

Preparation of neem biopesticides : A need of sustainable agriculture at farm level

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The scientific name for the neem of India is *Azadiracta indica*. It is also called as “free tree”. Its fact is derived from Azad- Darakth a persian word. The Indian people have for millennia used this tree in agriculture, public health, medicine, toiletries, cosmetics and livestock protection. However, there is a threat that the “free tree” will no longer be free, because common people continue to derive its benefits to control the various pests from centuries into the future as they have done in the past. The technology and practices that are being promoted are aimed at rejuvenating local low-cost use of neem as a biocontrol agent. It is meant to serve as a sustainable-agriculture initiative.

Neem has attracted worldwide attention in recent decades mainly due to its bioactive ingredients that find increasing use in modern crop and grain protection. The practice describes a range of neem products such as the neem leaf extract, the neem seed kernel extract, the neem cake extract, the neem oil emulsion and also neem in combination with other plant extracts for the control of a variety of pests. The technologies using neem are extremely simple and these products can be made by the farmer in his own backyard. They have been tested in the farmers’ fields and satisfactorily proven to be effective in controlling a wide range of pests. They have also been used in controlling stored grain pests.

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Biological effects of neem on insects:

The action of neem products as pest control agents can be manifested at different levels and in different ways. This is a very important point to be noted since the farmer would be used to the knock-out effect of chemical pesticides. Neem extracts do not exhibit this type of effect on pests but affect them in several other ways.

Insect growth regulation:

Regulation of the insects’ growth is a very interesting property of neem products which is unique in nature, since the products work on juvenile hormones. The insect larva feeds and as it grows, it sheds its old skin. This particular shedding of old skin is the phenomenon of ecdysis or moulting and is governed by an enzyme, ecdysone. When the neem components, especially azadirachtin, enter the body of the larva, the activity of ecdysone is suppressed and the larva fails to moult, remains in the larval stage and ultimately dies. If the concentration of azadirachtin is not high enough, the larva will die only after it has entered the pupal stage. If the concentration is lower still, the adult emerging from the pupa will be 100% malformed, and absolutely sterile.

Feeding deterrent:

The most important property of neem is feeding deterrence. When an insect larva sits on a leaf, it will want to feed on it. This particular trigger of feeding is given through the maxillary glands. Peristalsis in the alimentary canal is thus speeded up, and the larva feels hungry and starts feeding on the surface of the leaf. If the leaf is treated with a neem product, because of the presence of azadirachtin, salanin and melandriol, there will be an anti-peristaltic wave in the alimentary canal which produces something similar to a vomiting sensation in the

insect. Because of this sensation, the insect does not feed on the neem-treated surface. Its ability to swallow is also blocked.

Oviposition deterrent:

Another way in which neem controls pests is by preventing the females from depositing eggs. This property is known as oviposition deterrence, and comes in very handy when the seeds in storage are coated with neem kernel powder and neem oil. The seeds or grains obtained from the market may already be infested with some insects. Even these grains could be treated with neem seed kernel extract or neem oil. After this treatment, the insects will not feed on them. Further damage to the grains will be halted and the female will be unable to lay its eggs during the egg-laying period of its life cycle. There are also other known modes of action:

- The formation of chitin or the hard part covering the insect
- Mating as well as sexual communication are disrupted;
- Larvae and adults of insects are repelled;
- Adults are sterilized.
- Larvae and adults are poisoned.

The use of neem products does not give immediate results, unlike chemical insecticides. Some patience is required after the application of neem products. Besides its insecticidal and nematocidal properties, neem is also a promising agent for control of plant diseases. It has also been demonstrated to possess anti-fungal properties.

One of the problems with the use of chemical pesticides has been their impact on non-target species. Often they have proven harmful to various other species in the ecosystem that could be beneficial. However, neem extracts are devoid of these effects.

Neem leaves and seed kernels, when incorporated into potting soil containing earthworms, increased the earthworm population by 25%. Neem products have proven to be remarkably benign to spiders and also other insects such as bees that pollinate crops and trees, lady bird beetles that consume aphids, and wasps which act as parasites on various crop pests. Neem products have to be ingested to be effective. Those insects which feed on plant tissues, therefore, easily succumb. However, natural predators like spiders feed only on other insects while bees feed on nectar. Hence, they rarely come in contact with significant concentrations of neem products.

Preparation of extracts:

Neem kernel extract:

Fifty grams of neem kernel are required for use in 1

litre of water. The neem kernel is pounded gently in such a way that no oil comes out. The outer coat is removed before pounding. This is used as manure. If pounded with the seed coat on, one and a half times the amount of seeds (75 g) is required. The seeds that are used for the preparation of neem kernel extract should be between three and eight months old. Otherwise, the quantity of azadirachtin in the seeds is quite low and hence they cannot be efficiently used for pest control. The pounded neem kernel powder is gathered in a muslin pouch and soaked overnight in water. The pouch is squeezed and the extract is filtered. To the filtrate, an emulsifier like khadi soap solution (a soap with no detergent) is added. One millilitre of emulsifier is added to 1 litre of water. The emulsifier helps the extract to stick well to the leaf surface.

Keep in mind :

The kernel extract should be milky white in colour and not brownish. The kernel extract does not control sucking insects like aphids, white flies and stem borers. In these cases, one could use the neem oil spray solution.

Neem leaf extract:

For 5 litres of water, 1 kg of green neem leaf is required. Since the quantity of leaves required for the preparation of this extract is quite high (nearly 80 kg are required for 1 hectare), this can be used for nursery and kitchen gardens. The leaves are soaked overnight in water. The next day, they are ground and the extract is filtered. The extract is suited for use against leaf eating caterpillars, grubs, locusts and grasshoppers. To the extract, emulsifier is also added.

Keep in mind :

The advantage of using neem leaf extract is that it is available throughout the year. There is no need to boil the extract since boiling reduces the azadirachtin content. Hence the cold extract is more effective. Some farmers prefer to soak the leaves for about one week, but this creates a foul smell.

Neem cake extract:

One hundred grams of neem cake are required for 1 litre of water. The neem cake is put in a muslin pouch and soaked in water overnight. It is then filtered and an emulsifier is added at the rate of 1 millilitre for 1 litre of water, after which it is ready for spraying.

Neem oil spray:

Thirty millilitres of neem oil are added to the emulsifier and stirred well to ensure that the oil and water can mix

well. After this, 1 litre of water is added and stirred well. It is very essential to add the emulsifier with the oil before adding water.

Keep in mind:

It should be used immediately; otherwise oil droplets will start floating. A knapsack sprayer is better for neem oil spraying than a hand sprayer.

Pongam, aloe and neem extract:

One kilogram of pounded pongam cake, 1 kg of pounded neem cake and 250 g of pounded poison nut tree seeds are put in a muslin pouch and soaked overnight in water. In the morning, the pouch is squeezed and the extract is taken out. This is mixed with 1/2 litre of aloe vera leaf juice. To this, 15 litres of water is added. This is again mixed with 2-3 litres of cow's urine. Before spraying, 1 litre of this mixture is diluted with 10 litres of water. For an acre, 60-100 litres of spray is used. This is effective in the control of pests of cotton and crossandra.

Custard apple, neem, chilli extract:

Five hundred millilitres of water is added to 2 kg of ground custard apple leaves and stirred. This is filtered to get the extract and the filtrate is kept aside. Separately, 500 g of dry fruits of chilli are soaked in water overnight. The next day, this is ground and the solution filtered to get the extract. One kilogram of crushed neem fruits is soaked in 2 litres of water overnight and the extract is filtered. All the three filtrates are subsequently mixed with 50-60 litres of water, filtered again and sprayed over the crops.

Note: For all the above extracts, 250 millilitres of khadi soap solution should be added as an emulsifier before spraying.

General remarks about spraying:

- Spraying should be undertaken in the morning or late in the evening. Under hot conditions, the frequency of spraying should be increased. In winter, spraying once in 10 days and every day in the rainy season is recommended.

- Insects lay eggs on the underside of the leaves. Hence it is important to spray under the leaves also.

- While using a power sprayer, the quantity of water used should be halved.

- It is better to use low concentrations of extracts frequently.

- As a general guideline, it can be said that each acre of land to be protected can be sprayed with 60 litres of ready-to-use solution (not the concentrate). Of course, the volume may have to be varied depending on the exact

conditions prevailing, such as the intensity of the pest attack.

Treatment of stored grains:

Grains and pulses can be stored by mixing them with neem products like dried leaf powder, kernel powder or oil. The neem oil used against stored grain pests should be 1 % by weight of the grain. If the grain is used for seed purposes, 2% can be used. Using oil is easier than using leaves. The active ingredients of the neem plant are located in their maximum amounts in the seed and kernel.

Treatment of jute bags for storing grains:

The jute bag is dipped into a 10% neem kernel solution (here, no emulsifier need be added to the solution) for 15 minutes. After having been dried in the shade, the bag can now be used for storing grains. The stored grain pests will be repelled by the action of neem. If the jute bags are new, they should be soaked for half an hour. For jute bags with close meshes and small pores, a thinner solution can be used. It should be ensured that the bags are soaked on all sides in the extract. If the seeds or grains are kept inside the house or in a godown, where the temperature is stable and sunlight minimal, longer residual action of the neem product is obtained and the repellent effect will persist for four months. In storerooms, along with the cowdung that is used for cleaning the mud floor, neem cake or neem oil can be used straightaway (in the same concentration as used for spraying purposes). The same could also be used for the mud walls. Neem cake solution or neem kernel extract could also be sprayed. If one is using bamboo bins for storage, then one can paint the bins with a solution prepared from neem cake. To the dry neem cake powder, water is added, and a thick paste of this is painted all over the grain bin. If one wishes to store it for more than four months, the process should be repeated every four months.

Keep in mind:

Neem products work by intervening at several stages of the life of an insect. They may not kill the pest instantaneously but incapacitate it in a number of ways. The precise effect of various neem extracts on insect species is often difficult to pinpoint.

Problems or obstacles encountered and solution:

Farmers have gotten used to purchasing pesticides/fertilisers as a prepared product from a shop rather than preparing them themselves. They have been conditioned to use these prepared products which they can pick up from the shelves. They are also used to the knockdown

effect of the chemical pesticides. They are currently in a situation where they have lost confidence in their own technologies. Initially, farmers were sceptical about the efficacy of the extracts which were prepared in their backyards. They were used to buying pesticides from shops rather than preparing them themselves. Some of them initially felt that preparing these extracts would be quite laborious and would increase their workload. They also felt that only a product that is available commercially would work well. Farmers are also used to the knock-out effect of chemical pesticides while plant-based pesticides such as neem do not work in the same way. These extracts may cause disturbances in the physiology of the insect, rendering it inactive. Although the insect might still be present in the plant, it would not cause any harm. But the farmer may not be convinced about this, hence the need for education. After several demonstrations over a period of time, however, the farmers were quite convinced

of the efficacy of these products. They were also attracted by the economics of the technology.

Effects of the practice/innovative experience:

This practice of farmers making their own neem-based products for pest control would reduce their dependence on external inputs for agriculture. It would also bring down their cost of pest control to almost zero, leaving only labour as a potential expenditure item. Pests can also be controlled without the use of toxic chemical pesticides, which will reduce the harm posed to humans and the environment alike.
