Knowing Neem by David Whyte

In recent years, neem has grown in popularity due to its perceived benefits of being both insecticidal and good for the environment. The neem tree (*Azadirachta indica*), an evergreen, is indigenous to the Indian subcontinent, growing to 10 – 15 m. It is highly drought resistant and is considered a weed in dry locations such as parts of Australia and sub-Saharan Africa. The young shoots and flowers are edible, and various parts of the tree are used in traditional medicine.

The seeds are high in a number of complex molecules, which are highly oxidized tetranortriterpenoids. These molecules inhibit insects from feeding, causing the insects to starve to death. It also unsurprisingly acts as an insect repellent and egg laying (oviposition) repellent. The seeds can be ground up, and soaked in water to extract the molecules and the liquid sprayed on to the trees or plants as an insecticide.

In New Zealand, it can be purchased in oil form. The seeds go through a pressing process similar to that of olive oil. They can be cold pressed, hot pressed at 40-50°C or have the oil extracted via solvent extraction. The oil can then be diluted and applied to plants. As with olive oil, the higher the level of processing the seeds are subjected to, the lower the quality of oil produced. The residue remaining is sold as neem cake. This can be applied to the soil under trees, with the active components being taken up by the tree, resulting in systemic activity with all parts of the tree then containing the insecticidal compounds.

From my cursory perusal of the products available in New Zealand, the neem granules sold seem to be made from neem cake. Reading the general information available from suppliers, there would appear to be different grades of neem granules. This indicates to me that the grade given depends on how much processing the neem seeds underwent before the cake or granules were made. The recommended dose should take into account the strength of the neem granules.

The unique properties of neem products come from their complex chemistry of highly oxidized tetranortriterpenoids. Azadirachtin is the name given to the most common of these complex molecules, and it took scientists 22 years to figure out how to synthesize it in a laboratory due to its complex molecular structure.

A Google Scholar search found that neem tree extracts have an almost cure-all effect, being anti-cancer, antiviral, antibiotic etc. There is seemingly almost nothing neem can't do! So given it is produced from a plant, is natural, and prevents insect attacks, what isn't there to love about neem? My concerns about neem stem from the fact that if these substances are so powerful and systemic, how do they affect soil biology and insect ecology? I gleaned the following information from the scientific literature in an attempt to answer this question.

Effect on bees.

Since neem granules contain a cocktail of different chemicals, in differing amounts, it is much easier to study just one chemical. The dominant active chemical, azadirachtin, is tested since the exact concentration of this can be accurately determined.

Azadirachtin, pyriproxyfen (an insecticide often used in flea treatment products) and acetamiprid, a neonicotinoid, were applied to bee pupae and adults. All had significantly negative effects on the variables measured, and the neem chemical azadirachtin at the maximum recommended field concentration had the highest negative impact. In fact the sub-lethal effects on pupae survival could only be tested at the lowest azadirachtin concentration, due to the low number of bees that survived. Even at half of the maximum recommended field concentration, it had negative effects on the adult bees, although pyriproxyfen had a greater level of negative impact.

Bumble bees are also negatively impacted, with reduced offspring size, low reproduction and sometimes death.

One of the native bees present in the tropical areas of the Americas was also studied. It showed similar results between azadirachtin and a neonicotinoid, imidacloprid, resulting in reduced survival, pupal deformation, reduction in the reproductive organ size of queens, and other effects which could impact colony survival. We can conclude from this that if neem products are used before or while trees or plants are in blossom the pollinating insects are likely to suffer negative impacts.

Soil biology.

Soil biology is very complex, so any study can only examine either one specific species, or investigate general outcomes, otherwise the level of complexity quickly rises to the impossible. Here are some effects that have been determined in relation to use of neem products:

Suppression of beneficial phosphate-solubilising bacteria. These bacteria work on the locked up phosphorus in the soil, transforming it into phosphate that plants can absorb.

Strong suppression of the nitrifying bacteria (*Nitrosomonas* and *Nitrobacter*) at the recommended dose levels. These bacteria transform ammonia or ammonium into nitrites, performing a vital role in the nitrogen cycle. The nitrifying bacteria then transform the ammonia or ammonium into nitrites (NO_2^-) which are then transformed by bacteria into nitrates (NO_3^-) which is absorbed by plants. Suppressing these beneficial nitrifying bacteria will result in a decrease of nitrogen being made available for plant growth.

Reductions of the bacterial and fungal activity in soil up to 15 days post application at recommended dose levels. This was dose dependant and the higher the dose, the higher the impact on the biological activity. It also decreased the diversity of the bacterial and fungal populations. The half-life of neem in this study was 20 days. There would therefore still be approximately 10% remaining, four months post application. The half-life changes with soil temperature and organic matter content.

Impact on water ecology. Neem as also been shown to have a negative impact on the insects present in ponds that feed on algae, and are themselves predated on by insects further up the food chain. This disrupts the aquatic food chain in ponds. Neem has also been shown to have negative impact on fish, the exact effects seemed to be species-specific, and little research has been conducted in this area. There is also some evidence to suggest crustaceans may be negatively impacted.

Recommendations. Assuming that you still want to use neem (and after writing this article I am glad I have only used it once), the following points should be observed:

Firstly, if you are going to use neem, ask your supplier some questions. How was this neem product produced? In the case of oils, was it cold-pressed or a solvent extraction? It is likely that the supplier will be unable to tell you. But if you send your request in an email, it can be forwarded back up the supply chain and by asking these questions the knowledge of all involved can be improved.

Secondly, always apply neem products at the recommended rate. Increasing the application rate will only increase the negative impacts on soil biology.

Thirdly, do not apply neem in spring prior to or while trees are in blossom. Applying neem to the soil means the active compounds will be present in the plant for longer, compared to applying an oil spray. Either way, I would recommend waiting until after pollination before using neem products.

Finally, do not use in or over waterways, or in such a way that the spray can drift into waterways.

References:

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