell of neem and get disgusted and are repelled.

c) Insect growth regulatory effect : This is the most important physiological effect on insects. Azadirachtin ingested young insects do not reach adulthood or produce malformed or miniature adults. It is also known to prolong the larval period (upto 2 months). Evidence suggests that azadirachtin disrupts the development of insects.

d) Oviposition deterrent effect : Insects are prevented from laying eggs on BIONEEM treated area and there is drastic reduction in egg laying activity of adults.

e) Effect on fertility and reproduction : Azadirachtin also affects vitellogenesis, which is necessary for oocyte maturity. Marked reduction in reproduction is observed.

Stability

Azadirchtin gets degraded on exposure to Ultra-violet rays , which are present in the sunlight. BIONEEM contains UV protectants which assure 18 months shelf life. Other active ingredients such as melinotrial, other aza isomers, salanin, azadiradione polypeptides are also known to synergise the efficacy of the neem based pesticide.

BIOEFFECTIVNESS OF BIONEEM.

Recommendations

Low volume spray : Spray 0.5 to 1 litre of BIONEEM per acre depending on crop stage.

High volume spray : Spray @ 3 to 5 ml BIONEEM per litre water and cover entire foliage.

Range of action of BIONEEM

Wide variety insect-pests in the orders of *Lepidoptera, Diptera, Coleoptera, Hymenoptera, Homoptera, Orthoptera and Heteroptera* are controlled by use of *BIONEEM.* Most agriculturally important pests are covered under these orders.

BIONEEM can control following insects on different crops

Crop	*Insect pest*
Cotton	Jassids, *Amrasca bigutella* Aphids, *Aphis gossypii* White fly, *Bemesia tabaci*

	Spotted bollworm, *Earias insulana* Pink bollworm, *Pectinophora* sp. American bollworm, *Heliothes* sp. Leafworm, *Spodoptera littoralis*
Tomato	Jassid , *Amrasca bigutella* Tobacco caterpillar *Spodoptera litura* Leaf eating beetles *Epilachna* sp. White fly, *Bemesia tabaci* Scale insects, *Pseudococcus virgatis*
Potato	Aphids, *Myzus persicae* Leaf eating beetles, *Epilachna* sp Jassids , *Empoasca* sp
Onion	Thrips, *Thrips tabaci* Lucerne caterpillar, *Laphygma exigua* Tobacco caterpillar, *Spodoptera litura*
Lady's finger / Okra	Shoot and fruit borers. *Earias insulana* Jassids, *Amrasca bigutella* Leaf roller, *Sylepta derogata* White fly, Bemesia tabaci
Cucurbits	Pumpkin beetles, *Raphidopulpa* sp Melon fruit fly, *Dacus cucurbitae* Flea beetles , *Phylotreta cruciferae* Snake gourd semilooper, *Plusia* sp.
Chillies	Aphid, *Aphis gossypii* Thrips, *Scirtothrips dorsalis* Pod-borer, *Spodoptera litura*
Carrot	Aphids, *Brevioryne brassicae* Diamond back moth *Plutella maculepennis*
Cabbage, Cauliflower	Aphids, *Brevioryne brassicae* Diamond back moth, *Plutella* sp. Painted bug, *Bagrada cruciferum* Cabbage butterfly, *Pieris brassicae* Cabbage, borer, *Hellula undalis*
Rice	Tissue-borers, *Tryporyza incertulas* Paddy gall fly, *Pachydiplosis oryzae* Rice hispa, *Dicladispa armigera* Paddy caseworm, *Nymphula depunctalis* Swarming caterpillar, *Spodoptera mauritia* Paddy jassids, *Nephotettix apicalis* Brown Plant Hopper, *Nilaparvartha lugens*

Maize	Stem borers, *Chilo zonellus* Hairy caterpillars, *Amsacta moorie* Aphid, *Rhopalosiphum maidias* Grey weevils, *Myllocerus* spp. Shoot fly, *Atherigona* spp. Armyworm, *Mythimna unipuncta*
Sorghum	Shoot fly, *Atherigona varia soccata* Stem borer, *Chilo zonellus*
Gram	Gram caterpillar, *Heliothes armigera.* Gram pod borer, *Maruca testutalis*
Pea	Pea semilooper, *Plusia nigrisigna* Pea leafminor, *Phycomyza atricarnis.*
Cowpea/Lentil	Aphids, *Aphis craccivora*. Pea blue butterfly, *Lampides boeticus*. American bollworm, *Heliothis armigera*. Leaf miner,*Stomopteryx nerteria* Tobacco caterpillar, *Spodopera litura* Stem fly, *Melanagromyza phaseoli* Grey weevils, *Myllocerus* spp. Aphids, *Aphis crassivora*
Citrus	Lemon butterfly, *Papilio demoleus* Citrus leaf miner, *Phyllocniistis citralla* Citrus whiteflies, *Dialeurodes citri* Citrus psylla, *Diaphorina citri* Fruit sucking moths, *Otheris fullonia* Aphids, *Aphis gossypii*
Grapevine	Flea beetle, *Scaelodonta strigicollis* Thrip, *Rhipiphorothrips cruentalus* Scale insects, *Aspidiotus cydoniae* Leaf-roller, Sylepta lunalis Jassids, *Amrasca* spp.
Mango	Mango hoppers, *Idioscopus clypealis* Mango mealy bug, *Drosicha mangiferae* Fruit flies, *Dacus dorsalis*
Papaya	Stem borer, *Dasyses rugosellus* Fruit flies, *Dacus diversus.*
Groundnut	Leaf-miner, *Stomopteryx nerteria* Red hairy caterpillars, *Amsacta moorie*

	Groundnut aphid, *Aphis craccivora* Stem-borer, *Sphenoptera perotetti*
Rape and Mustard	Mustard aphid, *Lipahis erysimi* Mustard sawfly, *Athalia proxima* Cabbage butterfly, *Pieris brassicae* Diamond-back moth, *Plutella maculipennis*
Castor	Castor Semi-looper, *Achoea janata* Bihar Hairy Caterpillar, *Diacrisia obliqua*
Tobacco	Tobacco Caterpillar, *Spodoptera litura* Capsule Borer, *Heliothes armigera* Aphid, *Myzus persicae* White fly *Bemisia tabaci*
Sugarcane	Early Shoot Borer, *Chilo infuscatellus* Top Shoot Borer, *Scirpophaga nivella* Pyrilla, *Pyrilla perpusilla*
Cashewnut	Tea mosquito, *Helopeltis antonii*. Thrips, *Rhipipothrips cruentatus*
Sweet potato	White fly, Sweet potato weevil, *Cylas sp.*
Coconut	Palm weevil, *Rhychophorus sp.* Rhinoceros beetle, *Oryctes boas.*
Tea	Tea mosquito, *Helopeltis schoutedeni*. Black tea thrips, *Heliothrips* sp.
Banana	Banana weevil, *Cosmopolites sordidus.* Fruit scarring beetle, *Colaspis hypochlora.*

Observations of international scientists on Azadirachtin and neem based pesticides :

M.Jacobson, United States Dept of Agriculture (USDA), Beltsville Laboratory for Biologically Active Natural Products, United States of America.

"Scientists in the U.S.Dept of Agriculture have continued their research on the chemical, biological, toxicological and cultural aspects of the neem tree, Azadirachta india A Juss, which has come to be considered as possibly the ***world's most fantastically effective natural insect antifeedant known today****. This reputation is based*

on solid foundation of evidence in the scientific literature, which is increasing in volume with each passing year. "

T.Schurig, Head of Department for Rural Development. Federal Mininstry for Economic Cooperation, Bonn, Germany.

" No toxicity for men and domestic animals and no or only relatively negligible side effects on beneficial organisms are ***outstanding criteria of neem products which make their use desirable wherever possible "***

- ---

H.Schmutterer, Institute fur Phytopathologie und Angewandite Zoologie, Justus Liebig Universitat, Ludwigstrasse 23, 6300 Giessen, Germany.

" Azadirachtin influence the feeding behaviour, metamorphosis(IGR-effect), fecundity, and fitness of numerous insect species belonging to various orders. These orders comprise numerous ***important vegetable and fruit tree pests****. Some spider mites are also affected. Various nematode species are also influenced by neem products, provided they are worked into the soil."*

M.G.Jotwani, Division of Entomology, IARI, New Delhi,

"..... the pests ***preferred to starve to death*** *rather than feed on the neem treated leaves "*

K.R.S.Ascher, Dept of Toxicology, Agricultural Research Organisation, The Volcani Centre, Bet Dagan, Israel.

" Anti-feedant effects of neem extracts are well known. However, in most insect species ***IGR effect****s such as molting disturbance, prevention of pupation and of adult emergence or malformation- production of abnormal pupae and adults, and sterility effects induced by neem treatment in the seemingly normal surviving adults* ***are much more conspicuous and , in fact, important."***

R.C.Saxena, International Rice Research Institute, Manila, Philippines.

"Neem seed derivatives have been found to be promising against sucking insects : the green leafhopper, the brown plant hopper, whitebacked plant hopper, and foliage feeders such as rice leaffolder, ear cutting caterpilllar, and the rice armyworm. Insects ***fed far less, grew poorly and laid fewer eggs on rice plants."***

N.Z.Dimetry Pests and Plant Protection Department, National Research Centre, Dokki, Cairo,Egypt.

" Different studies conducted in Egypt indicated the possibility of using neem-kernel extract for control of different pests. The unique properties of the toxic principles from the seeds are repellent, antifeedant and insect growth regulation combined with low cost, local availability ***safety to envrronment and compatability with agroecosystem which emphasize their potential in insect -pest management systems ."***

S.A.Siddiq, Shambat Research Station, P.O.Box 30, Khartoum North, Sudan.

"Perfomance of IPM package including Neem significantly reduced the damage by whitefly (Bemesia tabaci) and Jassid (Empoasca lybica) during 1989-91 and ***increased the yield of potato from 16.2 to 25.6 tons per feddan."***

A.A.Ruiter, Natuproducten, Post Bus 740, NL 9400 AS.Assen, The Netherlands.

" Foundation for eco-development alternative and Dutch Agricultural University have initiated research on neem-extract against 170 insect species. ***Policy makers of EEC should follow the U.S.A and India's soft stand on registration."***

M. Rice, Department of Entomology, University of Queensland, 4072, Australia.

" Built in resistance prevention (BIRP) : A valuable property of azadirachtin ."

D.Gomez, Groupo Interinstitucional de Tomate. Apt.Postal P116, Managua, Nicaragua.

"Use of insecticides produced from neem is ***becoming a real alternative for the management of pests in vegetable crops*** *in Nicaragua. Population reduction occurs in important pests like Plutella xylostella in Cabbage, Bemesia tabaci in Tomato. Management of these insects by neem insecticides costs less than using chemical insecticides. "*

Padmashri Dr.A.B.Joshi, Former Dy.Director General Indian Council of Agricultural Research and Ex-Vice Chancellor Mahatma Phule Krishi Vidyapith, Rahuri.

" the use of "Pesticides" of plant origin (e.g. Neem, karanj) provides an excellent alternative for protecting crops from depredations of injurious insect pests. The word "Pesticides" is inappropriate to describe them. For, they do not kill insects; they serve as anti-feedants (insect repellents) and as insect growth regulators (impairing insect fecundity, oviposition and larval growth). They also do not destroy the beneficial parasites and predators. More importantly there is no question of emergence of resistant races of pest species, as happens in the case of chemical pesticides. In short, these "bio-pesticides are **equally effective, far cheaper and fully eco-friendly**."

Dr.M.S.Swaminathan FRS, Former Director General, Indian Council of Agricultural Research and Secretary to Govt of India and Former Director General International Rice Research Institute, Manila, Philippines.

*" Currently, neem has attained **a pride of place** in international research and literature. Export potential of neem needs to be kept in view, since `eco-friendly products' will be in great demand. "*