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# The Neem Tree (Azadirachin-Indica A. Juss), a Natural Pesticide Practice in Pakistan

By Mrs. Farzana Panhwar, May 2005

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## The Neem Tree (*Azadirachin-Indica A. Juss*), a Natural Pesticide Practice in Pakistan

### ABSTRACT

Insects, pests, fungus and bacteria attacks resulted in to heavy losses of crops. In order to protect them farmer are compelled to use synthetic pesticides but they have shown negative effect on the environments and human and health. The Scientist now are working on new source of pesticide, which are less harmful and environment friendly. Azadirachin a triterpenoid extracted from neem seed and it oil used as insecticide by following mode actions. \* Antifeedants. \* Repellents. \* Distruptants of normal growth.

We raised neem on 8 acres of land with tree population of 108 trees/acres. Since neem is un-social tree and does not flourish as monoculture, we planted another 108 trees of *Syziniim Cumminal* between neem trees in each now. Trees were treated with ground application, Foliar sprays with N:P:K and with micronutrients were also applied to help fast growth of the trees. In the year 4 neem trees shed their leaves in the preflowering stage. These leaves were collected and used as a mat of mulch under lychee, longan, peaches, guava, and grapes. These trees are mulch year around by maintaining 10" thick layer of weeds growing between the tree rows, due to mulch trees grow faster, fruit earlier, or attacked less by diseases and yield is 3 times that of non-mulch trees. On 50 % of the area under mulch we sprayed neem leaves to form a thin uniform layer about 1/2" thick and above it piled the waste material consisting of chopped weeds. The other half of the area received only mulch from cut-weeds. The average yield during the year 1997, from the two groups are given by the table below.

**AVERAGE YIELD PER TREE IN KGS**

NAME OF TREE CROP.	4" THICK NEEM MAT PLUS 10" LAYER OF MOWED WEEDS.	10" LAYER OF MOWED WEEDS ONLY.	INCREASE IN YIELD DUE TO USE OF A LAYER OF NEEM LEAVES.
LYCHEE.	35.7	31.5	11.3
LONGAN.	49.2	46.1	6.7
GRAPE.	68.3	57.9	17.9
GUAVA.	76.9	72.3	4.9
PEACHES.	54.6	42.9	27.3
APPLE.	79.8	67.3	18.6

### INTRODUCTION:

Neem belongs to the Family: Meliaceae (mahoganoy family) and sub-family: melioidear. Tribe: Melieae, Order, rutales, sub-order. Retainer, Genus. *Azadirachta*, Species. *Azadirachta Indica*. It has various common names like: Nimmi, Limba, Libo, Neem, Nim, Nimb, Nimba, Vermbu, Vepa, Veppam and more than 100 names, Kohomba, Sadao India, Kwinin, Dao, Imba, Mindi, Mimbo, Intaran, Nimbagaha, Indian Lilc.

## HISTORY OF NEEM TREE:

- Indian scientist started neem research in 1920's.
- Neem's ability to repel insects was first reported in the scientific literature in 1926 and 1929.
- In 1962, three scientists showing that neem applied to vegetable crops would repel locusts.
- 1968 United Nations report called a neem plantation in northern Nigeria "the greatest boon of the century" to the local inhabitants.
- Researchers at the U.S. Department of Agriculture have been studying since 1972.
- Neem's insect-growth-regulation (IGR) effects were independently observed in England and Kenya in 1972.
- 1975 U.S. Department of Agriculture Research at Beltsville, Maryland and 19 19 of its stations across the country embarked on a comprehensive program to study the post-control properties of various plants.
- Neem was introduced to Philippines only in 1978. By 1990 International Rice Research Institute (IRRI) distributed more than 120,000 seedlings and the trees were growing on at least eight Islands.
- Bangladesh, Burkina-Faso, Chad, Myanmar, Senegal, Thailand and Mali are being assisted by Denmark and France to set-up an International Net Work.
- New Guinea neem was introduced at the beginning of 1980s.
- Queensland and New South Wales, in 1990, 16,000 tree were planted the pre 1980 neem project was for ornamental or for timber but post 1980 project for pesticide.
- According to Morgan (1981), there is a marked difference in the yield of Azadirachtin from neem (*Azadirachta Indica* A. Juss) seeds from various sources. From seeds from Ghana he obtained 3.5 g/kg, and from old Indian seeds less than 0.2g/kg.
- 1991, several hundred researchers in at least dozen countries were studying various aspects of neem and its products.
- In Nicaragua neem trees have been introduced through a cooperative known as "COPINIM" helped by Germany, Australia and Sweden. In 1995 they produced 200 tons of neem fruit.

## NEEM ABILITIES:

Insects, pests, fungus and bacteria attacks resulted in the to heavy losses of crops. In order to protect them farmers are compelled to use synthetic pesticides but they have shown negative effect on the environments and human health. The scientist now are working on new source of pesticide, which are less harmful and environment friendly. Azadirachin a triterpenoid extracted from neem seed and its oil used as insecticide by following mode of actions.

- Antifeedants.
- Repellents.
- Disruptants of normal growth.

The synthetic pesticides cause toxicological and environmental problems. Neem compounds show less side effects than conventional insecticides. It provides ecologically sound methods to control fungal and bacterial diseases. Although the use of natural insecticides are limited due to:

- High literacy of farm worker leads to high application rate and high cost per hectare per season.
- Small production of botanical insecticides, which lead to high prices/per kg.
- Diversity of indigenous knowledge.
- The complex mode of action for natural Semichemicals (pheromones, repellents and trifeedants) and advance methods of customer alternation.

**ECOLOGY:**

In India 14 million neem trees yield about 30,000 yields reported from Northern Nigeria (Samaru) amounted to 169 m<sup>2</sup> of fuel wood per hectare after rotation of 8 years.

- \* Yields in Ghana were reported between 108 and 137 m<sup>3</sup> per hectare, after rotation of 8 years. Haiti, contain USAID Project planted 200,00 neem trees as part of road beautification program. Saudi Arabia, introduced neem more than 40 years ago. Neem extracts are rich sources of bioactive agrochemicals. One million hectares need to be brought under neem. It grows well with mixed forest like Acacia Sp. 66% of total growth of neem tree takes place during the first 3 years. Fruit ripens in June/July. Weight ratio of seed to pulp is 1:2. Annual rainfall needed is upto 300 mm. pH of the soil may be 6.2 - 6.5. seed is 1.5 - 2.2 cm long and 1.0 - 1.6 cm wide. It is monocotyledon. Protandric bisexual flowers and male flowers exist on the same individual (Polygamous). IBA is used for root development. It grows well in alkaline or saline soil. Neem tree thrives on waste and marginal lands. The most suitable temperatures are 21 – 32 °C.

**OUR EXPERIENCE WITH NEEM:**

We raised neem on 8 acres of land with tree population of 108 trees/acre. Since neem is un-social tree and does not flourish as monoculture, we planted another 108 trees of Syzium Cummini between neem trees in each row. Trees were treated with ground application. Foliar sprays with N:P:K and with micronutrients were also applied to help fast growth of the trees. In the year 4 neem trees shed their leaves in the pre-flowering stage. These leaves were collected and used as a mat of mulch under lychee, longan, peaches, guava, and grapes. These trees are mulched year around by maintaining 10" thick layer of weeds growing between the tree rows, due to mulch trees grow faster, fruit earlier, are attacked less by diseases and yield is 3 times that of non-mulch trees. On 50% of the area under mulch we sprayed neem leaves to form a thin uniform layer about 1/2" thick and above it piled the waste material consisting of chopped weeds. The other half of the area receive only mulch from cut-weeds.

The average yield during the year 1997, from the two groups are given by the table below:

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NAME OF TREE CROP.	4" THICK NEEM MAT PLUS 10" LAYER OF MOWED WEEDS.	10" LAYER OF MOWED WEEDS ONLY.	INCREASE IN YIELD USE OF A LAYER OF NEEM LEAVES.
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APPLE.	79.8	67.3	18.6

**Table showing spacings at Khesano for various fruit trees.**

Fruit-tree	Spacing in feet	Ride width feet	Furrow width feet
Lychee	20x15	6	14
Grapefruit.	15x15	6	9
Tahiti lime.	15x12	6	9
Guava.	13.33x8	6	7,33
Apple.	15x8	6	9
Peach.	12x8	6	6
Pomegranate	12x6	6	6
Longan.	20x15	6	14

**Table showing macro-nutrients (N:P:K) composition of FYM.**

Ingredient	Percentage in the FYM	Ingredients per 8 ton truck load in kgs
Grape fruit.	22	34
Lychee.	18	30
Tahiti lime.	36	48
Guava	14	26
Grapes	14	26
Peaches.	28	40
Pomegranate	22	34
Apple.	28	40

The effect of neem cake on nitrification of soil, these chemicals help in improving efficiency of nitrogen under situation, where losses due to denitrification and leaching accompanying nitrification are high the bitters in neem belong to a group of Tetranortriterpenoids, which is sulphur containing compound. Neem show inhibition of production of Aflatoxins, which can grow in some food. It has been estimated that by using water extraction, 20-30 kg of neem seed can normally treat 1 hectare.

#### **NEEM SHOW DISORDERS DUE TO ABIOTIC ENVIRONMENTAL STRESS:**

- Leaf curl.
- Defoliation.
- Dieback of shoots and branches.
- Roten root.
- Reddish brown dead leaves.

**THE NEEM LEAF COMPOSITION IS AS UNDER:**

<u>Nutrient</u>	<u>Total nutrient content (%)</u>
- Crude protein.	12.40 - 18.27
- Crude fibre.	11.40 - 23.08
- N-Free extract.	43.32 - 66.60
- Ether extract.	2.27 - 6.24
- Total ash.	7.73 - 18.37
- Calcium.	0.89 - 3.96
- Phosphorus.	0.10 - 0.30

**NEEM CAKE COMPOSITION:**

<u>Nutrient</u>	<u>Total nutrient content (%)</u>
- Crude protein.	13 - 35
- N <sub>2</sub> .	2 - 6
- Carbohydrates.	26 - 50
- Crude fibre.	8 - 26
- Ash.	5 - 18

**NEEM CAKE USED AS MANURE (FERTILISER).**

\* Neem cake have 7.7% nutrients content:

** Ash.	21.0%
** N.	0.5%
** P.	0.1%
** K.	0.5%

Kernel contains about 30-40% oil. Triterpenoid content of the kernel is about 2.5 - 3% Azadirachtin content in the kernels vary from 0.2 - 0.6%. Azadirachtin derived from neem fruits, seeds, seed kernel, twigs, stem bark, root bark, more than 100 compounds are extracted this way. The compounds derived from neem belong from Tetraterpenoid; Pentaterpenoid; Monoterpene ingredients. Azadirachtin contain insect antifeedant, insecticidal, insect, growth disrupting nematocidal, fungicidal and immunostimulating activities. 20 kgs of kernel produce 6- 8 kgs of oil.

## PROPAGATION:

Genetic engineering is used to develop pest resistance variety and having more quantity of azadirachtin. A micro-cuttings and clonal propagation of neem results in to high yield of Azadirachtin neem. Clonal propagation of neem is done by tissue culture. Micro-cuttings from auxiliary buds is the basis of multiplication. Platelets can also be obtained through micropropagation from leaflets, callus cotyledons and stem segments by using Murashiger and Skoug medium having cytokinins. Genetically involved neem show pest and disease resistance.

## USES:

- **TIMBER AND WOOD:-** As house-building, construction of roofs, used as poles, fence, posts, construction of furniture, window frame, carts, azles, ships, boat, building door panels, cupboard, drawers, excellent source of firewood.
- **BARK:** Used as toothpaste.
- **LEAVES:** Feed for goat and domestic animals, mulch to improve yields. Its powder used in cosmetics and in hair lotions.
- **FLOWERS:** The honey bee collect Nectar and convert it is to neem honey.
- **RESIN (GEM):** - This is used as medical purposes, as a stimulate silk dyers, used for preparation of colours.
- **SEED OIL:** - Used as pest control, soap-making, used in lamps, making candles, nail polish, cosmetics, silk and cotton cloth dyers, neem oil as a source of deep yellow colour.
- **SEED HUSK AND FRUIT PULP:-** Used as fuel, pulp used in generation of methane gas, production of alcohol had is a rich source of carbohydrates.
- **CONTROL OF WIND AND WATER EROSION:-** Suitable as wind breaks, well developed root system help in prevention of the loss of top soil system.
- **NEEM AS SHADE TREE:-** Neem tree shade is helpful to the poor people. Neem tree shade provide shelter to the birds domestic animals and to the human.
- **NEEM AS ORNAMENTAL TREE:-** It is used as ornamental tree.
- **REDUCTION OF CARBON DIOXIDE AND PRODUCTION OF OXYGEN:** It helps in reduction of  $\text{CO}_2$  in the air so helpful in slow down the global warming and it is also called air purifier.
- **TOLERANCE AGAINST AIR POLLUTION:-** It helps in reduction of  $\text{CO}_2$  and other gasses produced during the heavy traffic.
- **NEEM LEAVES FOR FRUIT PROTECTION:** Neem leaves are used as decoration and protection of fruits like custard apples, citrus, pomegranate, melons to make remain fresh and get longer time. Traditional way mix dried leaves with frains is use for storage, also for protection of clothiers, books and papers dried leaves kept between the pages of book show production in booklice. Leaves are used as repellent to insects so protect them from insect feeding. Leaves are also used as supplement for domestic animals as an insect repellent. The extract is used as anti-inflammatory activity. House sparrow, passer domestics use neem leaves in building the nest and protect off spring against parasites. In southern Punjab, neem leaf extract is sprinkled on what straw packed at the bottom of palli, 2-3 days before filling with grains.

## AGROFORESTRY:

Neem tree is used in farming, forestry, industrial sectors and used for sustainable agriculture. It is also used in agroforestry, firewood, wind break, soil improvement and prevention of erosion. It also helps in absorption of  $\text{CO}_2$  from the atmosphere so it slows down the global warming. Oil extracted from the neem is used in soap, as fertiliser, rich in nitrogen, phosphate, potash, and micronutrient. It is used to control virus of fruit, vegetable, field crop live-stock and may be human virus.

### **PEST -CONTROL ABILITY OF NEEM:**

It controls stored grain pests. It is used to control pest in storing general grains (paddy/rice, wheat, corn, sorghum), it helps in controlling the soil borne pests.

Neem extract is effective against more than 200 insect species, some mites, nematodes, fungi, bacteria and virus, several neem constituents are used for insect control for nematicidal, molluscicidal, bactericidal, fungicidal and cytotoxic activities. It is also used against major pest like leaf miners, chrychinch buys, aphids and thrips.

### **INSECTS AND PESTS.**

Neem oil is used against many insects.

Insects and pests like:

- Mollusca: Snails and slugs.
- Acarina: Mites (Tetranychidae) *Schizotetranychus hindustanus*.

#### **Insects like:**

- Insectera, Termites (Termitidae).
- Caelifera, short-horned Grasses hoppers including Locusts (Locustidae).
- Ensifera, Long-horned Grasshopper (Tettigoniidae) and Crickets (Gryllidae).
- Thysanoptera, Thrips (Thripidae).
- Heteroptera, Bugs - *Helopellis antonii*, Tea mosquito bug (Miridae).
- *Nezara viridula*, Green Stink bug (Pentatomidae).
- Homoptera, Leaf and Planthoppers, Aphids, Scale Insects and White flies.
- *Aphid Spiraecola*, citrus aphid (Aphididae).
- *Macropulvinaria Jacksoni* (Coccidae) and other soft scales.
- *Anonidiella Orientals*, Oriental scale (Diaspididae).
- *Chrysomphalus aonidum*, Egyptian black scale (Diaspididae).
- *Parlatoria Crypta*, Mango white scale (Diaspididae).
- *Pinnaspits Strachani* (*P. Minor strachani*), Lesser snow scale (Diaspididae).
- Other armored scales.

#### Hymenoptera, Ants

- *Acromyrmex* spp. and *Atta* spp. Leaf cutting ants (Formicidae).
- *Messor* spp., Harvester ant (Formicidae).

Coleoptera, Beetle

- *Epitragus sallei* (Tenebrionidae).
- *Apate monachus*, Black borer (Bostrichidae).
- *Holotrichia consanguinea*, *H. Scrrata*, *H. insularis* (Scarabaeidae).

Lepidoptera, Moth

- *Adoxophyes aureate*, East Asian neem - tartrix (Tortricidae).
- *Loboschiza Koenigiana* (= *Enarmonia - Koenigiana*, *Laspeyresia Koenigiana*) (Tortricidae)
- *Hypsipyla robusta* (Pyralidae).

Insects, nematode and pathogen.

- Orthoptera.
- *Acrida exaltata* walker *chrotogonus trachpterus* Blanchi, *Locusa migratoria* L. *Peocilocerus pictus*; *Periplanta American*; *Schistocerca gregaria* P.
- Lepidoptera.
- *Achaea Janata* L; *Agrotis ispilon* (Hufnagel) *Amsacta moorci* But; *Argyroploce leucaspis*; *Bomby x mori* Lann; *Chilo partellus* (Swinhoe).
- Monoptera.
- Hetroptera.
- Diptera
- Coleoptera.
- Hymenoptera.
- Isoptera
- Thysanoptera.
- Lepidoptera.
- Nematodes e.g *Helicotylechus indicus*;
- *Hirschamanniella oryzae*; *Homicri come moides* sp; *Hoplolaimus indicus*;
- *M. Arenaria*; *Meliodogyne incognia*;
- *M. Javanica*; *Roylechulus reniformis*;
- *Telenchus filiformis*; *Tylenchorhynchus*.

\* *Azadirachta Indica*, natural produced with significant bioactivity against insects.

**Neem based commercial insecticide.**

S.No.	Name of compound	Trade name	Crop	Pest control
1.	Azadirachtin 0.03% w/w	Margocide OK 80% EC	Cotton tomato cabbage	Jassid, <i>Heliothis Heloithis</i> , White fly Aphid
2.	Azadirachtin 0.15% w/w	Margocide OK 20% EC	cotton tomato tobacco	Boll worm, Jassid Frit borer, White fly. Tobacco caterpillar.

S.No.	Name of compound	Trade name	Crop	Pest control
3.	Azadirachtin 0.03%	Godrej Achook	Bengal gram red gram cotton  Jute  Okra. Brignjal.  Cabbage.	Podborer Heliothis Melangomyza Aphid, Jassid , White fly, Boll worm (Earias and Pectinophora). Semilooper, Hairy caterpillar. Fruit borer, White fly. Shoot and fruit borer beetle. Aphia, Moth, Worm, Looper
4.	Azadirachtin 0.03% EC	Neembecide.	Paddy. Cotton lab-lab	Gallmidge B.P.H. Aphid, leafroller Black aphid.
5.	Azadirachtin 0.03% EC	Bioneem	cotton	Aphid, Jassid and bollworm.
6.	Azadirachtin 0.15% (1500 ppm)	Nimabasol	cotton  cabbage	White fly, bollworm leafroller. Diamond, Black month.
7.	Neem oil 93EC Containing Azadirachtin 0.3% (300 ppm)	RD-9 Repelling 93-EC	rice cotton tobacco ground nut sun flower red gram	Leaf folder, stem borer Heliothis Spodoptera Aphia-Jassid Heliothis Heliothis
8.	Azadirachtin 5% Conc.	Neemazal F.	Cotton caster cabbage	Aphid, leaf hopper, White fly. Spondoptera, Diamond, back month.
9.	Azadirachtin 0.15% (1500 ppm).	Rakshak.	Cotton	Thrip, Aphid, Jassid.
10.	Azadirachtin 0.15% EC	Neem Gold	tobacco  coffee	Caterpillar, Spondoptera litura. Steam borer
11.	Azadirachtin 0.03%	Neemark	cotton  sugarcane	Aphid, Jassid, White fly, Bollworm. White fly.
12.	Azadirachtin 0.15% (1500 ppm)	Sukrina	okra	Leaf hopper, Aphid.

**Neem based pesticidal products.**

S.NO.	PRODUCT	ACTIVITY
1.	Godrej Ackook.	Antecedent, repellent, deternell, male sterility, growth regulator/disputant.
2.	Field Marshal	Antifeedant/repellent.
3.	Jawan Crop Protector.	Antifedent/repellent, distub growth and reproduction.
4.	Margocide-CK	Antifeedant, growth inhibitory.
5.	Margocide - OK.	Insecticide.
6.	Neem oil emulsion.	Pesticide.
7.	Neem mark.	Nematacidal, synergistic.
8.	Neem gold.	Antifeedant.
9.	Neem Guard.	Metamorphosis disruption.
10.	Neemta - 2100.	Repellent.
11.	Nethrin.	Pesticide.
12.	Nimba.	Pesticide.
13.	Nimbecidine	Antifeedant
14.	Nimlin.	Metamorphosis disruptor
15.	RD-9 Repelin.	Antfeedant, repellent.
16.	Sukrina.	Antifeedant, repellent.
17.	Wellgro.	Fungi inhibitor-Antiviroi.
18.	Suneem.	Antifeedant/repellent.

- Fungi.
- Aspergillus niger, puccinia arachidis sarocladium oryzae; Fusarium - O xysporum f. Sp. Cepae.
- Effect on Fungi.
- It shows inhibition of germination of plant pathogenic fungi by M. Azedarach extract use.

- **DISEASES.**

- Bacterial diseases.
- Pseudomonas azadirachtae (Psdeudomonadaceae).
- Xanthomonas azadirachtae (Psdeudomonadaceae).
- Fungal diseases.
- Pseudocercospora subsessilis (= Cercospora subsessilis) (Moniliaceae).
- Diseases of stored neem seeds and seed kernels.
- Aspergillus Spp. (Eurotceae).
- Parasitic plants.
- Dendrophoe falcata.
  - Tapinanthus Spp.
  - Loranthus spp.

- **PATENT:**

- Pattents on neem.

- Inventor - Japan - 1983.
- Neem bark extract - to ratard growth of sarcoma tumors in mice.
- Inventor - Japan - 1985.
- Neem bark extract - the process provide higher purity extract.
- Investor - USA - 1985.
- Azadirachtin from neem seed - biopesticide character.
- Investor - Germany - 1990.
- Azadirachtin - insect growth inhibitor ability.
- Inventor - USA - 1990.
- Hydrogenation of neem seed extract - Insecticidal property.
- Inventor - USA - 1990.
- Stabilized Azadirachtin extract - Azadirachitin as non-degrading solvent to improve its storage ability.
- Inventor - USA - 1993.
- Toothpaste root + branches - to control microbes present in paste compound.
- Inventor - USA - 1992
- Azadirachtin stable storage - Azadirachtin biopesticide.
- Inventor - USA - 1994
- Azadirachtin - Fungal pathogenic control.

**FUTURE RESEARCH:**

- To identify pests that can be controlled by neem economically under farmer conditions in various ecological zones.
- Neem propagation need new methods and techniques, the use of neem as safe photochemical pesticides needs further study.
- New research is required to study the natural compound like biosynthesis, intermediates, enzymes and their genes, mode of action, receptors and enzymes and their genes.
- Research is required to study the Azadirachtin possible role in global pest control antimicrobial role, biodegradable fungicidal role, which can be improved by the help of bio-technology.
- The metabolism and residual effects of neem products are still under study.
- New research in the field of locust neurobiology, pharmacology and chemical ecology need specific strategies to use neem for the control of locust.
- New research is required to discover that Ecdysteroids are insect moulting hormones, and phytoecdysteroid might protect, plants against non-adapted phytophagous insects.

**CONCLUSION:**

It was concluded that a thin layer of neem leaf as mulch due to presently unknown reasons increased fruit yield by about 5 to 25 %. It is yet unknown whether it is due to suppression nematodes in the soil or due to reduction in crawling insects like ants, which climb the fruit trees from ground. Further investigation is necessary.

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- 50 countries of the tropics and sub-tropics including Mexico, and East Africa for desert regeneration, as well as for land reclamation.
- Bangladesh, Burkina Faso, Chad, Myanmar Senegal, Thailand and Mali are being assisted by Denmark and France to set-up an International Network.
- In Nicaragua neem trees have been introduced through a cooperative known as "COPINIM" helped by Germany, Australia and Sweden. In 1995 they produced 200 tons of neem fruit.
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