Azadirachta Indica: The Neem Tree

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Figure 1 - Seeds and leaves of the neem tree
(National Research Council, 1992)

Abstract:
The A. indica is a tree profoundly known for its medicinal benefits harvested from its bark, leaves, and sap. The A. indica is also known for its agricultural benefits, as the tree can produce its own herbicide and repel insects, and this is used to ensure good plant growth. The A. indica is also known for its ability to survive in hot deserts with long droughts, and has been able to restore acidic and nutrient-deficient soil to benefit the ecosystem it is in.

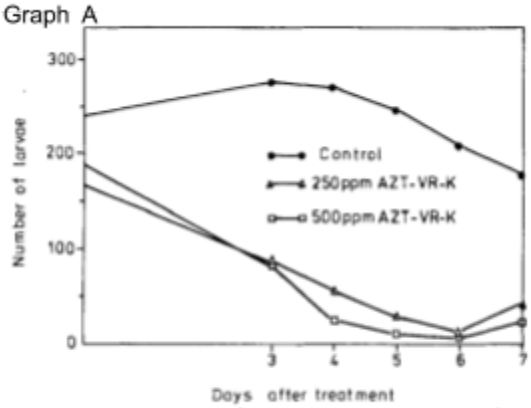
Keywords:
Pharmaceutical, Insecticide, Disease, Agriculture, Arid, Cultivation

The *A. indica* is a tree endemic to the Indian subcontinent as well as areas in the Middle East, arid zones of Africa, and many parts of south-eastern Asia (Koul *et al*, 1990). The *A. indica* is only one of two recognized species that belongs to the genus Azadirachta, and has been known for over centuries as the flowering plant with important medicinal value (Ashrafi, et. al, 2009). It is known as the 'Neem Tree' and has had significant importance to the people of India due to the medicinal and agricultural resources the neem tree provides. While cultivation of nutritious fruit is a common resource harvested for consumption (Koul *et al*, 1990), most of the resources harvested from the neem tree have natural and effective pharmaceutical benefits. The bark is extracted to treat common fevers, the oil is used to treat tetanus and leprosy, the juices of neem leaves can treat skin diseases, and neem tree twigs have been used as toothbrushes to ensure good oral hygiene (Govindachari, 1992) are just some of the uses of neem tree resources.

Yet, the uses of the versatile neem tree does not even end there. The most common benefit of *A. indica* is its ability to produce a natural insecticide to deter many species of insects away, as the chemical makeup of the natural insecticide prevents the growth of insect larvae from developing into adults (Govindachari, 1992). In a study conducted by H. Schmutter, an experiment was conducted to determine what types of insects are affected by the natural pesticide of the neem tree. The study included several species, but the graphs below shows data for 3 types of insects.

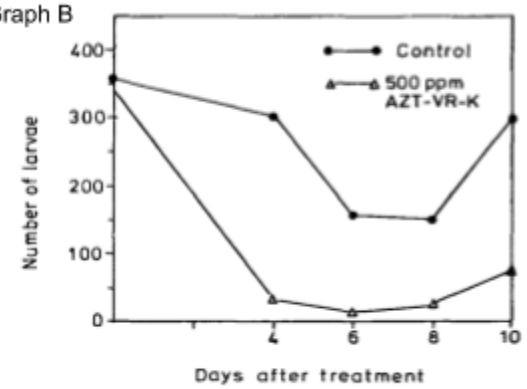
Source: (Schmutter, 1985)

Graph A



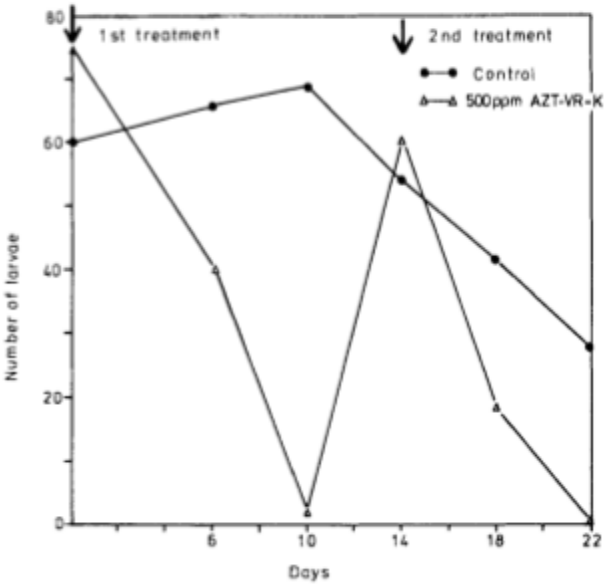
Treatment against larvae of colorado potato beetle (*L. decemlineata*)

Graph B



Treatment against larvae of cereal leaf beetle (*O. melanopus*)

Graph C



Treatment against larvae of spruce sawfly (P. abietina).

Figure 2 - Three results from H. Schmutters' experiment involving varying concentrations of AZT-VR-K from neem extracts affecting the number of larvae of 3 different pests. Compared to the control, the neem extracts appear to reduce the larvae population of the three different species immensely (Schmutter, 1985).

The results from H. Schmutters study indicates that the natural pesticide is quite effective against many species of insects and have beneficial uses for agriculture in developing countries (Schmutter, 1985). Therefore, the evidence from this study has demonstrated great potential for agricultural uses in developing countries in Asia and Africa. While artificial insecticides can have negative effects on other organisms and cause environmental drawbacks, the use of neem kernel extracts have proved to be an effective, low-cost solution to benefit farmers, with the additional benefit in providing health benefits for sheep and dogs (Ahmed & Grainge, 1986).

Clinical studies of neem extracts of leaves, fruits, and barks have been proven to treat many skin diseases and other intestinal problems, such as scabies, within a week or two (Biswas *et al*, 2002). In addition to curing skin diseases and common illnesses, neem tree sticks have also been used by people in India as a natural toothbrush as an alternative to manage oral hygiene. In another study involving patients using neem tree sticks as toothbrushes, patients chewed and brushed the twig against their teeth and compared the results to patients using a normal toothbrush. The data collected demonstrated very similar results, indicating that neem tree twigs remove plaque, ensures good gingival health, and overall provide good oral health to the extent of being as effective as a toothbrush (Bhambal, 2011).

Source: (Bhambal, 2011)

	QHPI-B	QHPI-L	GI-B	GI-L	GI- M	GI-D
ΔN	0.05±0.06	0.05	0.14±0.1	0.04±0.09	0.13±0.27	0.08±0.19
ΔT	0.05±0.12	0.06	0.09±0.0	0.03±0.07	0.11±0.21	0.07±0.16
P value	>0.05	>0.05	>0.05	>0.05	>0.05	>0.05

QHPI B- Quigley Hein Plaque Index for Buccal site, QHPI L - Quigley Hein Plaque Index for Lingual site, GI B – Gingival Index for Buccal aspect of tooth, GI L - Gingival Index for Lingual aspect of tooth, GI M – Gingival Index for Mesial aspect of tooth, GI D – Gingival Index for Distal aspect of tooth, ΔN – Difference in before and after scores with neemstick, ΔT – Difference in before and after scores with toothbrush.

Figure 3 - Difference of neem tree stick and toothbrush in comparison to measurements of plaque and gingivitis. The results under Delta N and Delta T show very similar values under each index, demonstrating that neem sticks are as effective as keeping good oral hygiene as toothbrushes (Bhambal, 2011).

Taxonomy
While *A. indica* is part of a small genus consisting of only two species, it is part of the Meliceae family, which makes up many other flowering plants and shrubs (Ashrafi *et al*, 2009). Within this family, there is another species that has been reportedly similar to the neem tree. The *M. azedarach* has leaves and fruit that are akin to the neem tree, and both are endemic to India and southeast Asia (Biswas *et al*, 2002). The neem tree can be further classified in the Sapindales order, an order that makes up many flowering plants, such as mahoganies, maples, and most importantly, neems.

Life Cycle
Neem trees are commonly found in warm areas with little to no rainfall, and does not require a lot of water in order to grow (Ahmed & Grainge, 1986). After the seedlings germinate, the saplings will benefit from water-rich soil, otherwise they will develop slowly (Ahmed & Grainge, 1986). The neem trees reach adulthood after 5 years and can begin the pollination process. Flowering of male and bisexual flowers can appear on the same tree, and the flowering process can vary between different parts of the tree (Undu, 1999). Pollination of the flowers are carried out by insects, and can travel between different trees or even the same tree, resulting in selfing or cross-pollination of the plant (Undu, 1999)

Habitat
Due to being found mostly in the Indian subcontinent, A. indica is known to thrive in dry environments with high temperatures and long droughts, but are also known to survive in subtropical areas with high humidity. Despite these extreme conditions, the neem tree can grow without a lot of water and are very resilient (Ahmed & Grainge, 1986). Neem trees are known to be deciduous and can grow in nutrient-poor soil. It's ability to survive with such limited resources is aided by having little competition with other neem trees and species (Undu, 1999)

Ecological Notes
As discussed above, the cultivation of neem trees has been an important resource harvested for pharmaceutical and agricultural benefits. The cultivation of neem kernel extracts from neem trees have been used primarily in India to disperse on soil, as the pesticidal properties ensure that the crops grow healthy without threat of being damaged by insects (Govindachari, 1992). Aside from being used as pesticides and medicine, neem trees have been cultivated on land to harvest timber and mitigate wind erosion on soil (Radwanski, 1969). A study in Nigeria indicates that neem trees can be planted in acidic or desolate soils, and can rejuvenate the soil with essential nutrients such as organic matter and magnesium over time. This allows the neem tree to provide nutrient availability to crops in the process (Radwanski, 1969).

To conclude, A. indica has proven to be a flowering tree with many versatile uses, and has benefited the people of India from agricultural, pharmaceutical, and even economical. The scientific knowledge surrounding the neem tree is abundant, but leaves more room for discoveries to be made. Further studies and experiments have been taking place to learn more about the neem tree's specializations and how it can better benefit modern society.

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