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A REVIEW ON NEEM DERIVATIVES AND THEIR AGRICULTURAL APPLICATIONS

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Abstract:

Rice is life for millions of people and is a staple food for more than of the world's population. The research experiments conducted resulted in compilation of agricultural use of neem and its byproducts in rice cultivation. The properties of neem as insecticide, antifeedant, hormonal, antifungal, antiviral and nematicidal properties are well known. These activities are brought about with neem use in the form of leaves, leaf extracts, oil, seed cakes, seed and fruit extracts. The neem and its products are used in seed treatment, soil application, foliar spraying, increasing nutrient efficiency by which the rice yield is enhanced and its sustainability is seen in rice cropping system. Evaluations of these products in managing the rice crop, through various agricultural practices at various stages of crop growth are detailed in this paper.

Keywords: Nutrient efficiency, extracts, crop growth, seed treatment.

Introduction:

Neem *(Azadirachta indica)* is a native to the arid regions of the Indian subcontinent. It requires 130mm of sufficient rainfall per annum for its normal growth [4]. The seeds, bark and leaves contain compounds with proven antiseptic, antiviral, antipyretic [10], anti-inflammatory, anti-ulcer and antifungal uses. Arista is the Sanskrit name for neem and it means 'perfect', complete and imperishable. Neem is recognized as a natural product which has much to offer in solving global, agricultural, environmental and health problems [2]. Natural properties of neem do not have any toxic reactions and so they are well used in plant management of pests and diseases. All parts of neem like seed, flowers, bark and leaf can be used for plant protection and management [3]. Neem products reduce insects' growth in crops and plants. Neem derivatives are used as neem insecticide, neem pesticide, neem pest fumigant, neem fertilizer, neem manure, neem urea coating agent and neem soil conditioner [5]. Neem derivatives help in controlling several nematodes and fungi [7].

Neem and its applications:

Preparation: Neem leaves are used in storage of grains. It is also used as green leaf manure and in litter composite. The twigs/ stem in the earlier stages are used as green manure after decomposing and widely incorporated in rice cultivation fields. Neem seed extracts are found to have insecticidal and fungicidal properties. It is used in foliar spraying and treating seeds in rice cultivation. Neem bark and roots have medicinal properties [6]. These are also used to control insects, fleas and sucking pests of rice crop [8]. Neem seed cake, a residue of neem seeds after oil extraction is used for soil amendment and it enriches the soil with organic matter and reduced nitrogen losses by inhibiting the nitrification process. It also acts as a nematicide [12][13]. Neem has anti-bacterial, anti-fungal and anti-nematicidal properties and positive effect in combating several diseases in rice cultivation and some more constituents of neem which are further to be exploited [22].

Neem as manure:

Manure may be of animal or plant origin used to fertilise the land for improving the soil fertility and crop productivity [1]. Neem manure is commanding popularity, as it is environmental friendly and also the compounds found in it help to increase the nitrogen and phosphorous content in the soil. It is rich in sulphur, potassium, calcium, nitrogen, etc. Neem cake is used to manufacture organic manure through high technology extraction methods like solvent extractions [7]. It can be used directly by mixing with the soil or can be blended with urea and other organic manure like farm yard manure for best results.

Neem as urea coating agent:

Neem and its parts are being used to manufacture urea coating agent to improve and maintain the fertility of soil. The neem urea helps to retard the activity and growth of the bacteria responsible for denitrification as a coating agent. It prevents the loss of urea in the soil. It can also be used to control a large number of pests such as beetles, caterpillars, leaf hoppers, borer, mites, etc. Urea coating is now available both in liquid form and powdered form. The properties of neem urea coating act as antifeedant, antifertility and pest growth regulator. These are excellent soil conditioners, natural or biopesticides, environmental friendly, non toxic, reduces urea consumption, convenient and easy to apply, high soil fertility and increases the yield of crops.

Neem as a fertilizer: Neem is used as a fertilizer both for food crops and cash crops, particularly for rice, banana and sugarcane [16]. The material left after oil is squeezed out from seeds and is known as seed cake. It acts as a biofertiliser and helps in providing the required nutrients to plants. It is used widely to obtain a high yield of crops.

Neem seed cake performs the dual function of both fertilizer and pesticide, acts as enricher of the soil reduces the growth of soil pests and bacteria, provides macronutrients essential for the plant growth, and increases the yield of plants in the long run [9].

Neem as soil conditioner:

Neem seed granules or powdered seeds are used to manufacture the soil conditioners. It can be applied during plant sowing, or sprinkled or raked into the soil. The process of sprinkling should be followed by proper irrigation, so that the product reaches the roots. It is a natural soil conditioner that helps improve the quality of soil and enhances the growth of fruits. As a soil conditioner it improves the soil quality [17]. It helps the plants to grow and prevents them from being destroyed by certain pests and insects. Organic soil conditioner is gaining popularity in agricultural industry. Neem soil conditioner application in plantation crops is known to be a soil enhancer that helps to increase the fertility.

Neem as a fumigant:

Neem pest fumigant is available in gaseous state and is used as a pesticide and disinfectant. According to studies undertaken, neem fumigant helps to protect the stored grains. One of the important characters of this organic fumigant is that pests do not develop resistance to it [14]. With the increasing trend of using bio-fertilisers, insecticides and pesticides, neem is being increasingly cultivated to get active ingredient-azadirachtin, responsible for inhibiting the growth of insect posts and pathogens [15]. Based on the fact that neem is cheaper, naturally occurring product and an effective method to control pests and insects, it also causes no side effects on plants or other living beings and it is useful for large scale production of natural pesticides and insecticides [18].

Neem fumigants are eco-friendly, do not harm other micro-organisms, non toxic and do not contaminate terrestrial and aquatic environment. There is no question of resistance development of organisms [11][19].

Neem as pesticide:

There has been an evident shift all over the world from synthetic pesticides to non synthetic ones. This is because of the awareness of the people more concerned with the side effects of the synthetic pesticides on living beings, plants and soil. Neem pesticides are being manufactured and exported to various countries, as researches are going on to test the bio-safety and efficacy of neem for use as a pesticide [24]. One of the most important advantages of neem-based pesticides is that they do not leave any residue on plants [23]. Azadirachtin is the main ingredient used to manufacture bio-pesticides. Neem oil and seed extracts are known to process germicidal and anti-bacterial properties

which are useful in plant protection. Further one of the best important usefulness of this neem and its derivatives is that they do not leave residue on the plants.

Chemistry of neem:

Of special interest in respect of neem are the terpenoids from different parts of the plant. Of its biological constituents, the most active and well studied component is Azadirachtin. Several kinds of Azadirachtins (A to K) have been isolated [20]. The neem terpenoids are present in all parts of the plant, in the living tissues. Recently, the site of synthesis and accumulation of neem chemicals have been identified as secretory cells [26]. Besides the terpenoids, neem also contains more than 20 sulphurous compounds responsible for the characteristic smell of crushed seeds and neem oil (Table 1) [21].

Table-1: Specifications for neem kernel oil.

Characteristic	Requirement
Maximum moisture and insoluble impurities Lovibond colour (1/4 in cell), expressed as Y +	0.3 % by weight
5R, not deeper than	45.0
Refractive index at 400C	1.4615 – 1.4705
Specific gravity	0.908 – 0.934
Saponification value	180-205
Iodine value (Wij's method)	65-80
Maximum acid value	15
Maximum unsaponifiable matter	2% by weight
Minimum titre	360C

Source: Indian Standards Institution Specification 4765.

Table-2: Requirements of neem cake for manuring.

Characteristic	Requirement
Maximum moisture (%by mass)	10.0
Minimum water-soluble organic N % by mass on moisture-free basis	2.5
Maximum total ash (% by mass)	13.0
Maximum acid-insoluble ash (% by mass) on moisture –free basis	5.0

Source: Indian Standards Institution Specification 8558.

Neem treated Urea and Coal-tar treated Urea:

The urea may be blended with crushed neem seed or neem cake 20% by weight [22]. The powdered neem cake is sieved and kept overnight. Urea can be mixed with gypsum in 1:3 ratios, or urea can be mixed with gypsum and neem cake at 5:4:1 ratio to increase the nitrogen use efficiency. For treating 100 Kg urea, 1 Kg coal-tar and 1.5 liters of

kerosene taken and urea mixed with melted coal-tar kerosene mixture. This is mixed in a plastic container using a stick and dried in shade and can be stored for a month and applied basally.

Plant Protection Schedule:

This table reveals the various management practices using neem oil (3%) or NSKE (5%) either alone or in combinations.

Table-3: Recommendations of use of neem oil and NSKE (Neem Seed Kernel Extract) for pest management practices.

Insects/ Pathogens	Recommendations
Brown plant hopper (Nilaparvata lugens)	Neem oil 3% NSKE 5% (or) Soil application @ 25 Kg/ha
Black bug (Scotino phoraluride)	Spray NSKE 5% (or) Soil application @ 25 Kg/ha
Earhead bug (Leptocorisa acuta)	NSKE 5%
Sheath rot (Sarocladium oryzae)	NSKE 5% (or) Neem oil 3%
Sheath blight (Rhizoctonia solani)	Neem oil foliar spraying 3%
Bacterial leaf blight (Xanthomonas campustris, pv. oryzae)	Neem oil 3% (or) NSKE 5%

Source: Subbalakshmi Lokanathan et al, 2012.

Mode of action:

Neem acts as a biopesticide at different levels and in various ways. Primarily, neem acts as an antifeedant and only because of this (presence of Azadirachtin in Neem), the larvae could not feed on leaves [24]. Secondly it acts as oviposition deterrent, i.e. it not allows the female larvae to deposit eggs on the leaf. It also acts as insect growth regulator. It is a very interesting property of neem derivatives and is unique practicability in nature that it works on juvenile hormone.

Neem pest control/ management:

The recent studies conducted on neem indicate that neem seed extract contain Azadirachtin which works by inhibiting the development of immature insects [22]. Neem oil enters the system of pests and obstructs their proper functioning. Neem oil does not harm the beneficial insects also, where in the use of chemical pesticides destroy the beneficial effects and causes toxicity also.

Conclusion:

The above information collected regarding the use of neem globally is matched with available literature. In recent years, especially of plant origin received much attention, as they are well suited for their effectiveness and it is

believed to be safe for human use extraordinarily. A good amount of screening of literature available on neem reported the fact that it is considered unanimously as an effective remedy among human beings.

In the field of medicine also, Unani, Ayurvedic and traditional practitioners, it is well utilized for treatment of ailments. Researchers are exploring the therapeutic potential of this neem plant as it has more therapeutic properties, which are further to be tapped. So, it is a Nature's Drug store.

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