Azadirachtin as an Insecticide

Pest control aspects of neem were found to be useful in both developing and industrialized countries by Schmutterer (1988), who observed that azadirachtin and azadirachtin-containing neem extract acted as an antifeedant growth regulator and sterilant. The mode of action of azadirachtin may be due to interference with the neuroendocrine system controlling ecdysone and juvenile hormone synthesis and to inhibition of ecdysone release from the hormone-producing gland. In addition, azadirachtin causes inhibition of chitin synthesis. Azadirachtin was found to be an unstable compound, whose residual effect lasted for 4-8 days, but degradation may be hastened by ultra-violet light, rainfall and other environmental factors.

Jacobson (1989), under phytochemical pesticides, covered various aspects of this tree in the book edited by him, laying stress on its insecticidal and insect repellent properties. In this book, Ascher and Meisner (1989) discussed insects attacking various crops and also on beneficial insects like the honeybee. Warthen (1989) compiled the literature on the pesticide activity of neem for the years 1979 – 1989. All the organisms, including arthropods, mollusks and nematodes, were covered. In a symposium on the insecticides of plant origin (Arnason et al., 1989), Saxena (1989) described insecticide from Neem, and Remboldt (1989) gave an account of the structure and mode of action of azadirachtin. In another symposium, Klocke and Barnby (1989) discussed azadirachtin as an antifeedant. Powell (1989), in yet another symposium on higher plants as a source of new insecticide compounds gave a detailed account of azadirachtin. Rovesti and Deseo (1990) further discussed the potentiality of neem in pest control. Arnason and Philogene (191), in memories of the entomological society of Canada, gave an account of plant-derived substances in insect control. Isman et al., (1991) studied variations in the azadirachtin content of 12 commercial samples of neem by their growth inhibition, antifeedant and moulting disruptive activity and concluded that the bioactivity of neem oil was dependent on its azadirachtin content. The possibility of a neem-based insecticide for Canada was discussed. Maramorosch (1991) reviewed the current status of research, while Remboldt and Raychaudhuri (1991) gave further details of the growth-inhibiting properties of azadirachtin. Champagne et al.,(1992) described the biological activity of limonoids from neem and the other members of the Rutales family. Mordue and Blackwell (1993) presented an update on azadirachtin. The potential and limitations of neem pesticide were reviewed by Soon and Bottrell (1994). The authors outlined the use of neem to control pests and its effect on non-target organisms like the honeybee, earthworm, aquatic life, man and other warm-blooded animals. In a workshop (Kleeberg, 1994), the production of neem ingredients, pheromones, and their effect on phytophagus insect pests, fresh water snails and pathogenic fungi were discussed. Remboldt (1994) gave a further account of azadirachtin and its mode of action.

In India, Bambarkar (1990) presented a table showing the activity of neem against twenty species of insect pests, ten nematodes and several fungi, while Subramanyam (1990) reviewed literature on the growth-disruptive effect of neem on insects. Singh and Kataria (1991) evaluated neem against insects, nematodes and fungi. Gujar (1992) reviewed briefly the latest developments and suggested a neem for standardization of formulations by using biological standards. An interesting observation was made by Gupta (1992), who isolated antifeedant microorganism from the leaves and endosperm of neem, active only in sunlight. Tewari (1992), in his book Monograph on Neem, devoted a chapter to pest management, stressing its use in the practice of forestry. Saxena (1993) suggested it as a source of natural insecticide under integrated pest management, Nagasampagai et al., (1993) bioactivity against insect pests. Randhawa and Parmar (1993) edited the book Neem Research and Development. Sidhu (1995) discussed the role of neem in pest management in forestry.

The above exhaustive studies confirmed the application of neem in the fight against pests. It was found to act on eggs, larvae / nymph and adults.

Mode of Action of Azadirachtin

The various studies showed that the mode of action (fig. 16) may be as follows:

1) Antifeedant through mouth
a) Primary: It inhibits the activity of sensory receptors of mouthparts, distorts normal probing feeding and intake of food.
b) Ingestion of active ingredients through food leads to starvation and death.
2) Dermal action: It enters through the cuticle of the insects and inhibits chitin synthesis, this causing desiccation and death.
3) Repellent effect: Due to change in the loco motor and settling behaviour of insects, in some cases mating as well as sexual communication is disrupted.
4) Growth-disruptive effect: By inhibition of the normal growth of the insect by interfering in the molting cycle. It suppresses the activity of ecdysone so the larve does not moult, but remains at the young stage and dies.
5) Effect on survival and reproduction by oviposition deterrent action: When the female comes to an egg-laying period of her life cycle, the egg laying is prevented.
6) Effect on endocrine system: Neem preparations are accumulated in the neurosecretory system and, by penetrating the blood brain barrier, are concentrated in the corpus cardiacum, resulting in reduced turnover of neurosecretory proteins.

Neem does not have an immediate knockdown effect like most of the synthetic chemicals and thus it is effective against those insects that have now become resistant to chemicals. It was also found effective against those pests that live concealed and well protected in the plant parts. Neem is not universal in its effect, which varies from insect to insect, lepidoptera being more sensitive to it, as compared to others.

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