Neem a friend of Organic Farmer

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Introduction

Agriculture during the last 3 decades relied heavily on externally produced inputs. Moving away from traditional practices of organic recycling and mixed cropping did improve the crop yields substantially, though the sustainability of these gains is being questioned now. Agrochemicals among others had a significant impact on the productivity, but the negative fall out of the indiscriminate use of pesticides is now being realised by all. However cost effective alternatives are to be provided to the farmers to minimise the use of such inputs. Due to the continuous extension efforts and awareness campaigns by scientists, development departments and NGOs, the concept of integrated pest management and non-chemical methods of pest suppression are gathering momentum across the country. Products derived from neem tree are one of the important components of non-pesticidal approach, which have proven their efficacy under field conditions and are now being routinely adopted by the farmers. Use of neem in pest management can be considered as one of the best examples of LEISA and if successfully adopted can be a role model for the so-called “alternate agriculture”.

Today neem-based products remain most potential and commercially viable biopesticides. Various results obtained globally have shown that neem and its allelochemicals have a variety of effects on pests. More than 140 active principles have been identified to date that occur in different parts of the tree. The most important components identified have been the tetranotriterpenoids,

the azadirachtins. These occur at concentrations of 0.1 to 0.9 % in the seed core and it has been established that a dose of 30 to 60 g azadirachtin per hectare is sufficient to combat and repel the key pests of various crops.

Over 500 species of insects have been tested with neem products and 413 of these are reportedly susceptible at different concentrations. Similarly, neem preparations also act as nematicides against endoparasitic species of Meloidogyne and Globodera, ectoparasitic species of Hoplolaimus and Tylenchorhynchus and semiendoparasitic species of Rotylenchus and Pratylenchus nematodes. The neem products also control many fungal and bacterial plant pathogens, mites, animal and plant viruses.

Mode of action of Azadirachtin

All biologically active Neem compounds are suspected to be derived from one parent compound, the tetracyclic triterpenoid tirucallol. All other products formed are considered successive rearrangement and oxidation products of tirucallol. It is generally accepted that the tetranotriterpenoid (also called limonoid) compound azadirachtin is responsible for the majority of biological effects observed in organisms exposed to Neem compounds (Isman, 1990). However, 25 different biologically active compounds have been isolated from Neem seeds (Lee et al., 1991). Both primary and secondary antifeedant effects have been observed in the case of azadirachtin. Primary effects include the process of chemoreception by the organism (e.g. sensory organs on mouthparts which stimulate the organism to begin feeding) whereas secondary processes are effects such as gut motility disorders due to topical application only. Schmutterer (1990) suggested that azadirachtin modifies the programs of insects by influencing hormonal systems, especially that of ecdysone. The effects of azadirachtin are both dose and time dependent, prevent both ecdysis and apolysis, and can cause death before or during molting, possibly inducing “permanent” larvae. Azadirachtin appears to block the release of neurosecretory

material from the corpora cardiaca resulting in a reduced turnover rate. This affects the rate of synthesis of PTTH by brain neurosecretory cells.

Use of Neem Products in Organic Farming

Azadirachtin, a tri-terpenoid present in neem seed kernels, is the main compound responsible for the antifeedant and repellent action of neem products. However, in nature there is a large variation in the quality of neem seeds available with respect to the active ingredient. Secondly, neem products are not effective against all pests. They are most effective against beetle larvae, butterfly and moth caterpillars, reasonably effective against plant hoppers and leaf miners, exhibit satisfactory effect on aphids and white flies but poor control on mealy bugs, scale insects and mites. Therefore, farmers should be made aware of this limitation. Further one cannot see a knock down effect with neem products as with chemical pesticides, since they act essentially as antifeedant, repellent and growth retardants. It is only in the past decade that the pest control potential of neem, which does not kill pest like neurotoxins but affects their behaviour and physiology, has been recognised. Though subtle, neem's effects such as repellency, feeding and oviposition deterrence, growth inhibition, mating disruption, chemosterilization,etc. are now considered far more desirable than a quick knock-down in integrated pest management programs as they reduce the risk of exposing pest natural enemies to poisoned food or starvation. Their safety to mammals is an added advantage. Toxicological data shows that azadirachtin to be relatively low in mammalian toxicity, with an acute oral LD50 to rats of >5000 mg/kg (Koul, 2004). The United States Environmental protection Agency has exempted Azadirachtin

from the requirement of a tolerance for residues at a usage rate of 20 gms a.i. per acre per application.

Use of neem products is the best example of an Indian ITK, which was forgotten with the advent of chemical pesticides but again revived during the last five years with new insights into the chemistry, mode of action and field efficacy of active ingredients from neem seed, largely due to extensive research done in India, UK and Germany. With increased awareness on its potential in IPM, a number of doable technologies have been developed which constitute both use of traditional extracts and the high-tech quality assured formulations produced in a modern factory. During the last two years, neem products have at last reached the farmers' fields from the research labs. With abundant resources of neem trees in India (estimated to be 15 million producing nearly 5 lakh tons of seed/annum), the priority has to be on a decentralised, low cost on farm pest management strategy, which truly reflects the concept of LEISA. Following are some recommended uses of neem products at the farm level. These practices can be adopted by the farmers with least external inputs and are based on extensive research during the last one-decade in India and abroad.

Neem Seed Kernel Extracts (NSKE):

This is prepared by mixing 5% finely ground powder/paste of well-dried neem seeds in water. The seed powder is tied in a cloth, immersed in water over-night and stirred well to make a ready to spray suspension. The suspension needs to be filtered through a double-layered cloth while filling the sprayer. The main advantage of the suspension is its effectiveness since it is prepared freshly and the drawback is that it cannot be stored for long since it is a water extract. Farmers need to collect neem fruits well ahead of the cropping season, de-pulp

and dry them under shade. Moisture control in the de-pulped seeds is critical in maintaining the quantity of the active ingredient. Drying seeds up to a moisture content of 8% is recommended for short term storage.

Use of Neem Oil

Neem oil is mixed in water at 0.5 to 2% concentration, emulsified well and sprayed on the crop. Adding soap solution (5 mL/L) or a commercial emulsifier is important as spraying of neem oil alone or oil not properly mixed with the water can damage the crop due to the phytotoxicity. The quality of neem oil is very important. The active ingredients in neem oil like azadirachtin and salanin remain stable only up to 65oC. Therefore, oil expelled from cold expellers where the temperature is regulated during expelling is most effective. Farmers can also use handexpelled oil without any loss of active ingredients. Because of the variation in the quality of neem oil used by the farmers, the effectiveness of the product differs from place to place.

Use of Neem Cake

Neem cake is used for soil amendment @ 0.25 to 0.5 t/ha and it has variety of effects such as control of nematodes, soil borne fungi and as nitrification inhibitor. Unlike kernel extracts and neem oil, which can be used against specific crop pests more effectively, neem cake can be used for a variety of crops and fruit trees to achieve multiple benefits of increased nitrogen use efficiency and control of soil borne pests and diseases.

Advantages of Neem Products

- The technology of preparation of extracts and application is fairly simple which the ordinary farmers can adopt easily.

- Biodegradable, easily obtained from renewable sources and is available locally

every year on the farmer's fields.

- Neem products do not leave residues in the environment, i.e. soil, groundwater and food products like grain, vegetables and fruits.

- Safe to non-target organisms including natural enemies.

- Low risk of pest resistance due to different mode-of-action.

Use of Locally Available Neem Seed Resources

For the neem products to be widely used in pest management, adequate seed resources are to be available to the farmers. Neem trees generally grow in the households, on village common lands, avenues, farm boundaries and often scattered in the middle of the farms. Unaware of the usefulness of the tree in pest control, farmers often cut well grown good yielding trees for marketing as timber. The seed available from the trees growing on common lands and avenues is collected by landless labourers and children and marketed to the village merchants at a low price, which then goes to the organized neem extraction factories in the cities. While this provides some employment and income to the poor, the valuable resource is going out of the village. Under the concept of LEISA farmers need to be educated to use the neem seed resources available within their households or farms for their own land. As a next step it should be ensured to use of entire seed resources generated in the village within that village only. This is a critical aspect of popularizing neem in a decentralized mode of pest management. Used properly, locally prepared neem extracts are as effective as the commercial neem formulations, which are quite expensive to the farmers.

Planting More and More Neem trees

Besides discouraging cutting of existing neem trees, there is a need to promote planting of neem trees in villages to ensure availability of seed resources on a sustainable basis locally. Many research centres have identified superior type neem trees which have higher quantity of active ingredients in the seed, besides having good silvi-cultural characters. Early flowering and fruiting in some of the selected trees helps in collecting much of the fruits before the starting of the monsoon season thus avoiding damage of fruits due to excess humidity and fungal infection. These seeds/saplings can be made available to the farmers and NGOs on a specific request. Even tissue culture plants of this elite clone can be made available in limited number for model plantations. These plants flower early and produce uniform yields. As a typical example of LEISA, 8-10 neem trees of selected variety planted around the farm boundary can provide sufficient seeds after 5 to 6 years to control important pests in one acre of land on a renewable basis. This practice of planting few trees around every farm is more sustainable than commercial block plantations in a concentrated manner. Neem planted in monoculture is prone to pests and diseases. Boundary plantation of neem trees therefore should be taken up as a campaign to produce enough seed for future use in IPM.

Other Plant Products

Like neem, pongamia and custard apple are other plant species with good potential in IPM and organic farming. Pongamia seed powder extracts, oil and cake can be used in similar manner as that of neem. Combined use of neem and pongamia oil in 5:1 ratio was found to be more effective than neem oil alone. Custard apple leaf extracts and seed extracts are also quite effective. Leaf extracts are prepared by grinding 50g fresh leaves in one litre or boiling in water till dark colour is obtained. Cooled extract is filtered and sprayed. In case of seed extracts 500g powder can be suspended in 10 litres. After 12h soaking, it is

ready for spray. In case of custard apple, oil extraction is not recommended at farm level as it causes irritation to eyes and skin. Even making seed powder results in fumes, which cause allergy and irritation. Farmers need to be trained properly in handling custard apple products.

The leaf extract of Vitex negundo, a common bush found on field bunds also contain pesticidal properties and is widely used as pesticide by many farmers in Andhra Pradesh. Five kg of chopped fresh leaves of Vitex is grinded followed by boiling for 30 min in 5 l of water. After cooling, the contents are filtered using a muslin cloth and another 45 l water is added to make the final volume to 50 l. Surfactants like any detergent powder are added before spraying. The fungicidal properties of V. negundo also have been reported. Soil application of neem cake, foliar sprays of neem seed kernel extract and leaf extract of V. negundo significantly reduced the leafhopper incidence in rice, which is a vector of rice tungro disease.

Conclusion

Azadirachtin together with other constituents of neem seeds such as salannin, nimbin, nimbidin, meliantriol and a number of other limonoids exhibit insect repellent, antifeedent and insect growth regulatory activities. In view of the multiple benefits of using neem based products in organic farming there is an urgent need to provide more promotion and awareness programmes.