NEEM - A NATURAL PESTICIDE

BY
M.H. PANHWAR AND FARZANA PANHWAR

In 1992 the Forest Department advertised for allotment of many thousands of acres to parties interested in raising forest trees under the scheme called "Social-Forestry". We also applied keeping in view that we would raise Neem trees on about 800 to 1000 acres and have a mini-industry for extraction of oils, especially azadirachtin from neem fruit, though leaves and twigs also yield similar oils in small quantities.

In 1983 we had already experimented on extraction of this oil from some neem trees growing wild on our farm. The process was primitive and 50 kg of twigs and leaves were chopped in an animal feed chopper into pieces of about ¼ to 3/8, put in 2 drums each containing 100 liters of water and about 25 kg of this material. The drums were kept in the open in the May sun. The temperature of water rose to 131ºF (55ºC) at 3.00 p.m. One man kept stirring the mixture.

After 48 hours, the leaves were taken out, the mixture filtered and sprayed over one acre of land under roses, having been infected with various types of insects. It controlled all insects and fungal diseases. We did not have to repeat the spray for the next tow months.

Prior to this, we were spraying decis-D or a mixture of malathion and dimethoate every month. These chemicals were available at very cheap rates then and the cost of labor involved in harvesting leaves, chopping and preparing neem-oil mixture was high but we discovered that mechanized harvest and industrial process of extraction of oil would cost much less. If the raw material was available from 1,000 acres, a mini-industry and from 10,000 acres a regular industrial plant could be established. We further studied the spacing of neem trees, water and soil requirements, agronomical practices including application of fertilizers, and found that 100 plants per acre and a total of 1,000 acre area, could produce enough seed to justify a small plant in the fifth or sixth year.

A paying tree.

Neem can be raised economically as a forest tree and would pay the grower much more than acacia or eucalyptus trees, being planned under Social-Forestry by the forest departments. When trees start crowding in Year 8 or 9, if wood is harvested from alternate trees and alternate rows, the wood will fetch more

money than acacia or eucalyptus annually. When they are again crowded in about 16 years alternate rows can be removed leaving 25 trees per acre.

We discussed the whole project with a FAO expert who was attached as advisor to the project being executed by the Forest Department in collaboration with the private sector. The allotment of land on a long term lease to the private sector is subject to the condition that 80 percent area would be under forest crops and the participants can grow any crop on the remaining 20 percent, be it fruit or crops.

This condition will be strictly enforced and loan and other facilities will also be available subject to that condition as definition of forest trees for the project includes only eucalyptus and acacia nilotica and no other forest tree. Thus we can grow neem tree only on 20 per cent and 80 per cent has to be under acacia and eucalyptus.

The neem oil (azadirachtin) industry would need about 10,000 acres under neem in a place like Sindh, where it would keep growing almost year around and even in winter the growth would slow down only partially, unlike Punjab where it may grow for only 8 months year and 15,000 to 20,000 acres may be needed there for a similar size industry. We thus will have about 50 per cent more output in terms of leaves twigs and fruit. High density planting as suggested above, will yield the same amount of fruit in the years, 8 or 9, as mature trees of low density planting will yield in year 25.

Neem as pesticides.

Neem probably is the world most efficient insect repellent with extracts from its fruit, kernels, leaves, and twigs, which yield a compound known as “azadirachtian” and which is systemic in action and has both insecticide and fungicide properties. The demand for Neem oil is already out-stripping supply.

The are plans for planting Neem in vast semi-arid, irrigated arid and tropical and sub-tropical lands. The developed countries are the first to have recognized its need and plantations have already been started in the various states of Australia, the leading being Queensland and Northern Territory followed by others.

Neem probably originated in South Burma and from there it was introduced in South Asia before Pleistocene (1.8 million years ago). The medical properties of Neem were known to both Aurevidic and Greek (Arabic) medical systems. The use of Neem tree as tooth-brush by crushing of end of a branch let having the thickness of a pencil, is common in the rural areas of South Asia and goes back many thousand years.

Today it is known that it contains world's best known natural dentifrice for manufacture of toothpaste.

The Neem oil has been used for various purposes including skin care, soaps and etc., in South Asia. The leaves are boiled in water for extracting azadeirachtian and diluted in water; it is taken orally against many diseases and used as bath for skin diseases. Neem is related to mahogany and has beautiful hard wood of pink color, highly suitable for furniture. At an age of about 20 years, the tree produces wood which is surpassed only by mahogany, teak and shsham. One aspect of its is that once furniture is made from its wood, it keeps on darkening i.e., acquiring deep pink color with age. Its timber besides being durable is not attacked by termites.

Characteristics.

Trees can be planted 20 feet apart in 20 feet wide rows. Congestion will start in the year 9 to 10 and alternate trees in alternate rows can be removed leaving 54 trees per acre. Next congestion will start in the year 16 to 18 and every alternate row can be removed leaving 27 trees per acre. This will keep yield at the highest from Year 8 onwards Annual pruning can be processed separately or used as mulch.

The neem tree prefers well drained deep soil and sandy-loams, with ground water at 10 feet depth or more. It takes about five years to produce the first fruit crop, but with application of mulch, irrigating and nutrition feeding, it can produce a good crop in the third year.

While it is growing, leaves can be harvested at the time of pruning or shaping the tree and used as insecticide or mulch in orchards. Its tap root is capable of reaching ground water 8-10 meters deep and thus can survive the arid conditions for long time without irrigation. It can survive in an annual rainfall of 12" or 1-2 irrigation / annually but for high yields of leaves and seeds, it needs irrigation.

Its seeds are harvested by shaking the tree. The seeds which usually are about 2 cm long and 1.5 cm diameter, yield kernel of about 1.5 cm length, containing about 30 to 40 percent oil. Pulp is removed and being sweet, it attracts birds and children the yield from 5-6 years old tree could be 20 kg kernels, which would produce 6-8 kg of oil and the residue can also be processed or emulsion in water and used as insecticide or as fertilizer. With high density planting at 20x20 feet or 108 trees per acre, 100 acres can yield about 700 tons of oil for a pilot plant and 10,000 acres would provide 7,000 tons for a small plant.

The tree has the ability to stand frost, due to a very thick suberised bark layer and can easily survive desert condition temperatures over 50ºC. It is thus suited to the tropical and sub-tropical climate of Pakistan right up to 31ºN except the high hills.

Recent research shows that Meliaceae family has strong ability to repel insects and there may be some new comers besides neem; this includes cedars and mahoganies but their respective oil properties have yet to be studied. It seems that a number of other insect repellent plant species may come to light, but as it grows in tropical and sub-tropical climate, with its active ingredient azadirachtian and its ten or more analogue + isomers, it stands the best chance at least in South Asian conditions.

Besides Azadirachtin neem extracts contain other oils namely; salannin, meliantriol, nimbin, nimbidin, limonoids and many other minor ingredients. These oils have different effects on insects. They can also control various viruses of fruits, vegetables, field crops, livestock and may be human viruses.

Their effect on insects is not to kill them out-right, but rather disrupting or inhibiting development of eggs, larvae, and pupae, blocking moulting of larvae or nymphs, disrupting mating, repelling larvae and adults, deterring female from laying eggs, sterilizing adults or deterring their feeding or blocking ability to swallow and inhibiting formation of chitin. In these processes, the insect and their future generations are eliminated.

Neem oils affect at least 200 insect species some of which are resistant to conventional pesticides. These include most resistant insects like sweet potato white-fly, green peach aphid, cotton aphid, floral thrips, diamondback moths, leaf-minors, fruit-flies, house-flies, white-flies, horn-flies, face-flies, shoot-flies, various kind of mosquitoes, flees, lice, beetles, grubs, erinose mite of lychee and other mites, cockroaches, aphids, thrips, moths, ear-worms, cob-worms, boll-worms, army-worms, bud-worms, horn-worms, buck-worms, hoppers, bugs, ants, weevils, various larvae, beetles, various kinds of hoppers, green vegetable bugs, root nematodes, brown ant hoppers, scale insects, grubs and etc.

Neem leaf mulch snails, crustaceans, fungi, and aflotoxin. Neem is successfully used as insecticide in case of lice (human and animal) fleas, ticks and grain insects. Neem oil can also be used as fungicide against powdery-mildew and even some viruses. Neem oil is also helpful for human health and the oil is known to work as fungicide, anti-bacterial and anti-viral and for wound-heeling, dental treatment and Chaga's disease. Internal vaginal application of neem oil has helped as birth control measures, replacing castor nut taken orally since ages. It also relieves pains and controls skin bacteria and fungus.

Neem oils is commonly used in soaps and cosmetics in India. Neem oil cake can be used as fertilizer as it is rich in nitrogen, phosphates, potash and micro nutrients.

It has been recognized across the world for new pesticides, which have no objection for being used in IPM (Integrated Pest Management) as it does not kill the predators of many insects and bees and thus is a friendly pesticide. On the other hand it attracts many beneficial insect species and butterflies, micro-wasps and bark hoppers, which become predators as well as pollinators of many fruit crops. Its leaf litter attracts micro-fauna which renew the soil. It increases the pH of acid soils and quickly raises it to about 7.0 or neutral soil.

Neems azadirachtian has the ability to upset the hormonal system of insects making their reproductive system ineffective for reproduction. The effect of spray lasts from a few days to about a month and the concentration used is from 0.01 – 0.10 percent. It is a true systemic biological insecticide and most suitable for Integrated Pest Management.

Neem tree while standing in an orchard does not keep insects away from other trees. However it attracts a range of insects, which can control pests on other trees as predators.

Plantations.

Neem tree was widely grown allover South Asia (Pakistan, India and Sri-Lanka), Burma and West Africa particularly Nigeria, but recently extensive plantation have been established in Saudi Arabia, Central and south-American tropics and sub-tropics including Haiti. Some multinational companies are funding neem plantation in Latin America.

In the 60s neem tree was planted as an ornamental tree along roads of various towns like Darwin, Elliot, Allis Springs and etc., in Australia, but now plantations have been extended to Western Australia, Queensland and New South Wales. In 1990, 16,000 trees were planted in Queensland and some private farms are planting 250-450 trees on each farm in addition to normal crops. The pre – 1980 neem projects were ornamental or for timber but post 1980 projects are for pesticides.

Now besides South Asia and South-east Asia it has become naturalized in 50 countries of the tropics and sub-tropics including Mexico and East Africa. It has become the fastest selling tree species for desert regeneration and land reclamation in Iran, Saudi Arabia, Egypt, Morocco, Tunis, Algeria, and Libya. It

is out selling eucalyptus species in these countries. African and Saudi Arabian demand for the plant is met by a large number of nurseries in Italy. Saudi Arabia has already established more than 10,000 trees within a few years. Of the African countries beside Nigeria, Ghana and countries from Somalia to Marutinia, have already been planted neem trees.

Bangladesh, Burkina-Faso, Chad, Myanmar, Senegal, Thailand and Mali are being assisted by Denmark and France to set-up an international neem network. In Nicaragua neem trees have been introduced through a cooperative known as "COPINIM" helped by Germany, Austrlaia and Sweden. In 1995 they produced 200 tons of neem fruit and are expected to have 300 tons of fruit in the year 1997, when an economic industrial plant could be established.

The properties of neem as insecticide/pesticide were very well known in South-Asia and to protect libraries, neem leaves were put inside a few pages of each book and leaves were also scattered in wooden boxes or racks containing them. Neem leaves are also put in woolen and other clothes, quilts and grains in storage in the South Asia.

The first scientific work on neem as an insecticide was published in undivided India in 1929, but the world did not know about it until a German scientist found that locust did not visit neem tree during their worst attack in Sudan in 1959. Scientific study of neems properties was started by U.S. Department of Agriculture in 1972.

Many of the ingredients in neem extracts are distant relative of steroids. These include cortisones and birth-control-pills. The neem-extracts do not contain objectionable items like chlorine, phosphorus, sulphur and nitrogen and therefore their mode of action is different from that of insecticides commonly in use. The use of neem oil and use of its derivatives as insecticides was well established by 1980 and many U.S. companies procured patents on extraction, processes. The neem based pharmaceutical, cosmetic, detergents, insecticide, and fungicide and etc., would account for annual business of a score of billion U.S. dollars a year and this being so, some 34 patents have been registered in Western Europe and Northern America, with the U.S. being the biggest some U.s. pesticides companies are financing neem projects in the Central America. W.R. Grace and Co., has established to seek a patent on seed derivative "Margosan-O".

Some U.S. plant breeders have also patented neem seeds. Since neem originated in South Asia and there are 14 millions neem trees in India alone and approximately the same number in Pakistan, Bangladesh and Sri-Lanka combined, there have been protests against the patent rights, as neem originated

here and therefore patent rights have no legal standing. In terms of economics, neem can out-do any other forest tree including mahogany, teak and shisham which take years to mature for quality timber and neem can start paying its seed from the third year onwards.