



Technical Note #77

An Introduction to Wood Vinegar

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*by Rick Burnette
Director, ECHO Asia Regional Office*

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Prakrit Khamduangdao was looking for an alternative to agricultural chemicals to control pests in his vegetable farm. However, he was not completely satisfied with various botanical pest control measures being promoted in northern Thailand. He reports that even though certain natural insect repellents were beneficial, their effects were too limited. Additionally, finding adequate amounts of necessary raw plant materials and processing them into sprays was laborious and time consuming.

When Mr. Prakrit first heard about wood vinegar in 2000 he was intrigued. Compelled by the idea of a natural by-product of charcoal production that can control pests and diseases of crops, he bought his first bottle. Having used the product, Mr. Prakrit was pleased with the ease of mixing and application. Ultimately, after observing much fewer insect pests and fungal diseases on his crops, he became convinced of the effectiveness of wood vinegar.

Not long afterwards, Mr. Prakrit became self sufficient in producing both charcoal and wood vinegar with a 200-liter horizontal drum kiln. He has been an advocate of wood vinegar ever since.

Wood vinegar (pyrolygineous liquor) is rapidly gaining acceptance as an essential Asian natural farming input. Reported agricultural use as a fertilizer and growth-promoting agent goes back to the 1930s, making the product a relatively new innovation.

Uses of Wood Vinegar

According to Thailand's Department of Agriculture, wood vinegar has the following broad benefits:

- Improvement of soil quality
- Elimination of pests
- Plant growth control; being able to accelerate the development of roots, stems, tubers, leaves, flowers, and fruit
- Used to increase amounts of fruit produced in orchards

Dr. Arnat Tancho at Mae Jo University also reports that wood vinegar can be applied to the soil surface to help increase the population of beneficial microbes and to promote plant root growth. Additionally, the product can help boost crop defenses against disease.



Wood Vinegar Production

Wood vinegar is produced when smoke from charcoal production is cooled by outside air while passing through a chimney or flue pipe. The cooling effect causes condensation of pyroligneous liquor, particularly when the temperature of smoke produced by carbonization ranges between 80 and 180°C/176 and 356°F (Nikhom). This temperature is reached at the carbonization stage of exothermic decomposition (see previous article about charcoal production) and is indicated by the production of yellowish, acrid smoke.

The following is a summary of key wood vinegar production steps:

- Arrange dry wood in the 200-liter drum kiln (see related article), close and cover every hole with clay before burning. Stop feeding the fire when smoke exiting the flue is very thick and white.
- Approximately 30 minutes to 1 hour after having stopped feeding fuel into the kiln, if the smoke is yellowish and acrid, close off most of the outer vent.
- Extend a hollow green bamboo pole (far end elevated to 45°) from the flue pipe. Wood vinegar can be collected with containers fastened underneath one to two holes, approximately 2 cm (3/4 in.) wide, drilled into the bamboo pole roughly 30 cm (11.8 in.) from the connection with the flue pipe.
- Thailand's Department of Agriculture reports that if wood is burned for 12 to 15 hours (or less, depending on the type and size of wood) in a 200-liter oil drum kiln, it should produce 2 to 7 liters of raw wood vinegar.
- Leave the raw wood vinegar sealed in a bottle for approximately three months to allow sediments to settle.

Nikhom Laemsak at Kasetsart University recommends refining raw wood vinegar by a simple standing method. The brown liquid collected during charcoal production is left sealed in a bottle for two to four months, during which time the components will settle into four distinct layers. The first and second layers at the bottom of the container will be black, containing wood tar and tar pitch. The third layer (located beneath the top strata of liquid) is the usable portion of wood vinegar. This component will be light yellow to reddish brown. The fourth (top) layer is classified as light oil and will have a skim of wood tar at the top.

Wood vinegar producers, such as Boonsong Thansrithong, an agriculturalist with Partners Thailand, recommends that the useable layer of wood vinegar (second from the top) can be harvested with a syringe or siphon after first sucking out the light oil layer on top. Refined wood vinegar does not perish quickly. Prakrit Khamduangdao is confident that the product can be stored in bottles at least five years.

One does not have to be a charcoal producer to access wood vinegar. Refined wood vinegar is available in many agricultural stores in Thailand with one liter bottles generally selling for 50 baht (\$1.72 US).

Composition and Characteristics of Wood Vinegar

Nikhom reports that wood vinegar yield per metric ton (2200 lbs.) of air dry wood is 314 kg (690.8 lbs.). The product contains approximately 200 components. These include:

- Alcohol (methanol, butanol, amylalcohol)
- Acid (acetic, formic, propionic, valeric)
- Neutral substances such as formaldehyde, acetone, furfural, valerolactone
- Phenols (syringol, cresol, phenol)
- Basic substances such as ammonia, methyl amine, pyridine

He also describes quality wood vinegar as having the following characteristics (most of which may require special laboratory instruments or methodology to determine):

- pH of approximately 3.0
- Specific gravity between 1.005-1.050
- Color ranging from pale yellow to bright brown to reddish brown
- Transparent
- Smoky odor
- Dissolved tar content: less than 3 percent
- Ignition residue: less than 0.2 percent by weight

Small Farm Uses of Wood Vinegar

Wood vinegar has some industrial applications; it is used as an ingredient in cosmetics, and for odor removal. De Guzman shares that a number of potential agricultural applications are also reported in which wood vinegar is blended with water in ratios ranging between 1:50 (1 liter wood vinegar and 50 liters water) to 1:800.

For improved plant production, the solution can be sprayed over plant shoots. Wood vinegar, like hormones, will be absorbed into twigs, trunks, or leaves, resulting in stronger plants and leaves that are greener and more resistant to pests and diseases (de Guzman).

Specific Farm Uses for Wood Vinegar

The Appropriate Technology Association of Thailand recommends the following wood vinegar/water solution rates for various farm uses (ATA, p. 27-28). Note that, in some cases, no details were given regarding the specific identity of pests:

- **Repel nematodes** – Tomatoes, 1:500 (apply to the base of plants); strawberries, 1:200 (apply to the base of plants); and black pepper vines, 1:1500 (apply in place of water).
- **Repel insect pests** – Cabbage and Chinese cabbage, 1:1500 (apply in place of water); corn 1:300 (spray onto leaves).
- **Control of fungal diseases** – Tomato and cucumber, 1:200 (spray onto leaves).
- **Control of root rot** – Tomato and cucumber, 1:200 (apply to the base of plants).
- **Reduce incidence of chili pepper flowers aborting** – 1:300 (spray onto leaves).
- **Improve flavor of sweet fruits and stimulate development of crops.** Mix solution rates of 1:500 to 1:1000. Wood vinegar prevents excessive nitrogen levels, improves plant metabolism and contributes to higher fruit sugar levels.
- **Stimulate compost production.** A solution rate of 1:100 will help increase the biological activity of various beneficial microbes and can decrease composting times.
- **Combat bad odor.** A wood vinegar solution of 1:50 will diminish the production of odor-causing ammonia in animal pens.
- **Supplement for livestock feed.** Mixed with livestock feed at rates of between 1:200 and 1:300, wood vinegar can adjust bacterial levels in the animal digestive tract which improve the absorption of nutrients from feed.
- **Enrich garden soil.** Use a strong solution of 1:30 to apply to the garden soil surface at a rate of 6 liters of solution per 1m² to enrich the soil prior to planting crops. To control soil-based plant pathogens, use an even stronger rate of 1:5 to 1:10.
- **Repel houseflies.** Dilute wood vinegar at a rate of 1:100 and apply to affected areas.

Sombat Chalermliamthong, also with Partners Thailand, reports that he has produced and used wood vinegar in a number of farm applications over the past several years. Such use includes spraying wood vinegar solution to control insect pests, such as rice stem borer, as well as to reduce bad odors in and around pig pens. Besides appreciating the availability of the product, whether homemade or purchased, like Prakrit Khamduangdao, Sombat is also impressed with the ease of mixing and applying wood vinegar and its overall effectiveness.

Wood Vinegar Concerns?

Thailand's Department of Agriculture stresses that wood vinegar is safe for organisms in the food chain, including pollinating insects. However, they also point out that the substance is slightly toxic to fish and very toxic to plants if applied excessively. Research at Mae Jo University also shows that wood vinegar with excessive amounts of tar can be harmful to plants.

More Opportunities for Wood Vinegar Research

Wood vinegar was little-known only one decade ago. The current level of interest in the production and usage of wood vinegar among farmers, development agencies, governmental organizations and universities in East and Southeast Asia is on the rise. Fortunately, the product is now receiving attention from research institutions in the region, enabling increased understanding of wood vinegar's benefits for its promoters and users.

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