

Neem as an Organic Plant Protectant in Agriculture

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Abstract

Neem plant is considered as the most beneficial traditional plant in India. The diverse properties of distinct components of neem tree are used specially as insecticide, fertilizer, manure, soil conditioner, urea coating agent, fumigant and many others. In recent technology the major undertaking is to increase the meals production without harming the environment and can manage the pest. On the grounds that, final a long-time pesticide has end up a crucial element in sustainable agriculture and the modern cultural practices like use of chemical insecticides and fertilizers are in eliminable. The herbal pesticides from *Azadirachta indica* are considered as less dangerous, biodegradable, least persistence, less poisonous to non-goal organism and also economic. Fruitful effects of application of formulated neem based totally products in agriculture will offer a cost-effective technology to the farming community.

Introduction

An increase in agriculture manufacturing will remain of important importance in 0.33 international countries within the destiny. The intensification of the rural production inside the tropics and sub tropics led within the beyond to an increase inside the use of production elements, like chemical fertilisers and mainly inside the area of plant and post-harvest safety. The usage of plant safety measures is aimed toward increasing crop yields and reducing the manufacturing danger by means of lowering crop losses in the field and in storage of the goods.

Neem (*Azadirachta indica* L.) usually referred to as 'Indian Lilac' and belongs to the own family *Meliaceae*, subfamily *Meloideae* and tribe *Melieae*. Neem is an evergreen, tall, fast-growing tree, which a top of 25m and 2.5m in girth which has an attractive crown of deep green foliage and honey scented flora). Neem is the most versatile, multifarious timber of tropics, with sizeable ability. It possesses most beneficial *non-wood* products (leaves, bark, vegetation, fruits, seed, gum, oil and neem cake) than any different tree species. These non-wooden products are recognised to have anti-allergenic, antidermatic, antifedent, antifungal,

antiinflammatory, antipyorrhoeic, antiscabic, cardiac, diuretic, insecticidal, larvicidal, nematocidal, spermicidal and other biological activities. Due to the fact of those activities' neem has determined tremendous programs making it a green treasure.

Taxonomical Classification

The neem plant is taxonomically classified as (Girish and Shankara, 2008; Anon, 2011)

Kingdom:	Plantae
Division:	Tracheophyta
Class:	Magnoliopsida
Order:	Sapindles
Family:	Meliaceae
Subfamily:	Melioideae
Tribe:	Melieae
Genus:	<i>Azadirachta</i>
Species:	<i>indica</i>

A. indica is synonymous with *Melia azadirachta* L. and *Antelaea azadirachta* L.

Neem tree

Plant Description *Azadirachta indica* L. belongs to *Meliaceae*, a family of dicots usually represented by way of timber and shrubs. The own family consists of about fifty-one genera and 550 species, with many of them prized for their wooden, edible fruits, and medicinal and ornamental traits. It is a small to medium-sized evergreen tree with a height of 15 m (30 m maximum), having a large rounded crown (10–20 m) with spreading branches and a branchless bole (7.5 m, diameter 90 cm). The bark of the tree is thick, fissured, darkish grey to crimson (inside) in coloration, and it possesses a gummy colourless sap. The leaves are long (20–40 cm), alternate, pinnate, exstipulate, and glabrous with a light green hue. The leaves have two pairs of basal glands with a subglabrous petiole (2–7 cm) and above, channeled rachis. Every leaf comprises 8–19 serrated, proximally exchange, ovate to lanceolate leaflets. Inflorescence is axillary clustered multiflowered thyrsus a hundred and fifty–250 vegetation) with a duration of 15–30 cm and minute caducous bracts. Vegetation of the tree are small (1 cm in diameter), white or faded yellow, and sweet smelling. They're actinomorphic, pentamerous, and bisexual or unisexual male on the same plant. The calyx of

the plants is imbricate, ovate, skinny, and puberulous from internal, while petals are free, spreading, imbricate, spathulate and ciliate from interior. Fruits are single (most of) and small (1–2 cm) in length. They're greenish to yellow in coloration and an ellipsoidal seeded drupe. The tree has a thin exocarp, pulpy mesocarp, and cartilaginous endocarp. Seeds are an unwinged, oval, or spherical structure with thin testa. The tree has a profound taproot system with full-size lateral roots. It may form suckers if roots encounter a few damages.

Important

A fifteen-year-old neem tree produces about 400 kg wood with a sp. gravity of 0.68. The neem tree and its parts like leaves, twigs, bark, gum, honey, wood, roots, flora, end result, fruit pulp, seed kernel, seed coat, oil and cake have numerous capabilities uses in medicine, dental care, animal care, silk drying, soap manufacturing, cosmetics, lubricant oil, animal feed, fodder, creation cloth, furniture, methane manufacturing and gasoline wood. But it's important uses are in plant safety, saved grain protectant, soil additive, leaf green manure, organic manure, nitrification inhibitor, mulching, making acidic soils neutral and as a wind break etc., may be efficiently utilized in natural farming.

Chemistry of neem

Neem plants contain numerous lots of chemical components. Of special interest are the terpenoids from distinct parts of the neem plant. Of its biological parts the maximum energetic and well-studied compound is Azadirachtin. However, in most conventional arrangements of neem as pesticide or medicine a combination of neem chemical compounds are present and offer the active principles. Several styles of azadirachtins (A to k) have been isolated, the most plentiful of that's Azadirachtin. The neem terpenoids are found in all elements of the plant, in the living tissues. Currently, the site of synthesis and accumulation of the neem chemical substances have been diagnosed as secretory cells. Secretory cells are the most abundant inside the seed kernels. The secretory cells can be visible with iodine solution. Except the terpenoids, neem additionally contains greater than 20 sulphurous compounds responsible for the characteristic smell of crushed seeds and neem oil.

Chemical compounds present in different parts of neem

S.NO.	Neem compound	Source	Biological activity
1.	Nimbidin	seed oil	ant-inflammatory, Antipyretic,

			Hypoglycemic Ant gastric ulcer
2.	Nimbin	Seed oil	Spermicidal
3.	Azadirachtin	Seed	Antimalarial
4.	Mahmood.	Seed oil	Antibacterial
5.	Gallic acid, (-) epicatechin and catechin	Bark	Anti-inflammatory Immunomodulatory Polysaccharides
6.	GIa	Bark	Antitumour
7.	Cyclic trisulphide and cyclic tetrasulphide	Leaf	Antifungal

Composition of Neem Oil

Oil is a vegetable oil pressed from the fruits and seeds of neem (*Azadirachta indica*). An evergreen tree that is endemic to the Indian subcontinent and has been added to many different areas inside the tropics. It is the most important of commercially available products of neem for natural farming and drugs. Neem oil varies in color, it can be golden yellow, yellowish brown, reddish brown, dark brown, greenish brown or shiny pink. Each part of neem tree has some medicinal properties and it is commercially exploitable. It is considered as a valuable supply of unique herbal products for improvement of drug treatments against numerous illnesses.

Neem vital oil from flower and leaves is a minor supply of volatile oil (0.08%), composed particularly of caryophyllene (85%). Neem seed oil (NSO) is a main source of volatiles, being composed of important oil and fatty acids. Neem seed oil is subjected to extensive phytochemical research because of its strong organic, agricultural, and medicinal properties. The chemical composition of neem seed oil may be very complex and wealthy in terpenoids, limonoids, and risky sulfur compounds. Until now, extra than 300 compounds

were removed from various elements of *A. indica*. However, neem seed oil by itself stated extra than a hundred decided biologically energetic compounds.

Neem seed oil is a prime source of fatty acid and is mainly composed of oleic acid (50%–60%), palmitic acid (13%–15%), stearic acid (14%–19%), linoleic acid (8%–16%), and arachidic acid (1%–3%). Oleic acid, linoleic acid, and α -linoleic acid are the essential ω -9, ω -6, and ω -three fatty acids, respectively, in neem seed oil (Mongkhon khajornsilp *et al.*, 2005). Besides, palmitic (31.76%), linoleic (18.57%), linolenic (12.44 %), oleic (9.74 %), arachidonic (7.38%).

Neem oil includes at least one hundred biologically energetic compounds. Amongst them, the main materials are triterpenes known as limonoids, the maximum vital being azadirachtin. which appears to cause 90% of the effect on maximum pests. The compound has a melting factor of a hundred and sixty°C and molecular weight of 720 g/mol. Other components gift consists of meliantriol, nimbin, nimbidin, nimbinin, nimbolides, fatty acids (oleic, stearic, and palmitic), and salannin. The fundamental neem product is the oil extracted from the seeds through different techniques. The opposite components of the neem tree include less azadirachtin, however also are used for oil extraction. It has been recommended that the content material of azadirachtin in the seeds can be accelerated with the aid of synthetic contamination with arbuscular mycorrhiza (Venkateswarlu *et al.*, 2008).

Among the botanical insecticides currently marketed, neem oil is one of the least toxic to people and indicates very low toxicity to useful organisms, so it is, consequently, very promising for the manipulate of many pests. Target insect species consist of the following. *Anopheles stephensi* (Lucantoni *et al.*, 2006), *A. culicifacies* (Chandramohan *et al.*, 2016), *Cnaphalocrocis medinalis*, *Diaphorina citri*, *Helicoverpa armigera*, *Nilaparvata lugens* Stal, *Pieris brassicae* and *Spodoptera frugiperda*. Arachnid goals include *Hyalomma anatolicum* and *Sarcoptes scabie* var. *cuniculi* larvae. The oil is considered a contact insecticide, presenting systemic and translaminar. It has a wide spectrum of movement, inhibiting feeding, affecting hormone characteristic in juvenile stages, decreasing ecdysone, deregulating increase, altering development and reproduction, suppressing fertility, sterilizing, repelling oviposition, and disrupting molting processes (Brahmachari, 2004).

The use of neem in agriculture is now not a new practice. In India, the conventional farming device hired neem extracts for pest management and to supply vitamins to flowers.

Scientific studies have shown that neem is safe for workers, with no managing dangers, and can be used for the duration of the whole crop production cycle (Boeke et al., 2004).

Functions of neem guide its contribution to natural agricultural production systems that are greater sustainable and do now not generate chemical residues (flowers and vegetation are grown without the use of any agrochemicals). This approach additionally helps to keep soil productivity, ensuring longer production instances. Natural agriculture can be a feasible alternative production approach for farmers, however there are severa challenges to be conquer. A key to fulfillment is to be open to new processes, and in this admire neem products can correctly contribute to organic agriculture, being used as organic pesticides and as soil fertilizers.

Neem Cake

Neem Cake may be acquired through extracting neem oil both from complete fruit, seed or kernel both by using expeller or solvent extraction.

Average Chemical Composition of the neem cake

❖ Dry matter	92 to 95 percent
❖ Nitrogen	4 to 5 percent
❖ CaO	1 to 2 percent
❖ P ₂ O ₅	0.5 to 1.5 percent
❖ K ₂ O	1 to 2 percent
❖ Organic matter	72 to 75 percent
❖ Remaining oil content	1 to 5 percent

Recommendations for farmers' use of Neem Cake in Nematode Management in Horticultural Crops.

Crop Quantity of Neem Cake Applied

- **Ginger:-** 500 g/m² or 4 kg/3 m² Rhizome rot. 2.5 t/ha before planting in control of root-knot nematode. 3 kg/m² - 3 weeks before sowing in control of citrus nematode.
- **Citrus:-** 2 kg. /m² before sowing in control of citrus nematode
- **Banana:-**250 g/pit - 3 weeks before planting against spiral Soaking.

Application of neem in different form :-Neem as Manure

Manure is any animal or plant cloth used to fertilize land specifically animal excreta for improving the soil fertility and thus promoting plant increase. Neem manure is gaining popularity due to the fact it is environmentally friendly and also the compounds determined in it assist to growth the nitrogen and phosphorous content in the soil. It is rich in sulphur, potassium, calcium, nitrogen, etc (Adeoye *et al.*, 2008). Neem cake is used to manufacture excessive first-class natural or natural manure, which does no longer have any negative effect on vegetation, soil and other living organisms. It could be obtained via the use of high technology extraction techniques like bloodless pressing or different solvent extraction. It may be used at once through mixing with the soil or it can be combined with urea and other organic manure like farm backyard manure and sea weed for good outcomes.

Neem as Fertilizer

Neem has confirmed use as a fertilizer, with the organic and inorganic compounds present in the plant material performing to enhance soil high-quality and enhance the quality and quantity of crops. The waste remaining after extraction of the oil from neem seeds (neem seed cake) can be used as a biofertilizer, imparting the macronutrients essential for plant growth (Ramachandran *et al.*, 2007;) Nitrogen is one of the important vitamins required with the aid of vegetation for their improvement, and urea is the essential source of nitrogen fertilizer used worldwide to supply the nitrogen demand of crops. The manipulate of urea hydrolysis and nitrification is one among the major strategies employed to keep away from nitrogen losses in agriculture. Neem has confirmed activity as a nitrification inhibitor, supporting to slow the bacterial activity that is responsible for denitrification, for this reason decreasing the loss of urea from the soil.

Neem as urea coating agent

Neem and its components are being used to manufacture urea coating agent to improve and keep the fertility of soil. Use of neem urea coating agent helps to retard the activity and growth of the microorganism responsible for denitrification (Bains *et al.*, 1971). It prevents the loss of urea in the soil. It can additionally be used to control a large range of pests such as caterpillars, beetles, leafhoppers, borer, mites and many others. Urea coating is normally available both in liquid form or powdered form. Properties of Neem Urea Coating are Anti feedant, anti-fertility and pest increase regulator.

Neem as a bio pesticides agent

Even though the insect pest handling best of neem is thought in view that time immemorial, the actual spoil-through become made only with the invention of the antifeedant property of aqueous extracts of neem seed kernels towards the wasteland locust, *Schistocerca gregaria* F. by Pradhan and Jotwan in 1962. In 1968, Butterworth and Morgan, first isolated azadirachtin which was then characterized in 1987 by way of participants of the British Neem Group⁸. Studies showed pesticidal properties of all parts of neem possessing an array of bio-active chemical substances which have an effect on several behavioural and physiological procedures in target bugs. Extracts from its extraordinarily sour seeds and leaves might also in reality be the best insecticides: they assault many pestiferous species, they appear to go away humans, animals and useful insects unharmed; they're biodegradable; and that they appear not likely to quick lose their efficiency to a buildup of genetic resistance within the pests. All in all, neem appears probably to offer non-toxic and long-lived replacements for some of nowadays most suspect artificial insecticides. One excellent neem component, azadirachtin, disrupts the metamorphosis of insect larvae. Through inhibiting moulting, it stops the larvae from developing into pupae; and they die without generating a new generation. Further, azadirachtin is frequently so repugnant to insects that scores of different leaf-chewing species even ones that normally strip the whole thing residing from plants – will starve to death rather than touch plants that carry lines of it. To reap the insecticides from this tree is easy. The leaves or seeds are merely crushed and steeped in water, alcohol or different solvents. For some purposes, the ensuing extracts may be used without similarly refinement. These pesticidal “Cocktails” containing 4 main and perhaps 20 minor compounds can be astonishingly effective. In concentrations of less than one-tenth of a part according to million, they have an effect on sure insects dramatically. Entomologists have located that neem material can have an effect on greater than two hundred insect species as nicely as some mites, nematodes, fungi, microorganism and even a few viruses. Success has also been stated on cotton and tobacco pests in India, Israel and united states of America, on cabbage pests in Togo, Dominican Republic and Mauritius, on rice pests in the Philippines⁴ and on coffee bugs in Kenya. And it's far not simply the residing plants which can be shielded. Neem merchandise have protected stored corn, sorghum, beans and other ingredients towards pests for up to ten months in some very sophisticated controlled experiments and field trials.

Azadirachtin

It is a first active components isolated from neem, azadirachtin has proved to be the tree's major agent for fighting insects. It appears to purpose some ninety percent of the impact on most pests. It does now not kill the insect – at least now not without delay. Instead, it each repels and disrupts their increase and duplicate.

Even though bio- effective compounds are determined at some stage in the tree, the ones in the seed kernels are the maximum concentrated and accessible. They are obtained through making numerous extracts of the kernels. Even though the energetic components are only slightly soluble in water, they're freely soluble in organic solvents.

Water Extraction

Water extraction is a simplest technique (now day most extensively employed) is to crush or grind the kernels and extract them with water for 12 hours. This is the maximum promising technique for use in third world villages. It's been predicted that via the use of water extraction, 20 to 30 kg of neem seed can normally treat 1 hectare. At this rate, the annual seed crop of one mature tree should treat up to half of a hectare. Five hundred grams of kernels are steeped in 10 litres of water. Recommendations for farmers – Vegetable crop.

Crop	Neem Seed Kernel Extract (NSKE)
Brinjal	NSKE 5% against Aphid/leaf beetle.
Okra	NSKE 5% against white fly, Jassid and Fruit borer.
Pumpkin	NSKE 5% against red pumpkin beetle.
Tomato	NSKE 5% against <i>Helicoverpa armigera</i> .
Cabbage	NSKE 4% 2 to 3 sprays at 10 to 15 days internal at primodel / head initiation stage.

Neem leaf extracts and neem oil sprayed. Seed is also treated either by soaking, coating or root dipping in neem extract before planting and its products major role in Integrated Pest Management.

Stored Grain Pests

It's good manage of pulse beetle *Callosobruchus maculatus*, *C. chinensis* in chick pea, cow pea, pigeon pea, mung bean, pink gram, black gram, green gram and lentils became found with Neem Seed powder at 1-2% concentrations. Neem oil at 0.25 to 5.0 % also give powerful manage of pulse beetle in green gram and cow pea, and gave higher safety of cow pea after 10 months.

Use of Neem Products in Tobacco Cultivation

Neem and its products are used in all the stages of its cultivation or even in opposition to storage pests. NSKE in nursery in opposition to caterpillars. Neem oil extract as suckercide, Neem bark extract against mosaic virus, Extract of de-oiled neem cake against aphids. Neem leaves as mulch. Neem leaf extract against fungal pathogens. Neem seed kernel in opposition to cigarette beetle a garage pest.

Erosion Control and Reforestation

Neem trees are also control soils erosion and avoid the deforestation and generate reforestation. It's leaves and fruits used for mulching form to control soil erosion and maintain the soil moisture.

Mode of Action

Neem acts as a biopesticide at distinct ranges and in various approaches. Normally it acts as antifeedant i.e., when an insect larva is hungry and it desires to feed on the leaf however if the leaf is dealt with neem product, because of the presence of azadirachtin, salanin and melandriol there is an antiperistaltic wave in the alimentary canal and this produces something similar to vomiting sensation in the insect. Due to the fact of this sensation the insect does now not feed on the neem treated floor and capacity to swallow is additionally blocked. Secondly it acts as oviposition deterrent i.e., through no longer allowing the female to deposits eggs comes in very reachable while the seeds in storage are covered with neem kernel powder and/or neem oil. It additionally acts as insect increase regulator. It is a very thrilling property of neem product and particular in nature. Which is works on juvenile hormone?

Conclusion

That's a want of price effective, biodegradable, capacity, ecofriendly and safe sustainable agricultural products alternating to the chemical fertilizers and insecticides. As

neem act as the most reliable supply of pro-pesticide having no unfavorable impact on human and animals. For that reason, neem.

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